PROPOSED
WALKERTON CENTRE FOR WATER QUALITY

FEASIBILITY STUDY
PHASE I (INVENTORY) REPORT

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EXECUTIVE SUMMARY

This document is a report on Phase I (Inventory) of the feasibility study for the Proposed Walkerton Centre for Water Quality. The inventory was conducted during December 2000 and January 2001 by a team consisting of Conestoga-Rovers & Associates, of Waterloo, Ontario, including its affiliated company, GAP EnviroMicrobial Services, of London, Ontario, the Ontario Centre for Environmental Technology Advancement and Mr. Douglas A. Jones.

The proposed Centre is an evolving concept being methodically developed by the Centre for Water Quality Committee (CWQC) in part as a response to the Walkerton *E.coli* water crisis. This community-oriented concept seeks to contribute to water-related community health and to the economic wellbeing of the area through job creation and related economic investment that could be stimulated by such a Centre.

The report assesses three key areas of the *status quo* of the water quality management scene in Ontario:

- Training and Certification of water system operators and water testing laboratory personnel;
- Water testing laboratories and procedures; and
- Research and Development.

Existing participants in each of the three areas are identified along with their roles in their respective areas. An overview of regulatory requirements (along with reference to other relevant policies and guidelines) is provided.

The report also discusses apparent deficiencies or gaps in each of the three areas and suggests possible measures to fill those gaps and improve upon the level of service provided by each sector. The inventory results are discussed in terms of how they may relate to the CWQC's evolving concept for the Centre for Water Quality.

Also provided in this Phase I report is a preliminary outline for a business plan for the proposed Centre for Water Quality. Preparation of a complete and comprehensive business plan can only be completed once the CWQC has considered alternative options for the structure and function of the Centre and has decided on the functions / roles to be performed and services to be provided by the Centre. In the end, the CWQC may decide that the Centre should include one, two or all three of the key areas identified

above, and may decide to include other roles/functions not addressed in the Phase I inventory.

The report lays the groundwork for Phase II (Information Analysis and Development of Alternative Options) and Phase III (Implementation) of the feasibility study.

1.0 INTRODUCTION

In May of 2000, the Town of Walkerton was devastated by an *E. coli* epidemic on a scale never before experienced in Canada. This event resulted in seven deaths and caused over 2,000 people to become ill. It has had a severe impact on the Town and its residents, not only economically but emotionally as well.

In June 2000, the Walkerton & District Chamber of Commerce, in response to this crisis, solicited ideas aimed at helping the Municipality bring some kind of positive outcome to the water tragedy. Colin Reesor, a resident of Brockton, brought forward the idea of establishing an educational centre to promote training and research regarding drinking water. The vision was that this could possibly become a world class educational and research centre, accomplished through partnerships with educational institutions, government and private organizations.

In July, 2000 a committee, the Centre for Water Quality Committee (CWQC) was formed. The committee arranged funding through Human Resources Development Canada, the Municipality of Brockton, the Saugeen Economic Development Committee (representing Arran-Elderslie, Brockton and West Grey) and the Walkerton & District Chamber of Commerce to do a feasibility study and appointed the Saugeen Economic Development Corporation (SEDC) as the organization that would manage the study.

In October of 2000 the CWQC issued a Request for Proposals to conduct a study to examine the viability of developing a Centre for Water Quality in Walkerton, Ontario.

At the outset in this report it is important to note that it is not the intent of the feasibility study or this Phase I Report to duplicate work done by the Walkerton Commission of Inquiry or any other investigations that may be underway as a result of the Walkerton tragedy. As noted in the Inquiry's *Rules of Procedure and Practice*:

> "Part II of the Inquiry is concerned with the policy issues related to ensuring the safety of Ontario's drinking water. It will involve a review of a broad range of factors which impact on the safety of drinking water including a review of the public health, technological and management factors associated with the production, treatment and distribution of drinking water as well as the contamination of source waters, where the primary focus will be on microbial contaminants capable of causing threats to public health."

