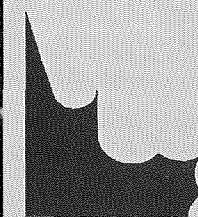
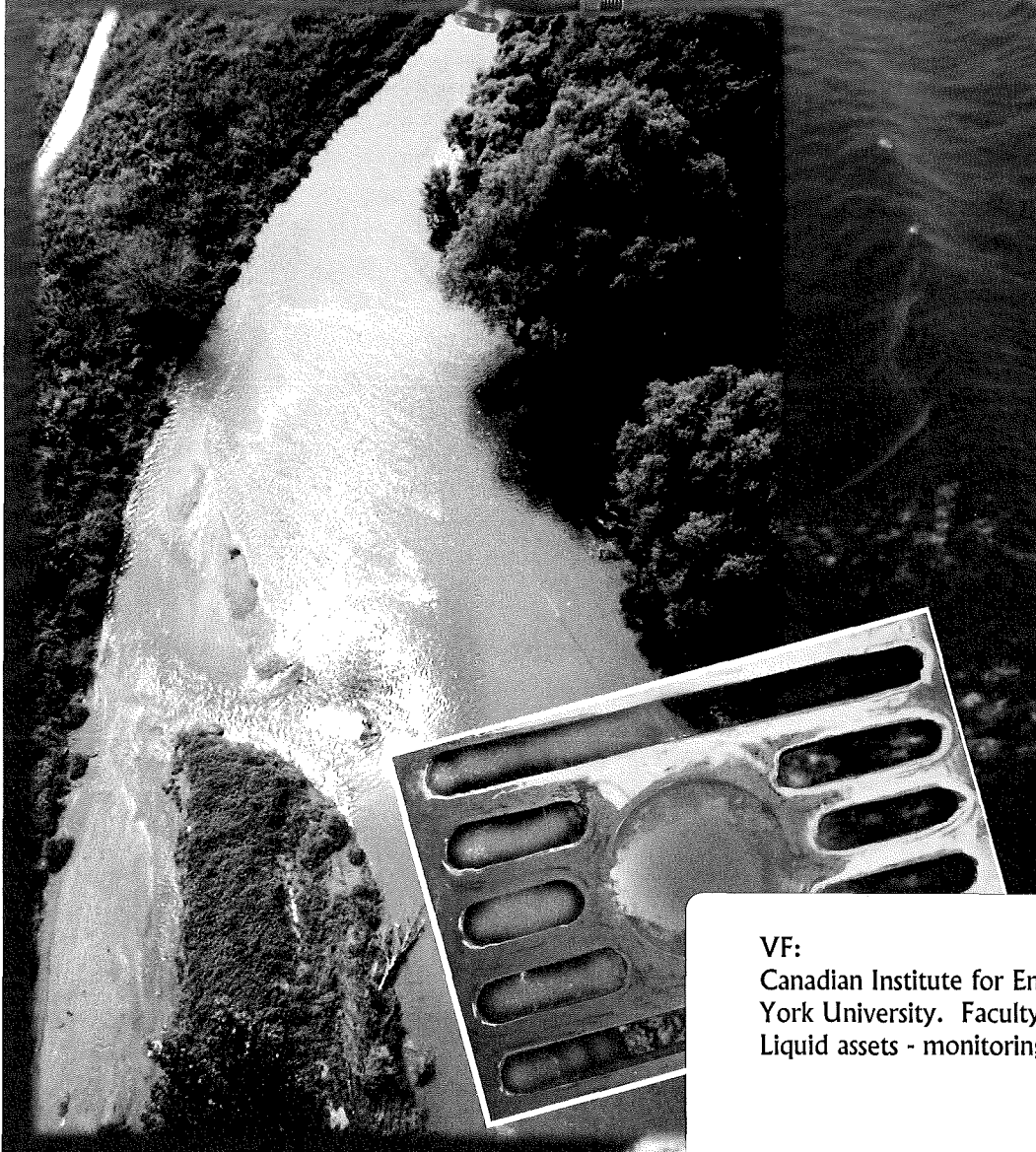


Liquid Assets — Monitoring Water Quality in Ontario



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York University's Faculty of Environmental Studies, one of the oldest and largest in Canada, has been at the leading edge of teaching and research for the past 30 years in all aspects of natural, built, and social and organizational environments. The York Centre for Applied Sustainability, an FES-affiliated research unit established in 1996, has been working to make the concept of sustainability a reality in all sectors of society and in people's daily lives.



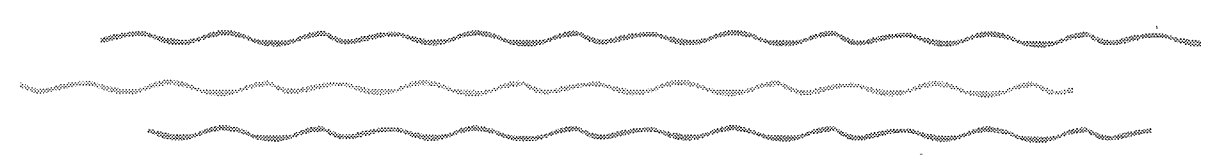
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Sustainable Toronto promotes community sustainability and facilitates the transition to a sustainable society through challenging and working with all sectors including governments, researchers, educators, businesses, non-profits and other community members.

Sustainable Toronto is a consortium between two academic units: the Environmental Studies Program of York College, University of Toronto; and the York Centre for Applied Sustainability, York University. We are also linked with the following key agencies: City of Toronto; the Canadian Institute for Environmental Law and Policy (CIELAP); and the Toronto Environmental Alliance (TEA) - as well as several other non-profit groups - in a unique and innovative partnership to promote community sustainability.

Liquid Assets — Monitoring Water Quality in Ontario



December 2001

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Anne Mitchell
Executive Director
December 2001

Cover photographs by Chris Philp

1. Introduction

We want Ontario's children and grandchildren to inherit a province with clean air, land, and water.

Premier Mike Harris
February 7, 2001 News Release

Premier Harris' noble sentiment expressed last February raises a most serious question: how will we know if Ontario's air, land and water are clean? This question is the motivation for this study, particularly in light of the Executive Resource Group's January 2001 report to the Ontario government, 'Managing the Environment. A Review of Best Practices'. ERG noted "...that the Ministry [of the Environment] has not been investing adequately in its monitoring program for the Great Lakes and associated watercourses... As well, MOE has not invested sufficiently in information portals to provide the private sector and the public with information on environmental quality compared to leading jurisdictions."¹ This study presents 'hard' information in support of this view.

We asked specific questions: Are the necessary environmental data being collected and evaluated? What is the state of the government's monitoring network? Are the results being communicated to the people of Ontario in a timely fashion? Are monitoring data used in any capacity, for example, to review the adequacy of current regulatory standards and develop improved standards? Is enforcement of current regulatory standards adequate? Is the provincial government capable of assessing the health of Ontario's aquatic environment?

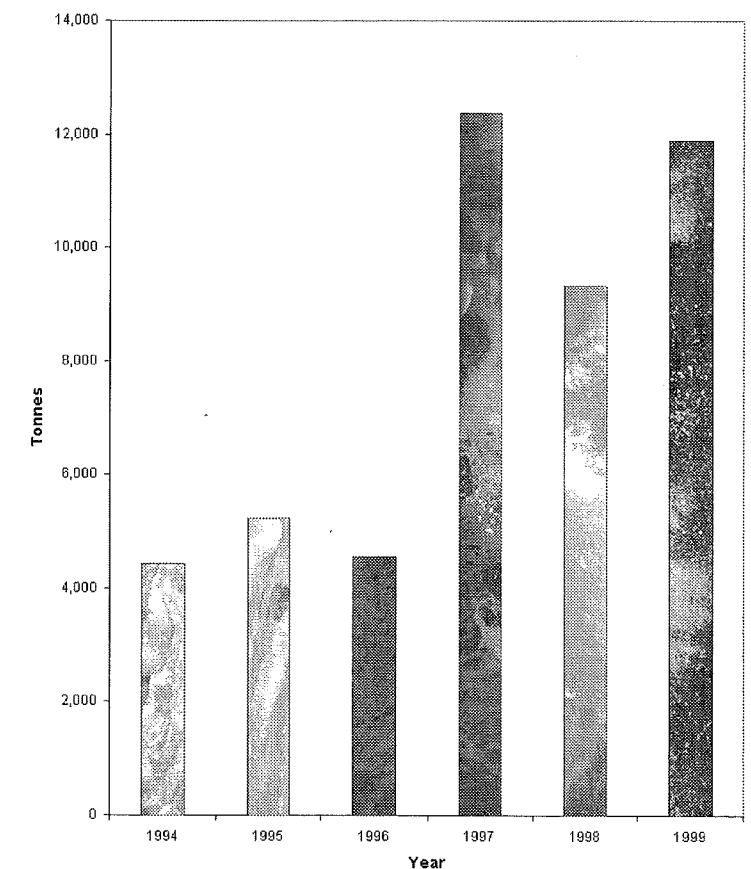
This brief study focuses on surface and ground waters but excludes drinking water because of the current Walkerton Inquiry into the *E.coli* contamination of the water supply in Walkerton, Ontario, and into the safety of Ontario's drinking water. This report is divided into sections dealing with pollution emissions, allocation of financial resources, enforcement, monitoring, reporting, ground waters and comparison to other jurisdictions. The primary focus is on the Ontario Ministry of the Environment (MOE) as the 'line' Ministry responsi-

ble for administering several relevant Acts. Several indicators are used to assess the capacity of the provincial government to monitor and evaluate the state of the environment and to enforce existing regulations.

