BETTER TREATMENT

'TAKING ACTION TO IMPROVE WATER QUALITY'

Report on Public Hearings

City of Winnipeg

Wastewater Collection and Treatment Systems

Presiding:

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Foreword

The United Nations *International Year of Freshwater - 2003* - serves to remind us that freshwater is precious and essential for life on our planet. It is indispensable for satisfying basic human needs and maintaining regional and global ecosystems.

In Manitoba, freshwater is vital to sustaining our natural environment, our economy and our quality of life. It is the basis for the Province's fisheries, tourism and agricultural industries and provides abundant recreational opportunities. However, there are signs on the horizon suggesting that our water resources are seriously threatened.

This report is a 'call to action' for the City of Winnipeg. It calls upon the City to do its part to improve water quality in the Red and Assiniboine rivers for the benefit of all Manitobans. It also challenges the Province and the City to work together in implementing sound and sustainable water policies and demonstrating their joint commitment to environmental stewardship. This report seeks the development of a comprehensive action plan to raise awareness, promote best water quality management practices and mobilize resources to meet the challenge of protecting and enhancing Manitoba's key waterways.

The year 2003 will mark an important milestone for all Manitobans if the City and the Province join together in response to the call for action that is outlined in this report.

Executive Summary

At the request of Manitoba's Minister of Conservation, the Manitoba Clean Environment Commission (CEC) conducted a public hearing on the City of Winnipeg's wastewater collection and treatment systems. The hearing was called partly in response to a spill of raw sewage from Winnipeg's North End Water Pollution Control Centre into the Red River on September 16, 2002. The mandate given to the Commission was to review the City's wastewater systems and related public concerns, and to provide a report to the Minister with advice and recommendations.

The Commission conducted the hearing in Winnipeg from January 20 to 22, 2003 and in Selkirk on January 27 and 28, 2003. Two motions were tabled on January 21, 2003 that called for suspension of the proceedings, further public review and preparation of an Environmental Impact Statement. On January 28, 2003, the Commission adjourned the hearing, requested that the City of Winnipeg provide additional information in an Environmental Impact Statement, advised that it would seek involvement of federal departments and committed to preparation of an interim report on the September 16, 2002 sewage spill. The City of Winnipeg submitted its Environmental Impact Statement on February 28, 2003 and, following filing of the Commission's interim report, the hearing was reconvened in Winnipeg from April 14 to 16, 2003.

Over 750 members of the public attended the hearings in Winnipeg and Selkirk. The four-member Panel heard presentations from Manitoba Conservation, the City of Winnipeg, the Department of Fisheries and Oceans, and Environment Canada, as well as groups that received participant funding assistance. Written and oral presentations were also received from 28 other organizations and individuals. The Commission registered a total of 126 exhibits during the nine days of hearings.

In response to recommendations in the Commission's 1992 public hearing report on water quality objectives and to direction provided by Manitoba Conservation, the City of Winnipeg proposed a 50-year pollution prevention plan to achieve Manitoba's *Water Quality Standards, Objectives and Guidelines.* The plan components included effluent disinfection, combined sewer overflow control, ammonia treatment, nutrient reduction, and biosolids (solid by-product of wastewater treatment) management. The City's Environmental Impact Statement also provided information on potential environmental effects of plan components, proposed measures to mitigate adverse effects and assessed the significance of residual environmental effects.

During the course of the hearing, the Commissioners heard a large number of concerns from individuals, environmental organizations, funded participants, and local and federal government officials. The concerns related to the impact of the spill of raw sewage on the environment and human health; effects of treated wastewaters and untreated sewer overflows on the Red and Assiniboine rivers; effects of nutrients and other substances on Lake Winnipeg; disposal of landfill leachate; training and certification of operators; standard operating procedures; emergency response plans; environmental management systems; consultation with the public and Aboriginal communities; and others

The Commission believes there is evidence to substantiate that Winnipeg's treated municipal wastewaters and untreated combined sewer overflows are adversely impacting the aquatic environments of the Red and Assiniboine rivers and Lake Winnipeg. While the Commission understands that Winnipeg is not the only contributor of pollutants to the Red and Assiniboine rivers or nutrients to Lake Winnipeg, the City's wastewater treatment plants and combined sewer outfalls are point sources that can be controlled. This provides the City of Winnipeg with an opportunity to take responsible action and demonstrate environmental stewardship for the benefit of all Manitobans.

The Commission is confident that, with Winnipeg's commitment to implement recommendations outlined in various investigative reports presented during the hearing and those in the Commission's interim report, the risk of future releases of raw sewage into the Red River from the North End Water Pollution Control Centre will be minimized. The Commission remains optimistic that reductions in the frequency, duration and magnitude of combined sewer overflows can be reduced to acceptable levels within a much shorter timeframe than that proposed by the City. Furthermore, the Commission believes that meaningful progress on effective management and mitigation of combined sewer overflows can be achieved within two years.

The Commission concluded that if *Environment Act* licences are issued for Winnipeg's three water pollution control centres, they should be granted on an 'interim' basis only, with a major public review on the City's evolving plan within two years. Many of the recommendations in this report can be implemented before then. The review should be conducted by the Commission based on detailed *Environment Act* licence proposals and an Environmental Impact Statement prepared in accordance with publicly reviewed guidelines issued by Manitoba Conservation. Subsequently, the Commission believes that it should be called upon to review the licences every three years until such time as the City has achieved significant, measurable progress toward completing its long-term plan. In summary, the Commission presented the following twenty recommendations:

Wastewater Treatment Plant Licencing

1. If *Environment Act* licences are issued for Winnipeg's three water pollution control centres, these licences should be issued on an 'interim' basis only.
2. The 'interim' *Environment Act* licences for Winnipeg's three water pollution control centres should be reviewed again in two years and every three years thereafter.
3. Manitoba Conservation should establish 'interim' effluent limits for Winnipeg's three water pollution control centres in accordance with Manitoba's *Water Quality Standards, Objectives and Guidelines*.

Environmental Impact Statement

4. The City of Winnipeg should be directed to prepare a comprehensive Environmental Impact Statement prior to the review of its three water pollution control centre 'interim' *Environment Act* licenses.

Nutrient Management Strategy

5. Manitoba Conservation should accelerate the schedule to complete the Nutrient Management Strategy for Southern Manitoba by December 2004.

6. The City of Winnipeg should be directed to plan for the removal of nitrogen and phosphorus from its municipal wastewaters, and to take immediate steps in support of the nutrient reduction targets established for Lake Winnipeg. The City's nutrient removal plan should be a key element of a licence review hearing to be scheduled within two years.

Combined Sewer Overflow Reduction

7. The City of Winnipeg should be directed to shorten the timeframe to complete its combined sewer overflow plan from the proposed 50 years to a 20 to 25-year period.

8. The City of Winnipeg should be directed to take immediate action to reduce combined sewer overflows by instrumenting outfalls, adjusting weirs, accelerating combined sewer replacement, advancing the pilot retention project and undertaking other reasonable measures to reduce combined sewer overflows within two years.

Public Notification System

9. The City of Winnipeg should be directed to develop and implement a notification system to inform the public whenever there is a release of raw sewage from any source into the Red and/or Assiniboine rivers. This public notification system should be operational by the beginning of the 2004 summer recreation season.

Wastewater Treatment System

10. The City of Winnipeg should be directed to proceed with disinfection of wastewaters at the North End Water Pollution Control Centre without delay, and should routinely test for pathogens in all wastewater discharges.

11. The City of Winnipeg should be directed to complete risk and criticality assessments at Winnipeg's three water pollution control centres by April 2004 and implement recommendations arising from such assessments to minimize the risk of future spills of untreated sewage.

12. The City of Winnipeg should be directed to increase the number of parameters measured in its influent and effluent streams to include contaminants of concern such as heavy metals, organochlorines, endocrine disrupting substances and pharmaceuticals.

13. The City of Winnipeg should be directed to implement changes to Winnipeg's Sewer By-Law that would expand the list of restricted substances, prevent disposal of contaminants of concern, encourage treatment at source, improve enforcement of the By-Law and increase penalties for violations.

14. The City of Winnipeg should be directed to stop the practice of disposing of landfill leachate at its water pollution control centres within a period of eighteen months.

Financial Support

15. The City of Winnipeg should be directly assisted by the Province of Manitoba in efforts to secure financial support under existing and future infrastructure programs for upgrades to its wastewater collection and treatment systems.

Environmental Management System

16. The City of Winnipeg should be directed to immediately begin development and implementation of an Environmental Management System for Winnipeg's three water pollution control centres with a completion date of no later than April 2005 with major components of the management system implemented much sooner.

Public Education

17. The City of Winnipeg should be strongly encouraged to develop and implement a permanent public education program to improve awareness of Winnipeg's wastewater collection and treatment systems, and to foster public involvement in activities focusing on water conservation and pollution prevention at source.

Public Consultation

18. The City of Winnipeg should be directed to prepare a public consultation plan for Winnipeg's wastewater collection and treatment systems for approval by Manitoba Conservation by April 2004.

Aboriginal Consultation

19. The City of Winnipeg should be encouraged and assisted by the Province, in cooperation with the federal government, to immediately begin developing and implementing a meaningful consultation program with Aboriginal communities concerning the continued operation and future development of its wastewater collection and treatment systems.

Environmental Research and Monitoring

20. A cooperative, cost-shared environmental research and monitoring program involving the City of Winnipeg, Province of Manitoba and the federal government should be established for the Red and Assiniboine rivers and Lake Winnipeg.

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Introduction

Background

During 1980 and 1981, the Manitoba Clean Environment Commission (CEC) conducted public hearings and issued a report [1] on the application of water quality objectives for the Red River Basin. The hearings followed a 1978 Commission report [2] recommending adoption of a program to establish water quality objectives and stream classification for all watersheds in Manitoba. The Commission's 1981 report provided conclusions and recommendations on Manitoba's water quality objectives and stream classification system, and on the City of Winnipeg's wastewater treatment systems. The recommendations set out specifics relating to fecal coliform limits, effluent disinfection, dissolved oxygen levels and tertiary treatment.

The Commission conducted further public hearings in 1991 and 1992 on water quality objectives for the Red and Assiniboine rivers and tributary streams within and downstream of the City of Winnipeg. The Commission's 1992 report [3] detailed recommendations relating to Manitoba's proposed surface water quality objectives, ammonia and fecal coliform (combined sewer overflow) studies, public warning systems and other related matters. Reports from the recommended ammonia and fecal coliform studies were to be submitted before 1997 and a public hearing was to be held within six months after that date to establish ammonia and fecal coliform objectives.

Sewage Release

On September 16, 2002, a mechanical failure at the City of Winnipeg's North End Water Pollution Control Centre resulted in a spill of raw sewage into the Red River. The release continued over a 57-hour period during which 427 million Litres of untreated sewage were discharged. The sewage spill caused widespread public concern, particularly by downstream residents and resource users, and resulted in extensive media coverage. The spill resulted in investigative reports by the City of Winnipeg, Manitoba Conservation and Associated Engineering, an investigation by Environment Canada, a water quality assessment by Manitoba Conservation and a hearing by the Clean Environment Commission.

Public Hearing

On October 3, 2002, the Minister of Conservation requested that the Commission convene a public hearing to review the City of Winnipeg's wastewater collection and treatment systems, and receive comments and concerns from the public respecting these systems. The Commission was also requested to provide a report with advice and recommendations to the Minister.

The Commission conducted hearings in Winnipeg from January 21 to 23, 2003 and in Selkirk from January 27 to 28, 2003. A member of a funded participant group (recipient of a financial award to facilitate hearing participation) presented two motions on January 21, 2003 calling for suspension of the proceedings, further public review and preparation of an Environmental Impact Statement. On January 28, 2003, the Commission suspended the hearing, requested that the City prepare an Environmental Impact Statement to assist in the Panel's review, advised that it would seek the involvement of federal departments, and committed to filing an interim report on the sewage spill with the Minister.

The City of Winnipeg provided the requested Environmental Impact Statement to Manitoba Conservation on February 28, 2003 and, following submission of the Commission's interim report on the sewage spill on April 1, 2003, the hearing reconvened in Winnipeg from April 14 to 16, 2003.

Purpose of Report

The purpose of this report is to provide the Minister of Conservation with advice and recommendations relating to the City of Winnipeg's wastewater collection and treatment systems based upon evidence presented at the public hearing. The report also incorporates recommendations from the Commission's interim report on the September 16, 2002 sewage spill[(4)].

Report Organization

Introductory and background information is provided in the Introduction, Public Hearing Process, Wastewater Collection and Treatment Systems and Regulatory Context sections. Evidence presented at the hearing by the proponent, the regulators, the funded participant groups and the public, as well as conclusions by the Commission are summarized in the Issues section. The Observations section contains comments and suggestions for consideration by government on matters of interest. The Recommendations section provides advice and direction to the Minister of Conservation on matters of concern directly related to the *Terms of Reference* for the hearing.

Public Hearing Process

Clean Environment Commission

The Manitoba Clean Environment Commission is an arms-length provincial agency that operates under the authority of *The Environment Act*. The Commission encourages and facilitates public involvement in environmental matters, and offers advice and recommendations to the government on sustainable development, environmental issues and licencing proposals. Its mandate is exercised through public hearings, investigations, mediation and education. Membership on the Commission includes a full-time Chairperson and fifteen part-time Commissioners appointed by Order-in-Council.

The panel of Commissioners formed for the City of Winnipeg's wastewater collection and treatment systems public hearing consisted of Mr. Terry Duguid (Chairperson), Mr. Ian Halket, Ms. Myrle Traverse and Mr. Ken Wait.

Participant Assistance Program

Manitoba Conservation announced a Participant Assistance Program for the public hearing on November 7, 2002. This Program provides financial assistance to groups or individuals participating in the public hearing process. Two applicants were awarded a combined total of $30,000 based on recommendations of a participant assistance panel consisting of Commissioners Mr. Moses Okimow (Chairperson), Mr. Wayne Sato and Mr. Ken Gibbons. One of the successful applicants later declined the award. The remaining funded participant was the "Ad Hoc Group" which consisted of five members representing various environmental interests.

A second Public Participation Program was announced for the reconvened public hearing by Manitoba Conservation on January 31, 2003. Based on recommendations from the participant assistance panel, four groups were awarded a total of approximately $20,000 to participate in the hearing. The successful participants were the Ad Hoc Group, the Winnipeg Fish and Game Association, the St. Norbert Arts Council, and Paul Clifton and Janet Vanderkruys.

Mandate and Scope

The Minster of Conservation requested that the Clean Environment Commission conduct a public hearing pursuant to clause 6(5)(b) of *The Environment Act* to review the City of Winnipeg's wastewater collection and treatment systems, and to receive public comments and concerns respecting those systems. The Commission was also asked to provide a report with advice and recommendations to the Minister in accordance with Subsection 7(3) of *The Environment Act.*

The scope of the Commission's review included:

- Reliability of the City's systems, especially the back-up capability of the systems, to prevent a discharge of inadequately treated sewage to the rivers during malfunctions.
- Appropriate ammonia, nutrient, combined sewer overflow and microbiological limits on effluent from the City's systems necessary to protect the aquatic environment and recreational activities, including in Lake Winnipeg.
- Current and planned effectiveness of the City's wastewater treatment systems to achieve discharge limits.
- Adequacy of the City's plans and schedule for upgrading the systems.
- Adequacy of processes being followed in reviewing those plans and schedule.

The Commission was also asked to consider applicable recommendations in the Commission's 1992 report on surface water quality objectives [(3)] and the recently updated Manitoba *Water Quality Standards Objectives and Guidelines*. *Terms of Reference* for the hearing are provided in Appendix A.

Notification

Notice of the public hearing was first issued as a Manitoba Government news release on October 7, 2002. Subsequently, the Commission announced the hearing dates and locations to the news media on October 31, 2002, and placed notices in the Winnipeg Free Press, La Liberté and the Selkirk Journal beginning November 2, 2002. Notices for the reconvened hearing were placed in the same area newspapers beginning March 15, 2003.

Public hearing notices were mailed to over 700 government offices, businesses, organizations and individuals on the Commission's mailing list. Notices of the hearing were also posted on the Manitoba Conservation and Commission web sites.

Schedule and Format

The first session of the public hearing was held in Winnipeg from January 20 to 23 and in Selkirk from January 27 to 28, 2003. The reconvened hearing was held in Winnipeg from April 14 to 16, 2003.

The initial public hearing in Winnipeg consisted of opening remarks by the Commission Chair and presentations by Manitoba Conservation, the City of Winnipeg, the funded participants, Environment Canada and members of the public. In Selkirk, the Commission provided opening remarks followed by short presentations by the City of Winnipeg and Manitoba Conservation. The format for the reconvened hearing in Winnipeg consisted of opening remarks by the Commission Chair and presentations by Manitoba Conservation, the City of Winnipeg, Department of Fisheries and Oceans, Environment Canada, funded participants and members of the public. Manitoba Conservation, the City of Winnipeg and the funded participants were all subject to questioning by each other, the panel and the public. A list of registered presenters is provided in Appendix B.

The public hearing was recorded and a transcript of the proceedings was produced for the public record. Written summaries of the proceedings were prepared after the hearing and posted on the Commission's web site.

Attendance

About 750 people including private citizens, business owners, government workers, consultants, environmental professionals and students attended the public hearing in Winnipeg and Selkirk. Most of these attendees were from the Winnipeg and Selkirk areas, with several individuals from rural Manitoba, Ontario and the United States.

Documentation

Reports produced by the City of Winnipeg's Water and Waste Department as well as related publications prepared by Manitoba Conservation were placed in the Public Registry. Documentation was also made available in electronic format on Manitoba Conservation's web site.

Exhibits

A total of 126 exhibits were recorded during the nine days of the public hearing (Appendix C).

Wastewater Collection and Treatment Systems

Wastewater Collection System

The City of Winnipeg wastewater collection system consists of combined, separate and interceptor sewers, land drainage systems, lift stations and diversion structures.

Combined Sewers

A combined sewer is a single pipe system that collects both municipal sewage and surface runoff from a defined service area. The older, central region of Winnipeg is served by 1,034 km of combined sewer (Figure 1). Prior to 1937, the collected sewage and storm runoff were discharged directly to local rivers. In 1937, an interceptor system was built to convey sewage in the combined sewer system to the North End Water Pollution Control Centre for treatment. Weirs were installed in all combined sewers near their outfalls to divert sewage to the interceptor system during low flow (dry weather) conditions but allow sewage to overflow to the river during high flow (wet weather) conditions.

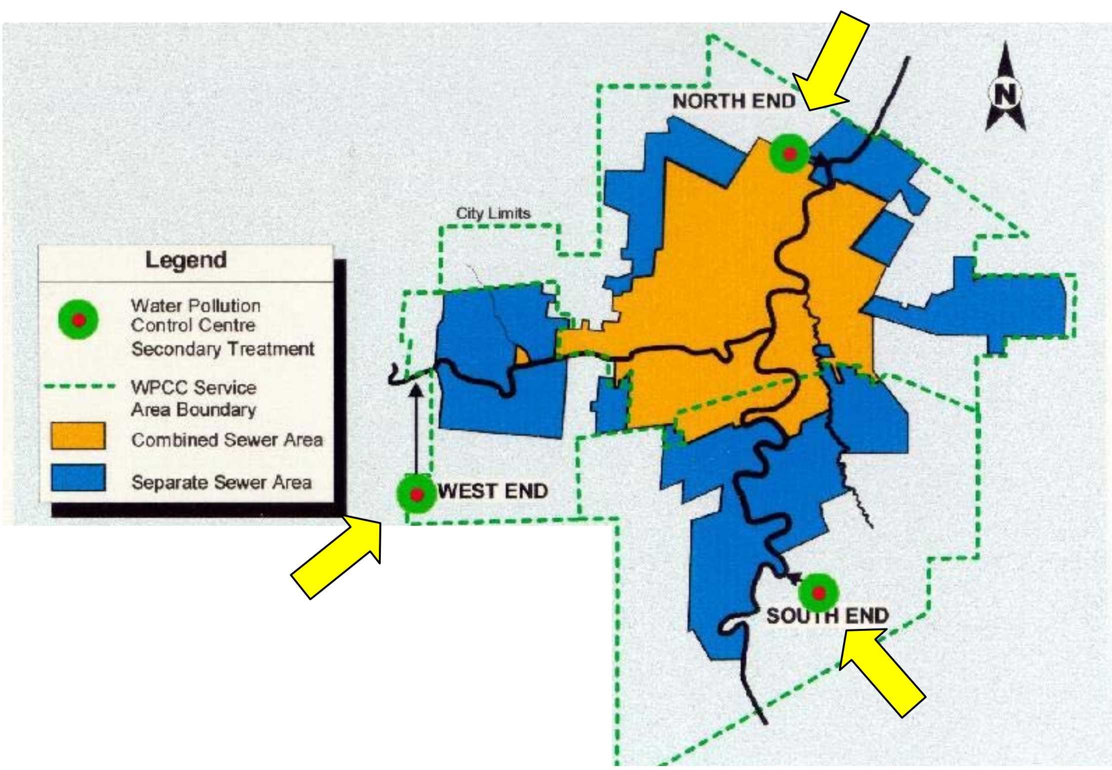


Figure 1. City of Winnipeg water pollution control centres and sewer areas

Historically, there were 43 combined sewer districts, which served approximately 10,500 ha within the City of Winnipeg. The combined sewer area has been reduced to approximately 8,700 ha or 30% of the City. Presently, there are 79 combined sewer outfalls to the rivers including relief pipes installed as part of a basement flooding relief program. Computer modelling of the combined sewer system over the past 40 years shows that combined sewer overflows occur an average of 18 times during the open water recreational season. The actual number ranges from 7 to 30 overflows depending on the combined sewer district. In a typical year, about 7.0 million m^3 of sewage is released from the combined sewer system through the outfalls into the river.

Separate Sewers

Since 1960, new developments in the City of Winnipeg have been serviced by a two-pipe system – one for sewage and the other for storm water (Figure 1). The sewage or sanitary sewer system consists of a 1,182 km dedicated piping system that is completely separated from the land drainage system. The role of the separate sanitary sewer system is to collect wastewater from domestic, commercial, institutional and industrial sources, and to convey it to a water pollution control centre for treatment.

Under normal dry weather conditions, all sanitary sewage is collected and conveyed to one of the three water pollution control centres. However, overflows from the separate sewers to the rivers is possible as a result of precipitation events or equipment malfunctions, so as to protect against wastewaters reaching levels that could result in basement flooding.

Interceptor Sewers

The interceptor sewers convey sanitary wastewater from the separate and combined sewer systems to the three water pollution control centres. There are 130 km of interceptor sewers in the City.

Land Drainage Sewers

Separate land drainage storm sewer systems have been used in new developments since the 1960s. The purpose of these systems is to carry rainfall and snowmelt runoff from urban areas to local watercourses. There are 1,372 km of land drainage sewers in Winnipeg. Total developed area with separate wastewater and land drainage areas is approximately 22,300 ha.

Lift Stations and Diversion Structures

Because of Winnipeg's relatively flat terrain it is necessary to pump wastewater using lift stations to the interceptor sewers or to the water pollution control centres, or in some cases, to trunk sewers. The primary purpose of a lift station is to raise sewage to a given elevation so that it can be discharged into a sewer system where it can flow by gravity. There are 76 wastewater pumping stations and 10 gravity-based wastewater diversion facilities distributed throughout the City.

Wastewater Treatment System

The City of Winnipeg wastewater treatment system consists of the North, West and South End Water Pollution Control Centres (Figure 1).

North End Water Pollution Control Centre

The North End Sewage Treatment Plant opened in 1937 (Figure 1). The plant has been upgraded and expanded over the past 66 years to become the North End Water Pollution Control Centre. The North End facility accepts municipal wastewaters generated from the north and central parts of Winnipeg, representing about 70% of the City or approximately 370,000 residents. The facility provides primary and secondary activated sludge treatment, and sludge processing. Treated wastewater is discharged to the Red River, which flows about 50 km north to Lake Winnipeg. It has a design population capacity of 395,000 and currently serves 374,000. The facility also accepts leachate from City landfills and septage from the Winnipeg area. Average design and actual dry weather flows are 332 and 226 million litres per day, respectively. Sewage sludge or biosolids are dewatered and are either applied to agricultural land north of Winnipeg or taken to the Brady Landfill.

West End Water Pollution Control Centre

The West End Water Pollution Control Centre is located west of Winnipeg and services the Charleswood, Assiniboia and St. James areas (Figure 1). The facility's sewage lagoons were first commissioned in 1964. A mechanical aeration plant was put into operation in 1976 and the facility upgraded to a conventional secondary treatment plant in 1994. The lagoons have been operated for effluent polishing since 1998. The facility has a design population capacity of 98,000 and currently serves 86,000. Average design and actual dry weather flows are 38 and 30 million litres per day, respectively. Sewage sludge is transported to the North End Water Pollution Control Centre for processing.

South End Water Pollution Control Centre

The South End Water Pollution Control Centre is located south of the City and services Fort Garry, St. Vital and St. Boniface (Figure 1). The facility was constructed in 1974 with a high purity oxygen secondary treatment system. The plant was expanded in 1993 and ultraviolet effluent disinfection installed in 1999. It has a design population capacity of 169,000 and currently serves 160,000. Average design and actual dry weather flows are 70 and 60 million litres per day, respectively. Sewage sludge from the South End facility is processed at the North End Water Pollution Control Centre.

Regulatory and Policy Context

Environment Canada

Ammonia Toxicity

Toxic substances are regulated in Canada under the *Canadian Environmental Protection Act* 1999. Respecting pollution prevention, the Act provides for protection of the environment and human health in order to contribute to sustainable development. The Act provides Environment Canada with the authority to assess and manage toxic substances and prevent pollution that could harm the environment and human health.

Environment Canada also administers the pollution prevention provisions of the *Fisheries Act* that fall under Subsection 36(3) and related sections. Subsection 36(3) prohibits the deposit of deleterious substances into water frequented by fish. Deleterious substances include those that are directly toxic or harmful to fish or fish habitat, or that can break down, degrade or alter water quality so that the water is, or may become, harmful to fish and fish habitat.

Ammonia as well as other substances such as inorganic chloramines, nonylphenols and chlorinated wastewater effluents have been designated as toxic under the *Canadian Environmental Protection Act* 1999. As part of its long-term strategy, Environment Canada also intends to work with others to develop a regulation under the *Fisheries Act* for municipal wastewater effluents.

Environment Canada's risk management objective for ammonia suggests no lethality from ammonia in the receiving environment or in the discharge (end of pipe) based on a calculated site-specific discharge limit that includes effluent pH and total ammonia, and receiving water pH and temperature. With respect to exceedences of this objective, Environment Canada would expect the City of Winnipeg to prepare and implement a pollution prevention plan according to a pre-defined schedule under the *Canadian Environmental Protection Act* 1999.

Nutrient Management

Environment Canada's concerns about the effects of nutrients on the environment are summarized in its report *Nutrients and Their Impact on the Canadian Environment* (5). The report concludes that nitrogen and phosphorus loadings from human activity have accelerated eutrophication of certain lakes and rivers resulting in loss of habitat, changes in biodiversity and loss of recreational potential, and that municipal sewage is the largest point source of nitrogen and phosphorus to freshwater in Canada. The cumulative impact of various point and non-point discharges of nitrogen and phosphorus on Lake Winnipeg is of particular concern.

Environment Canada stated that it believes the stage has been set for immediate action in Manitoba on non-point sources of nutrients to the Red River and Lake Winnipeg, and it is timely to address point sources of nutrients such as City of Winnipeg municipal wastewaters when opportunities such as issuance of new licences or review of existing licences arise.

Manitoba Conservation

Licencing

The City of Winnipeg submitted *Environment Act* proposals to licence its three water pollution control centres to Manitoba Conservation in 1990. In response to the proposals, the Commission held public hearings in 1991 and 1992 to determine surface water quality objectives for the Red and Assiniboine rivers and tributaries in the Winnipeg region required for the protection of current and future uses of those waters. The Commission's 1992 report(3) contained fourteen recommendations including site-specific studies respecting combined sewer overflows and un-ionized ammonia. The studies were to be completed in 1997 and then be subject to a public hearing.

As a result of the September 16, 2002 spill of raw sewage at the North End Water Pollution Control Centre, the Minister of Conservation requested that the Commission conduct a public hearing to review the spill event and the City of Winnipeg's wastewater collection and treatment systems, and to provide advice and recommendations. The scope of the review is outlined in Appendix A. Following the conclusion of the hearing and receipt of a report from the Commission, Manitoba Conservation indicated that it will develop and issue *Environment Act* licences for the City's three water pollution control centers. The Department has also stated that the draft licences will be made available for public review.

Water Quality Standards, Objectives and Guidelines

Manitoba's *Water Quality Standards, Objectives and Guidelines* provide for the protection of surface and groundwater as well as overall ecosystem integrity in the Province (Exhibit 5). They have been subject to public, stakeholder and technical review, and are at the final draft stage.

Standards, objectives and guidelines are provided for over 100 substances including dissolved oxygen, bacteria, nutrients, metals, organics, etc. They are provided as Tier I Standards, Tier II Objectives and Tier III Guidelines. The three-tiered approach is used to consolidate and harmonize Manitoba's approach with that developed through other programs in Canada.

A variety of scientific tools and management strategies are used proactively to protect, maintain and rehabilitate water quality in Manitoba. Two water quality management strategies are used simultaneously. First, all activities and waste discharges are controlled to the extent that it is reasonably practical and economically feasible using a consistent technology-based approach. Second, when more stringent environmental controls are required to protect important water uses, a water quality-based approach is used. Additional environmental limits are derived to ensure that applicable water quality standards, objectives and guidelines are not exceeded.

Modifications are made to the *Water Quality Standards Objectives and Guidelines* as region-specific or site-specific objectives are developed and new principles relating to environmental protection in Canada formulated through national consultative processes (e.g. those being pursued by the Canadian Council of Ministers of the Environment).

Nutrient Management Strategy

A draft *Nutrient Management Strategy for Surface Waters in Southern Manitoba* [6] was released by Manitoba Conservation for public review in 2000 to address the issue of enrichment of surface waters in southern Manitoba with plant nutrients such as nitrogen and phosphorus. The draft strategy identifies the main challenges, tasks and issues that will have to be considered in developing appropriate water quality objectives for prairie streams and receiving lakes such as Lake Winnipeg. As required, this will also involve developing an implementation plan to achieve reductions of nutrient loadings. The nutrient management strategy is planned to undergo public and stakeholder review in 2003 before being finalized in 2004.

Lake Winnipeg Action Plan

A *Lake Winnipeg Action Plan* [7] was announced by the Minster of Conservation at the Clean Environment Commission-sponsored Freshwater Forum held in Winnipeg during February 2003. The action plan includes establishment of a Lake Winnipeg Stewardship Board to help identify further actions necessary to reduce phosphorus and nitrogen in Lake Winnipeg to pre-1970 levels by 10 and 13% or more, respectively, subject to further findings of Manitoba's nutrient management strategy. Other actions announced include enhanced riparian protection, better programs for soil testing, tightened regulations for sewage and septic systems and additional requirements for larger treatment systems. As a result of the *Lake Winnipeg Action Plan*, the provincial priority for nutrient management has been elevated to the same as that for ammonia reduction.

Water Strategy

The *Lake Winnipeg Action Plan* was subsequently incorporated into Manitoba's *Water Strategy* announced in April 2003 [(7)]. The goal of the strategy is to develop watershed-based planning across the entire Province to ensure that future management of water-related issues is undertaken comprehensively. A sustainable approach is required to ensure that all needs are met while maintaining ecosystem protection. The strategy identifies six interrelated policy areas: water quality, conservation, use and allocation, water supply, flooding and drainage. The objective of Manitoba's water quality policies is to protect and enhance aquatic ecosystems by ensuring that surface and groundwater quality is adequate for all designated uses and ecosystem needs.

City of Winnipeg

The City of Winnipeg Sewer By-Law No. 7070/97 regulates construction and approval of sewers, discharges to sewers, sewer rates, over-strength wastewaters and other matters relating to the City's wastewater collection system. Part 5 of the By-Law provides for "Control of Discharge to Sewers" and Part 7 deals with "Over-strength Wastewaters". Disposal of over-strength wastewater or wastewater containing pollutants or having characteristics exceeding those scheduled in Section 25 of the By-Law requires a licence issued by the City of Winnipeg. Part 7 of the By-Law deals with over-strength wastewaters that are not considered to be hazardous waste.

Issues

This section presents information on environmental, social, economic and other issues raised by the public, the funded participants, the government interveners and the Commission at the public hearing on the City of Winnipeg's wastewater collection and treatment systems. The issues include matters of concern, contention or disagreement that fall within the Commission's *Terms of Reference*, and warrant further consideration and action by government. A concluding statement summarizing the Commission's opinion is highlighted at the end of each issue. The information on issues is presented as background in support of the Commission's recommendations to the Minister. There is no implied order of importance in which the sequence the issues are presented.

Purpose of Public Hearing

Based on the *Terms of Reference* for the public hearing, the Commission and many of the participants understood that the purpose of the hearing was to "review" the City of Winnipeg's wastewater systems and not to consider the question of the issuance of *Environment Act* licences for the City's water pollution control centres. Licencing was not specifically mentioned in the Terms, although a request was included for the Commission to comment on certain substance control limits (Appendix A). On the first day of the hearing a member of the Ad Hoc Group stated that correspondence had been received from the Minster of Conservation indicating that Manitoba Conservation would issue *Environment Act* licences for the City's three sewage treatment plants at the conclusion of the hearing. The Department confirmed that licences would be issued for the three water pollution control centres following receipt of the Commission's report (Exhibit 3). While agreeing with the "review" nature of the hearing, Manitoba Conservation reinforced its intention to proceed directly to licencing. The Department further asserted that the City had submitted the necessary *Environment Act* licence proposal documentation in 1990.

Participants expressed concern that proceeding directly to licencing of the City of Winnipeg's water pollution control centres would limit public input on all relevant issues. It was argued that the 1990 proposals were no longer valid as municipal wastewater technologies have evolved, and there are new and emerging issues related to contaminants in municipal wastewater. One of the participants noted that insufficient time was provided for meaningful public review of the information submitted by the City with respect to licencing. Another participant suggested that more applications for participant assistance would have been submitted and the applications would have been more focused on licencing issues if it was known that the hearing would lead directly to licencing. It was also noted that attendance at the hearing would likely have been greater, different people may have attended, more submissions would have been registered and the participants would have been better informed and prepared had the licencing nature of the hearing been more clearly enunciated.

Confusion over the purpose of the hearing led a member of the Ad Hoc Group to submit two motions for the Commission to suspend the hearing at the conclusion of the Winnipeg session and resume the hearing in Selkirk once additional documentation was provided. One of the motions called for the hearing to resume after a 90-day period so that the public would have an opportunity to review and comment on the documentation for licencing (Exhibit 50). The other motion requested that the hearing resume after the City of Winnipeg had submitted a licencing request and Environmental Impact Statement (Exhibit 49). The motions also requested that the Minster of Conservation reopen the participant assistance program to facilitate broader and more informed public participation.

The Commission responded to the two motions on January 28, 2003 by requesting that the City of Winnipeg provide an Environmental Impact Statement to Manitoba Conservation by February 28, 2003 and announcing that the public hearing would be reconvened in April 2003, to consider the Environmental Impact Statement and associated documentation. The Commission also stated that it would provide a report to the Minister of Conservation on the September 16, 2002 spill of raw sewage into the Red River by April 1, 2003.

The Commission believes that the direction given by the Minister of Conservation was to conduct a <u>review</u> hearing respecting the City of Winnipeg's wastewater collection and treatment systems including the September 16, 2002 sewage spill. It was believed that the three water pollution control centres would be licenced at some time in the future and that further public hearings would likely be called for that purpose.

The Commission is further of the opinion that a 12-year period between the submission of the City's original *Environment Act* proposal and the public hearing to consider the proposal is too great to consider the original documentation as adequate.

Finally, the Commission believes that the submission of a full and complete Environmental Impact Statement at the beginning of the public review process would have served to focus the proceedings on the important environmental, social and economic issues.

Environmental Impact Statement

The City of Winnipeg introduced its Environmental Impact Statement on the continued operation and future development of Winnipeg's wastewater systems at the reconvened pubic hearing in Winnipeg (Exhibits 89, 90). The City described the impact statement in terms of the benefits and adequacy of its wastewater operations and plans for the future, environmental responsibility and commitment for future improvements. The City went on to note that there was no prior indication that an environmental assessment was needed, the 30-day timeframe to complete the document was insufficient considering the scope of the assessment and, finally, noted that the 'effects assessment' was a first of its kind requested of any proponent in Manitoba.

The Ad Hoc Group strongly criticised the Environmental Impact Statement as a "repackaging of existing information" (Exhibits 95, 96, 97). The Group noted that the impact statement does not meet "best practice" standards and no scientific methods were used to identify and assess the environmental effects. They commented that the document does not include a comparison of alternatives including the *status quo*, a description of baseline or background environmental conditions or a full consideration of all environmental effects in a quantitative manner. They considered the socio-economic, health, cultural and cumulative effects components of the document to be particularly deficient. The Group also noted that the term "significance" is not defined and there is insufficient information to make a decision regarding the significance of the residual environmental effects.

The Ad Hoc Group went on to describe what is required by best practice for a cumulative effects assessment with reference to Canadian and United States sources (Exhibit 96). They advised that cumulative effects or impact was defined as the *"impact on the environment which results from the incremental impact of one action when added to other past, present and reasonably foreseeable future action regardless of which agency or person undertakes such other actions".* The Group discussed key considerations when assessing cumulative effects including issues identification, spatial and temporal scales, mitigation, follow-up and significance, and described procedural steps followed in a cumulative effects assessment. The Group recommended that the City be ordered to complete an appropriate cumulative effects assessment and submit it to Manitoba Conservation within two years after licencing.

The Ad Hoc Group concluded their review by stating that the Environmental Impact Statement was an insufficient response to the Commission's direction (Exhibit 96). The Group also concluded that the document failed to achieve the basic requirements of an 'effects assessment' listed in the COSDI (Committee on Sustainable Development Implementation) Report [8] and noted that the City had missed the opportunity to create a model 'effects assessment' helpful to all parties in the future.

Other participants did not comment extensively on the Environmental Impact Statement. However, one participant identified a number of problems with the document including the lack of baseline data and costs to future generations, and raised a number of questions regarding ammonia reduction, combined sewer overflow mitigation and nutrient control (Exhibit 110). Deficiencies were also identified with respect to land drainage systems, water conservation strategies and the application of the principles and guidelines of sustainable development.

One of the participants presented documentation on the impact of Winnipeg's municipal wastewaters on Lake Winnipeg (Exhibit 57). The participant reported that there have been substantial shifts in species composition and abundance for all types of aquatic communities in Lake Winnipeg. Specific changes in algal species composition and increases in exotic species were mentioned, and it was noted that effects on the food web and the production of toxins is not known. It was also reported that aquatic snail communities in Lake Winnipeg are currently sparse and are dominated by a small number of tolerant species. Monitoring of aquatic communities was recommended to provide a basis ~~of~~ for future comparisons and to evaluate the impact of events such as spills.

The Department of Fisheries and Oceans presented evidence on the impact of nitrogen and phosphorus on Lake Winnipeg based on analyses of sediments, plankton communities and nutrient dynamics (Exhibit 105). Fisheries and Oceans concluded that the Lake Winnipeg ecosystem is deteriorating as a result of phosphorus inputs, and that any decline in river flows resulting from climate change and/or drought would increase the impact on the Red River and Lake Winnipeg (it was explained that the City of Winnipeg contributes to the nutrient loading of Lake Winnipeg which promotes development of blue-green algae and restructuring of the biological community). Short-term changes mentioned included impairment of water quality, fouling of commercial fishing nets and lowered recreational property values. Long-term changes included fish kills, benthic and planktonic organism declines, food web function impairment, and fish reproductive losses.

The Winnipeg Game and Fish Association reported on fish quality and abundance in Lake Winnipeg based on a survey of recreational and commercial fishers and outfitters (Exhibits 112, 116). It was reported that survey respondents indicated changes in terms of fish abundance, size and quality, and expressed a number of concerns about the fishery including phosphorus and nitrogen loadings, water flows at Lockport and at the mouth of the Red River, use of Lake Winnipeg as a reservoir and algal blooms. The Association concluded that there are many things happening on Lake Winnipeg that are not known or understood, and noted it is prudent to exercise caution and foresight when conducting activities that can affect water quality. Improved monitoring of fish stocks and regulatory enforcement were recommended.

Members of the public, particularly those living downstream from Winnipeg, expressed concern about the impact of the September 16, 2002 sewage spill on the environment, socio-economic conditions, and human heath and well-being (Exhibits 71, 72, 77). Downstream residents were concerned about potential health effects, and requested they be notified about sewage spills and releases. Several individuals commented that the sewage spill had adversely affected social and economic activities. Social activities affected included boating, recreational fishing and hunting by area residents, while economic activities included commercial fishing, guiding for sport fishing, outfitting and nature viewing as part of the regional tourism and ecotourism industry. An outfitter mentioned that reservations were cancelled and clients advised to find alternative destinations as a direct result of the sewage spill.

The Commission appreciates that the City of Winnipeg completed the requested Environmental Impact Statement within a short time period using existing information, and without the benefit of pre-planning, initial scoping and written guidelines. However, the Commission believes that the City could have used the opportunity provided more effectively to prepare a high quality environmental assessment consistent with the COSDI Report and best professional practice. As noted by members of the public, elements of an 'effects assessment' were either not addressed (e.g. description of the existing environment) or were not considered properly (e.g. alternatives, cumulative effects, sustainability).

The Commission believes that further efforts are necessary to adequately identify and assess the full range of possible environmental, socio-economic and cumulative effects of the City's wastewater systems. This effort should include meaningful consultation with interested and affected publics, and a thorough examination of the systems in relation to the principles and guidelines of sustainable development.

The Commission believes that the application of environmental assessment principles and practices to future development projects is an indication of responsible management that should be addressed in the Water and Waste Department's Environmental Management System. An internal environmental assessment process would serve to identify projects with potentially significant adverse effects, ensure meaningful public involvement, provide for effective mitigation, permit internal auditing and facilitate subsequent approvals and licencing.

Nutrient Management Strategy

During the proceedings, Manitoba Conservation discussed Manitoba's *Lake Winnipeg Action Plan*[(7)] that was announced by the Minister of Conservation on February 18, 2003 (Exhibit 87). The action plan includes a commitment to reduce nitrogen and phosphorus in Lake Winnipeg to levels that existed prior to the 1970s. The Department explained that pre-1970 levels of nitrogen and phosphorus are interim targets and estimated that nitrogen and phosphorus loadings will have to be reduced by 10 and 13%, respectively, to meet the targets. The Department also revealed that the provincial priorities for action by the City of Winnipeg were revised by combining ammonia reduction with nutrient management, thereby elevating nutrient management to number three in priority behind a new potable drinking water plant and wastewater effluent disinfection.

The City of Winnipeg commented that the health of Lake Winnipeg is a common concern, and that nutrient loadings originate from a variety of sources including forests, agriculture, feedlots and urban drainage (Exhibit 91). The City offered a different perspective on nutrient inputs to Lake Winnipeg based on average loadings from 1994 to 2001, and proposed that phosphorus loadings have increased by 75% since 1992. On this basis, the City considered the proposed provincial targets to be ineffective. It was argued that no data is available to determine whether nitrogen or phosphorus is the limiting factor and it is premature to impose nutrient limits on the City.

The City of Winnipeg Environmental Impact Statement (Exhibit 88) reported that the treated discharges from Winnipeg's water pollution control centres contribute about 6.3% of the phosphorus and 5.2% of the nitrogen that enter Lake Winnipeg. The impact statement noted that even with full biological nutrient control at all three treatment plants the concentration of nitrogen and phosphorus in the effluent would be 10 and 1 mg/L, respectively, and the consequential loadings to Lake Winnipeg would be reduced from 6.3 to 3.5% for phosphorus and from 5.2 to

2.1% for nitrogen. The City concluded that the ecological effects and benefits of reducing nutrients from City sources on the Red and Assiniboine rivers and Lake Winnipeg are unknown.

During the hearing, Fisheries and Oceans Canada reviewed lessons learned from the Laurentian Great Lakes and the Experimental Lakes Area of northwest Ontario regarding the role that phosphorus played in the eutrophication of these surface waters and made comparisons to Lake Winnipeg (Exhibit 105). Fisheries and Oceans went on to speak about the linkage between Lake Winnipeg water quality and phosphorus loading and predicted that if the phosphorus input to Lake Winnipeg is not reduced, the condition of the lake would continue to deteriorate.

Environment Canada reviewed material from the City's reports on ammonia and its Environmental Impact Statement (Exhibits 107, 109a). The presenter recalled a recommendation made to the Commission in November 1991 at the public hearing on Red and Assiniboine river water quality objectives that a basin-wide reduction of phosphorus from point and non-point sources is required, and a statement at the 2002 public hearing on the Simplot Canada Ltd. Potato Processing Plant proposal that the cumulative impact of various point and non-point discharges of phosphorus and nitrogen is of particular concern. Environment Canada also referred to a conclusion of a report titled *Nutrients and Their Impact on the Canadian Environment* [(5)] indicating that municipal sewage is the largest point source of phosphorus and nitrogen to freshwater, groundwater and coastal waters in Canada (Exhibit 109b). Reference was also made to the national Agricultural Policy Framework that would see implementation of Environmental Farm plans that would increase beneficial environmental management practices (Exhibit 108). Environment Canada mentioned that the stage is set for immediate action in Manitoba and it is timely to commit to addressing point sources of nutrients, such as Winnipeg's municipal wastewaters, when opportunities such as the current licencing process arise.

One of the participants expressed concern regarding Winnipeg's contention that nutrient discharges from City sources form only a small portion of the total loading to Lake Winnipeg (Exhibit 56). Concern was also expressed that the timeframe proposed by the City to reduce pollutant loadings was too long, and a recommendation made that planning begin now to eliminate the nitrogen and phosphorus contribution to Lake Winnipeg.

Another participant commented that while nutrient discharges from the City of Winnipeg appear to be small in proportion to the total load to Lake Winnipeg, they are still an important and identifiable point source (Exhibit 60). The participant went on to state that there should be no delay in eliminating these inputs given the declining health of Lake Winnipeg. It was recommended by another participant that the City and the Province work together to immediately address the larger problem of nutrient loadings to Lake Winnipeg (Exhibit 58).

The Province of Manitoba should complete its *Nutrient Management Strategy for Southern Manitoba* as soon as possible. Implementation of the strategy is a pre-requisite to the reduction in nutrient loadings targeted for Lake Winnipeg. Water quality objectives for nitrogen and phosphorus in Manitoba's rivers and receiving lakes are required for this purpose.

The Commission is concerned that only limited progress has been made by the City of Winnipeg toward nutrient reduction in its wastewaters and that, until recently, Manitoba Conservation has not provided adequate direction in this regard. It is noted that other upstream municipalities along the Red and Assiniboine rivers in Canada and the United States have already, or are in the process of, implementing phosphorus or total nutrient removal from their wastewaters.

Based on the evidence presented at the public hearing, the Commission concludes that the City of Winnipeg must begin the process of removing nutrients from its municipal wastewaters in the near future. Nutrient removal should include both technological changes to the wastewater treatment processes and control measures to limit nutrients from other sources. The priority for nutrient removal is phosphorus followed by nitrogen. The testimony of Environment Canada and the Department of Fisheries and Oceans supports this conclusion.

The Commission also notes that Manitoba's *Water Quality Standards, Objectives and Guidelines* do not provide sufficient guidance for nitrogen and phosphorus levels in wastewaters or receiving environments.

Combined Sewer Overflow Mitigation

The Commission's 1992 report[(3)] on water quality objectives for the Red and Assiniboine rivers recommended that site-specific studies be undertaken to determine water quality impacts of the combined sewer system on the river systems. The studies were to include an inventory of the combined sewer system, a project schedule to ensure that a sufficient number of flow events are monitored, an understanding of routing through the sewer system, flow monitoring, rainfall monitoring network, water quality monitoring during overflow events, and the establishment of parameters concerning fecal coliform levels correlated to storm frequency and duration. Manitoba Conservation reported that the Commission's recommendation was adopted but the City of Winnipeg report on combined sewer overflows was not finalized until November 2002 (Exhibit 3). The Department noted that the City's combined sewer overflow report was under review, and subsequent actions will be taken in consideration of the comments received during the review.

The City proposed that a long-term combined sewer overflow program be adopted as described in the *Combined Sewer Overflow Management Study* report (Exhibits 33, 34). The City outlined a long-term program that would reduce overflow events on a City-wide basis to an average of four events per summer recreation season (May 15 to September 30, inclusive) within a 50-year timeframe at a cost of $270M. The proposed program included four components: 1) data acquisition systems, increase weir height, demonstration project and studies 2002-05: $14M); 2) integration with basement flooding relief and sewer rehabilitation programs (2005-43: $26M); 3) assessment of latent and available in-line storage (2028-33: $50M); and 4) additional storage to meet four events per season (2034-50: $180M).

The City of Winnipeg Environmental Impact Statement (Exhibit 88) concluded that the frequency of exceedences of surface water recreation objectives downstream from Winnipeg would be reduced by the proposed controls. It also concluded that the remaining four (average) combined sewer overflow events would not be stored and their impact zones would not be reduced. The projected total sewage discharged was calculated to be about 4 million m^3, or 1 million m^3 per event. The impact statement further concluded that wet weather events would result in non-compliance with Manitoba's surface fecal coliform objectives under wet weather events due to the four residual combined sewer overflows and land drainage.

To place the proposed combined sewer overflow mitigation plan into perspective with the September 16, 2002 sewage spill, the City advised that the remaining four combined sewer overflow events will discharge approximately 4 million m^3 or an average of about 1 million m^3 (or 1,000 Megalitres) of untreated sewage per overflow event into the Red and Assiniboine rivers (Exhibit 34). In comparison, the spill event discharged a total volume of 427,000 m^3 (or 427 Megalitres) of sewage to the Red River. Although the combined sewer overflow is expected to be more dilute than the dry weather discharge, contaminant loading to the river is expected to be more than 1.5 times more than that during the sewage spill.

One of the participants expressed concern that the timelines for the combined sewer overflow program were both too short and too long (Exhibit 58); too short with respect to looking down the road to assess the cumulative impact and too long in not proposing timely solutions. The participant commented that by 2060 it may be intolerable to discharge treated human waste into freshwater, and by then composting toilets may be a standard feature in all dwellings. The participant further recommended the Province provide funding so that the required work can be undertaken and completed in a more reasonable timeframe of 10 to 15 years.

Another participant expressed concern that the City's combined sewer overflow program did not include measures to reduce water consumption, increase soil infiltration or use of water for other purposes (Exhibit 60). The participant urged that the issue of water conservation be addressed and that a program to promote stormwater retention, collect rainwater and reduce concrete be implemented. It was further noted that little attention had been paid to the effects of land drainage systems on the environment and requested that the City be required to assess the impact of drainage systems on the environment (Exhibit 110).

Other participants mentioned that the City of Winnipeg should not propose a 50-year timeframe to address combined sewer overflows based on cost implications (Exhibit 81), expressed frustration over the City's proposal to minimize combined sewer overflows (Exhibit 71), described Winnipeg's wastewater systems as antiquated (Exhibit 117), and suggested measures to conserve water, stabilize wastewater production, manage sewage surges and enhance treatment performance (Exhibit 123).

The Commission is of the opinion that the proposed 50-year timeframe to reduce combined sewer overflows to an average of four during the recreational season is too long. The Commission believes the City of Winnipeg should prepare a plan that reduces this projection to a 20 to 25-year timeframe. At the same time, the Commission believes the City should be able to undertake immediate action to reduce combined sewer overflows over the next three years. Such measures include proceeding with the pilot retention project earlier in the plan, instrumenting the outfalls and monitoring rainfall events, adjusting the weirs for maximum effectiveness and accelerating combined sewer replacement in high discharge and industrial districts. The City is encouraged to redesign its combined sewer overflow management plan with these measures in mind.

The Commission understands that combined sewer overflows have been managed primarily to address public health concerns during the recreational season. However, based on concerns expressed during the public hearing and current initiatives to limit nutrient loadings to Lake Winnipeg, consideration of the impacts only as they may relate to the recreational season is insufficient. Combined sewer overflows should therefore be managed on an annual basis and not just during the summer months.

The Commission notes that the target of four combined sewer overflow events per year may not result in a significant improvement over the present situation if the remaining four events produce the highest volumes of wastewater (these four events can be expected to carry more than 1.5 times the contaminant load to the river than the September 16, 2002 sewage spill). The City is therefore encouraged to target combined sewer overflow districts on a priority basis considering both wastewater volumes and industrial use.

Ammonia Reduction

The 1992 Commission public hearing report [(3)] concerning application of water quality objectives for the Red and Assiniboine rivers recommended that detailed site-specific studies should be undertaken to determine both the acute toxicity and chronic effects of un-ionized ammonia from wastewater effluent on the cool water aquatic life of the rivers. Members of the scientific community were to be invited to collaborate in the study design. Recommendations were to be available before July 1997 on requirements to deal with un-ionized ammonia in wastewaters from the City's water pollution control centres. The study results were to be utilized to establish an un-ionized ammonia objective, and a public hearing was to be held on the matter within six months after completion of the study.

Manitoba Conservation reported that the Commission's 1992 recommendation on ammonia was adopted, but completion of the study was delayed and the City's ammonia report was not finalized until November 2002 (Exhibit 3). Although the site-specific studies have not been completed to the satisfaction of Manitoba Conservation, it was reported that the Department believes that the results will be in accordance with the ammonia objective in Manitoba's *Water Quality Standards, Objectives and Guidelines*. The Department noted that the objective may be modified based on advice from the Commission and upon completion of additional studies.

The City of Winnipeg proposed that a long-term ammonia reduction strategy be implemented as described in the City's *Red and Assiniboine Ammonia Criteria Study* report (Exhibits 11, 12). The City's ammonia reduction strategy includes: 1) regulation of discharges from the City's wastewater treatment plants on a site-specific basis; 2) control of ammonia to protect the aquatic environment including treatment of centrate (liquid remaining after dewatering biosolids) at the North End Water Pollution Control Centre; and 3) additional studies, monitoring programs and testing of ammonia toxicity to expand the site-specific knowledge of the effects of ammonia.

The City of Winnipeg explained that application of ammonia criteria involves several science-based and site-specific considerations including allowable ammonia concentration, exposures, design flow period of record and flow allocation (Exhibit 78). It was argued that mixing zones are required since it was not considered reasonable for all objectives to be met at the end of the effluent pipe. The City went on to propose that ammonia loadings be based on the lower of chronic in-stream criteria and no lethality in the mixing zone (acute criteria with 5:1 dilution ratio). The proposed chronic in-stream criteria would involve 90% flow allocation for the Red River, 75% flow allocation for the Assiniboine River and a 40-year period of record for river flows.

The City of Winnipeg Environmental Impact Statement (Exhibit 88) presented information on the effects of ammonia from Winnipeg's sewage treatment plants including acute and chronic effects on aquatic biota. The City reported that, with the exception of the North End Water Pollution Control Centre under low flow conditions, the discharges do influence ammonia concentrations in the rivers but not to the extent that they represent a toxicity concern. It was proposed to treat liquid centrate from centrifuging biosolids at the North End plant to be in compliance with site-specific criteria for ammonia. The impact statement concluded that, while the current and proposed operations will continue to result in ammonia discharges from the three water pollution control centres, the discharges would not cause a significant impact on aquatic life.

Environment Canada outlined its proposed risk management strategy to address ammonia, inorganic chloramines and chlorinated wastewater effluents (Exhibit 63) and explained that assessment reports have been completed for these substances. It has been concluded by Environment Canada that they are all considered "toxic" under Section 64 of the *Canadian Environmental Protection Act* 1999 and that municipal wastewater effluents are the primary sources of these substances. The approach being followed by Environment Canada includes pollution prevention planning and development of a long-term strategy for wastewater effluents considering both the *Canadian Environmental Protection Act* 1999 and the *Fisheries Act*.

Environment Canada observed that there is generally a high level of treatment in Manitoba and that treatment in the prairies is better than in other parts of the country. It was also noted that there are still local issues related to ammonia toxicity and compliance with the *Fisheries Act,* and that some facilities are not operating to design standards.

Environment Canada indicated that the City's plan to address ammonia toxicity solely through centrate treatment appears to be inadequate. Environment Canada went on to state that, without nitrification at all three sewage treatment plants, it is likely that effluents would not be in compliance with Subsection 36(3) of the *Fisheries Act* based on the expected high levels of un-ionized ammonia alone. Given pH and temperature ranges in the Red River of approximately 7.7-8.5 and 1-23^{o}C, respectively, it was expected that the effluents would be acutely toxic using a standard bioassay test. Environment Canada concluded that, while adoption of centrate treatment is an important first step towards ammonia control, a more rigorous and timely reduction of ammonia is required.

Environment Canada provided subsequent clarification and supporting information on a statement made at the public hearing concerning the toxicity of ammonia in wastewaters from the City of Winnipeg's sewage treatment plants to fish [(9)]. It was confirmed that the City would have to consider additional measures, beyond centrate treatment at the North End plant and maintaining the status quo at the other plants, to achieve compliance with the *Fisheries Act*.

One of the participants urged the Commission to pay particular attention to the processes that the City is proposing to reduce ammonia (Exhibit 56) and noted that converting ammonia to nitrate will increase algal growth. It was noted that effective ammonia treatment would serve to reduce nutrients thereby solving two problems with one solution. The participant proposed wetlands as a means to remove both nitrogen and phosphorus at a fraction of the cost of alternatives being proposed by the City. Another participant commented that the most reasonable option to treat ammonia is to modify the North End sewage plant to treat the biosolids centrate side-stream (Exhibit 58).

Based upon the statements made by Environment Canada, the Commission believes the City of Winnipeg must now develop pollution prevention and compliance strategies to adhere to the regulatory and policy provisions of the *Canadian Environmental Protection Act* 1999 and the *Fisheries Act* with respect to ammonia. While the timeframe to complete a pollution prevention plan and to achieve compliance is to be

worked out with Environment Canada, the provincial priority placed on protecting Lake Winnipeg should also be recognized. The Commission believes that the regulatory requirement to reduce ammonia provides an opportunity for the City to reduce nutrient levels at the same time, and encourages Manitoba Conservation to support that direction.

The Environment Canada requirement for Winnipeg to prepare pollution prevention plans for its three water pollution control centres provides a balanced approach to ammonia reduction including the prevention of pollution at source and the virtual elimination of ammonia in municipal wastewaters. This approach will facilitate protection of the downstream environment including Lake Winnipeg and resource users including recreational and commercial fishers, Aboriginal communities, tourism outfitters and the general public.

Proposed Effluent Limits

The City of Winnipeg proposed that effluent discharge limits for its three water pollution control centres be based on existing secondary treatment performance and that limits for fecal coliforms be established to protect the Red and Assiniboine rivers for recreational use during the summer recreation season (Exhibits 36). The City's proposed licence limits and conditions for treated effluent are as follows:

City of Winnipeg Proposed Effluent Limits	
Parameter	**Licence Limit/Conditions**
Carbonaceous BOD_5 (CBOD)	• Standard, Tier 1 • Based on protecting river dissolved oxygen content • Monthly average to achieve 25 mg/L with exceedences to be addressed
Total Suspended Solids (TSS)	• Objective, Tier 2 • Monthly average to achieve target of 30 m/L • Exceedences in accordance with Manitoba's *Water Quality Standards, Objectives and Guidelines* (+/- 25 mg/L) • Exclude algae from ponds
Fecal Coliforms (FC)	• Generally consistent with current South End sewage treatment plant licence conditions • Specifics to be reviewed as part of disinfection for North End

	sewage treatment plant
Total Coliforms (TC)	• No requirement
Ammonia	• Site-specific ammonia criteria to be determined • 90% allocation of assimilative capacity for Red River • 75% allocation of assimilative capacity for Assiniboine River • 1962-present flow record period • No lethality in mixing zone (acute criteria with 5:1 dilution ratio)
Nutrients (N and P)	• Premature to establish limits at this time

Manitoba Conservation recommended that effluent discharge limits be established to protect the Red and Assiniboine rivers for the uses recommended by the Clean Environment Commission in 1992 [(3)] and subsequently adopted by Manitoba Conservation (Exhibit 3). The Department explained that technology limits such as BOD, CBOD and total suspended solids would be applicable to all three water pollution control centres while water quality limits would be specific to each facility. The Department went on to note that the proposed limits represent a starting point and need further refinement. A second review of river flow data, effluent discharge data and treatment plant capacities would need to be undertaken before licence limits are finalized. The recommendations outlined by Manitoba Conservation are as follows (Exhibit 37, 38):

Manitoba Conservation Recommended Effluent Limits	
Parameter	**Licence Limit/Conditions**
BOD_5	• Not to exceed 30 mg/L
$CBOD_5$	• Not to exceed 25 mg/L provided that an ammonia limit is applied
Total Suspended Solids	• Not to exceed 30 mg/L
Fecal Coliforms	• Not to exceed 200 Colony Forming Units/100 mL • Application during summer recreation season • Monthly mean of 1 grab sample on each of a minimum of 3 consecutive days per week
Total Coliform	• Not to exceed 1500 Colony Forming Units/100 mL • Application similar to Fecal Coliform
Ammonia	• *Water Quality Standards, Objectives and Guidelines* • 75% allocation of assimilative capacity of Red and Assiniboine rivers • 1913-2002 flow record period

	• Available effluent discharge data
Nutrients	• Water quality objectives for nutrients by 2004

The Commission supports the effluent limits recommended by Manitoba Conservation and not those proposed by the City of Winnipeg. The Commission also believes that interim direction should be established for nitrogen and phosphorus that is consistent with limits for other jurisdictions in Canada and achievable through best practical and available treatment technology.

Wastewater Disinfection

The City of Winnipeg's pollution prevention plan proposes to disinfect wastewaters from the North End Water Pollution Control Centre using ultraviolet radiation by 2004 (Exhibit 9). Disinfection is not considered necessary at present for the West End plant as the effluent leaving the polishing ponds complies with provincial standards. Ultraviolet disinfection is already in place at the South End plant. The City's proposal is for effluent discharge limits for pathogens to be based on fecal coliform levels established to protect the Red and Assiniboine rivers for recreational use during the summer recreation season (Exhibit 9).

The City of Winnipeg presented a health risk assessment based on a formula developed from Canadian and United States studies linking receiving bacterial water quality and the incidence of secondary infections for recreational activities. Their assessment suggested that about 20 health cases per year could be attributed to river water quality based on the target fecal coliform level in the Red River with disinfection at the North End plant. The City did not look at the health risk of combined sewer overflows.

The Commission supports the City of Winnipeg proposal for effluent disinfection at the North End Water Pollution Control Centre, re-assessment of the West End facility and ongoing monitoring of fecal coliforms and *E. coli* in its wastewaters. The West End facility should be re-examined periodically, particularly if development increases in that part of the city. The Commission also believes that the City should include *E. coli* in all of their bacterial analyses and verify the effectiveness of disinfection at the three treatment plants on removing *Cryptosporidium* and *Giardia.*

Public Notification System

The Commission's 1992 report [3] on water quality objectives for the Red and Assiniboine rivers recommended that the then-provincial Minister of Environment, in conjunction with other departments and the City of Winnipeg, should research and develop a high fecal coliform level public warning system for operation during the recreation season. The warning system was to alert river users within the classification area when the fecal coliform standard was exceeded. It was also recommended that the warning system be operational during the recreational season following attainment of compliance with fecal coliform objectives. A separate recommendation called for posting rivers with precautionary notices regarding the safety of primary recreation following rainfall events of sufficient volume to cause combined sewer overflows to the rivers.

During the proceedings, Manitoba Conservation stated that the warning system was not implemented (Exhibit 3). The Department explained that routine exceedences of the fecal coliform objectives can be expected to occur until disinfection is implemented at the North End Water Pollution Control Centre, and the general advice provided through warning signs posted in 1998 would be adequate to protect users of the river. Once disinfection is implemented, the Department indicated it would consider providing a public warning system for high fecal coliform densities. An approach similar to the system presently used by Manitoba Conservation for approximately 50 recreational beaches in Manitoba each summer could be considered.

The City's report on the shutdown of the North End Water Pollution Control Centre describes communications following the incident (Exhibit 40). The City reported the mechanical failure and shutdown within an hour to the Director, Environmental Approvals Branch, Manitoba Conservation; The Chief Medical Officer of Health, Winnipeg Regional Health Authority; Director of Operations, City of Selkirk; and, Chief Administrative Officer, Rural Municipality of St. Andrews. Mayor Glen Murray of the City of Winnipeg and others were also advised about the incident. A telephone message was also left for Environment Canada concerning the plant shutdown.

Significant public concern was expressed at the hearing about the lack of notification of downstream residents after the September 16, 2002 sewage spill. The concerns were particularly strong at the Selkirk hearing where the participants asked why the Rural Municipality of St. Clements was not immediately advised about the spill and why some residents along the Red River were not informed. Several participants were particularly concerned that First Nation communities downstream from Winnipeg and around Lake Winnipeg were not notified about the sewage spill and the safety precautions they should have taken in response to the spill.

People living along the Red River downstream from the City of Winnipeg commented that they know when there has been a sewage release or combined sewer overflow by the odours and floating debris. They mentioned that they have to cease activities near the river, clean up their equipment and wash their clothes. Downstream residents noted that they were affected by both sewage spills and combined sewer overflows, and requested that they be notified every time sewage is released or discharged into the river.

A presenter at the Selkirk hearing recommended that the City of Winnipeg install a 24-hour automated pollution monitoring station on the bridge north of Selkirk and provide the public with continuous information on water speed, water current, water level and water quality through the Internet (Exhibit 72). It was also suggested that warning flags be flown at all boat launches along the rivers indicating when there is a high fecal coliform count (Exhibit 58). The colour of the flag would indicate whether Manitoba's *Water Quality Standards, Objectives and Guidelines* for primary or secondary recreation are exceeded. The warning system could also serve to raise the level of public awareness about water quality of the Red River.

The Commission believes the City of Winnipeg and the Province of Manitoba have not lived up to the spirit of the Commission's 1992 recommendation that a warning system be put into place for Winnipeg's rivers to advise the public about raw sewage discharge events. The public, particularly downstream residents and resource users, has a right to know when sewage spills occur, whether they are accidental releases or combined sewer overflows. A notification system should therefore be developed by the City of Winnipeg in consultation with Manitoba Conservation and Manitoba Health. The public should be involved in the design of the notification system to ensure that it is practical and effective. The system should also be developed as a procedure within the framework of the Water and Wastewater Department's Environmental Management System.

Sewage Spill Prevention

The City of Winnipeg's internal review of the September 16, 2002 shutdown of the North End Water Pollution Control Centre included descriptions of the treatment facility, equipment maintenance histories, events before and after the shutdown, communications with regulatory authorities and the public, and water quality impacts (Exhibit 40). The report presented conclusions dealing with operational procedures, facility design and emergency response. Recommendations included preparing procedures for isolating pumps, altering the main building pumps, preparing procedures for other key activities, placing external marking on valve stems, reviewing training procedures, and identifying and mitigating risks of future spills.

The City-commissioned Associated Engineering's review of the North End sewage treatment plant failure consisted of visual inspections, interviews with City staff and examinations of background information and current regulations (Exhibit 41). The review focused on the influent (inflow) pumping area of the plant and included related operating and maintenance procedures. The report presented recommendations on the design of the pumping system, conduct of a hazard and risk assessment, preparation of safe work procedures, upgrade of pump isolation and training procedures, drafting of an emergency response plan, compliance with workplace safety and health legislation, and development of a performance system.

Manitoba Conservation's investigation of the sewage spill at the North End plant consisted of observing remedial work and interviewing City staff (Exhibits 42, 43). The report concluded that flooding of the pump wells resulted in an inability to pump sewage through the treatment plant. Conclusions and recommendations from Manitoba Conservation's report included isolation of pump wells, design of a pump drainage system, installation of monitoring devices, and implementation of programs to investigate problems and to test valves.

Members of the public articulated numerous concerns regarding the effects of the September 16, 2002 spill of sewage on the environment, human health, economic activities and recreational pursuits. This was particularly evident at the Selkirk hearing where concerns were also expressed about municipal wastewater effluents (wastewater discharges) and combined sewer overflows.

The Commission believes that spills of raw sewage into the Red and Assiniboine rivers can be prevented by proper engineering design, routine maintenance practices and standard operating procedures. The investigation reports by Associated Engineering,

Manitoba Conservation and the City of Winnipeg outlined many technical, procedural, policy and other recommendations aimed at preventing future spills. The Commission notes that the City has committed to implementing recommendations in the investigation reports.

The Commission is confident that development and implementation of an ISO 14001 registered Environmental Management System for the Winnipeg's wastewater treatment facilities will further serve to prevent future spills of sewage.

Wastewater Systems Reliability

The Commission heard testimony from the City of Winnipeg regarding the reliability of its wastewater systems and of the back-up capabilities in place (Exhibit 39). The City made specific reference to design and operational features of its collection systems that include gravity flow in collection sewers and interceptors, redundant pumping units in lift stations, power interruption to lift stations, and monitoring and alarm systems. With respect to treatment systems the City noted that reliability, redundancy, standardization are integral to their design and that vital components are designed to allow for repair or replacement without interrupting treatment.

The City of Winnipeg proposes to undertake a risk and criticality assessment at Winnipeg's three water pollution control centres (Exhibits 9, 39, 46). The proposed assessment would characterize the systems, determine critical assets, identify potential failures and adverse consequences, assess the likelihood of failure, evaluate existing countermeasures, estimate mitigation costs and develop a risk reduction plan. Subject to City Council approval, the City proposed to undertake the assessment over a 12-month period at a cost of $750K and to complete the assessment in 2004.

The Associated Engineering review of the North End plant shutdown (Exhibit 41) recommended changes to operating and maintenance procedures, and modifications to reduce the possibility of a future failure. The review report noted that failure of influent pumping system components including suction valves can be expected to occur. The report's recommendations included a plant-wide assessment to identify hazards and risks including condition appraisal of equipment, safe job procedures and options for managing and mitigating risks.

The Commission also heard testimony from a member of the public regarding the reliability of Winnipeg's permanent sewage lift stations (Exhibit 74). It was explained that lift stations are used to raise the elevation of sewage so it can flow by gravity to the treatment plants. Concern was expressed that failure of the lift pumps during critical spring and summer periods could result in basement flooding and subsequent release of sewage into the Red River. It was recommended that the City of Winnipeg upgrade the reliability and capacity of lift station pumps, and adopt a minimum standard for all operating lift stations during the summer months.

The Commission recognizes the need to undertake risk management at Winnipeg's three wastewater treatment plants and supports the City of Winnipeg's proposed course of action. The completion date of December 31, 2003 recommended by Manitoba Conservation for the risk and criticality assessment is also supported. However, the Commission believes the proposed assessment would be more effective if it is implemented within the framework of an Environmental Management System.

Non-conventional Contaminants

The Ad Hoc Group provided an overview of the City of Winnipeg's wastewater collection system and described the various constituents of the influent stream that originate from domestic, commercial, industrial and stormwater sources (Exhibits 51, 53). Residential sewage was described to contain a variety of household cleaners and detergents, oil, grease and solvents, food wastes, pharmaceuticals, cosmetics and enteric bacteria, while commercial and industrial wastes includes oil and grease, metals, solvents and a variety of synthetic organic substances.

The Ad Hoc Group discussed various contaminants of concern that are contained in the influent stream such as persistent and bioaccumulative chemicals, endocrine disrupting substances and biological agents. The substances described included polybrominated diphenyl esthers (PBDEs), nonylphenols, pharmaceuticals and mercury. The Group noted that there are 23,000 chemicals on the Domestic Substances List [10] and 58,000 on the Non-Domestic Substances List [11] and that 2,000 to 3,000 new chemicals are introduced each year. Concern was expressed that little is known about the vast majority of these chemicals, comparing this knowledge to the tip of the "toxic iceberg". Particular attention was paid to pollutants of emerging concern that are not routinely tested for including persistent/bioaccumulative chemicals, endocrine disrupting substances and biological agents.

The Ad Hoc Group made suggestions as to what can be done to alleviate concerns about the lack of information about toxic and chronic effects of chemicals. These included identifying sources of contaminants in wastewaters, expanding local and provincial lists of pollutants of concern, addressing pollutants from upstream sources and moving from an acceptable risk assessment or pollution control approach to a primary prevention approach. Examples of proactive, forward-looking policies to prevent contamination of surface waters included product labelling and the right to know, mandatory pollution prevention planning for facilities and products releasing toxic chemicals into the environment, adopting a "green chemistry" approach, extended producer responsibility, mandatory environmental and health impact statements and integrated pest management.

The Ad Hoc Group provided recommendations for both the City of Winnipeg and Province of Manitoba regarding influent wastewaters. Such recommendations included the City moving to a primary pollution prevention approach, expanding the list of pollutants of concern, systematically documenting influents and effluents, monitoring dischargers more aggressively, enforcing new regulations and prosecuting violators, providing incentives to industry to comply, educating the public about household hazardous wastes and making information transparent. Recommendations for Manitoba Conservation included working towards consistent water pollution control programs among all jurisdictions, adopting a pollution prevention approach instead of an end-of-pipe control approach, issuing licences for the City's wastewater treatment plants and requiring that the City issue an annual compliance report.

Based upon the evidence presented at the hearing, it appears that insufficient attention has been given to the ongoing characterization of influent and effluent streams at Winnipeg's three water pollution control centres. An increasing number of chemicals including toxic substances, endocrine disrupting compounds, pharmaceuticals and other substances are discharged into the City's sewer system. Most of the chemicals are passed through the water pollution control centres untreated and end up in the Red and Assiniboine rivers. Those chemicals that are removed during the treatment process are largely deposited on agricultural land as biosolids. Routine monitoring of influent and effluent streams for all major contaminants of concern is therefore required.

Pollution Prevention

The Ad Hoc Group referenced the Canadian Council of Ministers of the Environment definition of pollution prevention: "*The use of processes, practices, materials, products or energy that avoid or minimize the creation of pollutants and wastes at source*" (Exhibits 51, 53). The Group commented that this definition of pollution prevention has been adopted by the Government of Canada, the *Canadian Environmental Protection Act*, the Province of Manitoba, the Federation of Canadian Municipalities and the Canadian Centre for Pollution Prevention. It was noted that the City's pollution prevention plan is not consistent with the accepted definition of pollution prevention.

The Ad Hoc Group went on to discuss why the City of Winnipeg should adopt a pollution prevention approach. The Group explained that municipal wastewater effluents constitute the largest pollution source to surface and groundwater in Canada, and wastewater treatment plants are not designed to treat the full range of chemicals contained in the influent stream. They argued that if the treatment plants cannot deal with all of the substances, the logical solution is to prevent these chemicals from entering the waste stream. Winnipeg's Sewer By-Law (15) was mentioned by the Ad Hoc Group as an effective mechanism to control the type and amount of chemicals discharged into the municipal wastewater system.

