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Public Information Document

THE REGIONAL MUNICIPALITY OF WATERLOO

REASSESSMENT OF THE LONG TERM WATER SUPPLY STRATEGY

Reference Book

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INTRODUCTION

1.0 INTRODUCTION

1.1 GENERAL

The Regional Municipality of Waterloo is undertaking a detailed reassessment of its long term water supply strategy. The Region intends to maintain regular communication with the community for continued input to the Study process. To this end, the Region has appointed a *Public Advisory Committee* to provide a direct link to various public interest groups and guidance and input on technical matters.

This document is a *Reference Book* for the Public Advisory Committee, the general public, and interested stakeholders. The *Introduction* contains relevant information relating to the background and approach to the Study as well as the proposed Public Participation Process. The *Reference Material* provides technical and descriptive information regarding the existing water supply conditions, the available long term water supply alternatives and the suggested evaluation criteria. *Comment Sheets* have been provided to allow you to voice your opinions, concerns and comments on the Region's Long Term Water Strategy.

The Introduction of this document has been prepared under the following headings:

- Study Background
- Study Approach
- Public Participation Process

1.2 STUDY BACKGROUND

In 1987 the Master Water Supply Study (Master Plan) was completed by M.M. Dillon Ltd. for the Regional Municipality of Waterloo, to establish a Long Term Water Supply Strategy for the Tri-City area: Kitchener, Waterloo and Cambridge. The Master Plan identified three water supply options, with sub-variants, as follows:

1) New Natural Groundwater Supply
   - for Kitchener-Waterloo
   - for Cambridge
2) Local Surface Water Supply
   - direct from the Grand River
   - from the Mannheim Artificial Recharge Scheme
   - from other artificial recharge areas

3) Remote Surface Water Supply
   - from a Great Lakes pipeline

The Great Lakes pipeline option was rejected in the initial stages of the study due primarily to its costs. The preferred strategy identified by the Master Plan, and approved by Regional Council was:

> *The Mannheim Artificial Recharge Scheme together with new natural groundwater supplies from the Southwest Aquifer, Puslinch-Mill Creek and the Shade's Mill Reservoir*

However, strong public and political opposition resulted in the exclusion of natural groundwater supplies from the study, and the chosen design alternative was:

> *The Mannheim Artificial Recharge Scheme to serve Kitchener, Waterloo and Cambridge for the next 50 years with a water treatment plant at Mannheim together with development of the Shade's Mill Reservoir groundwater supply as the first phases of implementation*

An aquifer is naturally recharged by infiltration of precipitation to the water bearing soil. Artificial recharge supplements this natural process by inducing infiltration to the aquifer via some manmade facility. The Mannheim Artificial Recharge Scheme was designed to convey water from the Grand River to the Mannheim aquifer for recovery and use during periods of high demand.

In June 1992, construction of Phase 1a of the Mannheim Scheme was completed including the Grand River intake works, a raw water pumping station and transmission main, and the Mannheim water treatment plant. Treated water is now being pumped from the treatment plant into the existing water supply system.

The Environmental Study Report prepared in conjunction with the design of the Mannheim Scheme recommended that the Study be reviewed in about five years time to re-evaluate the feasibility of the recharge process. The Region has identified a number of concerns that need be addressed prior to initiating construction and prototype testing of the recharge facilities, including:

- population growth rates
- future per capita water demands
- revised estimated lifetime of the Mannheim Recharge Scheme
- effectiveness and efficiency of the artificial recharge process
- implementation costs for future phases of the Mannheim Scheme

- risk of groundwater contamination; e.g. Elmira incident
- potential involvement of the Provincial Government; i.e. proposed Sewer and Water Corporation
- impact on the Grand River

The Region has therefore postponed subsequent phases of the Mannheim Artificial Recharge Scheme pending a detailed reassessment of its long term water supply alternatives which are the subject of this study.

1.3 STUDY APPROACH

The overall objective of the Study is to develop a long term strategy to assure a quality water supply to all Rural Municipalities and the Tri-Cities, for the next 50 years. To this end, the Region has commissioned Associated Engineering (Ont.) Ltd. in conjunction with other consultants on their team to complete a technical and economical evaluation of its long term water supply options.

The reassessment will consider the needs of the entire Region of Waterloo. In addition to addressing major volume demands in the Tri-Cities (including Elmira and St. Jacobs) the Study will identify opportunities to integrate other potential service areas including other settlement areas and currently unserviced rural areas where feasible and appropriate. The Study will also address the corridors of service pertinent to a Great Lakes pipeline.

The nature of the Study is a reassessment of the existing Master Plan, and a feasibility study rather than a full Environmental Study Report. That is, the Study will seek to advance the recommended strategic alternative(s) to Phases I and II of an Environmental Study as defined under the Environmental Assessment Act. Phase III of the Act (pre-design) will not be undertaken as part of this Study.

Control of the Study will be maintained by an integrated group of Study Teams (see Figure 1), described as follows:

Project Steering Committee

The project is being implemented under the general direction of the Project Steering Committee. The Committee consists of political representatives from the Cities of Kitchener, Waterloo and Cambridge, and the Townships of North Dumfries, Wellesley, Wilmot and Woolwich, and is chaired by the Regional Chairman.

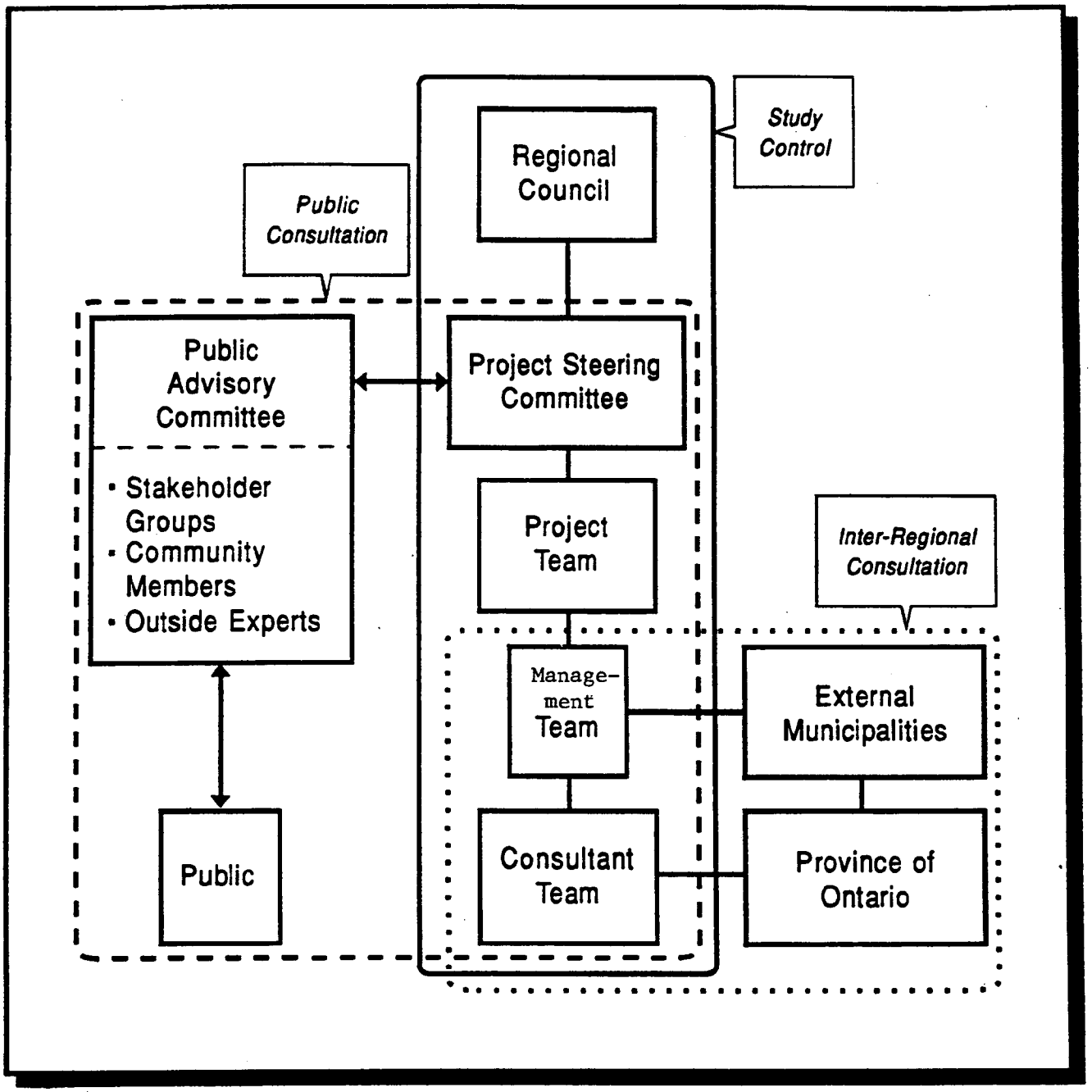

Figure 1
STUDY ORGANIZATIONAL STRUCTURE

Project Team

The Project Team consists of representatives of the Ministry of the Environment, Ministry of Natural Resources, the Grand River Conservation Authority, the combined Chambers of Commerce in the Tri-City area, the Waterloo Federation of Agriculture, a resident of the Township of Wilmot, and Regional Planning, Finance and Engineering Staff. The Project Team will review and evaluate the technical, financial, and environmental information prepared by the Consultant Team, prior to presentation to the Steering Committee.

