

CHAPTER 2 REPORT INTRODUCTION

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2.1. A WATER RESOURCES MANAGEMENT DECISION SUPPORT SYSTEM FOR THE GREAT LAKES

As water resources scientists, managers and policymakers in the Great Lakes-St. Lawrence River basin gain an increased understanding of the range and complexity of issues surrounding the region's needs and demands for high quality fresh water, they are increasingly relying on data, information and technology to answer difficult questions and inform their research in support of water resources decisionmaking. Decision support systems are becoming crucial tools in the fields of water resources science, planning and management.

A decision support system, which has emerged over the last decade as an important tool for environmental planning and management, is a broad concept that involves both descriptive information systems as well as normative, prescriptive optimization approaches. It may be defined as "any and all data, information, expertise and activities that contribute to option selection"(Andriole 1989). Similarly, decision support system is a mechanism that facilitates a complex decision-making by linking a combination of decision analysis (i.e. maximization, cost-benefit analysis) and the information component of decision support into a decision-making process. The essence of developing a DSS is to integrate data, information and knowledge from different sources for the purpose of improving the decision-making process.

As decision support systems help address new and complex issues, they must have access to accurate and uniform data, which can inform research and the development and application of decision support system information technologies.

The Great Lakes Commission and its project collaborators commenced this important project, titled *Toward A Water Resources Management Decision Support System for the Great Lakes*, in August 2000 in response to the increasing need for data and information on Great Lakes-St. Lawrence River water

resources and the renewed regional attention and commitment to Great Lakes water resources management on the part of the governors and premiers. This multi-year initiative was planned and designed to ensure that scientifically sound technical information on the status of Great Lakes water resources, current water uses and ecological impacts of individual and cumulative water withdrawals and uses is available to regional decisionmakers. The project is a status assessment of data and information used to inform decisions on proposals for new or increased uses of Great Lakes basin water.

2.2. BACKGROUND ON GREAT LAKES WATER RESOURCES MANAGEMENT AND DECISIONMAKING

2.2.1 HISTORICAL OVERVIEW

Water quantity management within the Great Lakes dates back as far as the Boundary Waters Treaty of 1909 between Great Britain and the United States. The 1909 Boundary Waters Treaty established the International Joint Commission (IJC), a bi-national agency consisting of six commissioners; three each appointed by the President of the United States and the Governor-in-Council (Prime Minister and Cabinet) of Canada. The IJC has quasi-judicial, arbitrational and advisory powers over the boundary waters between the two countries. The IJC's judicial powers stem from its authority to approve all new "uses, obstructions and diversions" which affect the levels and flows of boundary waters or those crossing the boundary. The Boundary Waters Treaty assigned the IJC the power to arbitrate in all matters of difference arising between the two countries and referred by both to the Commission. (This power has yet to be used.) Finally, the Treaty enabled the governments to refer any matter to the IJC for investigation and recommendations. The IJC is the body that developed Orders of Approval for the regulation of outflows from Lake Superior (1914, 1978, 1979) and Lake Ontario (1952, 1956). Administration for the distribution of flows in the Niagara River between the United States and Canada dates back to the provisions of the Niagara Treaty of 1950, which explicitly recognizes intra-basin flows through the Welland Canal and the New York Barge Canal. Outflows through the Lake Michigan Diversion at Chicago have been managed under Supreme Court oversight as early as 1905. During World War II, diplomatic letters between the U.S. and Canada provided for diversion of flows through Long Lac and the Ogoki River from the Albany River watershed into Lake Superior.

Dating back as far as the mid-1850s, dredging, sand mining, and/or encroachments in most of the connecting waterways of the Great Lakes-St. Lawrence system have occurred episodically (and increasingly), the impacts of which have been largely unremediated. These channel modifications have caused significant modification of channel efficiencies and regime changes upstream. Each of these anthropogenic changes to the water balance of the Great Lakes has had profound effects on the storage and retention of water supplies in one part of the system or another, outweighing cumulative impacts of diversions, withdrawals, or consumptive uses within the region. Frequently, decades of quality controlled water level data distributed across the lakes are required to infer the effects of these altered regime changes in the magnitude of a few centimeters. These facts illustrate that accurate decisionmaking requires a long-term and thorough commitment to data collection, information management and retrieval.