That said, the Terms of Reference for the CWQC's feasibility study include the recognition that the Walkerton quality issue provides "…a meaningful opportunity for the community of Walkerton in partnership with private enterprise, government and/or educational institutions to provide leadership on this emergent issue". The goal of the study is "…to determine the viability of locating and developing a Centre for Water Quality in the community of Walkerton in the new East Ridge Business Park". The Centre, should it prove to be feasible, would "…create a world class institute that would encompass training and certification of water plant personnel, laboratory testing, research and development on water quality and educational courses".

Given the mandate for Part II of the Inquiry (referenced above) and the Terms of Reference for the CWQC's feasibility study it is evident that there may be some overlap between the feasibility study and the issues to be officially examined by other bodies as part of the Inquiry. Recognizing the likelihood for such overlap it should be noted that this study also reflects the perspective and mandate of the SEDC, a federally-funded not-for-profit corporation governed by volunteers in partnership with Industry Canada. The SEDC assists rural communities to create jobs and to expand and diversify their local economies, as well as promotes community economic development through local participation and decision-making. So, while the feasibility study and Inquiry are looking at many of the same facets of the Walkerton water quality issue they do so from differing perspectives. Notwithstanding that the two activities approach the core issue (water quality and community health and wellbeing) from different directions the respective objectives are complementary.

The SEDC serves a geographic area that straddles the interior of Grey and Bruce Counties and the northern part of Wellington County. The Corporation serves the communities of Hanover, Walkerton, Chesley, Durham, Mildmay, Neustadt, Ayton, Holstein, Clifford, Markdale, Dundalk, Chatsworth, Harriston, Arthur and Mount Forest, as well as Flesherton and the former Township of Artemesia. These communities now make up, or are part of, the amalgamated municipalities of Arran-Elderslie, Brockton, South Bruce, West Grey, Southgate, Chatsworth, Artemesia and Wellington North.

The Walkerton & District Chamber of Commerce and the Municipality of Brockton collectively represent the municipality, the businesses and the residents of Walkerton who have been directly affected by this tragedy. These groups also have a vested interest in promoting the economic and emotional recovery of the town and it's residents.

Human Resources Development Canada, specifically the Walkerton Human Resource Centre Canada (HRCC), has been instrumental in funding this study. The Centre continues to work in co-operation with the Community and various community partners in addressing local needs.

A study team consisting of Conestoga-Rovers & Associates (of Waterloo, Ontario) including its affiliated company GAP EnviroMicrobial Services (of London, Ontario), the Ontario Centre for Environmental Technology Advancement and Mr. Douglas A. Jones, was invited to carry out the study. The Team proposed, and the CWQC accepted, a three-Phase approach consisting of an Inventory of current conditions (Phase I), an evaluation of those conditions and the development of alternative options (Phase II) and an Implementation stage (Phase III).

The purpose of this report is to provide the results of Phase I (Inventory) of the three-Phase study. As will be noted Phase I addressed three key areas related to water quality and its management: (a) Training and Certification of Water System personnel; (b) Water Testing; and, (c) Research and Development. The report also introduces a framework for a Business Plan, a critical implementation component should the proposed Centre be determined to be feasible by the CWQC.

While every effort has been made to ensure that the information contained in this report is accurate and up-to-date it must be recognized that the subject matter addressed in the three key areas is in a very dynamic state and there is a very great deal of it. Not only are new data, regulations, guidelines procedures, etc., being developed by a variety of government and quasi-government agencies, research institutions, commercial entities and individuals, but the quantity of that information extant in Ontario – and much more throughout North America – is significant. The information presented in this report is, nevertheless, more than adequate to enable the CWQC to move on to Phases II and III of the feasibility study.