Management Team

The Management Team consists of the Region's Commissioner of Engineering; Director of Water and Wastewater Operations; Project Coordinator and the prime consultant's Project Manager and Project Coordinator. The Management Team directs and manages the day to day progress of the study.

Consultant Team

The Consultant Team, under the direct supervision of Associated Engineering, will prepare all technical reports and memoranda as required for the completion of the Study assignment. The Consultant Team Organization is illustrated in Figure 2.

Public Advisory Committee

Effective Public Participation is critical to the success of the Study. The Public Advisory Committee is an integrated group of community members, stakeholder representatives and independent experts. The Committee will convene to review and comment on the progress of the Study and provide a direct link to various interested groups and provide guidance to the project team and the Steering Committee.

Water Efficiency Committee

The Water Efficiency Committee (formerly the Water Conservation Committee) is a special committee of Regional Council and consists of eight Regional Councillors as well as three members of the Public Advisory Committee who will sit on the Water Efficiency Committee for the duration of the Long Term Water Strategy Study. The mandate of the Water Efficiency Committee, as it relates to the Long Term Water Strategy, will be to provide an expanded public forum and

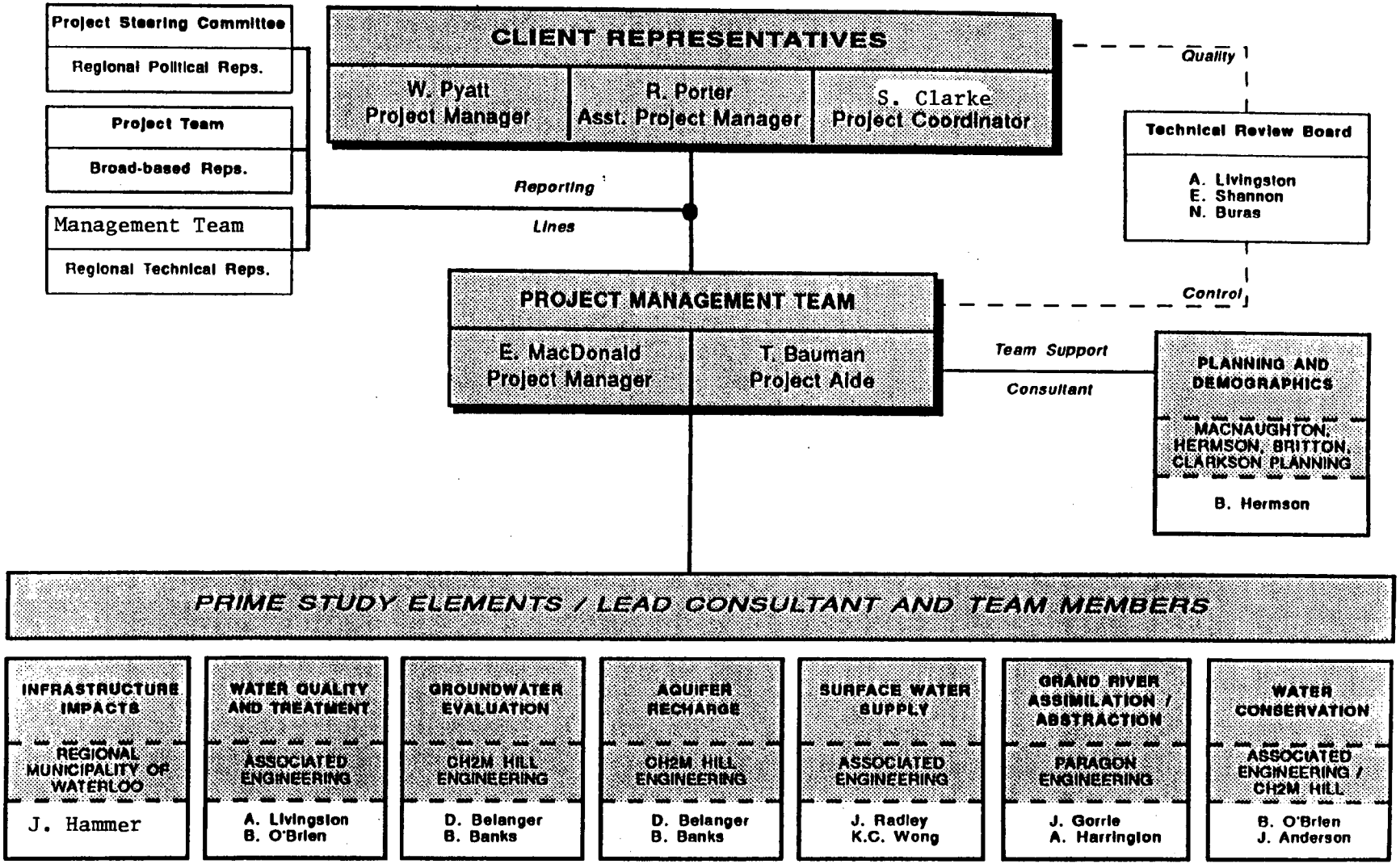

Figure 2
CONSULTANT TEAM ORGANIZATION

consider recommendations regarding the efficient use of water as the study progresses.

Consistent communication between these teams is required to ensure that the Study results will be technically sound and publicly acceptable. The recommended Long Term Water Supply Strategy for the Region will be a result of cooperative effort of these independent interacting Study Teams.

1.4 OTHER RELATED STUDIES/ISSUES

The Region has undertaken a number of other studies that relate directly to issues under consideration by the Long Term water Strategy Study. These issues include:

- Wastewater Treatment Master Plan
  - Grand River Simulation Modelling
- Ground Water Protection Strategy
  - Waterloo Moraine Study
- Tri-City Water Distribution System Study
  - distribution system modelling
- ROPP (Regional Official Policies Planning)
  - population growth and demographics
  - land use modelling

Regional staff from the Engineering and Planning Departments are coordinating their efforts on all of these studies to ensure that all related issues are properly addressed.

1.5 PROPOSED PUBLIC PARTICIPATION PROCESS

The end-product of the Study must have public and stakeholder satisfaction to be successful. The Proposed Public Participation Process has been designed to accommodate the following concepts:

- there must be *wide-ranging input* initially
- there must be a means of addressing *sensitive issues*
- the process must allow interested parties to *stay involved*
- a forum must be developed for *airing of opinions* related to sensitive issues
- the process must examine the 'big picture'; i.e. Regional requirements; but must also be *sensitive to local needs*

Central to the Public Participation Process, a Public Advisory Committee, incorporating broad community representation, has been created to provide a conduit for public involvement and guidance. Regular working sessions will be held for the Committee to review the progress of the Study; assist in the evaluation of the technical considerations; and provide guidance for future activities. The Public Advisory Committee Meetings will be open for general public attendance, and with local media coverage, maximum Regional exposure will be achieved. Four Public Advisory Committee Meetings are proposed as follows:

Public Advisory Committee Meeting #1
October 24, 1992

The first Public Advisory Committee meeting was held to discuss and define the scope of the Study for future evaluations. The Committee reviewed and finalized the proposed Public Participation Process; the proposed long term water supply alternatives; and the proposed evaluation criteria. Also, the Public Advisory Committee produced a Terms of Reference for itself as follows:

> On behalf of the public interest represented by the Public Advisory Committee, its purpose is to provide considered, informed, and to the extent possible, consensual advise to the Project Steering Committee regarding the Study's terms of reference, analysis and recommendations. Responsibilities of the Public Advisory Committee therefore include:
>
> - to attend and participate in all Public Advisory Committee meetings
> - to recognize the fundamental responsibility to the Public, whom the members represent
> - to provide an active communication link between the Committee and the respective public segment the member represents
> - to maintain an objective viewpoint in all discussions
> - to ensure all relevant issues are identified and are being considered in the technical evaluations
> - to critically review and evaluate the information brought forward by Regional Staff
> - to reach consensus through constructive dialogue
> - to formulate recommendations to be presented to the Project Steering Committee

Additionally, the Public Advisory Committee recognized *Water Use Efficiency* not only as an alternative the other water supply options under consideration, but as an integral management element of the Long Term Water Strategy. Therefore, at the direction of the Public Advisory Committee, the *Water Use Efficiency* task, as defined in the original scope of work, was expanded. The expanded task forms Section 3.0 of this reference book.