Various large-scale water supply proposals designed to take water out of the Great Lakes or bring water into the Great Lakes have been around since the signing of the Boundary Waters Treaty as well. Many of these early proposals did not generate significant attention because they were considered economically and/or environmentally unviable. In the late 1970s, due to heightened interest from regions outside the basin to divert and use Great Lakes water, the Great Lakes governors and premiers began to consider the importance of a regional approach to managing the system's precious water resources. In 1983, this interest culminated in the appointment, by the governors and premiers, of a Task Force on Water Diversion and Great Lakes Institutions. This Task Force was established to address ongoing concerns about future management of the Great Lakes-St. Lawrence River and the perceived significant economic

and environmental consequences to the region from large-scale diversions of Great Lakes water. The report of the Task Force, submitted in January 1985, addressed three main areas: the need for regional action in the area of water management; the need to protect the water resources of the Great Lakes-St. Lawrence; and the institutional capabilities and needs in the Great Lakes region. Out of this report came the Great Lakes Charter of 1985, a series of principles for the management of Great Lakes water resources.

One of the central themes running through the Task Force's 1985 report is that the best defense against outgoing interbasin diversions and intra-regional conflicts over water use is for the Great Lakes region to develop an effective, comprehensive program to manage the basin's water resources. The report goes on to say, "developing such a program, of which a common base of data is a first step, will entail a major long-range commitment on the part of the Great Lakes states and provinces." The Task Force also concluded "it is important to begin this process now, while public concern is high and political will is strong."

The Charter itself calls for the development of such a program to guide the future development, management and conservation of the water resources of the basin. The recommendation for a basin-wide Water Resources Management Program includes the consideration of the following elements:

- An inventory of the basin's surface and groundwater resources;
- An identification and assessment of existing and future demands for diversions (both inter-basin and intra-basin), withdrawals and consumptive uses and the ecological considerations of these uses;
- The development of cooperative policies and practices to minimize the consumptive use of the basin's water resources; and
- Policies to guide the coordinated conservation, development, protection, use and management of the water resources of the basin.

Since the signing of the Charter, the management framework has been slow to evolve due to changes in the regional leadership, public interest that has waxed and waned and inconsistent financial, programmatic and legislative support of water management programs especially those involving water use data collection and reporting.

Historically, implementation of the Charter principles has also been frustrated by numerous factors including:

- The lack of scientifically sound data and information on water withdrawals, diversions and consumptive uses;
- The lack of scientific understanding of and the limited ability to measure the various components of the Great Lakes hydrologic system that contribute to the development of a water balance;
- The lack of understanding of how individual, collective and cumulative withdrawals, diversions and consumptive uses impact the Great Lakes ecosystem;
- The lack of priority attention given to the implementation of the Charter;
- Insufficient establishment of legislative and programmatic authority to implement the Charter requirements;
- The lack of financial support necessary to carry out Charter requirements;
- The failure to consistently bring different interests and disciplines together to address the complex issues surrounding water resources management; and
- The tendency for the region to be reactive rather than proactive when faced with the decisionmaking demands of a water withdrawal or export proposal.

Adding another wrinkle to the Charter implementation process was the passage of the Water Resources Development Act of 1986. Section 1109 of the Act prohibited any new or increased diversion of Great Lakes water without the unanimous approval of the Great Lakes governors. Section 1109, while adding significant legal authority to the governors' ability to protect the Great Lakes water resources from outside interests, also affected the process of cooperative water resources decisionmaking laid out by the Charter. By giving the governors absolute veto power over new diversions of any size, Section 1109 (in a practical sense) counteracted the Charter trigger level provision that required prior notice and consultation only for diversions that exceeded 5 million gallons per day (mgd) (19 million litres per day) average over a thirty-day period. Section 1109 did not specify any consultation requirements although a case-by-case consultation process was used for those few diversion and consumptive proposals that were evaluated between 1986 and 1999. Section 1109 also created an undesirable dynamic with the Great Lakes provinces, which are not subject to U.S. law and were excluded (at least from a legal standpoint) from the WRDA decisionmaking process. It can also be argued that Section 1109 significantly slowed the progress toward Charter implementation because states no longer approached project approval with the prior notice and consultation process in mind, but rather from a consideration of whatever was required to gain project approval from the other jurisdictions. Hence, during the period from the late 1980s through the late 1990s little progress was made in the implementation of the Charter.