The Ad Hoc Group described various pollution prevention initiatives that have been or could be implemented by the City of Winnipeg and its residents. The initiatives included materials substitution, waste minimization, household hazardous waste management, storm sewer markings and public education. The Group recommended the City use the Sewer By-Law to improve influent quality by requiring that businesses and industries improve the quality and reduce the quantity of their wastewaters. They also recommended that Manitoba's plan to manage household hazardous waste (Exhibit 54) be adopted, and that the public be informed about pollution prevention in the home.

One of the participants expressed concern about the various chemicals entering the municipal wastewater system, and suggested the City of Winnipeg and the Province of Manitoba jointly develop plans to deal with persistent toxic substances and pharmaceuticals (Exhibit 58). Another participant asked about the effects of orthophosphates, metabolites from drugs and hormones, triahalomethanes or haloacetic acids from chlorination, and requested that the Commission ensure that dialogue occurs on these concerns before licences for the pollution control centres are considered (Exhibit 56). Concern was also expressed over the City's "end of pipe" solutions and the general lack of attention being paid to innovative approaches to reduce inputs to the wastewater system (Exhibit 60). Banning the use of pesticides within City limits was also proposed as a means to reduce chemical and nutrient inputs to the sewage system.

Other participants reviewed the City of Winnipeg's municipal wastewater systems and provided sustainable proposals and solutions for the short and long-term (Exhibit 118), suggested that Winnipeg do its utmost to minimize water pollution (Exhibit 111), and provided a series of recommendations to improve the City's wastewater collection and treatment systems (Exhibit 123).

The Commission heard substantial testimony and received considerable evidence concerning the benefits of pollution prevention and other initiatives that have been implemented at municipal wastewater treatment facilities elsewhere in North America. The Commission believes the City of Winnipeg could be doing much more to prevent pollution at source by enhancing the Sewer By-Law, enforcing its provisions and expanding the list of restricted substances

Landfill Leachate Disposal

During the public hearing it was determined that leachate from City of Winnipeg landfills is being disposed of at the North End Water Pollution Control Centre. Manitoba Conservation advised that leachate disposal at the North End plant is carried out under approval from the Department. Information on leachate disposal was not included in the City's pollution prevention plan and leachate was not assessed in the City of Winnipeg Environmental Impact Statement.

A member of the Ad Hoc Group explained that municipal wastewater treatment plants are designed to handle sewage and were never meant to treat leachate from landfills. Consequently, sewage treatment plants are not efficient at treating leachate and its many toxic constituents, which pass through the treatment process and end up in the wastewater or the sludge (biosolids). Some of the constituents break down during the treatment process into other toxic substances.

Information on the quantity and quality of leachate disposed of at the North End Water Pollution Control Centre in 2002 was provided by the City (Exhibits 92, 93). In 2002, 12,063 Kilolitres of leachate were received from the Brady Road Landfill while 31,050 Kilolitres of leachate were received from the Summit Road Landfill. In addition, 2,370 and 900 Kilolitres of leachate were received from the Kil-Cona Park and Westview Park landfills, respectively in 2002.

The Ad Hoc Group discussed leachate disposed of at the North End Water Pollution Control Centre (Exhibits 96, 98) and observed that many of the 108 chemicals identified in the leachate analysis (Exhibit 93) are persistent and bioaccumulative in the environment. The chemicals include DDT and p-DDE, benzene, toluene, phenolic compounds, lead, molybdenum, and 2,4,5-T and 2,4-D (Agent Orange herbicide). It was also noted that some of the chemicals in the leachate are prohibited in many other jurisdictions.

The Commission views disposal of leachate at the North End Water Pollution Control Centre as an unacceptable practice that should cease as soon as possible. The City of Winnipeg should be advised to explore other treatment and disposal alternatives including treatment at source. Manitoba Conservation should address leachate disposal in any future licencing of the North End facility in such a manner as to preclude the practice entirely.

Environmental Management System

The Ad Hoc Group (Exhibits 51 and 53) and other participants (Exhibit 79) commented on the need for an Environmental Management System for Winnipeg's Water and Waste Department. Examples of other municipalities in Canada were cited where Environmental Management Systems or similar environmental management plans were implemented (e.g. Vancouver, Calgary, Edmonton, Toronto, Ottawa and Hamilton). The International Standards Organization (ISO) 14001 Environmental Management Standard entitled "Environmental Management Systems – Specification with Guidance for Use" was recommended for implementation. This Standard specifies requirements for a management system to enable an organization to formulate policy, objectives and targets, taking into account legislative requirements and information about significant environmental impacts.

The Ad Hoc Group commented that no City of Winnipeg department or agency has an environmental management plan or system in place (Exhibit 51). It was further noted that Plan Winnipeg 2020 Vision (Exhibit 55) promotes environmentally responsible decision-making for the broad community and within its own operations, and that there is policy level support for environmentally responsible procedures such as an Environmental Management System. The Group suggested that the City put an Environmental Management System in place within Winnipeg's Water and Waste Department and that a corporate-level Environmental Management System be considered for all Winnipeg departments and operating agencies.

Members of the public expressed concerns during the public hearing regarding the need for documented procedures, staff training, emergency planning and due diligence (Exhibits 51, 53, 57, 79). One of the participants noted that due diligence is achievable through the implementation of environmental policies, environmental management plans, management systems, audits and inspections (internal and external), and planning (back-up systems, scheduled maintenance, staff training). An Environmental Management System was advocated as an effective management tool for organizations to assess and control the environmental impacts of their operations and activities.

The Associated Engineering review of the North End Water Pollution Control Centre failure recommended that performance indicators and critical success factors be developed. These indicators and factors would enable the City to measure its performance and ensure that continuous improvement is achieved (Exhibit 41). An Environmental Management System provides for measurement of environmental performance in relation to its environmental policy, objectives and targets.

Other evidence presented during the public hearing discussed how an ISO 14001 Environmental Management System would improve operation of the North End sewage treatment facility and prevent future raw sewage discharges (Exhibit 79). The management system would provide the framework and establish formal procedures that define the organization's environmental policy, identify environmental aspects and impacts, and establish priorities, objectives and targets for environmental performance as well as other matters covered by the ISO 14001 Standard.

The Commission believes that a formal Environmental Management System is an effective means to ensure that Winnipeg's wastewater collection and treatment systems operate in a safe and reliable manner, and serve to protect human health and the environment. An Environmental Management System would integrate environmental requirements into operational procedures and practices, allow for continual improvement of environmental performance, and provide for due diligence in the event of any future accident or malfunction. To be fully effective, the Environmental

Management System should adhere to the ISO 14001 Standard and it should be registered and audited in accordance with other applicable ISO 14000 Standards. The environmental policy adopted by Winnipeg's Water and Waste Department as part of the Environmental Management System should be consistent with the environmental policy frameworks of the City of Winnipeg and the Province of Manitoba. The Commission further believes that involvement of the Winnipeg's Civic Environment Committee would be beneficial in developing an Environmental Management System for Winnipeg's three water pollution control centers.

Employee Training and Certification

The Associated Engineering review of the sewage spill (Exhibit 41) noted that management responsible for the North End Water Pollution Control Centre has since made a commitment to training, and commented that an extensive and complete training program appears to be in the early stages of development. The report recommended that training resources be assigned to update and facilitate employee awareness, skills and safe work practices, and that training include the regular review of, and revision to, operating and maintenance procedures.

Several participants at the public hearing commented on the need for an appropriate level of training for wastewater treatment plant operators (Exhibits 51, 53, 79) and made reference to other jurisdictions in Canada that have implemented mandatory operator training and certification as part of environmental management planning initiatives. Training was described by one of the presenters as an example of due diligence behaviour.

The Commission recognizes the importance of providing required training to Winnipeg's Water and Waste Department staff so that they can perform their assigned duties in a safe and effective manner. The Commission believes that a formally approved training plan and an operator certification program are required for sewage treatment plant operators. The training plan and certification program should be developed within the framework of an Environmental Management System. Provincial regulations would serve to ensure that plant operators are trained, certified and upgraded in a consistent manner.

Operating Procedures

The Associated Engineering review of the September 16, 2002 sewage spill (Exhibit 41) reported that documentation on standard operating and safe working procedures does not exist for the North End Water Pollution Control Centre, and that work performed at the facility has not been analyzed on the basis of risk, hazards and best practice. Only significant projects such as disaster maintenance and boiler cleaning have written guidelines. The lack of safe work procedures was determined to be a major contributing factor in the flooding of the pump wells. This fact underscores the need to conduct safety audits to review and assess all work procedures, and to review the personal protection policy.

The City of Winnipeg's spill report (Exhibit 40) recognized the need for prescriptive procedures to deal with critical operations. The report identified requirements for written procedures that identify hazards and assign responsibilities, and listed the steps for isolating critical equipment. Recommendations were provided in the report that included preparation of written procedures to isolate pumps and other activities, and review of training for all procedures.

A participant at the hearing accepted the fact that valves "break and jam", but expressed concern that there are no regular testing procedures or a manual checklist for valves and sensors at the North End treatment facility (Exhibit 59). Another participant explained that development and implementation of an Environmental Management System would improve the operation of the North End facility and help to prevent future sewage spills (Exhibit 79). The management system would establish a formal set of procedures consistent with the ISO 14001 Standard including environmental aspects and impacts, legal and other requirements, objectives and targets, and an environmental management program.

Based on the public testimony and the assembled evidence, the Commission concludes that a formal system of operating procedures might have prevented the September 16, 2002 spill of raw sewage into the Red River. Improved operating procedures are required for a large number of operation and maintenance activities at Winnipeg's three water pollution control centres. To be effective, these procedures should be identified and documentation should be prepared within the framework of an Environmental Management System. Best practice procedures from other jurisdictions should be adopted or adapted whenever possible.

Emergency Response Planning

Participants at the public hearing spoke about emergency response planning or emergency preparedness for wastewater treatment plants and discussed the benefits to municipalities, businesses, human health and the environment. References were made to other municipalities across Canada that have implemented or are in the process of implementing emergency response plans and procedures (e.g. Calgary, Edmonton, Toronto). The Ad Hoc Group suggested that the City should prepare a comprehensive emergency response plan for each water pollution control centre, and that the plans be implemented within a City-wide emergency response plan with coordination among government, industry and the public (Exhibits 51, 53).

The Associated Engineering review of the September 16, 2002 failure (Exhibit 41) commented that there are no established procedures at the North End Water Pollution Control Centre for responding to emergencies, and recommended an emergency response plan be drafted for the facility. The report went on to state that flooding, fires, chemical spills and environmental threats are more effectively managed with a structured and rehearsed plan.

The Commission observed that the City's Water and Wastewater Department officials demonstrated responsibility by taking immediate action after the September 16, 2002 sewage spill, providing timely information to the public, and cooperating with regulatory authorities. The City's spill report (Exhibit 40) noted that an emergency response plan was developed early after the incident, and that planning decisions were made on a timely basis. A plan to re-establish the wastewater treatment processes was formulated in the hour immediately after the event. Daily briefings took place with key staff including the City’s public information staff and representatives from Manitoba Conservation.

The Commission supports recommendations made by the City of Winnipeg and its consultants calling for the preparation of emergency response plans for Winnipeg’s three wastewater treatment facilities and integration of the plans into a City-wide response plan. The City-wide plan should involve cooperative planning and implementation by government, industry and the public. To be effective, emergency response planning should be undertaken within the framework of an Environmental Management System for the City's Water and Waste Department. Further, emergency response plans should be prepared in accordance with accepted Manitoba and Canadian standards for emergency preparedness by industry.

Public Consultation

The City of Winnipeg discussed the public consultations undertaken for the combined sewer overflow management strategy (Exhibit 31) at the hearing. The consultations included open houses, presentations for special interest groups, and displays at malls, workshops, trade shows and professional meetings. The City also described a multi-disciplinary advisory committee formed to review information and reports and provide guidance. It was noted that future public consultations on the proposed pollution prevention plan were put on hold after the Minister of Conservation announced that the Clean Environment Commission would hold a public hearing.

The Ad Hoc Group reviewed the City of Winnipeg's policy on public involvement, discussed common difficulties with public involvement and described what other jurisdictions are doing (Exhibits 51, 53). Reference was made to the City's policy guidelines for citizen participation in public works projects and the requirements of Plan Winnipeg 2020. The Group went on to review and discuss public consultations undertaken by the City in terms of scope, coverage and status. Public consultation approaches by Toronto, Edmonton and Waterloo in Canada, and Los Angeles and Palo-Alto in the United States were also reviewed. The Group summarized key principles in designing participatory programs as a meaningful two-way exchange, involvement of multiple publics, degrees of participation, early public involvement, variety of engagement types, and balanced facilitation and reporting. It was suggested that the City have an ongoing, proactive public participation program that considers these principles and is driven by a staff member dedicated to public consultation.

The Ad Hoc Group also reviewed public participation requirements under Manitoba's *Environment Act* and the COSDI Report [8] (Exhibits 96, 98) and spoke about the benefits of involving the public. The Group went on to discuss public participation in relation to the City of Winnipeg Environmental Impact Statement. Recommendations presented by the Group on public participation included forming a citizen advisory committee, maintaining a scientific advisory committee, initiating neighbourhood advisory committees and hiring a public consultation coordinator for the City's Water and Waste Department.

The City of Winnipeg Environmental Impact Statement (Exhibit 88) summarized consultations carried out with the public for the combined sewer management study. The Impact Statement was not subject to public review and did not present new information on public consultation.

At the conclusion of the public hearing the City committed to continued and expanded efforts to share information with the public through the City of Winnipeg's web site, and creation of more frequent and earlier opportunities for public involvement in decision making (Exhibit 125).

The Commission notes that limited public consultation appears to have been carried out for the City of Winnipeg's pollution prevention plan as well as other matters related to municipal wastewater collection and treatment. It is also noted that there is no evidence to demonstrate how the public's input was used in ongoing planning and decision making.

The Commission appreciates that public consultation can be costly and time-consuming. It also acknowledges that the City's consultation plans were interrupted with the call for the current round of public hearings. However, the Commission still believes that the City of Winnipeg should be doing a better job of consulting with the public. A professionally designed public consultation plan is required to engage the public and stakeholders in meaningful two-way dialogue. Public consultation planning and procedures should also be developed and implemented within the framework of an Environmental Management System.

Aboriginal Consultation

Based on information contained in the City's reports on combined sewer overflows (Exhibits 33, 34) and ammonia reduction (Exhibits 11, 12), as well as information presented at the public hearing, it is evident that First Nation and Métis communities were not consulted on the continued operation and future development of Winnipeg's wastewater collection and treatment systems. The City of Winnipeg Environmental Impact Statement (Exhibit 88) also does not include any reference to consultation with Aboriginal communities.

The Ad Hoc Group presented information at the hearing relating to Aboriginal involvement, and discussed constitutional responsibilities of the federal and provincial governments to consult with First Nation and Métis communities that may be affected by decisions regarding effluent quality and setting effluent limits, setting limits regarding other chemicals of concern, wastewater system reliability planning and sewage spills (Exhibits 51, 53). The Group went on to discuss the meaning of Aboriginal involvement that includes consultation, public participation and relationship building, and provided examples of meaningful involvement with particular reference to municipal jurisdictions in Canada. Specific reference was made to provisions in Plan Winnipeg 2020 (Exhibit 55) and the draft discussion document titled, "*Strengthening Manitoba's Capital Region*" (12). With respect to Aboriginal involvement, the Group recommended that consultation policies should be developed for all levels of government.

The Ad Hoc Group discussed the concerns of Aboriginal communities regarding Winnipeg's municipal wastewaters and the September 16, 2002 sewage spill (Exhibits 96, 98). Aboriginal community concerns included the health of Lake Winnipeg, viability of fisheries, loss of recreational uses, impact on future development plans, lack of information on monitoring efforts and potable well water contamination. The Group recommended that governments discharge their responsibility to consult with Aboriginal peoples regarding potential impacts on their rights from government decisions such as licencing sewage treatment plants, discharging effluent into waterways, setting water quality guidelines, and managing and planning wastewater systems.

After reviewing the evidence submitted at the public hearing regarding Aboriginal consultation, the Commission is of the opinion that the City of Winnipeg has not initiated meaningful contacts with Aboriginal communities regarding the City's wastewater collection and treatment systems. The Commission believes that the City, with the advice and support of provincial and federal governments, should commence a process leading to full and complete consultations with Aboriginal communities downstream from Winnipeg and those around Lake Winnipeg respecting current and future operation of its wastewater collection and treatment systems.

Sustainability

The City stated that its pollution prevention plan was sustainable as it offers improved protection of public health, property and heritage resources (Exhibit 90). The City also stated the plan is consistent with the principles and guidelines of sustainable development but did not explain how. In terms of economic sustainability, the City noted the plan is consistent with the City's water management priorities and achievable within existing fiscal allocations.

The City's Environmental Impact Statement (Exhibit 88) commented on system sustainability in economic terms but biophysical, social and other components of sustainable development were not addressed. The City explained that the Environmental Projects Reserve would be used to finance proposed improvements to the City's wastewater collection and treatment systems. At present, the contribution to the Reserve fund is approximately $7 million per year. Increases to the Reserve fund will be required after 10 years to $14 million and after 20 years to $21 million, which would require increases to the sewer rates.

The Ad Hoc Group spoke about project sustainability in relation to the COSDI Report[(8)] (Exhibits 96, 98). The Group described sustainability as the balance between the biophysical, social and economic, cultural and human health benefits and impacts of a project. The Group criticized the City's Environmental Impact Statement by commenting that it does not define sustainability, analyse economics of other options or describe the long-term sustainability of environmental and socio-cultural factors. The Group went on to recommend that the City engage the citizens of Winnipeg and Selkirk/Lockport as well as Aboriginal communities and other stakeholders to develop a shared vision of sustainability, establish baseline stability parameters, and communicate with stakeholders to achieve a shared vision.

After reviewing the evidence presented at the public hearing, the Commission has concluded that a more in-depth analysis of the sustainability of the City's pollution prevention plan is required. The Commission believes that this analysis should form part of a comprehensive Environmental Impact Statement to be prepared by the City when licencing conditions for the pollution control centres are reviewed (see Recommendations section of this Report). The Commission suggests that this analysis should be carried out using the definition of sustainability and principles and guidelines of sustainable development prescribed by Manitoba's *Sustainable Development Act*.

Environmental Research and Monitoring

The City of Winnipeg provided information during the public hearing relating to the monitoring of influent and effluent streams at Winnipeg's three water pollution control centres. Parameters monitored in the influent stream include conventional measures (pH, total suspended solids, bacteriological oxygen demand, total organic carbon, total nitrogen and total phosphorus) and heavy metals (copper, cadmium, chromium, nickel, lead and zinc). The effluent stream is also monitored for total solids, turbidity, carbonaceous bacteriological oxygen demand, ammonia, nitrite and fecal coliform. The City reported that it has conducted a monitoring program for a full range of water quality parameters at 11 bridge locations on the Red and Assiniboine rivers since

1977. Limited monitoring of wastewaters is also conducted during combined sewer overflow events.

The City of Winnipeg Environmental Impact Statement (Exhibit 88) lists follow-up monitoring activities to be carried out as part of its pollution prevention plan. Monitoring relative to the combined sewer overflow control program includes determining changes in the magnitude, frequency and duration of combined sewer overflows, quality of wastewater stored in-line and off-line and the overall success of temporary storage during wet weather, and improvements in water quality in the rivers. Monitoring proposed for the ammonia reduction program includes determining baseline information on fish species potentially affected by ammonia, and distribution of ammonia concentrations during low flow conditions. No other environmental monitoring is proposed in the impact statement.

Manitoba Conservation reported on water quality monitoring carried out by the Water Quality Management Section of the Water Branch on the Red and Assiniboine rivers and Lake Winnipeg (Exhibit 4), and by the Environmental Approvals Branch on municipal effluents and other wastewaters (Exhibit 42). The Water Branch presented water quality information for a number of regulated parameters including bacteria, dissolved oxygen, ammonia and nutrients from monitoring sites on the Red River and Lake Winnipeg (Exhibit 4) and discussed results of water quality assessment following the September 16, 2002 sewage spill (Exhibits 44, 45).

The Ad Hoc Group (Exhibits 51, 53) discussed monitoring carried out on influent and effluent streams at Winnipeg's wastewater treatment plants. The Group went on to describe the biological, chemical and physical constituents of municipal wastewaters, and human health impacts associated with toxic metals, synthetic organic chemicals and human pathogens. It was noted that some of the toxic substances on the *Canadian Environmental Protection Act* 1999 Priority Substance Lists [13, 14] are not monitored by the City, and many more contaminants are discharged into the environment without adequate screening.

One of the participants provided information on the effects of pollution sources such as Winnipeg's municipal wastewaters on the aquatic environment with particular reference to Lake Winnipeg (Exhibit 57). Changes in species composition and abundance, and eradication of certain invertebrates in Lake Winnipeg were attributed, in part, to municipal wastewaters. The participant recommended that programs for routine monitoring and assessment should include ammonia, total nitrogen, total phosphorus, dissolved oxygen and total suspended solids, and that programs for biological assessment of aquatic communities should be in place to provide a basis for future comparisons or to evaluate the impacts of major events such as sewage spills.

Another participant expressed concern that baseline information relating to the Red and Assiniboine rivers and Lake Winnipeg is not adequate for the kinds of decisions being made on the future use and enjoyment of these waterbodies (Exhibit 56). He went on to recommended that existing monitoring and testing programs be expanded to include the effects on aquatic life from all known pollutants, and suggested that the results of these programs be published regularly so the public can remain informed.

A participant also commented that it would be wise to spend more money on monitoring and protecting the "13th largest lake in the world" which sustains the most valuable inland subsistence, commercial and recreational fisheries in Canada west of Lake Superior (Exhibit 80). The participant went on to ask why the necessary steps have not been taken to monitor and protect Lake Winnipeg from situations like the sewage spill given its economic, cultural and historic importance to all Manitobans and Canadians.

The Commission observed that there does not appear to be an integrated water quality monitoring network for the Red and Assiniboine rivers and Lake Winnipeg. Such a network is required to identify baseline or background water quality conditions, detect trends or changes due to pollutant sources or spill events, and provide a basis for regional planning and effective decision making. It was also noted that the City of Winnipeg Environmental Impact Statement did not provide an adequate description of baseline or background conditions, an essential requirement of an environmental assessment.

The Commission notes that the City's current river monitoring programs do not measure dissolved oxygen levels during the day and at night. Also, the Commission observed that limited sampling for benthic invertebrates was carried out. No information was provided at the hearing on sediments and invertebrates immediately downstream from the three sewage treatment plants. Permanent monitoring stations should be established and monitored regularly throughout the year for water quality parameters as well as for benthic invertebrates and sediment contaminants.

The Commission believes that separate federal, provincial and municipal research and

monitoring programs may not be the most cost-efficient and effective approach to environmental protection and management for the Red and Assiniboine rivers and Lake Winnipeg. A cooperative, cost-shared monitoring program is required to define baseline conditions, address information deficiencies and provide answers to questions about the impact of municipal wastewaters and other sources of pollution on the environment and human health.

Observations

The following observations are provided as general comments or suggestions to government regarding the City of Winnipeg's wastewater collection and treatment systems. They are presented as matters of importance or concern, which warrant consideration by government.

Wastewater Treatment Technology

During the course of the public hearing the Commission heard from a number of participants concerning alternative wastewater treatment technologies. A participant at the Winnipeg hearing spoke about industrial pre-treatment processes and suggested various measures to reduce water consumption and wastewater production (Exhibit 123). Another participant discussed new and emerging approaches to wastewater treatment and described a "water soft path" approach involving a combination of treatment strategies (Exhibit 117). One of the funded participants (Exhibit 124) advanced a "living system solution" or bioreactor system being proposed for the St. Norbert Arts Centre that also has wider applications.

The Commission supports innovative sewage treatment processes that serve as alternatives to the conventional technologies traditionally used by municipalities. The City of Winnipeg is encouraged to pursue new approaches along with proposed upgrades to its existing wastewater systems. As municipal wastewater treatment impacts the environment, human health, fisheries and a host of other inter-related jurisdictional responsibilities, funding for research and development should be available from both the federal and provincial levels of government. In addition, opportunities to partner with the private sector, universities, and/or not-for-profit organizations in research and development activities should also be explored.

Biosolids Management

The management of biosolids or the solid fraction of the waste stream produced by sewage treatment facilities was not specifically included in the Commission's *Terms of Reference* for the review of the City of Winnipeg's wastewater collection and treatment systems (Exhibit 2; Appendix A). The City's biosolids management program is regulated by an existing *Environment Act* licence which is currently under review. Manitoba Conservation views the priority for biosolids management to be lower than for potable water treatment, effluent disinfection and ammonia reduction/nutrient management, and higher than for combined sewer overflow mitigation.

During the course of the public hearing, the funded participants and members of the public expressed concern about the management of biosolids. Biosolids were also referenced as an important ($50 million) component of the City's pollution prevention plan, and were addressed in the City of Winnipeg Environmental Impact Statement. Accordingly, the Commission received sufficient information about biosolids to form an opinion about its future management.

The Commission believes that municipal wastewaters should be managed in their entirety including both solid (biosolids) and liquid (effluent) wastes. Pollution control measures aimed at improving effluent quality should not result in the transfer of contaminants to the biosolids side of the equation. Instead, pollution prevention measures aimed at improving both the liquid and solid fractions of the waste stream should be considered. Accordingly, the treatment and disposal of biosolids should be included in future *Environment Act* licences issued to the City of Winnipeg for the North End Pollution Control Centre and not licenced separately.

Environmental Assessment Process

The Commission was provided with extensive documentation relating to the City of Winnipeg's wastewater collection and treatment systems, and the potential environmental effects associated with their operation on the environment and human health. Stemming from recommendations in the Commission's 1992 report and direction by Manitoba Conservation, this documentation related mainly to ammonia, combined sewer overflows and selected pathogens. The effects of nutrients and other constituents of wastewater on the receiving environment were considered to a lesser extent. This was particularly evident in the City of Winnipeg Environmental Impact Statement where a full range of environmental effects on biophysical, social, economic, cultural and other components of the environment were not considered.

The Commission believes that the City of Winnipeg should establish an environmental assessment process to screen development proposals and conduct environmental assessments on projects with the potential to cause adverse environmental effects. Projects with properly conducted environmental assessments will likely increase public

acceptance, and facilitate provincial and federal licences and approvals. Plan Winnipeg's Vision provides for implementing a civic environmental impact review and monitoring process, which is compatible with Manitoba's *Environment Act*.

Cumulative Effects Assessment

The COSDI Report[8] lists elements that are to be considered in an 'effects assessment' of proposed developments in Manitoba. While an 'effects assessment' is not currently a regulated requirement in Manitoba, the COSDI Report has been adopted as provincial government policy. One of the elements of an 'effects assessment' is a description of cumulative and interdependent effects. Cumulative effects are changes to the environment caused by an action in combination with the effects of other past, present and reasonably foreseeable future human actions.

The City of Winnipeg Environmental Impact Statement (Exhibit 88) includes a general assessment of cumulative environmental effects resulting from the continued operation and future development of the City's wastewater collection and treatment systems. This assessment was strongly criticized and challenged at the public hearing by the Ad Hoc Group (Exhibit 96, 97). The Group noted that there was no assessment of the cumulative effects of the system.

The Commission agrees with the Ad Hoc Group's criticism of the City's Environmental Impact Statement in terms of its adequacy with respect to cumulative effects. Based on evidence provided by Fisheries and Oceans Canada and other participants, the combined effects of various pollutants from Winnipeg, other municipal and industrial developments, rural agricultural runoff, the United States and other sources may have already resulted in a significant cumulative impact on Lake Winnipeg. Given the nature, complexity and geographic extent of the issue the Commission believes a regional management approach to cumulative effects to be necessary. Both the Red River Basin Commission and the recently announced Lake Winnipeg Stewardship Board appear to be well-suited to taking on this responsibility.

Precautionary Principle

The precautionary principle was mentioned by several members of the public during the public hearing. The principle originates from the United Nations Conference on the Environment and

Development in 1992 and states that, "*Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation*". The Commission notes that it has been over a decade since the last public hearing involving the City of Winnipeg's wastewaters and only limited progress has been made on certain issues such as ammonia toxicity and nutrient enrichment. Application of the precautionary principle would serve to accelerate action by the City and Manitoba on these important issues.

Based on the evidence presented at the public hearing the Commission believes that the precautionary principle should be applied to the City of Winnipeg's wastewater collection and treatment systems "sooner rather than later". The City is in a position to take responsible action and demonstrate leadership by reducing ammonia and nutrient levels in wastewaters and mitigating combined sewer overflow events. Furthermore, emerging issues relating to endocrine disrupting substances, pharmaceuticals and nonylphenols as well as toxic, carcinogenic, persistent and bioaccumulative substances in wastewaters should be addressed using the precautionary principle.

Recommendations

Wastewater Treatment Plant Licencing

1. If Environment Act licences are issued for Winnipeg's three water pollution control centres, they should be issued on an 'interim' basis only.

The Commission maintains its position that the public hearing and review that is the subject of this report was not specifically directed to consider the question of *Environment Act* licensing for the City's water pollution control centres. This recommendation is offered in response to evidence presented at the hearing indicating that Manitoba Conservation contemplates proceeding to licencing of the City's water pollution control centres following the issuance of this report. The issuance of 'interim' *Environment Act* licenses would provide for the creation of an appropriate instrument through which the other recommendations contained in this report might be implemented.

2. The 'interim' Environment Act licences for Winnipeg's three water pollution control centres should be reviewed again in two years and every three years thereafter.

Licenses for the City's three water pollution control centres should be the subject of a major public review within two years to ensure public accountability. This review should be conducted by the Commission based on detailed *Environment Act* licence proposals and an Environmental Impact Statement prepared in accordance with publicly reviewed guidelines issued by Manitoba Conservation. Subsequently, the licences should be reviewed by the Commission every three years until such time as the City has substantially completed the upgrading of its wastewater collection and treatment systems as proposed in 2003.

3. Manitoba Conservation should establish 'interim' effluent limits for Winnipeg's three water pollution control centres in accordance with Manitoba's Water Quality Standards, Objectives and Guidelines.

The Commission supports the effluent limits proposed by the Environmental Approvals Branch as follows:

- Biological Oxygen Demand (BOD_5) – 30 mg/L
- Total Suspended Solids – 30 mg/L
- Fecal Coliform – 200 Colony Forming Units/100 mL

- Total Coliform – 1,500 Colony Forming Units/100 mL
- Ammonia based on 75% assimilative capacity using the 1913 to 2002 flow record

Given the evidence that the proposed treatment of centrate at the North End Water Pollution Control Centre will not result in compliance with the *Canadian Environmental Protection Act* 1999, an alternative technological solution appears to be required. Until site-specific studies are complete, the licences should reflect Manitoba's water quality objective for ammonia.

Environmental Impact Statement

4. The City of Winnipeg should be directed to prepare a comprehensive Environmental Impact Statement prior to the review of its three water pollution control centre 'interim' Environment Act licenses.

Specific guidelines for preparation of a comprehensive Environmental Impact Statement are required. The guidelines should incorporate best professional practice and prescribe the scope, methodology and public consultation for the environmental assessment. Further, the public should be given the opportunity to review the draft guidelines for the Environmental Impact Statement.

Nutrient Management Strategy

5. Manitoba Conservation should accelerate the schedule to complete the Nutrient Management Strategy for Southern Manitoba by December 2004.

Identification and implementation of actions necessary to reduce nitrogen and phosphorus levels in Lake Winnipeg to pre-1970 levels will be subject to direction provided by Manitoba's nutrient management strategy. The deteriorating condition of Lake Winnipeg reported during the hearing illustrates the nature and extent of the "nutrient" problem. Reducing nutrients from point and area sources in southern Manitoba should commence much sooner than presently contemplated.

6. The City of Winnipeg should be directed to plan for the removal of nitrogen and phosphorus from its municipal wastewaters, and to take immediate steps in support of the nutrient reduction targets established for Lake Winnipeg. The City's nutrient removal plan should be a key element of a licence review hearing to be scheduled within two years.

The City of Winnipeg should develop a plan to remove nutrients from its municipal wastewaters rather than deferring this until completion of Manitoba's nutrient management strategy. Priority should be placed on phosphorus. Other municipal jurisdictions in the Red and Assiniboine rivers basin have already implemented phosphorus removal, with effluent limits of 1 to 2 mg/L total phosphorus, and are also moving towards nitrogen removal. The City should also take immediate steps to reduce nutrients by accelerating the implementation of technological solutions at one or more of its water pollution control centres and controlling other point and area sources. Targets of 10 per cent for phosphorus and 13 per cent for nitrogen should be achievable within a two-year period.

Combined Sewer Overflow Reduction

7. The City of Winnipeg should be directed to shorten the timeframe to complete it's combined sewer overflow plan from the proposed 50 years to a 20 to 25-year period.

The shorter timeframe is necessary to address public concerns over the effects of sewage from combined sewer overflows on public health, recreation, tourism and aesthetics, and to further reduce nutrient loadings to Lake Winnipeg.

8. The City of Winnipeg should be directed to take immediate action to reduce combined sewer overflows by instrumenting outfalls, adjusting weirs, accelerating combined sewer replacement, advancing the pilot retention project and undertaking other reasonable measures to reduce combined sewer overflows within two years.

The City of Winnipeg should install instruments at combined sewer outfalls, collect required monitoring data and conduct necessary studies to verify the accuracy of modeling to predict overflow events. The City should determine actual volume of wastewaters entering the rivers from combined sewer overflows during the entire calendar year. Contributions of ammonia, nutrients, pathogens, metals and other parameters of concern from combined sewer overflows to the Red and Assiniboine rivers and Lake Winnipeg can then be determined and used to assess the impact on the aquatic environment, social and economic conditions, and human health. Information from monitoring combined sewer overflows can also be used to identify districts where sewers are to be replaced on a priority basis. The City should further target combined sewer overflow mitigation through replacement and other means in districts with high volumes of wastewater and heavy industrial and commercial use.

Public Notification System

9. The City of Winnipeg should be directed to develop and implement a notification system to inform the public whenever there is a release of raw sewage from any source into the Red and/or Assiniboine rivers. The public notification system should be operational by the beginning of the 2004 summer recreation season.

The public notification system should be developed in consultation with appropriate civic and provincial departments, and regional health authorities. The system should take advantage of existing notification mechanisms for air quality and public health emergencies. The public should be notified whenever there is an accidental sewage spill, combined sewer overflow or sanitary sewer malfunction. The publics to be notified should include Winnipeg and downstream municipalities and communities, including Aboriginal communities. They should be informed about the nature of the release, the potential health risk and the personal protection procedures to follow.

Wastewater Treatment System

10. The City of Winnipeg should be directed to proceed with disinfection of wastewaters at the North End Water Pollution Control Centre without delay and should routinely test for pathogens in all wastewater discharges.

The City of Winnipeg has indicated it is proceeding to install ultraviolet disinfection equipment at the North End Water Pollution Control Centre to control pathogens. In addition, the City should undertake a full characterization of an expanded range of pathogens contained in all of Winnipeg's municipal wastewater discharges including combined sewer overflows. The characterization should be repeated annually and the results made available to the public. In addition, the public should be notified immediately when pathogen levels in receiving waters pose a risk to human health.

11. The City of Winnipeg should be directed to complete risk and criticality assessments at Winnipeg's three water pollution control centres by April 2004 and implement recommendations to minimize the risk of future spills of untreated sewage.

Recommendations from the risk and criticality assessments should be used to establish on-site back-up equipment and capability including replacement equipment and redundancy for critical equipment at Winnipeg's three water pollution control centres. In addition, the results of the assessments should be implemented within the framework of an Environmental Management System to ensure ongoing monitoring for effectiveness and continual improvement.

12. The City of Winnipeg should be directed to increase the number of parameters measured in the influent and effluent streams to include contaminants of concern such as heavy metals, organochlorines, endocrine disrupting substances and pharmaceuticals.

Manitoba Conservation should use the *Canadian Environmental Protection Act* 1999 Priority Substance Lists to screen Winnipeg's municipal wastewaters for contaminants of concern. Increasing the number of parameters tested on a routine basis will provide an improved safety net for the environment and the public.

13. The City of Winnipeg should be directed to implement changes to Winnipeg's Sewer By-Law that would expand the list of restricted substances, prevent disposal of contaminants of concern, encourage treatment at source, improve enforcement of the By-Law and increase penalties for violations.

The City of Winnipeg Sewer By-Law provides an excellent opportunity to prevent pollution at source, limit demands on wastewater treatment facilities, reduce pollution control costs, and improve wastewater quality. To be more effective, the list of restricted materials should be expanded to increase the number of heavy metals of concern and to include persistent organic pollutants and other contaminants. Improved enforcement is required to discourage misuse of the sewage system.

14. The City of Winnipeg should be directed to stop the practice of disposing of landfill leachate at its water pollution control centres within a period of eighteen months.

Disposal of leachate from the City's landfills at the North End Water Pollution Control Centre is an unacceptable practice. Leachate contains many contaminants of concern that are on the *Canadian Environmental Protection Act* 1999 Priority Substances Lists. These substances are toxic to aquatic life, persistent and bioaccumulative in the environment and prohibited by other jurisdictions. Municipal wastewater treatment facilities are not designed to remove these contaminants and only serve to dilute them before they are released into the environment. Many of the contaminants in leachate end up in the biosolids, which are then applied to agricultural land.

Financial Support

15. The City of Winnipeg should be directly assisted by the Province of Manitoba in efforts to secure financial support under existing and future infrastructure programs for upgrades to its wastewater collection and treatment systems.

The estimated costs to upgrade Winnipeg's wastewater collection and treatment systems to achieve a better level of treatment and thereby improve water quality constitute a significant cost burden to a municipal level of government. Municipal governments have many competing priorities for funding and do not have access to the growth revenues of provincial and federal governments. Both the provincial and federal governments have placed significant emphasis on nutrient management with a strong focus on reducing nutrients in municipal wastewaters. The Commission believes that the senior levels of government should assist with the cost of achieving improved nutrient management and other water quality enhancement measures. Ideally, the funding formula of one-third municipal, one-third provincial and one-third federal should be used.

Environmental Management System

16. The City of Winnipeg should be directed to immediately begin development and implementation of an Environmental Management System for Winnipeg's three water pollution control centres with a completion date of no later than April 2005 with major components of the management system implemented much sooner.

The City of Winnipeg should adopt the appropriate ISO I4000 Environmental Management System standards, and the Environmental Management System should be registered and audited in accordance with those standards. The Environmental Management System should incorporate training and certification requirements, standard operating procedures and emergency response planning. A program of internal and external auditing should be implemented and the results should be considered during annual management reviews. A full-time staff member should be dedicated to the development and implementation of the management system. The City should begin this initiative with preparation of an Environmental Policy incorporating pollution prevention, the precautionary principle and sustainability provisions. The policy should be submitted to Manitoba Conservation by September 2003. Winnipeg's Civic Environment Committee should assist in developing and implementing the Environmental Management System.

Public Education

17. The City of Winnipeg should be strongly encouraged to develop and implement a permanent public education program to improve awareness of Winnipeg's wastewater collection and treatment systems and to foster public involvement in activities that focus on water conservation and pollution prevention at source.

A long-term public education program is required to improve citizen awareness of the City's wastewater collection and treatment systems, results from ongoing studies and monitoring programs, and responsibilities for water conservation and pollution prevention in the home and at work. The City should partner with industry to develop and deliver pollution prevention and other programs aimed at the private sector.

Public Consultation

18. The City of Winnipeg should be directed to prepare a public consultation plan for Winnipeg's wastewater collection and treatment systems for approval by Manitoba Conservation by April 2004.

The City should consider retaining the services of a professional public consultation specialist to assist in preparing and implementing the public consultation plan. The plan should include provisions to inform the public about municipal wastewater operations, programs and policies, and to involve the public in identifying and addressing issues and concerns. A regional stakeholder advisory group should be established to ensure meaningful two-way dialogue with the interested and affected public, particularly downstream communities. The City should also consult with the Lake Winnipeg Stewardship Board and the Lake Winnipeg Research Consortium, and actively support Manitoba's nutrient management strategy. Consideration should also be given to issuing an annual report card to the public on the operation of Winnipeg's wastewater systems through the City's Civic Environment Committee.

Aboriginal Consultation

19. The City of Winnipeg should be encouraged and assisted by the Province, in cooperation with the federal government, to immediately begin developing and implementing a meaningful consultation program with Aboriginal communities concerning the continued operation and future development of its wastewater collection and treatment systems.

The City of Winnipeg should work with the provincial and federal governments to create a communications strategy to support regular and ongoing dialogue with First Nation and Métis communities. The requirement and strategy for communication with Aboriginal communities should also be incorporated into the City's public consultation plan.

Environmental Research and Monitoring

20. A cooperative, cost-shared environmental research and monitoring program involving the City of Winnipeg, Province of Manitoba and the Government of Canada should be established for the Red and Assiniboine rivers and Lake Winnipeg.

Current environmental research and monitoring programs by the City of Winnipeg, Manitoba Conservation and Fisheries and Oceans Canada do not appear to be adequate for the long-term protection and management of the Red and Assiniboine rivers and Lake Winnipeg. Each program has a different purpose and together they are not sufficiently integrated to comprehensively address all potential environmental issues. A more integrated approach is required with common objectives, shared resources and joint problem solving to establish baseline conditions, address information deficiencies and provide environmental information for decision-making. Additional funding is necessary to support this initiative.

Final Words

The spill of raw sewage into the Red River on September 16, 2002 was a significant event that resulted in a number of major responses by government, including a Clean Environment Commission public hearing. The hearing served to inform the public about water quality problems affecting Manitoba's freshwater resources, focus attention on the impact of nutrients entering our waterways, particularly Lake Winnipeg, and spark public debate on actions required to address these matters.

The recommendations detailed in this report call for immediate action to upgrade Winnipeg's wastewater collection and treatment systems, improve the quality of its wastewaters, limit nutrient loadings to Lake Winnipeg, and educate and involve the public. The report challenges the City of Winnipeg to demonstrate responsible leadership and environmental stewardship, and thereby help to ensure the sustainability of our freshwater resources for generations to come. The Province of Manitoba also needs to respond by demanding improved wastewater treatment performance and accelerating its nutrient management strategy. The provincial and federal governments must both come to the table with funds to help the City meet its responsibilities.

The public also has an important role to play in improving water quality in Manitoba. Citizens must become informed about water quality issues that affect them, participate in water quality initiatives such as Manitoba's nutrient management strategy and hold their elected officials accountable for the implementation of sustainable water policies.

With governments working together, and our citizens engaged, Manitoba's precious waterways will benefit from "better treatment" for generations to come.

References

(1) Manitoba Clean Environment Commission. 1981. Report on a Proposal for the Classification of Manitoba's Surface Water, Red River Principal Watershed Division. Prepared by Manitoba Clean Environment Commission, Winnipeg, Manitoba. 194p.

(2) Manitoba Clean Environment Commission. 1978. Report on a Proposal Concerning Surface Water Quality Objectives and Stream Classification for the Province of Manitoba. Prepared by Manitoba Clean Environment Commission, Winnipeg, Manitoba.

(3) Manitoba Clean Environment Commission. 1992. Report on Public Hearings, Application of Water Quality Objectives for the Watershed Classification of the Red and Assiniboine Rivers and Tributaries Within and Downstream of the City of Winnipeg. Prepared by Manitoba Clean Environment Commission, Winnipeg, Manitoba. 83p.

(4) Manitoba Clean Environment Commission. 2003. Interim Report on Public Hearings: City of Winnipeg Wastewater Collection and Treatment Systems – "Sewage Spill". Prepared by Manitoba Clean Environment Commission, Winnipeg, Manitoba. 27p.

(5) Chambers, P.A., M. Guy, E.S. Roberts, M.N. Charlton, R. Kent, C. Gagnon, G. Grove and N. Foster. 2001. Nutrients and Their Impact on the Canadian Environment. Agriculture and Agri-Food Canada, Environment Canada, Fisheries and Oceans Canada, Health Canada and Natural Resources Canada, Ottawa, Ontario. 241p.

(6) Manitoba Conservation. 2000. Development of a Nutrient Management Strategy for Surface Waters in Southern Manitoba. Manitoba Conservation Information Bulletin 2000-02E:10p.

(7) Manitoba Government News Release. Province Announces Lake Winnipeg Action Plan. February 18, 2003.

(8) Manitoba. 1999. Report on the Consultation on Sustainable Development Implementation (COSDI). Report of the Core Group. 47p.

(9) Letter from B. Briscoe, Environment Canada to T. Duguid, Clean Environment Commission dated April 24, 2003 regarding Environment Canada's submission on the continued operation of the City of Winnipeg's wastewater treatment plants.

(10) Canada, *Canadian Environmental Protection Act,* Domestic Substances List.

(11) Canada, *Canadian Environmental Protection Act,* Non-Domestic Substances List.

(12) Regional Planning Advisory Committee for Manitoba's Capital Region. 2002. Strengthening Manitoba's Capital Region: General Principles and Policy Directions – A Public Discussion Paper. 40p.

(13) Canada, *Canadian Environmental Protection Act,* Priority Substance List 1.

(14) Canada, *Canadian Environmental Protection Act,* Priority Substance List 2.

(15) City of Winnipeg Sewer By-Law No. 7070/97. Updated December 11, 2002. 54p.

Appendix A

Terms of Reference

Background

In June of 1992, the Clean Environment Commission issued a report titled, "Report on Public ~~h~~Hearings. Application of Water Quality Objectives for the Watershed Classification of the Red and Assiniboine Rivers and Tributaries Within and Downstream of the City of Winnipeg." That report contained a number of recommendations that related to the City of Winnipeg's wastewater collection and treatment systems. The Manitoba government accepted those recommendations. Subsequently, the City, in consultation with Manitoba Conservation and the scientific community, has implemented upgrades, undertaken studies and prepared plans to improve its systems.

A serious malfunction occurred at the North End Sewage Treatment Plant on September 16, 2002 resulting in the discharge of untreated wastewater into the Red River and raising concerns with respect to the back-up capability of the systems.

Mandate of the Hearings

The Clean Environment Commission shall, pursuant to clause 6(5)(b) of *The Environment Act,* conduct public hearings to review the City of Winnipeg's wastewater collection and treatment systems and to receive public comments and concerns respecting the systems. Following the hearings, the Commission shall provide a report, with advice and recommendations, to the Minister in accordance with subsection 7(3) of *The Environment Act.* The Commission shall provide the report within 6 months of the date of the Minister's request to hold hearings. The Commission may at any time request that the Minister of Conservation review or clarify these Terms of Reference.

Scope of the Review

The Clean Environment Commission shall review the City of Winnipeg's wastewater collection and treatment systems and related public concerns and provide advice and recommendations on:

- The reliability of The City's systems, especially the back-up capability of the systems to prevent a discharge of inadequately treated sewage to the rivers during malfunctions.
- The appropriate ammonia, nutrient, combined sewer overflow and microbiological limits on effluent from the City's systems necessary to protect the aquatic environment and recreational activities, including in Lake Winnipeg.
- The current and planned effectiveness of the City's systems in treating wastewater to achieve the discharge limits.
- The adequacy of the City's plans and schedule for upgrading its systems.
- The adequacy of processes being followed in reviewing those plans and schedules.

In doing so, the CEC should consider the applicable recommendations in the 1992 Commission report and the recently updated Manitoba *Water Quality Standards, Objectives and Guidelines*.

Appendix B

List of Registered Presenters

Name	Organization
Larry Strachan	Environmental Approvals Branch, Manitoba Conservation
Barry MacBride	Water and Waste Department, City of Winnipeg
Mike Shkolny	Water and Waste Department, City of Winnipeg
George Rempel	TetrES Consultants Inc.
David Morgan	TetrES Consultants Inc.
Ron Dalmyn	The Organization
Dwight Williamson	Water Resources Branch, Manitoba Conservation
Merrell-Ann Phare	The Ad Hoc Group
Laura Orlando	The Ad Hoc Group
Kenton Lobe	The Ad Hoc Group
Rodney McDonald	The Ad Hoc Group
Mike Stainton	Freshwater Institute, Fisheries and Oceans Canada
Alex Salki	Freshwater Institute, Fisheries and Oceans Canada
Len Hendzel	Freshwater Institute, Fisheries and Oceans Canada
Hedy Kling	Freshwater Institute, Fisheries and Oceans Canada
Barry Briscoe	Environment Canada
Scott Kidd	Private Representation
Al Mackling	Winnipeg Game and Fish Association
Joletta Brown	Winnipeg Game and Fish Association
Eva Pip	University of Winnipeg
Paul MacKenzie	Private Representation
Jack Jonasson	Coalition for Flood Protection North of Winnipeg
Jesus Miguel-Garcia	Private Representation
Paul Clifton	Private Representation
Reg Gallop	Private Representation
Len Van Roon	Private Representation
Louise May	St. Norbert Arts Centre
Tang Lee	St. Norbert Arts Centre

Appendix C

List of Exhibits

No.	Exhibit
1.	*Letter* dated October 03, 2002 from the Hon. Steve Ashton, Minster of Conservation, to Terry Duguid, Chairman of the Clean Environment Commission.
2.	Terms of Reference for Clean Environment Commission Hearings into The City of Winnipeg's Wastewater Collection and Treatment Systems.
3.	"Environmental Approvals Branch, Manitoba Conservation Clean Environment Commission Public Hearings City of Winnipeg Sewage Investigation January 20, 2003: Opening Comments by Larry Strachan, Director, Environmental Approvals Branch." Submitted by Larry Strachan, Manitoba Conservation.
4.	*Visual Projections*: "Manitoba Water Quality Standards, Objectives, and Guidelines 2002". Submitted by Dwight Williamson, Manitoba Conservation.
5.	"Final Draft – For Additional Review and Comment – Manitoba Water Quality Standards, Objectives, and Guidelines". Manitoba Conservation. November 22, 2002. Submitted by Dwight Williamson, Manitoba Conservation.
6.	*Visual Projections*: "Manitoba's Nutrient Management Strategy". Submitted by Dwight Williamson, Manitoba Conservation.
7.	"A Preliminary Estimate of Total Nitrogen and Total Phosphorus Loading to Streams in Manitoba Canada". Water Quality Management Section, Water Branch, Manitoba Conservation. November 2002. Submitted by Dwight Williamson, Manitoba Conservation.
8.	"Long-Term Trends in Total Nitrogen and Total Phosphorus Concentrations in Manitoba Streams". Water Quality Section, Water Branch, Manitoba Conservation. December 2001. Submitted by Dwight Williamson, Manitoba Conservation.
9.	*Visual Projections*: "Overview Presentation Winnipeg's Wastewater Pollution Prevention Plan: Presented to the Clean Environment Commission January 20, 2003 City of Winnipeg – Water and Waste Department". Submitted by Barry MacBride, City of Winnipeg.
10.	*Visual Projections*: "Ammonia Reduction in City of Winnipeg Wastewater Effluents: Ammonia Criteria Study". Submitted by George Rempel, TetrES Consultants Inc., Mike Shkolny, City of Winnipeg.
11.	"Summary: Ammonia Reduction in City of Winnipeg Wastewater Effluents". December 2002. Submitted by Mike Shkolny, City of Winnipeg.
12.	"Red and Assiniboine Ammonia Criteria Study: Final Technical Report". November 2002. Submitted by Mike Shkolny, City of Winnipeg.
13.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Fish Population Technical Memorandum #FP01: The Occurrence of External Deformities, Erosion, Lesions, and Tumours (Delts) on Fish from the Red and Assiniboine Rivers, 1999". Submitted by Mike Shkolny, City of Winnipeg.
14.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Technical Memorandum # T1.0: Phase 2 Toxicity Workstream: Ammonia Toxicity-Testing Program in 1999 and 2000." March 2001. Submitted by Mike Shkolny, City of Winnipeg.
15.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Technical Memorandum #RC2.0: River Conditions". January 2001. Submitted by Mike Shkolny, City of Winnipeg.
16.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Fish Behaviour Technical Memorandum #FB04: Movements of 10 Northern Pike Tagged with

No.	Exhibit
	Acoustic Transmitters in the Red River in the Vicinity of NEWPCC Effluent Plume, February-March, 2000". November 2000. Submitted by Mike Shkolny, City of Winnipeg.
17.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Fish Populations Technical Memorandum #FP02: Species Composition, Abundance, and Distribution of Fish in the Red and Assiniboine Rivers within the City of Winnipeg Ammonia Criteria Study Area, 1999". November 2000". Submitted by Mike Shkolny, City of Winnipeg.
18.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Other Stressors; Physical Constraints Memorandum # OSPC01: Other Stressors; Physical Constraints to Fish Populations in the Red and Assiniboine Rivers". September 2000. Submitted by Mike Shkolny, City of Winnipeg.
19.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Fish Population Technical Memorandum #FP03: Abundance, Composition, and Distribution of Benthic Invertebrates in the Red and Assiniboine Rivers Within the City of Winnipeg, 1999". July 2000. Submitted by Mike Shkolny, City of Winnipeg.
20.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Technical Memorandum #RH2.0: Phase 2 Other Stressors Workstream: Resource Harvesting Program Report for 1999". May 2000. Submitted by Mike Shkolny, City of Winnipeg.
21.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Fish Behaviour Technical Memorandum #FB02: Biological and Environmental Data from Experimental Netting in the Vicinity of the NEWPCC Outfall, October, 1999". February 2000. Submitted by Mike Shkolny, City of Winnipeg.
22.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Fish Habitat Technical Memorandum #FH03: Water Chemistry Data to Characterize Fish Habitat in the Red and Assiniboine Rivers". January 2000. Submitted by Mike Shkolny, City of Winnipeg.
23.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Fish Habitat Technical Memorandum #FH02: Benthic Invertebrate and Sediment Data to Characterize Fish Habitat in the Red and Assiniboine Rivers". January 2000. Submitted by Mike Shkolny, City of Winnipeg.
24.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Fish Habitat Technical Memorandum #FH01: Physical Data to Characterize Fish Habitat in the Red and Assiniboine Rivers". January 2000. Submitted by Mike Shkolny, City of Winnipeg
25.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Fish Behaviour Technical Memorandum #FB03: Movements of Fish Tagged with Acoustic Transmitters in the Vicinity of the City of Winnipeg's Water Pollution Control Centres, 1999 – 2000". Submitted by Mike Shkolny, City of Winnipeg.
26.	"Phase 2 Technical Memorandum for Red and Assiniboine Ammonia Criteria Study: Fish Behaviour Technical Memorandum #FB01: Biological and Environmental Data from Experimental Gillnetting in the Vicinity of the NEWPCC Outfall, March, 1999". August 1999. Submitted by Mike Shkolny, City of Winnipeg.
27.	*Visual Projections*: "Nutrient Characterization of Discharges from Winnipeg". Submitted by Nick Szoke, City of Winnipeg.
28.	"City of Winnipeg Water and Waste Department Nitrification Study: Preliminary Design Report". November 2002. Submitted by Mike Shkolny, City of Winnipeg.
29.	"City of Winnipeg Water and Waste Department Nitrification Study: Conceptual Design Report". November 2002. Submitted by Mike Shkolny, City of Winnipeg.
30.	*Drawings*: "City of Winnipeg Water and Waste Department Nitrification Study: Conceptual

No.	Exhibit
	Design Report". Submitted by Mike Shkolny, City of Winnipeg.
31.	*Visual Projections*: "Combined Sewer Overflow Management Study". Submitted by George Rempel, TetrES Consultants Inc., and Mike Shkolny, City of Winnipeg.
32.	*Letter*, dated September 11, 2002 from Chris Leach, CSO Advisory Committee to Nicolas T. Szoke, City of Winnipeg.
33.	"Executive Summary: Combined Sewer Overflow Management Study". Submitted by Mike Shkolny, City of Winnipeg.
34.	"Final Report: Combined Sewer Overflow Management Study". Submitted by Mike Shkolny, City of Winnipeg.
35.	"Report to City of Winnipeg Water and Waste Department: Combined Sewer Overflow Management Study: Volume 1, 2, 3, 4 (of 4)". Wardrop Engineering Inc. and TetrES Consultants Inc. Submitted by Mike Shkolny, City of Winnipeg.
36.	*Visual Projections*: "Wastewater Effluent License Limits." Submitted by Nick Szoke, and J. Oleszkiewicz, City of Winnipeg.
37.	*Visual Projections*: "Proposed Effluent Limits for City of Winnipeg Sewage Treatment Plants". Submitted by Mike Van Den Bosch, Manitoba Conservation.
38.	"Environmental Approvals Branch, Manitoba Conservation - Clean Environment Commission Public Hearings City of Winnipeg Sewage Investigation – January 2003: Recommended Effluent Discharge Limits for City of Winnipeg Sewage Treatment Plants" Mike Van Den Bosch, A/Manager, Municipal, Industrial and Hazardous Waste Approvals Section. Submitted by Mike Van Den Bosch, Manitoba Conservation.
39.	*Visual Projections*: "Wastewater Systems Reliability by City of Winnipeg, Water and Waste Department for Clean Environment Commission Hearings, January 2003". Submitted by Mike Shkolny, City of Winnipeg.
40.	"Report on the Shutdown of the North End Water Pollution Control Centre on September 16, 2002". Winnipeg Water and Waste Department. December 19, 2002. Submitted by Mike Shkolny, City of Winnipeg.
41.	"Final Summary Report: City of Winnipeg North End Water Pollution Control Centre Review of Failure". Associated Engineering. January 2003. Submitted by Mike Shkolny, City of Winnipeg.
42.	*Visual Projections*: "Investigation Report: Raw Sewage Discharge to The Red River – City of Winnipeg North End Sewage Treatment Plant". Submitted by Mike Van Den Bosch and Brian Konzelman, Manitoba Conservation.
43.	"Investigation Report Raw Sewage Discharge to the Red River – City of Winnipeg North End Sewage Treatment Plant". Manitoba Conservation. January 2003. Submitted by Mike Van Den Bosch, Manitoba Conservation.
44.	*Visual Projections*: Water Quality Assessment Following Release of Raw Sewage from the City of Winnipeg, September 2002". Submitted by Dwight Williamson, Manitoba Conservation.
45.	"Water Quality Assessment of the Red River and Lake Winnipeg Following Release of Raw Sewage from The City of Winnipeg, September 2002". Water Quality Management Section, Water Branch, Manitoba Conservation. November 2002. Submitted by Dwight Williamson, Manitoba Conservation.
46.	*Visual Projections*: "Summary of Winnipeg's Plan to Improve Wastewater Treatment". Submitted by Mike Shkolny, City of Winnipeg.
47.	*Visual Projections*: "Environmental Approvals Branch (EAB) Comments on City of Winnipeg Recommendations". Submitted by Larry Strachan, Manitoba Conservation.
48.	"Environmental Approvals Branch (EAB) Comments on City of Winnipeg Recommendations to the Clean Environment Commission Public Hearings – January 20,

No.	Exhibit
	2003". Larry Strachan, Director, Environmental Approvals Branch, Manitoba Conservation. Submitted by Larry Strachan, Manitoba Conservation.
49.	*Motion:* #1 [Respecting Hearing Suspension]. Submitted by John Sinclair, Ad ~~h~~Hoc Group.
50.	*Motion: #2* [Respecting Hearing Suspension]. Submitted by John Sinclair, Ad ~~h~~Hoc Group.
51.	*Visual Projections*: "Manitoba Clean Environment Commission Public Hearing: City of Winnipeg Wastewater Collection and Treatment System – Winnipeg, Manitoba, 21 January 2003: Presenters: Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe. Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
52.	Biographies of Funded Participants Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
53.	*Appendices*: "Manitoba Clean Environment Commission Public Hearing: City of Winnipeg Wastewater Collection and Treatment System – Winnipeg, Manitoba, 21 January 2003: Presenters: Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe". Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
54.	"A Plan to Manage Household Hazardous Waste in Manitoba". Manitoba Conservation. July 2001. Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
55.	"Plan Winnipeg 2020 Vision". City of Winnipeg. Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
56.	*Brief*: "Prepared for Manitoba Clean Environment Commission Hearings By Winnipeg Game and Fish Association – January 21, 2003. Submitted by Al Mackling, Winnipeg Game and Fish Association.
57.	*Brief*: "A Brief on the Downstream Impacts of The City of Winnipeg Wastewater Treatment Plant Effluents". Submitted by Eva Pip.
58.	*Brief*: "Brief to the Clean Environment Commission Hearing on Winnipeg's Waste Water Collection and Treatment Systems – January 21, 2003". Submitted by Carolyn Garlich, Council of Women of Winnipeg.
59.	*Brief*: "Lake Winnipeg & Winnipeg's S.T.P. Spill January 21/2003". Submitted by Ron Dalmyn, The Organization.
60.	*Brief*: "Presentation to the Manitoba Clean Environment Commission regarding the City of Winnipeg's Wastewater Collection and Treatment Systems". Submitted by Scott Kidd.
61.	*Visual Projections*: "Proposed Risk Management Strategy Addressing Ammonia, Inorganic Chloramines and Chlorinated Wastewater Effluents – Winnipeg, Manitoba January 21, 2003". Environment Canada. Submitted by Barrie Briscoe and Claude Fortin, Environment Canada.
62.	"Pollution Prevention Planning for Ammonia, Inorganic Chloramines and Chlorinated Wastewater Effluents in Municipal Wastewater Effluents: Working Document: Part 4 of the *Canadian Environmental Protection Act* 1999". Environment Canada. July 2002. Submitted by Claude Fortin, Environment Canada.
63.	"Proposed Risk Management Strategy addressing Ammonia, Inorganic Chloramines and Chlorinated Wastewater Effluents under CEPA 1999: Pollution Prevention Planning as a Fist Step Toward a Long-term Strategy for Managing Wastewater Effluents". Environment Canada. August 2002. Submitted by Barrie Briscoe and Claude Fortin, Environment Canada.
64.	"Proposed Risk Management Strategy addressing Ammonia, Inorganic Chloramines and Chlorinated Wastewater Effluents under CEPA 1999: Report of Consultation Sessions August 20th to November 4th, 2002: Summary of Input from Participants". Environment

No.	Exhibit
	Canada. December 2002. Submitted by Barrie Briscoe and Claude Fortin, Environment Canada.
65.	"Environment Canada Proposed Risk Management Strategy Addressing Ammonia, Inorganic Chloramines and Chlorinated Wastewater Effluents Under CEPA 1999: 2nd Table Discussion (Recorder Notes): Feedback on Pollution Prevention Planning Implementation Issues, Winnipeg, MB". Environment Canada. Submitted by Barrie Briscoe and Claude Fortin, Environment Canada.
66.	"Federal Register: Part VII: Environmental Protection Agency: Combined Sewer Overflow (CSO) Control Policy; Notice: Tuesday April 19, 1994." Submitted by the Manitoba Clean Environment Commission.
67.	*Excerpts*: "Combined Sewer Overflows: Guidance For Long-Term Control Plan" United States Environmental Protection Agency. Pages 3-7, 3-8, 3-9, 3-10. Submitted by George Rempel, TetrES Consultants Inc. and Mike Shkolny, City of Winnipeg.
68.	*Excerpts*: "Health Effects Criteria for Fresh Recreational Waters". United States Environmental Protection Agency. August 1984. Page iv. Submitted by the Manitoba Clean Environment Commission.
69.	*Excerpts*: "Ambient Water Quality Criteria for Bacteria – 1986" United States Environmental Protection Agency. January 1986. Page 16 and Table 4. Submitted by the Manitoba Clean Environment Commission.
70.	*Excerpts*: "Guidelines for Water Reuse: Manual". United States Environmental Protection Agency. September 1992. Pages 133 and 134. Submitted by the Manitoba Clean Environment Commission.
71.	*Brief*: "Manitoba Clean Environment Commission - Share Your Views: City of Winnipeg Wastewater Collection and Treatment System". Submitted by Roxanne Anderson.
72.	*Brief*: "Re: Public Hearings scheduled for January 27/28 in Selkirk: Comments and Observations". Submitted by Karl Pohl.
73.	*Brief*. Submitted by John Einarson.
74.	*Brief*. "Presentation to Manitoba Clean Environment on City of Winnipeg Sewage Systems. January 27, 2003". Submitted by Paul Clifton.
75.	*Brief*. "Devil's Creek Watershed Coalition". Submitted by Jane Seniw and Bob Shearer, Devil's Creek Watershed Coalition.
76.	*Brief*. Submitted by Jerry Moskalyk.
77.	*Brief*. Submitted by Laurel Sarginson.
78.	*Visual Projections*: "City's Proposed Ammonia Loadings". Submitted by George Rempel, TetrES Consultants Inc. and Mike Shkolny, City of Winnipeg.
79.	*Visual Projections*: "Manitoba Clean Environment Commission Hearing: City of Winnipeg Wastewater Collection and Treatment Systems". Submitted by Dave Woytowich.
80.	*Brief*. Submitted by Stu McKay, Manitoba Lodge and Outfitters Association.
81.	*Brief*: "Presentation to Manitoba Clean Environment Commission Public Hearing: January 28, 2003, Selkirk, Manitoba". Submitted by Darla Campbell, United Water Canada.
82.	*Response to Motion*. Submitted by Manitoba Clean Environment Commission.
83.	*Letter* dated January 30, 2003 from Terry Duguid, Chairman of the Clean Environment Commission, to the Hon. Steve Ashton, Minster of Conservation.
84.	*Letter* dated January 31, 2003 from Terry Duguid, Chairman of the Clean Environment Commission, to the Hon. David Anderson, Minister of Environment.
85.	*Letter* dated February 12, 2003 from M. S. Samphir, City of Winnipeg, to Terry Duguid, Chairman of the Clean Environment Commission.
86.	*Letter* dated February 19, 2003 from Terry Duguid, Chairman of the Clean Environment Commission, to M. S. Samphir, City of Winnipeg.

No.	Exhibit
87.	"Clean Environment Commission Public Hearings on the City of Winnipeg Sewage Collection and Treatment Systems, April 14, 2003: Opening Comments by Larry Strachan, Director, Environmental Approvals Branch." Submitted by Larry Strachan, Manitoba Conservation.
88.	"Environmental Impact Statement: Continued Operation and Future Development of the City of Winnipeg Wastewater Collection and Treatment System, February 27, 2003. City of Winnipeg Water and Waste Department. Submitted by Mike Shkolny, City of Winnipeg.
89.	*Visual Projections*: "Winnipeg's Plan to Improve Wastewater Treatment: Clean Environment Commission Hearing, Winnipeg, MB - April 14, 2003: Water and Waste Department, City of Winnipeg". Submitted by Barry MacBride, City of Winnipeg.
90.	*Visual Projections*: "Environmental Impact Statement: City of Winnipeg Wastewater Collection and Treatment System". Submitted by Mike Shkolny, City of Winnipeg.
91.	*Visual Projections*: "Nutrient Management and Lake Winnipeg: Presentation to the CEC. April 14, 2003". Submitted by George Rempel, TetrES Consultants Inc., Mike Shkolny, City of Winnipeg.
92.	"2002 Leachate Hauling Summary" [City of Winnipeg]. Submitted by Mike Shkolny, City of Winnipeg.
93.	"Pumped Leachate Analysis – 2002 Yearly Summary" City of Winnipeg Water and Waste Department Laboratory Services Division-Research Branch. Submitted by Mike Shkolny, City of Winnipeg.
94.	"Presentation by The Organization: More Pigs vs. Saving Lake Winnipeg, April 14, 2003". Submitted by Ron Dalmyn, The Organization.
95.	Opening Statement submitted by Merrell-Ann Phare, Ad Hoc Group.
96.	*Visual Projections*: "Manitoba Clean Environment Commission Public Hearing: City of Winnipeg Wastewater Collection and Treatment System – Winnipeg, Manitoba, 15 April 2003: Presenters: Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe. Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
97.	*Summary Sheets*: "Effects Assessment Components". Submitted by Merrell-Ann Phare, Ad Hoc Group.
98.	*Appendices*: "Manitoba Clean Environment Commission Public Hearing: City of Winnipeg Wastewater Collection and Treatment System – Winnipeg, Manitoba, 15 April 2003: Presenters: Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe". Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
99.	"Exhibit P1: Examples of Toxic Pollutant Testing Requirements" Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
100.	"Exhibit P2: Model Laws, Regulations, and Projects". Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
101.	"Exhibit 2 Part 2: The National Pre-treatment Program". Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
102.	"Exhibit P3: Massachusetts Water Resources Authority Authorization to Discharge under the National Pollutant Discharge Elimination System, Annual Compliance Report, and other Reports". Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
103.	"Exhibit P3, Part 2: [Untitled]". Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.
104.	"Exhibit P4: Information on Mercury and Sludge". Submitted by Merrell-Ann Phare, John Sinclair, Laura Orlando, Rodney C. McDonald, Kenton Lobe, Ad Hoc Group.

No.	Exhibit
105.	"Evidence from Ecosystem Research by Fisheries and Oceans Canada for the Need to Protect Lake Winnipeg from Phosphorus Derived from the Red River Basin". Submitted by Michael Stainton, Alex Salki, Len Hendzel and Hedy Kling, Freshwater Institute, Fisheries and Oceans Canada.
106.	UNASSIGNED - NO EXHIBIT
107.	"Environment Canada Submission to the Clean Environment Commission Hearings on The City of Winnipeg Wastewater Collection and Treatment System. Winnipeg, Manitoba April 15, 2003". Submitted by Barry Briscoe, Environment Canada.
108.	"Agri-Info". March 2003, Volume 1: Agricultural Policy Framework. Agriculture and Agri-Food Canada. Submitted by Barry Briscoe, Environment Canada.
109a	*Visual Projections*: "Submission to Clean Environment Commission on the City of Winnipeg Wastewater Treatment Plants". Barry Briscoe, Environmental Protection, Environment Canada. April 15, 2003. Submitted by Barry Briscoe, Environment Canada.
109b	"The Impacts of Municipal Wastewater Effluents on Canadian Waters: A Review". (Water Quality Research Journal of Canada 1997, Volume 32, no. 4, pg 659-713). P. Chamber, M. Allard, S. L. Walker, et al. Submitted by Barry Briscoe, Environment Canada.
110.	"Presentation to the Manitoba Clean Environment Commission regarding the City of Winnipeg's Wastewater Collection and Treatment Systems". Submitted by Scott Kidd.
111.	*Brief* [Untitled] submitted by Al Mackling, Winnipeg Game and Fish Association.
112.	"Fish Quality and Abundance in the Lake Winnipeg System: Report on a Survey of Recreational and Commercial Fishers and Outfitters, April 2003". Joletta Brown and Eva Pip. Winnipeg Game and Fish Association. Submitted by Joletta Brown, Winnipeg Game and Fish Association.
113.	"Agricultural BMP Examples" 15 April 2003. TetrES Consultants Inc. Submitted by George Rempel, TetrES Consultants and Mike Shkolny, City of Winnipeg.
114.	"City of Winnipeg CSO Plan: Range of Volume and Number of Overflows". Submitted by Mike Shkolny, City of Winnipeg.
115.	*Brief* [Untitled] submitted by Paul Mackenzie.
116.	*Visual Projections*: "Fish Quality and Abundance in the Lake Winnipeg System". Submitted by Submitted by Joletta Brown, Winnipeg Game and Fish Association.
117.	"Presentation to the Clean Environment Commission: April 16, 2003". Submitted by Jack Jonasson, Coalition for Flood Protection North of Winnipeg.
118.	"Propositions and Solutions to Wastewater Collection and Treatment System in Winnipeg: Representation of Jesus Miguel-Garcia to the Manitoba Clean Environment Commission's Public Hearing, April 16, 2003". Submitted by Jesus Miguel-Garcia.
119.	*Visual Projections*: "MB Clean Environment Commission (CEC) April 16, 2003 – Oral Submission Re: City of Winnipeg Waste Water Systems". Submitted by Paul Clifton.
120.	"MB Clean Environment Commission (CEC) April 03, 2003 – Written Submission Re: City of Winnipeg Waste Water Systems". Submitted by Paul Clifton.
121.	"MB Clean Environment Commission (CEC) April 11, 2003 – Supplementary Submission Re: City of Winnipeg Waste Water Systems". Submitted by Paul Clifton.
122.	*Compact Disc*: "Site No. 2 Bartmanovich Road – RL 41, North Side of Roadway, 2003 03 29 (8)". Submitted by Paul Clifton.
123.	"Brief to the Public Hearings of the Manitoba Clean Environment Commission, on the City of Winnipeg Wastewater Collection and Treatment System April 16, 2003". Submitted by R. A. Gallop.
124.	"The Living System Solution". St. Norbert Arts Centre. Submitted by Louise May and Tang Lee, St. Norbert Arts Centre.
125.	*Visual Projections*: "Closing Statements Winnipeg's Plan to Improve Wastewater

No.	Exhibit
	Treatment: Clean Environment Commission Hearing, Winnipeg, Manitoba April 16, 2003". Submitted by Barry MacBride, City of Winnipeg.
126.	"Closing Comments By Larry Strachan, Director, Environmental Approvals Branch: Clean Environment Commission Public Hearings City of Winnipeg Wastewater Collection and Treatment Systems, Winnipeg, Manitoba – April 16, 2003". Submitted by Larry Strachan, Manitoba Conservation.

Winnipeg

Water and Waste Department

Disconnection/Reconnection Procedures

Disconnection Policies

1. Collection notices will be addressed to the person identified on the account who requested the service. In the case of a landlord/tenant situation where the landlord has registered with the utility, additional notice will be provided to the landlord. This serves as notice that there is a potential for the account arrears to be added to the landlord's property tax account.
2. If a landlord is responsible for water service at a tenant occupied premise, the water service will not be disconnected. Eligible arrears amounts will be added to the property tax account for the premise.
3. Disconnection is not completed if the arrears amount on the account is under $100.

Disconnection Procedures

1. The customer is billed for water used for the prior three months. The due date is 30 days from the bill date.
2. If payment is not received within 10 days of the due date, the customer receives a Reminder Notice which includes a statement similar to "Please pay the outstanding amount now to keep your water service".
3. If payment is not received within 30 days of the due date, customer receives a Turn Off Notice. The Turn Off Notice includes a statement similar to "Please make a payment immediately to keep your water service. If we don't hear from you, we will turn your water off as early as 10 days from the date of this notice."
4. If payment is not received following the Turn Off Notice, attempts are made to contact the customer by telephone.
5. If payment is not received within 40 days of the due date, water service may be disconnected. Where water cannot be turned off (e.g. Where landlord is responsible for water service or where disconnection would disrupt the water service of others) the arrears amount may be added to the owner's property tax account.

6. If water service is disconnected and the customer has not contacted the utility with 30 days, the utility will revisit the premise to attempt to verify if the water is disconnected. NOTE: This step is necessary as water shut off valves are mechanical devices that do fail.
7. If the utility has confirmed that water service is disconnected and the utility believes the premise is occupied and the resident(s) require assistance, information is forwarded to the City's Environmental Health Officer.