Public Advisory Committee Meeting #2
March 27, 1993

The primary goal of Meeting #2 is to establish a medium and long term forecast for Regional Population and Water Demands and the role Water Use Efficiency will play in these forecasts. Probability analysis may be introduced to assist in the development of these forecasts. The Committee will review the current progress of the Study and provide direction for future activities.

Public Advisory Committee Meeting #3
September 1993

The primary goal of Meeting #3 will be to complete the cost evaluation and risk assessment of the various water supply alternatives. Probability analysis may be employed to address these concerns. The Committee will review the current progress of the Study and provide direction for future activities.

Public Advisory Committee Meeting #4
December 1993

In the final Public Advisory Committee Meeting, members will review the Study technical results, and prepare recommendations for the Steering Committee regarding the preferred long term water supply strategy.

Meeting notes of Public Advisory Committee meetings are available from the Region upon request.

PUBLIC ADVISORY COMMITTEE MEMBERS

Peter Barret	Wilfrid Laurier University
Sandy Barrie	Township of North Dumfries
Bill Clarke	EEAC
Dave Devine Jr.	Waterloo Regional Labour Council
Gord Dodington	City of Waterloo
Mark Dorfman	Planning Consultant

Ted Fairless	City of Cambridge
Graham Farquhar	University of Waterloo
Ken Hunsberger	Waterloo Federation of Agriculture
John Lauer	Chambers of Commerce-Kitchener\Waterloo
Glen Martin	Waterloo Federation of Agriculture
Jack Michels	Township of Wilmot
Jim Robinson	The Water Network
Clare Snider	Township of Woolwich
George Stormont	City of Kitchener
Rudy Tavonius	K-W Homebuilders Association
Brenda Thompson	Cambridge Environmentalists
Carol Thorman	City of Cambridge
Wilbert Wagner	Township of Wellesley
Pat Zehr	Township of Wilmot

Discussion Meetings

Objective

The objective of the Discussion Meetings is to provide the public with a broader forum for participation in the Long Term Water Strategy.

The Discussion Meetings will:

- increase the involvement of interested Public Advisory Committee members, interested stakeholders, and the general public
- allow for discussion that will centre on sensitive issues relating to the areas of study within the Long Term Water Strategy and provide the forum for the airing of opinions regarding these sensitive issues
- reinforce the Region's commitment to remaining sensitive to local needs

Broad Categorization

- Groundwater Supply
- Grand River Supply
- Great Lakes Supply

As a result of direction given by the Public Advisory Committee, the area of study relating to **Water Use Efficiency** is now more comprehensive and the task as defined in the strategy work plan has been revised to reflect this change in scope.

Structure

There will be three Discussion Meetings relating to each of the three supply alternatives. The first set of meetings will provide information to the public, the second set will provide feedback to the public based upon issues raised at the initial meeting, and the third and final meetings will attempt to draw conclusions to be incorporated into the strategy.

The Discussion Meetings will be begin with an open house format where displays pertaining to the forum topic will be available for viewing and Regional staff and their consultants will be available to provide the public with information and for discussion.

Later on, a formal round table discussion will be convened, with an interested member of the Public Advisory Committee acting as chair. This segment will provide the members of the public an opportunity to express specific concerns and issues related to the forum topic in an open discussion of all attendes.

The meetings will continue as an informal discussion period where participants will be encouraged to discuss their ideas and concerns with one another and with Regional staff and their consultants. Comment sheets will be available to attendees to allow them further comment outside the structure of the meetings.

The revised Public Involvement Process is illustrated in the following figure:

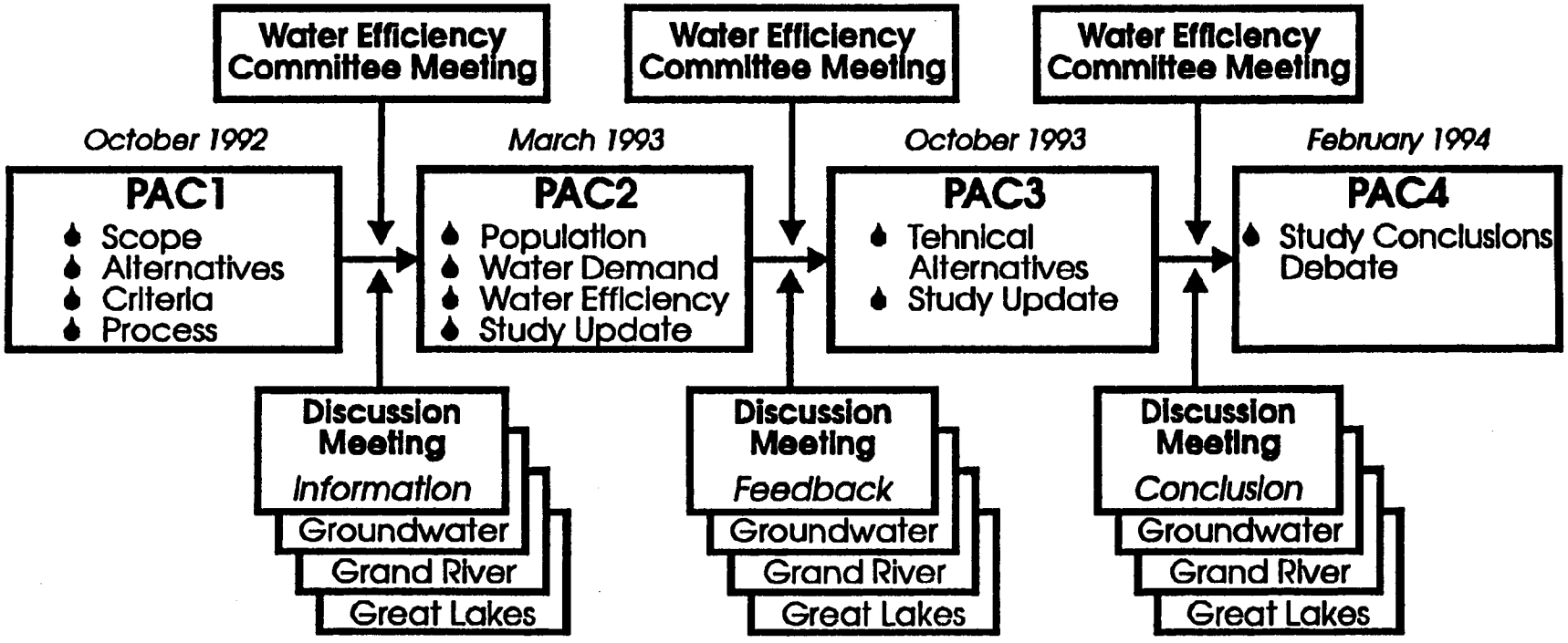

FIGURE #3

EXISTING CONDITIONS

2.0 EXISTING CONDITIONS

2.1 GENERAL

The Regional Municipality of Waterloo is located in the Grand River watershed and comprises an area of about 525 square miles (1,360 square kilometres). The Region is responsible for the supply of potable water for the Tri-Cities; Kitchener, Waterloo and Cambridge (including Elmira and St. Jacobs); and other settlement areas throughout the Region.

The Tri-Cities once formed the largest urban population in Canada that relied solely on groundwater for its water supply. In June 1992, the Mannheim Water Treatment Plant was commissioned for service in treating raw water from the Grand River. Municipal water supply for the Region is now provided by an integrated system of *groundwater* and *surface water* supplies.

2.2 GROUNDWATER SUPPLY

The Region currently operates 126 municipal wells in the Tri-City area, including 117 aquifer wells and nine induced infiltration wells (see Figure 4). The total combined *perennial yield* of this system is approximately *33 million imperial gallons per day* (MIGD) or in metric units, *150,000 cubic meters per day* (m^3/d). The perennial yield of a well is that amount of water that can be withdrawn continuously, without depleting the groundwater resource. The Region also measures the *7-day capacity* of a well; defined as the maximum amount of water available from a well within a 7-day period. Note that some aquifer recharge (natural or artificial) would be necessary to restore the perennial yield of a well following withdrawal of the 7-day capacity. The 7-day capacity of the Regional well system is approximately 51 MIGD (230,000 m^3/d).