2.0 METHODOLOGY

As noted above the Phase I (Inventory) component of the feasibility study addressed three areas relating to water quality management in Ontario and included the preparation of a preliminary framework for a business plan. Work on the Inventory began in early December of 2000, and was completed on January 14, 2001, with submittal to the CWQC of this Phase I Report. While the Inventory focussed on the Ontario scene, references to experience/conditions in other jurisdictions are made where relevant to the Inventory.

2.1 TRAINING AND CERTIFICATION

The importance of a strong training program for owners and operators of water treatment and distribution systems cannot be understated. The best and most advanced systems in the world cannot operate themselves. The human element is a critical component of the whole water supply delivery process.

The following outlines the inventory tasks carried out by the Study Team with respect to the Training and Certification component:

Task 1 – The CRA Study Team prepared an inventory of current training programs available in Ontario through private industry and educational institutions.

Task 2 – The CRA Study Team prepared a summary of the current certification process for water treatment operators. This summary documented the certification process previously in existence under Ontario Regulation (O.Reg.) 435/93 (Appendix A), and the new certification procedures required for the analytical component by O.Reg. 459/00, adopted in August of 2000.

Task 3 – The CRA Study Team identified potential areas of improvement in the current training and certification process. These proposed improvements would be geared to meet the often-different needs of water treatment system owners, managers, operators, and the public. The CRA Study Team envisioned providing a listing of training course components that should be available to the various stakeholders.

2.2 TESTING

The provision of high quality and responsive analytical testing services is a another critical factor in a water treatment system operator's ability to ensure a safe and secure supply of potable water. Ontario does have a large number of qualified contract laboratories providing analytical services to all sectors, including water treatment operations.

The following outlines the tasks completed by the Study Team with respect to the Testing component of this Feasibility Study under Phase I.

Task 1 – The CRA Study Team prepared an inventory of existing analytical laboratories accredited to perform the relevant analytical testing methods required by water treatment plant operations.

Task 2– The CRA Study Team examined the availability of training programs for laboratory technicians and documented existing capabilities in this regard. An analysis of gaps between existing available programs and what the team believes should be available was conducted. (N.B. Some components of this training may also be required by water treatment operators that are completing the actual sampling so that the entire process from initial sampling through to final analytical reporting is completed in a secure fashion that ensures the validity of the analytical results).

Task 3 – The CRA Study Team provided a description and assessment of current testing methodologies for water quality parameters relevant to water treatment plant operations, especially *E.coli*, and determined where current research is being directed.

2.3 RESEARCH AND DEVELOPMENT

Many organizations and institutions (especially universities) conduct water quality-related Research and Development (R&D). Within the R&D field, however, there may be opportunities to enhance current activities and to promote new activities through education and information exchange between the stakeholders in the water treatment industry (e.g., system owners, operators, municipalities, the public) and the academic world that completes much of the R&D work.

The following outlines the inventory work of the Study Team with respect to the Research and Development component of this Phase I inventory.

Task 1 – The CRA Study Team identified existing Research and Development facilities in Ontario that are focussed on aspects that relate to the water treatment field. This inventory also considered R&D activities that are directed to water quality and safety issues, including:

- water source integrity (surface and groundwater);
- farm nutrient practices;
- septic systems; and
- municipal wastewater treatment facilities.

2.4 BUSINESS PLAN OUTLINE

A draft outline for a business plan was prepared using a number of sources as background information. These sources included the personal experience of Team members, Provincial and Federal government business assistance resources (internet-based and printed materials) and examples of previously-prepared business plans.

The draft outline, found in Section 6.0 of this report, presents suggested areas / subjects that should be addressed by a business plan that may be developed in Phase III, if and when the CWQC is satisfied of the feasibility of the proposed Centre for Water Quality.

2.5 RESEARCH METHODS

With regard to inventory methods key members of the Inventory Team collaborated on a very compressed timetable to assemble information from a variety of sources (referenced throughout the report) and, drawing upon personal experience and expertise, assembled, sorted and collated that information. Tools used included personal communication, telephone and fax and, most significantly, Internet databases, augmented by CRA's extensive in-house technical resources. Frequent and regular e-mail communication enabled the rapid transfer and assembly of information. A list of personnel contacted during this study is provided in Appendix B. Internet web addresses that were used throughout the study can be found in Appendix C.