2. Ontario Pollutant Discharges 1994-1999

Why do we need a monitoring system? Why do we need to continually measure pollution concentrations throughout the environment? Reports on pollutant releases to surface waters from direct discharges, spills and leaks in Ontario (PollutionWatch Scorecard: www.scorecard.org/pollutionwatch/npri) show that the total amount of pollutants released more than doubled between 1994 and 1999 (Figure 1). While some of the increase may be due to more stringent reporting requirements, there is certainly no evidence

Figure 1. Pollutant Discharges to Ontario Surface Waters



t we can relax our vigil, in fact, quite the opposite. Moreover, the pollutants reported to NPRI do not include human and animal fecal waste or pesticides in agricultural runoff. The quantities and the trend in pollutants released to Ontario's waterways means that we must have an effective pollution monitoring system in place to determine their concentrations and track their movement and impacts.

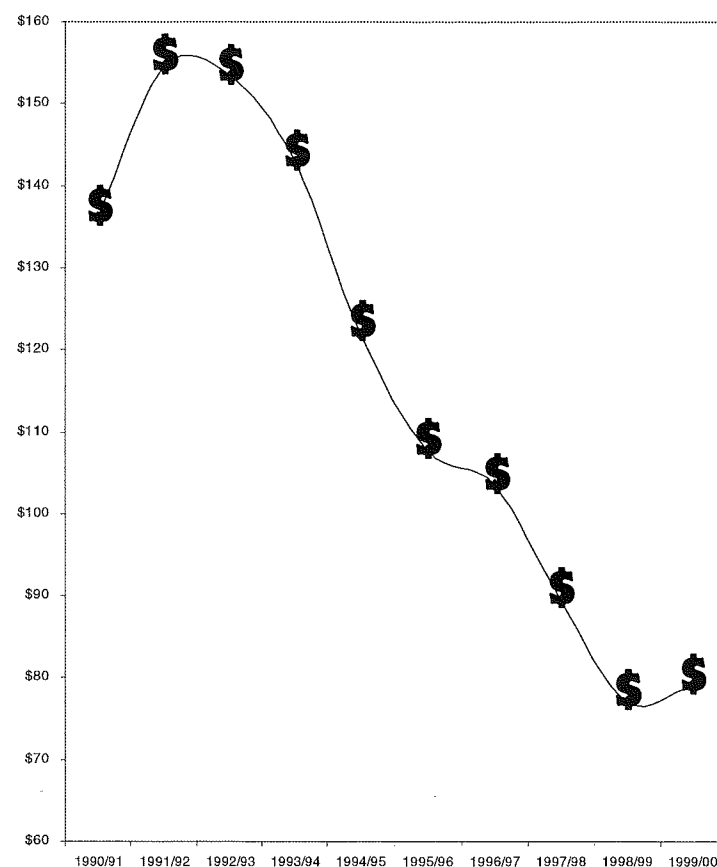
Trends in MOE Financial Resources

The discharge of MOE's primary responsibilities requires professional and technical personnel, as well as support staff. The amount of money allocated to Salaries and Wages is a good measure of staffing levels as long as salaries do not change appreciably as was the case through most of the 1990's. Ministry financial data show a decline in staffing resources allocated to MOE (Figure 2²) over the 10 year period 1990/91-1999/00. The decline was due primarily to layoffs in 1995/96 and attrition before then (some salaries were moved to the Clean Water Agency in 1993 and reported separately). The trend in Salaries and Wages is in keeping with this government's generally parsimonious attitude towards the public sector. Note that while the decline in funding began at least 5 years before the election of the provincial Progressive Conservatives in 1995, it continued to erode into their second term of office which began in 1999. The amount of funding allocated to Salaries and Wages dropped 27% between 1995/96 and 1999/00 indicating a large drop in the number of professional and technical staff.

Enforcing Environmental Laws

Even if properly designed, policies are only effective if violations of environmental laws and regulations are minimal. Enforcement is traditionally used to encourage compliance. The provincial government usually

Figure 2. MOE Salaries & Wages (Millions)



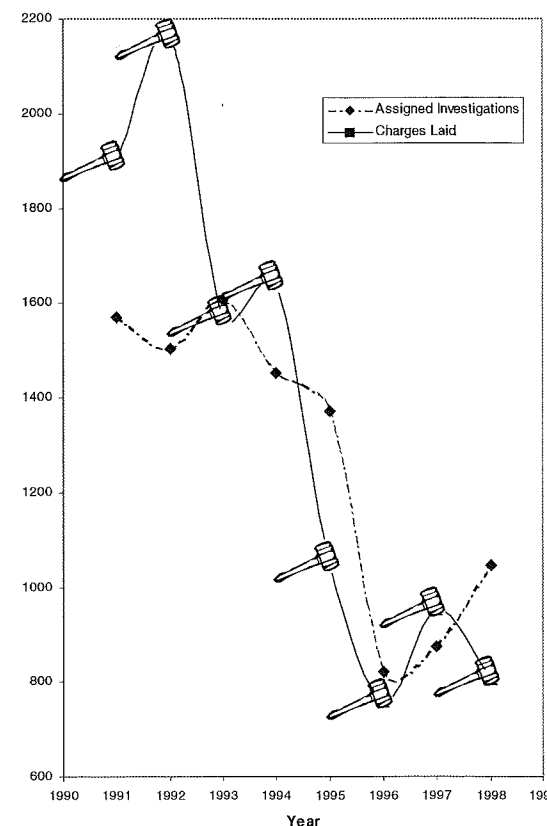
learns of violations of its statutes and regulations through complaints and inspections, and not the monitoring network. Once informed of a violation, the government may begin an investigation, after which it may lay charges and begin a prosecution or it may negotiate with the offender to change its practices. The MOE investigations and charges summary involves all of its statutes and regulations, not just water-related offenses, and as such is a general indicator of the government's overall capacity and willingness to enforce its environmental laws. A decline in these categories may reflect the government's lack of resources and inability to pursue violators.

Figure 3³ shows the number of investigations assigned and charges laid annually 1991 through 1998. The number of assigned investigations was relatively constant between 1991 and 1995, averaging 1500 but declined to an average of 914 investigations between

1996 and 1998 (a 39% decline). The trend in charges laid was similar, averaging 1662 between 1991 and 1995, and 838 between 1996 and 1998 (a 50% decline). 'Salaries and Wages' and 'Assigned Investigations' for 1991 to 1998 are highly correlated with both declining significantly during this period. The average amount of funding allocated to Salaries and Wages in 1994/95 and 1995/96 (Figure 2) was \$114.9 million, declining to an average of \$90 million in 1996/97 - 1998/99, a drop of 22%.

It is likely that the decline in staff under the present government contributed to the erosion of enforcement activity, which can only jeopardize environmental health. In response to criticisms, the government announced on May 2, 2001 the formation of an 'Environmental SWAT Team' to enhance inspection and enforcement activities. This may reverse the enforcement trend of recent years, however, there is some concern that too many trivial cases are being pursued in order to bolster the government's prosecution record.

Figure 3. MOE Annual Enforcement Data



5. Water Quality and Biomonitoring Programs

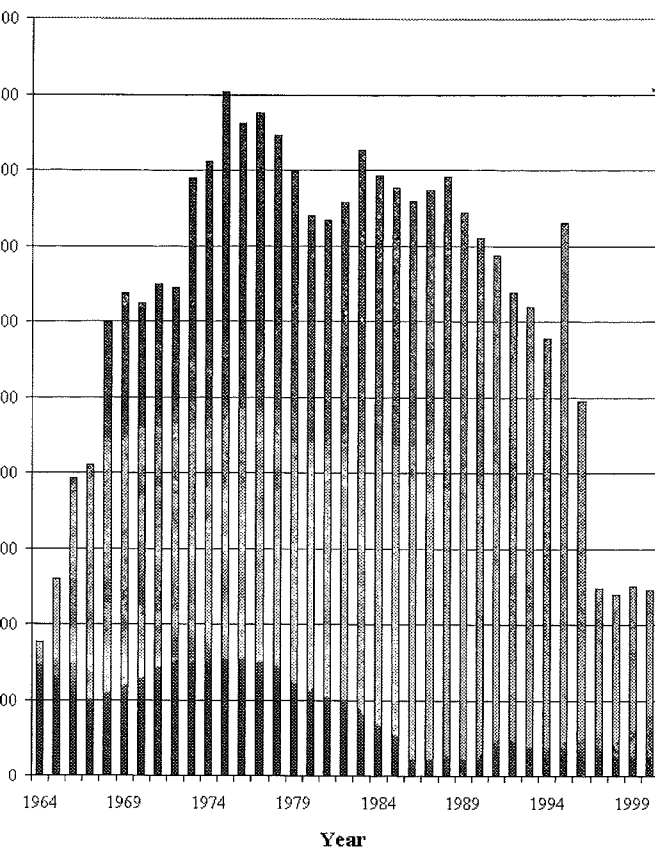
Monitoring programs are the Ministry's 'eyes and ears' on the natural world around us. Without them, it would be difficult, if not impossible to know whether the state of our surface waters is improving or worsening. Consequently, the Ministry would not know if policies and regulations need improvement. To be effective, a monitoring system must have several components - an adequate number of sampling sites, sufficient number of visits to each site, adequate number and type of measurements, rigorous data analysis, thorough interpretation of results, and rapid internal reporting to be followed by public reporting. Without these components, the state of Ontario's surface waters is essentially unknown.