The values indicated for perennial capacity are estimates based on current and historical withdrawal patterns. Actual perennial capacity is highly uncertain and is affected by many variables. The age of a well, and maintenance or rehabilitation practices can affect the ability of a well to withdraw water from an aquifer. Changes in vegetation, and/or urbanization in the recharge basin may also change surface infiltration and percolation to the groundwater table. Intensive hydrogeological investigations are required to assess the existing groundwater conditions necessary to predict the perennial yield of a well.

The records of communal groundwater supply extend prior to 1900 and some of the original well fields are still in use today. Wells and well fields have been developed in various locations throughout the Region as demand for

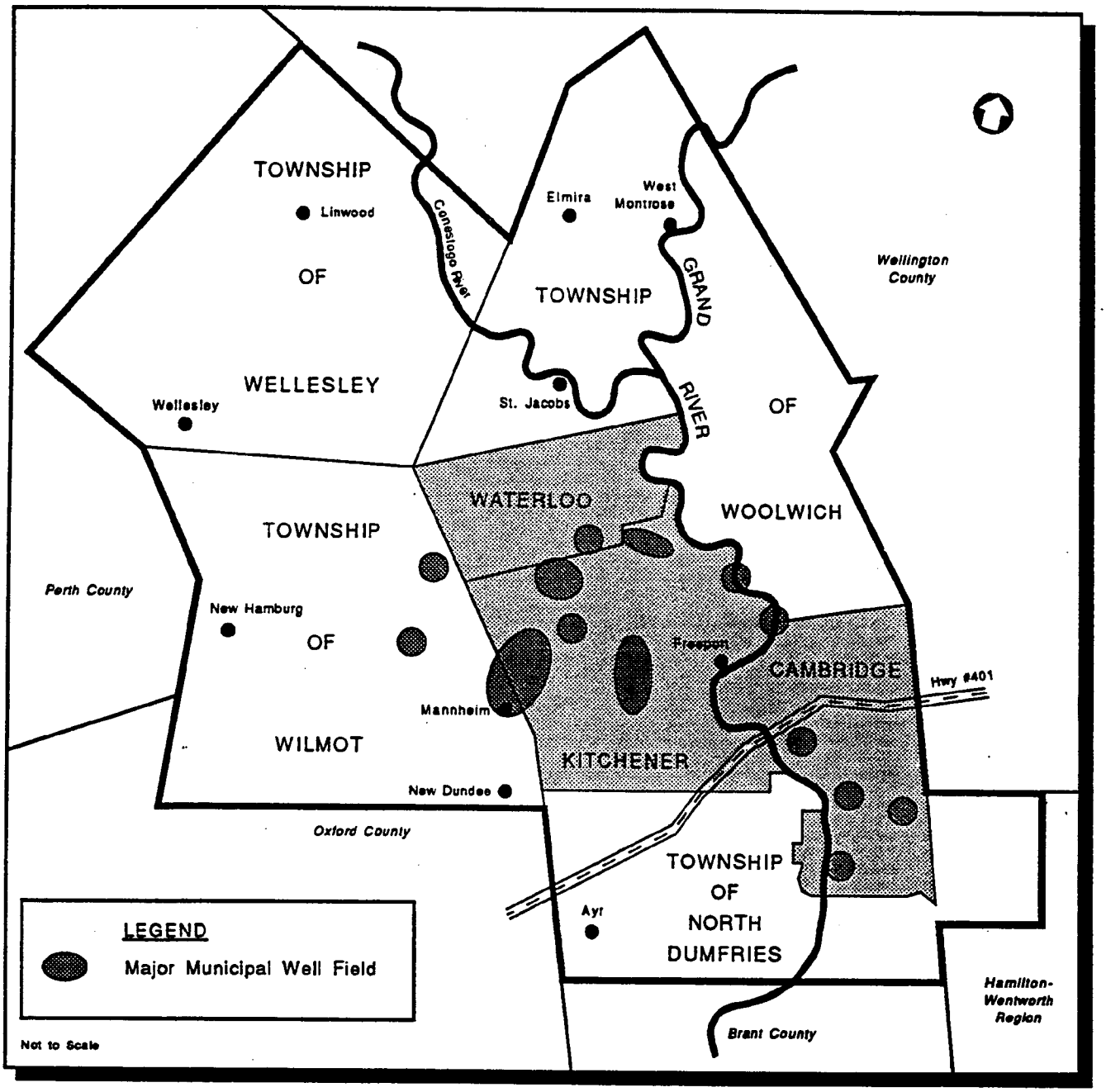

Figure 4
EXISTING GROUNDWATER SUPPLIES

water increased with growth and development. These efforts to expand the groundwater supply network have generally achieved success, although the physical limits of the groundwater resource and the potential long term effects of increased withdrawals from the resource are not clearly understood.

.1 Tri-Cities

There are seven well fields in the City of Kitchener:

- Greenbrook
- Mannheim East
- Mannheim West
- Parkway
- Wilmot
- Strange Street
- Lancaster

The total existing perennial supply capacity from these well fields is approximately 13.5 MIGD (61,350 m^3/d).

There are three well fields in the city of Waterloo:

- William Street
- Waterloo North
- Erb Street

The total combined perennial yield of this system is approximately 4.7 MIGD (21,350 m^3/d).

There are also three induced infiltration galleries along the Grand River.

- Pompeii
- Forwell
- Woolner Flats

The existing perennial supply capacity of this system is approximately 4.3 MIGD (19,540 m^3/d).

Well fields in the City of Cambridge are located over a wide area and consist of 24 wells in total, with 13 wells in Galt, 8 wells in Preston, and 3 wells in Hespeler. The combined perennial yield of the well system is approximately 10.4 MIGD (47,355 m^3/d).

.2 Other Settlement Areas

Small local water supply systems are also found in the communities of Ayr, Baden, Elmira, Heidelberg, Linwood, Maryhill, New Dundee, New Hamburg, Roseville, St. Agatha, St. Clements, Wellesley and West Montrose.

2.3 SURFACE WATER SUPPLY

The 1987 Master Plan identified the Grand River as a supplemental source of water supply to meet the long term demands of the Tri-Cities. The Grand River intake works, raw water pumping station and transmission main, and the Mannheim Water Treatment Plant were completed as part of Phase 1a of the Mannheim Scheme to treat raw water from the Grand River (see Figure 5). These facilities are currently in operation, feeding directly into the existing distribution system. The treatment capacity of the existing facility and the maximum withdrawal currently permitted is 16 MIGD (73,000 m^3/d). Currently, the plant is providing approximately 4 MIGD (18,000 m^3/d) to the system; it will be brought up to full capacity over the next several months.