The need to revisit regional water resources decisionmaking was kindled in late 1999, following a thwarted proposal by an Ontario company to secure a permit to withdraw Lake Superior water and consequently establish an overseas market for bulk water export. Addressing the precedent-setting nature of the proposal and the region's response to it, the Council of Great Lakes Governors issued a statement outlining a set of principles to guide the development and maintenance of a strengthened water resources management framework for the Great Lakes system. This statement was pivotal in refocusing regional discussion on these important issues and led to the development of the Great Lakes Charter Annex, signed by the Great Lakes-St. Lawrence governors and premiers in June 2001. The 1999 statement outlined the following set of principles for a water management regime that also recommit the region to the advancement and implementation of the requirements of the Great Lakes Charter and the ensuing Charter Annex:

- The resource must be protected. Resource protection, restoration and conservation must be the foundation for the legal standard upon which decisions concerning water withdrawals are based.
- The management regime must be durable. The framework for decisions must be able to endure legal challenges based upon, but not limited to, interstate commerce and international trade. It must be constitutionally sound on a bi-national basis, and the citizens of the Basin must support this framework.
- The management regime must be simple. The process for making decisions and resolving disputes should be straightforward, transparent and based on common sense.
- The management regime must be efficient. Implementation of the decisionmaking process should engage existing authorities and institutions without necessitating the establishment of new and large bureaucracies. The decisionmaking process should be flexible and responsive to the demands it will confront.
- Decisionmaking authority must be retained in the basin. Decisionmaking must remain vested in those authorities, the Great Lakes Governors and Premiers, who manage the resource on a day-to-day basis.

The Great Lakes governors and premiers signed the Charter Annex, an amendment to the Great Lakes Charter of 1985, in June 2001. In agreeing to the Annex, the governors and premiers reaffirmed their commitment to the broad principles set forth in the Great Lakes Charter, but also acknowledged the need to re-examine the strength and adequacy of the Charter provisions, particularly regarding the legal foundations upon which current regional water management authorities rest. The Charter Annex is a non-

binding agreement that creates a blueprint for water management programs to be created over the next several years. The Charter Annex objectives were developed based on state and provincial experience with water management and how these activities were influenced by the Great Lakes Charter and Section 1109 of WRDA 1986. The creation of the Annex also relied heavily on the governors' 1999 statement on water management, findings from the February 2000 International Joint Commission reference study report on water export and a study commissioned by the governors on Great Lakes and international water law. This study was supported by the Great Lakes Protection Fund and completed in May 1999.

The Charter Annex, through a series of six directives, commits the Great Lakes governors and premiers to the following:

- Outlining a framework for a set of binding agreements among the Great Lakes states and provinces;
- Establishing a series of principles for a new decisionmaking standard for reviewing proposed withdrawals of Great Lakes water under the proposed new agreements.
- An ongoing process for involving the public in developing the agreement and standard;
- Formal Inclusion of the Premiers of Ontario and Quebec in consulting on proposed diversions of Great Lakes water from the United States; and
- Strengthening the regional water management decision support system.

With this backdrop of regional activity and renewed commitment to address these priority water resources management issues, the Great Lakes Commission in partnership with the Great Lakes states and provinces and numerous U.S. and Canadian federal agencies with a mandate in water resources science, management and data collection, developed a multi-year proposal for assessing available data and information to assist the development of a regional water resources management decision support system. This project background, scope, methodology and accomplishments are described below beginning in Section 2.3.

2.2.2 THE RESOURCE AND ITS ECOLOGICAL/ECONOMIC ATTRIBUTES

The eight states and two provinces, which constitute the binational Great Lakes-St. Lawrence region, are blessed with an abundance of high quality fresh surface water. Collectively, the Great Lakes, their connecting channels and the St. Lawrence River comprise the world's largest body of fresh surface water. The Great Lakes system contains 6.5 quadrillion gallons (24.6 quadrillion litres) of fresh surface water, 20 percent of the world's supply and 95 percent of the supply of the contiguous United States. The Great Lakes influence and are inseparably linked to the region's environmental health, economic well-being and overall quality of life.