Modern aquatic monitoring programs can include several complementary approaches: chemical measurements of water, sediments and local flora and fauna, census of aquatic species present, and responses of standard laboratory test organisms such as the fathead minnow to polluted waters.

Provincial Water Quality Monitoring Network

In 1964, the first year of the provincial water quality monitoring network (PWQMN) program, there were 177 active stations where water samples were routinely collected for chemical analyses. The number of stations gradually increased, reaching a maximum in 1975 of 903 stations with the majority of stations sampled up to 8-10 times per year. This level remained relatively constant throughout the 1980s. Gradual cutbacks in the number of stations beginning in 1989 were followed by a drastic reduction in the number of sampling sites from 730 sites in 1995 to about 240 in 2000 (Figure 4⁴). About 40% of the active sampling sites are located in five major watersheds in southern Ontario - the Thames, Grand, Credit, Trent-Severn and Rideau watersheds. In total, over 2000 sites have been monitored at least once during the 40-year span of testing but almost 90% of them have been discontinued.

Figure 4



The number of active sites is not the only indicator of government activity on the monitoring front. How many times a year is each site visited? What is measured? The PWQMN sites are currently monitored by MOE and the Conservation Authorities (CA). The active sites are sampled approximately 8 times per year by MOE or CA staff and analyzed primarily by MOE Laboratory Services Branch for "standard" water quality indicators such as pH, turbidity, conductivity, nutrients, metals, major ions, alkalinity, and suspended solids. Prior to 1996 they were also sampled for several kinds of bacteria. Results of the water analyses are archived in a centralized computer database.

load information for the Grand River watershed reviewed for this study⁵. Of the 41 PWQMN stations sampled at least once between 1991 and 2001, organic contaminants were sampled at only one sta-

tion near Lake Erie. While this provides information on contaminant loading to Lake Erie, it doesn't provide any information on the sources because a positive test at the mouth of the river doesn't indicate where a contaminant entered the river. The seriousness of the problem is recognized by the provincial government because it publishes annual warnings advising anglers to limit sport fish consumption at many locations along the Grand River and its tributaries. Clearly, aquatic contamination is widespread in the Grand River watershed. Analyzing game fish is an excellent method for detecting contaminants that bioaccumulate, however, water quality may be also impaired by toxic contaminants that do not bioaccumulate and therefore will not show up in sport fish. In summary, it appears there is no systematic chemical monitoring of organic contaminants in the Grand River watershed and this is probably the case for other inland waters in Ontario.

Biomonitoring Programs

Provincial staff collect between 4000 and 6000 fish each year from approximately 1700 locations in Ontario's inland waters and the Great Lakes and send them to the MOE laboratory in Toronto. The fish are analyzed for a short list of substances that bioaccumulate, including mercury, PCBs, mirex, DDT and dioxins. The results are used to develop the tables in the 'Guide to Eating Ontario Sport' published every year, which give consumption advice for each species tested at each location. This advice is based on health protection guidelines developed by Health Canada. The Sport Fish Contaminant Monitoring Program is the largest testing and advisory program of its kind in North America.

Exposure of test organisms to industrial effluents has been used for many years in Ontario to assay the quality of the effluents, for example, in the MISA (Municipal/Industrial Strategy for Abatement) program. However, only one MISA monitoring report appears to have been released to the public in the last decade.

There are no biomonitoring programs in southern Ontario's inland waters aside from the sport fish program and monitoring of algae and zooplankton (these are mostly small crustaceans) in Lake Simcoe and selected lakes in central Ontario.

6. Information Management and Public Reporting

While the government continues to collect surface water data on a reduced scale, what does it do with it? Are the data reviewed, analyzed and interpreted to create scientific information in a timely fashion? Is the scientific information used to inform policy discussions? Is the public informed in a timely fashion?

There appear to have been few visible efforts in recent years to report on the general environmental state of Ontario's inland waters (the Great Lakes are not considered to be inland waters). The province discontinued publication of annual PWQMN data reports around 1990. Although almost 40% of the active PWQMN sites are located in just five watersheds in southern Ontario, we could find only two reports on the MOE website (www.ene.gov.on.ca/envision/techdocs/index.htm) containing information on these watersheds. One was a 1994 report on Rice and Sturgeon Lakes. The second was a technical report on Lake Ontario released in 1997 that presented data up to 1994 on several types of nutrients, metals and organic contaminants collected at the mouths of Lake Ontario tributaries. In addition, no reports of water effluent monitoring data under the MISA (Municipal/Industrial Strategy for Abatement) program have been released since 1993. The only biomonitoring report listed on the website is the narrowly focused annual 'Guide to Eating Ontario Sport' which does little more than advise which fish to avoid eating.

To view PWQMN data, the public must file a request with MOE using the Freedom of Information process and the PWQMN program must be specifically mentioned. The data would most likely be provided in raw form, and the agency requesting the data would be responsible for analysis. The cost of obtaining all PWQMN data for the last 10 years through an FOI request would probably exceed several thousand dollars.

Some Conservation Authorities are filling the gap left by the province and have issued or are about to release 'State of the Watershed' reports. This is a positive step that has been taken even though the province has greatly reduced funding to Conservation Authorities.

Another positive step is the creation of the Water Resources Information Program by the Ministry of Natural Resources. This program is intended to provide a common platform for sharing water resource information across government. It is in a very early stage. However, WRIP is intended to share information: it will not correct the gaps in MOE's monitoring programs nor will it create useful information out of MOE's raw data. Data is not information until it has been analyzed and interpreted.

7. Groundwaters

Until this year, the only program that monitored groundwater quality was the Drinking Water Surveillance Program which periodically samples 44 municipal waterworks of the 399 waterworks that receive their supply from groundwater. Recently, MOE and twenty-four Conservation Authorities announced the start of the Provincial Groundwater Monitoring Network. This six year sampling program will include approximately 400 wells by 2003. MOE will fund laboratory analyses only in the first year, leaving the CA's to fund it after that.

8. Comparing Ontario to Other Jurisdictions

While the Ontario government has greatly reduced its chemical monitoring program and provincial reporting has been virtually non-existent for most of the last decade, it might be argued by some that the program it exists today is good enough. The public has no way of knowing if this argument is valid, of course, because the scientific information with which to evaluate the monitoring program is not available except at great cost through a freedom of information request. Substantial expertise is also needed to analyze the data.

Ontario's approach is adequate, then other jurisdictions might be taking a similar approach and not needlessly spending money. We reviewed water quality monitoring and reporting programs in nearby Ohio just across Lake Erie from Ontario because it has similar geography, population and state of industrialization. A report by Beak International to the Ontario government, 'Environmental Monitoring: Leading Jurisdictions' (listed on the MOE website) identified Ohio as a 'Best Practice Jurisdiction'.

The US Clean Water Act requires states to assess progress in achieving the Objectives of the Act. Ohio routinely conducts biological and water quality surveys and produces comprehensive reports called "Water Resource Inventory"⁶ every four years. The Inventories and accompanying appendices and fact sheets are forthcoming about the extent and sources of impairment. These, and other current reports are available from the Ohio Environmental Protection Agency website (www.epa.state.oh.us/dsw) which also describes numerous biological and water quality programs. It is clear that Ontario's reporting pales in comparison and it is likely that Ontario's monitoring of inland waters does so as well.

9. Conclusions

Assessing the quality of Ontario's inland waters does not appear to have been a high priority for the Ontario government during the last decade. The Ministry of the Environment has seen large reductions in its professional staff and surface water quality monitoring program and no longer reports to the public on the state of the aquatic environment in inland waters. The water quality monitoring data are not accessible to the public without a Freedom of Information request. Some Conservation Authorities have attempted to fill the analysis and reporting vacuum caused by the MOE contraction and have released several State of the Watershed reports. In spite of this, the Ontario government is probably not in a position to determine whether current policies, statutes, regulations and water quality guidelines are adequately protecting environmental health. Since environmental health is synonymous with public health, this is cause for concern.