Reconnection Procedures

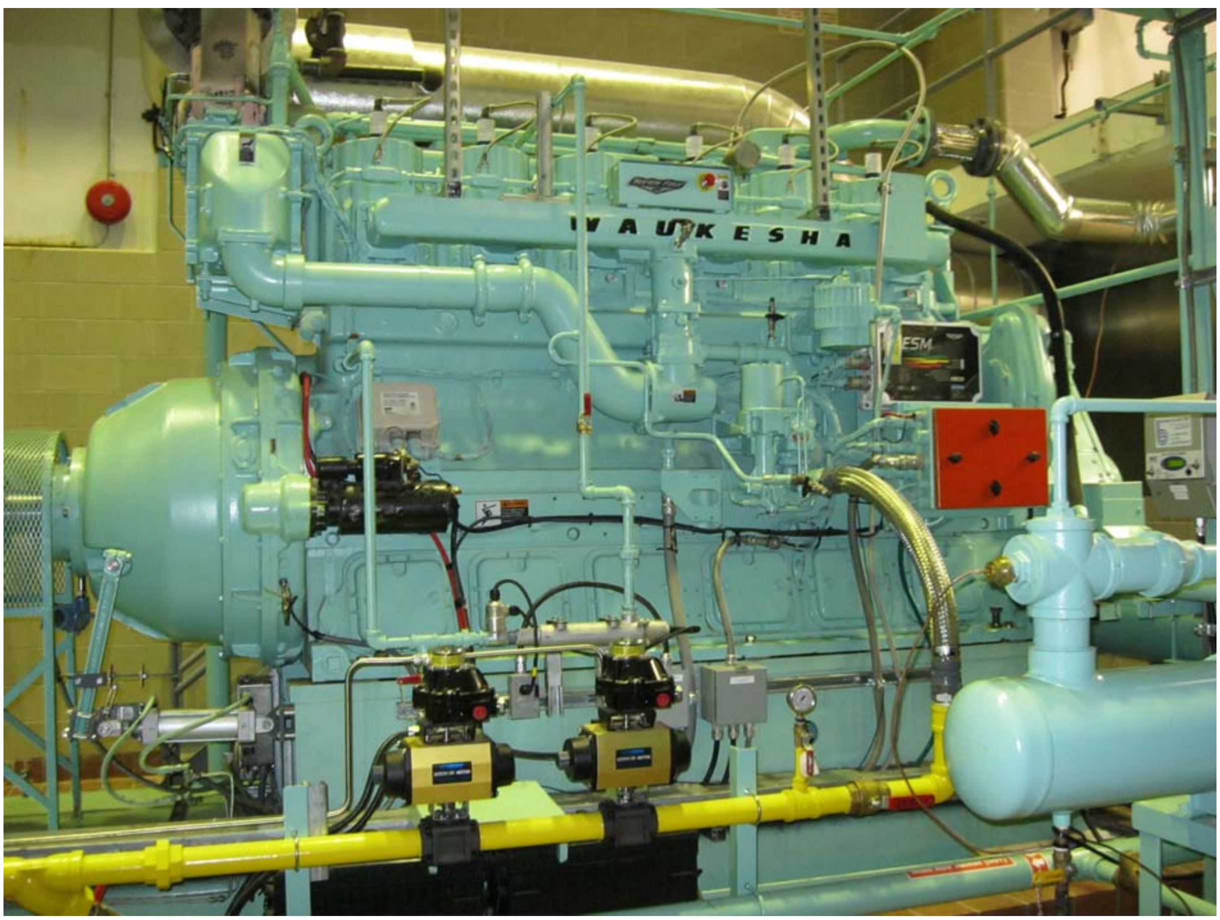
1. Water service will not normally be reconnected without full payment of the arrears amount plus the reconnection fee. To prevent property damage the utility requires an adult to be at the premise at the time service is reconnected.
2. Where payment arrangements are made with the customer, water service is subject to immediate disconnection if payment arrangements are not kept.

Winnipeg

The City of Winnipeg

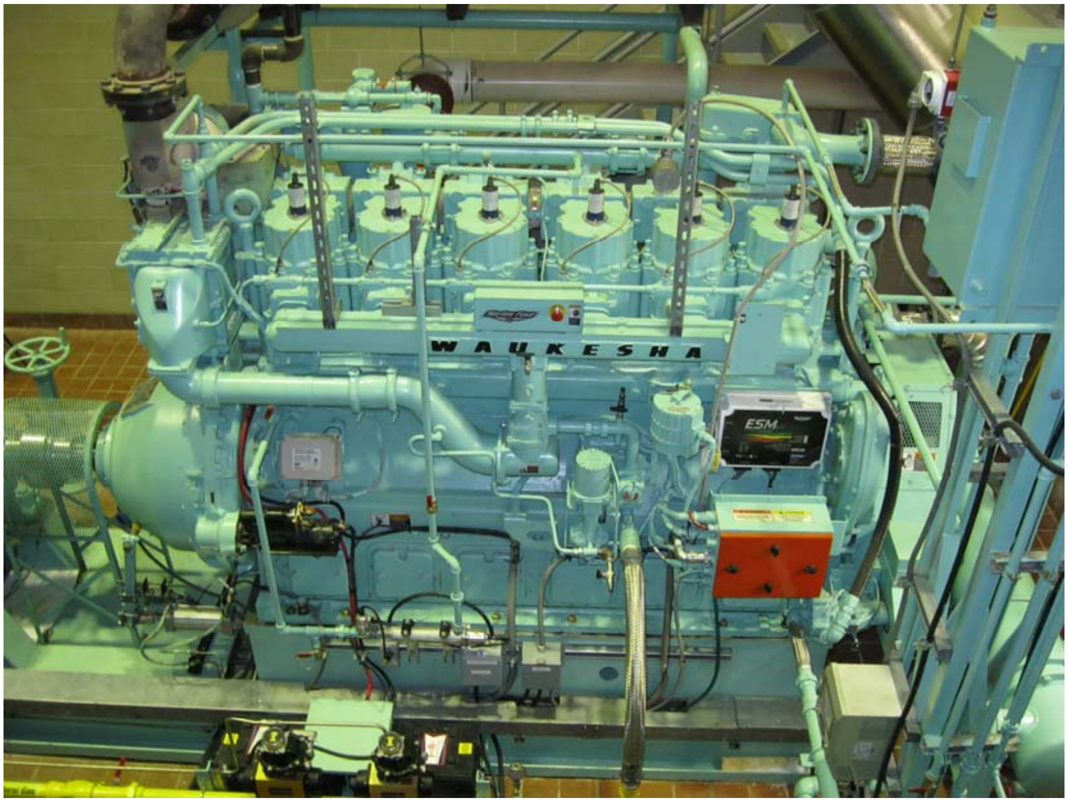
Water and Waste Department

2010 WATER CONSUMPTION SUMMARY REPORT

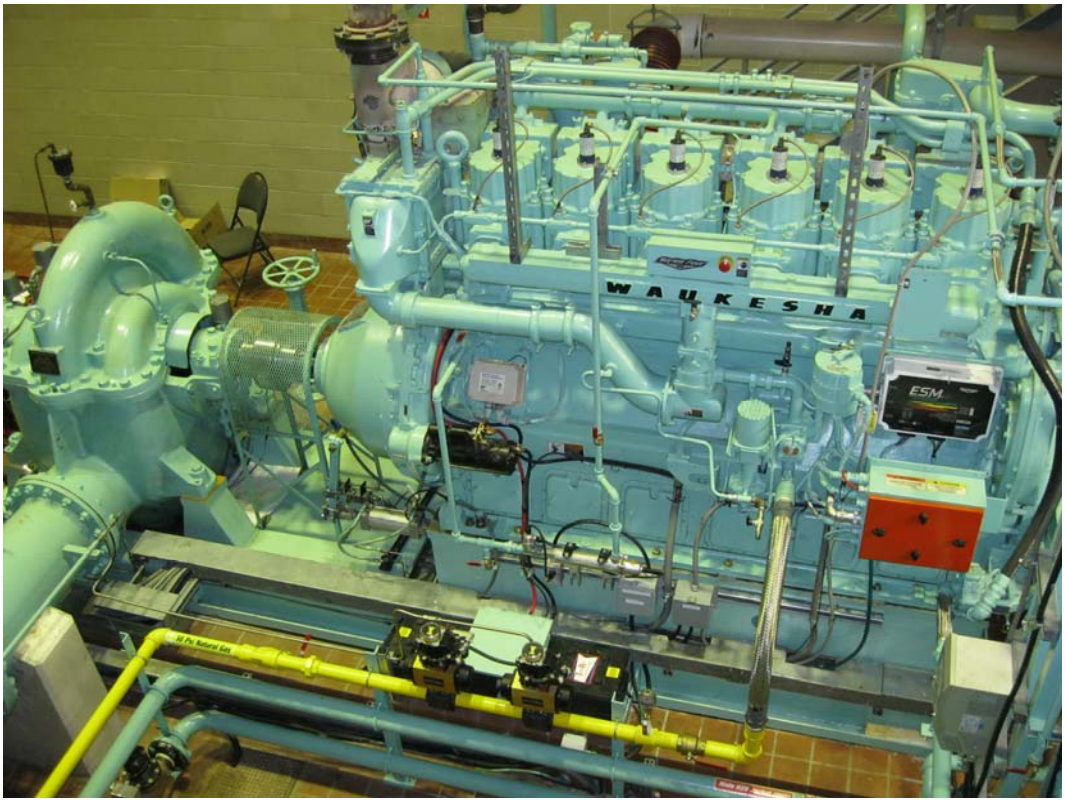


SLOW THE FLOW! SAVE FOR TOMORROW.

Cover: This is a photo of a new Waukesha natural gas engine P26 with 840 horse power.



Left: There are two new natural gas engines installed at the MacLean Pumping Station. The new Waukesha engines are 6- cylinder turbo charged engines. They have a smaller footprint and are more fuel efficient than the previous ones.



Left: The Waukesha engines operate as a backup to the electrical driven pumps and maintain reliable water pressure in the distribution system. They also run during periods of inclement weather where there may be a concern with electrical supply to the Pumping Station.

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

2010 WATER CONSUMPTION SUMMARY REPORT

Prepared by:

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Water Planning Technologist II
Water Planning and Project Delivery Branch
Engineering Division

Report Production: March 30, 2011

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List of Abbreviations

GL – giga litres or (1,000,000,000)
ML – mega litres or (1,000,000)
L/c/d – litres per capita per day
ML/d – mega litres per day

1.0 SUMMARY

The following information summarizes the water consumption for the year 2010.

Table 1.1 2010 Water Consumption Data

Statistic	2010 Actual Values	Present Capacity
Total Water Pumped	75.03 GL	130.0 GL
Average Day Consumption	205.6 ML/d	386.0 ML/d
Population[1]	683,200	
Per Capita Consumption	300.9 L/c/d	
Maximum Month Consumption (Load Factor)	221.6 ML/d (1.08)	
Maximum Day Consumption (Load Factor)	247.3 ML/d (1.20)	628.0 ML/d
Maximum Hour Consumption (Load Factor)	361.0 ML/d (1.76)	1,254.0 ML/d
Total Water Metered	63.46 GL	
Unaccounted–for Water	15.42 %	
Total Water Billed	63.14 GL	
Non-billed Water	15.85 %	

A summary of all historical consumption information is tabulated in Appendix A.

[1] City of Winnipeg – CAO Secretariat (Statistics Canada) – January 2011

2.0 INTRODUCTION

2.1 General

Since 1919, residents of the City of Winnipeg have enjoyed virtually unrestricted use of water supplied by a single gravity aqueduct from Shoal Lake. Shoal Lake is located approximately 160 km East of Winnipeg in the Canadian Shield. The lake straddles the Manitoba/Ontario border and is tributary to the Lake of the Woods, which straddles the Canada/United States Border. The existing water supply system is shown in Figure 2.1 (in Appendix A). The total water supply system consists of:

- An intake and low lift pumping station at Shoal Lake built in 1959 and upgraded in 1995. The 1995 upgrade increased the firm pumping capacity of the station to 386 ML/d;
- The main aqueduct with a 386 ML/d capacity completed in 1919;
- Deacon Reservoir consisting of four cells, two built in the 1970's, and two more completed in 1997;
- Deacon Booster Pumping Station built in 1978;
- Deacon Chemical Feed Facility built in 2000. The chemical feed facility adds orthophosphate to the water supply to control lead levels in drinking water and fluoride to the water supply;
- Branch I Aqueduct completed in 1919;
- Branch II Aqueduct built in 1960;
- MacLean Reservoir and Pumping Station built in 1964 and upgraded in 1998. The 1998 upgrade included pump refurbishment and the installation of new isolation valves;
- Tache Booster Pumping Station built in 1950;
- McPhillips Reservoir and Pumping Station built in 1919 and upgraded in 1975 and 1999. The 1999 upgrade included pump refurbishment, installation of new isolation valves, addition of a new pump and natural gas engine;
- Wilkes Reservoir and Hurst Pumping Station built in 1959 and upgraded in 1994 and 1996. The 1994 upgrade included the installation of three new pumps and the 1996 upgrade included the covering of the South Cell of the Reservoir;
- Installation of a UV system at the Deacon Booster Pumping Station in 2004 and placed in service in 2006;
- New valve chamber at Branch II Aqueduct and Aqueduct Interconnector intersection in 2005 was constructed;
- Branch I and II Aqueducts were relocated as part of the floodway expansion in 2006.
- Branch I Aqueduct Surge Tower was constructed as part of the Water Treatment Program in 2007;
- Water Treatment Plant started to deliver treated drinking water on December 9, 2009.

Each decade the Water and Waste Department undertakes a comprehensive planning study of the regional water supply system to define long-term quantity and quality needs.

In 1990, as part of the City of Winnipeg's water supply plan, a water projection was developed to the year 2040. The projection was based on the analysis of actual water consumption data from 1922 to 1989. The study concluded that an increase in per capita water use in the City of Winnipeg was expected to continue into the future.

In June 1992, Council of the City of Winnipeg adopted the recommendation that the City embark on a long-term water conservation program in response to the increasing per capita water use in the City of Winnipeg.

In 1995, the 1990 water projection was reviewed due to a reduction in per capita usage since 1990, and a change in population projections since 1988. The review concluded that in the short term, water use would be lower, but in the long term would be similar to the 1990 projection, due to a higher population projection.

In 1997 it became evident that changes in technology in the water use market warranted a reassessment of the water projections[2]. The reassessment indicated that the prevailing per capita residential water demand growth rate will not be as high as in the past due to demographic and technology changes. The reassessment also concluded that the population is expected to grow at about the same rate as the per capita demand will decline, therefore the total water demand projection will be essentially constant.

In 2009 the water conservation program was expanded to include a residential toilet credit program. This credit will encourage customers to purchase a new dual flush toilet.

The following initiatives were continued:

- Sponsorship of the Fort Whyte Alive in delivering the water conservation education school program;
- Water consumption database updates;
- Public education program; and
- Sale of water conservation kits.

[2] Rempel, G. et al, City of Winnipeg Water Conservation Program Water Demand Evaluation and Projections Report February 1998

2.2 Purpose and Scope

The purpose of the annual water consumption summary is to maintain a historical record of water consumption data, which provides a basis for the monitoring, planning, and design of the water supply and distribution system. This consumption and population data form a statistical base for the development of analytical parameters, such as per-capita consumption and load factors. These parameters are used in conjunction with population projections to predict future consumption.

2.3 Sources of Data

Production of this report requires the collection of data from within the Department and from outside agencies. The data sources are as follows:

Monthly Water Consumption Pumpage Report

- Generated at the Water Treatment Plant by the Water Services Division, available in Engineering file system (020-01-11-02-19)
- Data available:
  - Monthly Shoal Lake level
  - Total monthly pumpage
  - Monthly pumpage by station
  - Average monthly pumping rate
  - Annual pumpage to date
  - Monthly metered consumption
  - Monthly billed consumption
  - Unaccounted - For water
  - Unbilled consumption

Monthly Pumping Report

- Generated at the Water Treatment Plant by the Water Services Division, available in Engineering file system (020-01-11-02-12)
- Data available:
  - Total daily pumpage
  - Daily pumpage by station
  - Peak daily pumping rate by station
  - Daily aqueduct flow rate
  - Daily pumping station reservoir levels
  - Daily Deacon Reservoir levels
  - Daily pumpage by station
  - Total daily pumpage

Pumping Station SCADA Output

- Generated at the Water Treatment Plant by the Water Services Division
- Data available:
    - Instantaneous discharge rates for each pumping station
    - Instantaneous pressure at each pumping station

Intake Operating Record

- Generated by Water Services Division, available in Engineering file system (020-01-11-02-07)
- Data available:
    - Lake levels at Indian Bay on weekly basis

Consumption & Revenue Statistics

- Generated by Customer Accounts Branch, available from the Financial Analyst
- Data available:
    - Annual billed consumption, by block
    - Annual revenue, by block
    - Annual quarterly charges
    - Annual metered consumption
    - Annual pumpage
    - Unaccounted-for water

Environment Canada

- Data available:
    - Meteorological summary

3.0 CONSUMPTION DATA

3.1 Annual Statistics

The total water pumped for 2010 was 75.03 GL. This value is measured as an indicator of utilized aqueduct capacity. Figure 3.1 shows the trend in the total water pumped since 1955. A breakdown of the historical annual and monthly pumping volumes may be found in Tables B.1 and B.2.

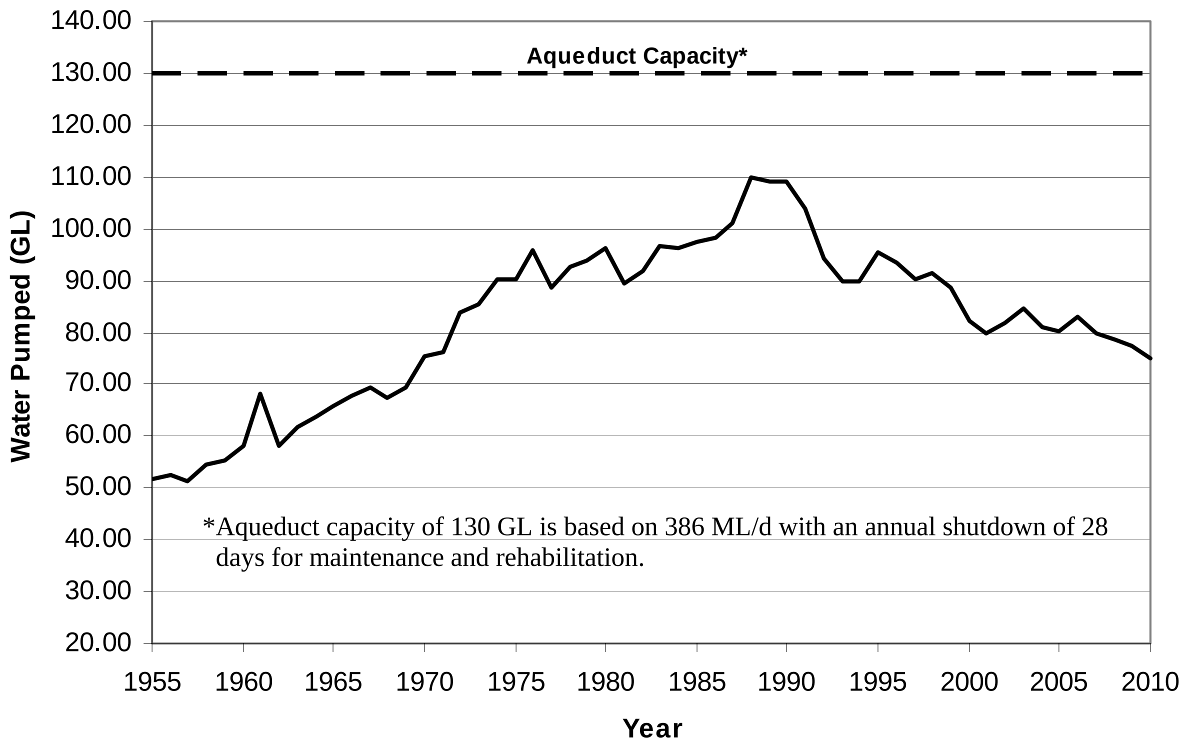

Figure 3.1 Total Water Pumped

The difference between the total water pumped and the total water metered is the unaccounted - for water. The typical causes of unaccounted - for water are leaks in the distribution system, water main flushing, sewer cleaning, water main renewals, meter errors, fire fighting or theft. With 75.03 GL of metered water in 2010, the unaccounted-for water represents 15.4% of the annual pumpage. This is a 0.1% point decrease from 2009. Figure 3.2 illustrates the yearly unaccounted-for water since 1977.

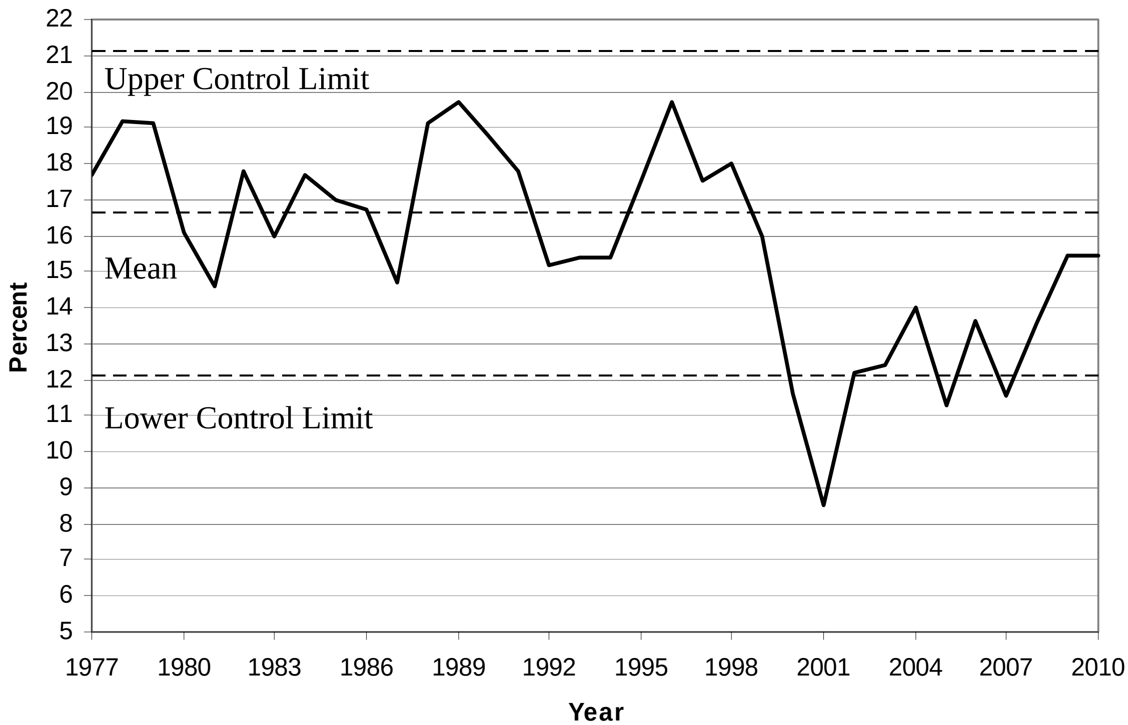

Figure 3.2 Annual Unaccounted – For Water

The number of water main repairs for 2010 totalled 328, a decrease of 24% from 2009. Overall, since the implementation of cathodic protection of metallic water mains in 1990 within the City of Winnipeg, the number of water main breaks has been reduced. Figure 3.3 illustrates the total water main repairs since 1975.

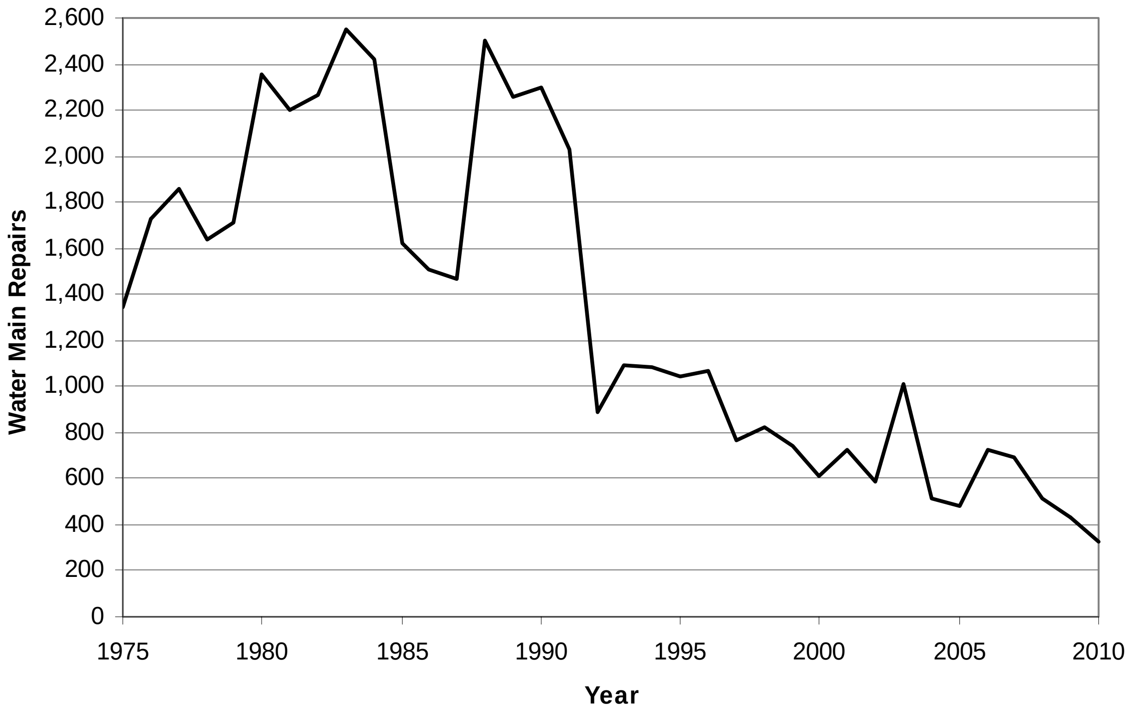

Figure 3.3 Annual Water Main Repairs

The total demand for water is also influenced by weather. In a dry and hot year, the total water demand is higher, largely due to residential outdoor usage (primarily lawn watering). In 2010, the total water pumped was 3% lower than the preceding year. A monthly summary of the temperatures and precipitation experienced during 2010 are included in Figures 3.4 and 3.5.

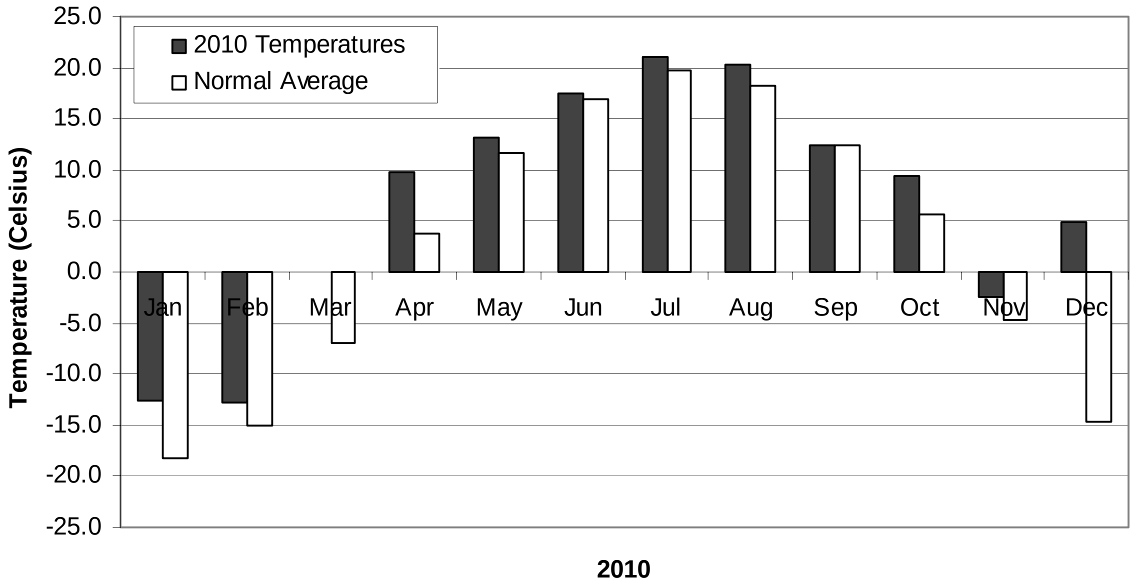

Figure 3.4 2010 Average Monthly Temperature

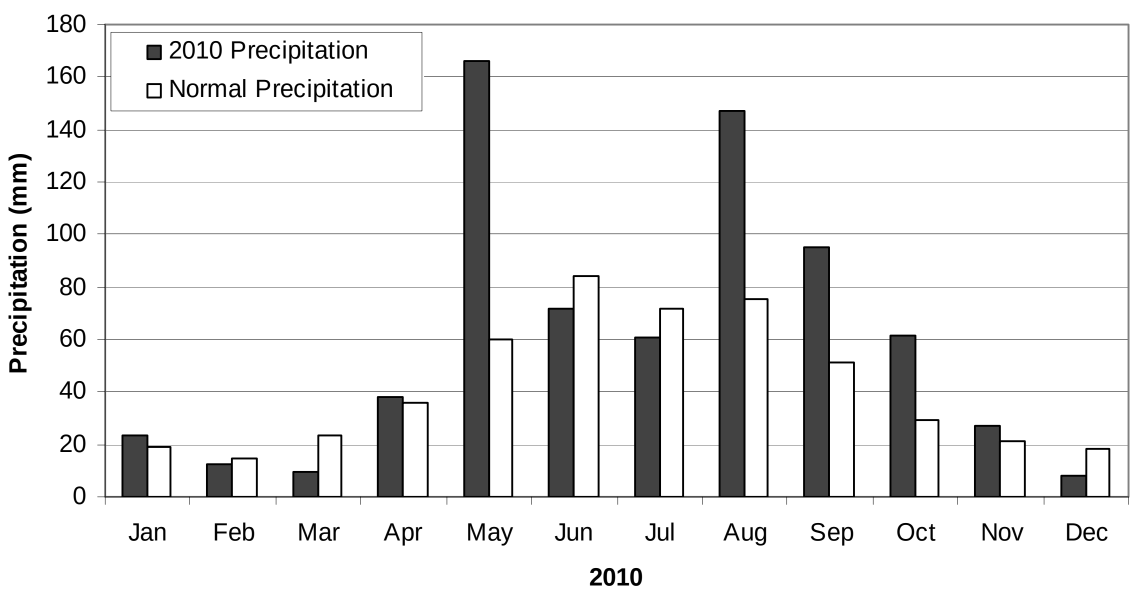

Figure 3.5 2010 Monthly Precipitation

3.2 Average Day Consumption

The average day consumption is used to determine the load factors for maximum hour, maximum day, maximum month; and the storage used in Deacon Reservoir. The average day consumption is calculated by dividing the total water pumped by the total number of days in the year. The calculated average day consumption for 2010 was 205.6 ML/d as indicated in Figure 3.6.

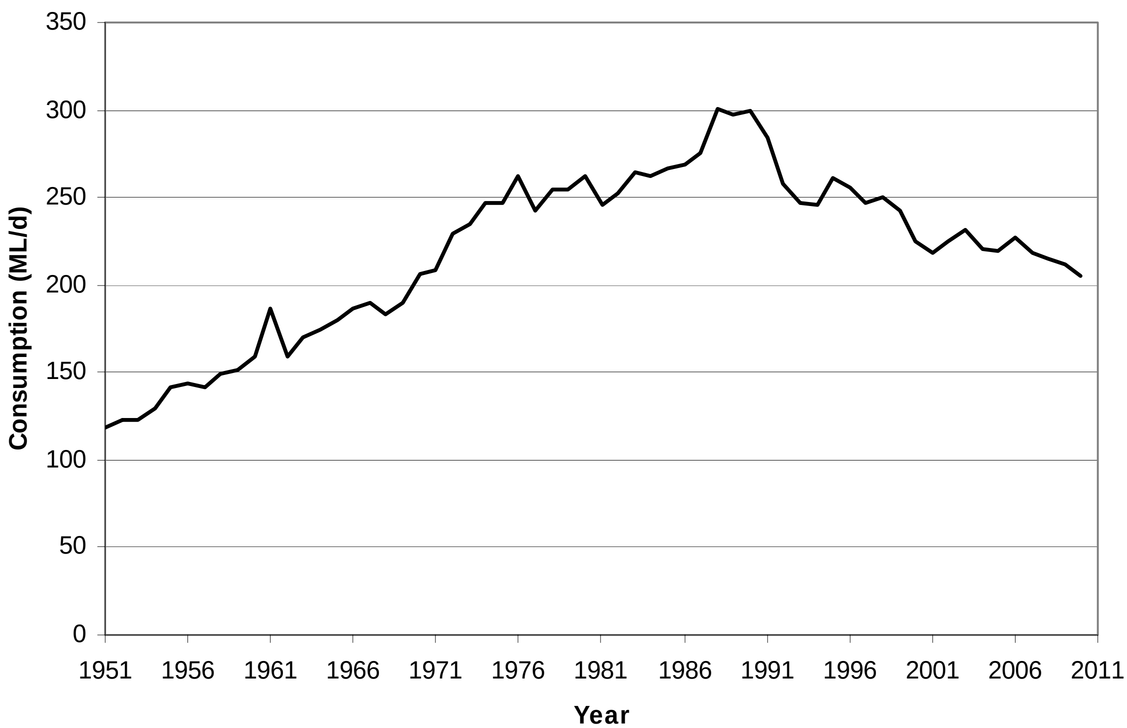

Figure 3.6 Average Day Consumption

3.3 Per Capita Consumption

The 2010 population within the boundaries of the City of Winnipeg is estimated to be 683,200. This estimate was obtained from the City of Winnipeg CAO Secretariat. Figure 3.7 illustrates the historic population of the City of Winnipeg.

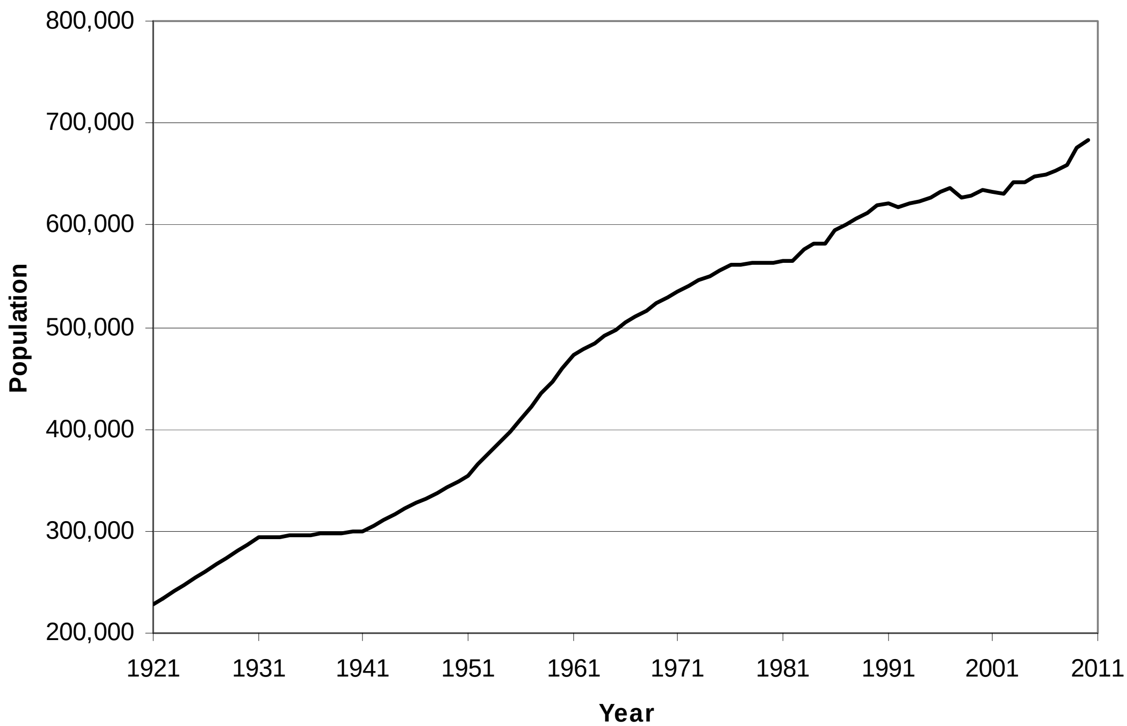

Figure 3.7 Population

Per capita consumption is calculated by dividing the average day consumption by the estimated population for the same year. With an average day consumption for 2010 of 205.6 ML/d, the per capita consumption was calculated to be 300.9 L/c/d, as shown in Figure 3.8.

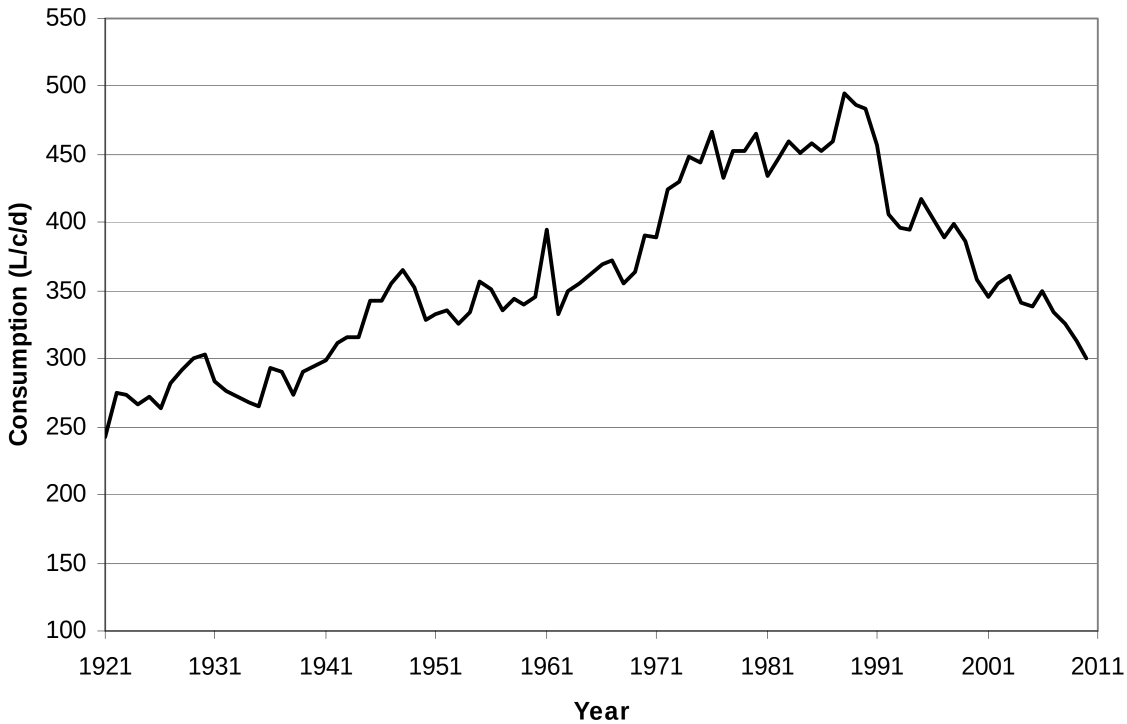

Figure 3.8 Per Capita Consumption

3.4 Extremes and Load Factors

The maximum pumping rates and load factors for various time periods are required to ensure that the supply system components have adequate capacities. Load factors are dimensionless values calculated by dividing various consumption rates by the year's average day consumption. Load factors were calculated for daily consumption, maximum month consumption, maximum day consumption and maximum hour consumption.

Maximum Month Consumption

The experienced maximum month consumption rate for 2010 was 221.6 ML/d for the month of July as shown in Figure 3.9. The maximum month load factor was 1.08.
The 31-day maximum consumption rate for 2010 was 242.1 ML/d for the period of June 30th to July 30th, inclusive. The 31-day maximum load factor was 1.08.

Maximum Week Consumption

The 7-day maximum consumption rate for 2010 was 247.3 ML/d for the period of May 15th to May 21st, inclusive. The maximum week load factor was 1.14.

Maximum and Minimum Day Consumption

The 2010 maximum day consumption of 247.3 ML was recorded on May 19th as shown in Figure 3.9. This is the summation of the individual maximum day pumping volumes of 66.2, 109.1 and 72.0 ML for McPhillips, Hurst and MacLean Stations, respectively. The maximum day load factor was 1.20. The existing record of 543.1 ML was set on June 6th, 1988.

In 2010, the minimum day consumption of 173.7 ML was recorded on December 25th. This total is the summation of the individual minimum day pumping volumes of 38.0, 86.5 and 49.2 ML for McPhillips, Hurst and MacLean Stations, respectively.

Maximum Hour Consumption

The 2010 maximum hour consumption rate of 361 ML/d was recorded at 7:38 a.m. on May 19th, as shown in Figure 3.9. This is the summation of the pumping rates at McPhillips, Hurst and MacLean Stations with values of 114, 147, and 99 ML/d, respectively. The maximum hour load factor was 1.76. The existing record for maximum hour consumption is 954 ML/d and was set on June 6th, 1988.

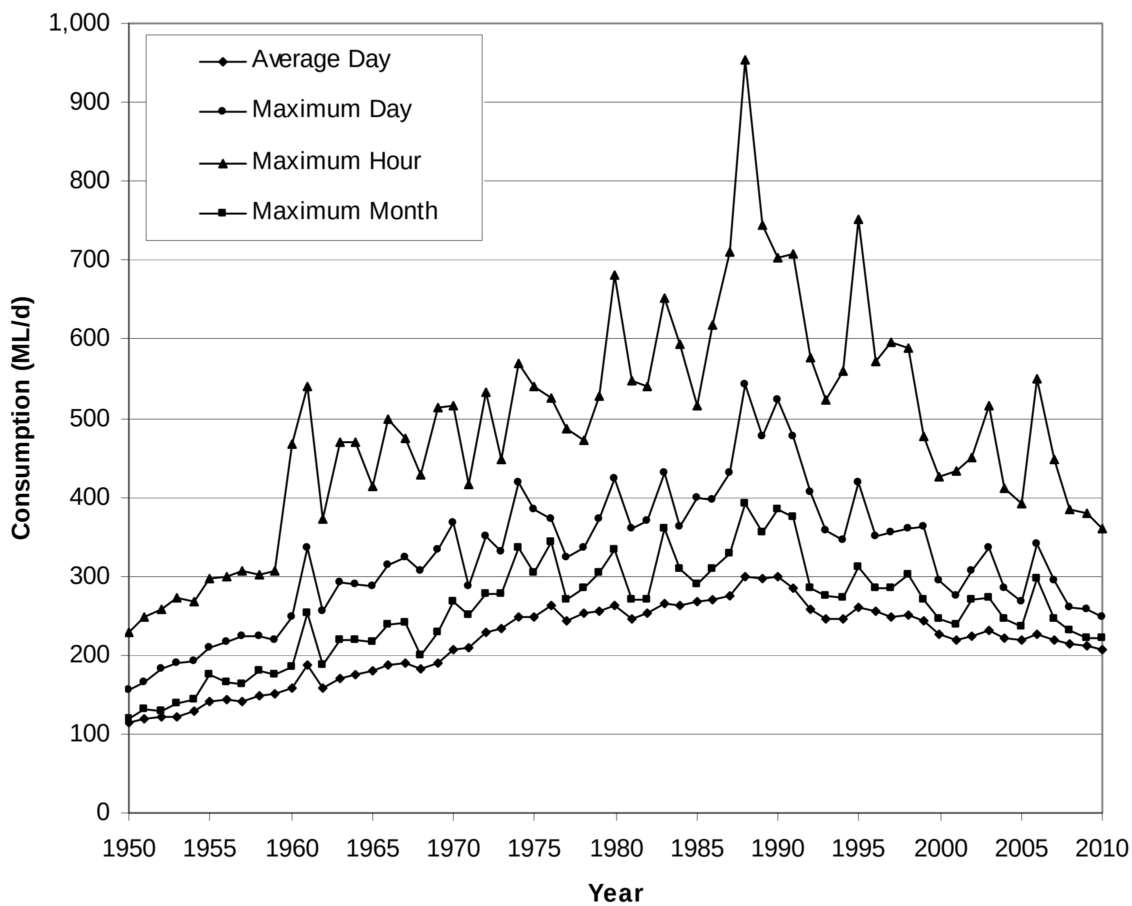

Figure 3.9 Consumption Rates

Minimum Hour Consumption

Typically the minimum hour consumption for the year occurs on December 25th. Reasons for this are that most businesses are closed for Christmas, residential consumption is lower and the demand period is shifted to later in the day. The minimum hour consumption rate on December 25th, 2010 was 76.42 ML/d, recorded at 4:00 am. This is the summation of individual pumping volumes on December 25th of 54.59 and 21.83 ML/d from the Hurst and MacLean Pumping stations, respectively. McPhillips usually does not operate between 12 midnight and 6 a.m. because of low nighttime flows. Figure 3.10 illustrates the minimum hour pumping rates.

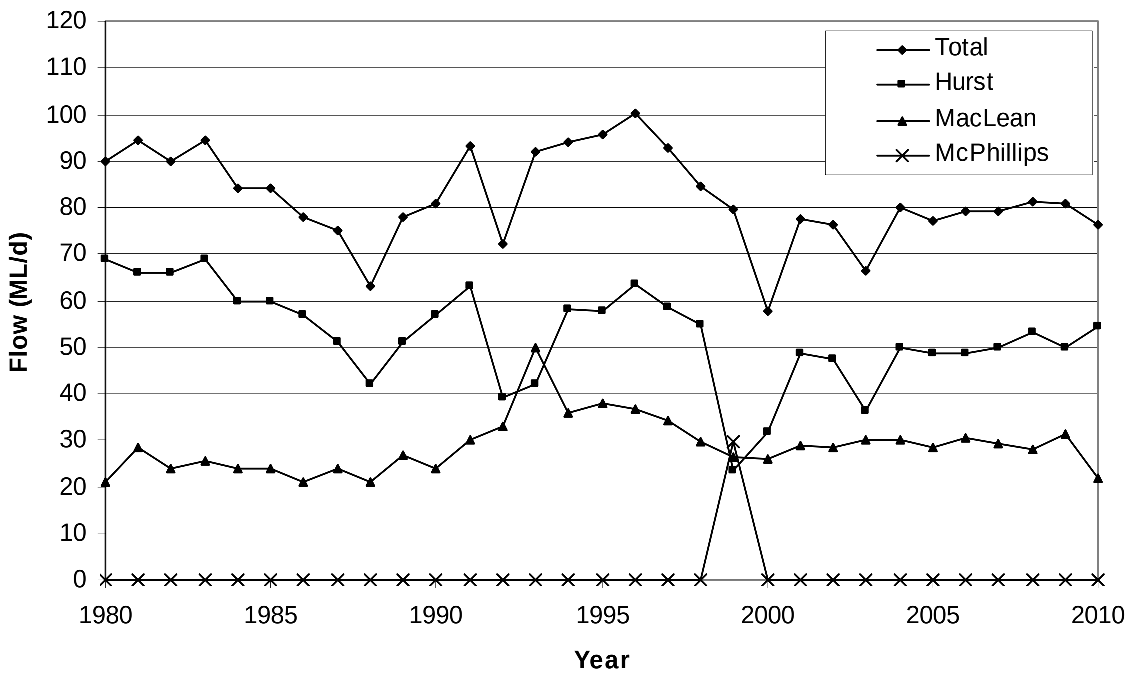

Figure 3.10 Minimum Hour Pumping Rates

Table 3.1 compares the load factors for the extreme 2010 consumption rates to the design load factors for the supply system. The historical load factors are illustrated in Figure 3.11 and the frequency distribution of daily load factors occurring in 2010 are illustrated in Figure 3.12.

Table 3.1 2010 Load Factors

Event	2010 Experienced Values	Design Values[3]
Maximum Month	1.08	1.20
Maximum Day	1.20	1.60
Maximum Hour	1.76	2.50

[3] Rempel, G. et al, Study A: Total Demand for Water to the Year 2030, J.F. MacLaren Ltd. Winnipeg, April 1979.

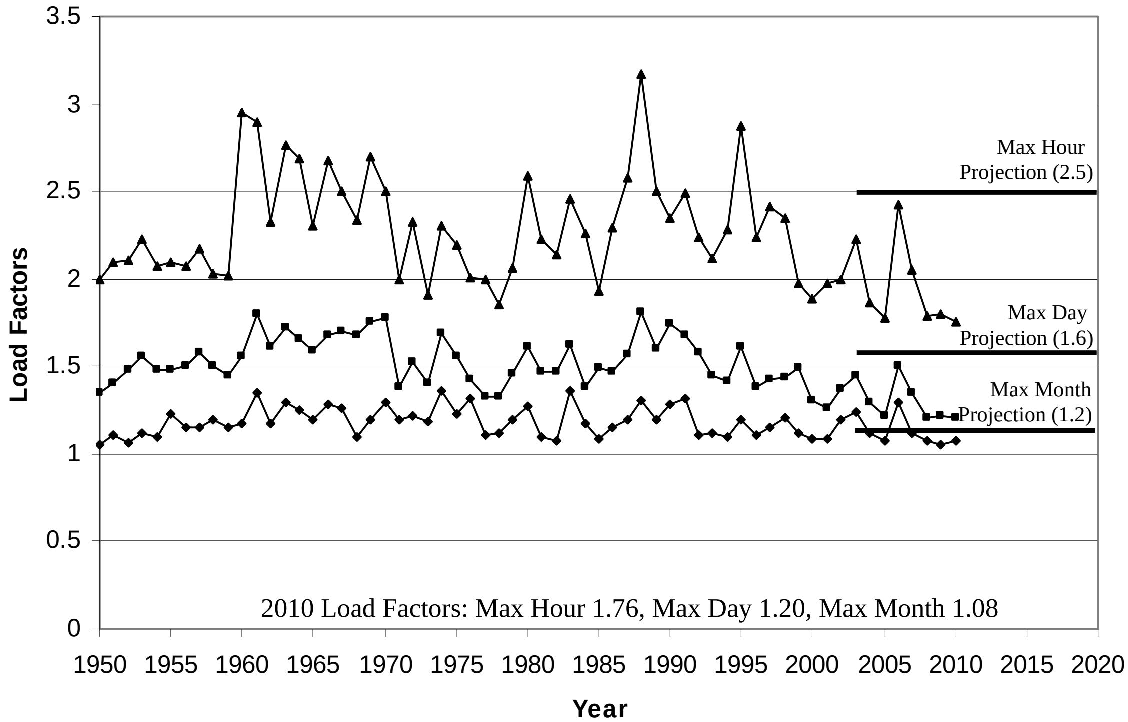

Figure 3.11 Load Factors

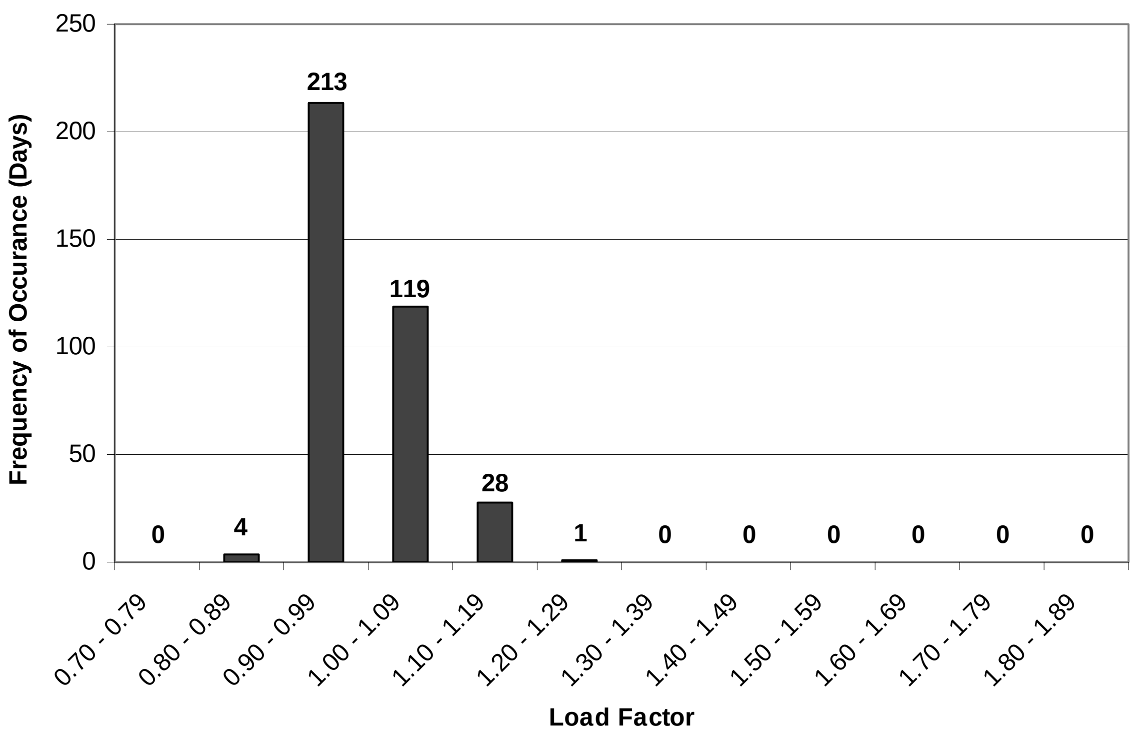

Figure 3.12 2010 Daily Load Factor Histogram

4.0 BALANCING STORAGE AND CAPACITY REQUIREMENTS

4.1 Shoal Lake Aqueduct

The Shoal Lake Aqueduct extends 136 kilometers from the intake at Shoal Lake to the Deacon Reservoir, East of Winnipeg. Water flows by gravity through the aqueduct due to the natural drop in land elevation. The City of Winnipeg is licensed to withdraw 454 ML/d from the lake. The aqueduct has a capacity of 386 ML/d, except the initial 16 kilometers, which were originally designed for a flow of 545 ML/d. The relationship between the lake level and aqueduct flow by gravity is illustrated in Figure 4.1 (Appendix C). An elevation of 322.40 m is required to sustain a flow rate of 386 ML/d. Figure 4.2 shows the frequency distribution of monthly lake levels from 1919 to 2010. Historically, 80 % of the time the lake level has been sufficient to supply 386 ML/d. A summary of the weekly lake levels recorded in 2010 is shown on Figure 4.3 and detailed in Table C.1 (Appendix C).

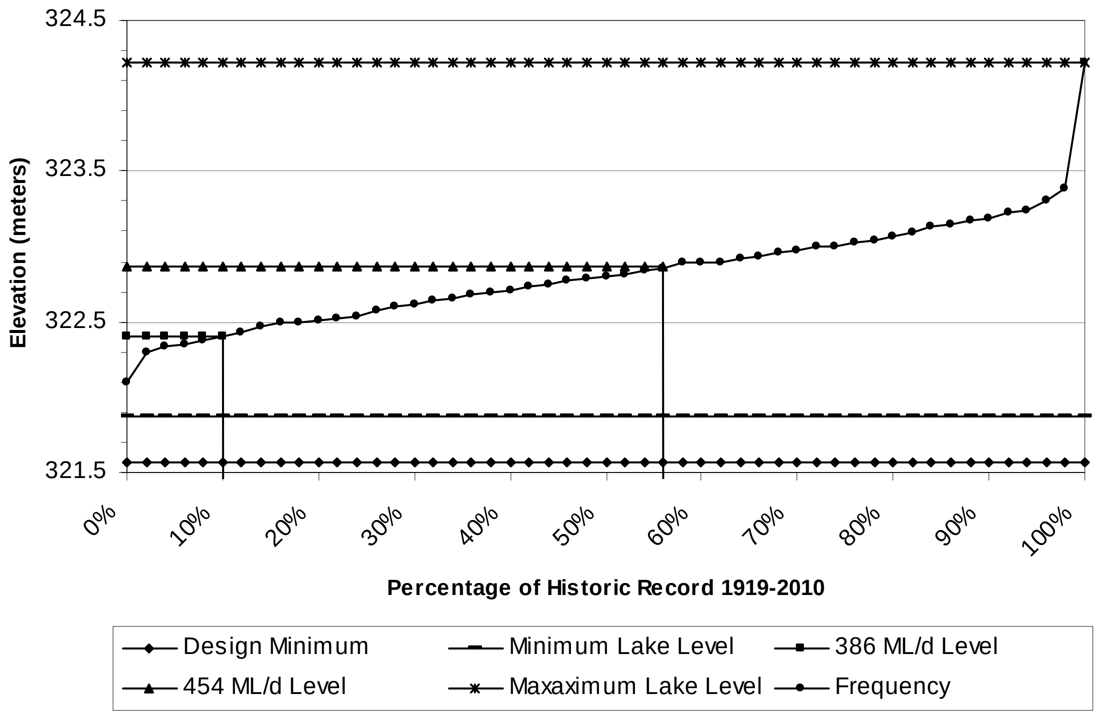

Figure 4.2 Shoal Lake Low Water Frequency

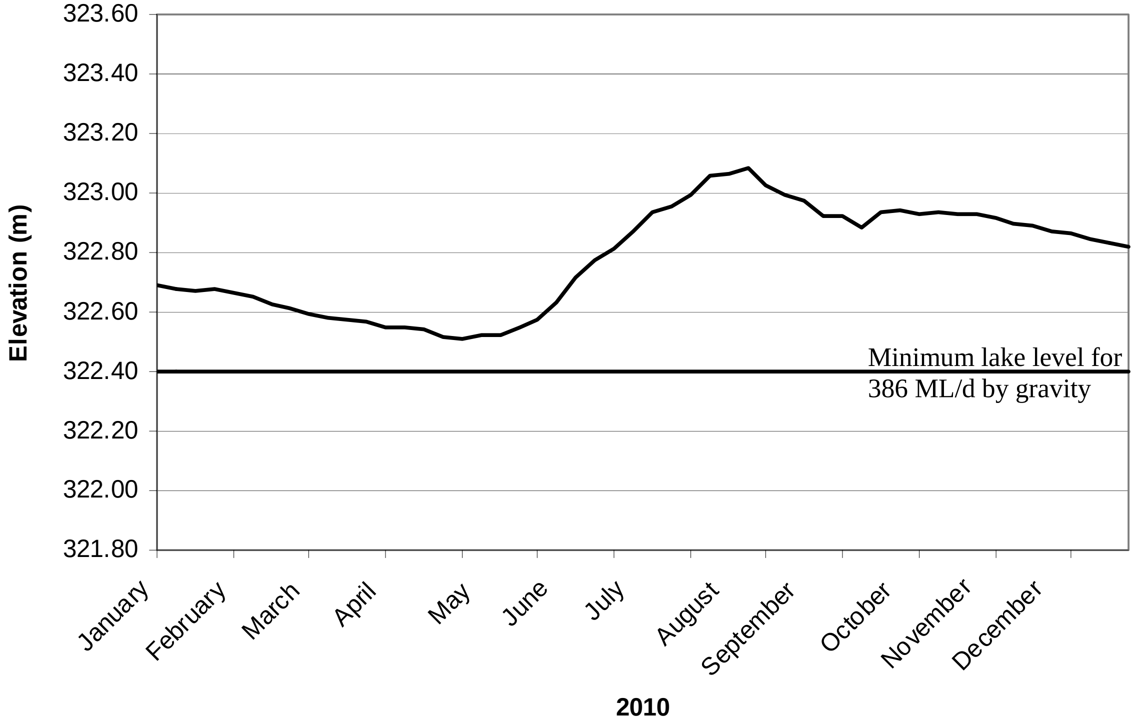

Figure 4.3 2010 Shoal Lake Levels

When the lake level is too low for sufficient flow by gravity, one of two pumps is used to lift the water from the lake into the aqueduct. The pumps are both 386 ML/d capacity, resulting in a present firm pumping capacity of 386 ML/d. Thus, a supply rate equal to the capacity of the aqueduct is available.

The maximum amount of water that can be supplied to the City annually is based on the aqueduct capacity and the number of days per year that it operates. Therefore, the annual delivery capacity is 130 GL based on a flow rate of 386 ML/d and a 28-day shutdown. During the year the flow rate of the aqueduct is varied in response to consumer demand and Deacon Reservoir levels. Figure 4.4 illustrates a summary of the aqueduct flow rates for 2010.

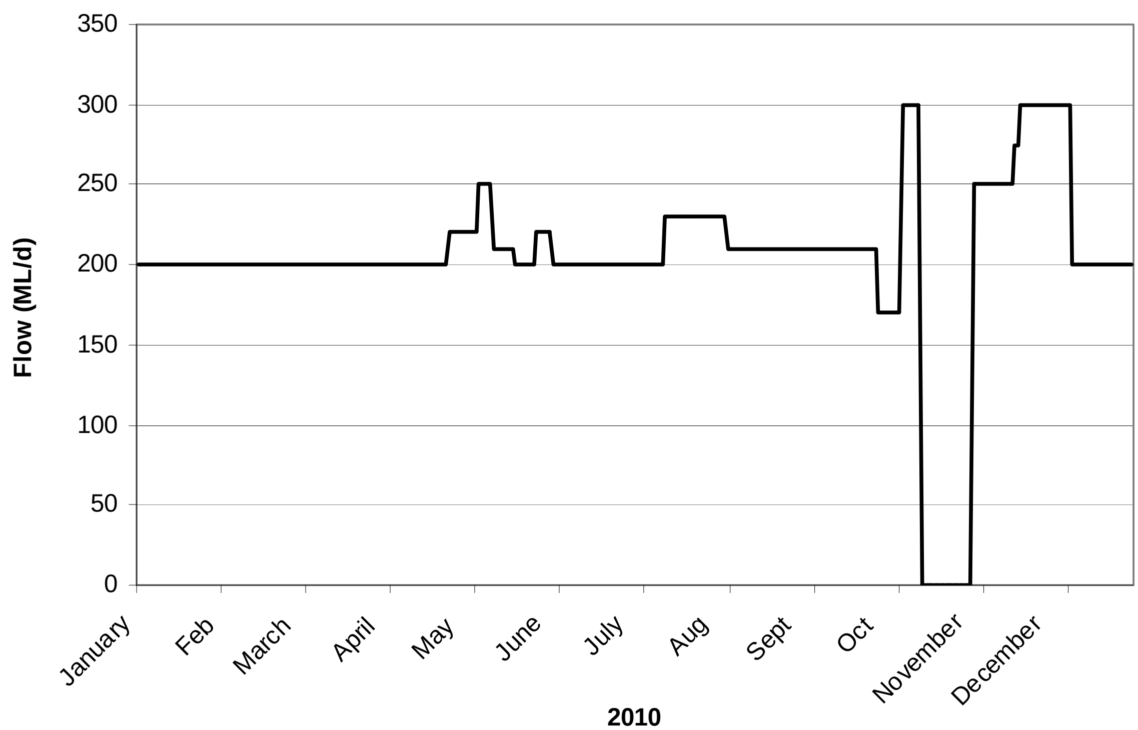

Figure 4.4 Shoal Lake Aqueduct Flow Rate

4.2 Deacon Reservoir

Deacon Reservoir is located at the terminus of the Shoal Lake Aqueduct and has four cells with a usable capacity of 8,400 ML. It is used to supplement the aqueduct flow when daily demand exceeds the aqueduct flow rate, as well as provide water to the City when the aqueduct is shut down for maintenance and rehabilitation.

The balancing storage requirement for Deacon Reservoir may be calculated based on an aqueduct capacity of 386 ML/d. The storage is calculated over a period where the daily consumption exceeds the aqueduct capacity. The maximum drawdown volume of the reservoir during such a time period is the balancing storage requirement.

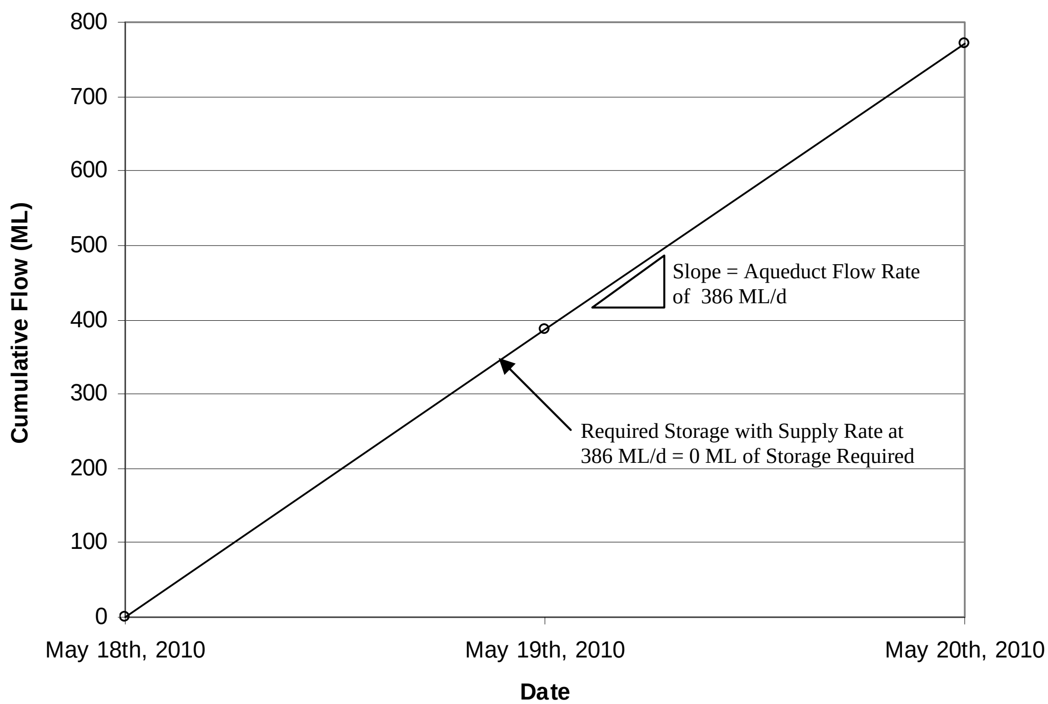

Figure 4.5 Deacon Reservoir Balancing Storage

An analysis of the balancing storage required during the 2010 critical demand period indicates that if the aqueduct were supplying Deacon at 386 ML/d, there was no additional storage requirement necessary. This balancing storage requirement is illustrated in Figure 4.5. Table 4.1 lists the Deacon balancing storage requirements since 1980.

Table 4.1 Deacon Reservoir Balancing Storage Requirements

Year	Aqueduct Flow Rate - 386 ML/d	
	Period	Storage Required (ML)
1980	May 21 – 23	86
1981	None	0
1982	None	0
1983	July 25 – 29	75
1984	None	0
1985	August 1	14
1986	May 28 – 29	19
1987	June 15 – 16	91
1988	May 29 – June 10	1110
1989	July 18 – August 2	347
1990	August 5 – 8	305
1991	August 10 – 29	301
1992	May 30 – June 1	39
1993	None	0
1994	None	0
1995	June 18 – 20	33
1996	None	0
1997	None	0
1998	None	0
1999	None	0
2000	None	0
2001	None	0
2002	None	0
2003	None	0
2004	None	0
2005	None	0
2006	None	0
2007	None	0
2008	None	0
2009	None	0
2010	None	0

4.3 Regional Supply System

The regional supply system consists of the Branch Aqueducts, Deacon Booster Pumping Station, Tache Booster Pumping Station, three regional reservoirs and three regional pumping stations. Table C.2 (Appendix C) is a daily record of the total water pumped by each of the regional pumping stations in 2010.

The maximum firm capacity of Deacon Booster Pumping Station to supply the Branch Aqueduct network is 480 MLD. The capacity is increased to 500 MLD with the Tache Booster Pumping Station in operation. The Branch I Aqueduct had a flow rate of 66.2 ML/d on the maximum day of 2010, as shown in Figure 4.6. Branch I was shut down during the maximum day in 2000 to accommodate the draining of Deacon Reservoir Cells 1 & 2 for maintenance and cleaning.

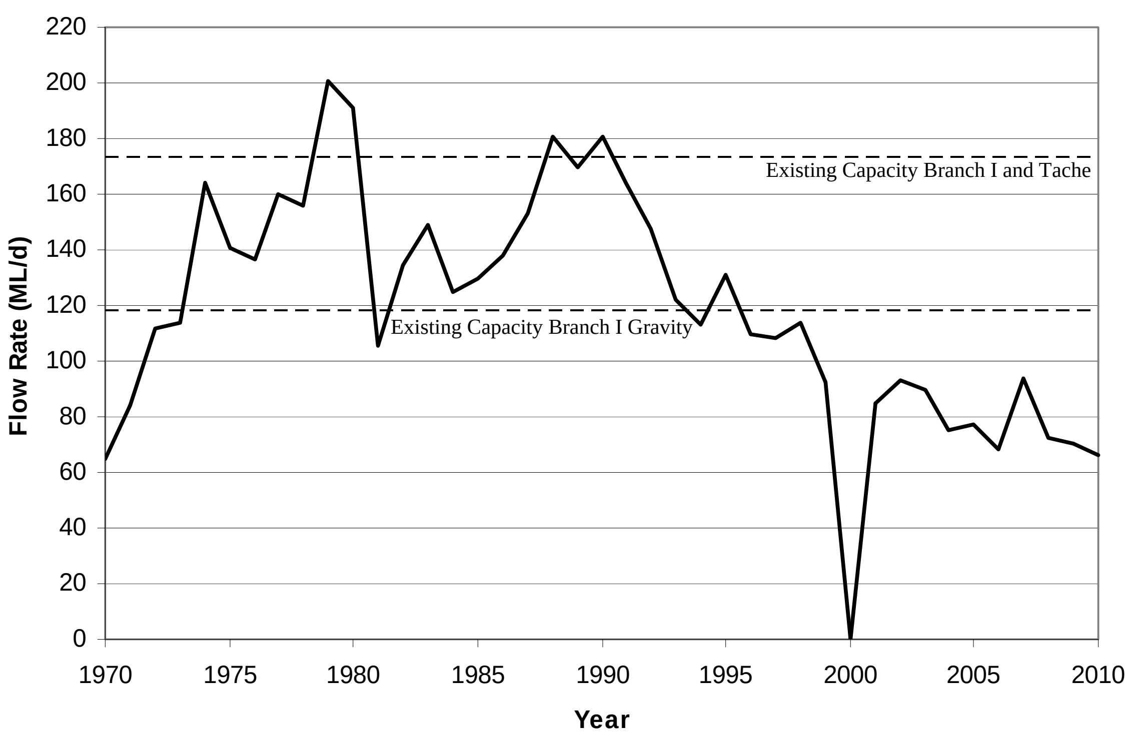

Figure 4.6 Branch I Aqueduct Maximum Day Flow

The Branch II Aqueduct had a flow rate of 181.1 ML/d on the maximum day of 2010, as shown on Figure 4.7.

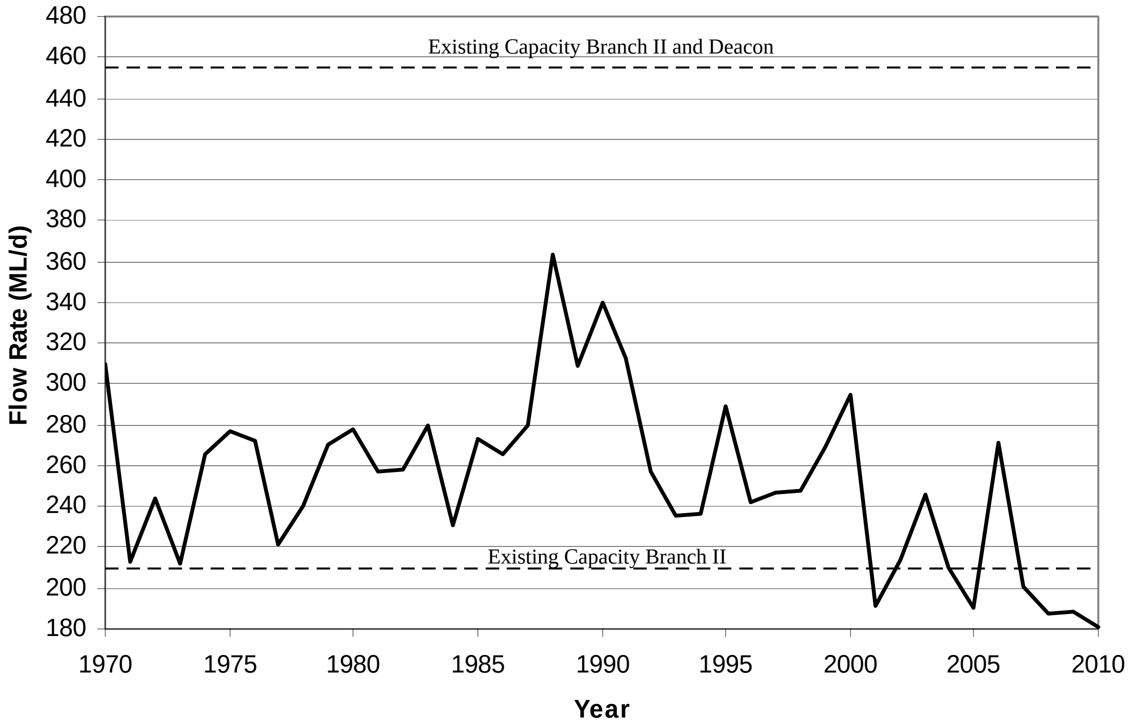

Figure 4.7 Branch II Aqueduct Maximum Day Flow

Assuming that the Branch Aqueducts were supplying the pumping station reservoirs at the maximum day flow rates, mass curves were drawn for each pumping station to determine the balancing storage required for each pumping station reservoir. The balancing storage required at each pumping station is shown in Figures 4.8, 4.9 and 4.10.