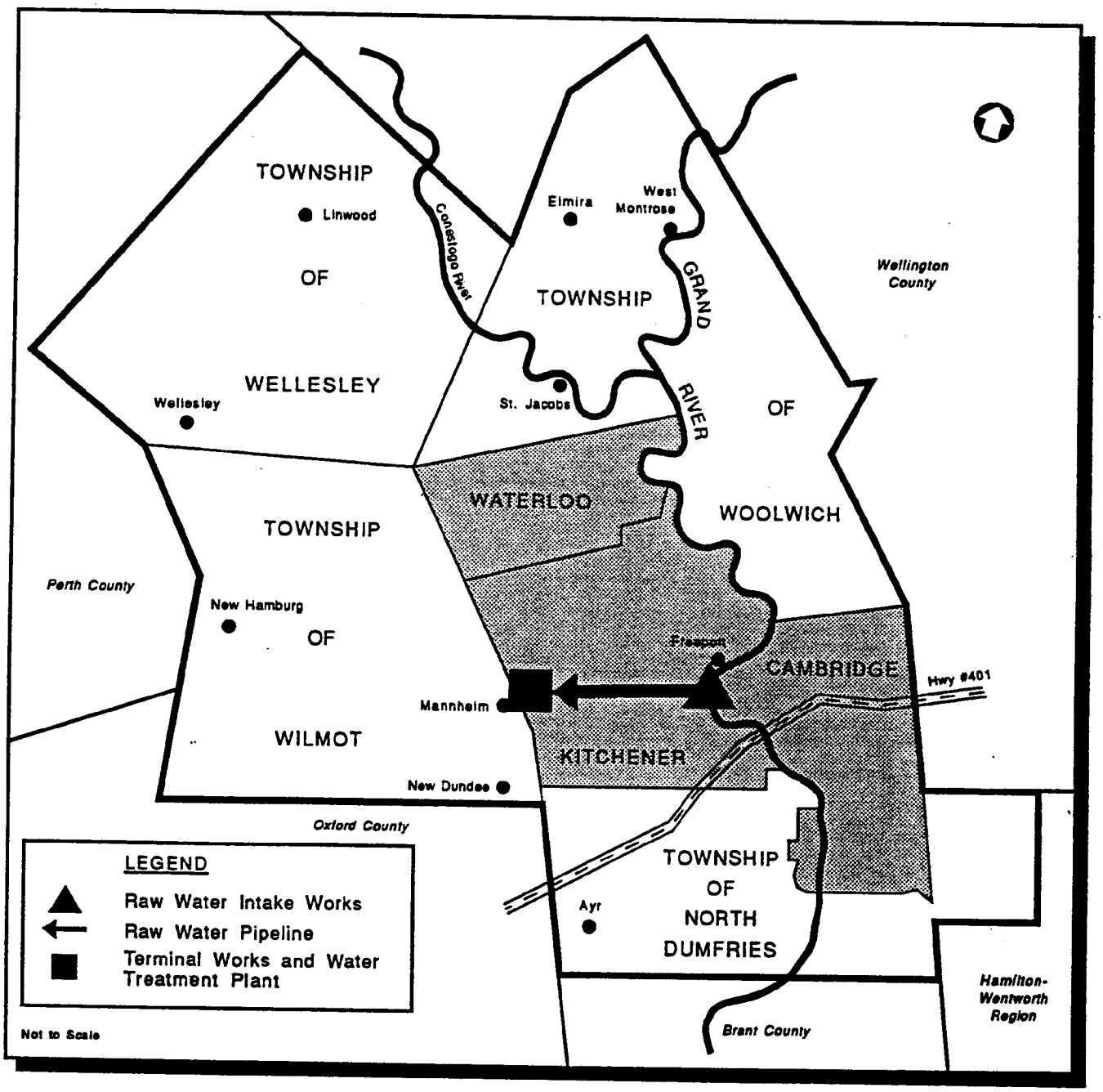

Figure 5
EXISTING SURFACE WATER SUPPLY

WATER USE EFFICIENCY

3.0 WATER USE EFFICIENCY

3.1 GENERAL

The Public Advisory Committee suggested that a cursory review and evaluation of current water efficiency efforts in inadequate; that evaluation of demand reduction is equally as important as investigating additional sources of supply. The revised water use efficiency task therefore will be more comprehensive than the original task, and more visionary. The essential difference being that Water Use Efficiency is a management element that will determine the need for, and the timing of, civil engineering alternatives.

A reduction of water demand can have a significant impact on future facility and infrastructure requirements. With the addition of the surface water supply from the Mannheim Water Treatment Plant, the Region currently has adequate resources to accommodate the existing and medium term demands of the Region. However, expansion of facilities is required in the future to satisfy the projected demand. Water efficiency efforts may help to delay such expansion significantly. For this reason, Water Use Efficiency is a unique element of the Long Term water Strategy, and is no longer simply an alternative.

3.2 WATER USE EFFICIENCY AS A MANAGEMENT ELEMENT

Water use efficiency (or water conservation) improvements will have the net effect of increased availability of water for municipal consumption; that is, using less water translates into more water available to use, even without expanding the existing water supply system. The concept involves optimizing the use of currently available resources, and requires implementation of specific policies, plans and procedures designed to protect or enhance the water supply resource. Three management alternatives define the scope of water use efficiency: Resource Management, Supply System Management and Demand Management.

.1 Resource Management

Resource management involves preservation of natural resources to ensure their long term reliability. Water supply for the Region is currently provided by an integrated system of groundwater and surface water resources.

Groundwater Resource Management

Provided that there is sufficient surface water available for natural aquifer recharge, groundwater is a renewable natural resource. However, continued groundwater withdrawal exceeding the recharge capacity of the aquifer will eventually deplete the resource.

Groundwater resource management requires extensive knowledge of the host aquifer(s) including:

- aquifer geology and hydrogeology
- aquifer distribution and inter-connection
- aquifer response and recovery
- inter-relationship with surface water
- sensitivity to contamination
- recharge areas

Once these characteristics are known, the perennial yield of an aquifer can be defined for maximum groundwater withdrawal, and efficient groundwater resource management. Studies to assess and understand the Region's groundwater sources are ongoing and will be integrated with this Study.

Surface Water Resource Management

A surface water resource often functions in many capacities; including water supply, wastewater assimilation and recreation, among other uses. Management of a surface water resource must therefore consider the multi-purpose character of the resource; maximum raw water abstraction is the amount in excess of that required to satisfy all other uses. Surface water resource management includes consideration of the following concerns:

- base flow
- raw water quality and treatment needs
- wastewater treatment standards
- assimilative capacity and downstream water quality
- inter-relationship with groundwater
- potential of upstream contamination
- watershed characteristics
- other uses

Effective resource management requires accurate and extensive knowledge of the properties of the natural resource. Definition and enforcement of usage requirements and/or restrictions will ensure continued service and long-term viability of the natural resource.

.2 Supply System Management

Supply system management involves maximizing the efficiency of the existing water production and delivery infrastructure, and is not affected by consumer practices. Supply system management activities include, among others:

Metering

A system for charging per unit of consumption has been shown to result in reduction of water usage; metering is essential to the implementation of such a program. Metering can also assist in the accounting of water usage to determine system efficiency.

Reduction in Unaccounted Water Usage

Unaccounted water usage can comprise a large volume of potable water that would otherwise be available for user consumption. Sources of unaccounted usage include:

- Watermain flushing
- Fire fighting
- Street washing
- Watermain leakage
- Inaccurate meters
- Other unmetered usage

Remediation of unaccounted usage must be cost efficient; that is, the amount of potable water 'retrieved' must warrant the associated expense. Careful examination of the existing water supply infrastructure and evaluation of current maintenance practices is required to assess the benefits of any proposed reduction in unaccounted water usage.

Pressure Reduction

The concept of supply system management by pressure reduction is simple; water will not flow as quickly when its driving pressure is reduced. A reduction of system pressure must not 'starve' any

consumer of water supply; this initiative is only applicable in areas of high pressure. Pressure reduction can also have a great effect in reducing system losses via watermain leakage.

.3 Demand Management

Demand management involves minimizing consumption of potable water, and relies greatly on user agreement and participation. Demand management policies include, among others:

Rate Structuring

Rate structuring is considered to be a fundamental component of a demand management program. The demand for water is sensitive to price fluctuation; realistic pricing may be the best way to encourage conservation and fund infrastructure rehabilitation. Pricing mechanisms that encourage conservation include:

- inclining rates
- quantity surcharges
- peak charges
- incentive fees

Managing the demand for water through deliberate price increases to reduce excessive demand will result in less water use as the costs of wasting water rise.

Public Education

Public awareness is essential to the success of any water conservation program. To be successful in reducing the per capita consumption rate of any area, full support and cooperation of all community sectors is required. Consumers must understand conservation principles and policies to observe them. Education can be used to communicate acceptable water use behaviour and to promote consumer interest in long-term water conservation practices.

Regulation

Water use regulations ensure a certain level of participation and are required when conservation initiatives are not voluntarily obeyed by consumers. In the past, demand management regulations have included seasonal lawn watering restrictions.

Water Use Efficiency Programs

The Region is currently fostering public awareness through the introduction of aggressive conservation programs for residential, business and industrial consumers as demand management initiatives. Suggested conservation actions include:

- water saving devices for new and retrofit plumbing installations
- xeriscape (low water) landscaping
- water saving tips for residential consumers
- recycling and/or reuse of industrial process water

Water use efficiency programs are a simple and sensible way to reduce the costs associated with water supply in the Region. The practice of water conservation not only encourages wise use of resources, but can help delay or decrease costs associated with expansion of the water supply system.

As indicated earlier in this reference book, a special committee of Regional Council, with the direct involvement of the Public Advisory Committee, will provide an expanded public forum and make recommendations to the Project Steering Committee regarding the efficient use of water.

PROPOSED WATER SUPPLY ALTERNATIVES

4.0 PROPOSED WATER SUPPLY ALTERNATIVES

4.1 GENERAL

There are many possible alternatives to provide a long term water supply for the Regional Municipality of Waterloo, and the preferred strategy can incorporate any number of these options. This section contains a brief description of each proposed alternative identified for the Study, as follows:

- Supplemental Grand River Supply
- Supplemental Groundwater Development
- Great Lakes Supply

Sub-variants of each alternative have also be identified, and are included in the following summaries.