Appendix

For a copy of the Report Appendix, please see our website at www.cielap.org/liquidassets.html or contact our office by phone (416) 923-3529 or e-mail, cielap@cielap.org.

Endnotes

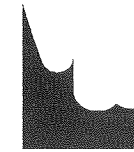
- ¹ Executive Resource Group (2001) Managing the Environment. A Review of Best Practices, [document online] (Government publication released on February 07, 2001 [cited on October 13, 2001]); available from Ministry of the Environment website <http://www.ene.gov.on.ca/envision/ergreport/index.htm>
- ² Ontario Ministry of Treasury, Economics and Internal Governmental Affairs. Public Accounts, for years 1990-91; 1991-92; 1992-93; 1993-94; 1994-95; 1995-96; 1996-97; 1997-98; 1998-99; and 1999-2000. Ministry of the Environment.
- ³ Ontario Ministry of the Environment Head Office. Annual Enforcement Summary: Calendar Years 1991-1998. Internal document. Faxed to CIELAP on January 12, 2000.
- ⁴ Internal document sent by Ministry of the Environment in February 2001. Available at CIELAP.
- ⁵ Ministry of the Environment. Data from the Provincial Water Quality Monitoring Network through FOI on 48 sites on the Grand River. Diskettes available at CIELAP's office.
- ⁶ Ohio Environmental Protection Agency (2000) Water Resource Inventory, [document online] (reports for years 2000, 1998, 1996, 1994 are available on the Internet [cited on October 13, 2001]); available from the Ohio EPA website http://www.epa.state.oh.us/dsw/document_index/305b.html



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Appendix

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1.0 Introduction

Groundwater is being depleted all over the world. The World Watch Institute commented in their "State of the World 2000" report that several countries (mainly non-fluent) are facing groundwater deficits of over billions of cubic meters per year. In areas in India, water tables are decreasing at an alarming rate of 0.6 to 0.7 meters per year. It is worse in China, where water tables are disappearing at 1-1.5 meters per year and demand is still increasing¹. So, how does any of this relate to a water rich country like Canada, particularly Ontario where the water appears to flow endlessly? Since July 2000, the Ontario Ministry of the Environment (MOE) has issued over 100 permits to take water from groundwater sources. A quick calculation of these permits showed that the combined amount of groundwater taken was approximately 200 billion litres: enough water to fill more than 53,000 Olympic-sized swimming pools. Such a level of water extraction may be sustainable but to accurately predict a sustainable level, MOE must have adequate knowledge about the state of groundwater in the province of Ontario.

In Ontario, over 2 million people rely upon groundwater as their primary source of drinking water². Approximately 90% of the rural population depends upon it for domestic uses³. It has been repeatedly stated over the past twenty years that Ontario's groundwaters have been poorly managed. The absence of groundwater monitoring, management, and protection may have contributed to the contamination of over 1300 farm water-wells⁴, a series of *E. coli* outbreaks, exacerbated water shortages, and continuous free water takings from groundwater sources without the proper understanding of their implications.

The 1994/1995 Environmental Commissioner's Report provided a framework regarding sustainable groundwater management. The Ontario Environmental Commissioner had outlined several factors that should be included in a comprehensive groundwater strategy noting the need for:

an economic assessment of the value of groundwater resources, including current and replacement value;

2. a strong emphasis on preventing contamination;
3. an establishment of specific groundwater protection zones;
4. an assistance to regional or municipal governments to develop controls to restrict activities that may contaminate groundwater;
5. a focus on priority candidate regions;
6. a publicly accessible inventory of groundwater resources;
7. a long-term monitoring network of water level for major aquifer systems;
8. an inventory of current and past sources of contamination and evaluation of their potential effect on health and ecosystems;
9. a program to control the effects of contaminated sites;
10. a focus on the cumulative effects of agriculture, septic systems, lawn chemicals and municipal systems on groundwater; and
11. a publicly accessible data management system, including water-well records, monitoring information, complaints, inspections and enforcement, and information about contamination and remediation.⁵

Although these elements could provide the foundation for the sustainable management of Ontario's groundwater resources, Ministry of the Environment (MOE) capacity to operationalize the framework may be limited due to a number of reasons.

The purpose of this research paper is to investigate MOE's capacity to create and deliver a sustainable management framework for groundwater by examining several (MOE-specific and external to MOE) facets of groundwater management:

1. Calculations of sustainable yields for groundwater taking.
2. The number of reports published on groundwater
3. The state of groundwater databases
4. Number of monitoring and protection programs and policies implemented over the years.
5. The number of staff dedicated to groundwater
6. Future initiatives

1.1 Background Who is Responsible for Groundwater Management?

There are two pieces of legislation focused on groundwater protection: the *Ontario Water Resources Act* and the *Environmental Protection Act*. As it is the Ontario Ministry of the Environment (MOE) that administers the two acts, it is the governmental agency that has the power to manage groundwater. Prior to 1993, the Drinking Water Section under the Environmental Monitoring and Reporting Branch was the only group responsible for groundwater⁶. Between 1993 and 1994, a Groundwater Management Unit was formed but the group was subsumed into the Water Monitoring group. Presently, there exists a Groundwater Unit, which is part of the Water Monitoring group and it deals with provincial initiatives for groundwater management.

The five MOE regional offices (Northern, Central, Eastern, West-Central, and Southwestern) are currently responsible for both delivering programs to protect groundwater quality and quantity, as well as issue permits to take water⁷.

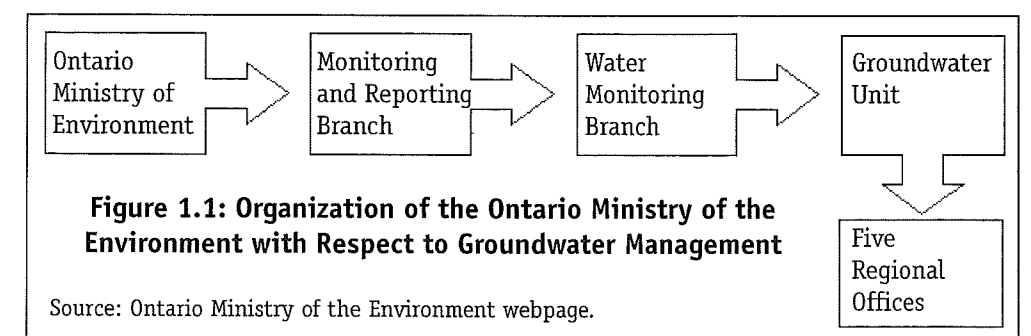
There are other ministries (both federal and provincial) that are responsible, to varying extents, for groundwater quality and quantity in Ontario. Table 1.1 summarizes the groundwater responsibilities of various ministries who are involved with various aspects of groundwater.

There are other pieces of legislation that affect groundwater management⁹:

- ⊙ Lakes and River Improvement Act
- ⊙ Pesticides Act
- ⊙ Environmental Bill of Rights
- ⊙ Conservation Authorities Act
- ⊙ Municipal Act
- ⊙ Petroleum Resources Act
- ⊙ Ontario Building Act and Code
- ⊙ Planning Act
- ⊙ Federal Fisheries Act

Table 1.1: Groundwater Responsibilities of Various Ministries in Ontario and Canada⁸

Ministry/Agency	Programs
Ministry of the Environment	<ul style="list-style-type: none"> ▶ Drinking Surveillance Program monitors 180 municipalities. ▶ Permit to Take Water Program ▶ Monitoring also occurs at most landfill sites, mine sites, radioactive waste deposits. ▶ Water Well Information Systems
Agriculture Canada	<ul style="list-style-type: none"> ▶ Since 1987 monitors pesticides in drinking water "Farm Groundwater Quality Survey, 1992"
Ministry of Natural Resources	<ul style="list-style-type: none"> ▶ Database of wells with information on lithology, E-logs ▶ Petroleum Resources Data System
Ministry of Northern Development and Mines	<ul style="list-style-type: none"> ▶ Stratigraphic and Geochemical data from boreholes ▶ Reconnaissance Till Sampling Program
Environment Canada	<ul style="list-style-type: none"> ▶ Municipal Water Use Database
Ministry of Agriculture, Foods, and Rural Affairs	<ul style="list-style-type: none"> ▶ Controls pesticide use
Ministry of Municipal Affairs and Housing	<ul style="list-style-type: none"> ▶ Responsible for septic systems and municipal planning.



0 Results of Indicators

Sustainable Yield for Groundwater Taking

The Ontario Ministry of the Environment controls the amount of water taken from ground sources by issuing permits through the Permit To Take Water (PTTW) program, which sets out several general terms and conditions to the proponent. Often times, the director will attach special conditions to the water taking specifying monitoring requirements, such as records on the amount of water extracted. These records could be required for a situation where an interference (i.e. adjacent wells are affected by the water taking) could occur, or where data is needed for water management or planning studies¹⁰. However, anecdotal evidence suggests that due to the lack of resources, the MOE does not permit staff to follow up on the data¹¹. Furthermore, there has not been any evidence of internal or external reporting regarding the cumulative effects of water takings that could be found on the MOE website or in Groundwater Unit's informal library.