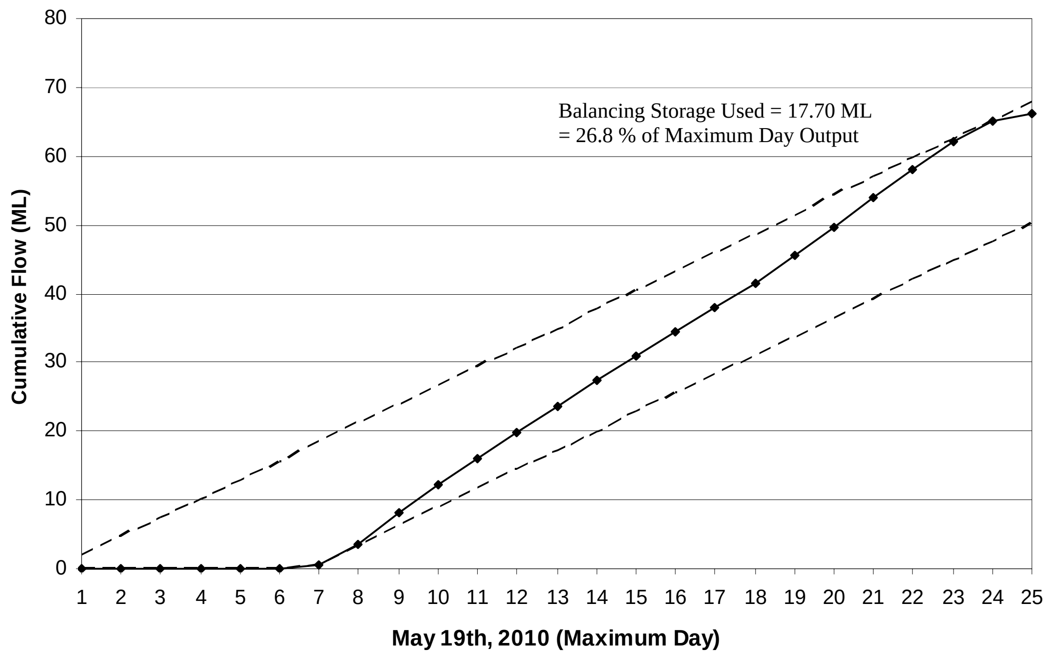

Figure 4.8 McPhillips Reservoir Balancing Storage

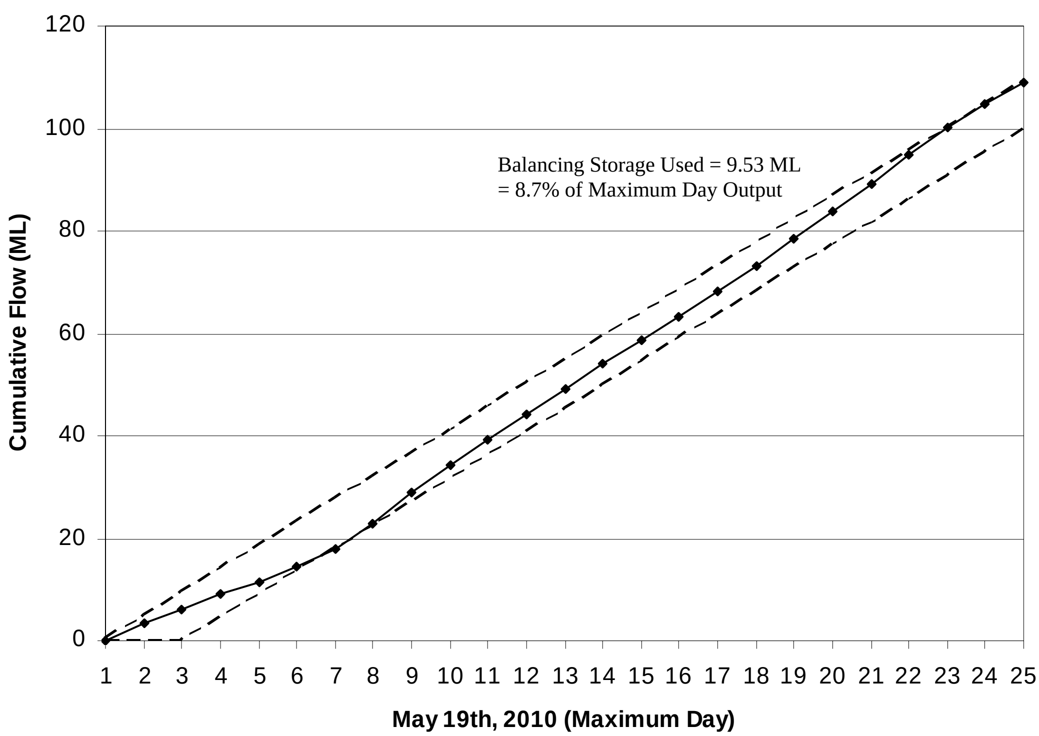

Figure 4.9 Wilkes Reservoir Balancing Storage

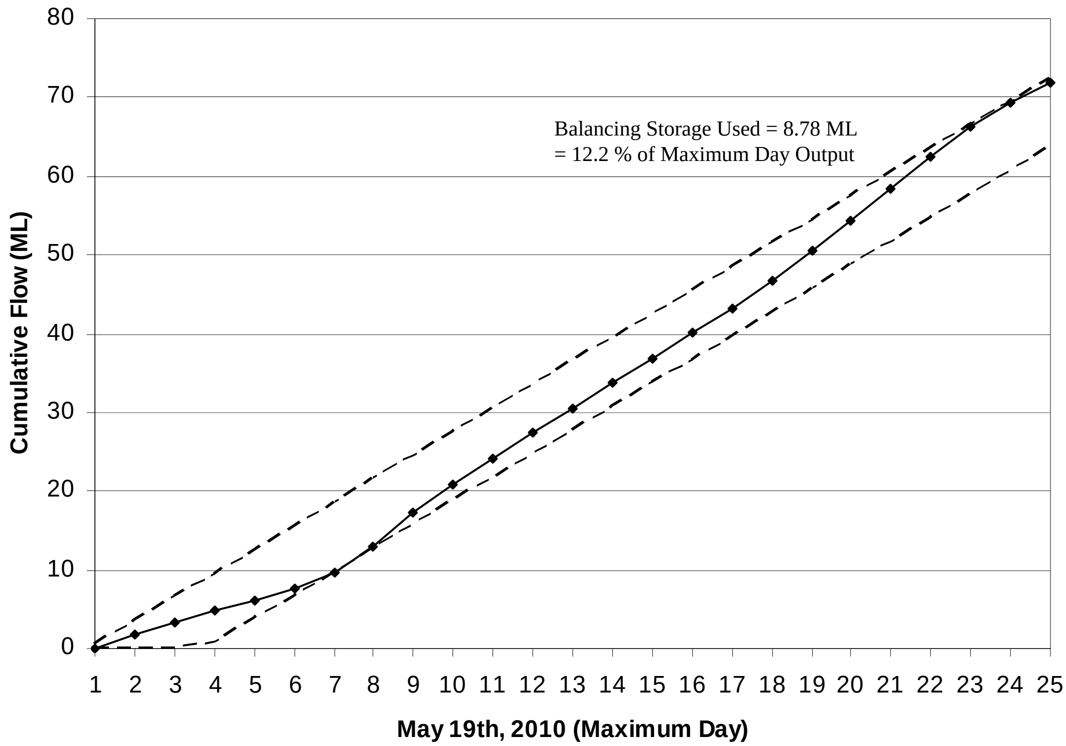

Figure 4.10 MacLean Reservoir Balancing Storage

The balancing storage at a distribution reservoir is the maximum amount of storage used on the maximum day. The balancing storage is the total drawdown volume of the reservoir during the time period where the hourly pumpage is greater than the average hourly pumpage for that day.

The design criterion put forth by the 1967 Water Supply Study was that the balancing storage required at a pumping station reservoir to provide for a maximum hour demand is approximately 18% of the volume of water pumped from that station during a maximum day. The balancing storage requirements at the McPhillips, Wilkes and MacLean Reservoirs in 2010 were approximately 26.8%, 8.7% and 12.2% of their maximum day outputs respectively.

To determine if the three existing pumping stations have the necessary capacity to supply sufficient water to the distribution system under maximum hour demands, graphs were drawn illustrating recorded maximum hour pumping rates and existing firm pumping capacities for the stations. Figures 4.11, 4.12 and 4.13 indicate the McPhillips, Hurst and MacLean Pumping Stations all had adequate capacity to provide for the 2010 maximum hour demand.

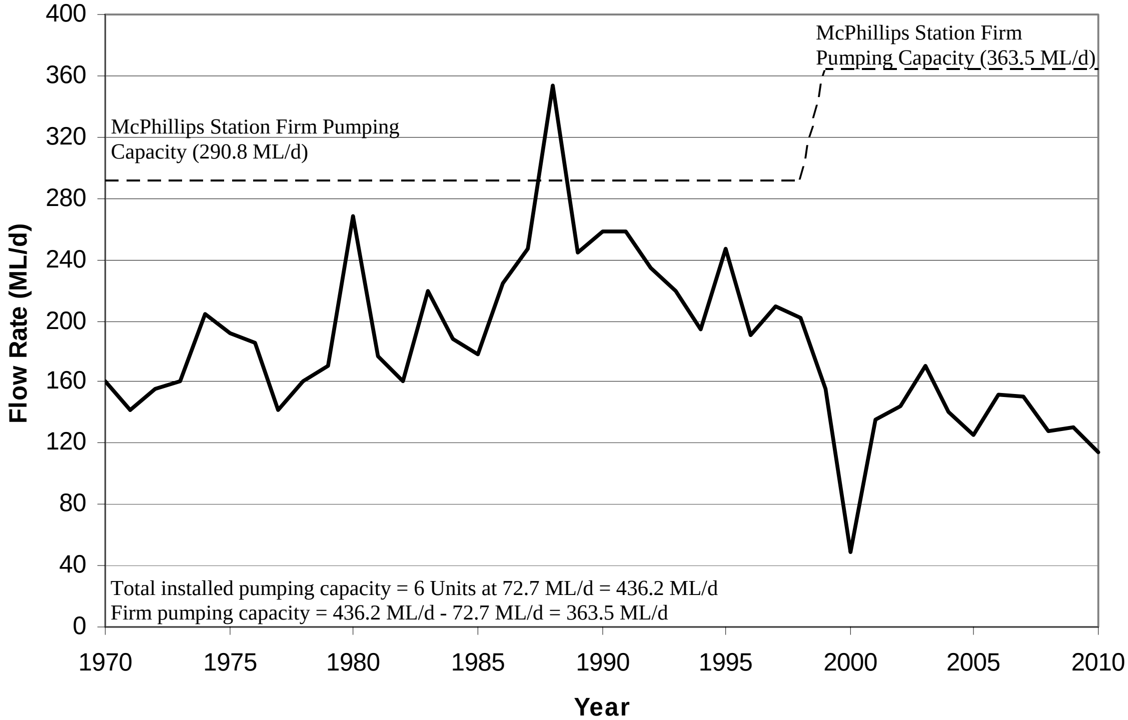

Figure 4.11 McPhillips Station Maximum Hour Pumping

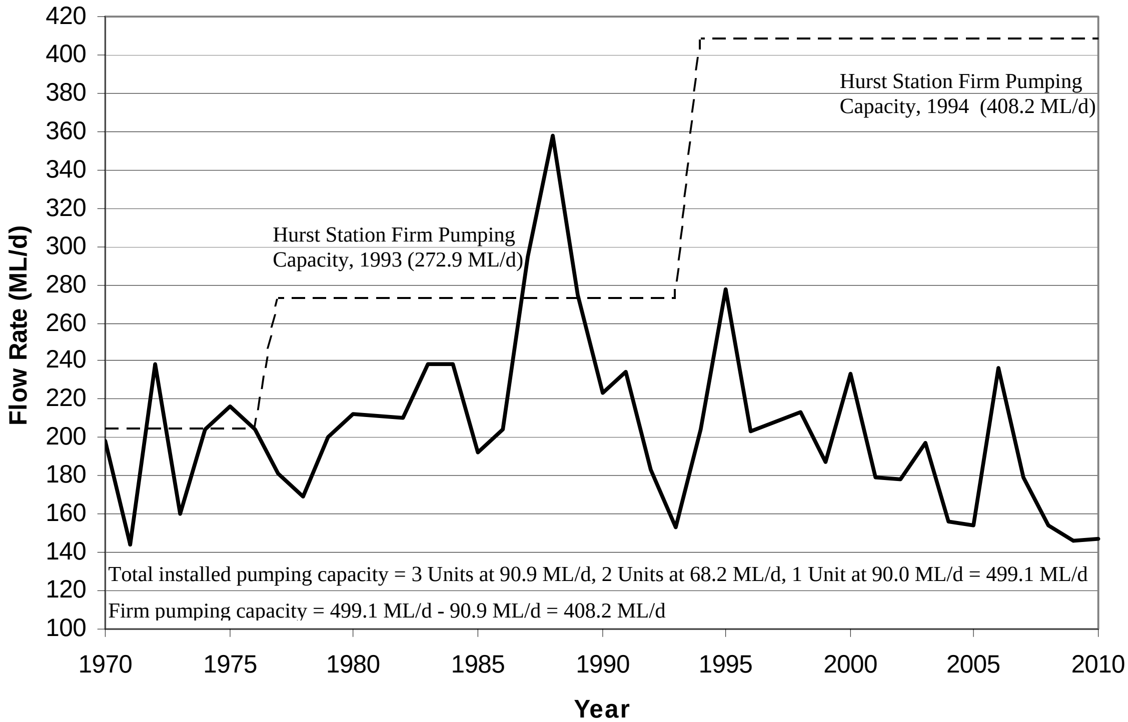

Figure 4.12 Hurst Station Maximum Hour Pumping

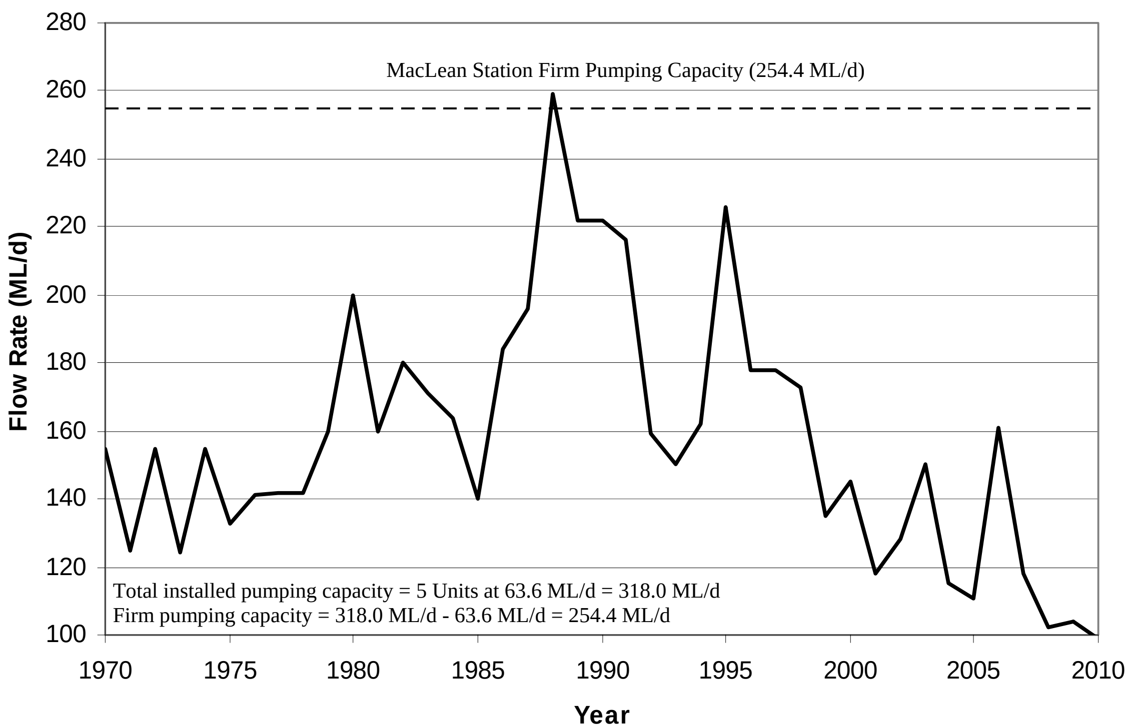

Figure 4.13 MacLean Station Maximum Hour Pumping

Neither the present combined firm pumping capacity for the three distribution pumping stations of 1,026.1 ML/d, nor the total installed capacity of 1,253.3 ML/d were exceeded during the 2010 peak demand period. The firm and installed capacities of the individual pumping stations are as follows:

Table 4.2 Distribution Pumping Station Capacity

Pumping Station	Firm Capacity (ML/d)	Installed Capacity (ML/d)
McPhillips	363.5	436.2
Hurst	408.2	499.1
MacLean	254.4	318.0
Total	1,026.1	1,253.3

5.0 METERED CONSUMPTION AND REVENUE

The water rate structure currently used is the Base Extra Capacity Method employing a three-block rate structure. The Block 1 rate is applied to consumption for 0 to 272 cubic meters; the Block 2 rate is applied to all consumption from 272 to 2718 cubic meters; and the Block 3 rate is applied to all consumption in excess of 2718 cubic meters.

The total water billed in 2010 was 63.14 GL. This value is used primarily in the determination of water rates. The total water pumped into the regional supply system was 75.03 GL, yielding a revenue loss factor of 15.85% for 2010. The revenue loss factor consists of unaccounted-for water (15.42%) and metered but non-billed water (0.2% for sewer chlorination and usage at the three Water Pollution Control Centers). A summary of the billed consumption's and generated revenues for each block is as follows:

Table 5.1 2010 Billed Consumption and Revenue by Block

Block	Billed Consumption		Water Revenue	
	GL	%	(Million $)	%
1	37.19	58.9	47.79	56.9
2	15.72	24.9	17.51	20.8
3	10.12	16.0	9.55	11.4
Public Water Outlets	0.11	0.2	0.25	0.3
Quarterly Charge	-	-	8.92	10.6
Total	**63.14**	**100.0**	**84.02**	**100.0**

Figures 5.1 and 5.2 illustrate the history of water consumption and revenue by block since 1977.

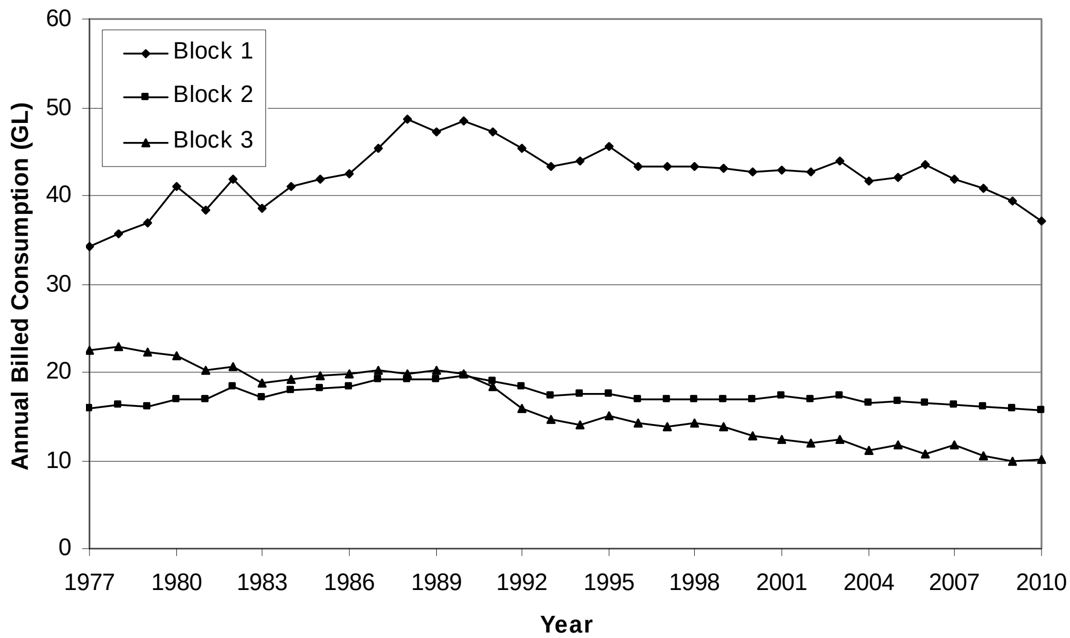

Figure 5.1 Billed Consumption by Block

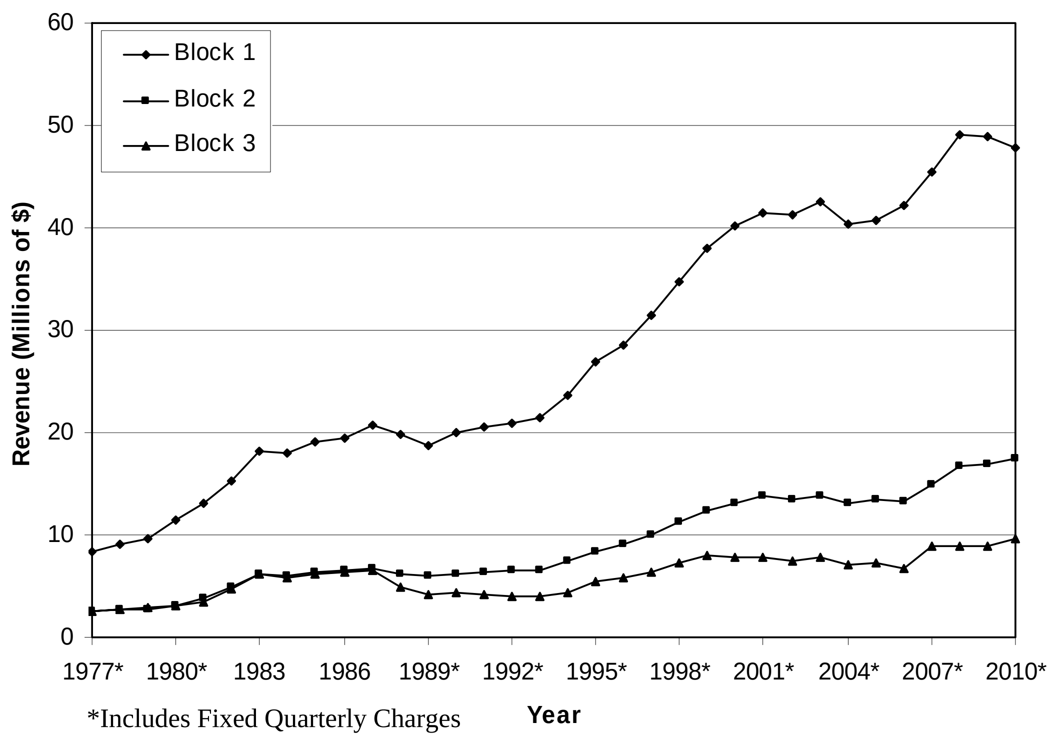

Figure 5.2 Annual Revenue by Block

Figure 5.3 illustrates the history of unit revenue by block since 1977. Unit revenue represents revenue divided by billed consumption. In order to estimate unit revenue by block, it was assumed that the revenue generated from fixed quarterly charges (implemented in 1988) could be proportioned among the blocks according to meter size.

For example, the fixed quarterly charges collected from accounts with 5/8" meters were assigned to Block 1 revenue, 3/4" to 1 ½" to Block 2 revenue, and 2" to 10" to Block 3 revenue.

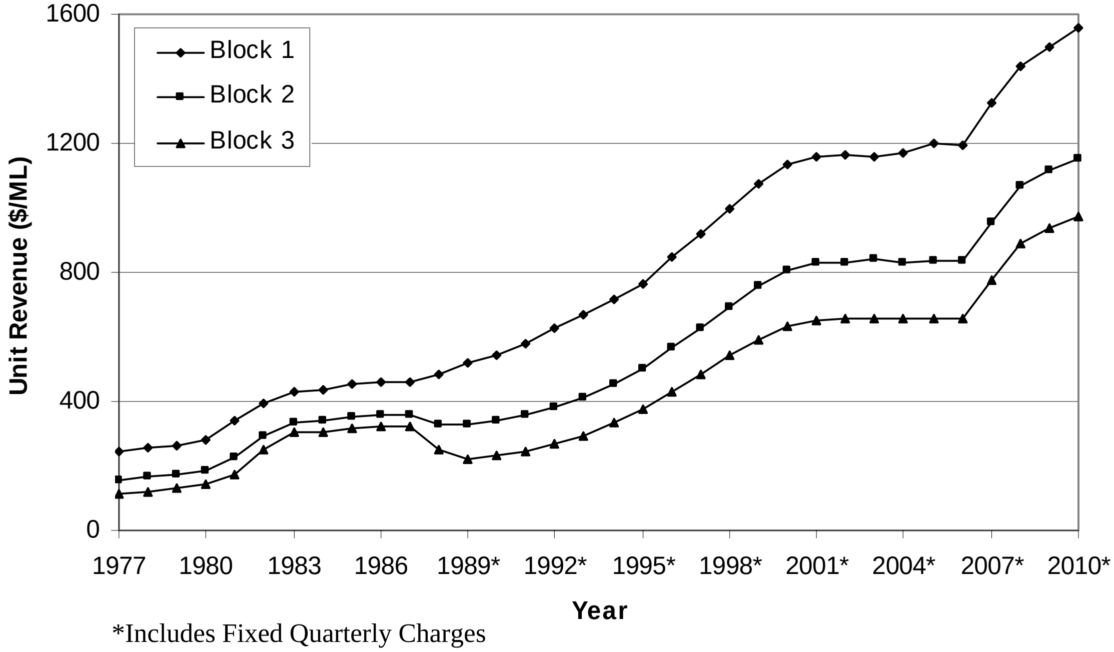

Figure 5.3 Unit Revenue by Block

The summaries of billed water consumption, revenue and unit revenue by blocks, non-billed water and unaccounted-for water for the years 1977 to 2010 are tabulated in Tables D.2, D.3, D.4, D.5 and D.6, respectively. (See Appendix D)

The new water rates, which took effect on January 1, 2010, are as follows:

Table 5.2 2010 Water Rates and Quarterly Charges

Block	Water Rate (per cu m per quarter)	Meters in Service	% Consumption
1	$ 1.29	184,159	58.9
2	$ 1.12	9,022	24.9
3	$ 0.95	1,413	16.0
Meter Size	**Quarterly Charge**	**Meters in Service**	
5/8” (residential)	$ 13.75	184,159	
3/4”	$ 14.80	3,998	
1”	$ 17.70	3,374	
1 1/2”	$ 21.45	1,650	
2”	$ 31.80	1,103	
3”	$ 109.45	183	
4”	$ 139.25	78	
6”	$ 207.60	41	
8”	$ 285.70	7	
10”	$363.80	1	

A history of the block rates since 1974 is included in Table D.1.

Appendix A

Historical Water Consumption Summary

Year	Total Water Pumped (Litres) x 1000	Population	Avg Day (ML/d)	Per Capita (L/c/d)	Max Day (ML/d)	Max Day Load Factor	Max Hour (ML/d)	Max Hour Load Factor	Max Month (ML/d)	Max Month Load Factor
1921 *	20,200,000	228,035	55.3	242.7						
1922 *	23,500,000	234,561	64.4	274.5						
1923 *	24,100,000	241,087	66.0	273.9						
1924 *	24,200,000	247,613	66.1	267.0		10.0				
1925 *	25,300,000	254,139	69.3	272.7						
1926 *	25,100,000	260,665	68.8	263.8						
1927 *	27,500,000	267,191	75.3	282.0						
1928 *	29,300,000	273,717	80.1	292.5						
1929 *	30,700,000	280,243	84.1	300.1						
1930 *	31,800,000	286,769	87.1	303.8						
1931 *	30,300,000	293,300	83.0	283.0						
1932 *	29,800,000	293,964	81.4	277.0						
1933 *	29,300,000	294,628	80.3	272.5						
1934 *	28,900,000	295,292	79.2	268.1						
1935 *	28,700,000	295,956	78.6	265.7						
1936 *	31,800,000	296,620	86.9	292.9						
1937 *	31,500,000	297,284	86.3	290.3						
1938 *	29,700,000	297,948	81.4	273.1						
1939 *	31,600,000	298,612	86.6	289.9						
1940 *	32,200,000	299,276	88.0	294.0						
1941 *	32,800,000	299,937	89.9	299.6	116.9	1.3				
1942 *	34,800,000	305,350	95.3	312.2	126.7	1.3				
1943 *	35,800,000	310,763	98.1	315.6	134.4	1.4				
1944 *	36,600,000	316,176	100.0	316.3	140.0	1.4				
1945 *	40,300,000	321,589	110.4	343.3	154.6	1.4	231.8	2.1	119.2	1.1
1946 *	40,900,000	327,002	112.1	342.7	156.9	1.4	246.6	2.2	117.7	1.1
1947 *	43,100,000	332,415	118.1	355.2	155.9	1.3	224.4	1.9	125.2	1.1
1948 *	45,100,000	337,828	123.2	364.8	170.0	1.4	235.3	1.9	134.3	1.1
1949	44,208,172	343,241	121.1	352.9	181.6	1.5	276.1	2.3	135.6	1.1
1950	41,835,651	348,654	114.6	328.7	154.7	1.3	229.2	2.0	120.3	1.0

* Estimated consumption data picked off graphs in the 1967 and 1979 Regional Water Supply Studies.

** The Max Day, Max Hour and Max Month for 1941-1948 were calculated by multiplying the Load Factors by Average Day.

Year	Total Water Pumped (Litres) x 1000	Population	Avg Day (ML/d)	Per Capita (L/c/d)	Max Day (ML/d)	Max Day Load Factor	Max Hour (ML/d)	Max Hour Load Factor	Max Month (ML/d)	Max Month Load Factor
1951	43,092,693	354,069	118.1	333.4	165.3	1.4	247.9	2.1	131.1	1.1
1952	44,825,923	365,079	122.5	335.5	181.7	1.5	257.8	2.1	130.1	1.1
1953	44,759,785	376,089	122.6	326.1	190.6	1.6	273.3	2.2	137.9	1.1
1954	47,281,127	387,099	129.5	334.6	191.6	1.5	268.1	2.1	142.5	1.1
1955	51,770,552	398,109	141.8	356.3	209.9	1.5	297.8	2.1	174.5	1.2
1956	52,598,338	409,121	143.7	351.3	216.2	1.5	298.3	2.1	165.7	1.2
1957	51,544,034	421,692	141.2	334.9	223.1	1.6	306.4	2.2	162.4	1.2
1958	54,440,442	434,263	149.2	343.5	223.7	1.5	302.8	2.0	179.0	1.2
1959	55,325,215	446,834	151.6	339.2	219.7	1.4	306.2	2.0	175.1	1.2
1960	58,176,203	459,405	159.0	346.0	247.0	1.6	468.3	2.9	185.8	1.2
1961	68,117,627	471,975	186.6	395.4	335.9	1.8	541.1	2.9	251.9	1.3
1962	58,162,583	478,415	159.3	333.1	256.5	1.6	371.3	2.3	186.4	1.2
1963	61,890,339	484,885	169.6	349.7	291.7	1.7	469.7	2.8	218.7	1.3
1964	63,882,175	491,295	174.5	355.3	288.5	1.7	468.5	2.7	218.5	1.3
1965	65,784,825	497,735	180.2	362.1	286.6	1.6	414.5	2.3	216.3	1.2
1966	67,939,783	504,176	186.1	369.2	312.7	1.7	498.8	2.7	238.2	1.3
1967	69,442,395	510,385	190.3	372.8	323.4	1.7	475.6	2.5	239.7	1.3
1968	67,189,134	516,594	183.6	355.4	307.4	1.7	428.9	2.3	200.6	1.1
1969	69,451,901	522,803	190.3	364.0	333.0	1.8	513.8	2.7	228.3	1.2
1970	75,400,937	529,012	206.6	390.5	367.7	1.8	516.4	2.5	268.5	1.3
1971	76,116,637	535,220	208.5	389.6	287.8	1.4	417.0	2.0	250.2	1.2
1972	83,845,946	540,351	229.1	424.0	349.2	1.5	532.9	2.3	277.9	1.2
1973	85,643,462	545,482	234.6	430.2	330.8	1.4	448.1	1.9	276.8	1.2
1974	90,220,902	550,613	247.2	448.9	417.7	1.7	568.5	2.3	336.1	1.4
1975	90,182,206	555,744	247.1	444.6	385.4	1.6	541.1	2.2	303.9	1.2
1976	95,847,932	560,874	261.9	466.9	372.9	1.4	525.1	2.0	344.0	1.3
1977	88,707,379	561,589	243.0	432.8	323.2	1.3	486.1	2.0	269.8	1.1
1978	92,802,098	562,303	254.3	452.2	336.3	1.3	472.8	1.9	285.3	1.1
1979	93,075,650	563,018	255.0	452.9	371.5	1.5	527.3	2.1	304.8	1.2
1980	96,082,581	563,732	262.5	465.7	423.1	1.6	681.0	2.6	334.1	1.3
1981	89,590,542	564,447	245.5	434.9	361.0	1.5	547.0	2.2	270.0	1.1
1982	91,962,290	565,215	252.0	445.8	371.0	1.5	540.0	2.1	270.0	1.1
1983	96,518,136	575,820	264.4	459.2	429.5	1.6	651.0	2.5	359.9	1.4

Year	Total Water Pumped (Litres) x 1000	Population	Avg Day (ML/d)	Per Capita (L/c/d)	Max Day (ML/d)	Max Day Load Factor	Max Hour (ML/d)	Max Hour Load Factor	Max Month (ML/d)	Max Month Load Factor
1984	96,135,957	581,550	262.7	451.7	362.1	1.4	594.0	2.3	309.4	1.2
1985	97,424,855	582,735	266.9	458.0	399.6	1.5	516.0	1.9	290.1	1.1
1986	98,275,244	594,551	269.2	452.9	396.1	1.5	618.0	2.3	309.2	1.1
1987	100,708,700	600,497	275.9	459.5	431.4	1.6	711.0	2.6	328.5	1.2
1988	109,929,970	606,502	300.4	495.2	543.1	1.8	954.0	3.2	391.0	1.3
1989	108,685,340	612,567	297.8	486.1	477.6	1.6	744.0	2.5	356.4	1.2
1990	109,315,930	618,693	299.5	484.1	522.5	1.7	702.0	2.3	385.2	1.3
1991	103,691,110	622,200	284.1	456.6	476.8	1.7	708.0	2.5	375.2	1.3
1992	94,248,520	617,790	257.5	416.8	405.0	1.6	576.0	2.2	285.5	1.1
1993	89,922,760	621,119	246.4	396.6	358.0	1.5	522.0	2.1	275.8	1.1
1994	89,830,350	623,600	246.1	394.7	346.7	1.4	560.0	2.3	271.9	1.1
1995	95,336,870	626,310	261.2	417.0	419.5	1.6	751.0	2.9	312.6	1.2
1996	93,369,600	632,338	255.1	403.4	351.5	1.4	572.0	2.2	284.1	1.1
1997	90,283,700	636,142	247.4	388.8	355.0	1.4	596.0	2.4	284.4	1.2
1998	91,301.600	627,300	250.1	398.7	361.2	1.4	588.0	2.4	301.9	1.2
1999	88,468.800	628,100	242.4	385.9	361.8	1.5	478.0	2.0	271.0	1.1
2000	82,414,500	629,800	225.2	357.6	294.5	1.3	427.0	1.9	245.6	1.1
2001	79,783,400	631,700	218.6	346.0	276.1	1.3	432.0	2.0	239.0	1.1
2002	81,921,258	631,200	224.4	355.5	307.6	1.4	450.0	2.0	270.2	1.2
2003	84,557,912	642,700	231.7	360.6	336.1	1.5	517.0	2.2	272.0	1.2
2004	81,046,806	642,700	221.0	341.9	285.0	1.3	411.0	1.9	245.0	1.1
2005	80,124,100	647,400	219.5	339.1	266.9	1.2	391.0	1.8	236.0	1.1
2006	82,831,200	649300	226.9	349.5	339.6	1.5	549.0	2.4	296.1	1.3
2007	79,624,500	653,300	218.1	333.8	294.9	1.35	447.0	2.1	244.9	1.1
2008	78,586,700	658,700	214.7	326.0	259.5	1.21	384.0	1.8	230.1	1.1
2009	77,302,700	675,100	211.8	313.7	258.6	1.22	380.0	1.8	222.6	1.1
2010	75,031,200	683,200	205.6	300.9	247.3	1.20	361.0	1.8	221.6	1.1

Existing Water Supply System

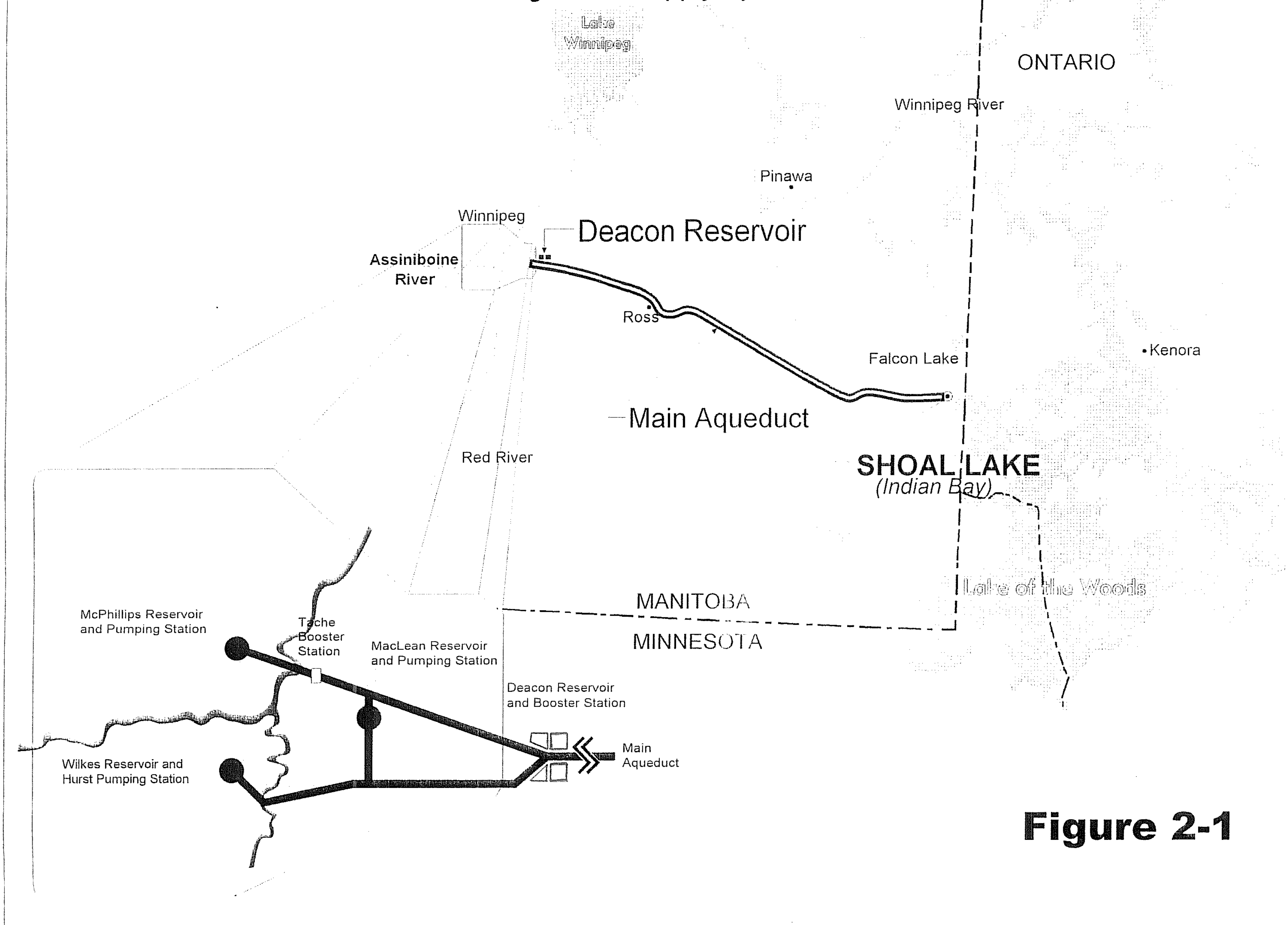

Figure 2-1

Appendix B

Table B.1

Historical Annual Pumping

Year	Total Megalitres	Percent Change From Previous Year
1955	51,770.55	
1956	52,598.34	1.60
1957	51,544.03	-2.00
1958	54,440.44	5.62
1959	55,325.22	1.63
1960	58,176.20	5.15
1961	68,117.63	17.09
1962	58,162.58	-14.61
1963	61,890.34	6.41
1964	63,882.18	3.22
1965	65,784.83	2.98
1966	67,939.78	3.28
1967	69,442.40	2.21
1968	67,189.13	-3.24
1969	69,451.90	3.37
1970	75,400.94	8.57
1971	76,116.64	0.95
1972	83,845.95	10.15
1973	85,643.46	2.14
1974	90,220.90	5.34
1975	90,182.21	-0.04
1976	95,847.93	6.28
1977	88,707.38	-7.45
1978	92,802.10	4.62
1979	93,955.11	1.24
1980	96,082.58	2.26
1981	89,590.54	-6.76
1982	91,962.29	2.65
1983	96,518.14	4.95
1984	96,135.96	-0.40
1985	97,424.86	1.34
1986	98,275.24	0.87
1987	100,708.70	2.48
1988	109,929.97	9.16
1989	108,685.34	-1.13
1990	109,315.93	0.58
1991	103,691.15	-5.15
1992	94,248.49	-9.11
1993	89,922.69	-4.59
1994	89,830.35	-0.10
1995	95,336.87	6.13
1996	93,369.60	-2.06
1997	90,283.70	-3.31
1998	91,301.60	1.13
1999	88,468.80	-3.10
2000	82,414.50	-6.84
2001	79,783.40	-3.19
2002	81,921.26	2.68
2003	84,557.91	3.24
2004	81,046.80	-4.15
2005	80,124.10	-1.14
2006	82,831.20	3.38
2007	79,624.50	-3.87
2008	78,586.70	-1.30
2009	77,302.70	-1.63
2010	75,031.20	-2.94

Table B.2

Historical Monthly Pumping
Megalitres

Year	January	% of Annual Pumpage	February	% of Annual Pumpage	March	% of Annual Pumpage
1955	4002.403	7.73	3788.655	7.32	4066.665	7.85
1956	4297.397	8.17	4018.619	7.64	4276.672	8.13
1957	4333.438	8.41	3891.903	7.55	4343.689	8.43
1958	4178.147	7.61	3739.926	6.81	4115.926	7.50
1959	4251.483	7.68	4080.753	7.38	4532.885	8.19
1960	4403.133	7.57	4233.903	7.28	4596.892	7.90
1961	4773.345	6.99	4321.168	6.33	4766.395	6.98
1962	4582.686	7.89	4261.075	7.34	4846.877	8.35
1963	4551.196	7.35	4388.086	7.09	4821.128	7.79
1964	4636.925	7.31	4528.139	7.13	5023.075	7.91
1965	5114.450	7.77	4858.733	7.39	5506.542	8.37
1966	5161.686	7.60	4889.355	7.20	5387.296	7.93
1967	5163.729	7.45	4896.615	7.07	5691.906	8.22
1968	5418.582	8.07	5206.370	7.75	5472.257	8.14
1969	5151.477	7.42	5250.716	7.56	5532.973	7.97
1970	5560.435	7.47	5214.103	7.01	6064.341	8.15
1971	5564.877	7.31	5628.666	7.39	6636.369	8.72
1972	6042.136	7.24	6545.272	7.84	7011.319	8.40
1973	6958.776	8.04	5931.598	6.85	6638.897	7.67
1974	6946.715	7.70	6417.775	7.11	6603.015	7.32
1975	7302.767	8.10	6538.207	7.25	7258.057	8.05
1976	7799.613	8.14	6636.887	6.92	7510.578	7.84
1977	7141.366	8.05	6446.160	7.27	7922.596	8.93
1978	7729.314	8.36	7202.378	7.79	7315.660	7.91
1979	7892.947	8.31	7222.094	7.61	8197.347	8.63
1980	7515.700	7.79	6771.825	7.02	7391.434	7.66
1981	7265.332	8.11	6300.951	7.03	7540.564	8.42
1982	6890.760	7.49	7703.200	8.38	7677.960	8.35
1983	7283.801	7.55	6965.400	7.22	7408.219	7.68
1984	7921.137	8.24	7398.030	7.70	7678.673	7.99
1985	7941.309	8.15	7806.500	8.01	8617.700	8.85
1986	7840.427	7.98	7228.720	7.36	8393.230	8.54
1987	7629.600	7.62	7063.200	7.05	8469.200	8.46
1988	8251.600	7.51	7989.200	7.27	8200.370	7.46
1989	8150.770	7.50	7916.240	7.28	8900.190	8.19
1990	8521.690	7.80	7873.730	7.20	8674.070	7.93
1991	8141.910	7.85	7517.500	7.25	8231.640	7.94
1992	7818.510	8.30	7248.190	7.69	7951.790	8.44
1993	7266.420	8.08	6529.320	7.26	7250.510	8.06
1994	7164.800	8.02	6972.300	7.81	7146.000	8.00
1995	7408.440	7.77	6883.180	7.22	7734.120	8.11
1996	7418.600	7.95	7187.000	7.70	7527.900	8.06
1997	7456.500	8.26	6736.200	7.46	6973.500	7.72
1998	7162.500	7.84	6538.300	7.16	7323.700	8.02
1999	7195.600	8.13	6625.600	7.49	7281.700	8.23
2000	6764.400	8.21	6533.000	7.93	6825.100	8.28
2001	6505.100	8.15	5781.200	7.25	6606.400	8.28
2002	6488.200	7.92	5883.000	7.18	6583.800	8.04
2003	6559.100	7.78	6128.400	7.27	7082.000	8.40
2004	6564.900	8.10	6312.500	8.14	6751.100	8.33
2005	6696.400	8.36	6176.400	8.01	6664.900	8.32
2006	6416.300	7.75	5810.000	7.46	6477.200	7.82
2007	6444.500	8.09	5815.000	7.61	6671.700	8.38
2008	6437.200	8.08	6024.000	7.88	6504.100	8.16
2009	6367.400	8.11	5860.800	7.70	6615.430	8.43
2010	6185.300	8.10	5504.200	7.43	6183.600	8.10

Table B.2 (Cont'd)

Historical Monthly Pumping
Megalitres

Year	April	% of Annual Pumpage	May	% of Annual Pumpage	June	% of Annual Pumpage
1955	3744.113	7.23	4177.333	8.07	4570.589	8.83
1956	4105.574	7.81	4189.744	7.97	4780.410	9.09
1957	4057.396	7.87	4615.758	8.95	3996.639	7.75
1958	4104.306	7.48	5236.192	9.54	5206.952	9.49
1959	4233.122	7.65	4547.532	8.22	4961.418	8.97
1960	4331.929	7.45	5087.201	8.74	5047.174	8.68
1961	4751.499	6.96	5834.291	8.54	8402.208	12.30
1962	4667.492	8.04	4906.098	8.45	5465.217	9.41
1963	4663.879	7.53	4852.619	7.84	5156.100	8.33
1964	4822.338	7.60	5440.889	8.57	6090.217	9.59
1965	5386.878	8.19	5057.707	7.69	6156.293	9.36
1966	5272.883	7.76	5188.673	7.64	6087.749	8.96
1967	4576.304	6.61	5851.748	8.45	7007.209	10.11
1968	5366.798	7.99	5712.122	8.50	5860.044	8.72
1969	5470.916	7.88	5573.587	8.03	6341.729	9.13
1970	5791.331	7.78	5601.608	7.53	6069.807	8.16
1971	5961.315	7.83	6222.583	8.17	6936.019	9.11
1972	6416.170	7.69	7759.195	9.29	8299.905	9.94
1973	6498.820	7.51	7919.487	9.15	7630.916	8.82
1974	7317.569	8.11	6951.270	7.70	8515.472	9.44
1975	7217.271	8.00	7326.947	8.12	7913.145	8.77
1976	7304.358	7.62	8380.551	8.74	9191.226	9.59
1977	7164.732	8.08	8228.578	9.28	7590.938	8.56
1978	7724.481	8.36	7879.855	8.52	7748.884	8.38
1979	8160.415	8.59	8658.869	9.12	7776.465	8.19
1980	7700.819	7.98	8929.437	9.26	10022.514	10.39
1981	7031.337	7.85	8500.919	9.49	7234.837	8.08
1982	7485.460	8.14	8412.320	9.15	8220.870	8.94
1983	7118.981	7.38	8107.272	8.40	8423.555	8.73
1984	7991.264	8.31	8070.219	8.39	8000.191	8.32
1985	7822.364	8.03	8475.955	8.70	8858.927	9.09
1986	7574.370	7.71	8539.140	8.69	9275.040	9.44
1987	7771.600	7.76	9422.800	9.41	9853.900	9.84
1988	8082.030	7.35	9943.880	9.05	11363.990	10.34
1989	8463.270	7.79	9650.750	8.88	9139.000	8.41
1990	8478.450	7.76	9661.390	8.84	9040.980	8.27
1991	7941.470	7.66	8971.480	8.65	9204.550	8.88
1992	7557.960	8.02	8785.400	9.32	8409.400	8.92
1993	7213.190	8.02	7902.600	8.79	8273.650	9.20
1994	7117.200	7.97	7912.400	8.86	7899.600	8.84
1995	7210.820	7.56	7942.920	8.33	9376.800	9.84
1996	7498.500	8.03	7849.800	8.41	8383.400	8.98
1997	7321.100	8.11	7471.900	8.28	8532.900	9.45
1998	7271.600	7.96	7817.900	8.56	7632.700	8.36
1999	7267.000	8.21	7431.800	8.40	7821.800	8.84
2000	6779.200	8.23	7344.300	8.91	7099.800	8.61
2001	6344.100	7.95	6693.900	8.39	6818.300	8.55
2002	6534.700	8.08	6934.500	8.57	7240.100	8.95
2003	6723.500	7.95	7259.000	8.62	7038.600	8.36
2004	6539.500	8.07	6755.400	8.34	6893.100	8.51
2005	6456.400	8.06	6664.700	8.32	6854.500	8.55
2006	6427.500	7.76	6803.800	8.21	7623.400	9.20
2007	6460.500	8.11	6778.100	8.51	6788.900	8.53
2008	6284.900	7.91	6803.700	8.56	6753.000	8.50
2009	6285.600	8.03	6530.810	8.35	6812.150	8.71
2010	6180.100	8.15	6529.500	8.61	6401.500	8.44

Table B.2 (Cont'd)

Historical Monthly Pumping
Megalitres

Year	July	% of Annual Pumpage	August	% of Annual Pumpage	September	% of Annual Pumpage
1955	4695.727	9.07	5551.457	10.72	4511.969	8.72
1956	4722.903	8.98	4823.174	9.17	4294.120	8.16
1957	5054.393	9.81	4625.137	8.97	4067.243	7.89
1958	4843.099	8.82	5482.221	9.99	4914.076	8.95
1959	5427.538	9.81	5325.053	9.63	4555.056	8.23
1960	5493.609	9.44	5759.15	9.90	5008.065	8.61
1961	7304.213	10.69	8077.319	11.83	5199.783	7.61
1962	5402.362	9.31	5266.273	9.07	4677.038	8.06
1963	7009.396	11.32	6308.375	10.19	5187.577	8.38
1964	6736.513	10.61	5837.346	9.20	5161.083	8.13
1965	5886.170	8.95	6680.106	10.15	5241.961	7.97
1966	7224.885	10.63	6943.065	10.22	5731.274	8.44
1967	6323.013	9.13	6938.36	10.02	6469.626	9.34
1968	6167.149	9.18	5787.981	8.61	5398.607	8.04
1969	6102.973	8.79	6689.448	9.63	6351.944	9.15
1970	7530.995	10.12	8346.952	11.22	6327.509	8.50
1971	6449.142	8.47	7744.466	10.17	6702.654	8.80
1972	8068.095	9.66	7866.276	9.42	6501.835	7.79
1973	8573.333	9.90	9074.847	10.48	7207.838	8.33
1974	10630.903	11.78	8412.891	9.32	7450.298	8.26
1975	9445.311	10.47	7559.284	8.38	8101.331	8.98
1976	8793.028	9.17	10087.624	10.52	7361.238	7.68
1977	8938.354	10.08	7465.882	8.42	6984.488	7.87
1978	8082.652	8.74	8563.300	9.26	7971.366	8.62
1979	9779.851	10.30	8295.354	8.74	7734.219	8.14
1980	9892.721	10.26	8146.022	8.45	8070.488	8.37
1981	8763.900	9.78	8470.382	9.45	7810.710	8.72
1982	7881.510	8.57	8367.800	9.10	7735.370	8.41
1983	9330.008	9.67	11158.382	11.56	8330.726	8.63
1984	8906.300	9.26	9590.645	9.98	7447.464	7.75
1985	8992.264	9.23	8178.218	8.39	8030.582	8.24
1986	8915.980	9.07	8203.000	8.35	9145.408	9.31
1987	9231.400	9.22	8957.800	8.95	8551.800	8.54
1988	10739.400	9.77	11068.180	10.07	9323.930	8.48
1989	11047.080	10.16	10615.790	9.77	9282.560	8.54
1990	10624.070	9.72	11940.430	10.92	9466.910	8.66
1991	9345.070	9.01	11629.660	11.22	9095.580	8.77
1992	8140.360	8.64	8850.690	9.39	7657.430	8.12
1993	7922.240	8.81	8114.900	9.02	7681.570	8.54
1994	7362.100	8.24	8595.900	9.62	7700.100	8.62
1995	9487.230	9.95	9518.460	9.98	7694.430	8.07
1996	8806.500	9.43	8600.900	9.21	7886.500	8.45
1997	8412.300	9.32	8524.700	9.44	7682.000	8.51
1998	8525.000	9.34	9359.600	10.25	8209.600	8.99
1999	8255.200	9.33	8400.300	9.50	7288.800	8.24
2000	7552.200	9.16	7614.400	9.24	6557.700	7.96
2001	7294.800	9.14	7409.900	9.29	6907.500	8.66
2002	8377.000	10.20	7409.500	9.02	6855.100	8.35
2003	7978.000	9.43	8433.200	9.97	7340.600	8.68
2004	7595.200	9.37	7087.200	8.74	6739.000	8.32
2005	7119.400	8.89	7316.500	9.13	6729.500	8.40
2006	9180.600	11.08	7729.200	9.33	7124.100	8.60
2007	7591.000	9.53	7489.200	9.41	6630.800	8.33
2008	7105.300	9.05	7133.500	9.08	6531.200	8.32
2009	6899.390	8.89	6648.900	8.56	6617.530	8.52
2010	6870.100	9.11	6675.000	8.85	6217.800	8.25

Table B.2 (Cont'd)

Historical Monthly Pumping
Megalitres

Year	October	% of Annual Pumpage	November	% of Annual Pumpage	December	% of Annual Pumpage
1955	4371.961	8.44	4114.735	7.95	4176.565	8.07
1956	4562.802	8.67	4160.795	7.91	4366.106	8.30
1957	4311.295	8.36	3981.628	7.72	4265.498	8.28
1958	4467.691	8.14	4242.295	7.73	4364.183	7.95
1959	4652.463	8.41	4372.861	7.90	4385.053	7.93
1960	5189.359	8.92	4619.045	7.94	4408.220	7.58
1961	5322.289	7.79	4970.175	7.28	4574.390	6.70
1962	5002.800	8.62	4432.886	7.64	4546.000	7.83
1963	5426.051	8.76	4750.706	7.67	4805.736	7.76
1964	5250.948	8.27	4954.381	7.81	4993.340	7.87
1965	5266.677	8.01	5286.552	8.04	5343.982	8.12
1966	5414.768	7.97	5222.336	7.69	5415.813	7.97
1967	5637.463	8.14	5368.049	7.75	5354.720	7.73
1968	5790.345	8.62	5493.755	8.18	5511.939	8.20
1969	5873.796	8.46	5191.591	7.48	5920.751	8.52
1970	5873.996	7.90	6032.597	8.11	5987.264	8.05
1971	5959.755	7.83	6245.863	8.20	6074.929	7.98
1972	6890.163	8.25	6079.502	7.28	6006.080	7.19
1973	7031.989	8.12	6533.779	7.55	6555.859	7.57
1974	7142.398	7.92	6912.443	7.66	6920.153	7.67
1975	7249.497	8.04	7271.282	8.06	6999.108	7.76
1976	8336.400	8.70	7365.111	7.68	7081.272	7.39
1977	7350.805	8.29	6827.801	7.70	6645.679	7.49
1978	8150.342	8.82	7280.192	7.88	6785.451	7.34
1979	7333.271	7.72	6900.569	7.27	7005.777	7.38
1980	7504.008	7.78	7158.034	7.42	7343.579	7.61
1981	7028.883	7.85	6867.763	7.67	6774.964	7.56
1982	7654.160	8.32	6740.980	7.33	7191.900	7.82
1983	7641.782	7.92	7528.637	7.80	7221.573	7.48
1984	8094.763	8.42	7571.862	7.88	7464.409	7.76
1985	7698.645	7.90	7884.491	8.09	7117.900	7.31
1986	7915.400	8.06	7622.700	7.76	7602.400	7.74
1987	7481.700	7.47	8125.300	8.11	7572.400	7.56
1988	8783.590	7.99	8035.940	7.31	8147.860	7.41
1989	8982.520	8.26	8195.410	7.54	8341.710	7.68
1990	8743.490	8.00	8262.970	7.56	8027.750	7.34
1991	8208.370	7.92	7626.060	7.35	7777.850	7.50
1992	7718.850	8.19	7083.760	7.52	7026.160	7.45
1993	7740.260	8.61	6969.740	7.75	7058.300	7.85
1994	7504.800	8.40	6985.500	7.82	6970.300	7.80
1995	7605.100	7.98	7176.000	7.53	7299.200	7.66
1996	7674.900	8.22	7188.400	7.70	7347.200	7.87
1997	7024.400	7.78	7013.100	7.77	7135.100	7.90
1998	7326.100	8.02	7081.600	7.76	7053.000	7.72
1999	7280.500	8.23	6837.600	7.73	6782.900	7.67
2000	6666.900	8.09	6276.000	7.62	6401.500	7.77
2001	6679.600	8.37	6301.900	7.90	6440.700	8.07
2002	6706.300	8.22	6398.300	7.84	6505.000	7.94
2003	6962.300	8.29	6436.300	7.61	6635.600	7.85
2004	6805.200	8.40	6407.500	7.91	6594.700	8.14
2005	6662.300	8.31	6261.300	7.81	6521.800	8.14
2006	6694.800	8.08	6106.700	7.37	6437.600	7.77
2007	6510.500	8.18	6144.200	7.72	6300.100	7.91
2008	6487.400	8.26	6194.500	7.88	6327.900	8.05
2009	6378.500	8.25	6071.050	7.85	6215.100	8.04
2010	6309.100	8.41	5911.400	7.88	6063.600	8.08

Appendix C

Table C.1

Weekly Shoal Lake Water Elevations 2010

Date	Feet	Metres	Date	Feet	Metres
January 7, 2010	1058.70	322.7	July 1, 2010	1059.28	322.9
January 14, 2010	1058.66	322.7	July 8, 2010	1059.51	322.9
January 21, 2010	1058.63	322.7	July 15, 2010	1059.57	323.0
January 28, 2010	1058.66	322.7	July 22, 2010	1059.68	323.0
			July 29, 2010	1059.91	323.1
February 4, 2010	1058.62	322.7	August 5, 2010	1059.93	323.1
February 11, 2010	1058.57	322.7	August 12, 2010	1059.98	323.1
February 18, 2010	1058.49	322.6	August 19, 2010	1059.80	323.0
February 25, 2010	1058.44	322.6	August 26, 2010	1059.68	323.0
March 4, 2010	1058.38	322.6	September 2, 2010	1059.62	323.0
March 11, 2010	1058.34	322.6	September 9, 2010	1059.46	322.9
March 18, 2010	1058.32	322.6	September 16, 2010	1059.46	322.9
March 25, 2010	1058.29	322.6	September 23, 2010	1059.33	322.9
			September 30, 2010	1059.50	322.9
April 1, 2010	1058.24	322.6	October 7, 2010	1059.52	322.9
April 8, 2010	1058.24	322.6	October 14, 2010	1059.48	322.9
April 15, 2010	1058.20	322.5	October 21, 2010	1059.50	322.9
April 22, 2010	1058.12	322.5	October 28, 2010	1059.48	322.9
April 29, 2010	1058.11	322.5			
May 6, 2010	1058.15	322.5	November 4, 2010	1059.48	322.9
May 13, 2010	1058.15	322.5	November 11, 2010	1059.44	322.9
May 20, 2010	1058.24	322.6	November 18, 2010	1059.38	322.9
May 27, 2010	1058.32	322.6	November 25, 2010	1059.36	322.9
June 3, 2010	1058.50	322.6	December 2, 2010	1059.28	322.9
June 10, 2010	1058.78	322.7	December 9, 2010	1059.26	322.9
June 17, 2010	1058.96	322.8	December 16, 2010	1059.20	322.8
June 24, 2010	1059.10	322.8	December 23, 2010	1059.16	322.8
			December 30, 2010	1059.12	322.8

Table C.2 2010 Water Pumpage Summary Report

Consumption in Millions of Litres

City of Winnipeg - Water and Waste Department

Date	MacLean	Hurst	McPhillips	Total	Cumulative Pumpage	Daily Load Factor	Monthly Total	Month Load Factor	31 Day Total	31 Day Load Factor	7 Day Total	7 Day Load Factor
January 1, 2010	57.4	79.7	46	183.1	183.1	0.89						
January 2, 2010	58.3	80.9	50.6	189.8	372.9	0.92						
January 3, 2010	62.1	82.6	55	199.7	572.6	0.97						
January 4, 2010	61.1	90.1	52.4	203.6	776.2	0.99						
January 5, 2010	60.1	90.3	51.3	201.7	977.9	0.98						
January 6, 2010	60.2	93.4	48.8	202.4	1180.3	0.98						
January 7, 2010	61.3	90.4	50.7	202.4	1382.7	0.98					1382.7	0.96
January 8, 2010	60	91.8	47.7	199.5	1582.2	0.97					1399.1	0.97
January 9, 2010	61.5	94.3	42.2	198	1780.2	0.96					1407.3	0.98
January 10, 2010	62	95.7	45.1	202.8	1983.0	0.99					1410.4	0.98
January 11, 2010	60.4	94.9	47.2	202.5	2185.5	0.98					1409.3	0.98
January 12, 2010	60.0	94.6	45.7	200.3	2385.8	0.97					1407.9	0.98
January 13, 2010	59.4	88.8	54.2	202.4	2588.2	0.98					1407.9	0.98
January 14, 2010	61.0	90.1	52.3	203.4	2791.6	0.99					1408.9	0.98
January 15, 2010	58.3	91.4	49.4	199.1	2990.7	0.97					1408.5	0.98
January 16, 2010	58.8	92.6	48.6	200	3190.7	0.97					1410.5	0.98
January 17, 2010	61.9	92.7	48.4	203	3393.7	0.99					1410.7	0.98
January 18, 2010	60.9	94.3	48.1	203.3	3597.0	0.99					1411.5	0.98
January 19, 2010	60.5	93.8	47.7	202.0	3799.0	0.98					1413.2	0.98
January 20, 2010	60.9	96.6	44.9	202.4	4001.4	0.98					1413.2	0.98
January 21, 2010	61.2	89.5	48.4	199.1	4200.5	0.97					1408.9	0.98
January 22, 2010	58.7	93.8	44.2	196.7	4397.2	0.96					1406.5	0.98
January 23, 2010	59.6	94.0	40.5	194.1	4591.3	0.94					1400.6	0.97
January 24, 2010	62.1	95.2	43.3	200.6	4791.9	0.98					1398.2	0.97
January 25, 2010	58.5	86.8	52.5	197.8	4989.7	0.96					1392.7	0.97
January 26, 2010	56.6	77.3	61.7	195.6	5185.3	0.95					1386.3	0.96
January 27, 2010	61.4	97.9	36.8	196.1	5381.4	0.95					1380.0	0.96
January 28, 2010	60.0	92.4	45.2	197.6	5579.0	0.96					1378.5	0.96
January 29, 2010	59.4	91.5	59.4	210.3	5789.3	1.02					1392.1	0.97
January 30, 2010	60.4	92.5	43.4	196.3	5985.6	0.95					1394.3	0.97
January 31, 2010	61.6	94.4	43.7	199.7	6185.3	0.97	6185.3	0.97	6185.30	0.97	1393.4	0.97
February 1, 2010	60.4	94.2	43.9	198.5	6383.8	0.97			6200.70	0.97	1394.1	0.97
February 2, 2010	59.1	91.7	45.6	196.4	6580.2	0.96			6207.30	0.97	1394.9	0.97
February 3, 2010	59.7	94.2	45.2	199.1	6779.3	0.97			6206.70	0.97	1397.9	0.97
February 4, 2010	59.5	93.5	44.7	197.7	6977.0	0.96			6200.80	0.97	1398.0	0.97
February 5, 2010	59.2	91.0	45.1	195.3	7172.3	0.95			6194.40	0.97	1383.0	0.96
February 6, 2010	60.9	93.6	39.7	194.2	7366.5	0.94			6186.20	0.97	1380.9	0.96
February 7, 2010	60.0	93.2	44.7	197.8	7564.3	0.96			6181.60	0.97	1379.0	0.96
February 8, 2010	59.2	93.6	45.4	198.2	7762.5	0.96			6180.30	0.97	1378.7	0.96
February 9, 2010	59.1	94.3	44.2	197.6	7960.1	0.96			6179.90	0.97	1379.9	0.96
February 10, 2010	59.4	94.6	44.9	198.9	8159.0	0.97			6176.00	0.97	1379.7	0.96
February 11, 2010	59.6	94.3	46.6	200.5	8359.5	0.98			6174.00	0.97	1382.5	0.96
February 12, 2010	58.9	93.3	43.1	195.3	8554.8	0.95			6169.00	0.97	1382.5	0.96
February 13, 2010	61.1	92.9	40.7	194.7	8749.5	0.95			6161.30	0.97	1383.0	0.96
February 14, 2010	50.4	96.9	39.7	186.9	8936.4	0.91			6144.80	0.96	1372.1	0.95
February 15, 2010	59.2	86.8	44.9	190.8	9127.2	0.93			6136.50	0.96	1364.7	0.95
February 16, 2010	61.8	95.6	39.2	196.5	9323.7	0.96			6133.00	0.96	1363.6	0.95
February 17, 2010	61.2	91.7	45.4	198.3	9522.0	0.96			6128.30	0.96	1363.0	0.95
February 18, 2010	59.4	93.0	46.0	198.4	9720.4	0.96			6123.40	0.96	1360.9	0.95
February 19, 2010	59.1	92.7	42.4	194.2	9914.6	0.94			6115.60	0.96	1359.8	0.94

Table C.2 2010 Water Pumpage Summary Report

Consumption in Millions of Litres

City of Winnipeg - Water and Waste Department

Date	MacLean	Hurst	McPhillips	Total	Cumulative Pumpage	Daily Load Factor	Monthly Total	Month Load Factor	31 Day Total	31 Day Load Factor	7 Day Total	7 Day Load Factor
February 20, 2010	60.7	89.3	45.1	195.1	10109.7	0.95			6108.30	0.96	1360.2	0.95
February 21, 2010	60.8	94.1	44.2	199.1	10308.8	0.97			6108.30	0.96	1372.4	0.95
February 22, 2010	62.1	96.5	41.1	199.6	10508.4	0.97			6111.20	0.96	1381.2	0.96
February 23, 2010	59.2	91.8	46.3	197.4	10705.8	0.96			6114.50	0.96	1382.1	0.96
February 24, 2010	59.8	93.6	43.0	196.4	10902.2	0.96			6110.30	0.96	1380.2	0.96
February 25, 2010	59.0	92.3	45.0	196.3	11098.5	0.95			6108.80	0.96	1378.1	0.96
February 26, 2010	58.8	92.1	45.1	196.0	11294.5	0.95			6109.20	0.96	1379.9	0.96
February 27, 2010	60.1	93.2	42.2	195.5	11490.0	0.95			6108.60	0.96	1380.3	0.96
February 28, 2010	60.5	94.0	44.6	199.1	11689.1	0.97	5503.8	0.96	6110.10	0.96	1380.3	0.96
March 1, 2010	57.6	94.9	46.9	199.3	11888.4	0.97			6099.10	0.96	1380.0	0.96
March 2, 2010	58.1	93.1	46.7	197.8	12086.2	0.96			6100.60	0.96	1380.4	0.96
March 3, 2010	60.3	82.0	57.2	199.5	12285.7	0.97			6100.40	0.96	1383.5	0.96
March 4, 2010	57.2	83.1	55.2	195.4	12481.1	0.95			6097.30	0.96	1382.6	0.96
March 5, 2010	60.4	84.3	53.6	198.3	12679.4	0.96			6099.20	0.96	1384.9	0.96
March 6, 2010	60.1	94.0	42.2	196.3	12875.7	0.95			6096.40	0.96	1385.7	0.96
March 7, 2010	60.7	94.8	44.4	199.9	13075.6	0.97			6098.60	0.96	1386.5	0.96
March 8, 2010	61.7	93.8	49.0	204.5	13280.1	0.99			6107.80	0.96	1391.7	0.97
March 9, 2010	59.9	67.2	74.5	201.6	13481.7	0.98			6115.20	0.96	1395.5	0.97
March 10, 2010	59.0	71.0	71.1	201.1	13682.8	0.98			6118.50	0.96	1397.1	0.97
March 11, 2010	61.1	83.3	55.1	199.5	13882.3	0.97			6119.80	0.96	1401.2	0.97
March 12, 2010	60.2	74.3	62.0	196.5	14078.8	0.96			6118.70	0.96	1399.4	0.97
March 13, 2010	62.5	89.0	50.0	201.5	14280.3	0.98			6121.30	0.96	1404.6	0.98
March 14, 2010	59.8	92.8	43.4	196.0	14476.3	0.95			6116.80	0.96	1400.7	0.97
March 15, 2010	60.8	84.2	60.3	205.3	14681.6	1.00			6126.80	0.96	1401.5	0.97
March 16, 2010	60.0	83.1	59.5	202.6	14884.2	0.99			6134.70	0.96	1402.5	0.97
March 17, 2010	60.5	95.8	47.7	204.0	15088.2	0.99			6151.80	0.97	1405.4	0.98
March 18, 2010	60.7	94.4	46.0	201.1	15289.3	0.98			6162.10	0.97	1407.0	0.98
March 19, 2010	61.9	95.4	42.1	199.4	15488.7	0.97			6165.00	0.97	1409.9	0.98
March 20, 2010	61.6	94.5	42.2	198.3	15687.0	0.96			6165.00	0.97	1406.7	0.98
March 21, 2010	61.7	94.2	46.1	202.0	15889.0	0.98			6168.60	0.97	1412.7	0.98
March 22, 2010	59.7	93.5	47.1	200.3	16089.3	0.97			6174.70	0.97	1407.7	0.98
March 23, 2010	59.6	94.3	46.4	200.3	16289.6	0.97			6179.90	0.97	1405.4	0.98
March 24, 2010	59.6	93.2	46.6	199.4	16489.0	0.97			6180.20	0.97	1400.8	0.97
March 25, 2010	59.1	92.1	46.8	198.0	16687.0	0.96			6178.60	0.97	1397.7	0.97
March 26, 2010	60.5	92.1	45.2	197.2	16884.2	0.96			6178.40	0.97	1395.5	0.97
March 27, 2010	60.0	92.3	43.7	195.9	17080.1	0.95			6177.90	0.97	1393.1	0.97
March 28, 2010	59.2	92.1	44.0	195.3	17275.4	0.95			6176.90	0.97	1386.4	0.96
March 29, 2010	58.7	93.4	48.4	200.5	17475.9	0.98			6181.40	0.97	1386.6	0.96
March 30, 2010	55.3	93.1	48.4	197.1	17673.0	0.96			6183.00	0.97	1383.4	0.96
March 31, 2010	59.2	95.7	44.1	198.7	17871.7	0.97	6182.6	0.97	6182.60	0.97	1382.7	0.96
April 1, 2010	59.0	92.2	43.8	195.0	18066.7	0.95			6178.30	0.97	1379.7	0.96
April 2, 2010	58.9	83.0	44.7	186.6	18253.3	0.91			6167.10	0.97	1369.1	0.95
April 3, 2010	58.2	90.8	39.4	188.4	18441.7	0.92			6156.00	0.97	1361.6	0.95
April 4, 2010	59.3	94.0	39.7	193.0	18634.7	0.94			6153.60	0.97	1359.3	0.94
April 5, 2010	61.5	99.0	44.9	205.4	18840.1	1.00			6160.70	0.97	1364.2	0.95
April 6, 2010	59.3	94.3	46.5	200.1	19040.2	0.97			6164.50	0.97	1367.2	0.95
April 7, 2010	57.2	95.4	44.7	197.3	19237.5	0.96			6161.90	0.97	1365.8	0.95
April 8, 2010	61.4	82.9	57.9	201.9	19439.4	0.98			6159.30	0.97	1372.7	0.95
April 9, 2010	60.9	100.1	36.9	197.9	19637.3	0.96			6155.60	0.97	1384.0	0.96
April 10, 2010	62.0	94.2	43.0	198.9	19836.2	0.97			6153.40	0.97	1394.5	0.97

Table C.2 2010 Water Pumpage Summary Report

Consumption in Millions of Litres

City of Winnipeg - Water and Waste Department

Date	MacLean	Hurst	McPhillips	Total	Cumulative Pumpage	Daily Load Factor	Monthly Total	Month Load Factor	31 Day Total	31 Day Load Factor	7 Day Total	7 Day Load Factor
April 11, 2010	63.3	88.7	50.6	202.6	20038.8	0.99			6156.50	0.97	1404.1	0.98
April 12, 2010	62.3	94.3	47.4	203.9	20242.7	0.99			6163.90	0.97	1402.6	0.97
April 13, 2010	61.0	95.3	46.9	203.3	20446.0	0.99			6165.70	0.97	1405.8	0.98
April 14, 2010	62.0	101.1	44.7	207.7	20653.7	1.01			6177.40	0.97	1416.2	0.98
April 15, 2010	61.7	108.4	36.0	206.1	20859.8	1.00			6178.20	0.97	1420.4	0.99
April 16, 2010	60.9	96.6	46.8	204.3	21064.1	0.99			6179.90	0.97	1426.8	0.99
April 17, 2010	63.0	98.3	45.6	206.9	21271.0	1.01			6182.80	0.97	1434.8	1.00
April 18, 2010	65.6	105.1	44.8	215.5	21486.5	1.05			6197.20	0.97	1447.7	1.01
April 19, 2010	66.5	106.8	46.3	219.6	21706.1	1.07			6217.40	0.98	1463.4	1.02
April 20, 2010	63.1	101.8	48.2	213.1	21919.2	1.04			6232.20	0.98	1473.2	1.02
April 21, 2010	64.5	100.3	49.7	214.5	22133.7	1.04			6244.70	0.98	1480.0	1.03
April 22, 2010	59.8	96.3	62.1	218.2	22351.9	1.06			6262.60	0.98	1492.1	1.04
April 23, 2010	66.2	100.8	52.8	219.8	22571.7	1.07			6282.10	0.99	1507.6	1.05
April 24, 2010	64.9	98.8	47.9	211.1	22782.8	1.03			6293.80	0.99	1511.8	1.05
April 25, 2010	67.1	100.4	51.5	218.9	23001.7	1.06			6314.70	0.99	1515.2	1.05
April 26, 2010	64.9	99.7	54.7	219.3	23221.0	1.07			6336.80	0.99	1514.9	1.05
April 27, 2010	64.6	85.7	68.9	219.2	23440.2	1.07			6360.10	1.00	1521.0	1.06
April 28, 2010	62.6	98.1	50.9	211.6	23651.8	1.03			6376.40	1.00	1518.1	1.05
April 29, 2010	53.3	94.3	53.9	201.5	23853.3	0.98			6377.40	1.00	1501.4	1.04
April 30, 2010	61.8	87.4	48.0	197.1	24050.4	0.96	6178.7	1.00	6377.40	1.00	1478.7	1.03
May 1, 2010	60.4	94.9	42.4	197.6	24248.0	0.96			6376.30	1.00	1465.2	1.02
May 2, 2010	61.5	95.9	44.2	201.6	24449.6	0.98			6382.90	1.00	1447.9	1.01
May 3, 2010	60.6	93.8	49.2	203.4	24653.0	0.99			6399.70	1.00	1432.0	0.99
May 4, 2010	59.7	91.3	50.4	201.4	24854.4	0.98			6412.70	1.01	1414.2	0.98
May 5, 2010	59.9	93.4	48.7	202.0	25056.4	0.98			6421.70	1.01	1404.6	0.98
May 6, 2010	60.6	87.7	55.2	203.5	25259.9	0.99			6419.80	1.01	1406.6	0.98
May 7, 2010	54.3	104.0	41.4	199.7	25459.6	0.97			6419.40	1.01	1409.2	0.98
May 8, 2010	61.8	93.2	44.3	199.3	25658.9	0.97			6421.40	1.01	1410.9	0.98
May 9, 2010	59.6	93.3	47.8	200.7	25859.6	0.98			6420.20	1.01	1410.0	0.98
May 10, 2010	60.0	94.8	48.4	203.2	26062.8	0.99			6425.50	1.01	1409.8	0.98
May 11, 2010	59.8	94.0	49.6	203.4	26266.2	0.99			6430.00	1.01	1411.8	0.98
May 12, 2010	61.2	96.3	50.1	207.6	26473.8	1.01			6435.00	1.01	1417.4	0.98
May 13, 2010	61.2	95.4	50.5	207.1	26680.9	1.01			6438.20	1.01	1421.0	0.99
May 14, 2010	63.0	98.7	52.5	214.2	26895.1	1.04			6449.10	1.01	1435.5	1.00
May 15, 2010	66.3	101.1	52.3	219.7	27114.8	1.07			6461.10	1.01	1455.9	1.01
May 16, 2010	69.5	100.9	55.6	226.0	27340.8	1.10			6481.00	1.02	1481.2	1.03
May 17, 2010	68.7	104.5	63.0	236.2	27577.0	1.15			6512.90	1.02	1514.2	1.05
May 18, 2010	72.3	93.6	74.9	240.8	27817.8	1.17			6546.80	1.03	1551.6	1.08
May 19, 2010	72.0	109.1	66.2	247.3	28065.1	1.20			6578.60	1.03	1591.3	1.11
May 20, 2010	72.1	108.1	65.0	245.2	28310.3	1.19			6604.20	1.04	1629.4	1.13
May 21, 2010	66.3	101.8	53.3	221.4	28531.7	1.08			6612.50	1.04	1636.6	1.14
May 22, 2010	60.3	91.8	44.6	196.7	28728.4	0.96			6594.70	1.03	1613.6	1.12
May 23, 2010	58.7	90.6	44.5	193.8	28922.2	0.94			6570.30	1.03	1581.4	1.10
May 24, 2010	62.6	91.4	52.5	206.6	29128.8	1.00			6557.10	1.03	1551.8	1.08
May 25, 2010	65.7	94.5	53.1	213.3	29342.1	1.04			6559.30	1.03	1524.3	1.06
May 26, 2010	70.3	93.2	52.5	216.0	29558.1	1.05			6556.40	1.03	1493.0	1.04
May 27, 2010	68.7	90.9	50.6	210.2	29768.3	1.02			6547.30	1.03	1458.0	1.01
May 28, 2010	64.7	84.1	52.6	201.4	29969.7	0.98			6529.50	1.02	1438.0	1.00
May 29, 2010	65.3	79.3	48.4	193.0	30162.7	0.94			6510.90	1.02	1434.3	1.00
May 30, 2010	69.8	87.0	50.5	207.3	30370.0	1.01			6516.70	1.02	1447.8	1.01