The Great Lakes-St. Lawrence River system represents a complex ecosystem with attributes that are related and dependent upon one another. The near-shore zone is particularly valuable and important both economically and ecologically and is also where the impacts from water withdrawals will be most discernable. Even minor chemical, physical or biological changes that might have no immediate discernable impact from a system-wide standpoint may be important when viewed from a near-shore or sub-watershed perspective. Also, collective impacts from multiple withdrawals or cumulative impacts from single or multiple withdrawals over time may have lasting impacts even on a system-wide scale.

2.2.3 THE MANAGEMENT OPPORTUNITY

In North America, many existing sources of water are being stressed by withdrawals and diversions from aquifers, lakes, rivers and reservoirs to meet the needs of cities, farms, homes and industries. The water rich region of the Great Lakes-St. Lawrence River has been mostly immune from serious water shortages and water supply problems. However, as other parts of the continent begin to experience water supply

shortages, the Great Lakes are increasingly being viewed as a source of high quality freshwater to serve the needs of communities and industries located outside of the basin. The water supply needs of communities within Great Lakes jurisdictions that lie just outside Great Lakes basin boundaries have also come to the recent attention of the Great Lakes governors and premiers. Implications of this increased interest present a significant challenge for Great Lakes water policy experts and resource managers. While in-basin demand for Great Lakes basin water has remained fairly constant over the past 10 years, uncertainty associated with long-term trends in lake level fluctuations, potential increases in water demand due to population and industrial growth, and regional consequences of global climate change and other factors, has challenged the region to compile and collect the data and information necessary for informed regional decisionmaking. Policymakers and scientists must also increase their understanding of how small and localized changes to the quality and quantity of Great Lakes water resources impact the Great Lakes ecosystem, focusing especially on long-term and cumulative effects.

One challenge to water resources scientists and managers studying the Great Lakes is to answer the questions, "how sensitive is the Great Lakes system to impacts associated with cumulative withdrawals, and at what level can those impacts be ascertained?" These questions are extremely complicated due to a variety of factors. The most significant factor is that the Great Lakes are no longer an entirely natural system. Changes to the Great Lakes-St. Lawrence River system, primarily for navigation and hydro purposes and improvements, have permanently altered the flow regime of the system. Dredging, diversions (both incoming and outgoing) and the construction of locks, dams and controlling works have created changes that are orders of magnitude greater than any changes that might occur from small-scale withdrawal, diversion or export projects. In addition, anthropogenic changes to the natural hydrologic/hydraulic regime have occurred to a lesser extent through consumptive uses and related resource demands since settlement began in the region.

Scientists and researchers need to address these issues with scientifically sound data and begin to work with Great Lakes policymakers on the formulation of socio-economically viable and environmentally responsible policies related to the management of the water resources of the Great Lakes. This will be fundamentally important to providing a sustainable future for the region.

2.3. PROJECT BACKGROUND

In the spring of 2000, in response to the Great Lakes governors' 1999 statement on water management, the Great Lakes Commission and numerous project collaborators prepared a proposal for consideration by the Great Lakes Protection Fund, to inventory and assess available water resources information to assist the governors and premiers in their deliberations on water resources management priorities and to inform the process for developing a framework for a water resources management decision support system for the Great Lakes. The proposal was approved for funding by the board of the Great Lakes Protection Fund in June 2000.

The results of this two-year effort, which commenced in August 2000, have been compiled and presented in this report in a manner to ensure immediate use and benefit to the Great Lakes states and provinces and other relevant water resources agencies. As this project has progressed and the process of gathering and assessing information has unfolded it has become clear to the project collaborators that while there is much that is known about the complex nature of Great Lakes-St. Lawrence River water resources, there is still much more that is needed to be known in order to advance scientifically-based decisionmaking.

The perspective and focus of this initiative was changed early in the process by the knowledge of and the advancement of the Charter Annex deliberations, which began in late 2001. Although the WRMDSS project began prior to the signing of the Annex, the Annex process influenced the evolution of the work plan and the approach taken by the individual technical subcommittees to help address several of the

priorities identified under the Annex. Additional tasks were added to the WRMDSS work plan in 2001 to address or refocus work related to the following issues:

- Water conservation and consumptive use, responding to the Annex directive #3 for establishing a new decision standard;
- Resource Improvement Standard, also responding to the Annex directive #3; and
- Use of scenarios and case studies to inform decisionmaking, responding to the Annex directives #3 and #6.