4.2 SUPPLEMENTAL GRAND RIVER SUPPLY

The Grand River is a convenient source of raw surface water for the Region. In addition to acting as a raw water source, the Grand River is also the receiving body for the effluent from several wastewater treatment plants. This use of the river places limitations on the quantity of water that can be extracted to augment water supply for the Region. These limitations are primarily due to water quality considerations; that is, sufficient flow levels must be maintained in the river to ensure its water quality meets regulated standards. The amount of water that can be withdrawn from the river varies throughout the year, with larger abstraction allowed when flows are high (spring runoff), and smaller abstraction when flows are low (summer).

The additional water quantity and quality data that have become available since the completion of the Master Plan will be used to evaluate opportunities that may exist to increase the volume of water that may be obtained from the Grand River. Alternatives will be examined in terms of their impact on river water quality and their ability to provide increased supply from the Grand River via *Seasonal Abstraction*, *Low Flow Augmentation* or *Increased Direct Supply*.

.1 Seasonal Abstraction

The Grand River exhibits a natural seasonal variation in flows, with higher flows during the spring snowmelt and runoff periods, and lower flows during the summer months. Because of this seasonal fluctuation in flows, the amount of water that can be withdrawn from the river while

maintaining water quality targets also varies throughout the year. This seasonal variation is reflected in the maximum permissible withdrawals that are allowed from the river.

The ability to withdraw larger quantities of water during periods of high river flow allows for the consideration of the Grand River as a direct supply during these periods. During periods of high river withdrawal, the groundwater aquifers would be allowed to 'rest'; during periods of low river withdrawal, combined groundwater and surface water supplies could be utilized.

In addition to the seasonal variability of river flows, there are shorter term variations in flows due to the response to storm runoff events of various durations. These peaks, superimposed on the annual variation, represent additional sources of supply that can be investigated. The concept of 'peak shaving', or increasing river withdrawals during short term periods of increased flow could provide additional surface water supplies.

.2 Low Flow Augmentation

The limit on water withdrawal from the Grand River during the summer months is directly related to water quality maintenance in the river. The existing system of reservoirs maintains sufficient base flow to allow continuous withdrawal of 16 MIGD (73,000 m^3/d) from the Grand River, Mannheim intake works. Low flow augmentation can be achieved by the following designs:

West Montrose Dam and Reservoir

In 1982 the Grand River Basin Water Management Study examined a dam and reservoir near West Montrose, in Woolwich Township. Rather than recommend construction of the reservoir, the study recommended protection of the site to ensure flexibility to provide further improvements in flood protection, water quality and water supply. Because construction of a reservoir at the West Montrose site (see Figure 6) has not been precluded, its contribution to the solution of water supply must be considered.

The West Montrose reservoir would provide on-stream storage of peak Grand River flow. Low flow augmentation would be achieved via controlled release from the reservoir. This operation would allow larger Grand River abstraction at the existing Mannheim intake works during the summer periods of low flow, while maintaining water quality objectives.

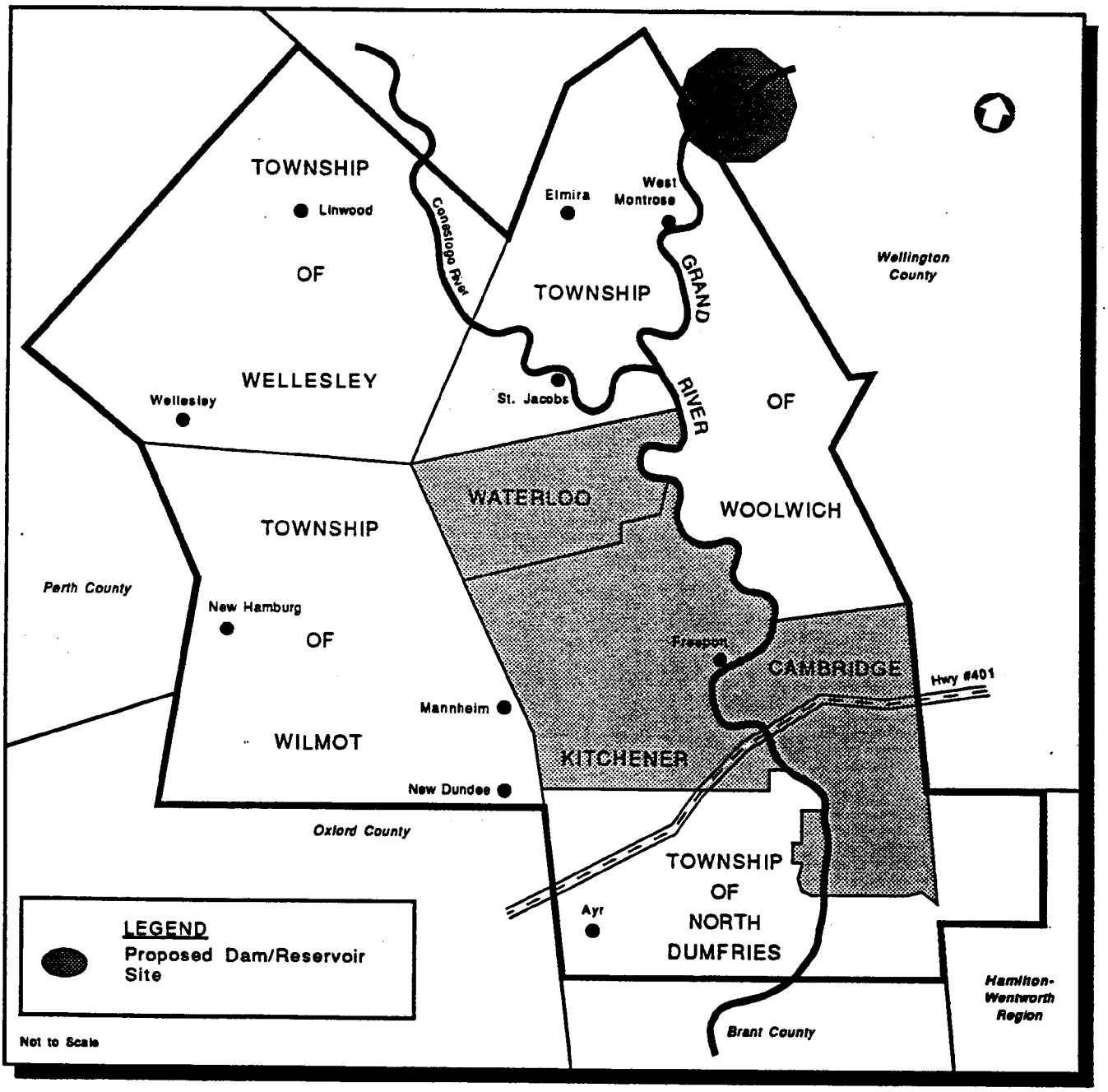

Figure 6
PROPOSED WEST MONTROSE DAM AND RESERVOIR

Georgian Bay Supplement

The concept of this alternative is to supplement the Grand River headwaters during periods of low flow with raw water piped from Georgian Bay. A new intake facility, raw water pumping station, and transmission main are required to convey raw water from Georgian Bay to the Grand River upstream of the Region (Lake Belwood). The existing Mannheim intake works and treatment facilities could be upgraded accordingly.

.3 Increased Direct Supply

The proposed West Montrose dam and reservoir presents another alternative for supplemental Grand River supply; increased abstraction directly from the proposed reservoir. A new treatment facility could be provided south of the dam and a transmission main constructed to connect to the Regional system in Waterloo. Other settlement areas en route to the Tri-Cities would also benefit from this supply alternative.

4.3 SUPPLEMENTAL GROUNDWATER DEVELOPMENT

Because of the complex nature of the groundwater resources within the Region, a comprehensive understanding of the existing and potential groundwater supplies has been slow to develop. Since the start of the Master Water Supply Study, considerable effort has been expended by the Region to define the extent and nature of its groundwater resources, the total groundwater available for water supply, and the optimal way to utilize these resources. While there have been considerable advances in recent years in the understanding of the groundwater resource, there is still some uncertainty regarding the total groundwater available for supplemental groundwater development.

.1 Additional Groundwater Supplies

Additional groundwater supplies may be derived from either optimization of existing well fields or from new groundwater sources. For some of the existing well fields there may be potential to obtain more water by the addition of new wells. These wells could be used as 'peaking wells' to obtain more water over a short period in times of high demand, or as long term perennial yield wells thereby increasing the total yield derived from areas between existing well fields or in areas that have not been explored to date.