Table C.2 2010 Water Pumpage Summary Report

Consumption in Millions of Litres

City of Winnipeg - Water and Waste Department

Date	MacLean	Hurst	McPhillips	Total	Cumulative Pumpage	Daily Load Factor	Monthly Total	Month Load Factor	31 Day Total	31 Day Load Factor	7 Day Total	7 Day Load Factor
May 31, 2010	69.1	89.7	50.9	209.7	30579.7	1.02	6529.3	1.02	6529.30	1.02	1450.9	1.01
June 1, 2010	67.8	90.8	51.2	209.7	30789.4	1.02			6541.40	1.03	1447.3	1.01
June 2, 2010	70.1	87.6	56.4	214.1	31003.5	1.04			6553.90	1.03	1445.4	1.00
June 3, 2010	69.1	92.1	53.0	214.2	31217.7	1.04			6564.70	1.03	1449.4	1.01
June 4, 2010	66.1	84.1	54.7	204.8	31422.5	1.00			6568.10	1.03	1452.8	1.01
June 5, 2010	66.4	86.2	45.8	198.4	31620.9	0.96			6564.50	1.03	1458.2	1.01
June 6, 2010	71.8	86.2	53.3	211.3	31832.2	1.03			6572.30	1.03	1462.2	1.02
June 7, 2010	68.3	89.8	63.4	221.5	32053.7	1.08			6594.10	1.03	1474.0	1.02
June 8, 2010	61.9	95.1	52.5	209.5	32263.2	1.02			6604.30	1.04	1473.8	1.02
June 9, 2010	63.4	100.0	44.0	207.4	32470.6	1.01			6611.00	1.04	1467.1	1.02
June 10, 2010	62.2	95.3	50.0	207.5	32678.1	1.01			6615.30	1.04	1460.4	1.01
June 11, 2010	60.4	91.8	51.3	203.5	32881.6	0.99			6615.40	1.04	1459.1	1.01
June 12, 2010	59.2	95.9	41.6	196.7	33078.3	0.96			6604.50	1.04	1457.4	1.01
June 13, 2010	63.4	98.9	48.3	210.6	33288.9	1.02			6608.00	1.04	1456.7	1.01
June 14, 2010	64.8	94.4	61.6	220.8	33509.7	1.07			6614.60	1.04	1456.0	1.01
June 15, 2010	64.3	100.3	55.5	220.1	33729.8	1.07			6615.00	1.04	1466.6	1.02
June 16, 2010	66.1	97.2	65.9	229.2	33959.0	1.11			6618.20	1.04	1488.4	1.03
June 17, 2010	63.2	96.5	54.2	213.9	34172.9	1.04			6595.90	1.03	1494.8	1.04
June 18, 2010	60.6	79.9	64.9	205.4	34378.3	1.00			6560.50	1.03	1496.7	1.04
June 19, 2010	78.7	62	65.0	205.7	34584.0	1.00			6518.90	1.02	1505.7	1.05
June 20, 2010	65.9	83.5	64.9	214.3	34798.3	1.04			6488.00	1.02	1509.4	1.05
June 21, 2010	69.2	79.3	75.5	219.1	35017.4	1.07			6485.70	1.02	1507.7	1.05
June 22, 2010	63.7	79.2	77.0	219.9	35237.3	1.07			6508.90	1.02	1507.5	1.05
June 23, 2010	65.5	103.6	55.7	224.9	35462.2	1.09			6540.00	1.03	1503.2	1.04
June 24, 2010	66.4	73.0	81.7	221.1	35683.3	1.08			6554.50	1.03	1510.4	1.05
June 25, 2010	64.8	77.8	79.6	222.2	35905.5	1.08			6563.40	1.03	1527.2	1.06
June 26, 2010	63.6	91.8	52.4	207.8	36113.3	1.01			6555.20	1.03	1529.3	1.06
June 27, 2010	63.3	95.5	46.4	205.2	36318.5	1.00			6550.20	1.03	1520.2	1.06
June 28, 2010	65.3	98.2	56.5	220.0	36538.5	1.07			6568.80	1.03	1521.1	1.06
June 29, 2010	65.0	98.3	56.6	219.9	36758.4	1.07			6595.70	1.03	1521.1	1.06
June 30, 2010	64.9	98.3	54.6	217.8	36976.2	1.06	6396.5	1.04	6606.20	1.04	1514.0	1.05
July 1, 2010	66.3	98.2	53.0	217.5	37193.7	1.06			6614.00	1.04	1510.4	1.05
July 2, 2010	66.5	97.8	59.4	223.7	37417.4	1.09			6628.00	1.04	1511.9	1.05
July 3, 2010	61.2	91.0	47.4	199.6	37617.0	0.97			6613.50	1.04	1503.7	1.04
July 4, 2010	64.5	95.8	52.0	212.4	37829.4	1.03			6611.70	1.04	1510.9	1.05
July 5, 2010	67.3	98.1	61.0	226.4	38055.8	1.10			6633.30	1.04	1517.3	1.05
July 6, 2010	65.6	96.7	58.6	220.9	38276.7	1.07			6655.80	1.04	1518.3	1.05
July 7, 2010	55.3	99.4	71.0	225.7	38502.4	1.10			6670.20	1.05	1526.2	1.06
July 8, 2010	66.5	101.5	61.3	229.3	38731.7	1.12			6678.00	1.05	1538.0	1.07
July 9, 2010	67.9	102.9	63.6	234.4	38966.1	1.14			6702.90	1.05	1548.7	1.08
July 10, 2010	63.3	99.2	51.1	213.6	39179.7	1.04			6709.10	1.05	1562.7	1.09
July 11, 2010	64.9	98.6	56.8	220.3	39400.0	1.07			6721.90	1.05	1570.6	1.09
July 12, 2010	68.6	74.5	97.1	240.1	39640.1	1.17			6758.50	1.06	1584.3	1.10
July 13, 2010	63.4	83.1	75.7	222.2	39862.3	1.08			6784.00	1.06	1585.6	1.10
July 14, 2010	62.5	97.3	58.7	230.0	40092.3	1.12			6803.40	1.07	1589.9	1.10
July 15, 2010	62.3	98.8	62.5	233.6	40325.9	1.14			6816.20	1.07	1594.2	1.11
July 16, 2010	59.6	100.4	61.2	221.2	40547.1	1.08			6817.30	1.07	1581.0	1.10
July 17, 2010	55.0	94.3	45.9	195.2	40742.3	0.95			6783.30	1.06	1562.6	1.09
July 18, 2010	57.9	99.9	52.8	210.6	40952.9	1.02			6780.00	1.06	1552.9	1.08
July 19, 2010	60.9	102.4	64.1	227.4	41180.3	1.11			6802.00	1.07	1540.2	1.07

Table C.2 2010 Water Pumpage Summary Report

Consumption in Millions of Litres

City of Winnipeg - Water and Waste Department

Date	MacLean	Hurst	McPhillips	Total	Cumulative Pumpage	Daily Load Factor	Monthly Total	Month Load Factor	31 Day Total	31 Day Load Factor	7 Day Total	7 Day Load Factor
July 20, 2010	61.0	103.1	64.4	228.6	41408.9	1.11			6824.90	1.07	1546.6	1.07
July 21, 2010	62.6	104.7	67.4	234.7	41643.6	1.14			6845.30	1.07	1551.3	1.08
July 22, 2010	60.2	100.5	61.3	221.9	41865.5	1.08			6848.10	1.07	1539.6	1.07
July 23, 2010	59.3	100.4	62.2	221.9	42087.4	1.08			6850.10	1.07	1540.3	1.07
July 24, 2010	58.2	98.3	54.7	211.2	42298.6	1.03			6836.40	1.07	1556.3	1.08
July 25, 2010	59.5	101.2	58.5	219.1	42517.7	1.07			6834.43	1.07	1564.8	1.09
July 26, 2010	64.7	107.1	70.3	242.1	42759.9	1.18			6854.35	1.08	1579.6	1.10
July 27, 2010	62.0	105.6	56.6	224.2	42984.1	1.09			6870.75	1.08	1575.2	1.09
July 28, 2010	62.4	103.6	62.6	228.6	43212.7	1.11			6894.15	1.08	1569.1	1.09
July 29, 2010	60.5	103.4	61.5	225.5	43438.2	1.10			6899.65	1.08	1572.7	1.09
July 30, 2010	59.7	94.2	66.2	220.0	43658.2	1.07			6899.75	1.08	1570.8	1.09
July 31, 2010	57.9	96.8	54.9	209.0	43867.2	1.02	6891.0	1.08	6890.95	1.08	1568.6	1.09
August 1, 2010	51.2	72.0	61.5	184.6	44051.8	0.90			6858.05	1.08	1534.0	1.07
August 2, 2010	56.3	79.0	70.2	205.4	44257.2	1.00			6839.75	1.07	1497.3	1.04
August 3, 2010	59.9	100.2	60.0	220.1	44477.3	1.07			6860.25	1.08	1493.2	1.04
August 4, 2010	58.7	98.8	56.4	213.9	44691.2	1.04			6861.75	1.08	1478.5	1.03
August 5, 2010	59.1	94.4	60.6	214.2	44905.4	1.04			6849.55	1.07	1467.2	1.02
August 6, 2010	60.4	85.5	73.9	219.2	45124.6	1.07			6847.85	1.07	1466.4	1.02
August 7, 2010	58.3	83.9	64.3	206.5	45331.1	1.00			6828.65	1.07	1463.9	1.02
August 8, 2010	62.5	100.2	60.6	223.4	45554.5	1.09			6822.75	1.07	1502.7	1.04
August 9, 2010	66.8	108.2	69.1	244.0	45798.5	1.19			6832.35	1.07	1541.3	1.07
August 10, 2010	63.3	105.6	64.4	233.2	46031.7	1.13			6851.95	1.08	1554.4	1.08
August 11, 2010	63.6	104.9	64.4	232.9	46264.6	1.13			6864.55	1.08	1573.4	1.09
August 12, 2010	64.4	102.1	64.5	231.0	46495.6	1.12			6855.45	1.08	1590.2	1.10
August 13, 2010	58.3	81.7	73.3	213.3	46708.9	1.04			6846.55	1.07	1584.3	1.10
August 14, 2010	54.7	76.2	62.9	193.8	46902.7	0.94			6810.35	1.07	1571.6	1.09
August 15, 2010	55.6	80.5	59.6	195.7	47098.4	0.95			6772.45	1.06	1543.9	1.07
August 16, 2010	59.3	89.2	72.3	211.7	47310.1	1.03			6762.95	1.06	1511.6	1.05
August 17, 2010	59.4	79.8	69.2	208.4	47518.5	1.01			6776.15	1.06	1486.8	1.03
August 18, 2010	59.7	82.6	73.4	215.7	47734.2	1.05			6781.25	1.06	1469.6	1.02
August 19, 2010	60.0	103.1	53.6	216.7	47950.9	1.05			6770.55	1.06	1455.3	1.01
August 20, 2010	59.6	98.6	61.2	219.3	48170.2	1.07			6761.25	1.06	1461.3	1.02
August 21, 2010	57.8	91.9	53.6	203.3	48373.5	0.99			6729.85	1.06	1470.8	1.02
August 22, 2010	59.6	92.1	61.3	213.0	48586.5	1.04			6720.95	1.05	1488.1	1.03
August 23, 2010	62.4	102.5	62.2	227.1	48813.6	1.10			6726.15	1.06	1503.5	1.04
August 24, 2010	58.4	98.0	55.2	211.7	49025.3	1.03			6726.65	1.06	1506.8	1.05
August 25, 2010	61.4	103.8	61.6	226.8	49252.1	1.10			6734.32	1.06	1517.9	1.05
August 26, 2010	62.4	106.5	61.8	230.7	49482.8	1.12			6722.90	1.05	1531.9	1.06
August 27, 2010	62.7	108.4	61.1	232.2	49715.0	1.13			6730.90	1.06	1544.8	1.07
August 28, 2010	54.0	92.3	48.8	195.1	49910.1	0.95			6697.40	1.05	1536.6	1.07
August 29, 2010	58.8	94.9	50.3	203.9	50114.0	0.99			6675.80	1.05	1527.5	1.06
August 30, 2010	59.2	92.7	57.9	209.7	50323.7	1.02			6665.50	1.05	1510.1	1.05
August 31, 2010	56.7	101.9	49.8	208.4	50532.1	1.01	6664.9	1.05	6664.90	1.05	1506.8	1.05
September 1, 2010	60.2	101.0	49.8	211.0	50743.1	1.03			6691.30	1.05	1491.0	1.04
September 2, 2010	57.7	99.4	48.4	205.5	50948.6	1.00			6691.40	1.05	1465.8	1.02
September 3, 2010	58.0	94.3	52.1	205.4	51154.0	1.00			6676.70	1.05	1439.0	1.00
September 4, 2010	52.5	84.7	48.6	185.6	51339.6	0.90			6648.40	1.04	1429.5	0.99
September 5, 2010	49.3	86.1	43.5	178.9	51518.5	0.87			6613.10	1.04	1404.5	0.98
September 6, 2010	55.0	92.8	53.6	201.4	51719.9	0.98			6595.30	1.03	1396.2	0.97
September 7, 2010	60.3	98.2	54.5	213.0	51932.9	1.04			6601.80	1.04	1400.8	0.97

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Consumption in Millions of Litres

City of Winnipeg - Water and Waste Department

Date	MacLean	Hurst	McPhillips	Total	Cumulative Pumpage	Daily Load Factor	Monthly Total	Month Load Factor	31 Day Total	31 Day Load Factor	7 Day Total	7 Day Load Factor
September 8, 2010	61.7	102.9	50.7	215.3	52148.2	1.05			6593.70	1.03	1405.1	0.98
September 9, 2010	61.7	99.0	49.4	210.1	52358.3	1.02			6559.80	1.03	1409.7	0.98
September 10, 2010	57.3	96.8	47.7	201.9	52560.2	0.98			6528.50	1.02	1406.2	0.98
September 11, 2010	57.2	95.6	46.5	197.3	52757.5	0.96			6492.90	1.02	1417.9	0.99
September 12, 2010	57.0	96.0	51.0	204.0	52961.5	0.99			6465.90	1.01	1443.0	1.00
September 13, 2010	58.3	98.5	51.8	208.6	53170.1	1.01			6461.20	1.01	1450.2	1.01
September 14, 2010	58.2	97.3	50.3	205.8	53375.9	1.00			6473.20	1.02	1443.0	1.00
September 15, 2010	57.6	93.3	54.9	205.8	53581.7	1.00			6483.30	1.02	1433.5	1.00
September 16, 2010	56.7	92.1	56.8	205.6	53787.3	1.00			6477.20	1.02	1429.0	0.99
September 17, 2010	57.3	91.3	53.3	201.9	53989.2	0.98			6470.70	1.02	1429.0	0.99
September 18, 2010	57.2	93.0	46.0	196.3	54185.5	0.95			6451.30	1.01	1428.0	0.99
September 19, 2010	58.0	80.7	63.9	202.6	54388.1	0.99			6437.20	1.01	1426.6	0.99
September 20, 2010	57.2	95.7	53.5	206.4	54594.5	1.00			6424.30	1.01	1424.4	0.99
September 21, 2010	57.6	74.5	72.7	204.8	54799.3	1.00			6425.80	1.01	1423.4	0.99
September 22, 2010	57.5	98.4	52.0	207.9	55007.2	1.01			6420.70	1.01	1425.5	0.99
September 23, 2010	61.4	112.1	30.3	203.8	55211.0	0.99			6397.40	1.00	1423.7	0.99
September 24, 2010	63.2	118.4	28.7	210.3	55421.3	1.02			6396.00	1.00	1432.1	1.00
September 25, 2010	64.2	126.1	21.6	211.9	55633.2	1.03			6381.10	1.00	1447.7	1.01
September 26, 2010	67.8	130.2	21.2	219.3	55852.5	1.07			6369.70	1.00	1464.4	1.02
September 27, 2010	68.7	130.1	24.4	223.2	56075.7	1.09			6360.70	1.00	1481.2	1.03
September 28, 2010	67.8	128.8	23.2	219.8	56295.5	1.07			6385.40	1.00	1496.2	1.04
September 29, 2010	67.2	132.1	23.1	222.4	56517.9	1.08			6403.90	1.00	1510.7	1.05
September 30, 2010	71.0	145.5	14.6	231.1	56749.0	1.12	6216.9	1.01	6425.30	1.01	1538.0	1.07
October 1, 2010	69.5	143.2	10.4	223.2	56972.2	1.09			6440.10	1.01	1550.9	1.08
October 2, 2010	65.5	124.2	10.4	201.0	57173.2	0.98			6430.10	1.01	1540.0	1.07
October 3, 2010	67.1	118.1	23.9	209.1	57382.3	1.02			6433.70	1.01	1529.8	1.06
October 4, 2010	67.8	99.1	22.1	209.1	57591.4	1.02			6437.40	1.01	1515.7	1.05
October 5, 2010	62.9	130.5	32.6	226.0	57817.4	1.10			6477.80	1.02	1521.9	1.06
October 6, 2010	57.8	99.4	52.1	209.3	58026.7	1.02			6508.20	1.02	1508.8	1.05
October 7, 2010	57.6	97.1	55.3	210.1	58236.8	1.02			6516.90	1.02	1487.8	1.03
October 8, 2010	57.1	97.4	52.9	207.3	58444.1	1.01			6511.20	1.02	1471.9	1.02
October 9, 2010	53.6	92.4	53.4	199.4	58643.5	0.97			6495.30	1.02	1470.3	1.02
October 10, 2010	53.5	89.4	48.0	190.9	58834.4	0.93			6476.10	1.02	1452.1	1.01
October 11, 2010	57.7	94.1	52.7	204.5	59038.9	0.99			6478.70	1.02	1447.5	1.01
October 12, 2010	57.1	100.1	50.3	207.5	59246.4	1.01			6488.90	1.02	1429.0	0.99
October 13, 2010	57.1	98.0	52.0	207.1	59453.5	1.01			6492.00	1.02	1426.8	0.99
October 14, 2010	56.7	98.5	51.0	206.2	59659.7	1.00			6489.60	1.02	1422.9	0.99
October 15, 2010	55.5	97.4	49.8	202.7	59862.4	0.99			6486.50	1.02	1418.3	0.99
October 16, 2010	56.9	98.5	46.3	201.6	60064.0	0.98			6482.30	1.02	1420.5	0.99
October 17, 2010	57.8	101.6	44.3	203.6	60267.6	0.99			6480.30	1.02	1433.2	1.00
October 18, 2010	56.7	99.7	49.7	206.1	60473.7	1.00			6484.50	1.02	1434.8	1.00
October 19, 2010	56.3	100.1	49.8	206.7	60680.4	1.01			6494.90	1.02	1434.0	1.00
October 20, 2010	55.9	97.7	51.4	204.9	60885.3	1.00			6497.20	1.02	1431.8	0.99
October 21, 2010	55.7	97.4	50.3	203.4	61088.7	0.99			6494.20	1.02	1429.0	0.99
October 22, 2010	56.1	97.7	49.4	203.2	61291.9	0.99			6492.60	1.02	1429.5	0.99
October 23, 2010	56.1	95.0	48.4	199.4	61491.3	0.97			6484.10	1.02	1427.3	0.99
October 24, 2010	56.8	98.0	49.1	203.9	61695.2	0.99			6484.20	1.02	1427.6	0.99
October 25, 2010	55.4	94.5	51.6	201.6	61896.8	0.98			6475.50	1.02	1423.1	0.99
October 26, 2010	54.7	90.7	53.7	199.2	62096.0	0.97			6462.80	1.01	1415.6	0.98
October 27, 2010	57.2	78.2	62.0	197.3	62293.3	0.96			6440.80	1.01	1408.0	0.98

Table C.2 2010 Water Pumpage Summary Report

Consumption in Millions of Litres

City of Winnipeg - Water and Waste Department

Date	MacLean	Hurst	McPhillips	Total	Cumulative Pumpage	Daily Load Factor	Monthly Total	Month Load Factor	31 Day Total	31 Day Load Factor	7 Day Total	7 Day Load Factor
October 28, 2010	54.9	93.2	51.2	199.3	62492.6	0.97			6416.90	1.01	1403.9	0.98
October 29, 2010	54.3	93.0	48.8	196.1	62688.7	0.95			6393.20	1.00	1396.8	0.97
October 30, 2010	55.6	94.1	46.0	195.7	62884.4	0.95			6366.50	1.00	1393.1	0.97
October 31, 2010	55.5	94.4	45.1	199.0	63083.4	0.97	6334.4	0.99	6334.40	0.99	1388.2	0.96
November 1, 2010	56.2	94.0	51.7	201.9	63285.3	0.98			6313.10	0.99	1388.5	0.96
November 2, 2010	55.3	93.9	50.3	199.6	63484.9	0.97			6311.70	0.99	1388.9	0.97
November 3, 2010	55.5	94.0	51.0	200.5	63685.4	0.98			6303.10	0.99	1392.1	0.97
November 4, 2010	55.5	93.9	50.4	199.8	63885.2	0.97			6293.80	0.99	1392.6	0.97
November 5, 2010	55.2	79.8	63.7	198.7	64083.9	0.97			6266.50	0.98	1395.2	0.97
November 6, 2010	56.2	96.5	43.9	196.6	64280.5	0.96			6253.80	0.98	1396.1	0.97
November 7, 2010	58.7	98.2	49.4	206.3	64486.8	1.00			6250.03	0.98	1403.4	0.98
November 8, 2010	53.8	94.4	52.3	200.5	64687.3	0.98			6243.23	0.98	1402.0	0.97
November 9, 2010	54.8	91.7	52.4	199.0	64886.3	0.97			6242.83	0.98	1401.4	0.97
November 10, 2010	53.4	90.8	48.4	192.6	65078.9	0.94			6244.53	0.98	1393.5	0.97
November 11, 2010	54.7	91.2	45.7	191.6	65270.5	0.93			6231.63	0.98	1385.3	0.96
November 12, 2010	53.2	91.0	48.5	192.7	65463.2	0.94			6216.83	0.98	1379.3	0.96
November 13, 2010	53.9	91.9	43.4	189.2	65652.4	0.92			6198.93	0.97	1371.9	0.95
November 14, 2010	55.5	86.4	54.2	196.1	65848.5	0.95			6188.83	0.97	1361.7	0.95
November 15, 2010	54.8	90.0	55.2	200.0	66048.5	0.97			6186.13	0.97	1361.2	0.95
November 16, 2010	54.6	98.0	46.2	198.8	66247.3	0.97			6183.33	0.97	1361.0	0.95
November 17, 2010	54.5	86.7	57.3	198.5	66445.8	0.97			6178.25	0.97	1366.9	0.95
November 18, 2010	54.5	97.5	44.3	196.3	66642.1	0.95			6168.40	0.97	1371.6	0.95
November 19, 2010	53.2	93.2	44.8	191.1	66833.2	0.93			6152.80	0.97	1370.0	0.95
November 20, 2010	54.8	92.7	46.3	193.8	67027.0	0.94			6141.70	0.96	1374.6	0.96
November 21, 2010	55.1	87.2	53.7	196.0	67223.0	0.95			6134.30	0.96	1374.5	0.96
November 22, 2010	55.6	92.3	51.4	199.3	67422.3	0.97			6130.40	0.96	1373.8	0.95
November 23, 2010	55.9	93.9	49.5	199.3	67621.6	0.97			6130.30	0.96	1374.3	0.95
November 24, 2010	53.5	95.6	45.8	194.9	67816.5	0.95			6121.30	0.96	1370.7	0.95
November 25, 2010	56.0	76.2	62.3	194.5	68011.0	0.95			6114.20	0.96	1368.9	0.95
November 26, 2010	54.5	93.7	46.3	194.4	68205.4	0.95			6109.40	0.96	1372.2	0.95
November 27, 2010	54.9	95.9	43.5	194.4	68399.8	0.95			6106.50	0.96	1372.8	0.95
November 28, 2010	55.7	99.1	43.2	197.9	68597.7	0.96			6105.10	0.96	1374.7	0.96
November 29, 2010	54.9	91.8	52.0	198.7	68796.4	0.97			6107.70	0.96	1374.1	0.95
November 30, 2010	53.9	91.2	53.3	198.4	68994.8	0.96	5911.4	0.96	6110.40	0.96	1373.2	0.95
December 1, 2010	55.1	98.9	46.6	200.6	69195.4	0.98			6112.00	0.96	1378.9	0.96
December 2, 2010	55.4	95.2	51.0	201.6	69397.0	0.98			6111.70	0.96	1386.0	0.96
December 3, 2010	54.3	92.9	49.7	196.9	69593.9	0.96			6109.00	0.96	1388.5	0.96
December 4, 2010	55.6	93.8	45.7	195.1	69789.0	0.95			6103.60	0.96	1389.2	0.97
December 5, 2010	55.7	94.9	49.0	199.6	69988.6	0.97			6103.40	0.96	1390.9	0.97
December 6, 2010	54.6	94.8	52.6	202.0	70190.6	0.98			6106.70	0.96	1394.2	0.97
December 7, 2010	54.6	95.4	49.0	199.0	70389.6	0.97			6109.10	0.96	1394.8	0.97
December 8, 2010	55.6	99.2	45.0	199.8	70589.4	0.97			6102.57	0.96	1394.0	0.97
December 9, 2010	55.2	91.6	49.4	196.2	70785.6	0.95			6098.27	0.96	1388.6	0.96
December 10, 2010	54.7	92.1	49.1	195.9	70981.5	0.95			6095.17	0.96	1387.6	0.96
December 11, 2010	55.5	93.8	46.0	195.3	71176.8	0.95			6097.87	0.96	1387.8	0.96
December 12, 2010	56.9	93.8	47.2	197.9	71374.7	0.96			6104.17	0.96	1386.1	0.96
December 13, 2010	54.7	93.1	49.4	197.2	71571.9	0.96			6108.67	0.96	1381.3	0.96
December 14, 2010	54.0	89.8	53.7	197.5	71769.4	0.96			6116.97	0.96	1379.8	0.96
December 15, 2010	54.5	92.1	52.3	198.9	71968.3	0.97			6119.77	0.96	1378.9	0.96
December 16, 2010	58.2	92.5	49.8	200.5	72168.8	0.98			6120.27	0.96	1383.2	0.96

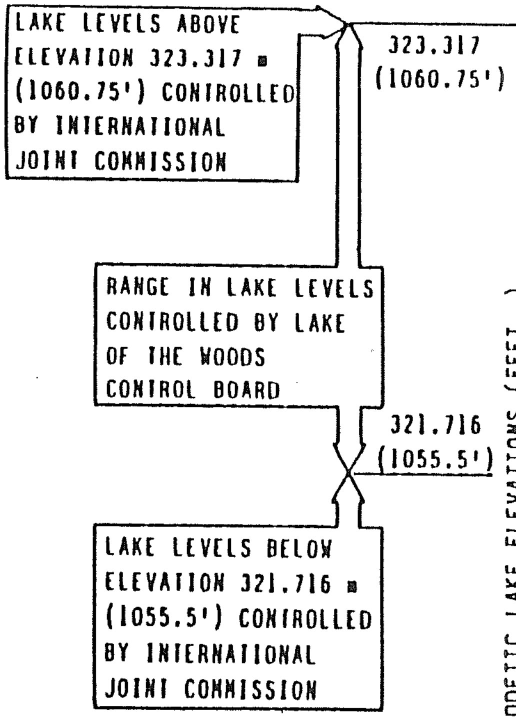
Table C.2 2010 Water Pumpage Summary Report

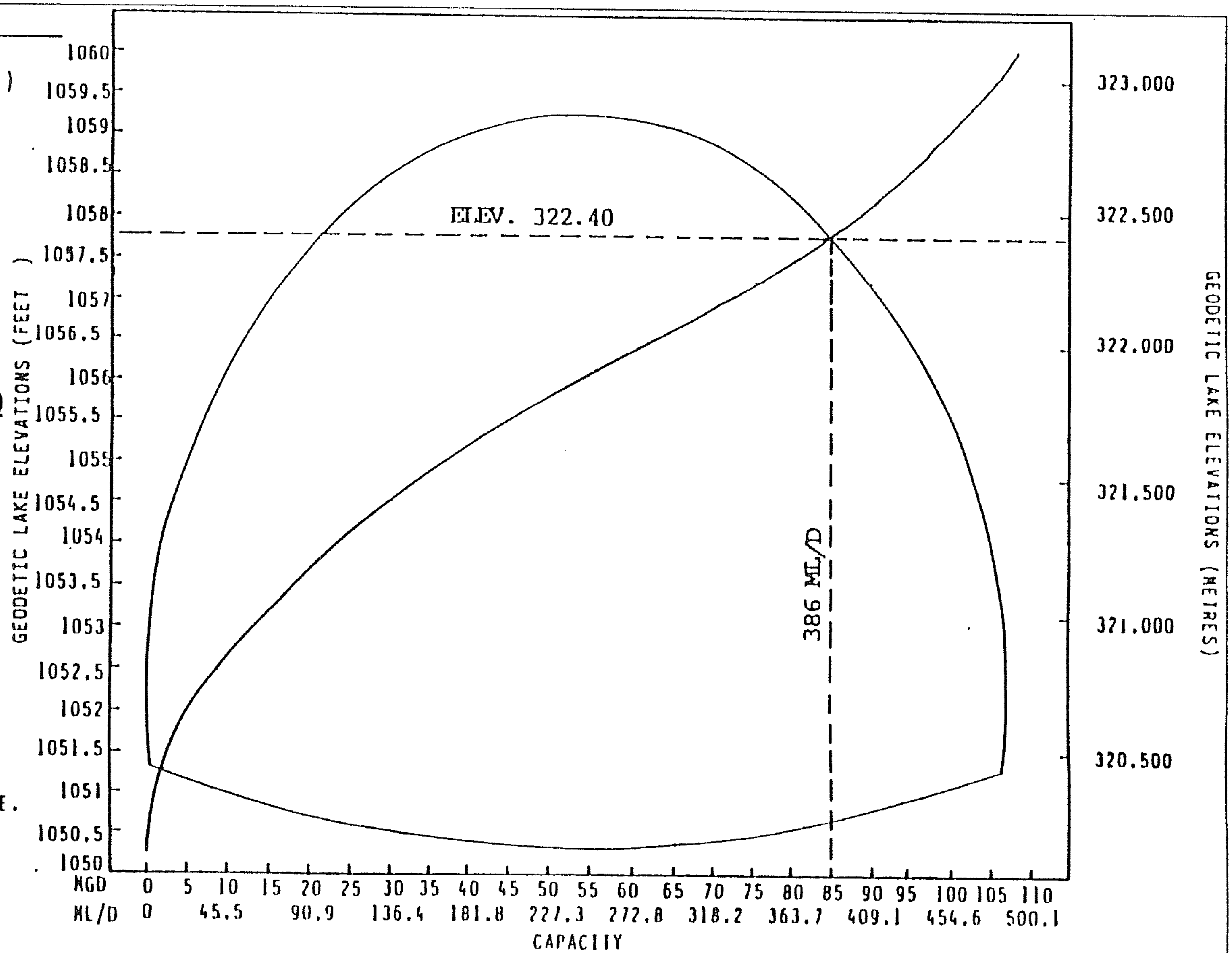
Consumption in Millions of Litres

City of Winnipeg - Water and Waste Department

Date	MacLean	Hurst	McPhillips	Total	Cumulative Pumpage	Daily Load Factor	Monthly Total	Month Load Factor	31 Day Total	31 Day Load Factor	7 Day Total	7 Day Load Factor
December 17, 2010	56.3	93.1	48.2	197.6	72366.4	0.96			6119.07	0.96	1384.9	0.96
December 18, 2010	54.8	90.7	49.2	194.7	72561.1	0.95			6115.25	0.96	1384.3	0.96
December 19, 2010	56.3	94.8	47.6	198.7	72759.8	0.97			6117.70	0.96	1385.1	0.96
December 20, 2010	52.7	94.6	52.8	200.1	72959.9	0.97			6126.70	0.96	1388.0	0.96
December 21, 2010	52.7	92.5	50.0	195.2	73155.1	0.95			6128.10	0.96	1385.7	0.96
December 22, 2010	50.4	94.8	51.0	196.2	73351.3	0.95			6128.30	0.96	1383.0	0.96
December 23, 2010	55.6	92.4	50.4	198.4	73549.7	0.96			6127.40	0.96	1380.9	0.96
December 24, 2010	55.0	90.8	49.5	195.3	73745.0	0.95			6123.40	0.96	1378.6	0.96
December 25, 2010	49.2	86.5	38.0	173.7	73918.7	0.84			6102.20	0.96	1357.6	0.94
December 26, 2010	50.5	89.1	39.0	178.6	74097.3	0.87			6086.30	0.95	1337.5	0.93
December 27, 2010	53.2	91.9	43.5	188.6	74285.9	0.92			6080.50	0.95	1326.0	0.92
December 28, 2010	55.1	92.9	48.0	196.0	74481.9	0.95			6082.10	0.95	1326.8	0.92
December 29, 2010	53.8	91.7	47.5	193.0	74674.9	0.94			6077.20	0.95	1323.6	0.92
December 30, 2010	54.6	91.0	49.2	194.8	74869.7	0.95			6073.30	0.95	1320.0	0.92
December 31, 2010	48.9	91.9	47.9	188.7	75058.4	0.92	6063.6	0.95	6063.60	0.95	1313.4	0.91

Aqueduct Flow Vs. Shoal Lake Level





NOTES:

PUMPING MODE OF OPERATION

FIRM CAPACITY 60 MGD (273 MLD)
1 UNIT 60-85 MGD (273-386 MLD)
1 UNIT 45-60 MGD (205-273 MLD)
BOTH UNITS WILL OPERATE THRU ENTIRE RGE.
AT WET WELL GEODETIC ELEVATIONS
1053.8-1058.75 ft. (321.198-322.707 m)

ONLY TWO OPERATION MODES ARE POSSIBLE
EITHER 100% PUMPING OR 100% GRAVITY

AQUEDUCT CAPACITY

MILE 0-87 (km 0-140) CAPACITY IS 85 MGD (386 MLD)
MILE 87-INTAKE (km 140-INTAKE CAPACITY IS 120 MGD (545 MLD)
THERE IS PROVISION FOR A 35 MGD (159 MLD) OFFTAKE AT
MILE 87 (km 140).

Figure 4-1

Appendix D

Table D.1

Historical Water Rates

Effective Date	Block 1 ($/100 cu. ft.)	Block 2 ($/100 cu. ft.)	Block 3 ($/100 cu. ft.)
January 1, 1974	0.42	0.27	0.19
April 1, 1974*	0.42	0.27	0.19
April 1, 1976	0.63	0.41	0.29
April 1, 1977	0.72	0.47	0.34
April 1, 1979**	0.75	0.50	0.38
May 1, 1980	0.83	0.55	0.42
April 1, 1981	1.06	0.70	0.54
April 1, 1982	1.17	0.91	0.82
January 1, 1983	1.24	0.96	0.87
January 1, 1985	1.30	1.01	0.91
April 1, 1988+	1.08	0.84	0.58
January 1, 1989+	1.13	0.88	0.60
February 1, 1990+	1.18	0.92	0.63
January 1, 1991+	1.24	0.96	0.66
January 1, 1992+	1.33	1.03	0.72
January 1, 1993+	1.41	1.10	0.78
January 1, 1994+	1.55	1.23	0.90
January 1, 1995 +	1.70	1.37	1.03
January 1, 1996 +	1.89	1.54	1.18
January 1, 1997 +	2.10	1.72	1.33
January 1, 1998 +	2.32	1.98	1.50
January 1, 1999 +	2.54	2.10	1.65
January 1, 2000 +	2.70	2.22	1.74
January 1, 2001 +	2.75	2.27	1.79
January 1, 2002 +	2.75	2.27	1.79
January 1, 2003 +	2.75	2.27	1.79
January 1, 2004 +	2.75	2.27	1.79
January 1, 2005 +	2.75	2.27	1.79
January 1, 2006 +	2.75	2.27	1.79
January 1, 2007 +	3.15	2.67	2.19
January 1, 2008 +	3.45	2.97	2.49
January 1, 2009 +	3.55	3.07	2.59
January 1, 2010 +	1.29***	1.12***	0.95***

* Instituted Service Charge
** Discontinued Service Charge
*** $ Per cubic metre per quarter
+ Plus Fixed Quarterly Charge

Table D.2

Historical Billed Water Consumption

BILLED CONSUMPTION (GL)					
Year	**Block 1**	**Block 2**	**Block 3**	**Public Water Outlets**	**Total**
1977	34.30	15.88	22.42	0.12	72.72
1978	35.67	16.20	22.85	0.14	74.86
1979	36.85	15.99	22.25	0.15	75.24
1980	40.96	17.01	21.87	0.16	80.00
1981	38.35	16.88	20.23	0.16	75.62
1982	38.60	17.13	18.76	0.23	74.72
1983	41.90	18.28	20.57	0.26	81.01
1984	41.0	17.9	19.1	0.27	78.26
1985	41.9	18.2	19.6	0.29	79.97
1986	42.56	18.28	19.78	0.31	80.93
1987	45.35	19.12	20.29	0.33	85.09
1988	48.61	19.25	19.88	0.39	88.13
1989	47.23	19.25	20.11	0.35	86.94
1990	48.49	19.65	19.86	0.33	88.33
1991	47.31	19.04	18.44	0.30	85.09
1992	45.26	18.25	15.84	0.29	79.64
1993	43.40	17.26	14.55	0.52	75.73
1994	43.83	17.50	14.06	0.27	75.66
1995	45.47	17.6	15.11	0.25	78.43
1996	43.27	17.00	14.26	0.27	74.81
1997	43.26	16.85	13.88	0.26	74.26
1998	43.22	16.98	14.16	0.28	74.64
1999	43.06	16.93	13.85	0.25	74.09
2000	42.76	16.91	12.75	0.17	72.59
2001	42.94	17.29	12.37	0.16	72.76
2002	42.6	16.94	11.95	0.16	71.65
2003	43.93	17.32	12.41	0.16	73.82
2004	41.72	16.41	11.16	0.15	69.44
2005	42.10	16.77	11.65	0.14	70.66
2006	43.54	16.51	10.8	0.11	70.96
2007	41.84	16.28	11.84	0.11	70.07
2008	40.91	16.18	10.43	0.11	67.63
2009	39.28	15.78	9.8	0.10	64.96
2010	37.19	15.72	10.12	0.11	63.14

GL = Gigalitres = 1,000,000,000 Litres

Source - Customer Accounts Branch

Table D.3

Historical Water Revenue

REVENUE x $1,000,000						
Year	**Block 1**	**Block 2**	**Block 3**	**Public Water Outlets**	**Quarterly Charges**	**Total**
1977	8.31	2.50	2.53	0.85 *	--	14.19
1978	9.08	2.68	2.74	0.87 *	--	15.37
1979	9.58	2.75	2.86	0.39 *	--	15.58
1980	11.46	3.16	3.08	0.07	--	17.77
1981	13.14	3.82	3.51	0.07	--	20.54
1982	15.32	4.99	4.67	0.10	--	25.08
1983	18.13	6.13	6.24	0.12	--	30.62
1984	17.91	6.03	5.85	0.12	--	29.91
1985	19.05	6.41	6.22	0.13	--	31.81
1986	19.47	6.50	6.34	0.14	--	32.45
1987	20.74	6.80	6.50	0.14	--	34.18
1988	19.79	6.11	4.85	0.17	3.94	34.86
1989	18.66	5.92	4.23	0.15	6.64	35.60
1990	19.95	6.24	4.36	0.15	7.07	37.77
1991	20.51	6.40	4.26	0.13	7.68	38.98
1992	20.99	6.55	3.97	0.13	8.12	39.76
1993	21.37	6.62	3.95	0.21	8.41	40.57
1994	23.61	7.46	4.41	0.24	8.74	44.45
1995	26.89	8.37	5.39	0.30	8.73	49.67
1996	28.48	9.08	5.82	0.30	9.00	52.67
1997	31.51	10.05	6.40	0.30	9.10	57.36
1998	34.80	11.25	7.36	0.36	8.97	62.74
1999	37.96	12.34	7.92	0.36	9.16	67.74
2000	40.26	13.10	7.76	0.24	9.19	70.55
2001	41.42	13.76	7.76	0.21	9.30	72.45
2002	41.23	13.53	7.53	0.21	9.17	71.67
2003	42.51	13.83	7.82	0.21	7.58	71.95
2004	40.38	13.11	7.03	0.19	7.51	68.22
2005	40.74	13.40	7.34	0.18	8.58	70.25
2006	42.14	13.19	6.81	0.17	8.70	71.01
2007	45.50	14.92	8.91	0.19	8.82	78.34
2008	49.04	16.65	8.98	0.21	8.92	83.80
2009	48.88	16.97	8.88	0.22	8.85	83.80
2010	47.79	17.51	9.55	0.25	8.92	84.02

* Includes service charges totalling $0.80, $0.81 and $0.33 for 1977, 1978 and 1979, respectively.

Source - Customer Accounts Branch

Table D.4

Historical Unit Water Revenue

UNIT REVENUE ($/ML) *			
Year	**Block 1**	**Block 2**	**Block 3**
1977	242.30	157.40	112.80
1978	254.60	165.40	119.90
1979	260.00	172.00	128.50
1980	279.80	185.80	140.80
1981	342.60	226.30	173.50
1982	396.90	291.30	248.90
1983	432.70	335.30	303.40
1984	436.40	337.80	306.30
1985	454.20	352.40	318.20
1986	457.50	355.60	320.50
1987	457.30	355.60	320.40
1988 **	480.80	328.30	251.50
1989 **	522.30	326.20	222.80
1990 **	544.20	337.90	233.10
1991 **	581.90	358.70	247.30
1992 **	627.50	384.10	270.83
1993 **	668.35	411.35	293.90
1994 **	717.26	454.09	335.41
1995 **	766.56	504.03	376.45
1996 **	846.68	564.34	429.23
1997 **	917.84	627.13	482.96
1998 **	996.06	693.41	540.38
1999 **	1073.81	760.36	593.54
2000 **	1135.80	806.90	630.69
2001 **	1158.95	827.22	650.89
2002 **	1164.88	830.64	654.63
2003**	1160.08	830.44	653.88
2004 **	1171.80	832.17	656.59
2005 **	1199.43	835.58	656.20
2006 **	1193.59	836.36	658.34
2007 **	1324.01	954.34	777.87
2008 **	1441.42	1067.04	890.08
2009 **	1500.26	1114.54	936.58
2010 **	1557.25	1153.05	974.86

* Revenue divided by Billed Consumption

** Includes fixed quarterly charges according to meter size

Table D.5

Historical Non-Billed Water

Year	Water Pumped (GL)	Water Billed (GL)	Non-Billed * (GL)	%
1977	88.69	72.72	15.97	18.01
1978	93.05	74.86	18.19	19.55
1979	93.96	75.24	18.72	19.92
1980	96.08	80.00	16.08	16.74
1981	89.59	75.62	13.97	15.59
1982	91.96	74.72	17.24	18.75
1983	96.52	81.01	15.51	16.07
1984	96.13	78.26	17.87	18.59
1985	97.42	79.97	17.45	17.91
1986	98.26	80.93	17.33	17.64
1987	100.71	85.09	15.62	15.51
1988	109.93	88.13	21.80	19.83
1989	108.69	86.94	21.75	20.01
1990	109.32	88.33	20.99	19.20
1991	103.69	85.09	18.60	17.94
1992	94.25	79.64	14.61	15.50
1993	89.92	75.74	14.18	15.77
1994	89.83	75.66	14.17	15.77
1995	95.34	78.43	16.91	17.74
1996	93.37	74.81	18.56	19.88
1997	90.28	74.26	16.02	17.74
1998	91.30	74.64	16.66	18.25
1999	88.47	74.09	14.38	16.25
2000	82.41	72.59	9.82	11.92
2001	79.78	72.76	7.02	8.80
2002	81.92	71.65	10.27	12.54
2003	84.58	73.82	10.76	12.72
2004	81.05	69.44	11.61	14.32
2005	80.12	70.66	9.46	11.81
2006	82.83	70.96	11.87	14.33
2007	79.62	70.07	9.55	11.99
2008	78.59	67.63	10.96	13.95
2009	77.30	64.96	12.34	15.96
2010	75.03	63.14	11.89	15.85

* Difference between water pumped and water billed

GL = Gigalitres = 1,000,000,000 Litres

Source - Customer Accounts Branch

Table D.6

Historical Unaccounted - For Water

Year	Water Pumped (GL)	Water Metered * (GL)	Unaccounted (GL)	%
1977	88.69	73.00	15.69	17.69
1978	93.05	75.14	17.91	19.25
1979	93.96	76.06	17.90	19.05
1980	96.08	80.62	15.46	16.09
1981	89.59	76.52	13.07	14.59
1982	91.96	75.56	16.40	17.83
1983	96.52	81.08	15.44	16.00
1984	96.13	79.12	17.01	17.69
1985	97.42	80.83	16.59	17.03
1986	98.26	81.82	16.44	16.73
1987	100.71	85.94	14.77	14.67
1988	109.93	88.90	21.03	19.13
1989	108.69	87.28	21.41	19.70
1990	109.32	88.76	20.56	18.81
1991	103.69	85.20	18.49	17.83
1992	94.25	79.93	14.32	15.19
1993	89.92	76.04	13.88	15.44
1994	89.83	76.04	13.79	15.35
1995	95.34	78.65	16.69	17.51
1996	93.37	75.02	18.35	19.65
1997	90.28	74.46	15.82	17.52
1998	91.30	74.82	16.48	18.05
1999	88.47	74.34	14.13	15.97
2000	82.41	72.86	9.55	11.59
2001	79.78	73.01	6.77	8.49
2002	81.92	71.91	10.01	12.22
2003	84.58	74.12	10.46	12.37
2004	81.05	70.93	10.12	14.01
2005	80.12	71.07	9.05	11.30
2006	82.83	71.56	11.27	13.61
2007	79.62	70.43	9.19	11.54
2008	78.59	67.92	10.67	13.58
2009	77.30	65.36	11.94	15.45
2010	75.03	63.46	11.57	15.42

Winnipeg

Water and Waste Department

Important Information for Landlords

Before you rent

- **Contact us** to register as a landlord. We need your name, your mailing address, and a list of the properties you rent.
- **Contact us** to find out about the water meters and your private water service pipe for each of your rental units or buildings. Any time a water pipe serves more than one unit or building, we can only turn the water off due to non-payment if there is a separate shut-off valve for that building at the property line. Outstanding balances are added to the property owner's tax bill.

When renting

- **Contact us on the day your tenant signs a rental agreement**. This will ensure the account is set up in the appropriate name. If the new tenant is to be the account holder, please make sure that we have all the information we need. If we do not receive information about a new tenant, we will automatically put the bill in your name.
- **Contact us on the day the tenant moves in** to confirm that we have a first meter reading.
- **Contact us on the day the tenant moves out** to confirm that we have a final reading. We can then issue a final bill for water and sewer service right away. We will send you a letter with the final bill amount if we may add unpaid final bills to your property taxes. You can withhold the security deposit until the bill is paid.

When selling your rental property

- **Contact us with a meter reading** to make sure that we bill you only for the water used at your property until the time of the sale. Do this even if your tenant is responsible for the water bill and plans to rent from the new owner. If we don't receive a reading until months after the sale, we pro-rate the bill between the former owner and the new owner. If the new owner rents to a tenant that uses lots of water, you may end up with a higher bill than you expected.

When purchasing property

- Do not finalize the sale until the vendor provides a meter reading and his or her lawyer pays the final water bill. Your lawyer should make sure the final actual water bill is paid before you finalize the purchase. Remember, we may add unpaid water bills to your property taxes.

Billing and collection procedures

- If we do not receive information about a new tenant, we will automatically put the bill in your name. If you receive a bill for charges that you believe should be billed to a tenant, we will adjust your bill and bill your tenant for up to one bill period (typically one quarter).
- We will send notices to the tenant any time there is an outstanding balance (at 40 days from the billing date and again at 60 days from the billing date).
- We will send you a letter any time your tenant has an outstanding balance that may be added to your property tax (at 40 days from the billing date and again at 60 days from the billing date if payment has still not been made).

Situations where we may turn off water to a rental property

We may turn off the water to accounts with outstanding balances of $100 or more when we have not received payment within 80 days of the billing date, unless the tenant has contacted us to make arrangements to pay off the outstanding balance in regular instalments. Before we can agree to payment arrangements that extend past 70 days from the billing date, we must have your approval as the landlord.

Situations where we don't turn off water to a rental property

We can't turn off the water to a rental property in the following circumstances:

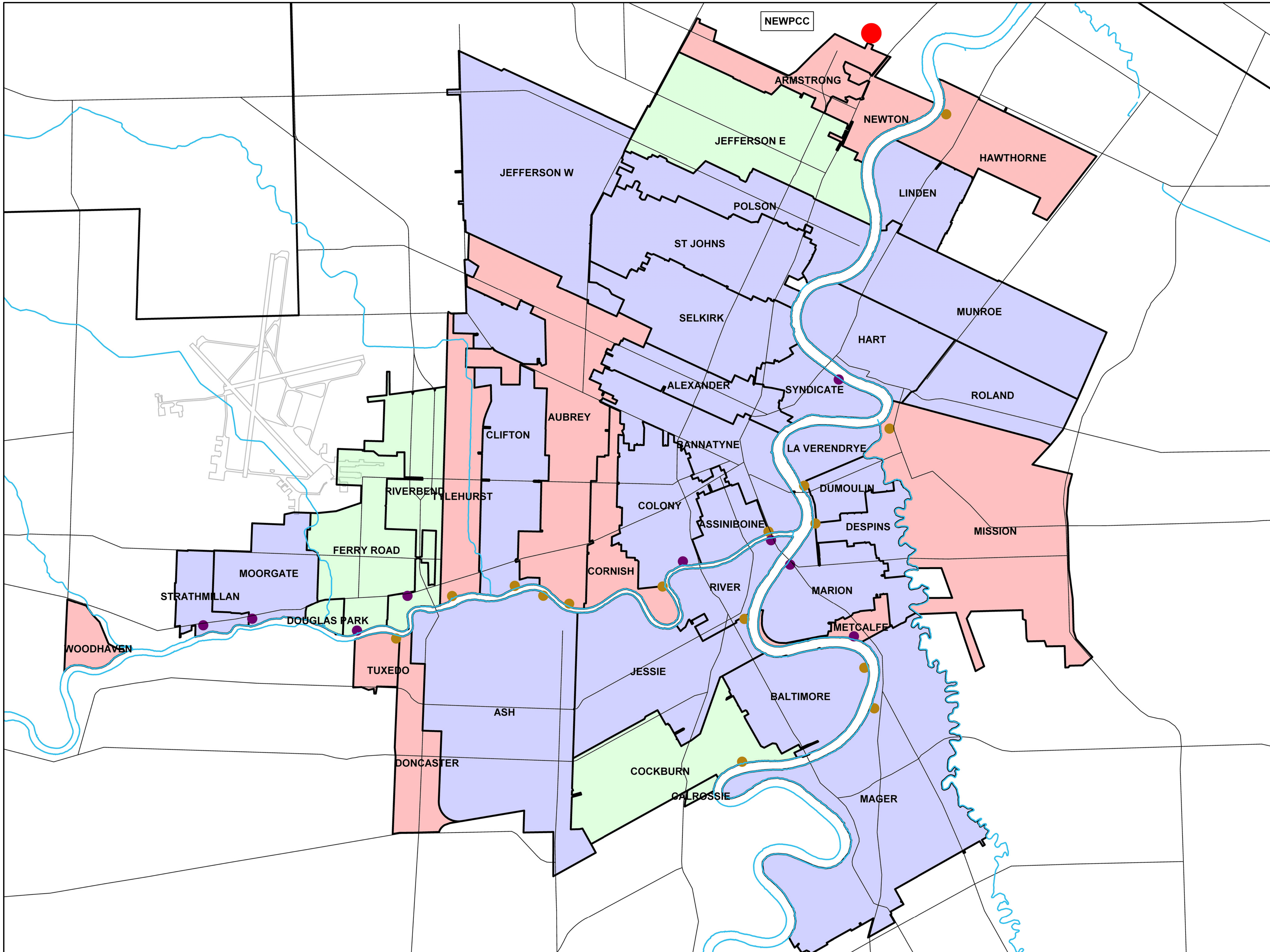
- the water bill is in the property owner's name
- one water meter measures water use to more than one unit
- the shut-off valve controls water to more than one unit
- the shut-off valve is on private property

In these cases, we will add outstanding balances of $100 or more to the property owner's tax bill when payment has not been received within 105 days of the billing date.

When a tenant vacates your rental unit with an outstanding amount owing

If a tenant vacates your rental unit with an outstanding final bill of $100 or more and we have not received payment within 50 days of the billing date, we:

- Try to recover the money from the tenant. We will send the tenant's final bill to a forwarding address (if we have the information) or the service address on file (if we do not have a forwarding address).
- Try to turn off the water at the tenant's new address if we have this information and the water bill is in the tenant's name at this address.
- Notify you of the tenant's outstanding balance. We encourage you to try to collect this money from your tenant. You might consider:
  - Government of Manitoba Small Claims Court
  - Government of Manitoba Residential Tenancies Branch
  - Private collection agencies



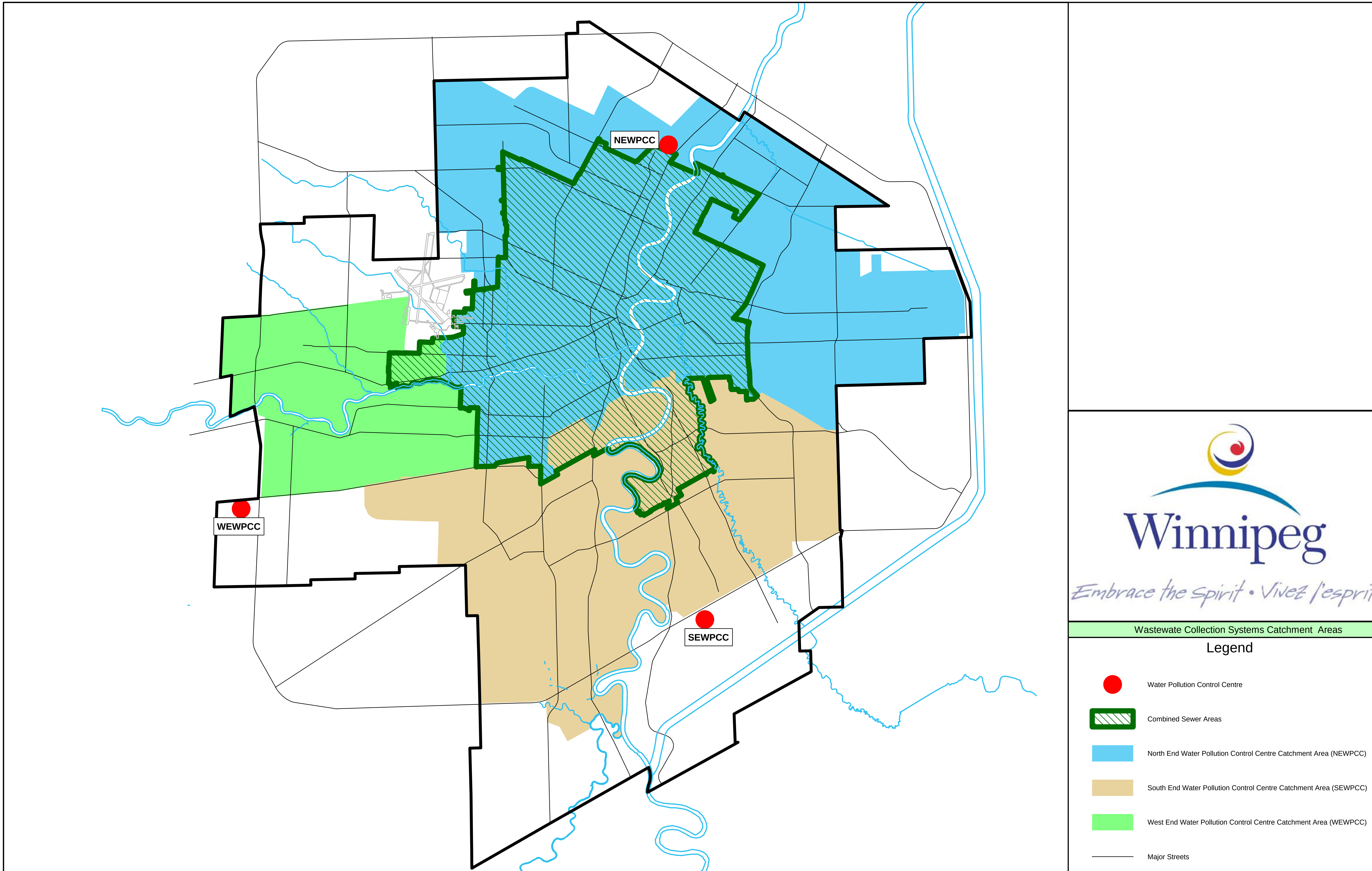
Winnipeg

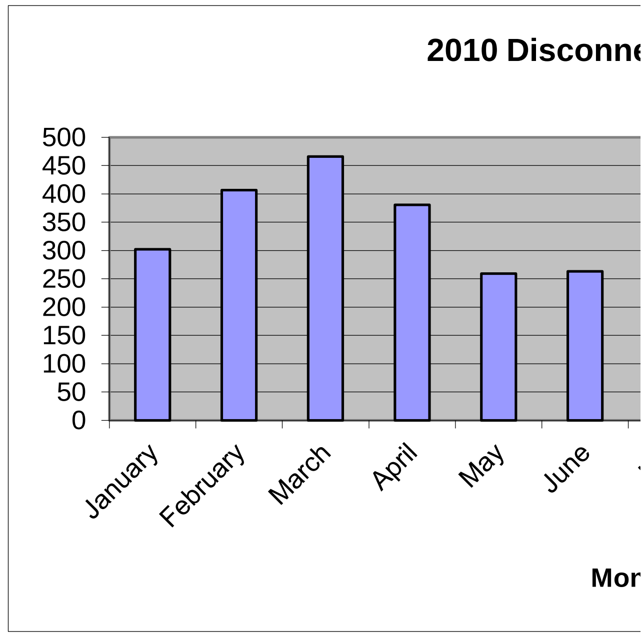
Embrace the Spirit • Vivez l'esprit

Combined Sewer (CS) Districts and Combined Sewer Overflow (CSO) Information

Legend

- Relieved CS Districts
- Unrelieved CS Districts Relief in Progress
- Unrelieved CS Districts
- Existing CSO Outfall Monitoring
- Planned 2012 CSO Outfall Monitoring
- Major Streets


NEWPCC
WEWPCC
SEWPCC
Winnipeg
Embrace the spirit • Vivez l'esprit
Wastewate Collection Systems Catchment Areas
Legend
Water Pollution Control Centre
Combined Sewer Areas
North End Water Pollution Control Centre Catchment Area (NEWPCC)
South End Water Pollution Control Centre Catchment Area (SEWPCC)
West End Water Pollution Control Centre Catchment Area (WEWPCC)
Major Streets


2010 Disconne
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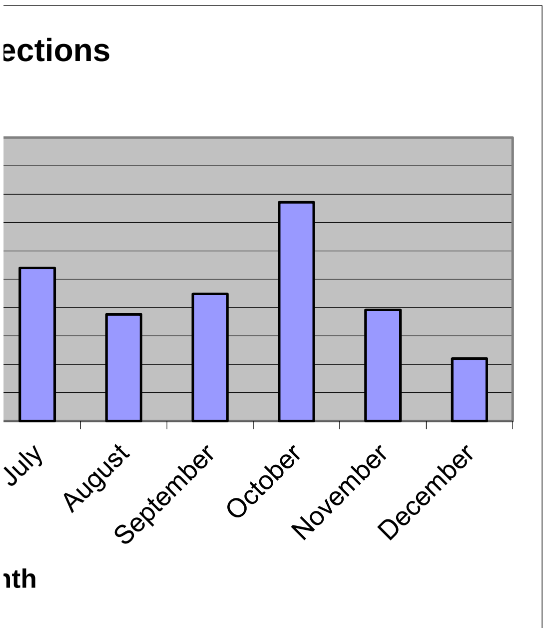

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September
October
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December
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PUB FTE Analysis - 2011Adopted Budget

Water Utility	
Water Services	278
Finance	58
Engineering	42
Environmental Standards	9
Customer Services	19
Information Technology	9
Human Resources	12
Total	427

Sewer Utility	
Wastewater Services	237
Finance	48
Engineering	48
Environmental Standards	26
Customer Services	18
Information Technology	8
Human Resources	10
Total	394

Winnipeg

Water and Waste Department • Service des eaux et des déchets

July 25, 2011

MR. LANDLORD
555 PORTAGE AVE
WINNIPEG MB R5E 5E5

Re: Tenant's Overdue Water Bill

Our records show that your tenant, JOHN DOE at 123 MAIN STREET, has an outstanding balance of $234.77.

Sometimes we are unable to turn off water for non payment. For example, one meter might supply water to several residences or businesses.

If we are unable to turn off the water at this address, we will add this amount to your property tax bill in 65 calendar days from the date of this letter.

The City of Winnipeg Charter gives us the authority to apply a tenant's outstanding water bill to the property owner's tax bill.

Once this is done, the amount is subject to all tax penalties and an administration charge of $31. If you are on the Tax Installment Payment Program, the entire amount will be added to your next monthly installment.

More information is in our landlord information package. Contact us for a copy or view it on our web site at winnipeg.ca/waterandwaste/dept/landlord.stm

We may have already received payment from your tenant by the time this notice reaches you.

Please contact us to verify the status of this account. You can reach us:

- by phone at 204-986-2455, 8:30 am to 4:30 pm, Monday to Friday, except holidays
- by email at waterbill@winnipeg.ca

Winnipeg

Water and Waste Department

If you have questions about your bill,
phone **204-986-2455** or email **waterbill@winnipeg.ca**

Customer	**JOHN DOE**	**Amount due**	**$234.77**
Account number	**90484872768**	**Due date**	**Immediately**
		Notice date	July 25, 2011
Property Serviced	123 MAIN STREET		

Your account is past due!

You have an outstanding amount owing of $234.77.

This includes a late payment charge of $6.82.

Please pay the outstanding amount now to keep your water service.

You can pay:
- in person at 510 Main Street or 100-614 Des Meurons Street (cash, cheque, money order, Interac)
- with cheques/money orders (payable to City of Winnipeg)
    - o by mail to 510 Main Street, Winnipeg, MB, R3B 3M1
    - o in drop boxes (Manitoba Hydro, MTS)
- through your bank (e.g., in person, online, telephone banking) - payments can take up to five business days to reach us

If you have already paid your bill, please ignore this notice.

Winnipeg

Winnipeg

Water and Waste Department • Service des eaux et des déchets

August 12, 2011

MR. LANDLORD
555 PORTAGE AVE
WINNIPEG MB R5E 5E5

Re: Tenant's Outstanding Water Bill

Our records show that your tenant, JOHN DOE at 123 MAIN STREET, has an outstanding balance of $234.77.

Sometimes we are unable to turn off water for non payment. For example, one meter might supply water to several residences or businesses.

If we are unable to turn off the water at this address, we will add this amount to your property tax bill in 45 calendar days from the date of this letter.

The City of Winnipeg Charter gives us the authority to apply a tenant's outstanding water bill to the property owner's tax bill.

Once this is done, the amount is subject to all tax penalties and an administration charge of $31. If you are on the Tax Installment Payment Program, the entire amount will be added to your next monthly installment.

To avoid these charges to your tax bill, you can contact us and pay directly.

We encourage you to try to collect this money from your tenant. You might consider:
- Government of Manitoba Small Claims Court
- Government of Manitoba Residential Tenancies Branch
- Private collection agencies

More information is in our landlord information package. Contact us for a copy or view it on our web site at winnipeg.ca/waterandwaste/dept/landlord.stm

We may have already received payment from your tenant by the time this notice reaches you. Please contact us to verify the status of this account. You can reach us:
- by phone at 204-986-2455, 8:30 am to 4:30 pm, Monday to Friday, except holidays
- by email at waterbill@winnipeg.ca

Winnipeg

Water and Waste Department

If you have questions about your bill,
phone **204-986-2455** or email **waterbill@winnipeg.ca**

Customer	**JOHN DOE**	**Amount due**	**$234.77**
Account number	**90484872768**	**Due date**	**Immediately**
		Notice date	August 12, 2011
Property Serviced	123 MAIN STREET		

Your water will be turned off!

You have an outstanding amount owing of $234.77.

Please make a payment immediately to keep your water service.

If we don't hear from you, we will turn your water off as early as 10 days from the date of this notice.

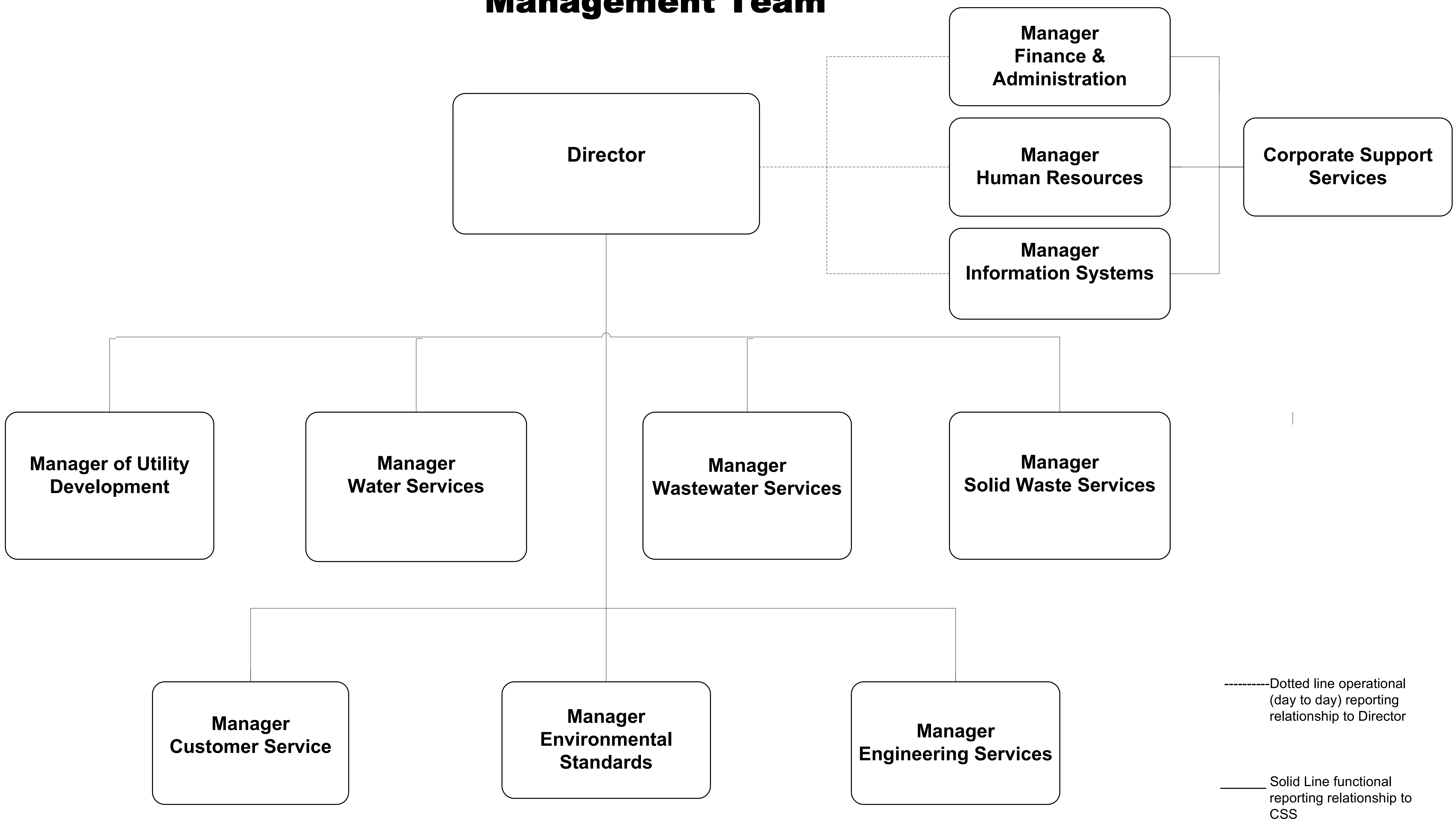
We may turn your water off after regular business hours when our payments offices are closed.

If we turn off your water:
- you will have to pay an extra $100 to have the water turned back on
- you may have to wait 24 to 48 hours after we receive your payment

You can:
- pay in person at 510 Main Street or 100-614 Des Meurons Street (cash, cheque, money order, Interac)
- pay through your bank (e.g., in person, online, telephone), but payments can take up to five business days to reach us

Winnipeg

Water and Waste Department
Management Team



Winnipeg
Water and Waste Department

WATER CONSERVATION PROGRAM

Mission Statement

To increase water use efficiency in Winnipeg without negatively impacting the quality of life enjoyed by Winnipeggers, and to defer expansions to the water supply system.

Goals

The main goals of the Water Conservation Program are:

- To maintain water demand within the aqueduct capacity, hence avoiding the need to find a new water source
- Provide long-term water conservation solutions, and avoid the "quick-fix" solutions that offer short-term success
- Create a program that achieves sustained awareness of the value of water and defer any water shortage crisis

The City of Winnipeg's water conservation program is intended to demonstrate that water can be used more effectively.

Water Conservation Research and Studies History

- 1990: The City of Winnipeg Comprehensive Study of the Water Supply System
- 1992: Slow the Flow Water Education Program: Wally Watersaver, Pilot Study for Retrofit Kits
- 1994: The City of Winnipeg in partnership with FortWhyte Alive (Centre) in Water Efficient Landscaping
- 1994: The City of Winnipeg Water Conservation Database and Waterfront Website
- 1994: The City of Winnipeg Water Conservation Pilot Retrofit Program and Report
- 1994: The City of Winnipeg Toilet Rebate Program
- 1995: Regional Water Supply Study
- 1995: Industrial Water Consumption Customer Survey
- 1996: The City of Winnipeg in partnership with FortWhyte Alive in the Youth Education Program
- 1997: The City of Winnipeg Water Use Projections Analysis
- 1998: The City of Winnipeg Water Demand Evaluation and Projection Report
- 1999: Summer Excess Water Demand and Water Treatment Capacity Assessments
- 2003: Maximum Performance (MaP) Testing of Popular Toilet Models Funding Project
- 2004: The City of Winnipeg Water Demand Evaluation and Projection Report Updated
- 2008: The City of Winnipeg Water Conservation Web page Redesign
- 2009 The City of Winnipeg Residential Toilet Replacement Credit Program

Slow the Flow Water Education Program

Slow the Flow Water Education Program began in 1992 after a comprehensive study of Winnipeg's water supply system was initiated in 1990. Statistics show that Winnipeg teenagers use more water at home each day than any other age group.

The City of Winnipeg Water Conservation Team developed the Slow the Flow Water Education Program for implementation in Winnipeg schools.

The goals of the Slow the Flow Water Education program are:

- To develop a general awareness of water conservation.
- To create life-long water conservationists – the decision makers of the future.
- To enhance existing core subjects with relevant lifestyle information.

Educating pre-teens about their water use habits shows them that they can have a positive impact in conserving this precious resource for the future. This classroom-ready program teaches middle-years students how to reduce residential water consumption before their water-wasting teenage years.

Slow the Flow was designed in Manitoba using provincial curriculum guides and pilot-tested with local teachers and students. Slow the Flow activities are locally relevant and impact each student's house, school and community. In 1996, an environmental education partnership was formed with FortWhyte Alive and they began administering the program. The program curriculum and delivery method was updated in 2010.

Wally Watersaver

In 1992, a slogan and mascot was created for the Water Conservation Program. “Wally Watersaver” and his motto of “Slow the Flow, Save for Tomorrow” was shown to appeal to both the older population, in that they are more adapt to the idea of saving for their families, and the younger population with a catchy slogan and eye pleasing character.

The City of Winnipeg took advantage of space they own on the utility vehicles. The fleet was fitted with Water Conservation markings prominently displaying the "Slow the Flow" slogan and graphics of "Wally Watersaver".