2.3.1 PROJECT SCOPE

This report addresses the status and availability of data, information and models and other resources required to support the development of a Water Resources Management Decision Support System (WRMDSS). This includes an assessment of water resources data compiled to support a water balance for the Great Lakes, water withdrawal, diversion and consumptive use information and a description of models and resources related to the ecological effects of water withdrawals. The Great Lakes Commission and its collaborators have inventoried and characterized information and data sources pertaining to basin surface and groundwater resources; existing uses of basin resources; and ecological impacts of present and expected uses. Further, state and provincial water resource management programs and practices have been characterized and to the extent appropriate, evaluated with regard to requirements of the Great Lakes Charter. Report products and information also included an evaluation of data and information gaps and needs with an eye toward data and information requirements to support current and potential new decisionmaking standards.

The project scope does address the importance of scale (both geographic and temporal) in the assessment of data and information availability, requirements and needs. The ability to discern impacts and the importance of those impacts will vary depending on where a potential withdrawal or diversion is occurring within the system. For example, the data, information requirements and models used to assess the impacts of a water withdrawal from the Great Lakes themselves will vary significantly from the data, information and models required to assess a withdrawal at the sub-watershed level within the Great Lakes basin. The way that this issue is presented and addressed varies throughout the report and is function of the different project element work plans. Some of the project elements focused more on the larger system-wide data and information requirements, while other elements, such as the ecological impacts component, have a larger focus on the importance of discerning impacts at the local sub-watershed level. Any decision support system will likely have to consider all the different spatial and temporal scales that could be associated with the water withdrawal and use issue.

Of additional note is that the project scope did not include the evaluation of potential requirements or frameworks for an actual decision support system to evaluate water withdrawal and use proposals. Data and information requirements are but one component of a decision support system, that will include issues pertaining to the legal framework and decision standards that are being developed under the Charter Annex process. This effort represents one very important piece of what is necessary to inform the next step in developing and designing an actual decision support system for Great Lakes-St. Lawrence water withdrawal projects.

2.4. PROJECT PROCESS AND ACCOMPLISHMENTS

The Great Lakes Commission and its collaborators have provided the data, information and a needs assessment to assist the Great Lakes-St. Lawrence River governors and premiers in the important next steps of design and development of a water resources decision support system for the Great Lakes-St. Lawrence. The large-scale collaborative effort has produced a status assessment of Great Lakes water resources, an inventory of the withdrawals and uses of Great Lakes water, and enhanced understanding of

the ecological consequences of such use. This initiative has also produced several major products, which, singly and collectively, will strengthen water quantity decisionmaking and management processes.

2.4.1 PROJECT ELEMENT ONE: DETAILED PROJECT DESIGN AND INFRASTRUCTURE

At the outset of the project, the Great Lakes Commission established a formal project administrative structure, management team responsibilities, and the role and responsibility of project stakeholders. The chosen administrative structure provided for a Project Management Team (PMT), a Stakeholders Advisory Committee (SAC), a Project Secretariat (Great Lakes Commission staff), and three Technical Subcommittees (TSCs) (see Figure 1). The PMT, with representatives from each of the ten Great Lakes states and provinces and the U.S. and Canadian federal agencies with a major water resources related role or mandate, provided overall leadership and direction in the design and conduct of all project elements. The SAC, composed of policy and technical experts from other regional and federal agencies as well as citizen, environmental, and industry groups, provided valuable information and advice on the project. The TSCs, composed of experts on topical areas, contributed to work on Project Elements two through four: a Status Assessment of Water Resources; an Inventory of Water Withdrawal and Use; and an Inventory of Information on Ecological Impacts. More information about the initial scoping exercise and the makeup of these bodies is available in the Appendix.