Recent investigations conducted by the Region since the completion of the Master Plan indicate the potential for additional groundwater supply in the following areas:

- Waterloo North
- Waterloo Moraine
- Mannheim
- Shades Mills
- Clemens Mills

Confirmation of new groundwater sources typically requires extensive exploration, testing and development. Such investigations are currently proceeding in the Shades Mills and Clemens Mills areas to assess the potential for additional groundwater development. Information from the recently initiated Waterloo Moraine Study will also aid in this regard, although its primary focus is protection of the groundwater resource.

.2 Artificial Aquifer Recharge

Artificial aquifer recharge may be defined as increasing the natural flow of surface water into an aquifer by some manmade, or artificial method. Artificial recharge for the Region is proposed to provide subsurface storage for imported surface water from the Grand River.

Surface water treated for potable use often exhibits subtle aesthetic differences; e.g. minor quality and temperature abberations; from natural groundwater. By temporarily storing treated surface water in natural groundwater aquifers, these aesthetic variations are often eliminated or otherwise diminished. Therefore the groundwater recovered following artificial recharge will have quality and temperature characteristics similar to that of the natural groundwater; to avoid aesthetic complaints from consumers.

The proposed Mannheim Scheme involved artificial recharge of treated water from the Grand River during periods of peak river flow. Typically, periods of peak river flow coincide with low demand, and vice versa. The Mannheim Scheme would allow the off-season peak river flow to be stored and partially recovered for use in peak demand.

At present, the water supply capacity of the Mannheim Artificial Recharge Scheme is undefined since the prototype testing of the system has not been completed. The capacity of the system will depend largely on the amount of water that can be injected into the aquifer since injection well capacity may be limited by the permeability of the aquifer, and since injection wells

may be susceptible to clogging. Similarly, the amount of water that may be recovered from the system will depend on the amount of water lost to the aquifer; i.e. all of the recharge water may not be recovered. Prototype testing is essential to determine the feasibility of this process.

4.4 GREAT LAKES SUPPLY

To meet the long term requirements of water demand in the Region, the study of surface water supply explores various alternatives to obtain additional water from the following surface water sources. The Great Lakes Supply Alternatives (see Figure 7) include:

- Lake Ontario
- Lake Erie
- Lake Huron
- Georgian Bay

Although Georgian Bay is not one of the Great Lakes, it is included as a 'Great Lakes' supply alternative, being a large body of water available as a surface water source.

Each supply alternative will also consider the potential for integrating supply to neighbouring communities near the pipeline corridor. In all cases, raw water intake works, treatment facilities, pumping facilities and transmission mains are required to provide potable water from the Great Lakes.

.1 Lake Ontario

The proposed pipeline from Lake Ontario will pass through the Region of Hamilton-Wentworth. The estimated length of the transmission main is approximately 52 miles (84 kilometres). Potential supply connection points include: Ancaster, Dundas and Flamborough.

.2 Lake Erie

The proposed pipeline from Lake Erie will pass through the Region of Haldimand-Norfolk, and Brant County. The estimated length of the transmission main is approximately 52 miles (84 kilometres). Potential supply connection points include: Simcoe, Brantford and Paris.

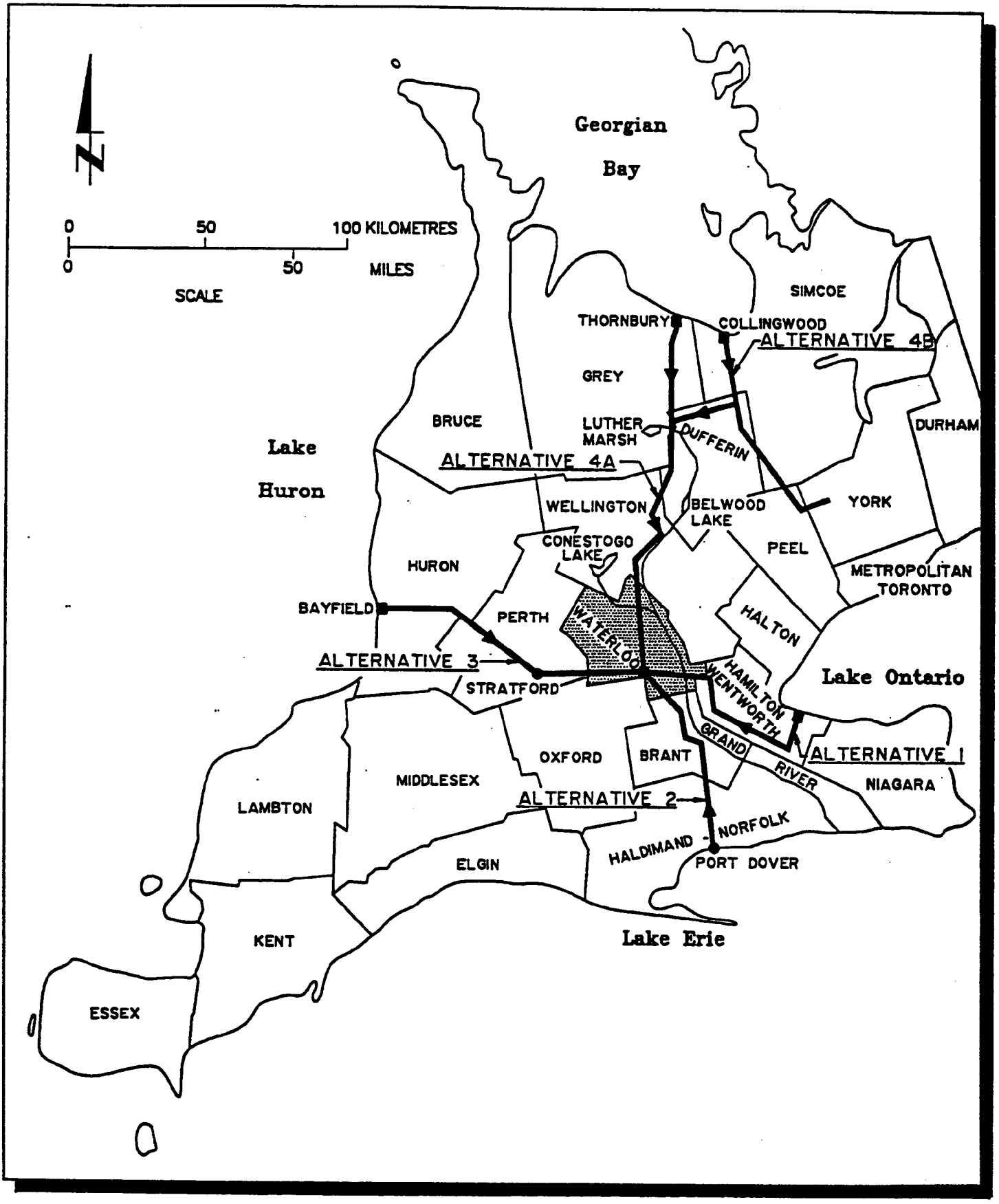

FIGURE 7

GREAT LAKES SUPPLY ALTERNATIVES

.3 Lake Huron

The proposed pipeline from Lake Huron will pass through Huron County and Perth County. The estimated length of the transmission main is approximately 66 miles (105 kilometres). Potential supply connection points include: Mitchell, Seaforth and Stratford, as well as the communities of New Hamburg and Baden in Waterloo Region. There is an abandoned CPR right-of-way that may be suitable for use as a pipeline corridor from Lake Huron.

.4 Georgian Bay

The proposed pipeline from Georgian Bay will pass through Grey County or Simcoe County, Dufferin County, and Wellington County. The estimated length of the transmission main is approximately 86 miles (138 kilometres). Potential supply connection points include: Erin, Fergus, Grand Valley, Guelph, New Tecumseth, Orangeville, Shelburne, and York Region.

EVALUATION CRITERIA

5.0 EVALUATION CRITERIA

5.1 GENERAL

The evaluation criteria will be used to rank the proposed water supply alternatives. They have been grouped in the following categories:

- Water Supply
- Cost
- Performance
- Natural Environment
- Social Environment

5.2 WATER SUPPLY

The evaluation criteria relating to *Water Supply* include: Water Quality, Supply Reliability/Security, Supply Flexibility, and Supply Capability.

.1 Water Quality

Water quality parameters have been established for both *Raw Water* and *Potable Water* uses.

Raw Water

The Canadian Water Quality Guidelines (1987) contain recommendations for chemical, physical, radiological and biological parameters necessary to protect and enhance the following major uses of inland surface waters and groundwaters:

- Raw water for drinking water supply
- Recreational water quality and aesthetics
- Freshwater aquatic life
- Agricultural uses
- Industrial water supplies

Raw water quality will also determine what treatment processes are necessary to satisfy drinking water requirements.