One of MOE's newest pieces of legislation, referred to as the *Water Taking and Transfer Regulation, 1999*, prohibits the transfer of water from Ontario's major water basins. Accordingly MOE agents issuing Permits To Take Water (PTTW) must take into account:

- Protection of the natural functions of ecosystems;
- the effects of ground and surface water takings on other users of the water;
- the concerns of others who may be affected by the PTTW; and
- the Great Lakes Charter, an international agreement protecting water resources in the Great Lakes Basin.

In addition to these guidelines to the PTTW, MOE has updated their Statement of Environmental Values which expresses an "ecosystem approach" to environmental management.

It states,

"The Ministry will adopt an ecosystem approach to environmental protection and re-

source management. This approach views the ecosystem as composed of air, land, water, and living organisms, including humans, and the interactions among them.

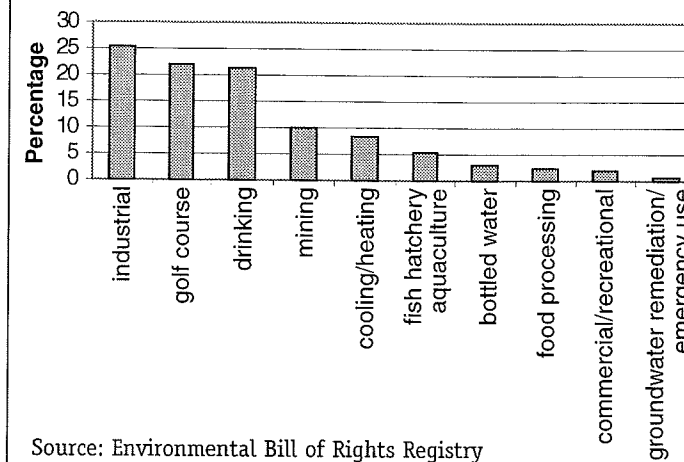
When making decisions, the Ministry will consider: the cumulative effects on the environment; the interdependence of air, land, water and living organisms; and the interrelations among the environment, the economy and society."¹²

However, several comments posted on the EBR registry have accused the government of not using the "ecosystem approach" as expressed in their Statement of Environmental Values, or the powers to refuse permits on several conditions set out by the *Water Taking and Transfer* regulation. The EBR registry was used to calculate the number of water taking permits issued from July 2000 to July 2001. Unfortunately, the registry is not a reliable database to measure the exact amount of water extracted. Only water takings that are more than 50,000 litres per day need to be registered and there are exemptions such as most municipal water takings; takings for irrigation of crops; and takings of less than one year in length¹³. The Permit To Take Program completely ignores the vast number of active individual wells that take water everyday.

In spite of its deficiencies, the EBR registry can still be utilized (albeit in a limited way) to describe the amount of water that has been removed from ground sources. As mentioned earlier, from July 2000 to July 2001, the Ontario Ministry of the Environment granted over 200 billion litres of groundwater to be taken in the next two to ten years as posted on the Environmental Bill of Rights (EBR) registry. Figure 2.1.1 shows the percentage of water taken for the various uses of water (e.g. industrial, bottled water, drinking, etc).

The majority of extractions were for industrial purposes (25%). This was followed by golf course irrigation at 22% and water for consumption (21%). Although it would appear that more water was allocated to golf course irrigations than for drinking purposes, rarely do municipal withdrawals, which are, in general, greater than industrial uses¹⁴. Moreover, about

Figure 2.1.1: Percentage of Groundwater Extraction by Use between July 2000 and 2001



Source: Environmental Bill of Rights Registry

9% percent of the permits issued were for bottled water companies, which constitute about 3% of the total extraction from July 2000 to 2001. This translates into approximately 5.6 billion litres of water overall. Are these water takings sustainable? What fraction of the annual groundwater recharge is being extracted? What is happening to local water tables?

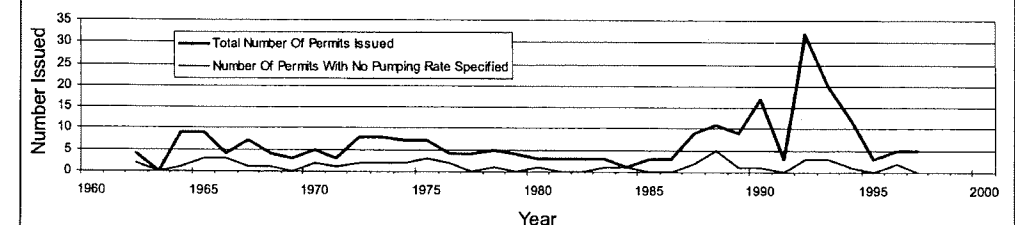
In October 1999, Artemesia Water Ltd (AWL) requested a Permit To Take Water for 483,840 litres a day for 365 days a year by MOE. The Ministry granted the permit despite the 2485 comments that were sent asking the Ministry to decline it. During the tribunal hearing regarding the request to "Leave to Appeal", a process whereby MOE decisions on granting permits/certificates can be appealed by the public, a farmer testified that the region had been experiencing a drought for two years, leading to a loss (for 23 of the area's farmers) of \$520,056. Furthermore, 17 residents whose wells were adjacent to the company site had complained of their wells running dry. Nevertheless, the board had denied the applicants' "Leave to Appeal" the Ministry Director's decision on the permit (i.e. AWL was still allowed to take water),

most likely due to the extra conditions laid out to AWL for monitoring their extractions¹⁵.

There were other similar cases that gave rise to MOE adding extra conditions onto the proponent when issuing the permit, such as monitoring groundwater levels. However, due to the fact that the monitoring only occurs during the extraction process, there is little background knowledge of what the groundwater levels were prior to the water taking. Such information would further help MOE make decisions to grant or decline requests for permits. An additional problem of MOE action to shortages is the claim by residents regarding the length it takes MOE to respond to interference occurrences after it is initially reported. Thus negative impacts may occur if the response time is too long and the company is not told not to stop taking water right away.

Further grievances with the Permits To Take Water Program have to do with administration. In most cases, the permits are filed away in paper form and slowly computerized. Although this may appear to be an insignificant problem, it becomes complicated when Conservation Authorities or municipalities request MOE to provide them with the number of permits issued for a certain waterbody or watershed. Without a complete database, the MOE agents need the permit number or the address of the proponent to track down the paper forms. Some Conservation Authority agents have taken upon themselves to update the files. Figure 2.1.2 shows the Credit Valley Conservation Authority's efforts to update the number of permits issued for the Credit Watershed until 1997¹⁶.

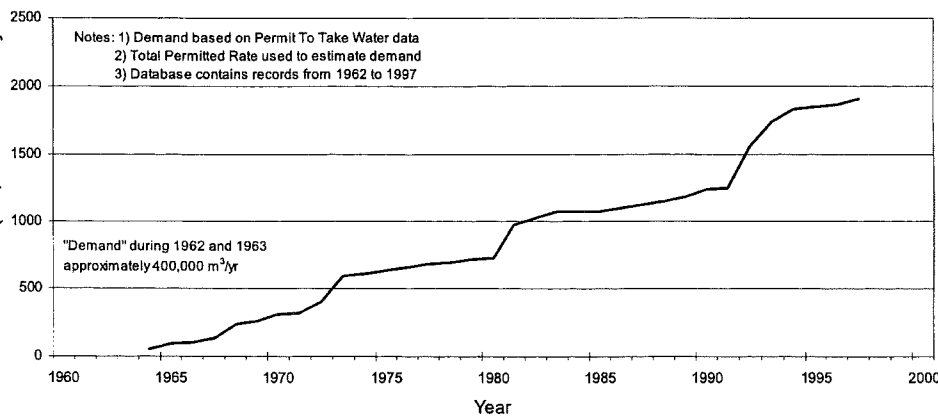
Figure 2.1.2: Water Taking Permits Issued Within the Credit River Watershed



Source: Credit Valley Conservation Authorities' *Water Report* [page 11]. Online document available at <http://www.creditvalleycons.com/aboutcvc/images/1999H20report.pdf>

ing this information, the Credit Valley Conservation Authority was able to calculate that there has been a e-fold increase in the amount of water demand since 1962. They have illustrated the trends in Figure 2.1.3.

Figure 2.1.3: Total Water Demand Within the Credit River Watershed



Source: Credit Valley Conservation Authorities' *Water Report* [page 11]. Online document available at <http://www.creditvalleycons.com/aboutcvc/images/1999H20report.pdf>

The Grand River Conservation Authority (GRCA) has taken the initiative to update the number of permits around their watershed. In 1998, a staff member of the GRCA went to the MOE West-Central regional office and entered all the paper files for the Permits To Take Water from 1984 into a computerized database¹⁷. The database is able to categorize the permits into source of taking, purpose, and location and allowed the GRCA to plot all the permits onto a map of the Grand River watershed¹⁰.