3.0 INVENTORY RESULTS

As can be seen in the following there is a substantial body of information pertaining to water quality management in Ontario. A summary of such information relating to the three key areas of the Inventory is presented in the following sections. Where appropriate copies of documents referenced in the text are attached to this report as appendices. Other documentation relating to the new Drinking Water Standards has been provided as a separate document accompanying this report. Where it has been deemed impractical to append major documents or other bodies of information (e.g., website resources) the reader is provided with references (e.g., website addresses and links/pathways) to those resources. For the purposes of this report the intent has been to provide the most directly relevant information to assist the CWQC in making its decisions under Phases II and III.

3.1 TRAINING AND CERTIFICATION

3.1.1 HISTORY OF TRAINING PROGRAMS IN ONTARIO

The Ontario Water Resources Commission (OWRC) was originally responsible for training water treatment operators until that function was transferred to the Ministry of the Environment (MOE), Training section. In 1979, the MOE established a training centre in Brampton, Ontario providing a number of courses including water treatment operator certification. These courses were subsidized by the government of Ontario and, as a result, cost $40 per person per course. Approximately 2000 people per year went through the centre's water treatment courses alone. Operators from municipalities and Public Utilities Commissions across Ontario attended courses offered by the centre. Because courses were subsidized and therefore inexpensive for users, a high attendance rate was achieved, and operators from all classifications of facilities participated.

Five training officers were hired by the MOE to instruct the classes offered at the Brampton training centre. Subject areas covered at the Brampton facility included: water, wastewater, solid waste, engineering design and, air and noise. Roles of the training officers included increasing the standards of the courses, and the skills of the students in areas of math, chemistry and biology.

By all accounts the Brampton facility was working very well. The centre had qualified instructors, standardized courses, good course content and high attendance. When the Ontario government started to cut back on spending during the mid-80s, one of the first areas hit was training. The MOE training section could no longer subsidize the courses

for the Brampton centre. By 1987 the Brampton training facility could no longer function and had to close. The MOE turned over responsibility of training to community colleges and transferred to the colleges (at no cost) all the information and materials (e.g., course curricula, books, etc.) necessary to provide the courses. Without a subsidy, however, colleges were required to charge $300 per person per course.

During the first couple of years water treatment operators signed up for college courses to improve their skills. But operators did not need to go for a course every year; once they were trained there was not enough demand for each college to offer the same water treatment operator courses. As enrollment dropped, the colleges were not making enough money to hold the programs and they reduced their availability or stopped offering them altogether. For the colleges it was a matter of supply and demand: from their point of view it was apparent that there were not enough water treatment operators in Ontario to justify keeping all the courses running at all the colleges offering them.

When colleges were given the responsibility of training water treatment operators they had to get technical experts to instruct the courses, and some of the experts were not always trained as adult educators. This was often reflected in the quality of the courses offered at some colleges.

Around the same time that the MOE transferred the training responsibility to the colleges, the ministry also handed over responsibility of the water treatment plants it was operating. The Ontario Clean Water Agency (OCWA) was created on November 15, 1993 under the Capital Investment Plan Act with a mandate to provide reliable water and wastewater services to Ontario municipalities on a cost-recovery basis.

Training resources from the Brampton centre were also given to the OCWA, and it was mandated to train municipal water system operators, even in those plants OCWA itself was not responsible for. Unfortunately it took OCWA a year, following its formation before a training system was in place for either its own employees or its municipal 'client' operators.

Public Utilities Commissions (PUC) make up another group of bodies that operate water treatment plants throughout Ontario. Training of operators for those water treatment systems is up to the PUCs themselves, and in the past training has been limited in many cases.