The Residential Retrofit Program

Encouraging Winnipeggers to retrofit their plumbing is an important part of the City's Water Conservation Program. The residential retrofit program began by first targeting single family dwellings, then moving into offering kits to multi-family units such as apartment blocks within the City of Winnipeg.

A pilot program was launched in the fall of 1992 to investigate and assess methods of water conservation kit delivery & payment. A retrofit kit offer brochure was mailed to approximately one half of the City of Winnipeg in 1995. Further kit promotions were conducted using several water bill inserts in 1996, 1997 and 1998.

These pre-packaged kits include:

- Low-flow showerheads save 40-50% of water flow over conventional showerheads, while lowering water heating costs
- Bathroom tap aerators reduce water flow.

- Toilet devices reduce water flushed by 20-50%
- A Kitchen tap aerator reduces water flow
- Toilet dye tablets will help you spot a silent and costly toilet leak

The retrofit devices will save enough water to pay for themselves in approximately 6 months.

This program is planning to sun set in the near future because of the implementation Manitoba Hydro's Power Smart Water and Energy Saver Kit Program and updated water efficiency standards in the 2010 Manitoba Plumbing Code.

Xeriscape Garden

Xeriscape is an organized concept for saving water in landscaped areas. In 1994, a demonstration garden was constructed at the FortWhyte Alive as a resource to inform the public on the benefits of water efficient landscaping.

Water Conservation Database

Evaluation of program activities is a key component of the City's water conservation initiatives. An electronic database was developed in 1994 to assist the team in the ongoing evaluation of the program so it could achieve the optimum cost-effectiveness.

The database allows the conservation team to analyze usage patterns for different years, times of year (seasonal) or user groups. It was also used to process orders for water conservation kits in the residential conservation program. This database was reconfigured in 2009 because of a new water billing system and is one of the most valuable assets in the department.

Waterfront Website

The City of Winnipeg's Waterfront Website is an information source on water conservation in Winnipeg.

The site was first launched in 1994 and was Canada's first on-line information resource for Municipal water conservation. In 2000, the site was revised with a new look and feel to update the current water conservation efforts. Along with information about the City of Winnipeg and water utility history, it details the Water Conservation Program goals, initiatives and numerous helpful hints.

The Water Conservation Website was redesigned in 2008 to provide easier access to water conservation information for the citizens of Winnipeg.

Multi-Family Residential Retrofit Program

This program was created in 1994 to supply water saving devices to multi-family residential building owners or property managers. Promotion of the program was conducted by a direct mail campaign to the customer.

The Water Conservation Team assessed customer usage records for Multi-family Residences and started the program by targeting the largest water users first. Offers were mailed to the 300 largest "customers". These customers accounted for over 80% of the multi-family residential water consumption. The direct mail campaign contained information on the City of Winnipeg Conservation Program and information about the retrofit devices available and potential savings in using the retrofit devices in their properties.

The devices available for sale are identical to that in a Water Conservation Kit offered to residential homeowners. Unlike the pre-packaged kits offered in the Residential Retrofit Program, these devices can be purchased in any selection of quantity and type.

Commercial Retrofit Program

Although it was not formally promoted, there were several commercial and institutional water customers of various types (hotels, restaurants, daycares, country clubs & personal care homes) who have purchased water saving devices from the multi-family residential stock.

Toilet Rebate Pilot Program

A 6 litre toilet rebate program was evaluated in 1994 and the water conservation kits were determined to be the most cost effective method to reduce long-term water demands at the time. The common complaint about the 6 litre toilet has been the poor flushing performance.

Industrial Customer Survey

In 1995, the City completed a survey of industrial water users in order to better understand the water use characteristics of this diverse customer group and to assess the extent water conservation was being practiced. The 44 largest users, (determined to use over 77% of the total industrial water consumed (19.8ML/d) were asked to participate in the study.

Of the surveyed group, 28 industries, representing 60% (15.5 ML/d) of industrial water use, responded to the survey. As a result of this survey, the City of Winnipeg has gained an improved knowledge of their industrial customer's water usage and familiarized the industrial users with the Water Conservation Program. This information assists the City and Industrial Customers with water conservation planning.

Water Demand Evaluation and Projections

In 1997, the City of Winnipeg realized it was evident that major changes in the water use technology market warranted a reassessment of the water projections. Previously, water demand projections were based on historic use and projected population growth. This study considered the effects of technological changes in the use of water in the home and also changes in people’s lifestyles and habits. The water demand analysis included the effect of replacement of older high volume toilets for new 6L toilets during renovations to existing homes. The results of this study substantially lowered the future water use projections and aided in downsizing the capacity of the new water treatment plant.

Summer Excess Water Demand and Water Treatment Capacity Assessments

In 1998, the Water Conservation Team conducted an analysis of summer excess water usage by user group (residential, commercial and industrial) and related to weather patterns.

Using this information, the team developed a predictive model, which can warn of imminent periods of extremely high water usage (e.g. during extended periods of very hot, dry summer weather). This model can be used to suggest the need for short-term measures to ensure adequate water supply (e.g. lawn-watering restrictions) and to identify which user groups would be most appropriate to participate in a campaign to reduce peak water usage. This information was used when creating the peak demand reduction tips. These valuable tips are available on the City of Winnipeg’s Website and incorporated in various Water Conservation Program activities.

Maximum Performance (MaP) Testing of Popular Toilet Models

The City of Winnipeg joined a co-operative of Canadian and American municipalities and contributed funds to a program to help consumers determine which 6L toilets not only met the requirements of the CSA and ANSI/ASME, but also met the performance expectations of the customer.

Updating Water Use Projections

The Water Conservation Team conducted an updated water use projection for the City of Winnipeg in 1997, 2003, 2004, and 2011. This new projection used more recent information regarding population, technological changes and water usage trends than what was used before any water conservation program was in place. New projections in 2004 suggested that the City's usage was changing to the extent that the City would not exceed aqueduct capacity. In 2011, the projection suggests that the trend in decreasing residential indoor demand on a per capita basis will continue over the next 25 years.

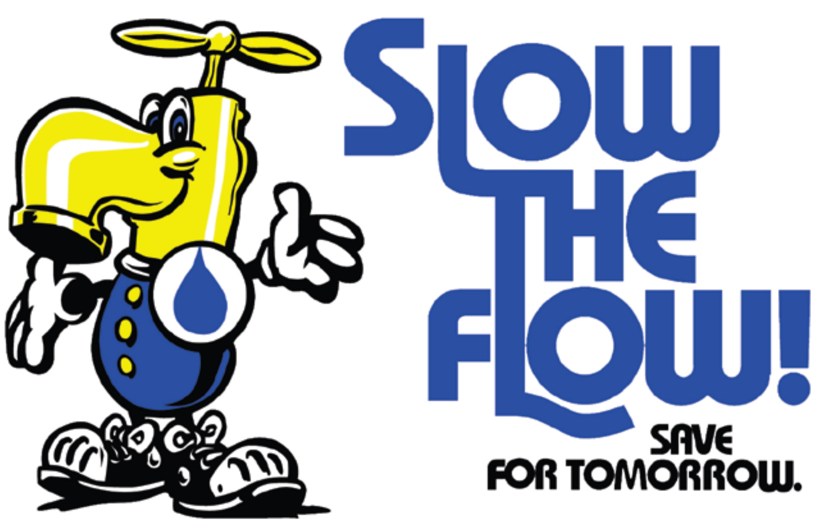
Residential Toilet Replacement Credit Program

In 2009, the Water Conservation Team developed and implemented a Residential Toilet Replacement Credit Program. The purpose of the program is to promote long term water conservation by reducing both water consumption and wastewater flows into the City's three wastewater treatment plants. By educating and promoting residents to replace inefficient toilets, the City will increase water use efficiency without negatively impacting the quality of life enjoyed by Winnipeggers.

Listed below is the yearly breakdown of toilet credits issued.

2009: 981 credits
2010: 2722 credits
2011: 3195 credits as of Oct. 21, 2011, projected year end 3900 credits

Based on the 2009 data, we are achieving on average a 13% reduction in a customer's water and sewer bill.



Water and Waste
Department

City of Winnipeg
Water Conservation Program

Water Demand Evaluation and Projections Report

February 1998
0110A2405

TetrES
CONSULTANTS INC.

Duane Griffin

Water and Waste Department

SLOW THE FLOW! SAVE FOR TOMORROW.

City of Winnipeg
Water Conservation Program

Water Demand Evaluation and Projections Report

February 1998
0110A2405

TetrES CONSULTANTS INC.

TetrES CONSULTANTS INC.

603-386 Broadway,
Winnipeg, Manitoba,
CANADA, R3C 3R6

Phone: (204) 942-2505
FAX: (204) 942-2548

Principals

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0110-A-24-05
February 16, 1998

Mr. M. Shkolny, P. Eng.
Acting Manager of Engineering
City of Winnipeg
Water & Waste Department
1500 Plessis Road
Winnipeg, MB
R2C 5G6

Attention: Dr. D. Griffin, P. Eng., Water Conservation Coordinator

Dear Mr. Shkolny:

RE: **WATER DEMAND EVALUATION AND PROJECTIONS REPORT**

In 1997, as part of the City of Winnipeg's Water Conservation Program, an evaluation of current and historical water demand patterns was undertaken. This data was employed to provide a new water demand projection for the City of Winnipeg. The current projection is significantly different from previous predictions and will effect future planning decisions.

This report documents the new projection and the methodology used in its calculation. The methodology accounted for changing demographics and technology as well as the impact of future water conservation programs. We hope that you will find the information useful.

Our staff enjoyed working closely with the City on this challenging and interesting assignment and appreciate the assistance provided by the City over the course of this study.

Yours truly,

Tetr*ES* Consultants Inc.

D. Morgan, Ph.D., P. Eng.
Project Manager

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Enclosures

ACKNOWLEDGEMENTS

The Study Team wishes to express their appreciation to the Water and Waste Department Staff who assisted in the compilation of data for this report. In particular, Ms. Josephine Behr for her help in obtaining data necessary for the update of the Water Conservation Database.

The Study Team would also like to acknowledge the contributions of Mr. Duane Griffin, Water Conservation Coordinator for the City of Winnipeg. Mr. Griffin developed the first version of a water projection model and researched the changing technology trends in Winnipeg and elsewhere.

STUDY TEAM

Tetr*ES* Consultants Inc.

Mr. George Rempel, M.Sc., P. Eng.	Study Director
Dr. David Morgan, Ph.D., P. Eng.	Project Manager
Mr. Michael Sweet, B.Sc.	Project Scientist

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1. INTRODUCTION

1.1 BACKGROUND

In 1990, as part of the City of Winnipeg's water supply plan, a water projection was developed to the year 2040 (Wardrop/Tetr*ES* 1994). This projection was based on the analysis of actual water consumption data from 1922 to 1989. The analyses considered water use patterns in the residential, commercial and industrial categories, as well as other miscellaneous uses. The overall per capita water demand was calculated for each historic year and statistical regression analysis was used to determine that the long-term average annual growth was about 0.9% per year (see Figure 1-1). The overall City average water demand of 480 litres per capita per day (LCD) was still low when compared to other Canadian cities and, in general, the trend for increasing per capita use was prevalent in other cities. Therefore, it was reasonable to expect the growth rate in per capita use for Winnipeg to continue into the future. The historic record was therefore used to project a continued future trend of strong growth in per capita demand. An upper and lower projection was developed to provide an envelope of possible future demands. Statistically, this was the 95% prediction limit, which suggests that 95% of future demands should fall within this projection envelope, based on historic usage trends. The population forecast used in the water supply demand projection was based on a preliminary City Planning Department forecast done in 1988 which projected very low growth in the near future, and no growth after 2016 (Wardrop/Tetr*ES* 1994).

In 1995, the water projection was reviewed by Wardrop/Tetr*ES*, since there were two significant changes in the information used to develop the projection:

- New population projections by the City (Wardrop/Tetr*ES* 1994) projected steady growth continuing to the year 2040. This was a considerable change from the original projections (see Figure 1-2).

- A review of the water consumption since the first projection was completed in 1990 showed a dramatic drop in water consumption (see Figure 1-1).

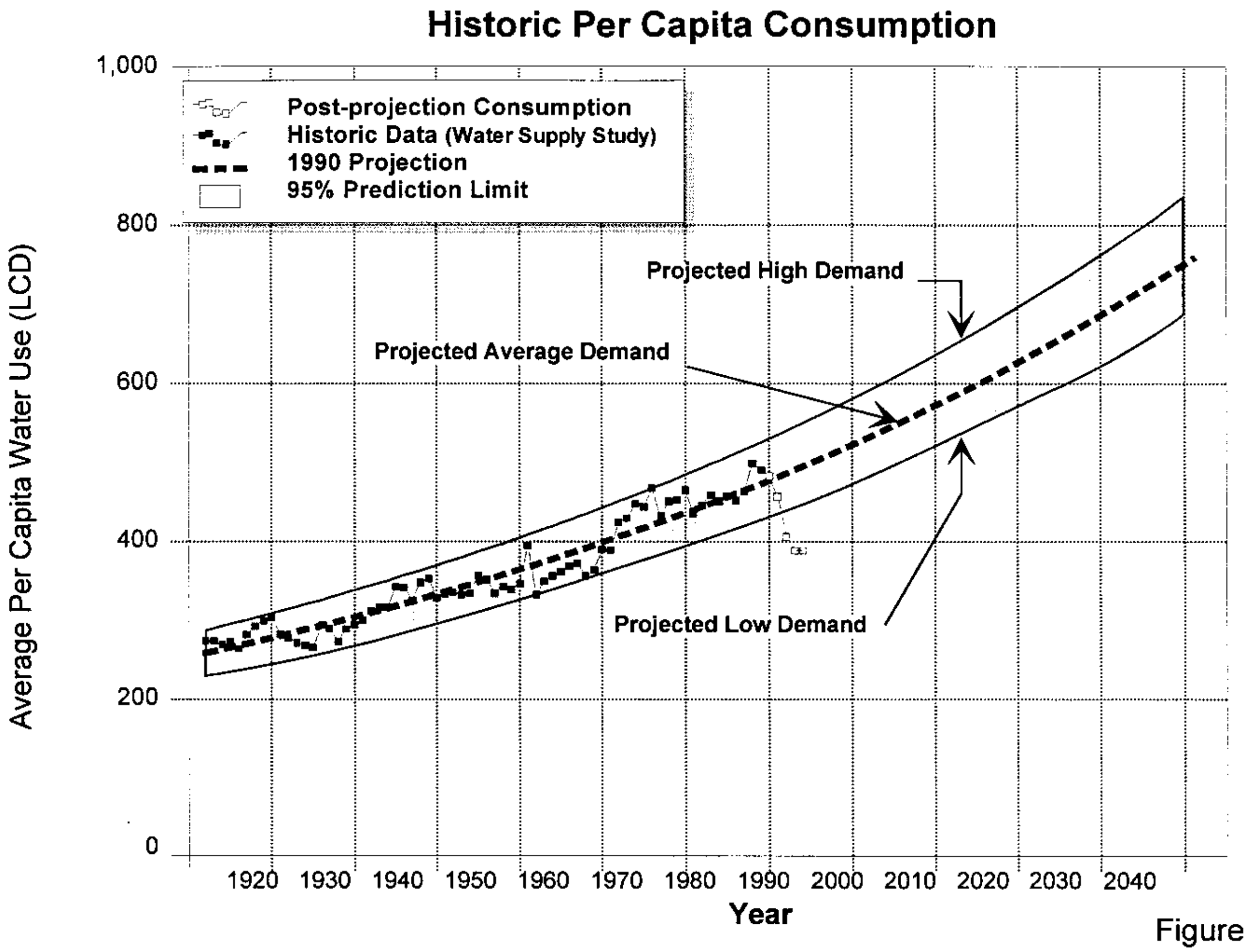

Figure 1-1

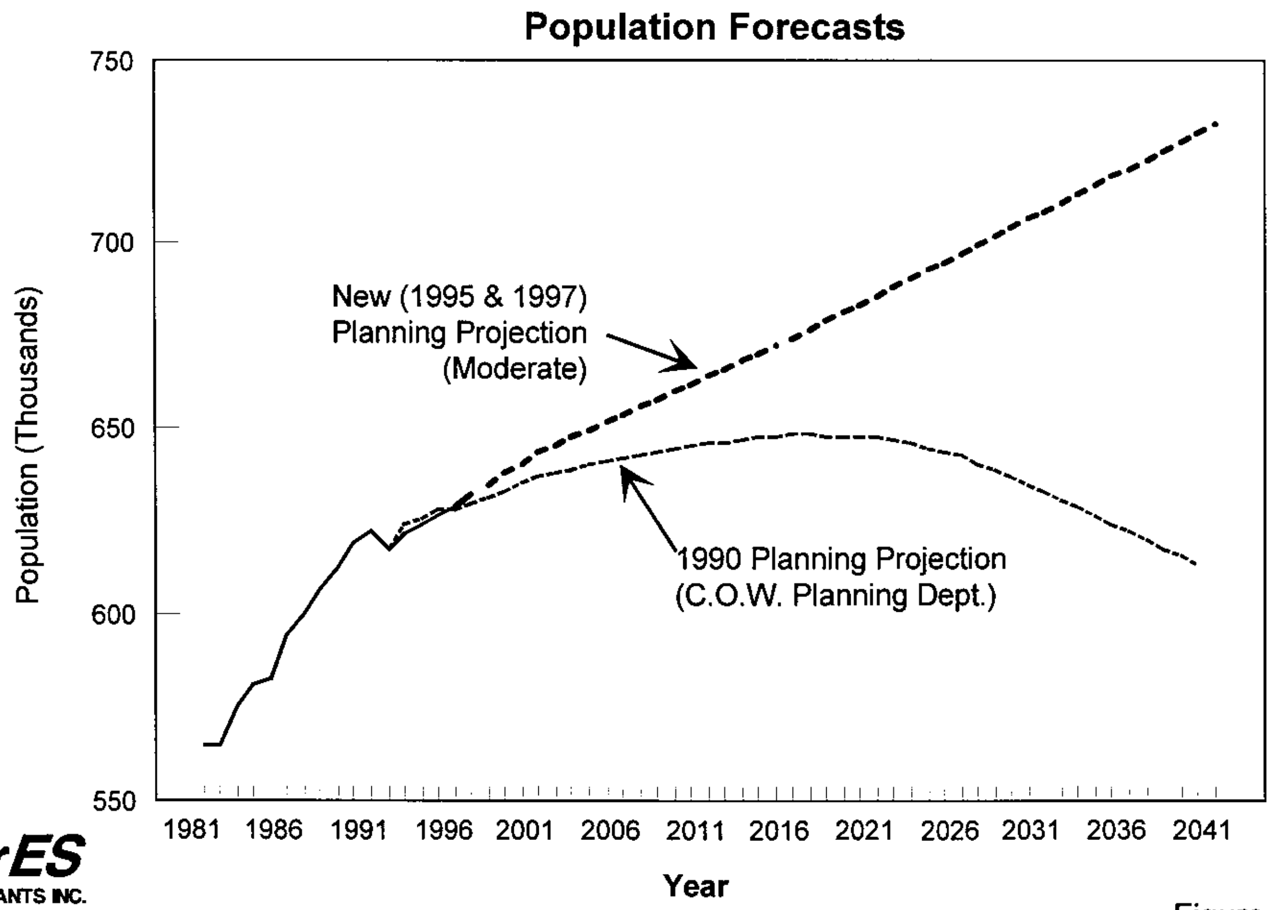

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Figure 1-2

The new population projections by the City included four different projections; a very low, low, moderate and high. The one selected for the 1995 projection and the current projection was the moderate projection, which considered that, after 1995, net migrational would increase from 0 to a high of 500 people per year by the year 2006 and thereafter remain constant at 500 people per year.

The actual water consumption in the early to mid-1990s also showed a dramatic departure from prior trends. Consumption in the three years, 1992, 1993 and 1994, were all below the projected low demand developed using the 1995 prediction limit. This indicated that, for the first time in the history of water supply in Winnipeg, there was a significant change in the annual growth rate pattern. The 1993 projection was 16% below the 1990 projection and was clearly statistically significant. During this time, the City had embarked in a water conservation program, emphasizing water efficiency but it was recognized that this did not explain the change in water use. Therefore, new projections were developed in an Addendum to the Regional Water Supply Study (Wardrop/Tetr*ES* 1995).

The 1995 projections were developed based on several key assumptions listed below:

- Since most of the change in water consumption occurred in the commercial sector (see Section 2 Evaluation of Past Usage and Trends), the change was considered to be a 15% "correction" of which 3% was due to water conservation caused by the City of Winnipeg program. The remaining (and larger) portion of the reduction in water consumption was considered due to economic conditions and increased environmental awareness.

- After the "correction", the per capita growth projection in the Regional Water Supply Study was considered as likely to continue, as in the past, at 0.9% per year.

- Additional water conservation results from a continuing program was considered as able to provide an additional 7% reduction below the unadjusted projection.

- A 5% increase in demand due to the water treatment process backwash which would occur after the water treatment was built in the year 2004 (now projected at 2006).

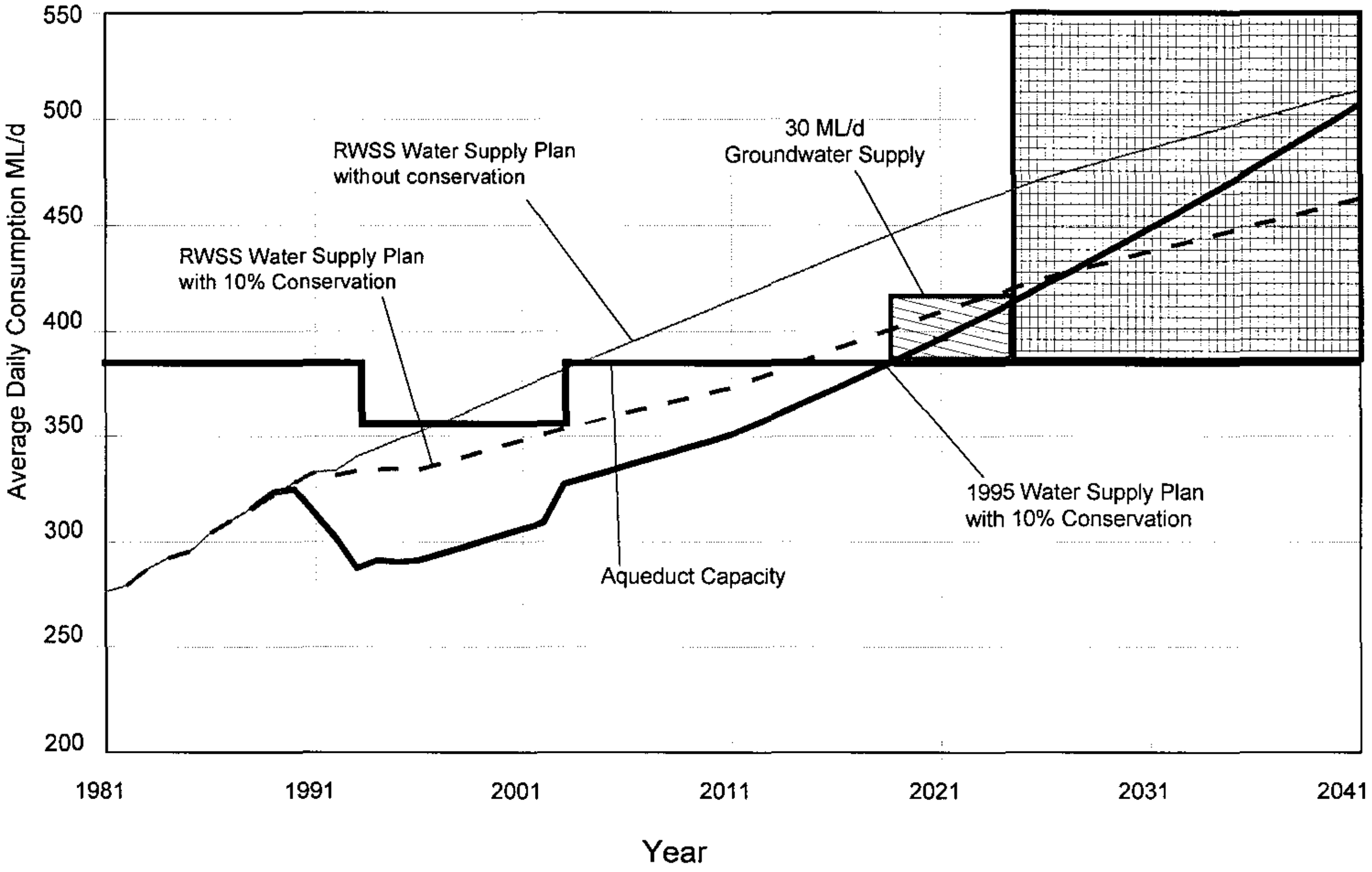
Figure 1-3 shows the 1990 and 1995 water projections versus the proposed system capacity with expansions to the year 2040. The 1995 projection is lower in the near-term to approximately 2020, however, in the long-term, was very much the same or higher than the 1990 projection, due to a higher population projection. The 1995 Addendum discussed the need for a major review of the water supply plan in 1997.

1.2 1997 PROJECTIONS

In 1997, it became evident that major changes in the water use technology market warranted a reassessment of the water projections (Griffin *pers. comm.* 1997, see Appendix A). At the time of the Regional Water Supply Study, 23 litre toilets, i.e., 23 L per flush, were commonly available, with 13 litre toilets being promoted as water conserving toilets. However, building codes in many jurisdictions (including Manitoba) allowed 23 litre toilets. Under the U.S. Energy Policy Act of 1992, the 6-litre per flush toilet was made mandatory in the United States, starting in January of 1995. This caused a change in the U.S. marketplace. A similar legislation within Ontario made the 6-litre toilet dominant within the Canadian market. Several jurisdictions in British Columbia also have by-laws which require the installation of 6 litre toilets in new construction (Klassen *pers. comm.* 1998). At present, 13 litre and 6 litre toilets are generally available in Manitoba. With the legislated changes in the major markets in North America, the 6-litre toilet is now becoming increasing prevalent within Manitoba and will continue to dominate, until it will soon be the only toilet available. Monitoring of the local water appliance distributors by the City of Winnipeg Water Conservation Group (Griffin *pers. comm.* 1997) in 1996 and 1997, showed that the change in availability of the 6-litre toilet in the Manitoba market was already occurring. These major changes made it necessary to look beyond the simple historic use of water and the projected population growth and to consider the effect of technological changes in the use of water in the home. The fundamental factors characterizing water use will have to be reconsidered since future use patterns will not be reflected by past experience and technology, i.e., the future is not a simple extension of the past.

Figure 1-4 illustrates the various factors affecting residential water use projections. Within Winnipeg, residential water use is by far the largest of the three sectors (residential 55%,

City of Winnipeg
Water Use Projection & System Capacity
(1995 Regional Water Supply Study Addendum)



RWSS - Regional Water Supply Study

Source: Wardrop, TetrES 1995

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Figure 1-3

Factors Affecting Residential Water Use Projections

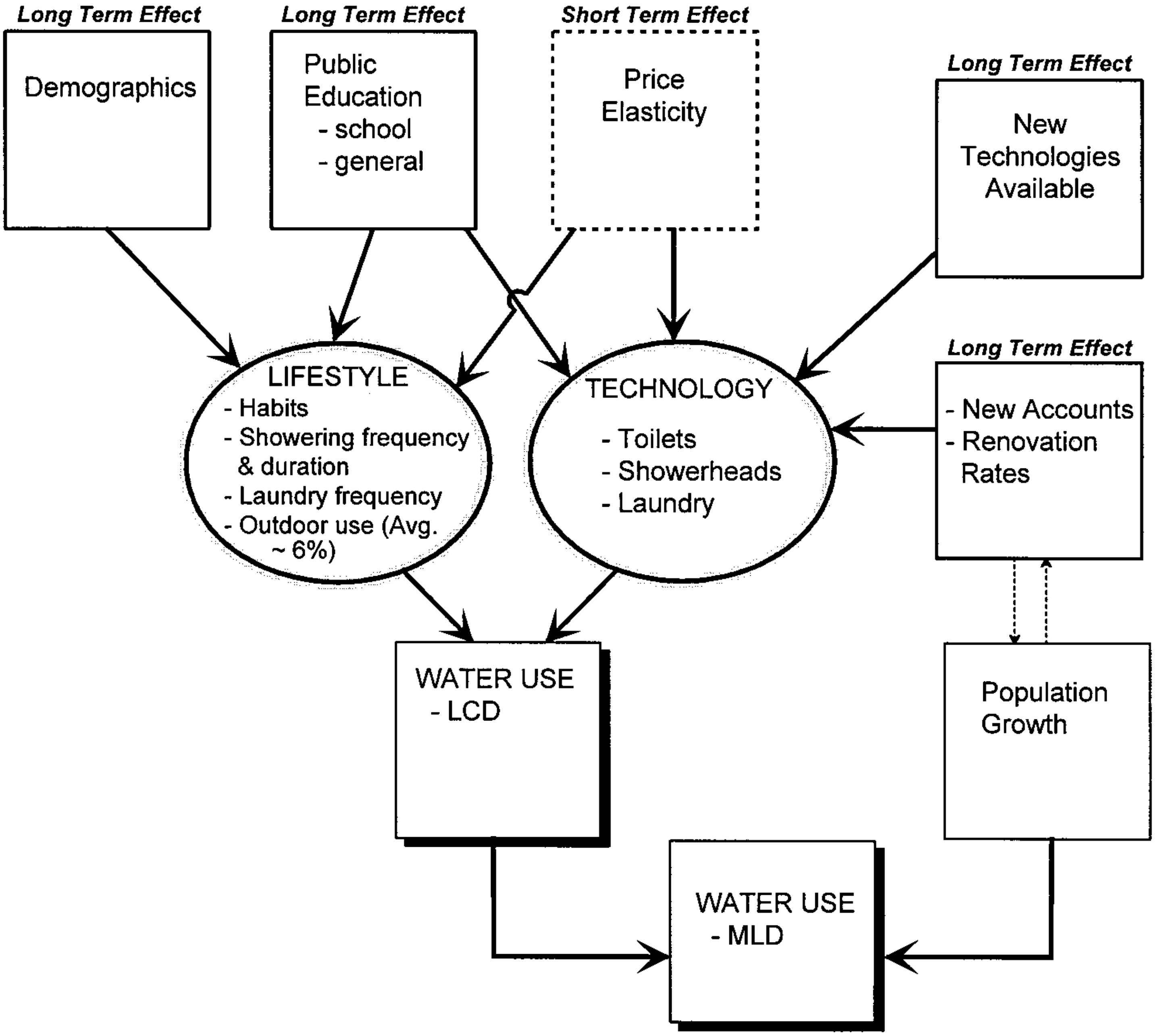

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Figure 1-4

commercial 18% and industrial 12%), with unaccounted-for-water at 15% and will be the driving factor in future projections. Factors that need to be considered are:

- the demographics, how people of different ages, or people born in different eras, use water;
- the effect of public education, greater awareness due to school and general education of the public with respect to water use, efficiency, and conservation ethics;
- the availability of new technologies in the marketplace, which will impact new accounts due to new construction and renovation rates (people replacing old appliances with new appliances).

The two governing factors in residential water use are people's lifestyles (their habits, showering frequency and duration, laundry frequency, outdoor use; although outdoor use is only 6% on average in Winnipeg) and the technology for using water. The technological devices which are key to residential water use are toilets, showerheads and laundry devices. All these factors were considered in developing the new 1997 projections. In addition, other changes since 1995, including the planned construction of a water treatment plant, have been moved from the year 2004 to the year 2006.

Price elasticity was assessed to determine the expected impact of rate increase on sales for the short-term (i.e., 5 years).

1.3 OUTLINE OF REPORT

This report will provide an evaluation of the **past usage by sector and discuss recent trends in usage** in these sectors in Section 2. Development of **long-term future trends** is done in Section 3 which will consider demographic changes in population growth and lifestyle changes. This **base trend** does not consider technology changes, public education, and price elasticity impacts. This base trend will then be adjusted in the following sections to account for **technology change** (Section 4), and **public education** (Section 5). **Revised long-term projections** are then presented in Section 6. These projections are then tested for response **to short-term price elasticity impacts** (Section 7). Since all projections are based on certain assumptions, it is important to do sensitivity analysis by varying the basic underlying assumptions. This **sensitivity analysis** will be shown in Section 8. A **summary and conclusions** follows in Section 9.

2. EVALUATION OF PAST USAGE

In order to assess long-term trends of water usage and the more recent dramatic changes in water usage, historic water usage was obtained from a variety of sources such as:

- the detailed water database which has been maintained from 1992 to 1996;
- City of Winnipeg water consumption summaries;
- previous water use reports run in 1989 and 1991 giving detailed information by water sector; and
- previous water planning reports (MacLaren 1979; CoW 1967; McLaren 1961).

The historic per capita water demand for residential/non-residential water uses since 1959 is shown on Figure 2-1. The historic water use by sector has not been documented annually since 1950. Since about 1975, annual water consumption reports have documented summaries of water use by billing block rather than sector. There is therefore limited data on use by sector over the years, however, the points obtained do indicate a trend, as discussed below. The non-residential usage includes industrial/commercial and unaccounted for water. This simplified division of the sectors was done to remain consistent with the type of division used in the early reports (MacLaren 1961 and CoW 1967). This figure shows a general increasing trend in both sectors from 1959 until about 1989 and then a levelling off the residential sector and a large decrease in the non-residential sector.

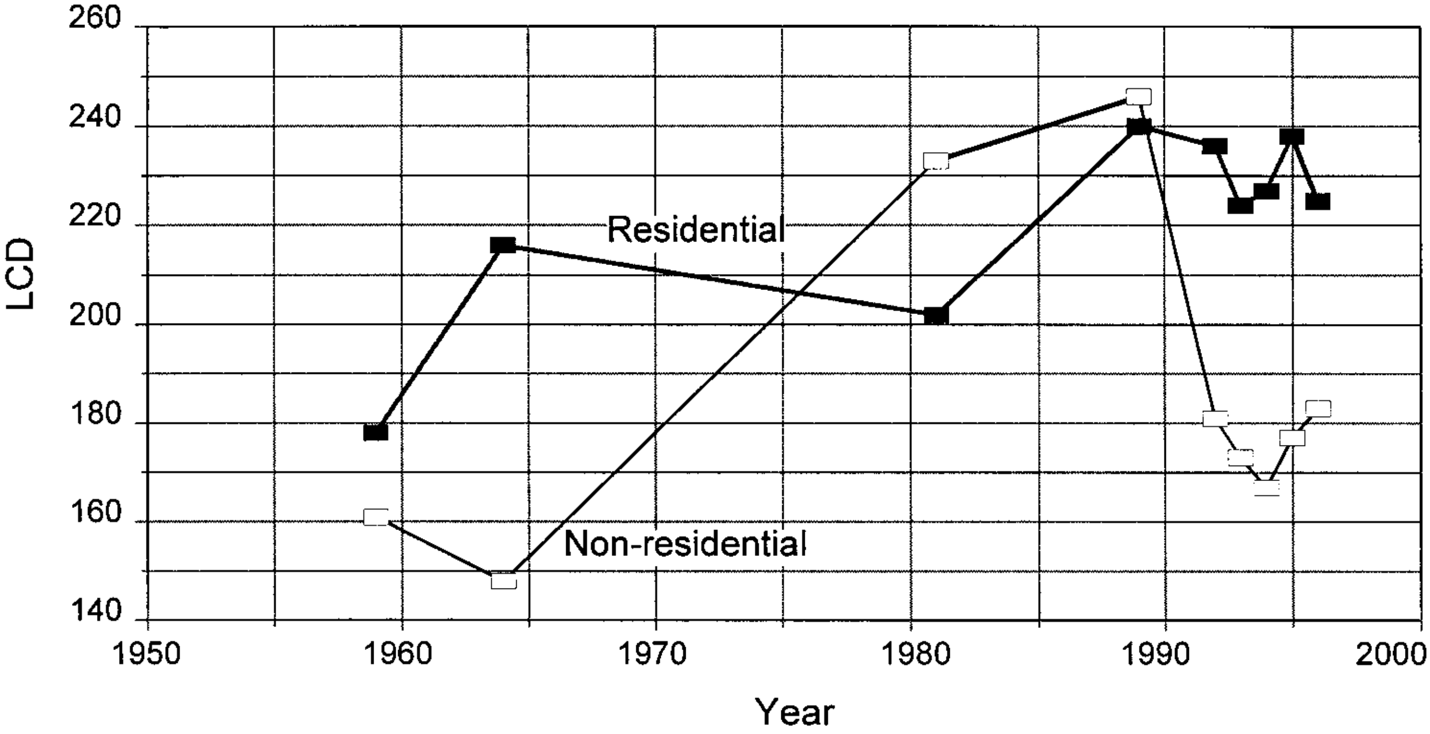
Other specific information on residential water use was obtained from the 1992 water use survey done for the water conservation pilot retrofit report (Wardrop/Tetr*ES* 1994b). In addition, a survey of the largest industrial water users was done in 1995 (Tetr*ES* 1996). This survey indicated that 55% of the 28 largest users were practicing water conservation and expected to be using less water in 5 years (see Appendix B for a summary of the survey).

The potential factors causing this large drop in usage from 1989 to 1993 were numerous. The potential factors are listed below and several are discussed in more detail later in the report:

- in the early 1990s, there was an economic slow-down which caused a reduction in new housing and a reduction in new commercial development;

Historic Per Capita Water Demand

Residential and Non-Residential



Note: Non-residential includes industrial, commercial and UFW.

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Figure 2-1

- over this period, the City of Winnipeg increased the price of water and sewer at a rate significantly higher than the inflation rate (this is discussed in more detail in Section 6);

- there was increased awareness of water usage due to the water conservation program of the City and the start of the aqueduct repair program and its associated publicity;

- demographic changes which may have a longer term effect on water usage were beginning to become significant (see Section 3);

- during the early 1990s (1992 and 1993) the summers were much wetter than during the late 1980s. This would have reduced outdoor water use; and

- the late 1980s and early 1990s were a period of increasing environmental awareness, due to the "green" movement in which citizens were becoming more environmentally aware. This contributed to reduced water consumption.

3. ASSESSMENT OF WATER USE TRENDS

This section will look at predicting the trends in various water-use sectors before the impact of technology change, price impacts and impacts of increased public education. Water use will be looked at under the various sectors:

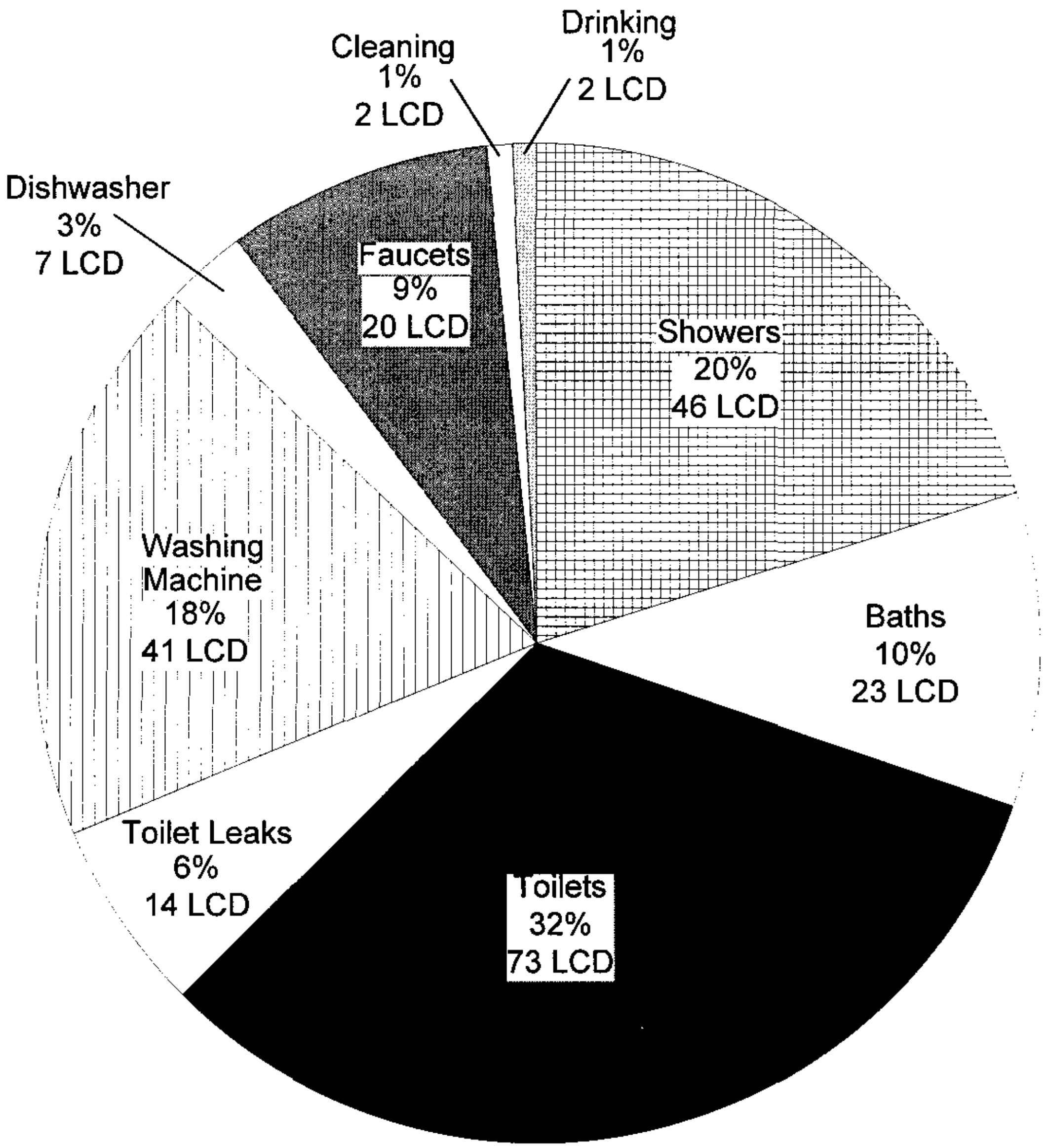
- residential indoor usage;
- commercial indoor usage;
- industrial indoor usage;
- additional summer usage across all sectors;
- unaccounted-for water; and
- other uses such as treatment plant uses.

3.1 RESIDENTIAL USAGE TRENDS

The biggest factors impacting residential water-usage trends in the past and in the future was and will be the demographic trends. The 1992 survey on Winnipeg's water usage and demographics analyzed how various factors such as household size and either the age or the birth-date of a person impacted the water use in that household. This estimation of water use by demographic groups is useful since much of historic-use data and future population planning is based on demographics. Historic census population by age cohort was obtained from 1951 to 1991. The City of Winnipeg has done a population projection by cohort to the year 2016. Tetr*ES* Consultants extended this analysis using the same basic principles of demographic modelling to the year 2046. This information is shown in Appendix C. These projections include the number of dwellings, as well as populations by cohort, which will assist in determining the number of new housing starts to be expected in the future.

Before discussing overall residential water usage, it is useful to review how water is used indoors. Figure 3-1 illustrates a breakdown of residential water use for the City of Winnipeg. This was developed in 1992 using information from the water use survey and general information on water consumption in the home, under various categories and is generally

Residential Indoor Water Use in Winnipeg



Total Residential Indoor Use - 228 LCD
LCD - Litres /capita /day

Source: Wardrop, TetrES, 1992

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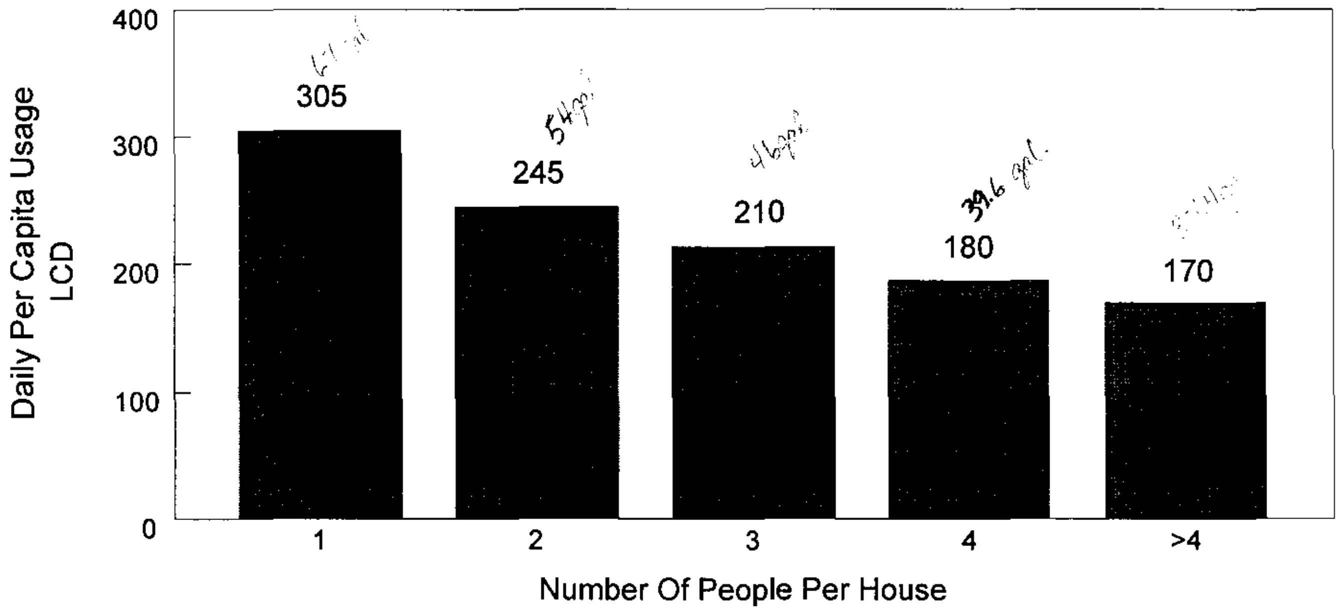
Figure 3-1

consistent with experience reported elsewhere. As can be seen, the largest indoor uses are toilets, which are significantly affected by technology, and showers, which can be affected by demographics, as discussed later.

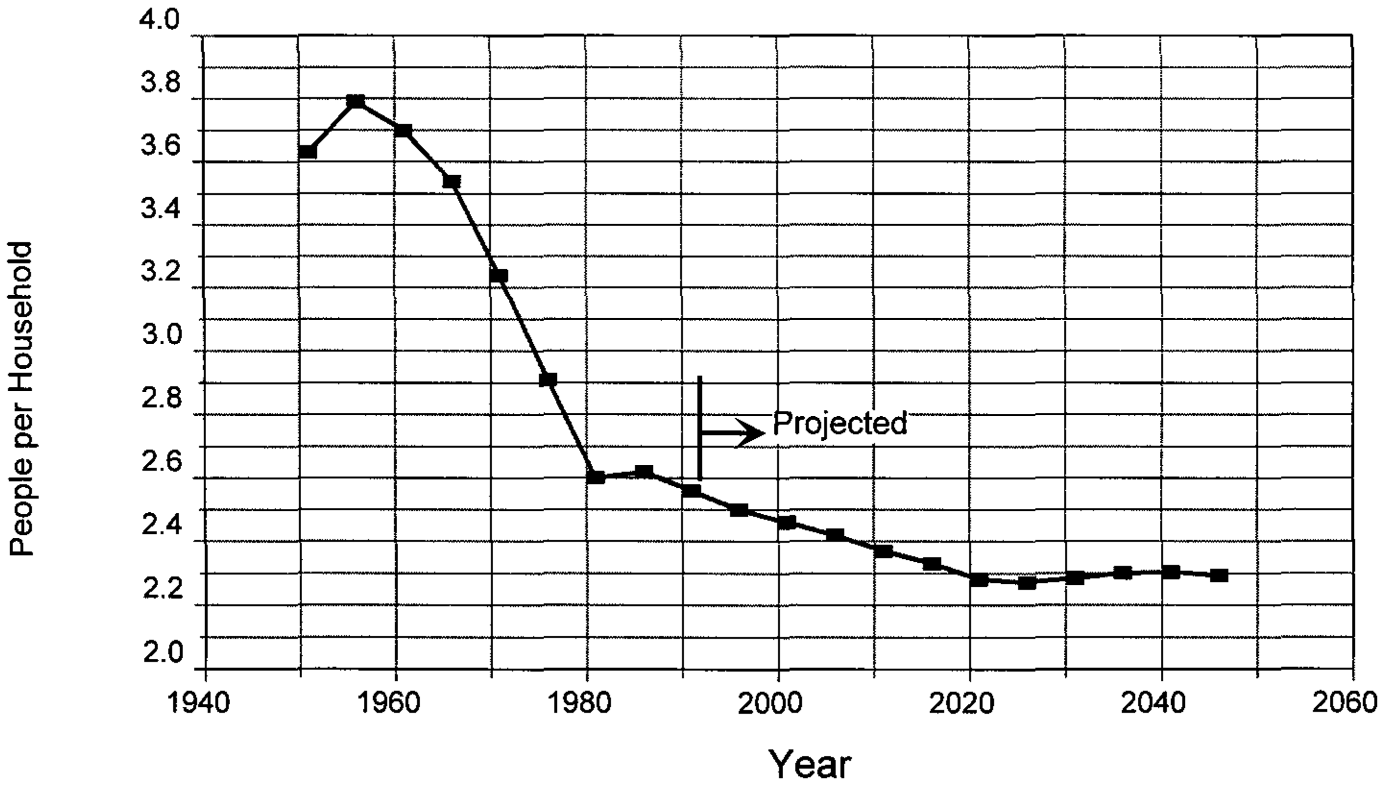
Figure 3-2 illustrates the per capita water use in Winnipeg homes varies, depending upon the number of people per house. The more people in a household, the lower the per capita usage. For example, with 4 people per household, the usage is 180 L/capita/day (LCD). When there is only 3 people in a home, the average per capita usage is 210 LCD. This increases to 245 LCD which only 2 people are in one household. Figure 3-3 shows the average number of people per household from 1950 until 1991 as determined by Census Canada. Household sizes were projected using the various cohort models. As can be seen starting in the late 1950s, the average people per household peaked at about 3.8. During the 1960s and through the 1970s, the household size dropped dramatically to about 2.5. This could have been due to various factors such as the end of the baby-boom, people moving out to start their own households at a younger age, and the increase in single-parent families. This dramatic drop in people per household, coupled with the trend seen in Figure 3-2, illustrates that these changes can have major impacts on city-wide per capita water use.

Another interesting finding in the 1992 water survey was that per capita usage appeared to vary, depending upon the age of the people within the household. A regression analysis approach was used to determine the usage which can be attributed to the "household" and the incremental use attributed to each member of the household, depending upon their age. Figure 3-4a illustrates this water usage pattern by age. About 221 litres per household per day was attributed as a base value for the "household" and the additional water usage per person varied from about 60 LCD for those under six to 157 for those between the ages of 13 and 19. There appears to be a large increase in water use after the age of 12, increasing from about 80 LCD to 157 LCD. After that, there is a slight decrease until the age 64. For those over 65, the water use is significantly lower.

This water use correlated well with the requested specific type of water use, namely showers or baths per person by age. Analysis done on showers and bath per person or age is shown in Figure 3-4b. As can be seen, this trend in showers or baths is very similar to that in water use in each of the age groups. Therefore the showering and bathing habits appear to be the



Per Capita Usage with Varying People
Figure 3-2



Average Number of People per Household
Figure 3-3

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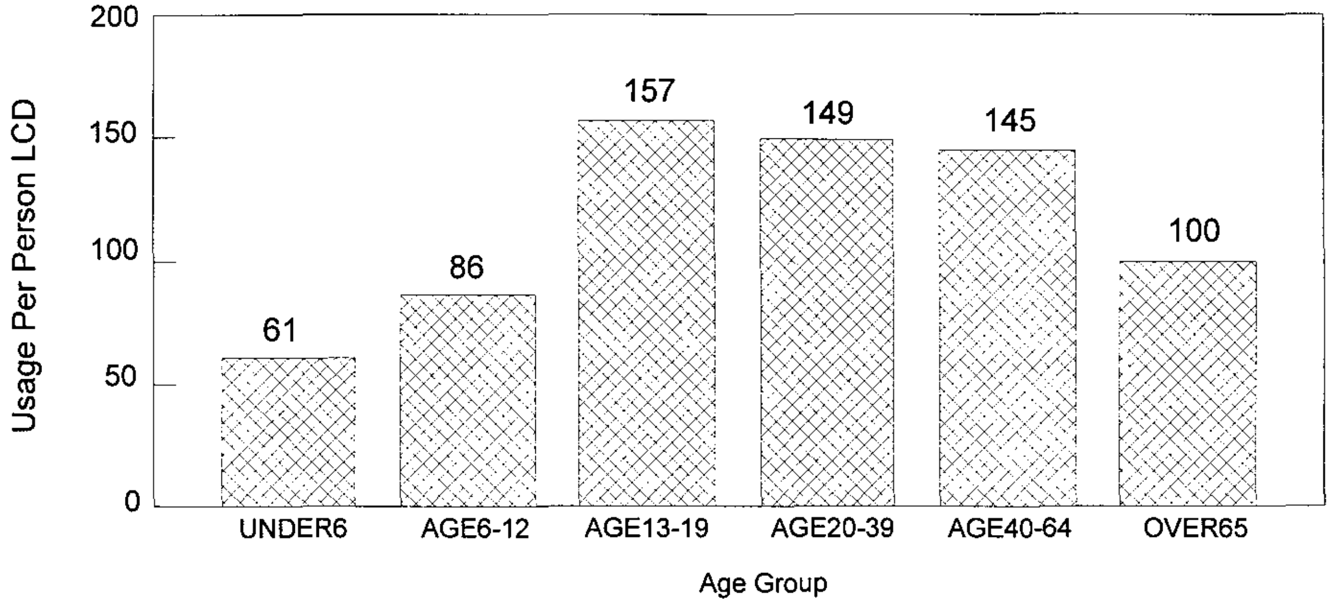
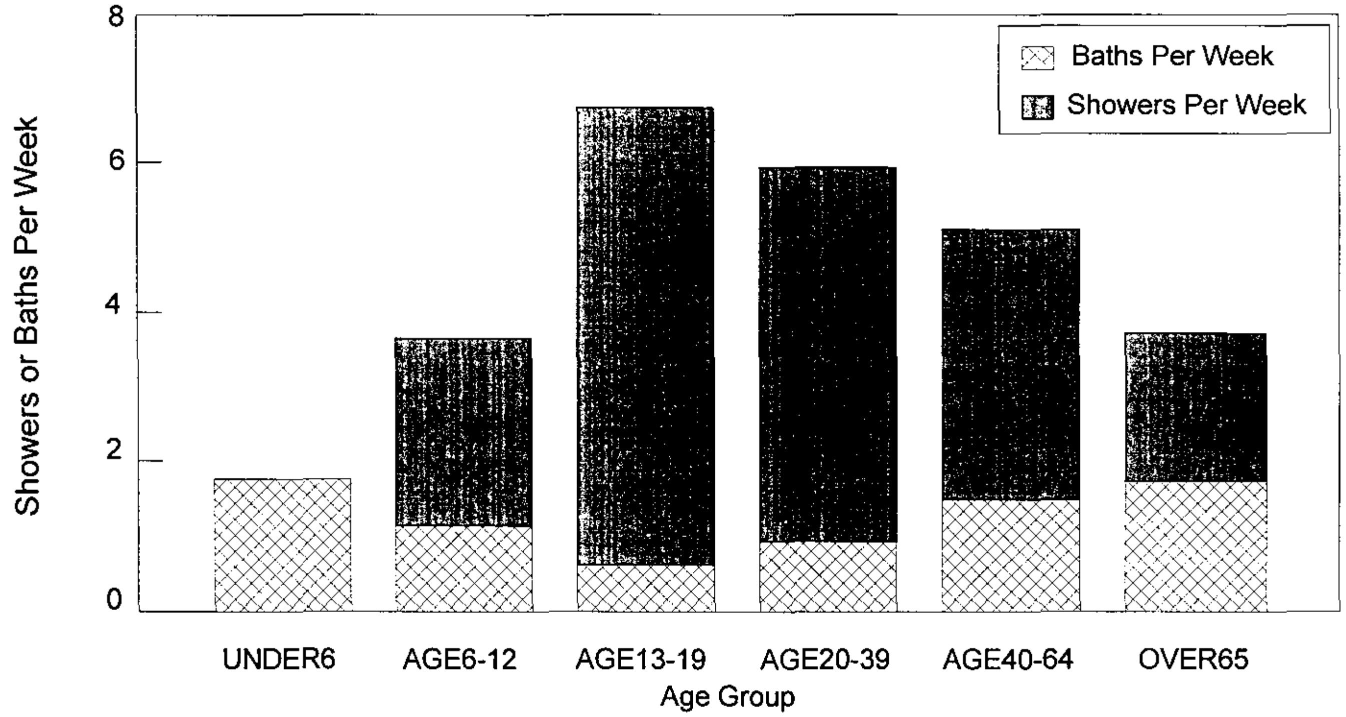


Base Usage Per House=221 L/H/D

Usage per Person in Age Group (a)



Showers or Baths Per Week by Age (b)

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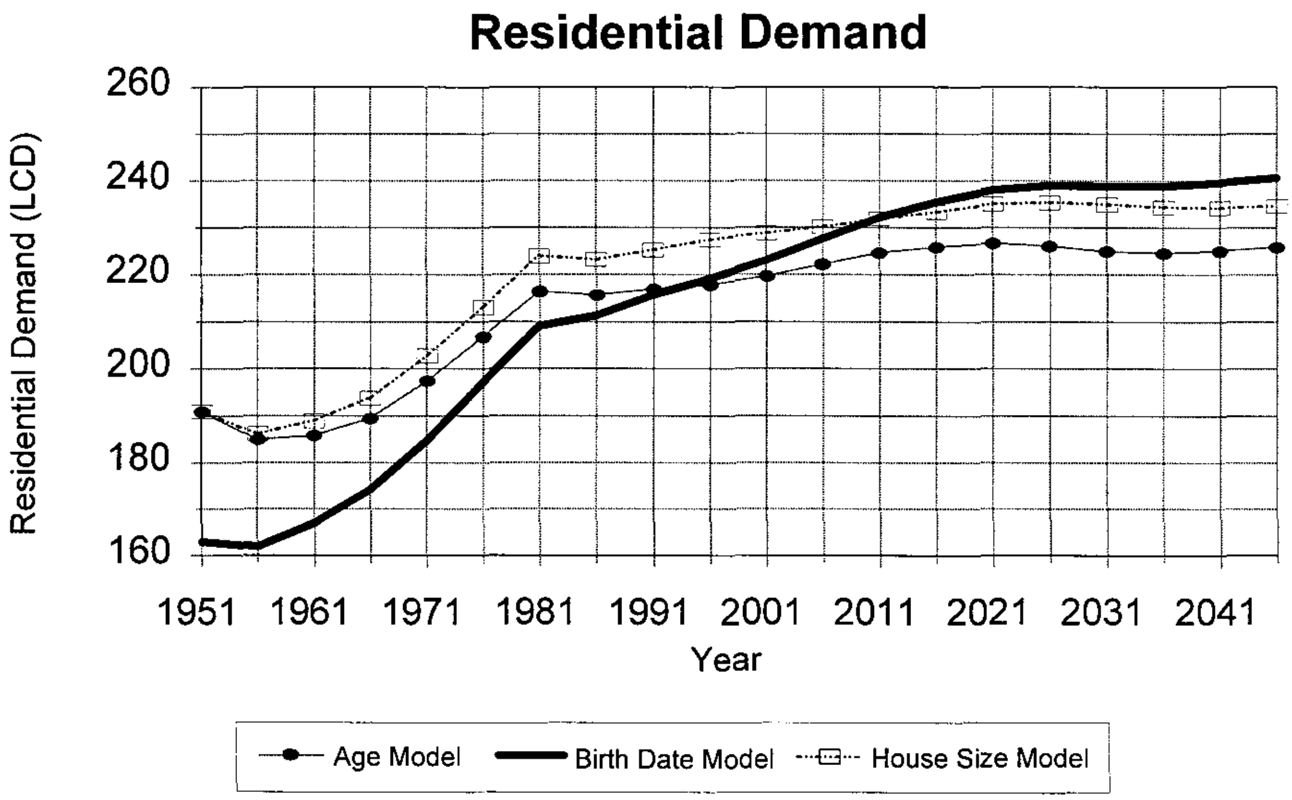
Figure 3-4

main reason for the variance in each age group. This could be due to two different demographic trends. One is that people's water use varies with age, or, that people's water use varies with their birth-date. One hypothesis would be that independent of when the person was born they will use more water in their teenage years than they will in their 20s, 30s, 40s, 50s and then their water use will decrease after 65 during retirement. A second hypothesis would be that their water use is dependent upon the "age" they were born. Those born in the period before 1930 have grown up in the times when water use habits were much different. Bathing every second day was more common than it is today. This hypothesis would imply that when today's generations of 20 to 60 year olds retire they will still bath almost every day and have water use habits very similar to their current ones.

This information on water use habits and population cohort models was used to develop a projected residential water use model. Three different models were developed. These are:

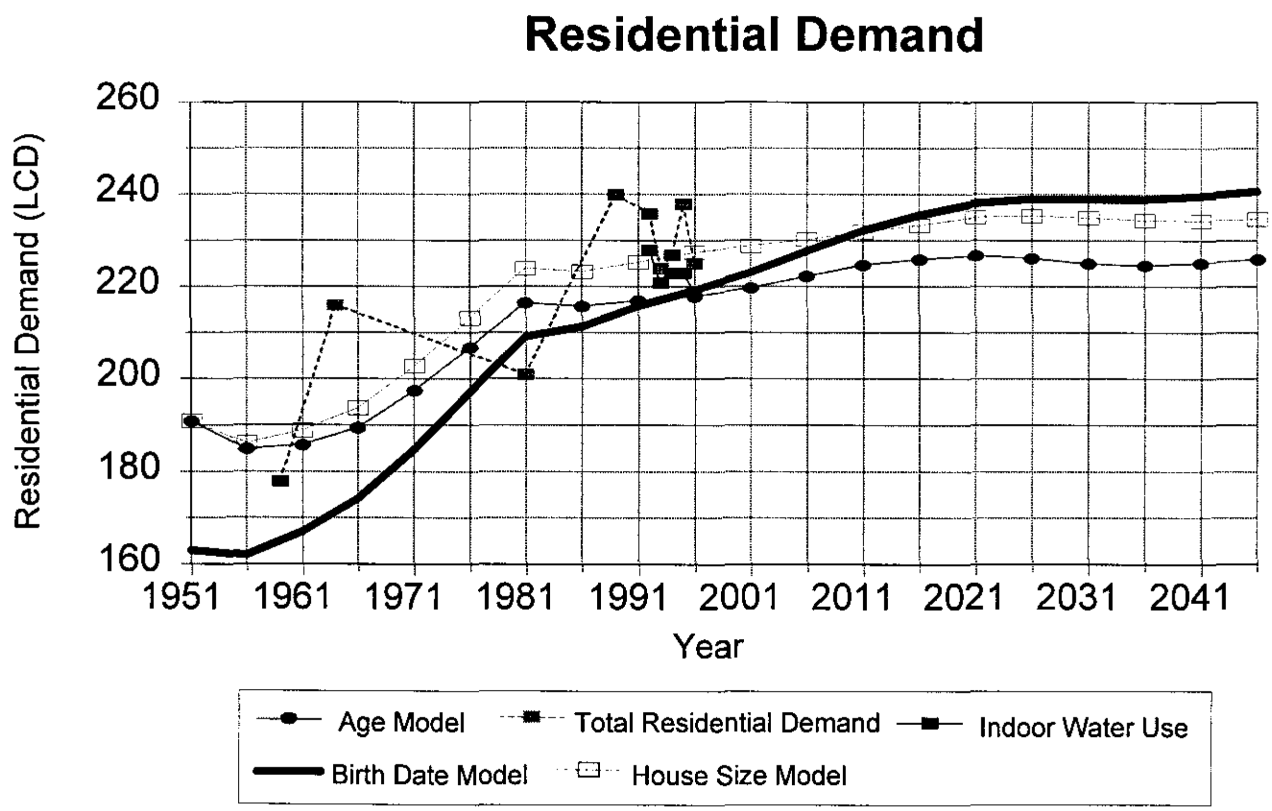
- *Age Model* - In this model the age of the person affects water use;
- *Birth-date Model* - In this model the date of birth of the persons affects water use (those under 12 excluded); and
- *Household Size Model* - In this model, only the number of people per dwelling affects per capita water use.

The details of each of these models is shown in Appendix D and the resultant demand is predicted by these models as are shown in Figure 3-5 for the period 1950 to 2041. Figure 3-6 shows the same three models along with the actual residential per capita demands since 1950. The important aspect to note about all these model results is the trends rather than the actual use. All models show the 1956 to 1981 period as strong per capita growth averaging about 0.8% per year. From 1981 to 2001, the models show slow per capita growth, averaging at about 0.19% per year. Post-2021, there is virtually no projected per capita growth in water consumption. The usage estimate by the various models and the growth in estimates by various models in litres/capita/year and percent/year, are shown in Tables 3-1,3-2, and 3-3.



Demographic Models

Figure 3-5



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Demographic Models and Historic Data

Figure 3-6

Table 3-1
Usage Estimate By Various Models
(LCD)

Year	House Size Model	Age Model	Birth Date Model
1956	186	185	162
1981	224	216	209
2021	235	227	238
2046	235	226	241

Table 3-2
Growth Estimate By Various Models
LCD/year

Period	House Size Model	Age Model	Birth Date Model	Actual
1956-1981	1.52	1.24	1.88	1.55
1981-2021	0.28	0.28	0.73	0.43
post 2021	0.00	(0.04)	0.12	0.03

Table 3-3
Growth Estimate By Various Models
%/year

Period	House Size Model	Age Model	Birth Date Model	Average
1956-1981	0.75%	0.62%	1.02%	0.80%
1981-2021	0.12%	0.12%	0.33%	0.19%
post 2021	0.00%	-0.02%	0.05%	0.01%

For the residential per capita demand projection, certain assumptions were made based on the analysis shown in these tables. The per capita demand (without technological or public attitude changes) is expected to increase from the current rate at 0.73 LCD/yr (or 0.33%/yr) from the present time until 2021. After 2021, it is assumed that there will be no growth in per capita demand. These assumptions would show the per capita demand growing from 228 LCD to about 250 LCD by the year 2020. Following 2020, the per capita residential water usage would remain constant.

3.2 INDUSTRIAL AND COMMERCIAL TRENDS

As seen in Section 2, there has been a large decrease in industrial and commercial usage in the early 1990s. This change is likely due to an economic slow-down in the 1990s as reflected in industrial, commercial and institutional (ICI) construction trends shown on Figure 3-7, and an increased efficiency in water use in reaction to increasing prices. For the long term, we believe that both industrial and commercial water usage will not increase in terms of per capita usage. This assumption is based on several factors:

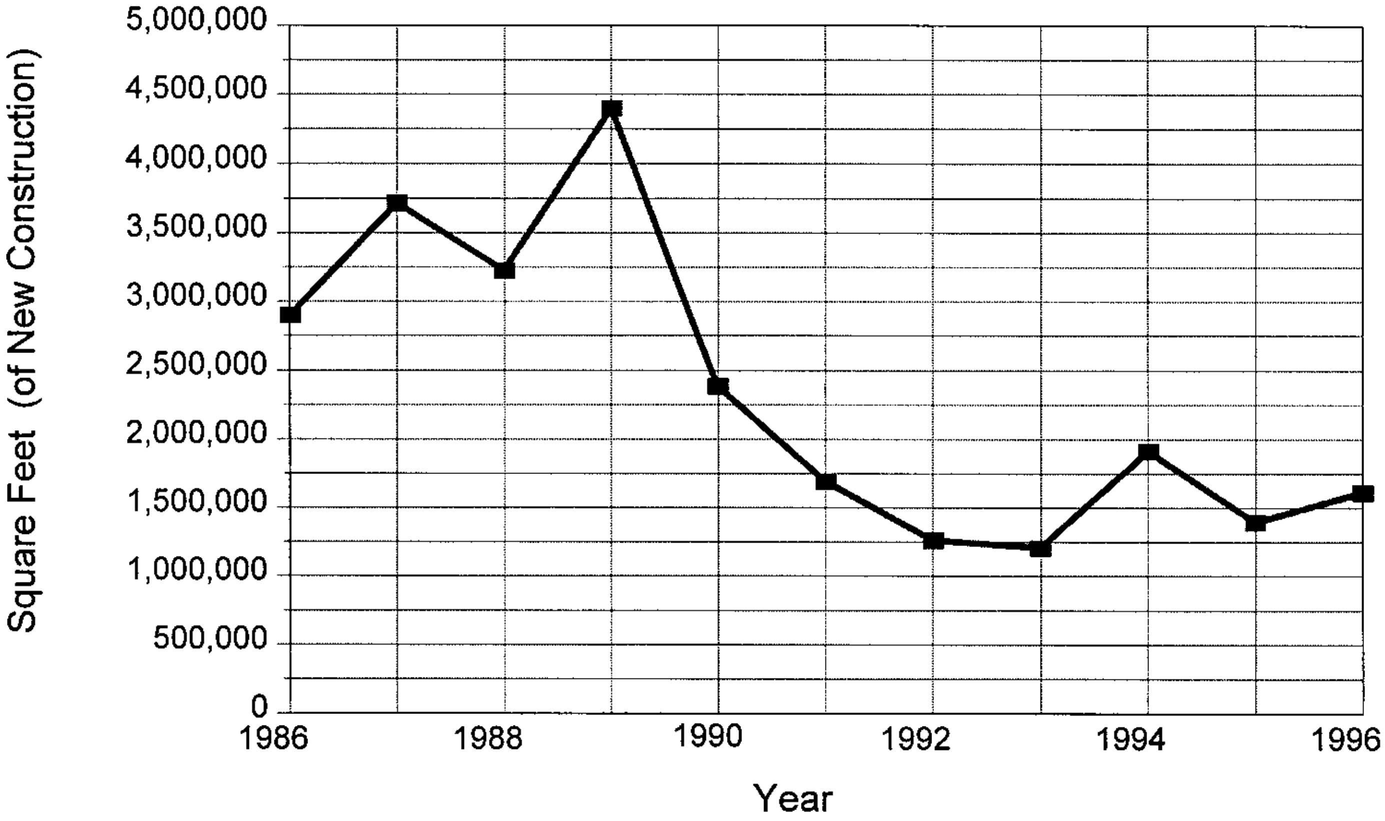
- with implementation of water treatment in the future, the cost of water will be higher, leading to ICI customers improving their water use efficiently or a change to greater groundwater use;

- commercial usage could reflect savings in toilet use, as expected in residential (see next section), although this will not be as dramatic since commercial toilets are currently very efficient; and

- a recent customer survey of the largest industrial users (Tetr*ES* 1995) indicated that this group's consumption is expected to remain constant or drop further in the future.

Therefore, we believe that the assumption of a constant per capita use for industrial consumption of 50 LCD and for commercial consumption of 75 LCD is reasonable and probably conservatively high.

Industrial / Commercial / Institutional Construction



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Construction Trends in Industrial / Commercial / Institutional Sectors
Figure 3-7

3.3 UNACCOUNTED-FOR WATER

For planning purposes, the highest unaccounted-for water measured in the last decade of 19.7% in 1989 was used in making our future water projections. This is likely on the high side, since unaccounted-for water could be reduced due to the continuing watermain renewal effort. For the purposes of estimating sales, unaccounted-for water is not a factor. It should also be noted that as the average daily use decreases the volume of UFW remains constant and thereby becomes a larger percentage. UFW is not related to water consumed but rather a function of the water system, i.e., leaks, pressure and unmetered uses such as fire-fighting, street-sweeping and sewer-flushing.

3.4 TREATMENT PLANT USES

For planning purposes in developing a long-term projection, we have assumed that treatment plant usage due to filter backwashing will be 5% of total water usage. This is likely high, since current indications are that 1 to 2% can be expected. The purpose of doing these planning projections is to assure that capacities are available at the treatment plant from the main supply aqueduct for the long term. It is important to note that the backwash water allowance should not be included in any revenue projection model, as this water is lost due to the WTP.

3.5 ADDITIONAL SUMMER WATER USE

A review of daily historic water use has shown that additional summer use can vary from 3% to 12.6% of annual usage (1988). In order to develop the upper envelope used in water supply planning, 12.6% is assumed. A review of the detailed water use database from 1992 to 1996 indicated that the additional use should not be attributed to lawn watering only. There is an increase in water use in the commercial and industrial sectors in the summer as well.

The average "outdoor" use in Winnipeg is 6% of total annual pumpage, however most of this additional water is consumed over the summer season (May through September).

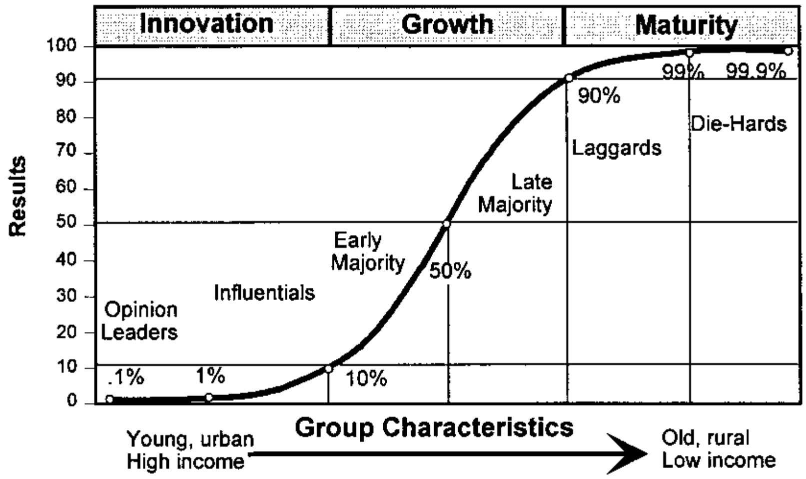
4. IMPACT OF TECHNOLOGY CHANGE

In order to determine the impact of technology change on the projection, three key questions are especially relevant:

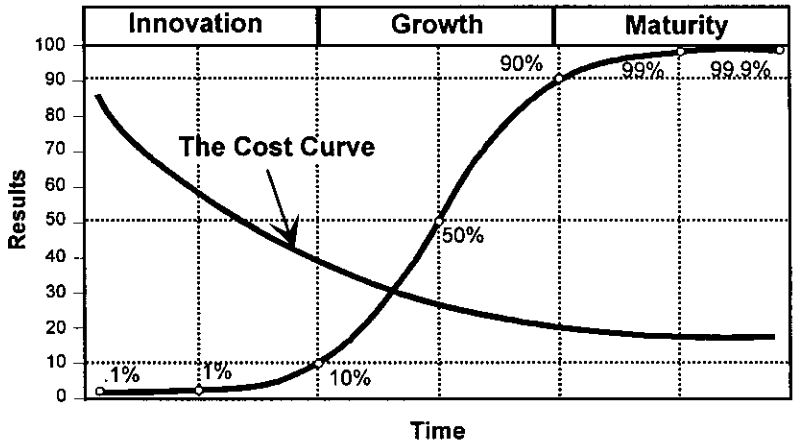
- which devices will change in the future?
- how much of an improvement in efficiency can be expected from each device?
- how fast are these devices replaced in the home?