2 The number of reports published on Groundwater

The most comprehensive reports regarding groundwater were done prior to 1987. Between 1970 and 1986, MOE and the Ontario Water Resources Commission produced 14 **groundwater probability maps**, which covered 11 counties and two regional municipalities. The maps included information on depth to water; all yields of bedrock and overburden aquifers; flow patterns, and some water quality data. Furthermore, eight maps of major aquifers in Southern Ontario were published between 1973 and 1978 as part of the **Major**

Aquifers in Ontario Map Series. Two of them covered the entire Lake Ontario Drainage Basin; the others provided information on Guelph-Amabel and the Guelph-Lockport aquifers, the Alliston and the Oak Ridges aquifer complexes.

There were 22 **Water Resources Reports** published between 1969 and 1982 on surface and groundwater. These reports provided information on various drainage basins in Ontario; the reports ceased in 1982.

Contractors are required to fill out a form regarding information on water wells when they are constructed. These files were compiled into a series of groundwater reports called the **Water Resources Bulletins**. The last published report was compiled in

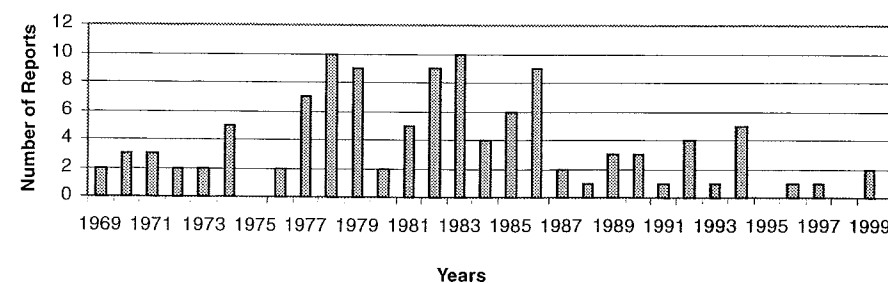
1981. To replace the paper files, MOE created the **Water Well Information Systems (WWIS)**, a database for all the wells in Ontario.

Between 1981 and 1986, MOE studied 26 areas in the province to produce **Susceptibility of Groundwater to Contamination** maps. These maps are based on the presence or absence of shallow aquifers, the permeability of surface materials, and groundwater use. All these factors are rated on a high/low system.

There have been a variable number of Ministry reports on groundwater since the early 1980s. Furthermore, these more recent reports are mostly guidelines regarding the use of groundwater.

Figure 2.2.1 illustrates the estimated number of groundwater reports released between 1969 and 2000. Between 1995 and 2000 there have been only five reports published including those highlighting regulation changes affecting groundwater. The most comprehensive report since 1982 was done in 1997.

Figure 2.2.1: Approximate Number of Reports Produced by MOE Pertaining to Groundwater in Ontario from 1969 to 2000



Source: MacRitchie et al (1994) bibliography, MOE publications website, and the Groundwater Unit's resource centre.

"The Hydrogeology of Southern Ontario" (1997)

The most recent publication speaking to the state of groundwater in Ontario was produced in 1997 titled *The Hydrogeology of Southern Ontario*¹⁸. It is a compilation of studies done prior to 1992 with the help from the Water Well Information System (see section 2.3.4) and computer mapping databases (e.g. GIS) and programs (e.g. RAISON). When a well for water extractions is constructed several parameters must be measured such as type of water found in well, yield, materials, and location. All these parameters are transferred into the WWIS and it has become a powerful data-collecting tool for certain purposes.

MOE used the WWIS to locate water wells to describe characteristics of southern Ontario hydrogeologic units. However, *The Hydrogeology of Southern Ontario* does not indicate what criteria were used to select the wells.

The report provides hydraulic parameters of various bedrock and overburden units, and the geologic conditions which groundwater flow systems operate. It tries to assess the occurrence, quality and quantity of groundwater in Southern Ontario by:

- ⊗ compiling, analyzing, and interpreting existing information on physiography, geology, topography, drainage, and climate;
- ⊗ determining the hydraulic parameters of important hydrogeologic units;

- ⊗ identifying geologic conditions under which various groundwater flow systems operate;
- ⊗ evaluating long-term groundwater recharge and discharge for selected watersheds; and finally,
- ⊗ assessing groundwater quality from samples taken when the wells was first constructed.

Eighteen hydrogeological units were used to measure the specific capacity and transmissivity distributions for

bedrock and overburden wells.

1. Precambrian Hydrogeologic unit
2. Nepean-March-Oxford Hydrogeologic unit
3. Rockcliffe hydrogeologic unit
4. Ottawa Group hydrogeologic unit
5. Simcoe Group Hydrogeologic unit
6. Billings-Carlsbad-Queenston Hydrogeologic unit
7. Blue Mountain-Georgian Bay Hydrogeologic unit
8. Queenston Hydrogeologic unit
9. Cataract Group Hydrogeologic unit
10. Dyer-Wingfield-St. Edmund Hydrogeologic unit
11. Clinton Group Hydrogeologic unit
12. Amabel-Lockport-Guelph Hydrogeologic unit
13. Salina hydrogeologic unit
14. Bass Island Hydrogeologic unit
15. Bois Blanc Hydrogeologic unit
16. Detroit River Group Hydrogeologic unit
17. Dundee Hydrogeologic unit
18. Hamilton Group hydrogeologic unit
19. Kettle Point Hydrogeologic unit

The results indicate that Bois Blanc, Detroit River Group, Salina, Bass Island, Dundee, and Amabel-Lockport-Guelph hydrogeologic units were the highest yielding units although values for the water yield were not presented.

2.3 Groundwater Databases/Monitoring

There are a number of databases that deal with various aspects of groundwater, such as water level monitoring, quality measurements, the number of groundwater contaminations, and enforcements. In this section of the paper, these databases will be discussed and how they have changed over the years.

3.1 Water Level Monitoring

Before 1984, there was a water level monitoring network in Ontario that was stored on computer until 1981 and on paper until 1984¹⁹. Afterwards, the regional offices were responsible for continuing to monitor groundwater levels if they wished to do so. In 1993, the Southwestern, West Central and Central Regions continued to monitor groundwater with several observation wells²⁰. Currently, the Southwestern region reported that their database has many gaps and they are unsure as to the usefulness of the data for any long-term trends; also, their equipment for monitoring is out of date²¹. Although the West-Central region still uses the observation wells, they no longer monitor groundwater²². The Eastern Region also reported having 12 observational wells but only three are functional²³. There is no indication that they are being replaced.

Most of the observation wells are used for case-by-case incidences. If any historical data needs to be compiled, the municipalities that use groundwater sources need to be contacted as the provincial government has not monitored groundwater since 1983²⁴.

3.2 Groundwater Quality Databases

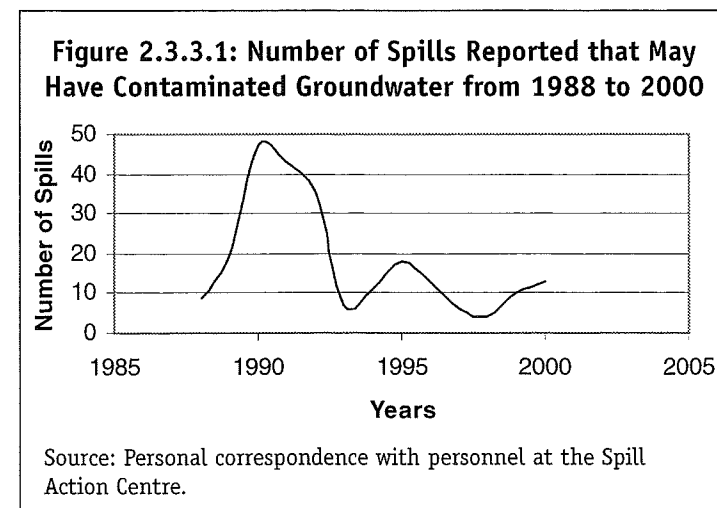
The only database that deals with quality is the **Drinking Water Surveillance Program**. Although it is not specific to groundwater, it does monitor some of those municipalities that receive their water supply from groundwater. It monitors for over 180 biological parameters.

There are approximately 399 municipal waterworks that use groundwater. The Drinking Water Surveillance Program only covers the water operations of 44 municipalities.

3.3 Databases Recording Contaminations, Complaints, Investigations, and Approvals

The provincial database on all complaints and violations under the MOE is recorded and put into the **Occurrence Report Information System (ORIS)**. Potentially, complaints and violations related to groundwater can be obtained from this database²⁵. A sample of what ORIS is used for is to record the

number of spill reported that occurred in the past few years that might have contaminated groundwater. This is shown in Figure 2.3.3.1²⁶.



Some regional offices also developed databases on their own to track complaints, investigations, and approvals. In 1993, Environment Canada reported that the Eastern Region (Kingston) had one of the most elaborate databases²⁷. It recorded all field activities including investigations into complaints, interference of water supplies, and site assessments. When this information was followed up in 2001, however, the groundwater unit (technical support staff) did not know anything about this database. Thus it is an example of the loss of institutional memory when employees leave their position and a lack of co-ordination and communication.