During the 1980's the Ontario government decided to use the certification exams themselves as a source of revenue, but the revenue generated did not cover the costs

associated with administering the exam process (office, salaries, etc.). As a result the government decided to hire another organization (the Municipal Engineers Association) to run the certification office and exam process.

3.1.2 CURRENT TRAINING PROGRAMS IN ONTARIO

Water Treatment System Operators are not required to take any one particular course or training program to obtain their certification. If an operator wants to further his/her education or needs education as part of requirements for certification, there are courses currently offered through private companies and colleges/universities. Courses offered by private companies for Water Treatment System Operators are listed on the Ontario Environmental Training Consortium (OETC) website, and are found in Appendix D to this report. There are 11 suggested trainers/companies listed by the OETC and they are:

- Lexicon Environmental Consulting Services Inc. (Oakville);
- Canadian Enviro-Courses (Bracebridge);
- Electrical Utilities Safety Association (Mississauga);
- Environmental Training Institute (Fonthill);
- Heath Consultants Ltd. (London, Toronto);
- Ontario Good Roads Association (Mississauga);
- Pennsylvania State University (Pennsylvania);
- Tangible Skills Training (Milton);
- Technical Learning Courses (Cambridge);
- Western Lake Ontario Training & Certification Group (SW municipalities); and
- California State University (Sacramento).

Course preparation and content are left up to the individual company to develop and present. Courses vary in length from one day to four days. There are correspondence courses offered by California State University (Sacramento) that equal 9 Continuing Education Units (CEUs) or 90 hours.

The qualification of each trainer varies depending on his/her experience as a water treatment system operator and his/her ability as an adult instructor. A summary of each company and its trainer(s) is listed below:

LEXICON Environmental Consulting Services Inc.

Courses are given by Mr. Hany Jadaa, C.Chem., M.Sc.Eng. He was asked by OETC at the end of May 2000 to show them his work and training modules for its review. The OETC liked his courses and he was then put on their trainers list. He has worked with OETC to develop a Water Quality Analyst course and will start offering it in January 2001. Mr. Hany will travel to a location if required to give courses. In the past he has trained personnel in the Region of Hamilton-Wentworth water treatment and wastewater treatment plants.

Canadian Enviro-Courses

Mr. Dave Durant is the instructor of these courses. Many sources have said that he offers the best Chlorination courses in Canada. He is willing to travel to deliver the courses throughout Ontario. Mr. Durant has been instructing these courses for the past 12 years. He has experience with chemical delivery systems, and is a Professional Engineer (chemical).

Electrical Utilities Safety Association

The Electrical Utilities Safety Association (EUSA) provides training for the electrical trades, including the Public Utilities Commissions. Since the PUCs became responsible for water and electrical components, the EUSA started to offer courses related to water.

Environmental Training Institute

This company, represented by Mr. Peter Van Caulart, has been offering courses for water treatment operators for the past 12 years. Mr. Van Caulart is willing to travel to the students and train in their location if required. Mr. Van Caulart worked in the training section of the MOE and was responsible for the water treatment operator training courses when MOE still offered them. He also developed training courses for Sheridan College when the community colleges offered the program after MOE handed it to them. Recently he has developed a Water Quality Analyst course and is offering it in January 2001.

Heath Consultants Ltd. – Safety Training

This course is focused on confined space training. The instructor is a past MOE employee who has experience working with safety issues. Most of the courses offered by this company are safety related.

Ontario Good Roads Association

Ontario Good Roads Association (OGRA) instructs courses primarily for road superintendents. There is a road school at the University of Guelph where the association teaches how to paint roads, lay and repair asphalt, install and maintain road signs, etc. Approximately 4 years ago the OGRA saw an opportunity to provide water system operator training since water pipes run under and along the rights-of-way of its members' roads. The staff at OGRA do not teach the water courses themselves; instead they get local experts from each location where the course is being offered.