Toilets are the largest water using device in the home today and there has been a dramatic shift in the water-use efficiency of this device. Historically, most toilets use about 22 litres/flush. Low flush toilets introduced in the 1980s in Winnipeg used about 13 litres/flush and the current and future expectation for water-efficient toilets is about 6 litres/flush. Showering is another major water use in the home. Efficiency of showerheads has improved from 16 litres/min to 12 litres/min, and is now down to 8.3 litres/min. Washing machines are also a large user. A recent study, presented at the 1996 AWWA Water Conservation Conference (Hill *et al.* 1996), indicated that, although many machines may save up to 50% of water use, on average, new high-efficiency washing machines use about 20% less water than current models. This would increase the water efficiency in the average home and reduce water use from 41 LCD to 33 LCD.

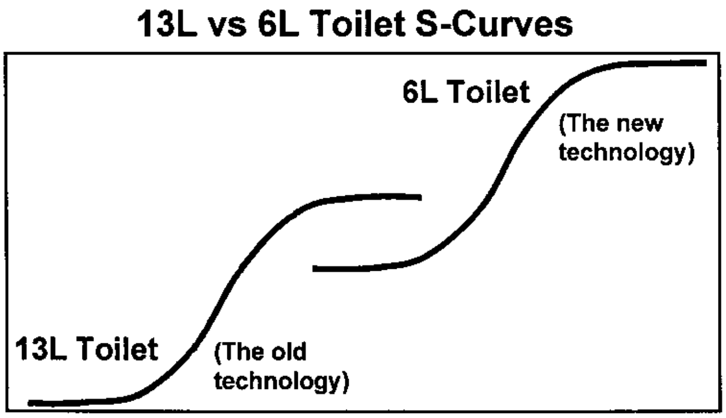
In order to estimate what technology will be in place in each home in the future, it is necessary to estimate what percentage of each type of technology is available on the market in a certain time, and at what rate that new technology is installed in the home, either due to new dwellings being developed, or renovations involving the replacement of the old technology. The introduction of new technology is best defined by "S" curves (Dent 1993). Figure 4-1 shows a series of these "S" curves. Figure 4-1a shows that after an initial period of innovation, about 10% of the market will use the new technology, followed by a period of large growth in which, fairly quickly, 90% of the market will use the new technology. The maturity stage is when the residual people are introduced to the technology. Figure 4-1b shows that much of this "S" curve is driven by a reduction in cost of the technology due to improved production and economy of scale. Figure 4-1c shows an example of how the 13 and 6 litre toilet technology is being introduced through the 1980s, 1990s and into the year 2000. The 13 litre toilet has had



Consumer Adoption Patterns (a)



The Cost Curve (b)



Source: Harry S. Dent Jr.
The Great Boom Ahead
1993

Overlapping S-Curves of 13L and 6L toilets (c)

Market Change due to Technology Acceptance

Figure 4-1

a period of both innovation and growth which is expected to be followed by the 6 litre toilets period of innovation and growth. The 6L innovation period has taken place and we are in the early growth period.

In order to estimate future toilet sales by efficiency type in Winnipeg, specific "S" curves were developed for Winnipeg. An example of such a curve is shown in Figure 4-2. The 6 litre toilet was introduced in the early 1990s in Winnipeg and informal surveys of distributors within Winnipeg (Griffin *pers. comm.* 1997) have shown that currently 30 to 50% of the toilet inventory in Winnipeg are 6 litres at present (see Table 4-1). This would indicate that we are in the growth phase of the market for 6 litre/flush toilets.

A 4% renovation rate assumption for toilets is based on information from a 1996 Survey of Manitoba Residents (Prairie Research 1996). In order to estimate what percentage of each type of toilet will be in Winnipeg homes in the future (see Figure 4-3), the 4% renovation rate was assumed for bathrooms and 44% of current toilets were assumed to be 13 litres/flush and 56% to be 22 litres/flush (1992 datum). The current estimate of 44% was arrived at by assuming that 13 litre toilets have been available since 1983 and that all homes renovated or built since that time have used 13 litre toilets. This appears to be reasonable, since this ratio of toilets would give an average flush of 18 litre/flush and assuming 4 flushes/person/day would give a toilet usage of about 72 LCD, which is the estimated toilet usage from other sources (Wardrop/Tetr*ES* 1994b). Figure 4-4 demonstrates the dramatic impact this change in type of toilets will have over the next half-century on indoor water use. The per capita water use for toilets will drop from 73 LCD to 30 LCD.

A similar analysis was done with showerheads. Three devices were considered: 16 litres/min showers, 12 litres/min showers, and 8.3 litres/min showers. The annual increase due to demographic changes of 0.73 LCD/yr was all attributed to an increasing length of shower. Therefore, when the analysis of water use in showers was done (see Figure 4-4), shower usage appears to be relatively constant from 1992 to 2045. This is due to increasing efficiency of showers being counteracted by an increasing average shower length for people in the future.

TABLE 4-1

BREAKDOWN OF TOILET SALES IN WINNIPEG

PERCENTAGE SALES IN MANITOBA			
TOILET	1995	1996	1997
6L	10%	24%	50%
13L	90%	76%	50%
22L	0%	0%	0%

Source: Greg Barachuk (given verbally)

Note: December 1997 6L and 13L toilets are the same price

	2005*	
6 l or less	81.8 %	dual 13.4% / 6l 68.4%
13 l	18.2%	

* Sales of 13L Toilet versus Low-Flush Models in Canada (2005)

Toilet Sales By Type in Winnipeg

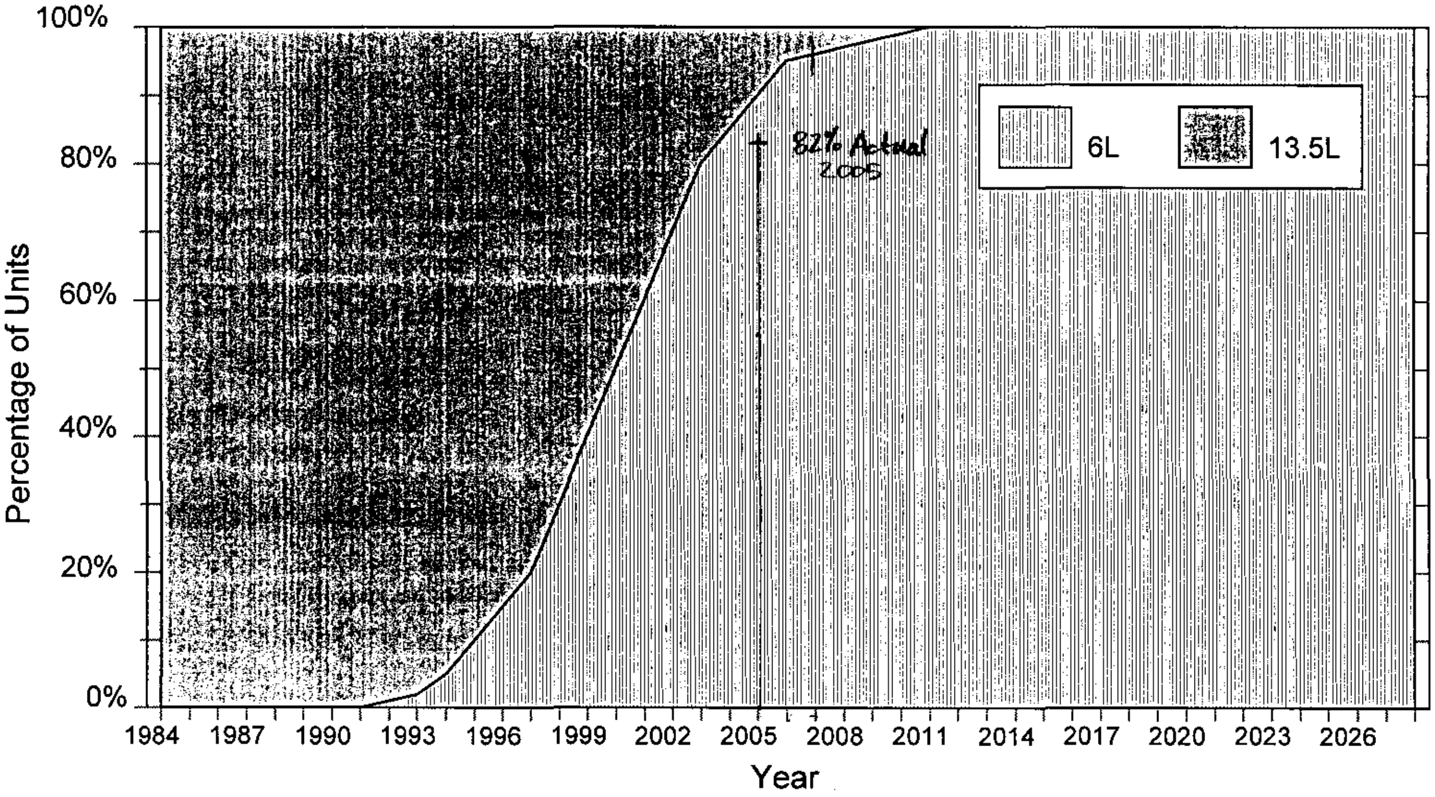


Figure 4-2

Transition in Toilets Used

(4% Renovation Rate)

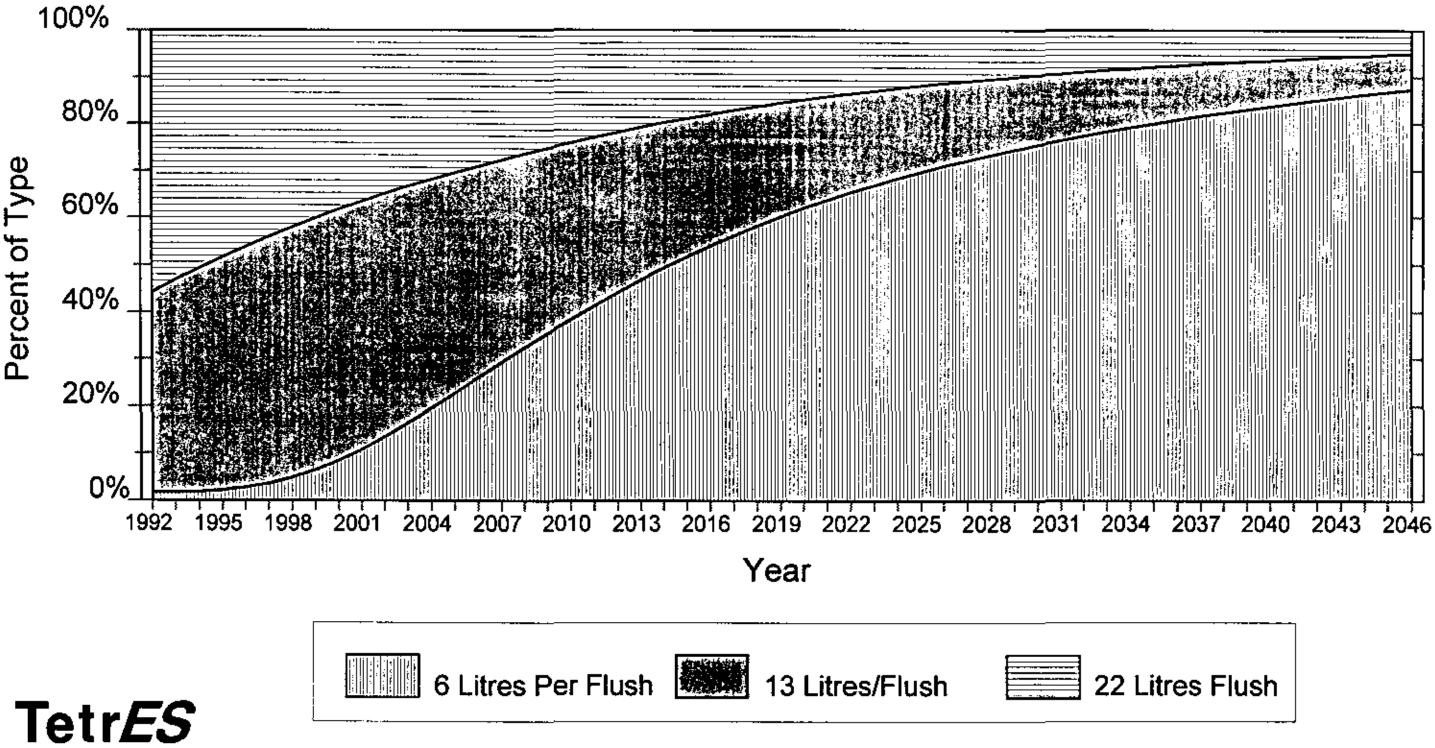


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Figure 4-3

Per Capita Toilet and Shower Water Use

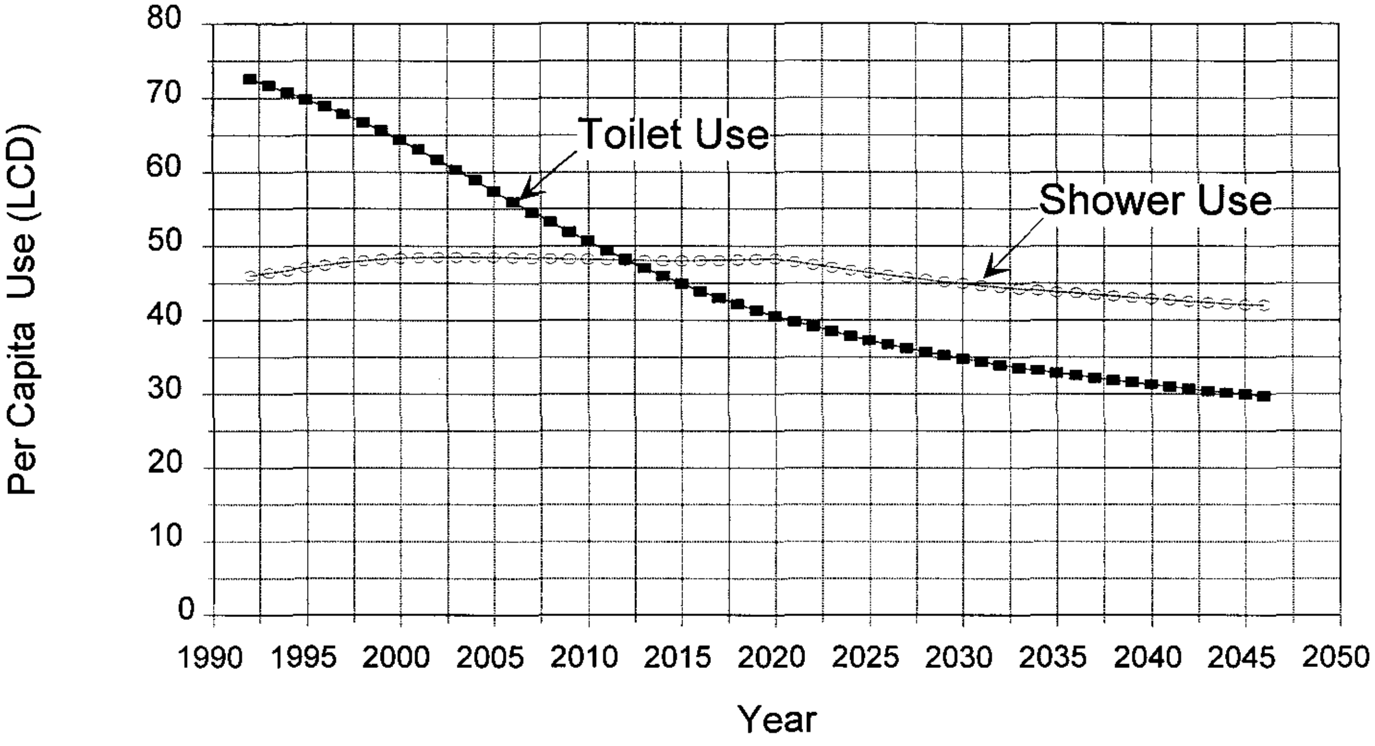

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Figure 4-4

When considering washing machines, we find that more efficient washers are just being introduced in our market, however, the price is high - $1,000 to $1,400 per unit (Griffin *pers. comm.* 1997). The type of laundry washing machines sold in Winnipeg is expected to remain as predominantly low-efficiency washers for the near future. The "S" curve for washer sales in Winnipeg is shown in Figure 4-5. Because of the higher cost of high-efficiency washers currently, significant introduction of these washers is not expected until 1999, and high-efficiency washers are not expected to dominate the market until after 2010. The difference between the two technologies is the new water efficient units are generally front load and wash using the same tumble action as a clothes dryer. Assuming a 7%/yr change-out rate of washers (a 15-year life span of a washer), the type of washers installed in Winnipeg homes in the future is shown in Figure 4-6.

Figure 4-7 shows how the changing residential indoor water use will evolve over the next half-century. Water consumption is expected to decrease from 228 LCD per capita in 1992 to 174 LCD per capita in 2046. Most of that decrease will be due to the large reduction in toilet usage due to the introduction of 6 litres/flush toilets (from 73 LCD to 30 LCD). This 25% reduction may appear to be a dramatic change, however, experience in Winnipeg has indicated it is a reasonable expectation. A toilet rebate program was done in 1994-95, and 5 homes used the offer to replace their existing toilet with a 6 litre per flush ULF model. Their savings averaged 34%, considerably higher than the estimation used in this report (see Appendix E for details).

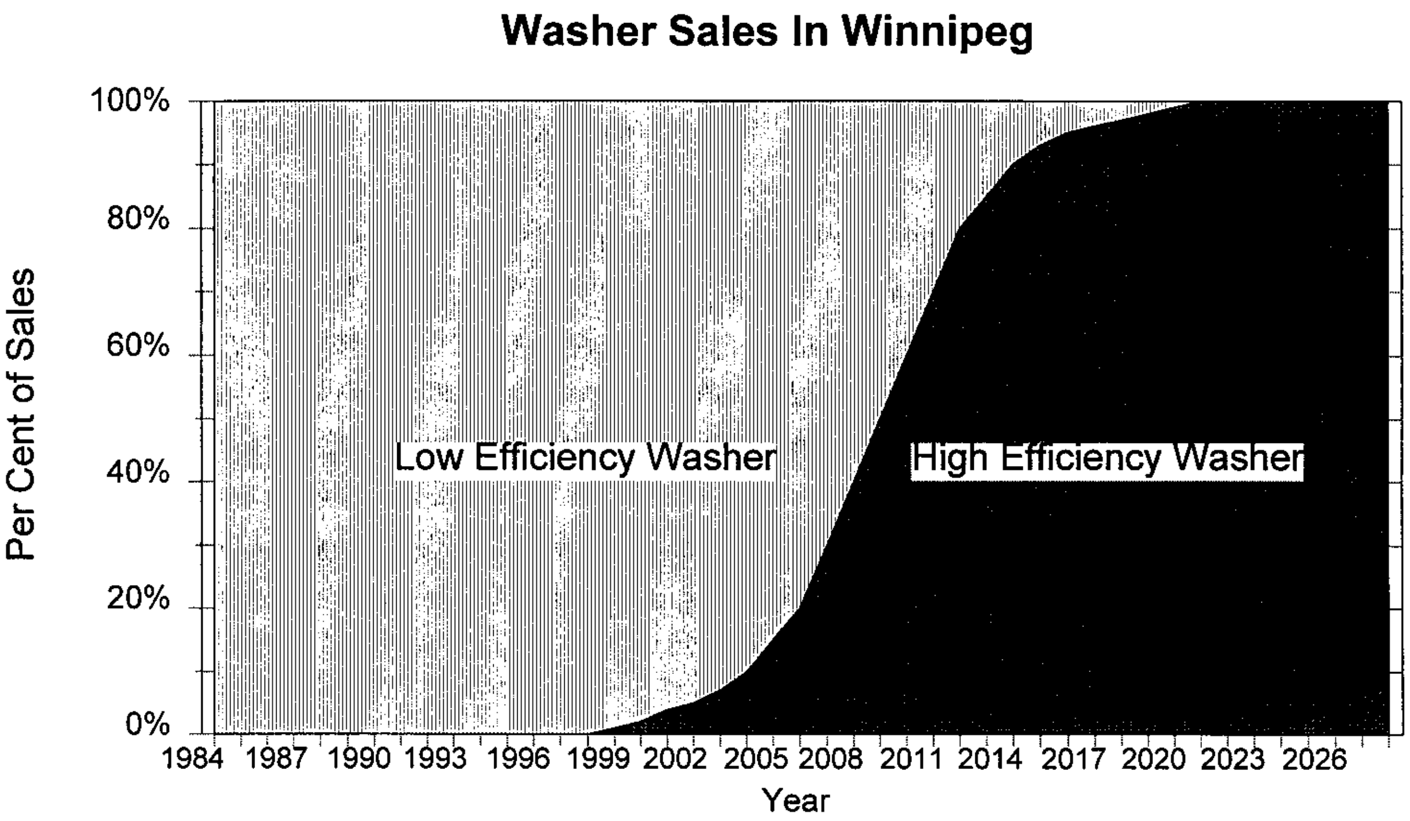

Figure 4-5

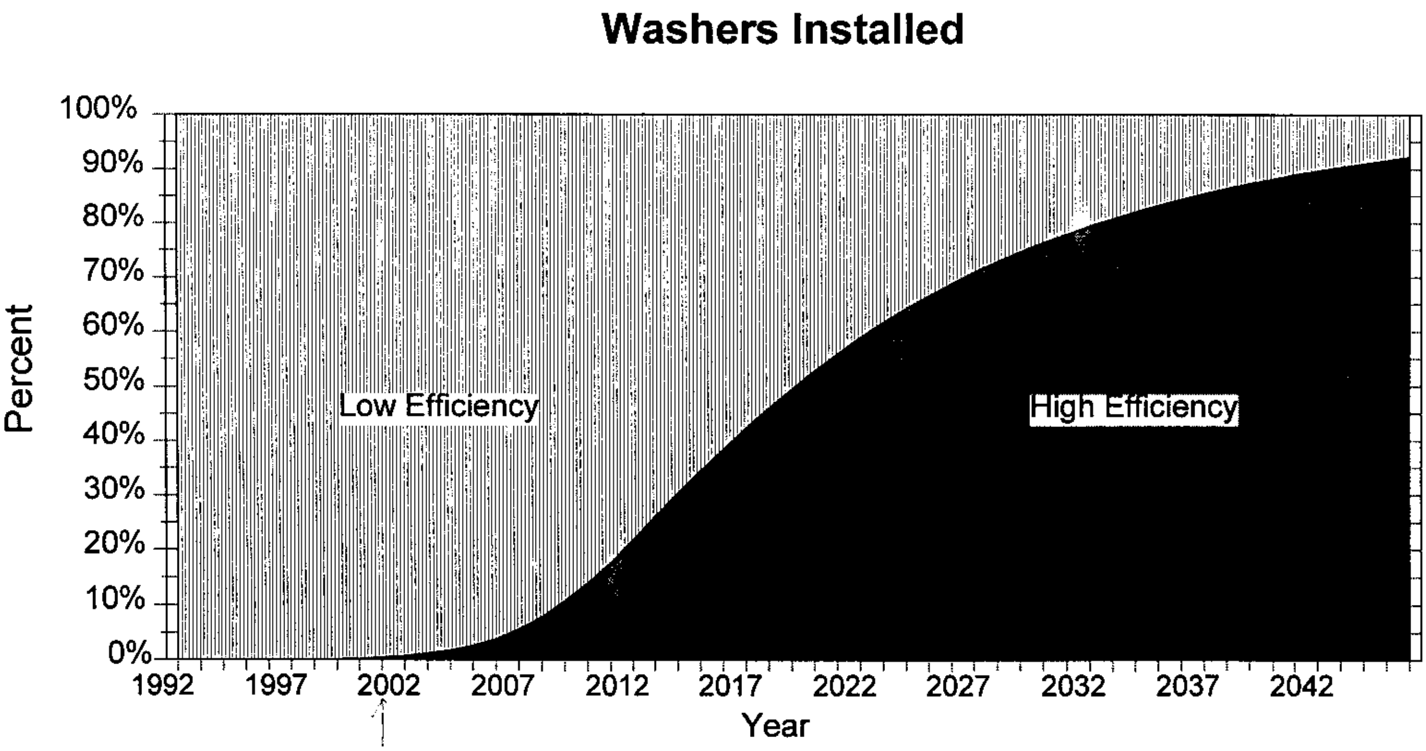

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Figure 4-6

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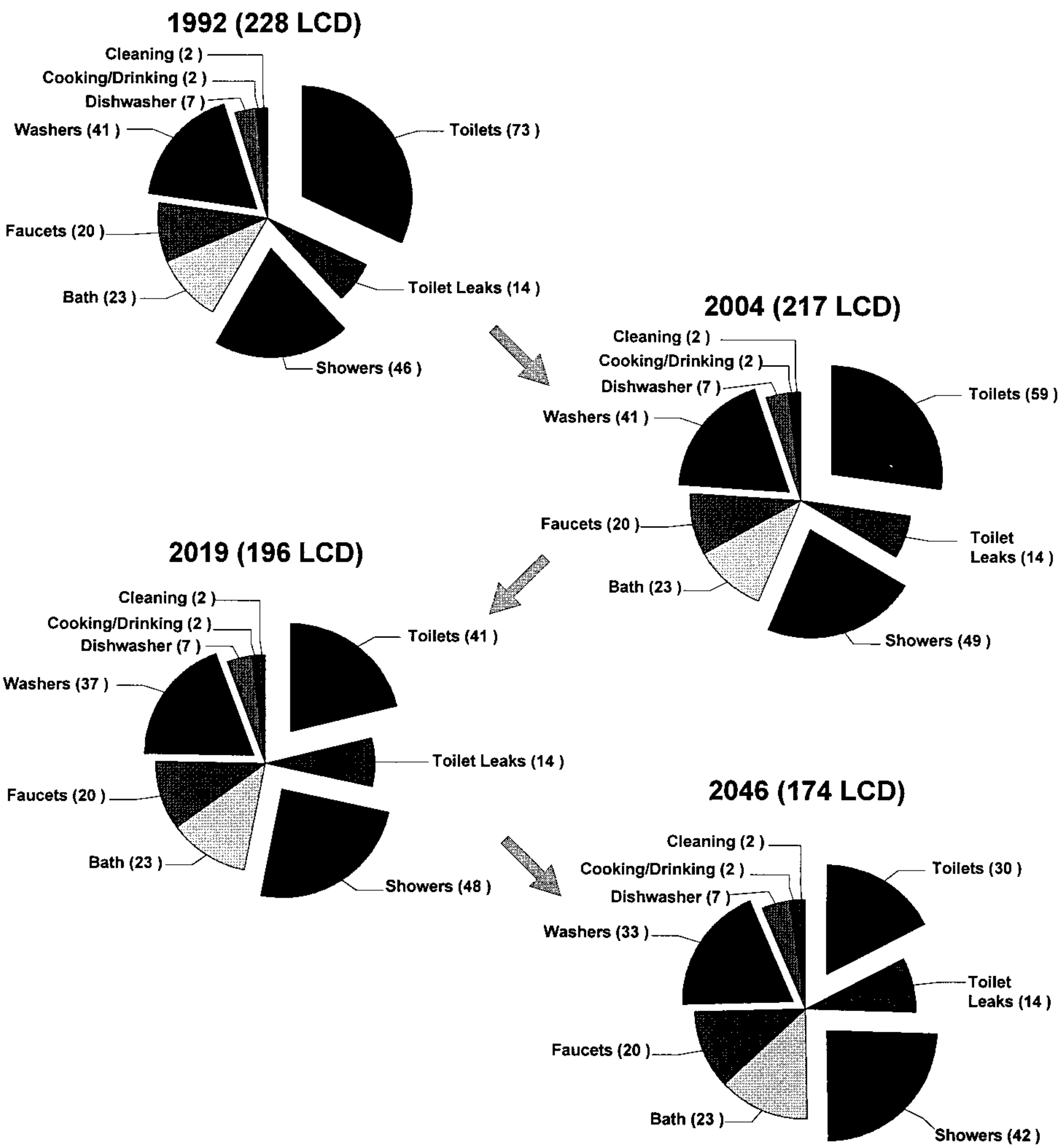
Residential Indoor Water Use



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Effects of Technology Change
Figure 4-7

5. IMPACT OF PUBLIC EDUCATION PROGRAMS

Current research indicates that water conservation "awareness" has a short retention period as it is usually associated with a crisis. Once the crisis is over, people return to their "normal use". One of the goals of the Public Education Program is to have a long-term effect on people's water use habits. The City has a partnership with the Fort Whyte Centre to provide youth water conservation education. This may be an effective method of changing habits of the new generation.

The Fort Whyte Program is quite broad-based in its application. The main initiative will be to promote the City's Water Conservation School Package to teachers, students and school administrators and to provide program support to educators who wish to implement the Slow the Flow lesson package. Fort Whyte also has a Xeriscape demonstration plot at the centre and other initiatives are planned for the future.

With the inevitable introduction of new technology which will change the water use in toilets, washers, and showering, public education programs of the future will have to focus on lifestyle rather than technology and on assisting the customers in finding toilet leaks. Toilet leaks represent about 6% of residential indoor water usage (14 LCD) (Wardrop/Tetr*ES* 1994b) and, if this could be cut by 1/3, a 2% reduction could be sustained in the future.

Also, because the new water consumption projections suggest that annual consumption will not exceed aqueduct capacity in the foreseeable future, some of the conservation initiatives will target the reduction of peak water demands which can affect items such as water treatment plant sizing. New information regarding outdoor water use and methods of reducing usage in this area will need to be a component of future public education initiatives.

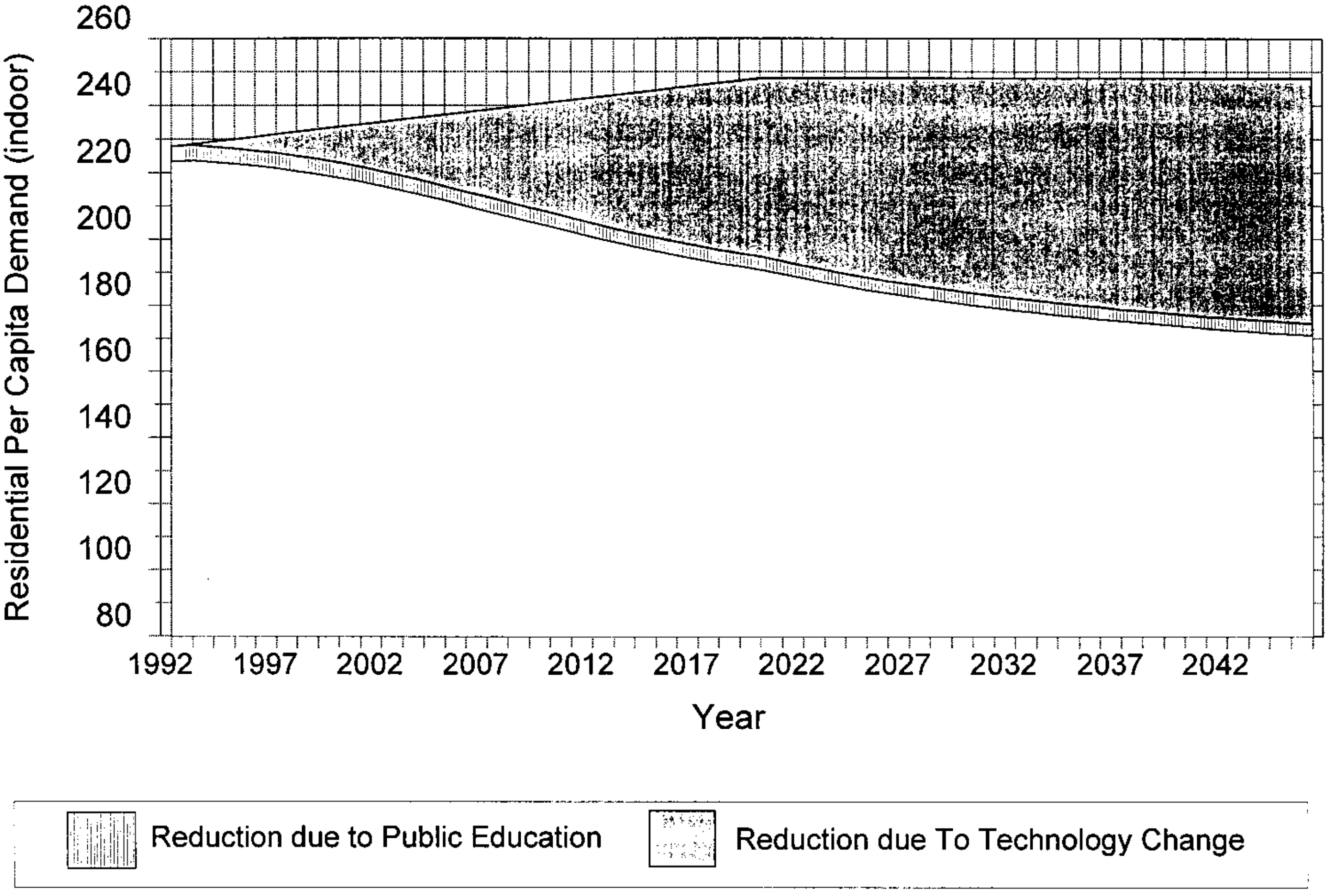
6. LONG-TERM PROJECTIONS

This section develops the long-term water projections using the per capita demands developed in Section 3 for all of the various water use sectors and considering the impacts of technology change and public education programs.

Detailed tables of the projections are shown in Appendix F. The projected residential per capita indoor water use to the year 2046 is shown in Figure 6-1. As can be seen, without technology change or public education, the expected demand would grow from 228 LCD to close to 250 LCD. However, with the impact of technology change and public education the per capita demand can be expected to decrease to about 170 LCD for indoor water use. This dramatic change in residential per capita demand will govern the total demand for the City of Winnipeg over the next half century.

In order to estimate the total demand, the industrial and commercial consumption trends were used as developed in Section 3.2, i.e., an industrial consumption of 50 LCD and a commercial consumption of 75 LCD until the year 2046. These are higher than the existing consumptions, however, they are suitable for the purpose of developing a projection for the planning of future water projects (supply and treatment). Unaccounted-for water is assumed at 19.7% as discussed in Section 3.3, and the treatment plant usage is assumed to be 5% of total water usage. **During a hot dry year**, total summer excess water use can be as high as 12.6% of total water demand. The total per capita water consumption assuming this high summer excess water use was developed to the year 2046 (see Figure 6-2). It should be noted that the **average** summer excess is only 6.3%.

Using the population projection developed in 1992, and extending it to 2046, and combining this with per capita demand, the total water demand in ML/d can be estimated into the future. Figure 6-3 shows this projection. The total water demand is expected to remain relatively constant and no higher than 300 ML/d until the year 2006 when the water treatment plant is built and thereafter remain constant at about 315 ML/d. This is significantly lower than the aqueduct capacity of 385 ML/d, and not much higher than the highest annual demand on historic record of about 300 ML/d in 1988-89.



Changes in Residential Per Capita Use Due to Demographic and Technological Changes and Public Education

Figure 6-1

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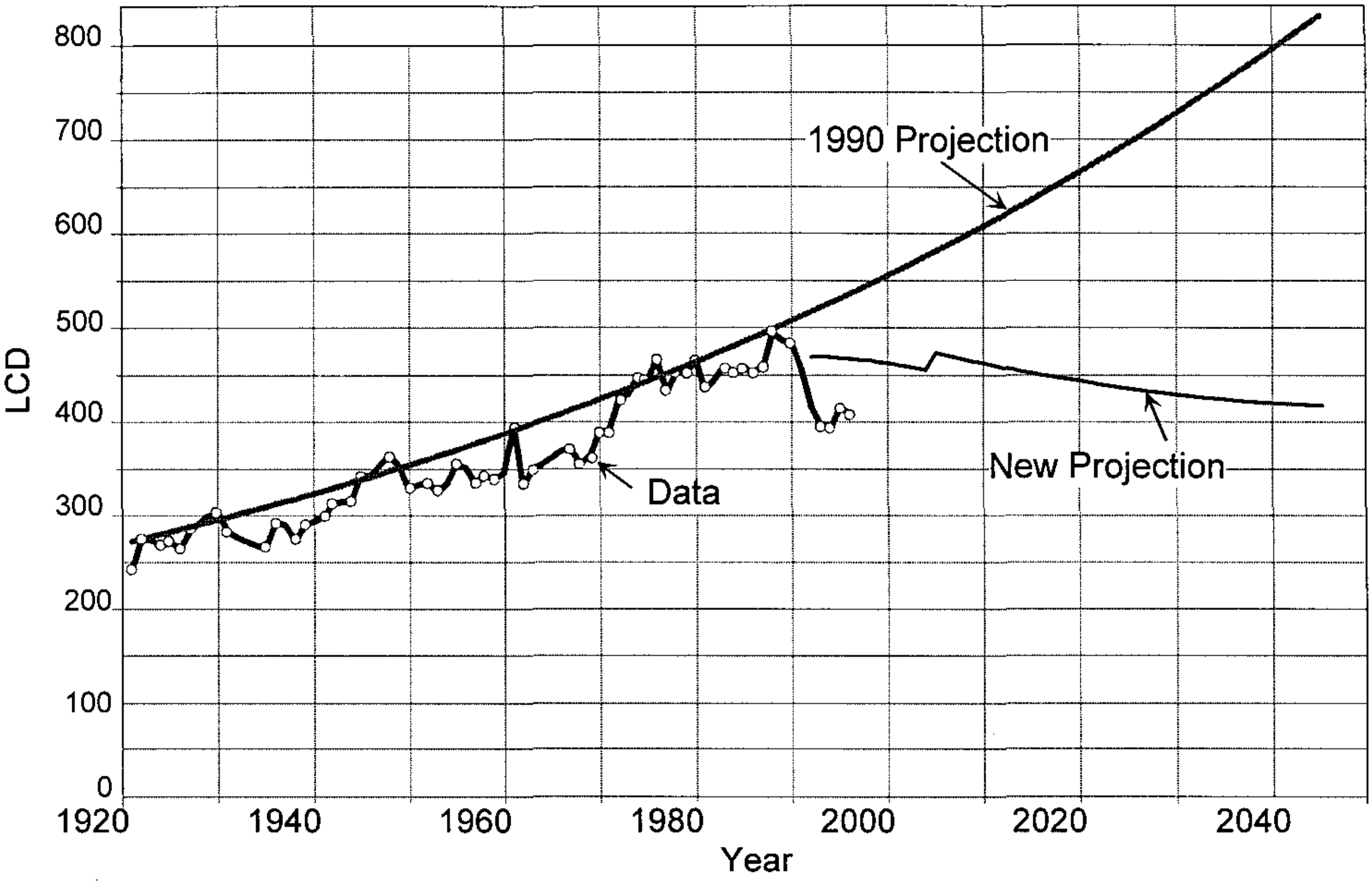
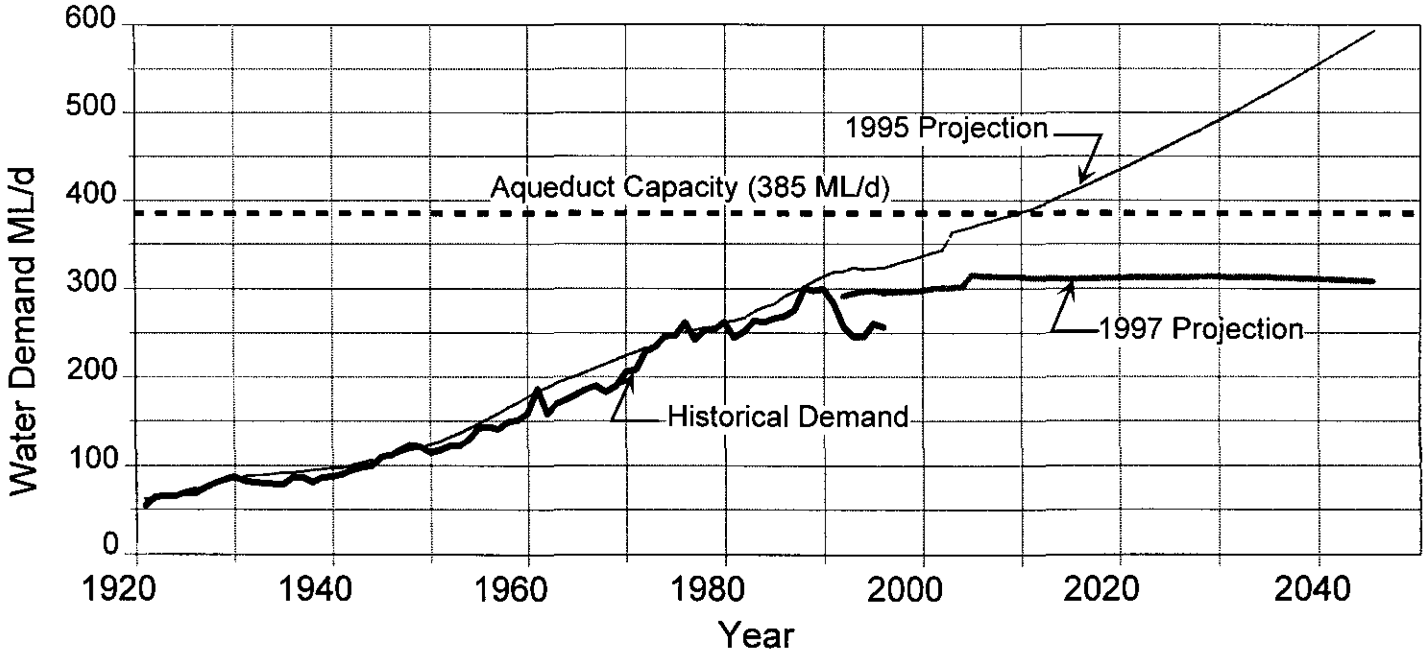


Per Capita Projections

Figure 6-2



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Water Projections

(Planning Projections)

Figure 6-3

This implies that the existing water supply aqueduct will be of sufficient capacity to deliver projected water demands for the foreseeable future. This has major benefits for the City in avoiding major capital costs for system expansion. It should be noted that the commercial, industrial, UFW, water treatment demand and additional summer usage are all assumed to be on the high end of expected values. Therefore, the projected demand line is significantly higher than recent demand, and will continue to be above the typical demand. The planning projection is intended to be used for planning of supply and treatment works, not for estimate of sales.

7. PRICE ELASTICITY - IMPACT ON WATER SALES

The impacts of price elasticity were reviewed for the short term (i.e., only about 5 years into the future). The projected rate increases from 1997 to 2002 are shown in Table 7-1. In order to determine the impact on price increases on future demands, it is required to estimate the price elasticity factor (*e*). This factor is used to explain the relationship between rate increases and water consumption.

Price elasticity of demand is the relative responsiveness of quantity demanded to a change in price. The percentage change in quantity caused by a 1% change in price. A factor of -1 indicates for each 1% increase, a decrease of 1% in water use is expected. The historic water and sewer charges from 1974 until 1997 were compiled and the estimated price of water and sewer for a typical household using 2200 ft^3 per quarter were estimated. This is shown on Table 7-1. The historic water sales from 1982 to 1996 were compiled, and are shown on Figure 7-1. Then, using a price elasticity model in which the base increase in per capita water use per year was 0.33%, the water demand was projected assuming a price elasticity of $e = -0.3$. The comparison of the actual weather-adjusted sales and the price sensitive projection model is shown in Figure 7-1. This illustrates that a significant portion of the reduction in sales from 1990 to 1993 could be attributed to dramatic rate increases in the range of 5 to 8% per year (after being adjusted for inflation). This appears realistic since, as discussed earlier, some of the decrease could have been due to an economic slow-down occurring in the City of Winnipeg at the same time.

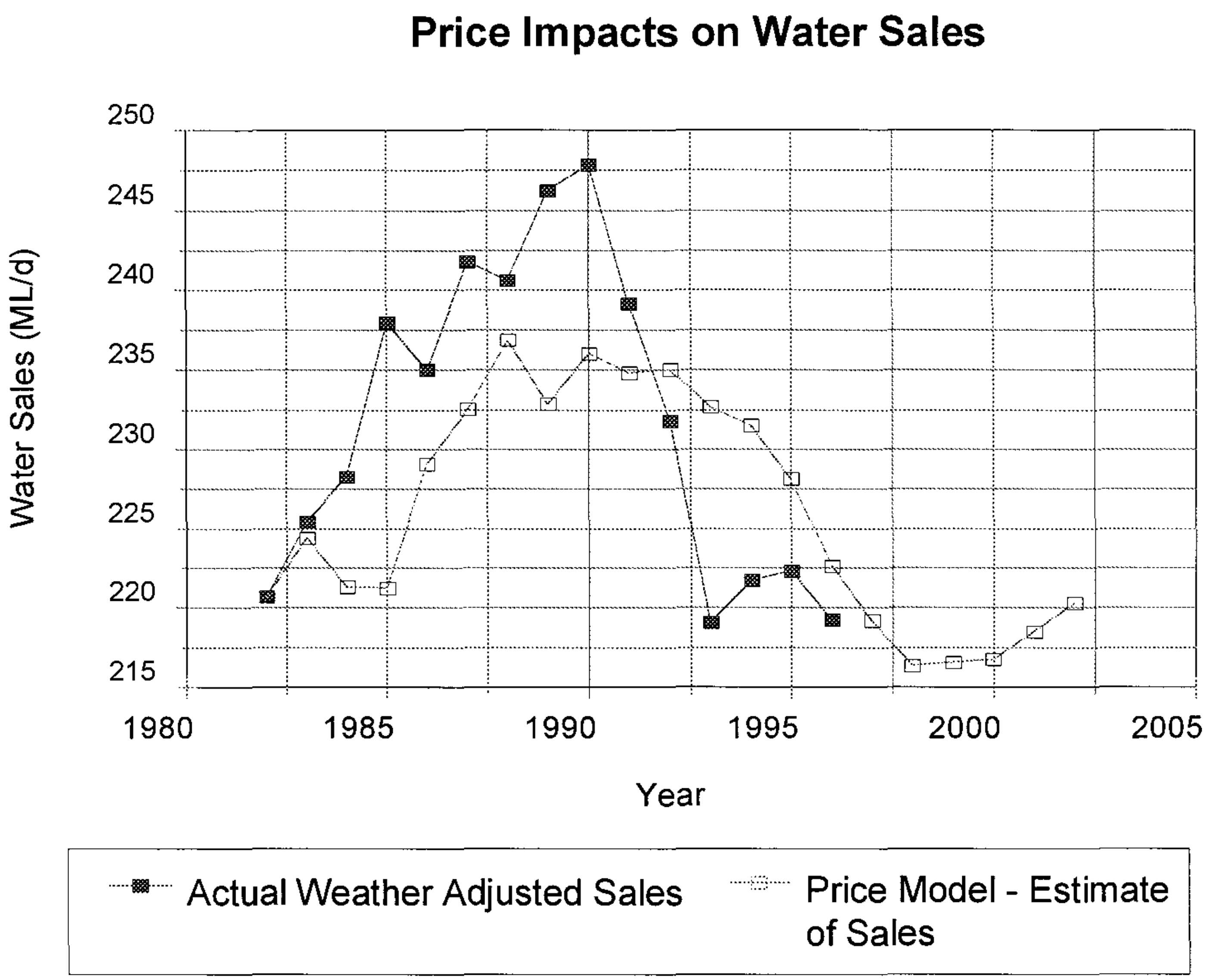
Price elasticity varies from Residential, Commercial and Industrial. The blend for the City of Winnipeg is about -0.3. Industrial users have been reducing consumption for the past 17 years and commercial use has reduced dramatically in the past 7 years. The residential customer has been the least price-sensitive in the past, until the last couple of years in which there is some sign of use reduction.

The price sensitive projection model was used to project water sales into the future as shown on Figure 7-1. This model illustrates that a continued downward trend for the next few years is expected and sales are not likely to rebound to current levels until about the year 2001. By that time, the impact of technology change should be reducing per capita consumption at a

Table 7-1
Historical Water and Sanitary Sewer Rates for the City of Winnipeg

Year	Rate [$/100 cu. ft.] Water Blk 1	Water Blk 2	Water Blk 3	Sewer	Residential W & S	% change	Quarterly Charge 5/8" Meter	Metered Amount (cu. ft.)	Charge for 2200 cu. ft. of W	Total Bill	% change	CPI for Wpg.	Real Percent Increase
1974	$0.42	$0.27	$0.19	$0.23	$0.65			2,200	14.39	14.39		*10.8*	
1975	$0.42	$0.27	$0.19	$0.23	$0.65	0%	0	2,200	14.39	14.39	0.0	*10.8*	-10.8
1976	$0.63	$0.41	$0.29	$0.23	$0.86	32%	0	2,200	19.01	19.01	32.1	*7.5*	24.6
1977	$0.72	$0.47	$0.34	$0.34	$1.06	23%	0	2,200	23.32	23.32	22.7	*8.0*	14.7
1978	$0.72	$0.47	$0.34	$0.40	$1.12	6%	0	2,200	24.71	24.71	5.9	*9.0*	-3.1
1979	$0.75	$0.50	$0.38	$0.43	$1.18	5%	0	2,200	26.05	26.05	5.4	*9.1*	-3.7
1980	$0.83	$0.55	$0.42	$0.47	$1.30	9%	0	2,200	28.49	28.49	9.4	*10.2*	-0.8
1981	$1.06	$0.70	$0.54	$0.52	$1.58	22%	0	2,200	34.76	34.76	22.0	*12.4*	9.6
1982	$1.17	$0.91	$0.82	$0.52	$1.69	7%	0	2,200	37.18	37.18	7.0	*10.9*	-3.9
1983	$1.24	$0.96	$0.87	$0.65	$1.89	12%	0	2,200	41.58	41.58	11.8	*5.7*	6.1
1984	$1.24	$0.96	$0.87	$0.77	$2.01	6%	0	2,200	44.11	44.11	6.1	*4.4*	1.7
1985	$1.30	$1.01	$0.91	$0.88	$2.18	9%	0	2,200	47.96	47.96	8.7	*3.9*	4.8
1986	$1.30	$1.01	$0.91	$0.96	$2.26	4%	0	2,200	49.72	49.72	3.7	*4.2*	-0.5
1987	$1.30	$1.01	$0.91	$1.02	$2.32	6%	0	2,200	51.04	51.04	2.7	*4.4*	-1.7
1988	$1.08	$0.84	$0.58	$1.14	$2.22	-2%	9.30	2,200	48.84	58.14	13.9	*4.0*	9.9
1989	$1.13	$0.88	$0.60	$1.22	$2.35	6%	9.30	2,200	51.70	61.00	4.9	*5.0*	-0.1
1990	$1.18	$0.92	$0.63	$1.34	$2.52	7%	9.85	2,200	55.44	65.29	7.0	4.6	2.4
1991	$1.24	$0.96	$0.66	$1.49	$2.73	8%	10.71	2,200	60.06	70.77	8.4	5.1	3.3
1992	$1.33	$1.03	$0.72	$1.65	$2.98	9%	11.16	2,200	65.56	76.72	8.4	1.5	6.9
1993	$1.41	$1.10	$0.78	$1.83	$3.24	9%	11.51	2,200	71.28	82.79	7.9	2.7	5.2
1994	$1.55	$1.23	$0.90	$2.05	$3.60	11%	11.70	2,200	79.20	90.90	9.8	1.4	8.4
1995	$1.70	$1.37	$1.03	$2.29	$3.99	11%	11.86	2,200	87.78	99.64	9.6	2.3	6.9
1996	$1.89	$1.54	$1.18	$2.56	$4.45	12%	12.10	2,200	97.90	110.00	10.4	~~2.7~~ 2.1	7.7
1997	$2.10	$1.72	$1.33	$2.83	$4.93	11%	12.10	2,200	108.46	120.56	9.6	~~2.7~~ 2.1	6.9
1998					$5.18						5.0	**2.7** /1.3 *	2.3
1999					$5.44						5.0	**2.7**	2.3
2000					$5.71						5.0	**2.7**	2.3
2001					$5.88						3.0	**2.7**	0.3
2002					$5.88						0.0	**2.7**	-2.7

* FCM data source.



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Price Impacts on Use

Figure 7-1

significant rate within the City of Winnipeg. It is therefore expected that no increase in total sales above the current usage should be expected under normal weather patterns. Of course, hot dry weather could increase water sales on any given year by up to 10%.

8. SENSITIVITY ANALYSIS

In order to develop this water projection various assumptions had to be made, as described in the earlier sections. Considerable information and thought was given to selecting the appropriate model parameters when developing the projection, however, assumptions about the future are uncertain. Therefore, sensitivity analyses were performed in order to determine if the water projection would vary considerably if different, yet reasonable, assumptions were made with respect to some of the factors. The key assumptions used in developing these water projections are shown in Table 8-1. Four of these key assumptions were varied in order to develop an envelope of potential water projections. These four variables were:

- **renovation rates**, assumed to be 4%, were varied between 1% to 8% per year. This impacted the rate at which high-efficiency toilets and high-efficiency showers will be introduced into the home;

- **high-efficiency toilets**, assumed to have an efficiency of 6 L per flush, were varied up to 10 L per flush to account for the uncertainty in whether the new toilets will perform as well as expected in each and every home;

- the **highest-efficiency showerhead,** assumed to be 8.3 L per minute, was varied up to be 12 L per minute to account for the possibility that consumer tastes will not allow the lowest efficiency showerhead to become common;

- **industrial and commercial growth rates** are an unknown factor in the future. This can vary, depending upon what type of industry moves into the City over the next half century. It was assumed that growth in per capita industrial commercial demand would remain constant as the balance between new industry and the water efficiency of all industries will counteract each other. Various scenarios were looked at in which the per capita growth rate for industrial and commercial usage varied from 0% to 0.8% per year.

The sensitivity of varying each of these parameters individually is explored in Tables 8-2 through 8-5. The sensitivity analysis illustrates that, even at very low renovation rates of 1% of

Table 8-1

Key Assumptions

Planning Projection

Renovation Rate	**4%**	
Toilet	4.06	flushes/day)
ULF Toilet	**6.00**	**L/Flush**
Per Capita Increase (1992-2020)	0.7300	LCD
Base Shower Rate	14.171	L/Min
Annual Shower Time Increase (1992-2020)	0.05152	Minutes
Lowest Flow Shower	**8.300**	**L/Min**
Life of Washer	**15**	**years**
Washer Change out =	7%	
Improved Washer Efficiency	20%	
Public Education	2.0%	
Industrial Per capita Demand	50	LCD
Industrial Growth Rate	**0.000%**	
Commercial Per capita Demand	75	LCD
Commericial Growth Rate	**0.000%**	
Treatment Plant	**5.0%**	
UFW Design	**19.7%**	
Peak Outdoor Use Rate	12.6%	
Average Outdoor Use Rate	6.7%	
Current (1997)	296	ML/d
2006 Design Usage	314	ML/d
2011 Design Usage	312	ML/d
2016 Design Usage	312	ML/d
2021 Design Usage	313	ML/d
2031 Design Usage	313	ML/d
2046 Design Usage	309	ML/d

Sensitivity Analysis

Table 8-2

Sensitivity Analysis of Renovation Rate

Renovation Rate	2004 ML/d	2019 ML/d	2046 ML/d
1.0%	311	335	337
2.0%	307	324	322
3.0%	303	316	313
4.0%	**300**	**310**	**307**
5.0%	297	305	304
6.0%	294	301	301
7.0%	291	297	300
8.0%	289	295	300

Table 8-3

Sensitivity Analysis of Industrial/Commercial Per Capita Growth Rate

Industrial/Commercial Per capita Growth Rate	2004 ML/d	2019 ML/d	2046 ML/d
0.0%	**300**	**310**	**307**
0.1%	301	313	314
0.2%	302	317	322
0.3%	304	320	330
0.4%	305	324	338
0.5%	306	327	347
0.6%	308	331	356
0.7%	309	335	366

Table 8-4

Sensitivity Analysis of High Efficiency Toilet

High Efficiency Toilet L/flush	2004 ML/d	2019 ML/d	2046 ML/d
6	**300**	**310**	**307**
7	300	312	311
8	301	315	314
9	302	317	318
10	302	319	321

Table 8-5

Sensitivity Analysis of High Efficiency Shower

High Efficiency Shower L/min	2004 ML/d	2019 ML/d	2046 ML/d
8.3	**300**	**310**	**307**
9.0	300	312	310
10.0	301	314	314
11.0	301	317	318
12.0	302	320	322

bathrooms per year, the highest total demand is only 337 ML/d (still much below the aqueduct capacity of 385 ML/d). If toilets or showers are less efficient than is expected, this will only have an impact of about a 2% increase in demand, with demands only being as high as 320 ML/d in either case. Probably the most sensitive parameter is the expected industrial/ commercial per capita growth rate which, if it is significantly higher, may increase total demand to as high as 366 ML/d. However, the Winnipeg area has ample groundwater resources that may be used by industries instead of more expensive treated water. It should be noted that any one of these alternatives still show future demands as below the aqueduct capacity of 385 ML/d.

In order to estimate a planning envelope for the future projections, two sets of assumptions were made, which considered the variability of all four of the previously-discussed parameters. Tables 8-6 and 8-7 show the assumptions made in the high and low projections. In the high projection (see Figure 8-1) the demand could be expected to grow as high as 350 ML/d by the year 2046. The low projection envelope shows estimated demand staying relatively constant at 290 ML/d.

It should be noted that these projection numbers reflect the planning demand, that is, assuming high summer demand of 12.6% of annual demand (not average summer demand of 6.7% of annual demand).

In addition, as discussed in Section 6, industrial usage, commercial usage, water treatment plant losses and UFW are all assumed to be on the high side of estimates.

Table 8-6

Key Assumptions

High Projection

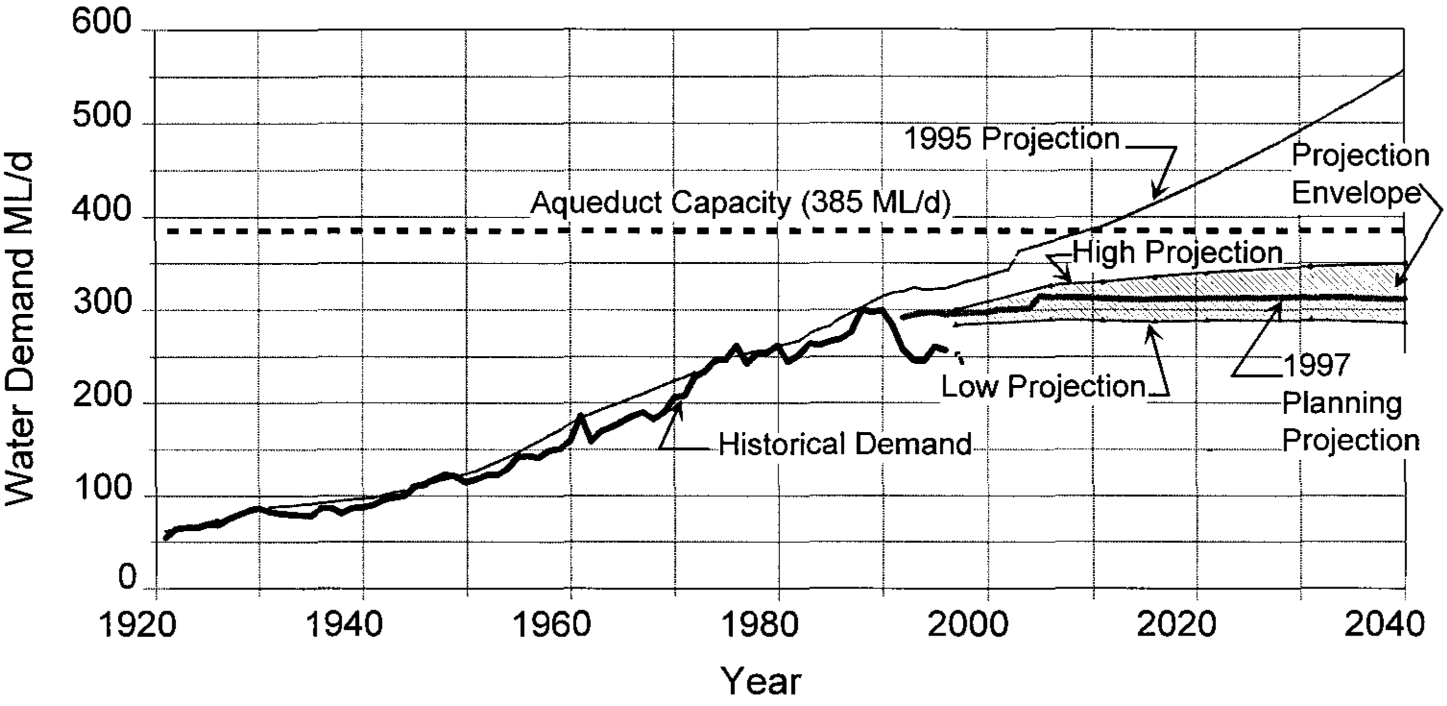
Renovation Rate	**3%**	
Toilet	4.06	flushes/day)
ULF Toilet	**8.00**	**L/Flush**
Per Capita Increase (1992-2020)	0.7300	LCD
Base Shower Rate	14.202	L/Min
Annual Shower Time Increase (1992-2020)	0.05140	Minutes
Lowest Flow Shower	**10.000**	**L/Min**
Life of Washer	**15**	**years**
Washer Change out =	7%	
Improved Washer Efficiency	20%	
Public Education	2.0%	
Industrial Per capita Demand	50	LCD
Industrial Growth Rate	**0.300%**	
Commercial Per capita Demand	75	LCD
Commericial Growth Rate	**0.300%**	
Treatment Plant	**5.0%**	
UFW Design	**19.7%**	
Peak Outdoor Use Rate	12.6%	
Average Outdoor Use Rate	6.7%	
Current (1997)	300	ML/d
2006 Design Usage	326	ML/d
2011 Design Usage	329	ML/d
2016 Design Usage	334	ML/d
2021 Design Usage	339	ML/d
2031 Design Usage	346	ML/d
2046 Design Usage	351	ML/d

Table 8-7

Key Assumptions

Low Projection

Renovation Rate	**5%**	
Toilet	4.06	flushes/day)
ULF Toilet	**6.00**	**L/Flush**
Per Capita Increase (1992-2020)	0.7300	LCD
Base Shower Rate	14.157	L/Min
Annual Shower Time Increase (1992-2020)	0.05157	Minutes
Lowest Flow Shower	**8.300**	**L/Min**
Life of Washer	**15**	**years**
Washer Change out =	7%	
Improved Washer Efficiency	20%	
Public Education	2.0%	
Industrial Per capita Demand	50	LCD
Industrial Growth Rate	**0.000%**	
Commercial Per capita Demand	75	LCD
Commericial Growth Rate	**0.000%**	
Treatment Plant	**2.0%**	
UFW Design	**15.0%**	
Peak Outdoor Use Rate	12.6%	
Average Outdoor Use Rate	6.7%	
Current (1997)	284	ML/d
2006 Design Usage	290	ML/d
2011 Design Usage	288	ML/d
2016 Design Usage	287	ML/d
2021 Design Usage	288	ML/d
2031 Design Usage	288	ML/d
2046 Design Usage	286	ML/d



TetrES
CONSULTANTS INC.

Desproj
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Water Projection Envelope
(Planning Projections)
Figure 8-1

9. SUMMARY AND CONCLUSIONS

The prevailing per capita residential water demand growth rate will not be as high as in the past due to demographic and technology changes. Technology change in residential water use is inevitable specifically with respect to toilets and showerheads. These changes could reduce per capita demand projections by up to 25%. Due to the future dominance of water-saving devices in the marketplace; public education should be aimed at water waste such as toilet leaks and faucets usages, these measures may save 2% off projection. The population is expected to grow at about the same rate as the per capita demand will decline, therefore the total water demand projection is essentially constant. This is a dramatic change from the historic pattern of continued per capita growth. Historically, in Winnipeg as in other cities, continued per capita growth in water demand and population growth resulted in a steady increase in total water demand.

This "no growth" scenario indicates that no water or wastewater expansion will be required in the foreseeable future to accommodate growth in demand. Expansions in the future will be related to improved water or wastewater quality, not capacity. This will result in the future activities in the utility focussing on operational efficiency in order to provide low cost water and wastewater services to the community.

Forecast price increases over the next few years will cause slightly lower sales (not considering variable summer weather from year to year) due to price elasticity response by the customers. Water and wastewater rates must be designed so as to reflect this "no growth" demand scenario.

This city-wide improvement in water efficiency means the need for aqueduct expansion appears unlikely and therefore the citizens of Winnipeg will avoid a major capital expenditure. The water treatment plant to be built in the near future will likely be smaller and less costly than originally planned. Similarly, expansions in wastewater treatment plants will therefore be able to be deferred into the future. Therefore, there is existing capacity in the existing water system in order to allow for innovative planning such as promoting water sales to the Capital Region. Winnipeg also has the capacity remaining in its system to increase its industrial and commercial customer base.

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APPENDIX A

Letter from D. Griffin, P. Eng.

June 19, 1997

THE CITY OF WINNIPEG - VILLE DE WINNIPEG

WATER AND WASTE DEPARTMENT • SERVICE DES EAUX ET DES DÉCHETS
ENGINEERING DIVISION • DIVISION DE L'INGÉNIERIE

1500 PLESSIS ROAD
1500, CHEMIN PLESSIS
WINNIPEG, MANITOBA
R2C 5G6

FAX/TÉLÉC.: (204) 224-0032

June 19, 1997

Our File No.: **020-18-21-09-00**

David Morgan, Ph.D., P.Eng.
TetrES Consultants Inc.
603-386 Broadway
Winnipeg, MB
R3C 3R6

RECEIVED
... 23 1997
TetrES

Dear David:

RE: 1997 WATER CONSERVATION - NEW PROJECTION MODEL

This is to commence work on the Evaluation portion of the 1997 Water Conservation Program. Our goal for this work function is to develop a method to incorporate the effects for water conservation devices, price elasticity, construction and renovation rates, and possible reductions to unaccounted-for water into the current water projection method.

Past water consumption projections have been based on two inputs, population forecast and per capita water consumption. Such a method utilized the past history in Litres/Capita/Day (LCD) and projected the best fit curve into the future. What this assumes is that the future water consumption can be predicted from the past, water use habits are the same now as in the past, the way the consumer views the product in relation to other consumer products is the same as the past. These assumptions are no longer valid.

Water consuming appliances became popular in the last 20 years: automatic washers, automatic dishwashers, lawn irrigation systems, whirl tubs, food disposers, and swimming pools thereby adding to the LCD. However, manufacturers are now focusing on water efficiency and creating substantial water savings. A very significant development is the new toilet designs that operate on 6 litres of water per flush instead of 23 litres, that is a 74% reduction. Now that the baby boom generation is approaching retirement CMHC is predicting less new homes starts and higher activity in the renovation market and condominium development. As the existing stock of water appliances and fixtures are replaced with water efficient units and the population shift from single family homes to condominium settings, water consumption will be impacted. The phenomenon of reduced water consumption is taking place across the country and is not unique to Winnipeg.

The price of water and sewer has increased well above inflation in the last 8 years (about 59% in total). Industrial water users has been reducing consumption for over 10 years now, commercial has cut back significantly in the last few years and residential is no longer growing at the historical 3%

annually. Price is having an effect now too.

Public attitude towards the environment has changed and conservation of resources is of primary concern now. We see this in recycling, water conservation, reforesting programs and more stringent sewage treatment requirements.

The enclosed spreadsheet model is my attempt to compile and integrate price and technology into the latest Regional Water Supply Addendum-1995 water projection. As I mentioned in the past this is draft, requires refinements and detailed analysis. Also enclosed are two reports that I have been working from:

- A Revised Water Demand Projection For Edmonton Water (1995 to 2005), and
- CMHC Winnipeg Housing Outlook Conference, November 1996.

The goal is to assess the impact of various components ie. price, technology, population growth etc. in an attempt to predict the impacts on total water consumption and LCD. The result will not be one solution but a range of solutions based on the sensitivity of the components and judgement as to what is realistic. I don't see this model being back calibrated to cover the events of the last ten years. Once you can dedicate some time I will explain this material in further detail and set a time line for completion.

Look forward to working with you.