2.3.4 Water Well Information System

The Water Well Information System (WWIS) has become one of the most used databases in groundwater management. When a well is constructed the licensed contractor must fill out "Form 9", the well record. This record is posted onto the WWIS. The information contains:

- ⊗ the date the well was constructed
- ⊗ types of materials
- ⊗ type of water found in the well
- ⊗ casing and open hole description
- ⊗ screen description
- ⊗ pumping test results
- ⊗ final status of well

- ⊗ water use
- ⊗ method of construction
- ⊗ location
- ⊗ plugging and sealing record (if they apply)

This is not a monitoring database. The owner of the well does not have to re-check the water quality or require another pumping test. In addition, if the owner wants a water quality check after a few years, the results are not updated into WWIS. Nevertheless, MOE has used WWIS to describe groundwater availability and quality in Ontario. Furthermore, WWIS is an instrumental tool for the new Provincial Groundwater Monitoring Network. This program will be discussed in greater detail in "Future Initiatives".

2.4 Programs and Policies Implemented by MOE in the Last Few Years to Monitor and/or Protect Groundwater

For the past few years, MOE has implemented a number of programs and policies that are meant to control and/or protect groundwater resources. Most of these initiatives do not only pertain to groundwater resources but to surface water as well; the following is a list of Ministry initiatives designed to protect groundwater (some of which have already been considered):

- ⊗ Permit To Take Water (PTTW) program
- ⊗ Pesticides Monitoring in Well Water
- ⊗ Drinking Water Surveillance Program (DWSP)
- ⊗ Water Taking and Transfer Regulation (WTTR)
- ⊗ Provincial Groundwater Monitoring Network (PGMN)
- ⊗ Occurrence Reporting Information System (ORIS)
- ⊗ Adverse Water Quality Reports (AWQR)
- ⊗ Provincial Water Protection Fund (PWPF)
- ⊗ OSTAR –SuperBuild fund

Not all of these programs are active today. Some of them have been discontinued most likely due to a lack of continued funding or a loss of political interest. This section of this paper will discuss the Pesticides in Water Wells, Adverse Water Quality Reports, the Provincial Water Protection Fund, and OSTAR (Ontario Small Town and Rural) fund are discussed. Other programs were or will be discussed in other sections.

In 1985, MOE established a Provincial Pesticides Monitoring Network. Its purpose was to assess the impact of the agricultural chemicals on groundwater supplies in Ontario. It monitored for triazine groups, metachlor, alachor, and carbamates. The last paper written for this program was published in 1991.

The Adverse Water Quality Reports were a new initiative by the government which started in 2000. It requires that each regional office post violations on the web. Now Ontarians have access to information regarding violators of governmental regulations/policies; before, they had to request them through the Freedom of Information department.

The Provincial Water Protection Fund was established in 1996 for municipalities to conduct various water studies and to improve water works management. According to the Association of Municipalities of Ontario (AMO), the Provincial Water Protection Fund was a significantly lower provincial funding program for waterworks than previous programs. The largest allotment of the fund was provided in 1996 with \$96,000,000 and it steadily declined until the last year of funding \$37,000,000 in 1999²⁸. Part of the total funding in 2000 was allotted to groundwater management studies (\$4.3 million) and 34 municipalities took advantage of the funding listed below²⁹:

- 1) Burford (County of Brant)
- 2) Municipality of Centre Hastings
- 3) Town of Larder Lake
- 4) Town of Strathroy
- 5) Town of Wasaga Beach
- 6) The Corporation of Loyalist Township
- 7) Town of Erin
- 8) Village of Merrickville-Wolford
- 9) Town of Milton
- 10) Township of North Grenville
- 11) Township of Centre Wellington
- 12) County of Oxford
- 13) Township of Eldon
- 14) Corporation of the County of Huron
- 15) Township of Ottonabee-South Monaghan
- 16) Untied Counties of Leeds and Grenville
- 17) AEMOT Study Area
- 18) Stratford Public Utility Commission

) Township of North Wellington
) Town of Minto
) Town of Orangeville
) Town of Exeter
) Perth County
) Victoria County
) Township of Mapleton
) Township of Mulmur
) Township of East Garafraxa
) Township of Amaranth
) Township of Norfolk
) United Counties of Prescott and Russell
) United Counties of Stormont, Dundas, and Glengarry
) Township of East Luther-Grand Valley
) Town of Shelburne
) Town of Mono

any of these municipalities are still finalizing the reports. However, the Village of Merrickville-Wolford

and the County of Oxford have completed theirs and are available on the Web at <http://www.merrickville-olford.on.ca/m/Final%20Rpt.pdf> and <http://www.county.oxford.on.ca/groundwater/>, respectively.

In November 2001, the new Minister of the Environment, Elizabeth Côté, declared an additional \$100 million to municipalities and conservation authorities for further studies. The list of the new initiatives is available on the Ministry's website at <http://www.ene.gov.on.ca/environ/ews/111401mb2.htm>.

Some of the municipalities, which had funding in 1998, are on the new

as well. This either means that the municipalities are doing another study or they require additional funds to complete the old one.

The OSTAR (Ontario Small Town and Rural) fund was established by the SuperBuild Corporation in 2000 and is intended to last for approximately five years to help small municipalities invest and improve infrastructures.

SuperBuild Corporation was created in December 1999 for the purpose of improving infrastructure through partnerships between the public and private sectors and direct funding³⁰. The first round of funding for OSTAR was allotted in 2000 with an emphasis on infrastructure improvement particularly for water and wastewater works. There was also a small section allotted for groundwater studies. Unfortunately, SuperBuild Corporation is unsure what the emphasis will be for the next round because the government has not announced it yet.

The lifespan of policies and/or programs is varied – some survive changing governmental parties while others are discarded regardless of their importance. Table 2.4.1 summarizes the commencement and ending (if applicable) of each of the programs listed in the beginning of this section.

Table 2.4.1. Programs/Policies by MOE for Groundwater Management

Program/Policy	Commencement	End	Total Number of Years Active
Permit to Take Water	1962	Ongoing	41
Provincial Pesticide Groundwater Monitoring	1985	1989	4
Drinking Water Surveillance Program	1986	Ongoing	15
Water Taking and Transfer	1999	Ongoing	2
Occurrence Reporting Information Systems	1988	Ongoing	13
Adverse Water Quality Reports	2000	Ongoing	1
Provincial Water Protection Fund	1996	2000	4
OSTAR (groundwater)	1999	2000	1

2.5 Number of Staff Dedicated to Groundwater

The number of staff dedicated to groundwater management has fluctuated significantly in the past years. Generally the staff titles at MOE are hydrogeologists, groundwater leaders, environmental officers, and water well records clerks.

In order to track the changes in staff numbers, several methods were used. The Canadian Institute for Environmental Law and Policy (CIELAP) produced a series of reports called *Ontario's Environment and the Common Sense Revolution*, which followed the changes in staff number for the past five years. In addition, the governmental telephone directories also indicated the number of staff changes over a longer period of time.

Presently, there are 35 staff in MOE in the central and regional offices who deal with groundwater issues. This number also includes those people who have been hired on a short-term period (e.g. those who work on program implementation). In the central office, the numbers have fluctuated from as low as four to as high as nine people since 1985.

Table 2.5.1 shows the number of staff who were related to water management that have been cut in 1996. These numbers do not include a further reduction of 153 in 1997 that occurred in all fields in the Ministry.

Table 2.5.1 MOE Water-Related Staff Reductions in 1996

Area	Number of Positions in 1995	Number of Eliminated positions	Percentage Cutback
Water and Drinking Water	113	48	42
Groundwater and Hydrogeology	28	15	53
Watershed Management	12	3	25
Wastewater	15	5	33
Total	168	71	42

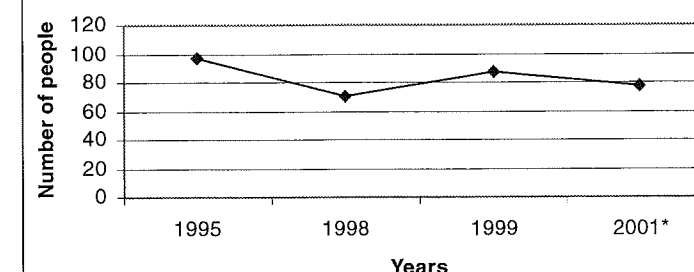
Source: CIELAP's *Common Sense Revolution: Fourth Year* report.

These large staff reductions seem most obviously related to the 45% decrease in operating budget experienced by MOE from 1996 to 1999³¹.

At a time when development and the population in Ontario are growing fairly quickly, MOE requires an adequate number of staff to effectively carry out the Ministry's mandate for an "ecosystem approach". Severe staff reductions seem to have rendered the organization unable to sustainably manage water resources. For example, staff are unable to keep up with computerization of permits to take water so that MOE can readily track up the number of permits for certain water bodies. This knowledge, if available, would have an impact on the number of permits granted.