Pennsylvania State University

Philips Utilities was running a water treatment plant and decided to look for training companies in the USA to develop ties. Pennsylvania State University courses are listed on the OETC site with dates "To Be Announced" (TBA), but the university has not given a course for the last 5 years. The university's website states: "The Wastewater Biology courses in Canada have been cancelled". Therefore this trainer should not even be listed on the OETC site.

Tangible Skills Training

Mr. Jim Williams is responsible for these courses. He is a former employee of the MOE and has experience as a water treatment operator. Tangible Skills Training runs courses in conjunction with Technical Learning Courses. The listings on the OETC website are misleading because it looks like each company is offering the course. In fact the companies are offering them jointly.

Technical Learning Courses

Mr. Peter Fowler runs the courses offered by Technical Learning Courses with Tangible Skills Training. He has direct experience in plant operation and has developed training courses for water treatment system operators.

Western Lake Ontario Training & Certification Group

When OCWA did not offer the training to all municipalities, some municipalities took their own action. Large municipalities grouped together to form their own training (Durham, Metropolitan Toronto, Halton, Hamilton-Wentworth, Niagara and Windsor). They ran their own courses with their own staff, and even produced a couple of books.

In the last 4 years such training has been significantly reduced or eliminated, and some of the municipalities have asked Environmental Training Institute to teach their staff.

California State University (Sacramento)

The University received grants to produce books on water treatment. According to some sources the books published are the best books ever written on water treatment. Correspondence courses are offered through the university and include the contents of their books. The content of the courses is excellent and on completion of the course a successful student receives a certificate. Not everyone takes these courses because they are offered only by correspondence. These courses give a high number of Continuing Education Units (CEU) if you complete them, making the program attractive to the operator. Being an American institution, the math units are not in metric, whereas operators working in Ontario are familiar with metric units and understand metric. If an Ontario student has any questions or needs technical assistance during a correspondence course, he/she must contact the Environmental Training Institute.

Course descriptions are available for most of the OETC-suggested courses and are attached as Appendix E.

Community colleges in Ontario also offer water treatment courses usually as part of a technologist/technician program. Normally these courses are available only for students enrolled in that specific program and are usually offered in their second and/or third year. There are 15 colleges across Ontario currently offering water treatment courses for this calendar year. They are:

- Algonquin - Nepean;
- Conestoga - Kitchener;
- Confederation – Thunder Bay;
- Fanshawe- London;
- Georgian - Barrie;
- Humber - Etobicoke;
- Lambton - Sarnia;
- Loyalist - Belleville;
- Mohawk - Hamilton;
- Niagara - Welland;
- Sault - Sault Ste. Marie;

- Seneca – North York;
- Sheridan - Oakville;
- Sir Sanford Fleming - Peterborough; and
- St. Lawrence - Kingston.

Ryerson University, located in Toronto, offers a water pollution course as part of its Civil Engineering degree, as do most other universities. Given the limited nature of such training relevant to this Phase I Inventory other universities were not looked at in detail. Course descriptions for water treatment-related courses offered at the community colleges and Ryerson University are attached to this report as Appendix F.

3.1.3 TRAINING REQUIREMENTS

Although there are no courses for water treatment operators that are specifically designated / required for certification, there is a requirement for each operator to complete a certain number of training hours per year. O.Reg. 435 / 93 requires owners to provide every operator with 40 hours of training during every 12-month period. The owner may use any type of training period (i.e., calendar or fiscal year) as long as it is consistent for all employees. Consequently training periods vary widely among water system operators. Training may include formal classroom training, hands-on training, conferences or seminars. It can include training on new or revised operating procedures, reviews of existing operating procedures, safety training, computer training and training in related environmental / technical areas.

Staff who are employed on a part-time basis are still required to receive training each year. Training for part time staff may be pro-rated, on the following basis:

Actual Operating Hours/Week	***Hours Training Required/Year***
>20	40
15-20	30
5-19	20
<5	10

3.1.4 HISTORY OF WATER TREATMENT OPERATOR CERTIFICATION

The MOE developed a certification program more than 30 years ago based on a model used in the United States. Most provinces in Canada have developed licensing

programs based on this model, and are still using it today. Since 1972 the Association of Boards of Certification (ABC) offers this model in the USA and provides guidance and resources to certification authorities across North America. Ontario is a testing service client of ABC and pays ABC a fee to use the exams.