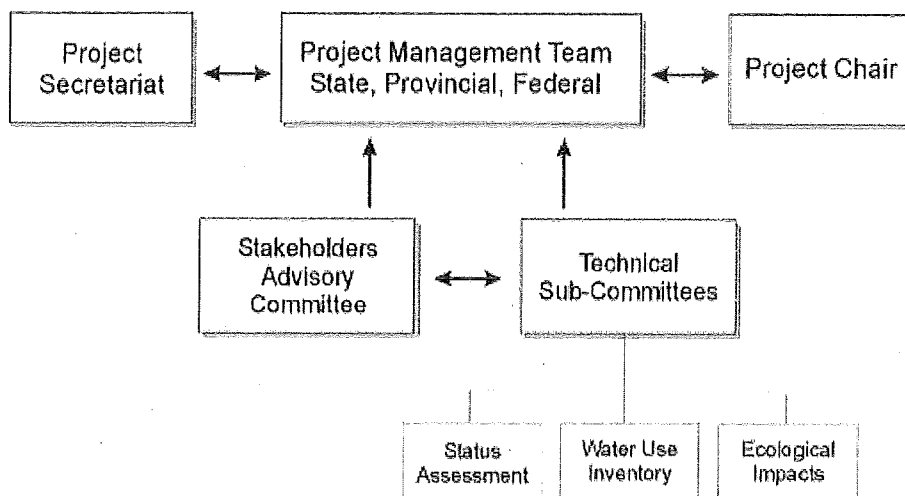


Figure 1
Project Infrastructure Schematic

2.4.2 PROJECT ELEMENT TWO: STATUS ASSESSMENT OF WATER RESOURCES

One of the foundational elements of this effort was the compilation of data and information on the Great Lakes hydrologic system and the completion and update of a water balance for the Great Lakes. This water balance approach involved assembling data and information associated with both ground and surface water resources based on hydrologic variables such as precipitation, runoff, evaporation, groundwater levels and connecting channel flows. This assessment lays the groundwork for a decision support system that is applicable to a broad range of variables and geographic areas ranging from small sub-basins (e.g., a single tributary) to the entire Great Lakes system. Another important component of the work for this element included a series of three flows accounting workshops that examined connecting channel flows, diversions and other inputs and outputs to the Great Lakes system. A critical part of the

overall characterization and interpretation of the available hydrologic data was to quantitatively and qualitatively identify errors associated with measures or estimates of the various components of the Great Lakes water balance. Another important task under this project element was the development of a "one stop-shopping" Internet site for all of the basin's relevant water resources data in the context of the lakes' water balance. This website (<http://www.glc.org/wateruse/wrmdss/>) contains the information for all of the project elements, including the various reports in the Appendix.

2.4.3 PROJECT ELEMENT THREE: INVENTORY OF WATER WITHDRAWAL AND USE

Knowledge of the demand for Great Lakes water resources, such as the amount of water withdrawn and used on a daily, monthly or annual basis, is valuable information for water resources managers. This information is important to scientists working on the Great Lakes water balance but is also crucial to developing water budgets at the watershed and sub-watershed level and vital to the understanding of cumulative impacts associated with increases in demand over time.

Every day nearly one trillion gallons (about 3.75 trillion liters) of water are withdrawn or used instream for industrial, municipal, agricultural, power generation and other purposes, according to data provided by the Great Lakes states and provinces to the Regional Water Use Database. While these numbers inform the discussion of water use activities in the Great Lakes basin in a broad sense, there have been long-standing concerns over the quality, quantity and compatibility of water use data provided by the jurisdictions to the regional database. This lack of high quality, complete and uniform data has contributed to the region's inability to move forward on important activities such as demand forecasting, conducting trend analyses and developing water budgets at the watershed level. Recognizing this area as one of critical need, the project partners have focused significant effort on documenting data gaps and information needs in this area and providing guidance to the states and provinces on ways to improve water use data collection and reporting activities.

Using the Great Lakes Commission's existing Great Lakes Regional Water Use Database as a foundation, the Project Secretariat, with oversight from the water withdrawal and use technical subcommittee, assessed the latest available water use data as it relates to withdrawals, in-stream uses, diversions and consumptive use. Beginning in the late 1980s, the states and provinces through the Water Resources Management Committee and its Technical Work Group, established the parameters for data collection and reporting for the regional water use database. Data is compiled by each jurisdiction for nine categories of use and presented in aggregate form on an annual basis, broken down by jurisdiction, lake basin and category of water use. The members of TSC3 used the preparation of the 1998 water use report as an opportunity to evaluate data and information needs, methodologies for data collection and reporting, and the database's functionality.