Staff reductions also have a significant impact in the area of enforcement and prosecutions. In comparison to 1995 numbers, the size of the Investigation and Enforcement Branch has declined about 20% since 1995. Figure 2.5.1 shows the number of people in this sector of MOE in 1995, 1998, 1999, and 2001. The numbers for the first three years were taken from the CIELAP's 2000 report³² and the 2001 number was taken from the MOE on-line telephone directory.

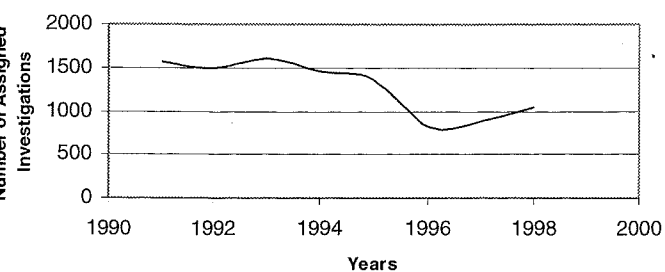
Figure 2.5.1: Population of the Investigation and Enforcement Branch



*2001 data came from the On-line MOE Telephone directory at http://www.infogo.gov.on.ca/pacweb/owa/intergtd_en.min_list?IN_GTD_SERVICE=GTD

The number staff in the Investigation and Enforcement Branch would foreseeably affect the number of investigations that could occur. Figure 2.5.2 shows the number of assigned investigation that has taken place since 1991 to 1998³³.

Figure 2.5.2: Assigned Investigations from 1991 to 1998



Source: Personal correspondence with personnel at the Ministry of the Environment.

As illustrated in both figures (2.5.1 and 2.5.2), the relationship between the two factors is quite close. In fact, the 25% reduction of people in the Investigation and Enforcement Branch between 1995 and 1998 is closely followed by a 28% drop in the number investigations in that period as well.

2.6 Future Initiatives: An ambient groundwater-monitoring program in partnership with the Conservation Authorities

By the year 2003, the province wants to establish approximately 400 observation wells that will record both water quality and quantity data. Each Conservation Authority will have approximately 10 observational wells set up for monitoring purposes.

Within the next three years several steps must be taken to implement the monitoring network.

- 1) MOE will identify vulnerable watersheds that will be monitored.
- 2) They will plot all the wells in Ontario using the Water Well Information System.
- 3) The ministry will choose the wells located around the desired monitoring area.
- 4) Conservation Authorities will go out to the field and investigate the chosen wells to see whether they are suitable.
- 5) Finally, both MOE and Conservation Authorities will instrument the suitable wells.

Presently, twenty-four Conservation Authorities have signed a Memorandum of Understanding with MOE³⁴. According to the document, the MOE has the responsibility to:

- ⊗ design the Provincial Groundwater Monitoring Network in consultation with the C.A. and local municipalities;
- ⊗ provide standards and criteria for and fund, aquifer and hydrogeological mapping where required;
- ⊗ consult with Technical Committee regarding acquisition of hydrogeological mapping, laboratory analytical services and equipment requirement;
- ⊗ administer contracts for aquifer and hydrogeological mapping;
- ⊗ confirm necessary well site locations in consultation with the C.A. and local municipalities and provide and oversee the installation of monitoring equipment
- ⊗ fund initial, comprehensive laboratory analysis in year 1;
- ⊗ identify water quality parameters for long term monitoring in consultation with the C.A. and local municipalities;
- ⊗ fund development of project data base and information management systems;
- ⊗ fund the acquisition of necessary equipment such as well data logging and data transmission equipment as required and maximize provisions for long term equipment warranties;
- ⊗ through the Information Management Sub-Committee establish protocols for data and information management;
- ⊗ undertake provincial level data analysis and reporting;
- ⊗ chair the Project Steering Committee, the Information Management Sub-Committee and the local Technical Committees;
- ⊗ develop protocols for sampling/monitoring;
- ⊗ provide for necessary staff training, e.g. sampling and equipment maintenance;
- ⊗ communicate provincial network details to stakeholders;

- ⊗ conduct periodic project audits; and
- ⊗ provide technical assistance to C.A. as needed.

In turn, the Conservation Authorities have agreed to:

- ⊗ participate in and agree to the design of the groundwater monitoring network;
- ⊗ participate in and agree to the selection of well sites and development of sample analysis parameters;
- ⊗ communicate network details to local stakeholders;
- ⊗ negotiate access to and maintain equipment at well sites;
- ⊗ be responsible for protection of well site integrity;
- ⊗ collect data and water quality samples and process in accordance with established protocol including submission to the provincial quality database;
- ⊗ collect samples for comprehensive water quality analysis (year 1);
- ⊗ subsequent to the initial comprehensive analyses, collect samples and fund analyses by accredited laboratories of water quality parameters;
- ⊗ undertake local level data analyses and reporting;
- ⊗ act as liaison with watershed municipalities where necessary to facilitate implementation;
- ⊗ participate as a member of the local Technical Committee;
- ⊗ ensure project staff are trained;
- ⊗ participate with MOE on project communication initiatives and audits; and
- ⊗ maintain and operate the equipment subsequent to year 1 for the duration of the agreement.

The MOU is a six-year contract starting at the date of signing. However, either party can unilaterally cancel the agreement by providing six months notice in writing to the other party or any period of time if both parties agree to terminate.

The \$6 million dollars allocated to the program is for capital costs only. It also includes the salaries of the three additional personnel hired on contract to implement the program at MOE. The Conservation Authori-

ties have received no additional funding but have agreed to use the Municipal Levy to pay operating costs. It is unclear what will occur after the six-year contract has ended but the Groundwater Unit and Conservation Authorities are optimistic it will continue.

There are some uncertainties within the program. It is yet unclear whether biological parameters will be measured but at the moment they will be recorded twice a year. Chemicals to be analyzed will include minerals and metals, particularly in the northern watersheds. It is also unclear whether 10 monitoring wells are sufficient to provide a representative picture of the various groundwater resources within each Conservation Authority.

The hope of this program to the Groundwater Unit and the Conservation Authorities is that the data will help in the formulation of policies regarding groundwater management.

3.0 Discussion and Conclusions

The track record of the Ontario government in the past concerning groundwater issues has not been positive. They are still operating some programs without the appropriate background knowledge (e.g. Permit To Take Water program) as to the long term effects on the resource. These poor practices can be attributed to major cutbacks in staff and funding and there has been little evidence of any recovery. Most of the civil servants in the Groundwater unit are very dedicated but overworked individuals who have positive attitudes, particularly towards the new Provincial Groundwater Monitoring Network. However, without the political will to support their enthusiasm there is little chance that much will improve.

Some of the Conservation Authorities have taken upon themselves to fill the gap in groundwater knowledge by initiating their own programs (such as water balance studies). They also work in cooperation with Ministry of the Environment to help implement programs at their own expense or to improve outdated filing systems.

Without a doubt, much of the hopes for achieving sustainable management practices are riding on the provincial Groundwater Monitoring Network (PGMN) and as yet uncommitted funding from the government for further groundwater management studies. However, as noted earlier, the government has demonstrated their lack of commitment by pulling funding away after only a few years in place. As for the PGMN, it is hard to conclude whether the new program will result in better overall management. Although they have started to implement it, there has not been any substantial funding for it. The Ministry is relying upon the Conservation Authority to pick up a good portion of the costs.

During the next few years, MOE's actions will have to be monitored with respect to groundwater issues before one can conclude that they are on the path to adopting sustainable visions and practices. It is vitally important that the public expresses their concern for the way the government has conducted groundwater management in the past. During the drought of 1998 induced by low precipitation and the Walkerton tragedy, some Ontarians have experienced what some less economically affluent countries experience every day. This province cannot afford to ineffectively manage groundwater any longer.

Endnotes

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- ²³ Personal correspondence with hydrogeologist at the Eastern Regional Office of the Ministry of the Environment on May 7, 2001.
- ²⁴ Personal correspondence with personnel at the Groundwater Unit at the Ministry of the Environment on May 11, 2001
- ²⁵ MacRitchie, S., Pupp, C., Grove, G., Howard, K.W.R, and Lapcevic, L. (1994). Groundwater in Ontario: Hydrogeology, Quality Concerns and Management. Environment Canada.
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- ²⁸ Association of Municipalities of Ontario (AMO) (2001) Financing of Municipal Waterworks: Analysis and Case Studies. Online. Available at: http://www.amo.on.ca/whats_new/Temporary/ENV01-06.pdf
- ²⁹ List of municipalities participating in the 1998/1999 Groundwater Management Studies was obtained from MOE personal in August.
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- ³¹ Winfield, M. and Jenish, G. (1999) Ontario's Environment and the Common Sense Revolution: A Fourth Year Report. Canadian Institute for Environmental Law and Policy.
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- ³³ Ontario Ministry of the Environment Head Office. Annual Enforcement Summary: Calendar Years 1991-1998. Internal document. Faxed to CIELAP on January 12, 2000.
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