When a certification exam is written in Ontario each person writing the exam must pay a fee and some of this goes towards the fee from ABC. The benefit of having this licensing program is that operators are certified equally across North America. If water treatment operators move from one province or state to another, when they apply for their certification in the new location they may not be required to write the exam (same exam standards if given by ABC). More information on ABC can be found in Appendix G.

In 1986 the head of the MOE training and certification section, who was also the Ontario representative for ABC at that time, created the voluntary certification program. Under this program water treatment operators were encouraged to voluntarily seek training and write certification exams. Many water treatment system operators who had years of experience felt they should not have to take training or write exams to become certified.

As a result a "grandparenting" provision was created in 1990. It was a limited time program allowing operators to become licensed at the level of their facility, without meeting the education and examination requirements. Operators were still required to meet the experience requirements.

Under the voluntary certification program, grandparenting was granted to those operators who applied before October 1, 1990 and who met the required years of experience. Because it was voluntary not everyone applied for this certification.

In 1993, the Ontario government changed the voluntary certification program to a mandatory program through O.Reg. 435/93, under section 75 of the Ontario Water Resources Act (see Appendix H). When this happened, people who had not applied for voluntary certification under the grandparenting provision decided they then wanted it. A second Phase of grandparenting took place and the deadline for that was February 1, 1994. Operators who were grandparented under this program were required to write an exam at the level of their license, but if they did not pass the exam they were issued a license of one class lower when they renewed.

If an operator of a plant was grandparented he/she was licensed to work only in that plant, and could not switch to another without being certified for the new facility. By comparison, the advantage of going through the regular certification process was that an operator's license was valid at all Ontario plants of similar class.

3.1.5 CURRENT WATER TREATMENT OPERATOR CERTIFICATION PROCESS

Representatives from associations and bargaining agents active in the water industry sit on a body called the Advisory Committee on Water/Wastewater Operator Certification. The committee's role is to advise the Minister (MOE) on policy issues and individual operator concerns. The committee meets 2-3 times a year to discuss these issues. Its last meeting was held in September 2000. Presently operators are not members of the committee but concerns have been raised that there should be operator input on the issues discussed by the committee. During the past few committee meetings the main focus of the discussions has been on how to include operators on the committee. The committee's plans are to hopefully have operator representation on the committee by the end of this year (2001).

The Ontario Environmental Training Consortium (OETC) which operates under the umbrella of CON*NECT (the Colleges of Ontario Network for Education and Training), is contracted by and responsible to the MOE for the certification of water treatment operators in Ontario using the ABC model. The OETC is located in Brampton, Ontario, where it has an office with 4 certification staff. The OETC administers and is responsible for facility classifications, water treatment operator certification exams, license renewals, and providing study materials for certification exams.

The OETC certification office issues all certification exams. Operators may write examinations one class higher than the class of licence that they hold, and can only obtain a licence one class higher than the classification of the facility they operate in. Licenced operators and classified facilities receive copies of the "Ontario Certification News Letter" which notifies operators of scheduled examinations. Certification exams are held in the spring and fall at: Barrie, Belleville, Kenora, Kingston, London, North Bay, Ottawa, Sault Ste. Marie, Sudbury, Timmins, Thunder Bay, and Windsor. Exams are also held at Humber College in Toronto on the third Monday of each month, except during July and August. A list of exam dates and locations is found in Appendix I.

A facility owner may also request that an examination be held on-site, which involves an invigilator who is approved by the MOE. However, due to limited staff resources, the Certification Office can accept only a minimal number of special exams per year and they are on a first come, first served basis.