Yours truly,

Duane Griffin

Duane E. Griffin, P.Eng.
Water Conservation Coordinator

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APPENDIX B

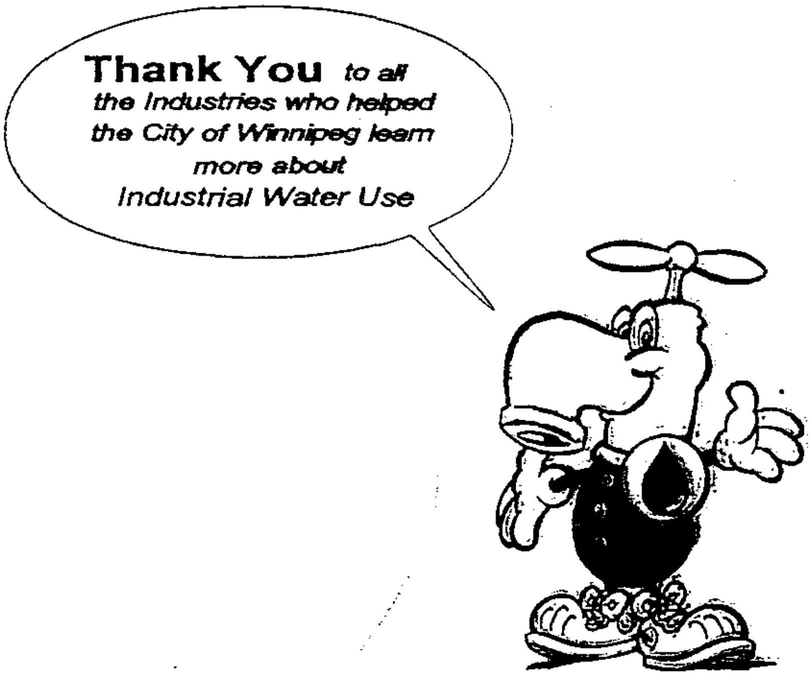
Customer Survey Summary

from Industrial Water

Consumption Survey (1995)

CUSTOMER SURVEY SUMMARY

Water Audits	15/28 surveyed	50%	have conducted a water audit
Flow Meters	10/28 surveyed	35%	have flow meters in addition to the City's meter to monitor water use
Readings	11/28 surveyed	40%	reported taking meter readings on a daily basis
Initiatives	10/28 surveyed	35%	implemented water conservation initiatives
Sources	14/28 surveyed	50%	utilize an additional source of water (in addition to City water)
Improvement	20/28 surveyed	70%	practice improvement initiatives
Energy/Recycling	23/28 surveyed	80%	practice energy conservation and/or recycling
Water Conservation	15/28 surveyed	55%	practice water conservation
Committee Individual	19/28 surveyed	70%	have a committee or individual which/who is responsible for implemented changes in the workplace
Monetary	27/28 surveyed	95%	noted the reason for conserving water is savings
Sewer Surcharge	8/28 surveyed	30%	concerned about increases in pollution concentration in water discharged to the sewer if conserve water
Share Ideas	23/28 surveyed	80%	indicated a willingness to share ideas with other industries either through a group forum or through written correspondence
Seminars	2/28 surveyed	5%	attended a water conservation seminar in the past



APPENDIX C

City of Winnipeg's

Historic and Projected

Population by Cohort

City of Winnipeg's Historic and Projected Population by Cohort

	Historic Data									Extrapolated COW					Extraplolated TCI					
Year	**1951**	**1956**	**1961**	**1966**	**1971**	**1976**	**1981**	**1986**	**1991**	**1996**	**2001**	**2006**	**2011**	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2046**
Population	348,069	409,115	475,929	508,759	540,255	560,285	564,490	594,570	617,972	632,338	651,360	665,608	678,132	691,751	706,525	720,453	730,835	736,812	739,825	742,516
Population Increase		61,046	66,814	32,830	31,496	20,030	4,205	30,080	23,402	14,366	19,022	14,248	12,524	13,619	14,774	13,929	10,382	5,977	3,013	2,691
# of Dwellings	95,955	107,841	128,532	143,710	166,670	192,585	217,230	227,145	241,165	253,200	264,400	274,800	285,900	297,441	309,682	317,282	319,969	320,392	321,274	323,818
Average persons	3.63	3.79	3.70	3.54	3.24	2.91	2.60	2.62	2.56	2.50	2.46	2.42	2.37	2.33	2.28	2.27	2.28	2.30	2.30	2.29
Under 1						8,220														
1-4						32,790														
0-4	31,713	44,991	52,872	50,552	43,215		38,025	40,640	43,785	46,470	42,892	39,856	39,561	41,770	44,453	46,196	46,014	44,242	42,980	43,371
5-9	27,329	39,837	48,208	51,479	49,790	41,880	38,460	38,110	40,355	46,673	46,885	43,276	40,213	39,915	42,144	44,850	46,609	46,425	44,638	43,365
10-14	20,546	28,703	42,281	47,537	49,980	48,015	40,365	39,030	38,355	42,855	48,794	49,016	45,242	42,040	41,728	44,058	46,888	48,726	48,535	46,666
15-19	22,790	24,861	33,386	44,772	50,880	53,030	50,435	43,360	41,755	40,355	44,998	51,234	51,467	47,504	44,142	43,815	46,261	49,232	51,163	50,961
20-24	28,512	30,076	33,470	39,224	53,015	58,015	57,410	58,240	49,787	41,338	41,482	46,255	52,664	52,904	48,830	45,374	45,038	47,553	50,607	52,591
25-29				31,562		51,315			57,020	45,607	42,224	42,370	47,246	53,793	54,038	49,877	46,347	46,004	48,572	51,692
25-34	60,868	65,038	66,815		71,890		98,475	109,065												
30-34				31,067		37,895			55,540	55,994	46,550	43,097	43,246	48,222	54,904	55,154	50,908	47,305	46,954	49,576
35-39				32,082		30,130			50,265	53,034	54,972	45,696	42,305	42,453	47,338	53,897	54,143	49,974	46,437	46,093
35-44	52,245	59,603	66,813		60,655		63,690	81,100												
40-44				33,978		29,290			45,235	47,888	51,263	53,139	44,171	40,892	41,035	45,757	52,097	52,335	48,305	44,886
45-49				30,131		29,490			34,180	42,546	46,125	49,376	51,184	42,543	39,385	39,523	44,070	50,177	50,406	46,525
45-54	38,495	44,173	53,228		61,050		56,570	55,930												
50-54				28,147		31,495			27,575	31,994	40,694	44,116	47,224	48,956	40,691	37,670	37,802	42,152	47,993	48,212
55-59				23,124		27,045			26,135	25,622	30,372	38,633	41,881	44,827	46,471	38,626	35,758	35,883	40,012	45,557
55-64	33,935	33,224	35,954		48,525		55,350	55,925												
60-64				18,555		25,075			26,720	24,512	24,501	29,043	36,945	40,048	42,865	44,437	36,935	34,193	34,313	38,261
65-69	13,957	14,984	14,386	14,867	17,155	19,760	23,010			23,588	22,958	22,950	27,202	34,609	37,516	40,155	41,627	34,600	32,031	32,143
65-74								43,565	46,395											
70 +over	17,679	23,625	28,516		34,100		42,700													
70-74				12,862		14,950				23,096	21,063	20,475	20,472	24,261	30,867	33,460	35,813	37,127	30,859	28,568
75 +over								29,605	34,870											
75-79				9,685		10,210				16,919	19,358	17,616	17,091	17,092	20,255	25,771	27,935	29,900	30,997	25,764
80-84				5,898		6,170														
85-89				2,434		3,770														
90+						1,740														
90-94				671																
95+				132																
80+										23,847	26,229	29,460	30,018	29,922	29,862	31,833	36,588	40,983	45,023	48,285

APPENDIX D

Details of Demographic

Water Use Models

Table D-1
Per Capita Usage By Birth Date

Age Range	Average Age	Average Birth Date	Per Capita Use (LCD)
0-5	2	1990	61
6-12	9	1983	86
13-19	16	1976	157
20-39	30	1962	149
40-64	52	1940	145
65-	75	1917	100

Table D-2
Usage By Household Size

People Per House	Use Per House	Per Capita Use
1	305	305
2	490	245
3	630	210
4	720	180
5	850	170

Details of Water Use Projection By Cohort for Water Use Dependant on Birthdate

		Year	1951	1956	1961	1966	1971	1976	1981	1986
		Residential Indoor Usage LCd	163	162	167	174	185	197	209	211
		Residential Indoor Usage ML/d (Sum + 221/L/house)	56.73	66.28	79.48	88.59	99.85	110.41	118.05	125.63
			Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort
Usage			Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day
61	1	Under 1	0	0	0	0	0	501,420	0	0
61	3	1-4	0	0	0	0	0	2,000,190	0	0
61	2	0-4	1,934,493	2,744,451	3,225,192	3,083,672	2,636,115	0	2,319,525	2,479,040
86	7	5-9	2,350,294	3,425,982	4,145,888	4,427,194	4,281,940	3,601,680	3,307,560	3,277,460
122	12	10-14	2,496,339	3,487,415	5,137,142	5,775,746	6,072,570	5,833,823	4,904,348	4,742,145
Depends of Birth Date	17	15-19	3,031,070	3,555,123	4,674,356	6,581,484	7,530,240	7,848,440	7,565,250	6,634,080
Depends of Birth Date	22	20-24	3,506,976	4,000,108	4,786,210	5,726,704	7,793,205	8,586,220	8,496,680	8,736,000
Depends of Birth Date	27	25-29	0	0	0	4,513,366	0	7,543,305	0	0
Depends of Birth Date	30	25-34	6,573,744	7,674,484	8,485,505	0	10,424,050	0	14,475,825	16,141,620
Depends of Birth Date	32	30-34	0	0	0	4,131,911	0	5,532,670	0	0
Depends of Birth Date	37	35-39	0	0	0	3,946,086	0	4,308,590	0	0
Depends of Birth Date	40	35-44	5,224,500	5,960,300	7,215,804	0	7,703,185	0	9,235,050	11,840,600
Depends of Birth Date	42	40-44	0	0	0	3,873,492	0	3,895,570	0	0
Depends of Birth Date	47	45-49	0	0	0	3,133,624	0	3,627,270	0	0
Depends of Birth Date	50	45-54	3,849,500	4,417,300	5,322,800	0	6,593,400	0	7,184,390	7,662,410
Depends of Birth Date	52	50-54	0	0	0	2,814,700	0	3,590,430	0	0
Depends of Birth Date	57	55-59	0	0	0	2,312,400	0	2,812,680	0	0
Depends of Birth Date	60	55-64	3,393,500	3,322,400	3,595,400	0	4,852,500	0	5,977,800	6,599,150
Depends of Birth Date	62	60-64	0	0	0	1,855,500	0	2,507,500	0	0
Depends of Birth Date	67	65-69	1,395,700	1,498,400	1,438,600	1,486,700	1,715,500	1,976,000	2,301,000	0
Depends of Birth Date	70	65-74	0	0	0	0	0	0	0	4,356,500
Depends of Birth Date	80	70 +over	1,767,900	2,362,500	2,851,600	0	3,410,000	0	4,270,000	0
Depends of Birth Date	72	70-74	0	0	0	1,286,200	0	1,495,000	0	0
Depends of Birth Date	85	75 +over	0	0	0	0	0	0	0	2,960,500
Depends of Birth Date	77	75-79	0	0	0	968,500	0	1,021,000	0	0
Depends of Birth Date	82	80-84	0	0	0	589,800	0	617,000	0	0
Depends of Birth Date	87	85-89	0	0	0	243,400	0	377,000	0	0
Depends of Birth Date	92	90+	0	0	0	0	0	174,000	0	0
Depends of Birth Date	92	90-94	0	0	0	67,100	0	0	0	0
Depends of Birth Date	97	95+	0	0	0	13,200	0	0	0	0
Depends of Birth Date	85	80+	0	0	0	0	0	0	0	0

		Year	1991	1996	2001	2006	2011	2016	2021	2026	2031	2036	2041	2046
		Residential Indoor Usage LCd	216	219	223	228	232	236	238	239	239	239	240	241
		Residential Indoor Usage ML/d (Sum + 221/L/house)	133.29	138.64	145.35	151.59	157.48	162.94	168.24	172.24	174.61	176.10	177.36	178.72
			Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort
Usage			Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day
61	1	Under 1	0	0	0	0	0	0	0	0	0	0	0	0
61	3	1-4	0	0	0	0	0	0	0	0	0	0	0	0
61	2	0-4	2,670,885	2,834,670	2,616,412	2,431,216	2,413,221	2,547,970	2,711,610	2,817,926	2,806,839	2,698,749	2,621,804	2,645,644
86	7	5-9	3,470,530	4,013,878	4,032,110	3,721,736	3,458,318	3,432,690	3,624,364	3,857,134	4,008,363	3,992,592	3,838,840	3,729,389
122	12	10-14	4,660,133	5,206,883	5,928,471	5,955,444	5,496,903	5,107,860	5,070,008	5,353,106	5,696,903	5,920,265	5,896,971	5,669,882
Depends of Birth Date	17	15-19	6,513,780	6,335,735	7,064,686	8,043,738	8,080,319	7,458,128	6,930,279	6,878,922	7,263,026	7,729,485	8,032,540	8,000,936
Depends of Birth Date	22	20-24	7,617,411	6,448,728	6,512,674	7,262,035	8,268,248	8,305,928	7,666,365	7,123,778	7,070,987	7,465,816	7,945,299	8,256,815
Depends of Birth Date	27	25-29	8,553,000	6,977,871	6,586,944	6,652,090	7,417,622	8,445,501	8,483,989	7,830,715	7,276,496	7,222,574	7,625,866	8,115,628
Depends of Birth Date	30	25-34	0	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	32	30-34	8,219,920	8,399,100	7,122,150	6,723,132	6,789,622	7,570,854	8,619,967	8,659,250	7,992,480	7,426,813	7,371,776	7,783,400
Depends of Birth Date	37	35-39	7,439,220	7,849,032	8,245,800	6,991,488	6,599,580	6,665,121	7,432,028	8,461,903	8,500,465	7,845,923	7,290,628	7,236,601
Depends of Birth Date	40	35-44	0	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	42	40-44	6,649,545	7,087,424	7,586,924	7,970,850	6,758,163	6,379,152	6,442,504	7,183,796	8,179,273	8,216,547	7,583,866	7,047,119
Depends of Birth Date	47	45-49	4,990,280	6,254,262	6,626,500	7,307,648	7,677,600	6,509,079	6,144,037	6,205,054	6,919,024	7,877,811	7,913,712	7,304,350
Depends of Birth Date	50	45-54	0	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	52	50-54	3,943,225	4,671,124	5,982,016	6,529,168	6,989,152	7,343,400	6,225,744	5,876,592	5,934,953	6,617,844	7,534,896	7,569,234
Depends of Birth Date	57	55-59	3,475,955	3,663,946	4,434,312	5,679,051	6,198,388	6,634,396	6,970,663	5,909,737	5,578,307	5,633,706	6,281,935	7,152,439
Depends of Birth Date	60	55-64	0	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	62	60-64	3,286,560	3,260,096	3,503,643	4,240,278	5,430,915	5,927,104	6,344,029	6,665,579	5,651,086	5,334,162	5,387,136	6,006,995
Depends of Birth Date	67	65-69	0	2,901,324	3,053,414	3,281,850	3,971,492	5,087,523	5,552,338	5,942,902	6,244,120	5,293,773	4,996,888	5,046,512
Depends of Birth Date	70	65-74	5,010,660	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	80	70 +over	0	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	72	70-74	0	2,632,944	2,590,749	2,723,175	2,927,496	3,542,106	4,537,475	4,952,036	5,300,373	5,569,024	4,721,426	4,456,639
Depends of Birth Date	85	75 +over	3,487,000	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	77	75-79	0	1,759,576	2,206,812	2,166,768	2,273,103	2,444,156	2,957,292	3,788,322	4,134,437	4,425,262	4,649,559	3,941,902
Depends of Birth Date	82	80-84	0	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	87	85-89	0	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	92	90+	0	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	92	90-94	0	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	97	95+	0	0	0	0	0	0	0	0	0	0	0	0
Depends of Birth Date	85	80+	0	2,384,700	2,622,900	3,181,680	3,542,124	3,800,094	4,091,047	4,615,731	5,341,813	6,024,480	6,663,344	7,194,472

Table D-4
Details of Water Use Projection By Cohort for Water Use Dependant on Age

		Year	1951	1956	1961	1966	1971	1976	1981	1986
		Residential Indoor Usage LCD (House Size Model)	191	186	189	194	203	213	224	223
		Residential Indoor Usage LCD (Birth Date Model See Table D-3))	163	162	167	174	185	197	209	211
		Residential Indoor Usage LCD (Age Model)	191	185	186	190	197	207	216	216
		Residential Indoor Usage ML/d (Age Model= Sum of Column + 221 L/House/day)	66.48	75.68	88.45	96.44	106.69	115.90	122.20	128.28
			Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort
Usage LCD	Age		Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day
61	1	Under 1	0	0	0	0	0	501,420	0	0
61	3	1-4	0	0	0	0	0	2,000,190	0	0
61	2	0-4	1,934,493	2,744,451	3,225,192	3,083,672	2,636,115	0	2,319,525	2,479,040
86	7	5-9	2,350,294	3,425,982	4,145,888	4,427,194	4,281,940	3,601,680	3,307,560	3,277,460
122	12	10-14	2,496,339	3,487,415	5,137,142	5,775,746	6,072,570	5,833,823	4,904,348	4,742,145
157	17	15-19	3,578,030	3,903,177	5,241,602	7,029,204	7,988,160	8,325,710	7,918,295	6,807,520
149	22	20-24	4,248,288	4,481,324	4,987,030	5,844,376	7,899,235	8,644,235	8,554,090	8,677,760
149	27	25-29	0	0	0	4,702,738	0	7,645,935	0	0
149	30	25-34	9,069,332	9,690,662	9,955,435	0	10,711,610	0	14,672,775	16,250,685
149	32	30-34	0	0	0	4,628,983	0	5,646,355	0	0
149	37	35-39	0	0	0	4,780,218	0	4,489,370	0	0
149	40	35-44	7,784,505	8,880,847	9,955,137	0	9,037,595	0	9,489,810	12,083,900
149	42	40-44	0	0	0	5,062,722	0	4,364,210	0	0
147	47	45-49	0	0	0	4,429,257	0	4,335,030	0	0
147	50	45-54	5,658,765	6,493,431	7,824,516	0	8,974,350	0	8,315,790	8,221,710
147	52	50-54	0	0	0	4,137,609	0	4,629,765	0	0
147	57	55-59	0	0	0	3,399,228	0	3,975,615	0	0
147	60	55-64	4,988,445	4,883,928	5,285,238	0	7,133,175	0	8,136,450	8,220,975
147	62	60-64	0	0	0	2,727,585	0	3,686,025	0	0
100	67	65-69	1,395,700	1,498,400	1,438,600	1,486,700	1,715,500	1,976,000	2,301,000	0
100	70	65-74	0	0	0	0	0	0	0	4,356,500
100	80	70 +over	1,767,900	2,362,500	2,851,600	0	3,410,000	0	4,270,000	0
100	72	70-74	0	0	0	1,286,200	0	1,495,000	0	0
100	85	75 +over	0	0	0	0	0	0	0	2,960,500
100	77	75-79	0	0	0	968,500	0	1,021,000	0	0
100	82	80-84	0	0	0	589,800	0	617,000	0	0
100	87	85-89	0	0	0	243,400	0	377,000	0	0
100	92	90+	0	0	0	0	0	174,000	0	0
100	92	90-94	0	0	0	67,100	0	0	0	0
100	97	95+	0	0	0	13,200	0	0	0	0
100	85	80+	0	0	0	0	0	0	0	0

		Year	1991	1996	2001	2006	2011	2016	2021	2026	2031	2036	2041	2046
		Residential Indoor Usage LCD (House Size Model)	225	228	229	230	232	233	235	236	235	235	234	235
		Residential Indoor Usage LCD (Birth Date Model See Table D-3))	216	219	223	228	232	236	238	239	239	239	240	241
		Residential Indoor Usage LCD (Age Model)	217	218	220	222	225	226	227	226	225	225	225	226
		Residential Indoor Usage ML/d (Age Model= Sum of Column + 221 L/House/day)	134.05	137.76	143.10	147.98	152.38	156.30	160.21	162.96	164.44	165.51	166.56	167.81
			Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort	Usage By Cohort
Usage LCD	Age		Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day	Litres/day
61	1	Under 1	0	0	0	0	0	0	0	0	0	0	0	0
61	3	1-4	0	0	0	0	0	0	0	0	0	0	0	0
61	2	0-4	2,670,885	2,834,670	2,616,412	2,431,216	2,413,221	2,547,970	2,711,610	2,817,926	2,806,839	2,698,749	2,621,804	2,645,644
86	7	5-9	3,470,530	4,013,878	4,032,110	3,721,736	3,458,318	3,432,690	3,624,364	3,857,134	4,008,363	3,992,592	3,838,840	3,729,389
122	12	10-14	4,660,133	5,206,883	5,928,471	5,955,444	5,496,903	5,107,860	5,070,008	5,353,106	5,696,903	5,920,265	5,896,971	5,669,882
157	17	15-19	6,555,535	6,335,735	7,064,686	8,043,738	8,080,319	7,458,128	6,930,279	6,878,922	7,263,026	7,729,485	8,032,540	8,000,936
149	22	20-24	7,418,263	6,159,362	6,180,818	6,891,995	7,846,936	7,882,696	7,275,722	6,760,783	6,710,682	7,085,392	7,540,443	7,836,086
149	27	25-29	8,495,980	6,795,443	6,291,376	6,313,130	7,039,654	8,015,157	8,051,684	7,431,698	6,905,720	6,854,544	7,237,287	7,702,093
149	30	25-34	0	0	0	0	0	0	0	0	0	0	0	0
149	32	30-34	8,275,460	8,343,106	6,935,950	6,421,453	6,443,654	7,185,078	8,180,733	8,218,014	7,585,220	7,048,377	6,996,145	7,386,794
149	37	35-39	7,489,485	7,902,066	8,190,828	6,808,704	6,303,445	6,325,497	7,053,326	8,030,723	8,067,321	7,446,130	6,919,131	6,867,857
149	40	35-44	0	0	0	0	0	0	0	0	0	0	0	0
149	42	40-44	6,740,015	7,135,312	7,638,187	7,917,711	6,581,479	6,092,908	6,114,223	6,817,742	7,762,494	7,797,870	7,197,427	6,688,030
147	47	45-49	5,024,460	6,254,262	6,780,375	7,258,272	7,524,048	6,253,821	5,789,573	5,809,828	6,478,322	7,376,040	7,409,654	6,839,105
147	50	45-54	0	0	0	0	0	0	0	0	0	0	0	0
147	52	50-54	4,053,525	4,703,118	5,982,018	6,485,052	6,941,928	7,196,532	5,981,597	5,537,558	5,556,930	6,196,326	7,054,966	7,087,117
147	57	55-59	3,841,845	3,766,434	4,464,684	5,679,051	6,156,507	6,589,569	6,831,250	5,677,983	5,256,482	5,274,871	5,881,812	6,696,870
147	60	55-64	0	0	0	0	0	0	0	0	0	0	0	0
147	62	60-64	3,927,840	3,603,264	3,601,647	4,269,321	5,430,915	5,887,056	6,301,164	6,532,267	5,429,475	5,026,422	5,044,007	5,624,384
100	67	65-69	0	2,358,800	2,295,800	2,295,000	2,720,200	3,460,900	3,751,580	4,015,474	4,162,747	3,459,982	3,203,133	3,214,339
100	70	65-74	4,639,500	0	0	0	0	0	0	0	0	0	0	0
100	80	70 +over	0	0	0	0	0	0	0	0	0	0	0	0
100	72	70-74	0	2,309,600	2,106,300	2,047,500	2,047,200	2,426,100	3,086,718	3,345,970	3,581,333	3,712,683	3,085,899	2,856,820
100	85	75 +over	3,487,000	0	0	0	0	0	0	0	0	0	0	0
100	77	75-79	0	1,691,900	1,935,800	1,761,600	1,709,100	1,709,200	2,025,542	2,577,090	2,793,539	2,990,042	3,099,706	2,576,406
100	82	80-84	0	0	0	0	0	0	0	0	0	0	0	0
100	87	85-89	0	0	0	0	0	0	0	0	0	0	0	0
100	92	90+	0	0	0	0	0	0	0	0	0	0	0	0
100	92	90-94	0	0	0	0	0	0	0	0	0	0	0	0
100	97	95+	0	0	0	0	0	0	0	0	0	0	0	0
100	85	80+	0	2,384,700	2,622,900	2,946,000	3,001,800	2,992,200	2,986,166	3,183,263	3,658,776	4,098,286	4,502,260	4,828,504

APPENDIX E

Assessment of

Water Savings from

Ultra Low Flush Toilet

Installation in Winnipeg

APPENDIX E

Winnipeg Specific Examples of Potential Savings from Installation of ULFTs

As part of Stage 1 of the City of Winnipeg, residential retrofit program conducted in late 1994, the City offered a $40 rebate to any homeowner who purchased a 6 litre ULFT. Due to the relatively short time-frame allotted for this program, interested parties were asked to "register their interest" in participating in the program by December 16, 1994. Once they had done this, they were given until June 1, 1995 to purchase the toilet and provide the City with proof of purchase. Five homeowners applied for the rebate. These accounts (ULFT 1-5) were used to assess the potential savings from ULFT installation in Winnipeg households (see Figure E1-E5). Three of the households purchased their ULFTs in 1995 and two had purchased their ULFT in 1994. Exact installation date for the ULFTs was unknown, so for the purpose of this evaluation it was assumed that the ULFT was installed sometime in 1995. Winter water consumption (Nov-Mar) for 1993 and 1994 was compared to winter water consumption for 1996. All five accounts showed a drop in water consumption after installation of the ULFT with a range of savings from 9 to 56% (see Figure E-6). The average saving over the five accounts was 34%. Although this is a small sample size, the fact that all accounts showed a drop in consumption (and 4 of 5 accounts saved at least 26%) indicates a significant potential for savings from ULFT installation.

(1)

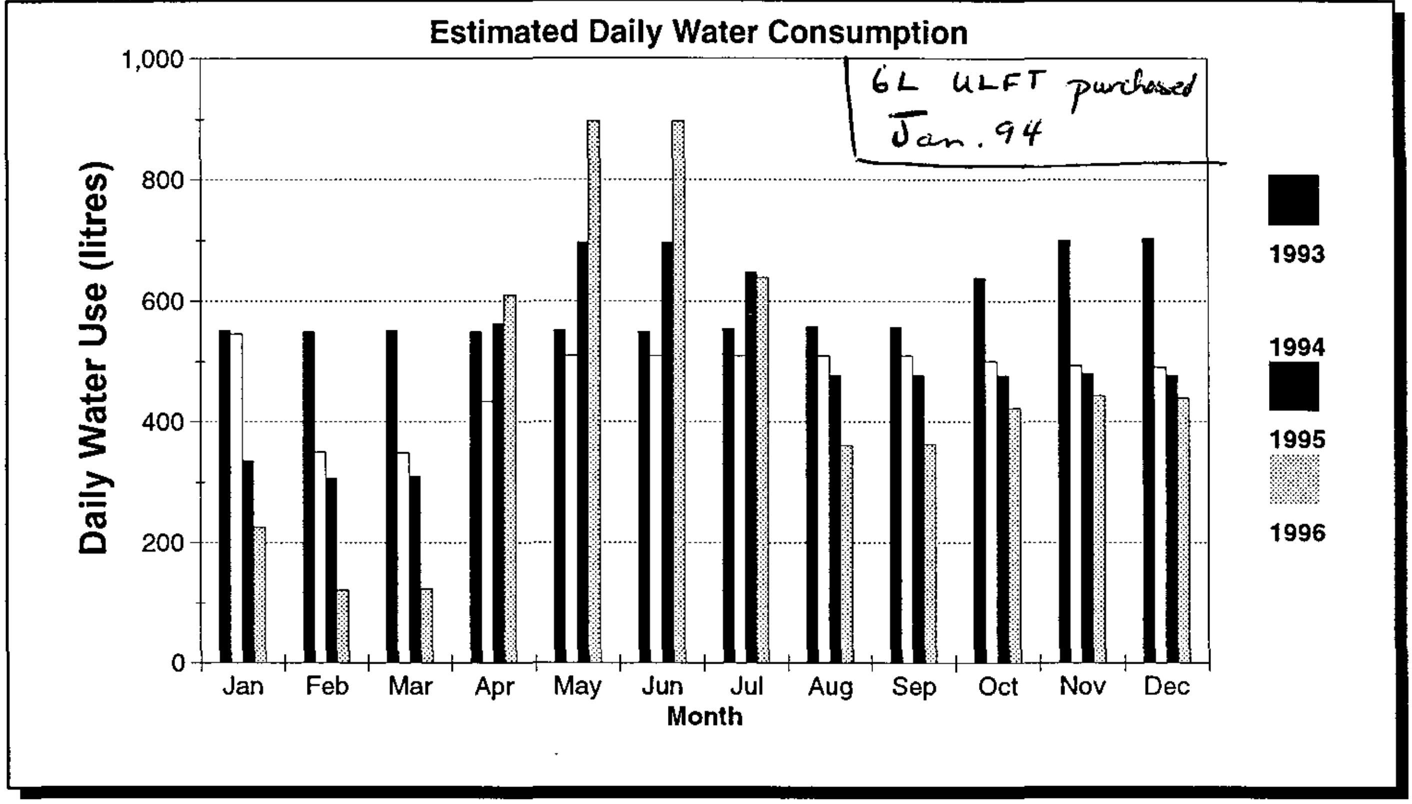
Account number : ULFT #1

Customer

Customer Clas **SINGLE FAMILY DWELLING**

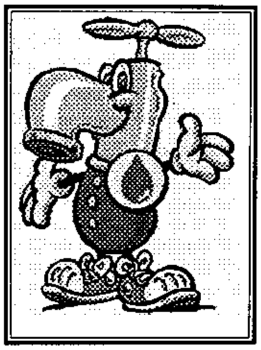
Service Address:
R2G0Z3

Phone Number	
Residential	3384913
Business	0
Facsimilie	
Modem :	



Estimated Daily Water Use (Litres)

Month	1993	1994	1995	1996
January	552	545	335	226
February	550	350	307	121
March	552	348	310	123
April	550	433	563	610
May	552	510	697	897
June	550	510	697	897
July	555	510	648	639
August	558	510	477	361
September	557	510	477	363
October	639	500	477	423
November	700	493	480	443
December	703	490	477	439



49 % Drop

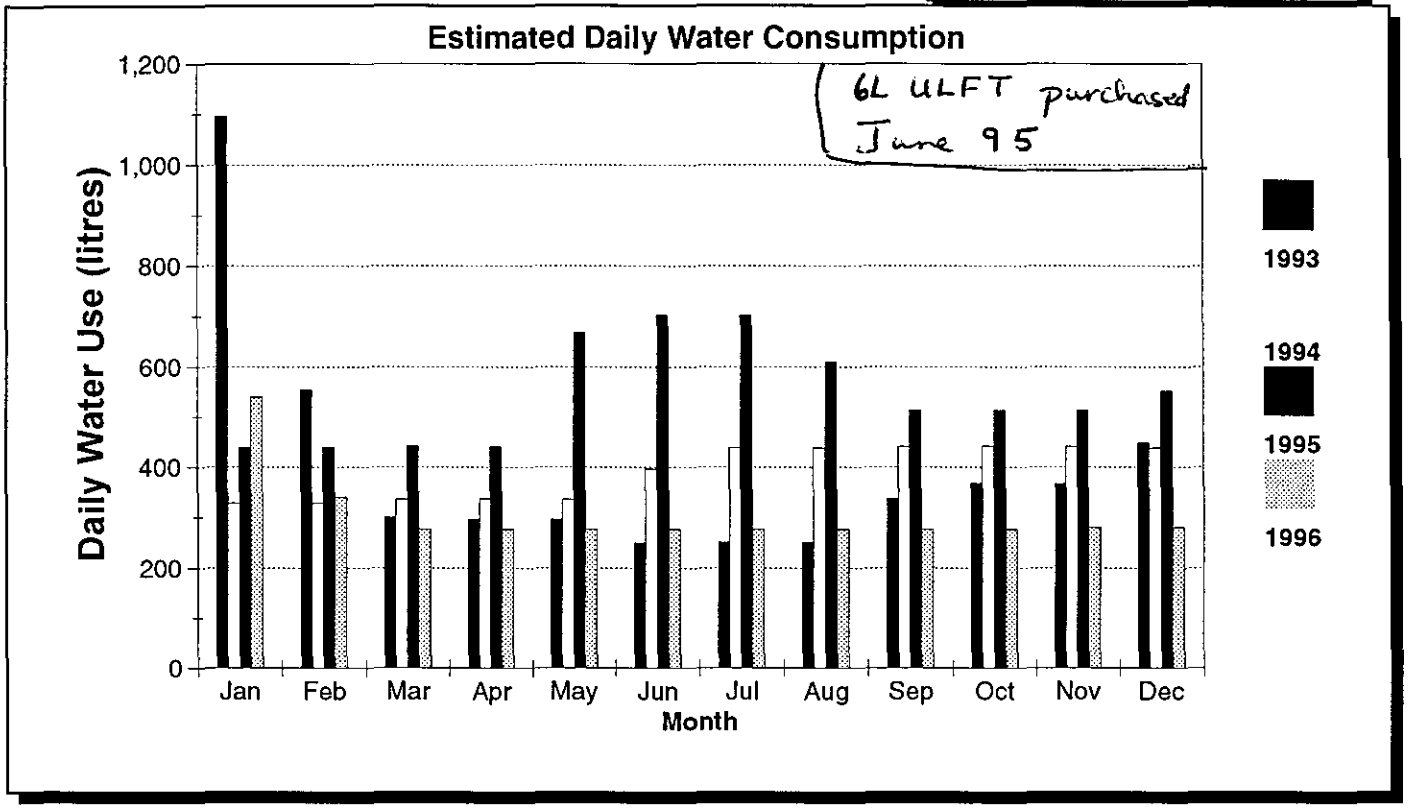
Figure E-1

Winter Avg (Nov-Mar) 93/94 - 528.3 Winter 96 - 270.4

(2)

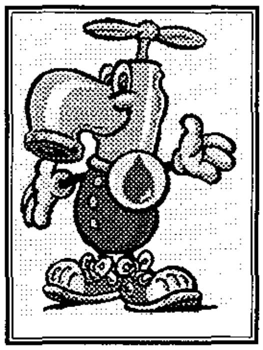
Account number :	ULFT #2
Customer	
Customer Clas	*SINGLE FAMILY DWELLING*
Service Address:	*R3R0S1*

Phone Number	
Residential	8320673
Business	7893793
Facsimilie	
Modem :	



Estimated Daily Water Use (Litres)

Month	1993	1994	1995	1996
January	1,097	329	439	539
February	554	329	439	341
March	300	335	442	277
April	297	337	440	277
May	297	335	668	277
June	250	397	703	277
July	252	439	703	277
August	252	439	610	277
September	337	440	513	277
October	368	442	513	277
November	367	440	513	280
December	448	439	552	281



26% Drop

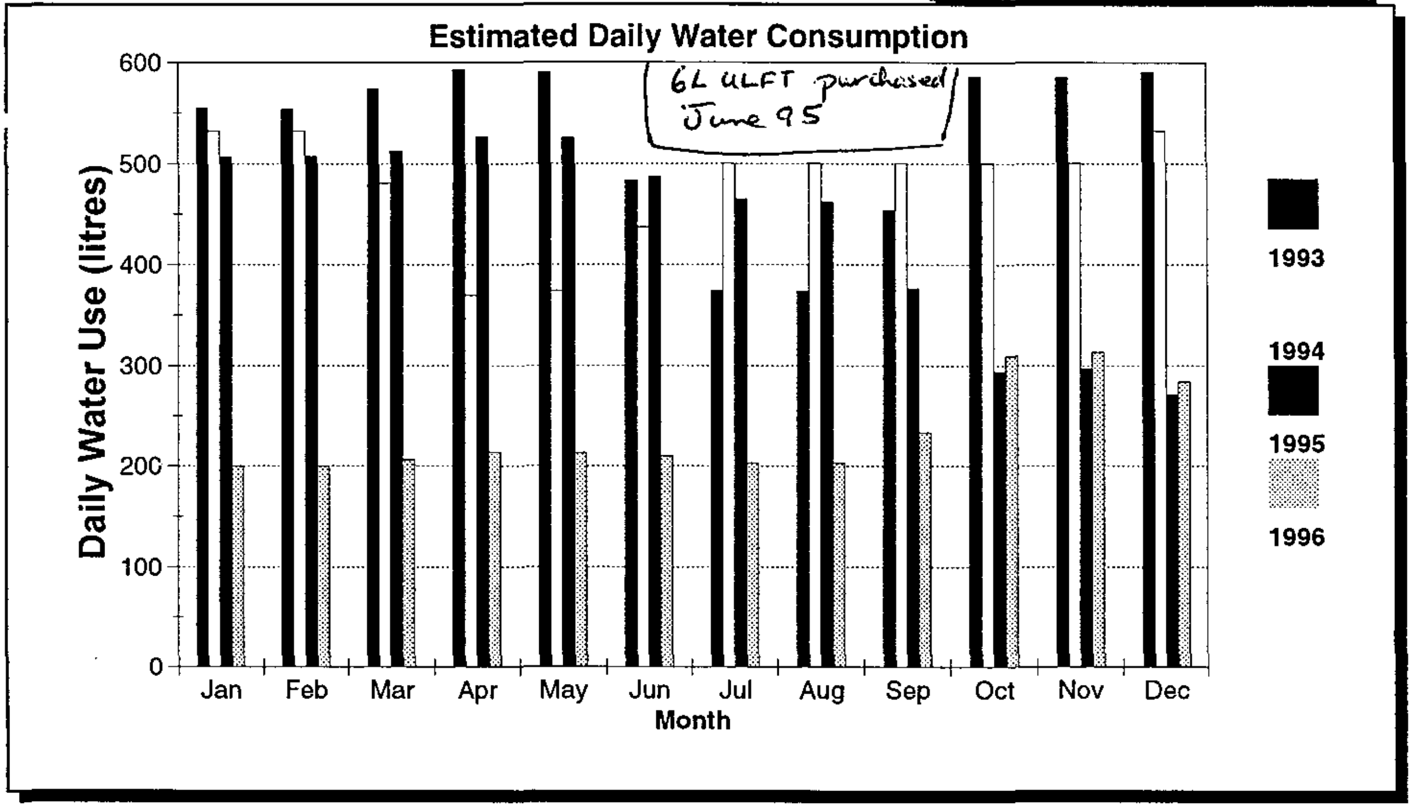
Figure E-2

nter Avg. (Nov-Mar) 93/94 - 463.8 Winter 96 - 343.6

(3)

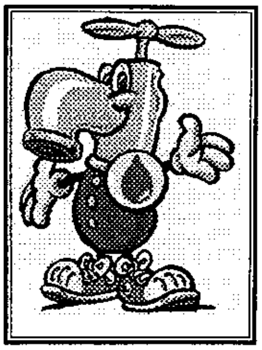
Account number :	ULFT # 3
Customer	
Customer Clas	*SINGLE FAMILY DWELLING*
Service Address:	***R2X2C2***

Phone Number	
Residential	5894739
Business	0
Facsimilie	
Modem :	



Estimated Daily Water Use (Litres)

Month	1993	1994	1995	1996
January	555	532	506	200
February	554	532	507	200
March	574	481	513	206
April	593	370	527	213
May	590	374	526	213
June	483	437	487	210
July	374	500	465	203
August	374	500	461	203
September	453	500	377	233
October	587	500	294	310
November	585	500	297	313
December	591	532	271	284



56% Drop

Figure E-3

Winter Avg (Nov - Mar) 93/94 - 543.6 Winter 96 - 240.6

(4)

Account number :

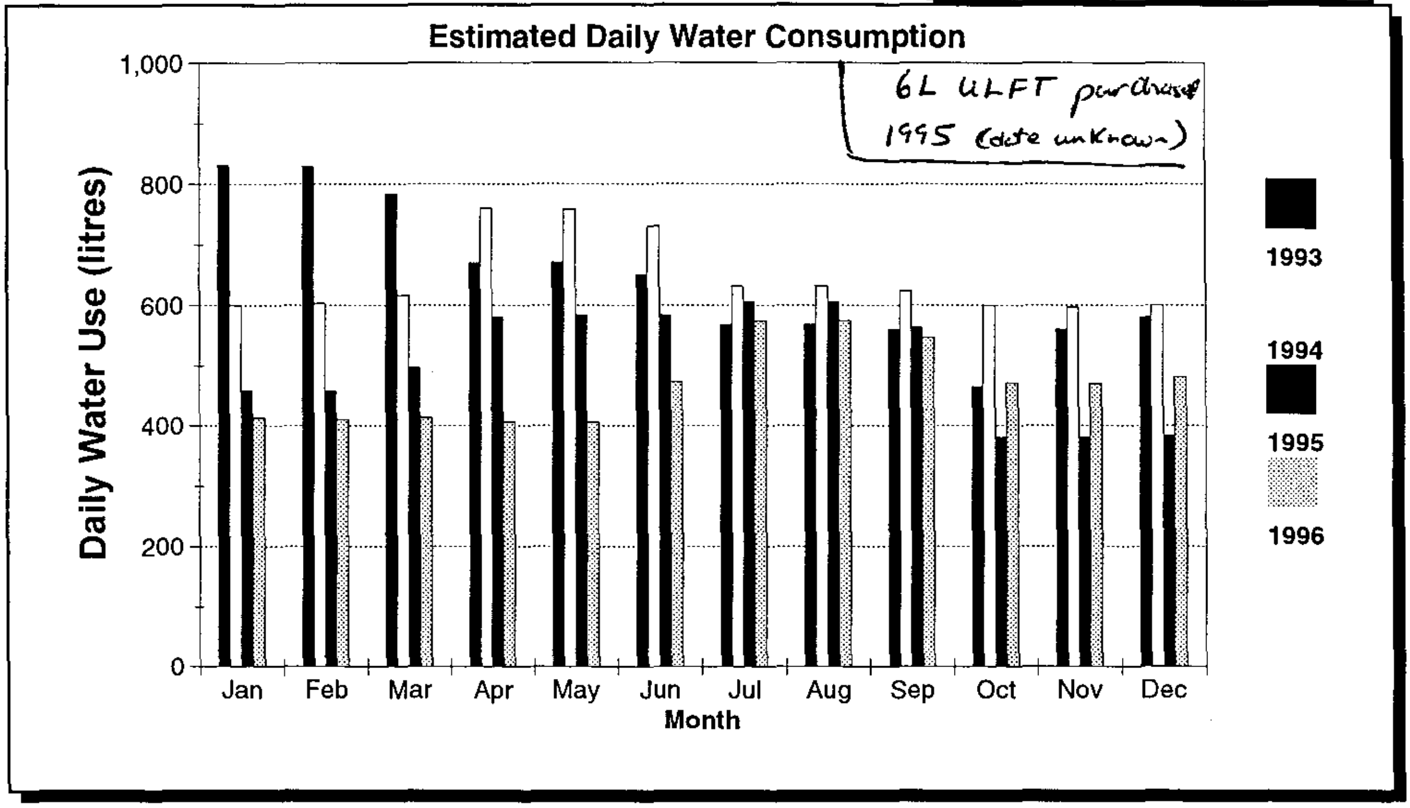
ULFT #4

Customer

Customer Clas SINGLE FAMILY DWELLING

Service Address:
R2M4J6

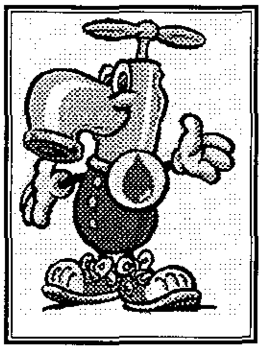
Phone Number	
Residential	0
Business	0
Facsimilie	
Modem :	



Estimated Daily Water Use (Litres)

Month	1993	1994	1995	1996
January	832	600	458	413
February	829	604	457	410
March	784	616	497	413
April	670	760	580	407
May	671	758	584	406
June	650	730	583	473
July	568	632	606	574
August	568	632	606	574
September	560	623	563	547
October	465	600	381	471
November	560	597	380	470
December	581	600	384	481

Winter Avg (Nov-Mar) 93/94 - 660.3 Winter 96 - 437.4



34% Drop

Figure E-4

ULFT #5

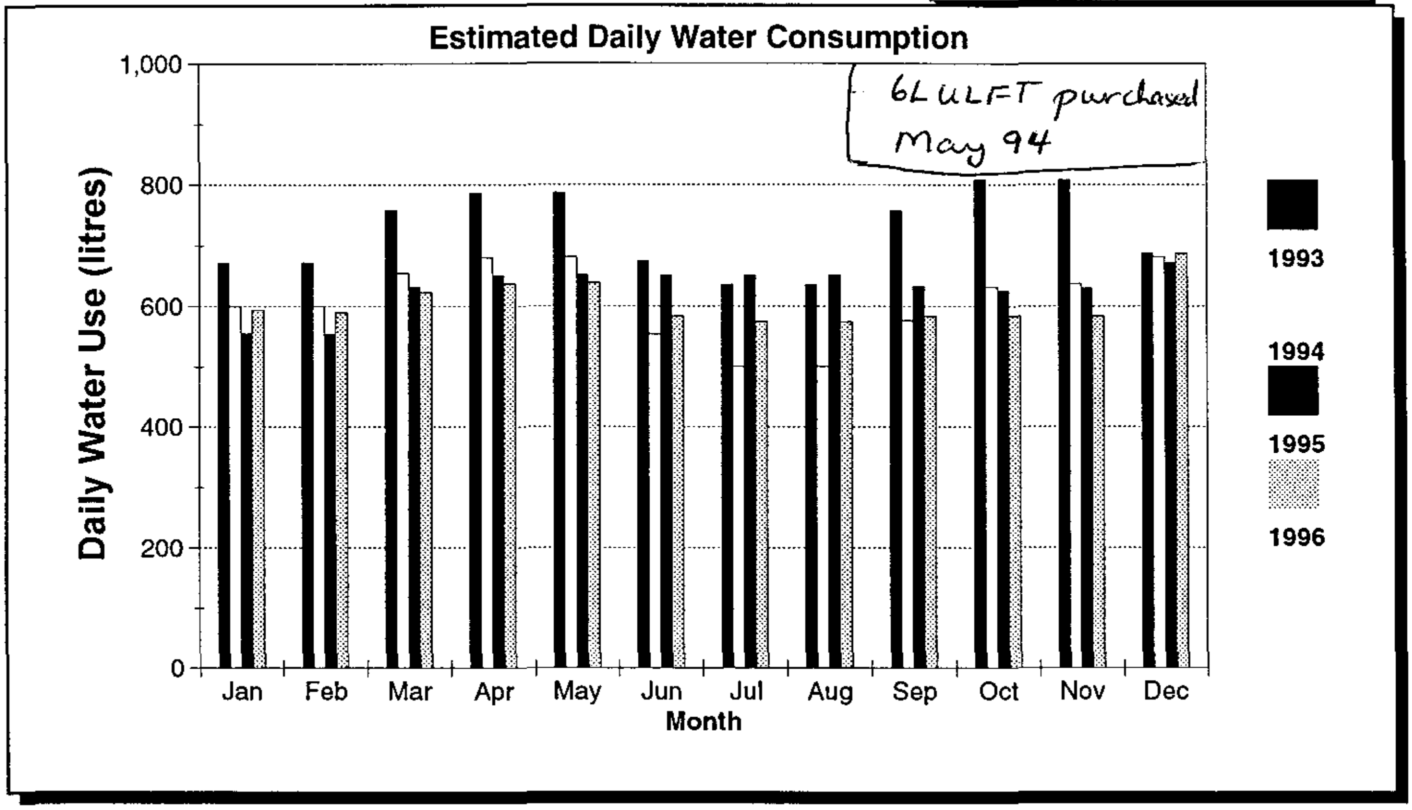
Account number :

Customer

Customer Clas *SINGLE FAMILY DWELLING*

Service Address:
R2K2A1

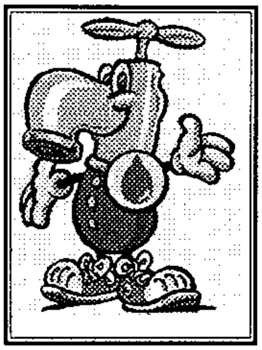
Phone Number	
Residential	0
Business	0
Facsimilie	
Modem :	



Estimated Daily Water Use (Litres)

Month	1993	1994	1995	1996
January	671	600	555	594
February	671	600	554	590
March	758	655	632	623
April	787	680	650	637
May	787	681	652	639
June	673	553	650	583
July	635	500	652	574
August	635	500	652	574
September	757	577	633	583
October	808	632	626	584
November	808	637	630	583
December	688	681	671	687

Winter Avg (Nov-Mar) 93/94 - 676.9 Winter 96 - 615.4



9 % Drop

Figure E-5

Assessment of Water Savings from Ultra Low Flush Toilets in Winnipeg

(from Accounts claiming ULF Toilet Rebate from C.O.W.)

- **Five accounts claimed the rebate in Stage 1 of Single-Family Retrofit Program**
- **Most ULFTs installed sometime in 1995 (actual date unknown)**
- **For evaluation of savings, compared Winter Consumption (Nov-Mar) for 1993 & 1994 with Winter 1996 Consumption**

Account	Winter 1993/94 L/day	Winter 1996 L/day	Change +\-
1	528.3	270.4	-49%
2	463.8	343.6	-26%
3	543.6	240.6	-56%
4	660.3	437.4	-34%
5	676.9	615.4	-9%
Avg.	574.6	381.5	-34%

- **1997 model**

  1992 usage: 2.5 x 228 LCD = 570 L/day

  2046 usage: 2.5 x 171 LCD = 427 L/day

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Figure E-6

APPENDIX F

Long Term

Projection Details

F-1
Details of Residential Water Use Model

Year	New Dwelling Start	Existing Dwelling 1991	New Dwelling Since 1991	% New Dwelling Start$		Toilets: High Efficiency L/Flush 6.00	Toilets: Medium Efficiency L/Flush 13	Toilets: Low Efficiency L/Flush 22	Toilets: Demand LCD	Toilet Leaks	Shower: High Efficiency L/min 6.3	Shower: Medium Efficiency L/min 12	Shower: Low Efficiency L/min 18	Shower: Min/day	Shower: LCD	Bath	Faucets	Laundry: High Use 41	Laundry: Low Use 33	Laundry: LCD	Dishwasher	Cooking/Drinkin	Cleaning
1992	1489	241,165	1,489	0.61%	100.0%	1.6%	42.6%	56.8%	73	14	2%	43%	56%	3.25	46.06	23	20	100%	0%	41	7	2	2
1993	1489	242,654	2,979	0.61%	100.0%	1.7%	45.1%	53.2%	72	14	2%	45%	53%	3.302	46.45	23	20	100%	0%	41	7	2	2
1994	1489	244,144	4,468	0.60%	100.0%	1.8%	47.4%	50.8%	71	14	2%	47%	51%	3.353	46.82	23	20	100%	0%	41	7	2	2
1995	1489	245,633	5,957	0.59%	100.0%	2.2%	49.3%	48.5%	70	14	2%	49%	48%	3.405	47.18	23	20	100%	0%	41	7	2	2
1996	1621	247,254	7,579	0.64%	100.0%	2.8%	51.0%	46.2%	69	14	3%	51%	46%	3.456	47.51	23	20	100%	0%	41	7	2	2
1997	1621	248,876	9,200	0.63%	100.0%	3.6%	52.3%	44.1%	68	14	4%	52%	44%	3.508	47.82	23	20	100%	0%	41	7	2	2
1998	1621	250,497	10,822	0.62%	100.0%	4.8%	53.1%	42.1%	67	14	5%	53%	42%	3.559	48.07	23	20	100%	0%	41	7	2	2
1999	1621	252,119	12,443	0.61%	100.0%	6.4%	53.5%	40.2%	66	14	6%	53%	40%	3.611	48.27	23	20	100%	0%	41	7	2	2
2000	1621	253,740	14,064	0.61%	100.0%	8.4%	53.3%	38.3%	64	14	8%	53%	38%	3.662	48.42	23	20	100%	0%	41	7	2	2
2001	1343	255,083	15,408	0.50%	100.0%	10.7%	52.7%	36.6%	63	14	11%	53%	37%	3.714	48.53	23	20	100%	0%	41	7	2	2
2002	1343	256,427	16,751	0.49%	100.0%	13.3%	51.7%	35.0%	62	14	13%	52%	35%	3.765	48.59	23	20	99%	1%	41	7	2	2
2003	1343	257,770	18,094	0.49%	100.0%	16.3%	50.3%	33.4%	60	14	16%	50%	33%	3.817	48.59	23	20	99%	1%	41	7	2	2
2004	1343	259,113	19,438	0.48%	100.0%	19.4%	48.7%	31.9%	59	14	19%	49%	32%	3.868	48.58	23	20	98%	2%	41	7	2	2
2005	1343	260,457	20,781	0.48%	100.0%	22.5%	47.0%	30.5%	58	14	23%	47%	30%	3.920	48.55	23	20	97%	3%	41	7	2	2
2006	1809	262,266	22,590	0.64%	100.0%	25.9%	45.0%	29.1%	56	14	26%	45%	29%	3.971	48.47	23	20	96%	4%	41	7	2	2
2007	1809	264,075	24,400	0.63%	100.0%	29.1%	43.2%	27.8%	55	14	29%	43%	28%	4.023	48.41	23	20	94%	6%	41	7	2	2
2008	1809	265,885	26,209	0.62%	100.0%	32.2%	41.3%	26.5%	53	14	32%	41%	26%	4.074	48.35	23	20	92%	8%	40	7	2	2
2009	1809	267,694	28,019	0.61%	100.0%	35.2%	39.5%	25.3%	52	14	36%	40%	25%	4.126	48.30	23	20	89%	11%	40	7	2	2
2010	1809	269,504	29,828	0.60%	100.0%	38.1%	37.7%	24.1%	51	14	38%	38%	24%	4.177	48.26	23	20	85%	15%	40	7	2	2
2011	2591	272,094	32,419	0.85%	100.0%	41.1%	35.9%	22.9%	49	14	41%	36%	23%	4.229	48.19	23	20	82%	18%	39	7	2	2
2012	2591	274,685	35,009	0.84%	100.0%	43.9%	34.2%	21.8%	48	14	44%	34%	22%	4.280	48.14	23	20	77%	23%	39	7	2	2
2013	2591	277,275	37,600	0.82%	100.0%	46.6%	32.6%	20.8%	47	14	47%	33%	21%	4.332	48.11	23	20	73%	27%	39	7	2	2
2014	2591	279,866	40,190	0.81%	100.0%	49.2%	31.0%	19.8%	46	14	49%	31%	20%	4.383	48.10	23	20	69%	31%	38	7	2	2
2015	2591	282,457	42,781	0.80%	100.0%	51.6%	29.5%	18.9%	45	14	52%	30%	19%	4.435	48.10	23	20	64%	36%	38	7	2	2
2016	2448	284,905	45,229	0.74%	100.0%	53.9%	28.1%	18.0%	44	14	54%	28%	18%	4.486	48.12	23	20	60%	40%	38	7	2	2
2017	2448	287,353	47,678	0.73%	100.0%	56.0%	26.8%	17.1%	43	14	56%	27%	17%	4.538	48.16	23	20	56%	44%	37	7	2	2
2018	2448	289,802	50,126	0.72%	100.0%	58.1%	25.6%	16.3%	42	14	58%	26%	16%	4.589	48.21	23	20	52%	48%	37	7	2	2
2019	2448	292,250	52,574	0.71%	100.0%	60.1%	24.4%	15.6%	41	14	60%	24%	16%	4.641	48.27	23	20	49%	51%	37	7	2	2
2020	2448	294,698	55,022	0.70%	100.0%	61.9%	23.2%	14.8%	41	14	62%	23%	15%	4.692	48.34	23	20	46%	54%	37	7	2	2
2021	1520	296,218	56,542	0.43%	100.0%	63.6%	22.2%	14.2%	40	14	64%	22%	14%	4.692	47.93	23	20	42%	58%	36	7	2	2
2022	1520	297,738	58,062	0.43%	100.0%	65.2%	21.2%	13.6%	39	14	65%	21%	14%	4.692	47.53	23	20	39%	61%	36	7	2	2
2023	1520	299,258	59,582	0.42%	100.0%	66.7%	20.3%	13.0%	39	14	67%	20%	13%	4.692	47.16	23	20	37%	63%	36	7	2	2
2024	1520	300,778	61,102	0.42%	100.0%	68.2%	19.4%	12.4%	38	14	68%	19%	12%	4.692	46.79	23	20	34%	66%	36	7	2	2
2025	1520	302,298	62,622	0.42%	100.0%	69.6%	18.5%	11.8%	37	14	70%	18%	12%	4.692	46.45	23	20	32%	68%	35	7	2	2
2026	537	302,835	63,160	0.15%	100.0%	70.9%	17.6%	11.4%	37	14	71%	18%	11%	4.692	46.14	23	20	29%	71%	35	7	2	2
2027	537	303,373	63,697	0.15%	100.0%	72.1%	17.0%	10.9%	36	14	72%	17%	11%	4.692	45.84	23	20	27%	73%	35	7	2	2
2028	537	303,910	64,234	0.15%	100.0%	73.2%	16.3%	10.4%	36	14	73%	16%	10%	4.692	45.56	23	20	25%	75%	35	7	2	2
2029	537	304,448	64,772	0.15%	100.0%	74.3%	15.7%	10.0%	35	14	74%	16%	10%	4.692	45.28	23	20	24%	76%	35	7	2	2
2030	537	304,985	65,309	0.15%	100.0%	75.4%	15.0%	9.6%	35	14	75%	15%	10%	4.692	45.02	23	20	22%	78%	35	7	2	2
2031	84	305,069	65,394	0.02%	100.0%	76.4%	14.4%	9.2%	34	14	76%	14%	9%	4.692	44.78	23	20	20%	80%	34	7	2	2
2032	84	305,154	65,478	0.02%	100.0%	77.3%	13.8%	8.8%	34	14	77%	14%	9%	4.692	44.54	23	20	19%	81%	34	7	2	2
2033	84	305,238	65,563	0.02%	100.0%	78.2%	13.3%	8.5%	34	14	78%	13%	8%	4.692	44.32	23	20	18%	82%	34	7	2	2
2034	84	305,323	65,647	0.02%	100.0%	79.1%	12.7%	8.1%	33	14	79%	13%	8%	4.692	44.10	23	20	16%	84%	34	7	2	2
2035	84	305,407	65,732	0.02%	100.0%	80.0%	12.2%	7.8%	33	14	80%	12%	8%	4.692	43.89	23	20	15%	85%	34	7	2	2
2036	177	305,584	65,908	0.05%	100.0%	80.8%	11.7%	7.5%	33	14	81%	12%	7%	4.692	43.69	23	20	14%	86%	34	7	2	2
2037	177	305,760	66,085	0.05%	100.0%	81.5%	11.3%	7.2%	32	14	82%	11%	7%	4.692	43.50	23	20	13%	87%	34	7	2	2
2038	177	305,937	66,261	0.05%	100.0%	82.3%	10.8%	6.9%	32	14	82%	11%	7%	4.692	43.32	23	20	12%	88%	34	7	2	2
2039	177	306,114	66,438	0.05%	100.0%	83.0%	10.4%	6.6%	32	14	83%	10%	7%	4.692	43.14	23	20	11%	89%	34	7	2	2
2040	177	306,290	66,614	0.05%	100.0%	83.7%	9.9%	6.4%	31	14	84%	10%	6%	4.692	42.97	23	20	11%	89%	34	7	2	2
2041	509	306,799	67,123	0.14%	100.0%	84.4%	9.5%	6.1%	31	14	84%	10%	6%	4.692	42.80	23	20	10%	90%	34	7	2	2
2042	509	307,308	67,632	0.14%	100.0%	85.0%	9.1%	5.8%	31	14	85%	9%	6%	4.692	42.64	23	20	9%	91%	34	7	2	2
2043	509	307,816	68,141	0.14%	100.0%	85.6%	8.8%	5.6%	30	14	86%	9%	6%	4.692	42.49	23	20	9%	91%	34	7	2	2
2044	509	308,325	68,649	0.13%	100.0%	86.2%	8.4%	5.4%	30	14	86%	8%	5%	4.692	42.35	23	20	8%	92%	33	7	2	2
2045	509	308,834	69,158	0.13%	100.0%	86.8%	8.1%	5.1%	30	14	87%	8%	5%	4.692	42.21	23	20	7%	93%	33	7	2	2
2046	509	309,343	69,667	0.13%	100.0%	87.3%	7.7%	4.9%	30	14	87%	8%	5%	4.692	42.07	23	20	7%	93%	33	7	2	2

F-2
Residential Water Use Model Projections

Year	Resindential Demand No Technology Changes	Resindential Demand With Technology Changes	Residential Demand With Public Education	Population	Residential Use
	LCD	LCD	LCD		ML/d
1992	228	228	223	622,652	139
1993	228	228	224	627,333	140
1994	229	228	223	632,013	141
1995	230	227	223	636,694	142
1996	231	226	222	632,338	140
1997	231	226	221	635,211	141
1998	232	225	220	638,084	141
1999	233	224	219	640,958	141
2000	234	223	218	643,831	141
2001	234	222	217	651,360	141
2002	235	220	216	655,164	141
2003	236	219	214	658,969	141
2004	237	217	213	662,773	141
2005	237	216	212	666,578	141
2006	238	214	210	665,608	140
2007	239	213	208	668,458	139
2008	239	211	207	671,307	139
2009	240	209	205	674,157	138
2010	241	208	204	677,006	138
2011	242	206	202	678,132	137
2012	242	205	200	680,637	136
2013	243	203	199	683,142	136
2014	244	202	198	685,646	135
2015	245	200	196	688,151	135
2016	245	199	195	691,751	135
2017	246	198	194	694,475	135
2018	247	197	193	697,199	134
2019	247	195	192	699,922	134
2020	248	194	191	702,646	134
2021	248	193	189	706,525	134
2022	248	192	188	709,479	133
2023	248	191	187	712,434	133
2024	248	189	186	715,389	133
2025	248	188	184	718,343	132
2026	248	187	183	720,453	132
2027	248	186	182	723,239	132
2028	248	185	182	726,025	132
2029	248	184	181	728,811	132
2030	248	183	180	731,596	132
2031	248	183	179	730,835	131
2032	248	182	178	732,912	131
2033	248	181	178	734,988	131
2034	248	181	177	737,064	130
2035	248	180	176	739,141	130
2036	248	179	176	736,812	129
2037	248	179	175	738,007	129
2038	248	178	174	739,202	129
2039	248	177	174	740,398	129
2040	248	177	173	741,593	129
2041	248	176	173	739,825	128
2042	248	176	172	740,428	128
2043	248	175	172	741,030	127
2044	248	175	172	741,633	127
2045	248	175	171	742,235	127
2046	248	174	171	742,516	127

F-3
Residential Water Use Model Projections (LCD)

Year	Residential Indoor	Industrial	Commercial	UFW	Peak Outdoor Use	Average Outdoor Use	Max Day outdoor	Treatment Plant 5%	Total Per Capita
	LCD	LCD	LCD	LCD	LCD	LCD	LCD	LCD	LCD
1992	223	50	75	69	53	28	458		469
1993	224	50	75	69	53	28	458		470
1994	223	50	75	69	53	28	458		469
1995	223	50	75	68	52	28	458		468
1996	222	50	75	68	52	28	458		468
1997	221	50	75	68	52	28	458		467
1998	220	50	75	68	52	28	458		466
1999	219	50	75	68	52	28	458		464
2000	218	50	75	68	52	28	458		463
2001	217	50	75	67	52	27	458		461
2002	216	50	75	67	51	27	458		459
2003	214	50	75	67	51	27	458		458
2004	213	50	75	67	51	27	458		456
2005	212	50	75	66	51	27	458	20	474
2006	210	50	75	66	51	27	458	20	471
2007	208	50	75	66	50	27	458	20	469
2008	207	50	75	65	50	27	458	20	467
2009	205	50	75	65	50	26	458	20	465
2010	204	50	75	65	50	26	458	20	463
2011	202	50	75	64	49	26	458	20	460
2012	200	50	75	64	49	26	458	19	458
2013	199	50	75	64	49	26	458	19	456
2014	198	50	75	64	49	26	458	19	454
2015	196	50	75	63	48	26	458	19	452
2016	195	50	75	63	48	26	458	19	450
2017	194	50	75	63	48	26	458	19	449
2018	193	50	75	63	48	25	458	19	447
2019	192	50	75	62	48	25	458	19	446
2020	191	50	75	62	48	25	458	19	444
2021	189	50	75	62	47	25	458	19	442
2022	188	50	75	62	47	25	458	19	441
2023	187	50	75	61	47	25	458	19	439
2024	186	50	75	61	47	25	458	19	437
2025	184	50	75	61	47	25	458	19	436
2026	183	50	75	61	47	25	458	18	434
2027	182	50	75	61	46	25	458	18	433
2028	182	50	75	60	46	25	458	18	431
2029	181	50	75	60	46	25	458	18	430
2030	180	50	75	60	46	24	458	18	429
2031	179	50	75	60	46	24	458	18	428
2032	178	50	75	60	46	24	458	18	427
2033	178	50	75	60	46	24	458	18	426
2034	177	50	75	59	46	24	458	18	425
2035	176	50	75	59	45	24	458	18	424
2036	176	50	75	59	45	24	458	18	423
2037	175	50	75	59	45	24	458	18	422
2038	174	50	75	59	45	24	458	18	422
2039	174	50	75	59	45	24	458	18	421
2040	173	50	75	59	45	24	458	18	420
2041	173	50	75	59	45	24	458	18	419
2042	172	50	75	59	45	24	458	18	419
2043	172	50	75	59	45	24	458	18	418
2044	172	50	75	58	45	24	458	18	417
2045	171	50	75	58	45	24	458	18	417
2046	171	50	75	58	45	24	458	18	416

F-4
Water Use Model
Projections (ML/d)

Year	Residential Indoor	Industrial	Commercial	Design UFW	Peak Outdoor Use	Average Summer Use	Treatment Plant	Max DAy Excess	Planning Demand Total ML/d
	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d
1992	139	31	47	43	33	17	0	285	292
1993	140	31	47	43	33	18	0	287	295
1994	141	32	47	43	33	18	0	289	297
1995	142	32	48	44	33	18	0	292	298
1996	140	32	47	43	33	18	0	290	296
1997	141	32	48	43	33	18	0	291	296
1998	141	32	48	43	33	18	0	292	297
1999	141	32	48	43	33	18	0	294	298
2000	141	32	48	44	33	18	0	295	298
2001	141	33	49	44	34	18	0	298	300
2002	141	33	49	44	34	18	0	300	301
2003	141	33	49	44	34	18	0	302	302
2004	141	33	50	44	34	18	0	304	302
2005	141	33	50	44	34	18	13	305	316
2006	140	33	50	44	34	18	13	305	314
2007	139	33	50	44	34	18	13	306	314
2008	139	34	50	44	34	18	13	307	314
2009	138	34	51	44	34	18	13	309	313
2010	138	34	51	44	34	18	13	310	313
2011	137	34	51	44	33	18	13	311	312
2012	136	34	51	44	33	18	13	312	312
2013	136	34	51	44	33	18	13	313	312
2014	135	34	51	44	33	18	13	314	311
2015	135	34	52	44	33	18	13	315	311
2016	135	35	52	44	33	18	13	317	312
2017	135	35	52	44	33	18	13	318	312
2018	134	35	52	44	33	18	13	319	312
2019	134	35	52	44	33	18	13	321	312
2020	134	35	53	44	33	18	13	322	312
2021	134	35	53	44	33	18	13	324	313
2022	133	35	53	44	33	18	13	325	313
2023	133	36	53	44	33	18	13	326	313
2024	133	36	54	44	34	18	13	328	313
2025	132	36	54	44	34	18	13	329	313
2026	132	36	54	44	34	18	13	330	313
2027	132	36	54	44	34	18	13	331	313
2028	132	36	54	44	34	18	13	333	313
2029	132	36	55	44	34	18	13	334	314
2030	132	37	55	44	34	18	13	335	314
2031	131	37	55	44	34	18	13	335	313
2032	131	37	55	44	34	18	13	336	313
2033	131	37	55	44	34	18	13	337	313
2034	130	37	55	44	34	18	13	338	313
2035	130	37	55	44	34	18	13	339	313
2036	129	37	55	44	33	18	13	337	312
2037	129	37	55	44	33	18	13	338	312
2038	129	37	55	44	33	18	13	339	312
2039	129	37	56	44	33	18	13	339	312
2040	129	37	56	44	33	18	13	340	312
2041	128	37	55	43	33	18	13	339	310
2042	128	37	56	43	33	18	13	339	310
2043	127	37	56	43	33	18	13	339	310
2044	127	37	56	43	33	18	13	340	310
2045	127	37	56	43	33	18	13	340	309
2046	127	37	56	43	33	18	13	340	309

F-5
Water Projections

Year	Planning Total Demand ML/d	Planning Total Demand ML/d	Planning Total Demand ML/d
	Normal	High	Low
1992	292	292	281
1993	295	296	283
1994	297	298	284
1995	298	300	286
1996	296	298	283
1997	296	300	284
1998	297	301	284
1999	298	302	284
2000	298	303	284
2001	300	307	287
2002	301	308	287
2003	302	310	287
2004	302	311	287
2005	316	327	292
2006	314	326	290
2007	314	327	290
2008	314	328	290
2009	313	329	289
2010	313	329	289
2011	312	329	288
2012	312	330	287
2013	312	331	287
2014	311	331	287
2015	311	332	287
2016	312	334	287
2017	312	335	287
2018	312	336	287
2019	312	337	287
2020	312	338	287
2021	313	339	288
2022	313	340	288
2023	313	341	288
2024	313	341	288
2025	313	342	288
2026	313	343	288
2027	313	344	288
2028	313	345	289
2029	314	346	289
2030	314	347	289
2031	313	346	288
2032	313	347	289
2033	313	348	289
2034	313	349	289
2035	313	350	289
2036	312	348	288
2037	312	349	288
2038	312	349	288
2039	312	350	288
2040	312	350	288
2041	310	349	287
2042	310	350	287
2043	310	350	287
2044	310	350	286
2045	309	351	286
2046	309	351	286

2011 sewer service interruptions

Untreated wastewater discharges from the wastewater collection system to the river system:

Date	Location	Estimated discharge	Estimated duration	Cause	Incident details and response
Oct. 21	St Johns Park combined sewer outfall pipe	unknown	unknown	Sewer blocked	• Crews discovered a small flow discharging into the Red River from the combined sewer outfall pipe on the north side of St Johns Park at 11:30 am on October 21, 2011. • Crews closed the sluice gate on the St. Johns combined relief pipe at 12:25 pm, preventing any further discharge to the Red River. • Crews investigated the St. Johns drainage area and found a blockage in the combined sewer at Redwood Ave and Salter St. They removed the blockage at 4:20 pm on October 21, 2011. • Incident reported to Manitoba Conservation, Manitoba Environmental Accident Reporting

					Line and Environment Canada.
Oct. 7	St. Norbert lift station, 25 De La Digue Ave.	0.12 ML or 120,000 litres	20 minutes	sewage pumps were not working due to a hydro power failure	• An alarm was received for St. Norbert lift station on Friday at 4:48 p.m. • A Wastewater Services crew was onsite at 5:25 p.m. and discovered pumps were not running due to a Hydro power failure. They closed the overflow gate to prevent a raw sewage discharge and began storing sewage in the sewer pipe system. • While staff worked to get a trailer mounted generator functioning, sewage levels in the sewer system approached a critical elevation. To reduce the risk of sewer backup in basements, they had to lower levels in the sewer by opening the overflow gate on two brief occasions – from 7:00 - 7:10 pm and from 8:23 - 8:33 pm. • By 8:54 p.m., the crew

					restored temporary power to the sewage lift pumps with the generator. • Hydro restored power to the station at 04:12 a.m. on October 8. • Incident reported to Manitoba Conservation, Manitoba Environmental Accident Reporting Line and Environment Canada.
May 20 to May 25	Assiniboine River (via Sturgeon Creek) - Outfall located near 54 Lonsdale Drive	2.1 ML or 2,100,000 litres	4 days, 21 hours, 54 minutes	Blockage in wastewater sewer	• 311 received email at 2:11 p.m. on Friday, May 20, reporting discharge from outfall and created service request. • Environmental Standards staff opened service request on Tuesday, May 24 and investigated. • Wastewater collection branch notified on Wednesday, May 25 at 10:00 a.m. Crew dispatched and found blockage of grease and rags in sewer causing diluted raw sewage to

					build up and overflow through outfall pipe. Blockage removed at 12:05 p.m. • Lag time between notification and resolution due to oversight in internal protocol. Response process reviewed and will be improved for future similar events. • Incident reported to Manitoba Conservation, Manitoba Environmental Accident Reporting Line and Environment Canada.

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Don't throw garbage down the drain

Help keep our rivers clean. Don't use the sewer as a garbage can.

Things that go into the sewer through toilets, sinks or storm drains can end up in our rivers. You can help make a difference in the health of our waterways by following these proper disposal suggestions:

- **In your home or where you work**
  Put the following items in the garbage where they belong, instead of down the drain:
  - cigarette butts
  - dental floss
  - condoms
  - rags
  - tampons and tampon applicators
  - sanitary napkins
  - disposable diapers
  - human and pet hair
  - cotton swabs
  - cosmetics/makeup
  - food scraps (an even better solution is to compost them or dig them into your garden)
  - vegetable and animal grease, fats, oils (these substances can clog the sewer in your home and the City system and cause sewer backup)
- **In your yard and on the street**
  Anything on the ground can wash into the storm drains on streets and lanes and end up in the rivers, so:
  - clean up your pet waste.
  - check your vehicle regularly to make sure hazardous waste fluids, such as oil, antifreeze and gasoline, aren't leaking.
  - don't litter.
  - don't put grass clippings, leaves and other yard waste on the streets or into rivers – not only do they add harmful chemicals and nutrients to the rivers and clog storm drains, it's against Sewer By-law 92/2010.
- **Hazardous waste products, chemicals and prescription drugs**
  These potentially dangerous substances don't belong in the

garbage or dumped down the drain – they need special handling.

- Dispose of hazardous waste products safely by taking them to a free household hazardous waste collection depot.
  - Information on collection centres is also available by calling the recycling and garbage information line at 986-8888, code 9811 or contacting us
  - These danger symbols can help you identify many hazardous waste products – e.g., corrosive, explosive, poison and flammable

- Many chemicals can damage the sewer in your home and the City system. Plus, our wastewater treatment plants may not be able to remove them and they can end up in the river, harming fish and other aquatic life.
- Take leftover or expired prescription drugs and over-the-counter medicines to a pharmacy where they will be disposed of safely.

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Wastewater collection system operation

Our wastewater collection (sewer) system is made up of:

- combined sewers
- interceptor sewers
- separate sewers
- land drainage systems
- lift stations and diversion structures
- combined and separate sewer areas

Combined sewers

- A system of single pipes that collect both wastewater from homes, businesses and industries as well as surface runoff from rainstorms and snow melt.

- There are 79 combined sewer outfalls or outlets to the river system.

- The older, central region of Winnipeg is served by 1,280 km of combined sewer pipes.

- Prior to 1937, the collected sewage and storm runoff flowed directly into the local river system without being treated.

- In 1937, an interceptor sewer system was built to carry sewage in the combined sewer system to the North End Treatment Plant.

- There are 130 kilometers of interceptor sewers in the city that carry sewage to the three treatment plants.

- Weirs, or small dams, were installed in all combined

Select any image below to see a larger version.

sewers near the outlet of the pipe to divert sewage to the interceptor sewer system during dry weather conditions.

- In wet weather conditions, flows are higher because runoff enters the system. A higher flow means the wastewater level in the pipe may become higher than the height of the weir. When this happens, combined sewers overflow to the river system.

- Combined sewer overflows occur an average of 18 times during the open water recreational season (May 1 – September 30).

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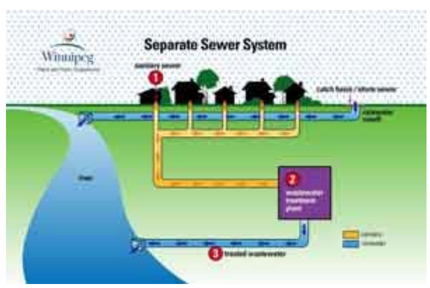
Separate sewers

- A system of two pipes where one pipe carries wastewater and the other carries land drainage and surface runoff from rainstorms and snow melt.
- The role of the separate sewer system is to collect wastewater from homes, businesses and industries and carry it to a water pollution control centre for treatment.



- Since the 1960s, new property developments in the city have been serviced by a two-pipe system.
- The sewage or sanitary sewer system has about 1,182 km of dedicated pipes that are completely separate from the land drainage system.

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Land drainage sewers

- A system of single pipes that carries rainfall and snow melt runoff from urban areas to the river system.

- There are 1,372 km of land drainage sewers in Winnipeg.

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Lift stations and diversion structures

- Because of Winnipeg's relatively flat terrain, it is necessary to pump wastewater using lift stations to the interceptor sewers or to the water pollution control centres.

- The main purpose of a lift station is to raise sewage to a higher level so that it can be moved into a sewer system where it can flow by gravity.

- There are 76 wastewater pumping stations and 10 gravity-based wastewater diversion facilities located throughout the city.

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Combined and separate sewer areas

- The combined sewer system services an area of approximately 8,700 hectares or about 30% of the city.

- The separate wastewater and land drainage sewers services an area of approximately 22,300 hectares or about 70% of the city.

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Sewer overflow information system

Current status	Legend
O	O White indicates low probability of overflow ● Grey indicates likelihood of overflow ● Black indicates high probability of overflow

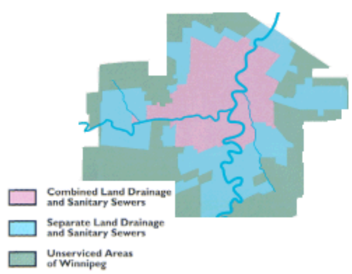
This system indicates the current condition of our entire sewer network with regard to overflows into the Red and Assiniboine Rivers. It is based on a reading of high water sensors in the sewer pipes at various overflow locations along the city's rivers, like the one pictured above, together with an assessment of other indicators, such as river levels.

What do the coloured dots represent?

- A white dot indicates that there is a low probability of overflows.
- A grey dot indicates an increased likelihood of overflows.
- A black dot indicates a high probability of sewer overflows.

Where do sewer overflows occur?

Most overflows occur in the combined sewer system of our entire sewer network.



What are combined sewers?

Combined sewers are pipes that carry both wastewater (sewage from homes and businesses) and land drainage. There are about 1,280 kilometres of combined sewers. Typically, they serve areas of the city built before the 1960s.

When do combined sewers overflow?

Combined sewers carry all of the wastewater flow to the wastewater treatment plants during dry weather conditions. In fact, they can carry up to a minimum of 2.75 times the normal dry weather flow. However, during rainstorms they cannot handle all of the runoff that enters the sewer system. Most of the rain/wastewater mixture flows to the treatment plants, but some of the diluted wastewater overflows to the river system.

How often do sewer overflows occur?

Our annual average is 18 overflows during the recreation season (May 1 to September 30).

Are combined sewers unique to Winnipeg?

No. Many North American cities, including several others in Manitoba, have similar wastewater systems. Hundreds of communities built combined sewers because they were a cost-effective way to provide sewer service and improve drainage.

Combined sewers in our city date from 1880. They were the first sewer infrastructure.

Do I have to take any special precautions if I use the rivers?
Yes. Dr. Michael Routledge, Medical Officer of Health with the Winnipeg Regional Health Authority, advises:

- Never drink river water, whether overflows are occurring or not.
- Do not swim in the river system at any time because of fast currents, cloudy water, and slippery, muddy banks.
- Wash your hands if they come in contact with river water, particularly before you touch food.

Fish caught in the rivers are safe to eat as long as they are cooked thoroughly.

Sometimes I see garbage floating in the rivers? Is this from a sewer overflow?
There are floating debris in the rivers when an overflow occurs. However, most of the time, the material has been washed into sewers from the streets during a rainstorm. Residents can help reduce floating debris by keeping their yards clean and not putting garbage down their household drain or toilets.

I see foam on the river. Is it harmful?
Foam on the river:

- is not harmful to the environment
- occurs naturally
- is usually seen on the Assiniboine River when the water level changes
- is sometimes brown in colour
- is caused by materials such as pollen and algae
- is similar to the foam you often see when waves crash on a beach

I see what looks like an oil slick on the river.

- could be caused by algae, oil or a combined sewer overflow
- contact us and report it
- we will investigate and determine if we need to take any action

I see what looks like green paint on the river or retention pond.

- likely caused by algae
- contact us and report it
- we will investigate and determine if we need to take any action

I see water draining from a pipe into a river/stream

- likely runoff from rainwater or snowmelt
- in winter, the drainage can cause unsafe conditions on the ice, so contact us and report it

What are you doing to reduce sewer overflows?

We could be investing up to $450 million over the next 25 years to reduce the number of combined sewer overflows from our current average of 18 to a target of 4 during the recreation season (May 1 to September 30). We will modify the system to allow us to store the sewage until it can be pumped to the treatment plants. We could also spend an additional $695 million on other wastewater system improvements *(pdf - 364kb)*, such as reducing nutrients in effluent, and disinfecting effluent.

Our sewer service interruptions page also lists untreated wastewater discharges from the wastewater collection system.

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Summary of sewer overflows in the last 24-hour period.

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