Other significant work products produced under project element three include an evaluation of ways to improve access and use of water use data by decisionmakers and other stakeholders, a detailed state/provincial water use programs report, briefing papers on consumptive use and water conservation, and a scenarios process to evaluate water withdrawal and use data and information needs for decisionmaking. Research on water conservation conducted under this project was pursued because of an identified need for additional information to support the Great Lakes Charter Annex's mandate for a decisionmaking standard that includes water conservation measures. Although this topic was not part of the original project work plan, the Project Management Team agreed that water conservation can inform the decision support process and authorized the additional research.

2.4.4 PROJECT ELEMENT FOUR: INVENTORY OF INFORMATION ON ECOLOGICAL IMPACTS

The Great Lakes ecosystem has adapted to a hydrological system that is dynamic and highly complex. Levels and flows within the system constantly fluctuate in response to both natural and human-induced factors, and alterations to this system have an ecological effect that can be cumulative, occurring over space and time. Experts generally agree that demands on Great Lakes water resources are likely to increase and impacts to the Great Lakes basin ecosystem likely will intensify. Enhanced understanding of ecological/biological impacts (local and system-wide) associated with increased water use will be key to formulating scientifically sound resource management decisions that respect ecological considerations.

This project element included three significant and discreet activities/products. A scientific literature review of the ecological impacts of water use and changes in levels and flows provided information on the status of current knowledge. A descriptive inventory of models with prospective relevance to ecological impacts of water withdrawals complements information gathered through the literature search. The Project Secretariat also convened an experts workshop, which brought together U.S. and Canadian researchers and scientists with policy and management officials to determine how scientific understanding and modeling capabilities can be incorporated into a decision support system.

The third discreet project task involved a focus group approach to determining the potential definitions and application of a resource improvement standard that might be applied to water withdrawal and use proposals. A briefing paper and one-day workshop will help inform future discussion on this topic as called for in Directive #3 of the Great Lakes Charter Annex. Although resource improvement was not part of the original project work plan, the Project Management Team agreed to support research on the topic to assist the regional policy development effort.

2.4.5 PROJECT ELEMENT FIVE: PROJECT SYNTHESIS AND NEXT STEPS

Work products associated with the project have been synthesized and presented in a manner that will ensure immediate use and benefit to the Great Lakes states and provinces and other relevant agencies. This report contains a comprehensive series of findings and recommendations associated with each of the project elements and their products as developed and approved by the Project Management Team in consultation with the Stakeholders Advisory Committee. These statements identify remaining gaps and unmet needs associated with the project work and propose a strategy and timeline for addressing them.

Some of the preliminary findings and recommendations were derived from a scenarios workshop that bridged the work of the technical products and their policy and management applications by providing visualization of how water use proposals may be reviewed under decisionmaking mechanisms developed through the Great Lakes Charter Annex process. The workshop also provided an improved understanding of the consequences of cumulative effects over time and space and highlighted the need to address this topic in development of future decisionmaking strategies.

2.5. REPORT FORMAT

This report provides a description of the results of the work done through the WRMDSS project and provides findings and recommendations that have resulted from that work. Chapter 3 provides a summary of the activities of the Technical Subcommittee on the Status Assessment of Great Lakes/St. Lawrence River Water Resources. Chapter 4 provides a summary of the activities of the Technical Subcommittee on the Inventory of Water Withdrawal and Use Data and Information. Chapter 5 provides information on water conservation in the Great Lakes-St. Lawrence region, research that was done to support the Annex process (an activity of the Water Withdrawal and Use Subcommittee). Chapter 6 is a summary of the activities of the Technical Subcommittee on Ecological Impacts Associated with Great Lakes Water Withdrawals. Chapter 7 addresses the resource improvement standard for water resources projects, also in

support of the Annex process (an activity of the Ecological Impacts Subcommittee). Finally, Chapter 8 brings together many of the recommendations and looks at how they fit into a possible decision support system. Findings and recommendations are explicitly addressed within each chapter, and then are brought together cohesively in the final chapter.

This written report and the many reports that have resulted from this project provide a wealth of information about the water resources and associated policies related to the Great Lakes-St. Lawrence Basin. Along with the reports generated by the project, the report appendices provide information on the mandate for Great Lakes regional water resources management, annotated bibliographies, a summary project work plan, and a list of project participants. The appendices are attached in CD-ROM form and are available at <http://www.glc.org/wateruse/wrmdss/>.

2.6. REFERENCES

Andriole, S.J. 1989. Handbook of Decision Support Systems. Philadelphia: TAB Books Inc.