Potable Water

Water intended for human consumption (potable water) should not contain any disease-causing organisms or hazardous concentrations of toxic chemicals or radio-active substances. Aesthetic considerations

may also provide a basis for drinking water objectives since the water should be pleasant to drink. Temperature, taste, odour, turbidity and colour are all important in achieving waters which are aesthetically acceptable and pleasant to drink. Other aspects of water quality such as corrosiveness, tendency to form encrustations and excessive soap consumption should be controlled on the basis of economic considerations because of their effects on the distribution system and/or the intended domestic and industrial use of the water.

For aesthetic parameters such as iron and manganese, Regional requirements are more stringent than the Ministry of Environment (Ont.) Drinking Water Objectives.

.2 Supply Reliability/Security

Reliability and security are essential elements of a successful water supply strategy relating to its ability to consistently provide an adequate quality of water. Careful risk assessment is important when considering these criteria to determine any future potential for supply inadequacy due to changes in the resource, or supply contamination; rendering the source incapable of providing sufficient water. Such an assessment would allow a level of confidence to be associated with a strategy as it relates to its long term supply reliability and security.

.3 Supply Flexibility

The ability of a water supply strategy to respond to varying population and water demand patterns should be prominent in the selection of the preferred strategy. Supply flexibility is important because population and water demand forecasts are not always accurate. The water supply strategy should be able to accommodate otherwise unforeseen water demands without excessive, expensive re-evaluation.

.4 Supply Capability

A water supply strategy must be able to adequately provide for the total projected demands of the communities. Timing and phasing of construction are critical when considering that it may take years to initiate, design and construct the facilities required for any water supply alternative. The supply capability of the preferred strategy must therefore consider the instantaneous water supply capacity at any time in the life of the scheme, and be able to satisfy the corresponding demand.

5.3 COST

The evaluation criteria relating to *Cost* include: Capital Costs; Operating and Maintenance Costs; and Affordability.

.1 Capital Costs

Capital cost estimates are typically based primarily on the recorded cost of comparable water supply systems, and include costs related to labour, materials, land, engineering and contingencies. It is also necessary to consider the year in which capital costs will be incurred to estimate the effects of inflation and interest rates on future expenditures.

.2 Operating and Maintenance Costs

Successful operation and maintenance of water supply facilities is essential to consistently meet long term quality requirements. Operating costs are those relating to energy, chemicals and labour. Regularly scheduled preventative maintenance is also required to ensure long term performance and reliability of the supply facilities.

Annual operation and maintenance expenditures are calculated as a net present value; i.e. the current capital investment required to finance the annual expenses over the expected life of the facility.

.3 Affordability

Budgetary considerations can be decisive when preparing a master plan for water supply. Government subsidies and/or cost sharing with external Municipalities can be pursued, but the net expense must be affordable to the Region; accommodated by tax and/or water service revenue. The future cost of the commodity to the Regional consumer is also an important consideration when evaluating the affordability of a water supply strategy.

5.4 PERFORMANCE

The evaluation criteria relating to *Performance* of a water supply alternative include: Infrastructure Impacts; Timing; and Operation.

.1 Infrastructure Impacts

Any of the viable strategic options will have impacts on the existing and proposed water distribution infrastructure; e.g. distribution mains, pumping stations, water storage facilities, etc.. These physical components required for the internal distribution system must be assessed for the Region-wide infrastructure; i.e. both rural and urban. Assessment of the existing infrastructure must include both economic and feasibility evaluation to ensure a cost effective and hydraulically balanced solution.

.2 Timing

Timing and phasing of construction have great effect on the flexibility of a supply strategy. Timing and phasing of construction are critical when considering that it may take years to initiate, design and construct the facilities required for any water supply alternative.

.3 Operation

Operational considerations must be assessed to determine the effects on the existing organizational and operational structure. Additional manpower and other resources may be necessary to realize the preferred supply strategy.

5.5 NATURAL ENVIRONMENT

The evaluation criteria relating to the *Natural Environment* include: Wildlife and Vegetation; Water Resources; and Natural Areas.

.1 Wildlife and Vegetation

Natural wildlife and vegetation, both aquatic and terrestrial, should not be unacceptably affected by changes to the natural environment. Great care must be maintained in the assessment and restitution of the natural habitat for any construction required for a water supply alternative.

.2 Water Resources

Surface water resources must be protected to satisfy regulated quality standards and to maintain the current usage of surface water bodies. Effective watershed management can assist in maintaining surface water quality.

Surface water also provides a source of natural recharge to aquifers. This relationship should be defined further to assess the net effects of surface water modifications.

Groundwater resources must be guarded and controlled to ensure long term use and reliability. Continued groundwater withdrawal exceeding the natural recharge capability of an aquifer can result in one or more of the following adverse conditions:

- Progressive reduction of the groundwater resource
- Development of uneconomic pumping conditions
- Degradation of groundwater quality
- Interference with prior water rights
- Land subsidence caused by lowered groundwater levels

.3 Natural Areas

Natural areas that should be protected include: fisheries, wetlands, woodlots, etc.. These areas are important to maintain the natural ecological balance, and also provide recreational usage to local communities.

5.6 SOCIAL ENVIRONMENT

The evaluation criteria relating to the *Social Environment* include: Employment Opportunities; Heritage Resources; Recreation; Growth and Development; Public Opinion; and Aesthetics.

.1 Employment Opportunities

Industrial and commercial development or closures can be motivated by water supply capability. Employment opportunities, or lack thereof, are subsequently affected.

.2 Heritage Resources

The Regional Municipality of Waterloo has a rich heritage of distinctive cultures, traditions, landmarks, buildings, and archaeological resources of significant value and interest to both residents and visitors. The study area includes a number of heritage and cultural features that must be protected for their cultural value.

.3 Recreation

Recreation can be affected by water supply alternatives that influence surface water conditions. The effects of quantity and quality alteration to lakes and rivers can have great impact on recreational usage.

The Grand River is significant for its recreational value. The Grand River Conservation Authority (GRCA) has jurisdiction over the study area, and a variety of outdoor recreational facilities are available at several conservation areas including the Laurel Creek, the Chicopee Hills, and the Shade's Mills Conservation Areas. The Laurel Creek and Shade's Mills reservoirs also provide opportunities for swimming, boating, camping and hiking.

.4 Growth and Development

Water supply can have great implications on future growth and development; that is, a certain level of water supply capability has a corresponding level of development that can be accommodated by the supply capacity. Water supply deficiencies in quantity or quality can result in development restrictions and may promote emigration from the Region. Conversely, excess quality water supply can attract development and encourage immigration to the Region.

.5 Public Opinion

The concerns of the public for long term water supply are very important. Although certain perceptions or popular opinion may not be entirely valid in terms of scientific fact, this does not mean that these issues can be assigned a lower priority. It is important to address the concerns of the public and assure society that its needs are being addressed to gain support and maintain credibility for the preferred strategy.

The Regional Municipality of Waterloo is committed to a program of continuing dialogue with the community regarding future water supply for the Region, so that the adopted strategy accurately reflects the views and needs of residents of the Region.

.6 Aesthetics

Aesthetics do not affect performance or capability of a water supply alternative, but can further public acceptance of the preferred strategy.

COMMENT SHEETS

6.0 COMMENT SHEETS

6.1 GENERAL

Comment Sheets provide a means of receiving your written comments and concerns not otherwise addressed in this reference book. Please complete the Comment Sheets as necessary, at your convenience. Additional sheets will be available at the meeting, if required. Completed sheets may be placed in the boxes provided at the meeting, or mailed to the Region at the address shown.

Your input is essential to the successful completion of the Study. Thank you for your attendance and your involvement.

THE REGIONAL MUNICIPALITY OF WATERLOO

REASSESSMENT OF THE LONG TERM WATER SUPPLY STRATEGY

Public Information Document

COMMENT SHEET

Name: _____

Address: _____

_____

Phone: _____

Would you like to be on the mailing list for future public mailouts?

YES NO (Please circle)

Comments: _____

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Note: *Comments will be published in the Study Report.*

Completed sheets may be mailed or FAXED to the Region at the following address:

Mr. Scott Clarke
Regional Municipality of Waterloo
Engineering Department
Water and Wastewater Division
20 Erb Street West, Marsland Centre
Waterloo, Ontario N2J 4G7
Phone: (519) 885-9523 FAX: (519) 746-2741

THE REGIONAL MUNICIPALITY OF WATERLOO

REASSESSMENT OF THE LONG TERM WATER SUPPLY STRATEGY

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