An operator must apply to write an exam through the Certification Office. This involves sending a completed "Examination Request Form" (Appendix J) and payment at least four weeks prior to the examination date requested. Examination fees and associated costs are listed in Appendix K.

3.1.6 STUDY MATERIALS

The OETC Certification Office has developed a list of recommended study materials for operator licensing exams. Most of the materials are available for a cost varying in range from $20 – $75 A list of prices is shown in Appendix L. There are three study material items that are provided by the Certification Office free to the operator: the Resource Guide, Operator-Need-To-Know, and the Secrets to Success video. The Resource Guide was not available from the Certification Office, but the Need-to-Know publication is attached to this report as Appendix M. A copy of the video accompanies this report separately. Also available from the OETC office free of charge is a Program Guide (Appendix N) which provides much of the same information that is available on the OETC website.

Other study materials that are available through the OETC office include:

- Operator-In-Training Examination Study Guide;
- Alberta Water & Wastewater Operations Manual Level 1;
- Alberta Water & Wastewater Operations Manual Level 2;
- Operation and Maintenance of Wastewater Collection System Volume 1;
- Operator Certification Study Guide;
- Certification Study Guide for Wastewater Treatment Personnel;
- Certification Study Guide for Collection Systems Personnel;
- Mathematics for Water and Wastewater Operations; and
- California State University Correspondence Courses.

3.1.7 FACILITY CLASSIFICATION

The first step in the licensing process is the classification of the water treatment system. An operator may not obtain a license until the facility has been classified as a Class I, II, III, IV, or Small Water System (six residential units or less). This study does not cover the Small Water System operators. Each facility is classified on the basis of several

factors such as size (i.e., capacity), population served, process and technological complexity, and the state of the water source. As the facility increases in complexity and size, the Class designation also increases. Appendix O shows the tables used to calculate the classification of a facility.

In Ontario there are currently 554 water treatment plants with a Class I to IV certificate of classification. (This list does not include 91 "Small Water Systems"). These plants vary in size and complexity. At the time of this report (January, 2001) the classification breakdown of Ontario water treatment plants is:

- Class I facilities – 262 (47.3 %);
- Class II facilities – 145 (26.2 %);
- Class III facilities – 100 (18 %); and
- Class IV facilities – 47 (8.5 %).

The Ontario Clean Water Agency currently operates 190 (i.e., 34%) water treatment plants in Ontario, varying from Class I to Class IV.

3.1.8 POSITIONS IN A WATER TREATMENT PLANT

Water treatment operators require certification in order to work at a water treatment plant. There are, however, designated positions at many plants which are independent from the certification requirements. Examples of these positions include: the owner, the Operator-in-Charge, and the Operator in Overall Operational Responsibility. Roles and responsibilities for each of these positions are defined in O.Reg. 435/93 and are described below.

Owner

Under the *Ontario Water Resources Act* an owner is defined as "a municipality or person having the authority to construct, maintain, operate, repair, improve or extend water works or sewage works". ("Director" is defined under the OWRA as an employee of the Ministry of the Environment appointed by the Minister to carry out various duties.)

Facility owners have been given a number of responsibilities under the regulation. These include:

- filing an application with the Director for the classification of the facility;
- ensuring that every operator holds the appropriate licence applicable to that type of facility or a licence as an operator in training;
- ensuring that responsibility for the overall operation of the facility is placed with an operator who holds a licence that is applicable to that type of facility, and that is of the same class as or higher than the class of the facility. The owner of the facility cannot permit responsibility for the overall operation of a facility to be placed with an operator who holds an Operator-In-Training licence;
- notifying the Director without delay if the owner relies on a temporary substitute for more than 60 days in any twelve month period;
- ensuring that the classification certificate is conspicuously displayed at the facility or at premises from which the operation of the facility are managed;
- ensuring that a copy of the licence of every licensed operator who is employed in the facility is conspicuously displayed at the operator's workplace, or at premises from which the operation of the facility is managed;
- ensuring that operators of a facility have ready access to comprehensive operation and maintenance manuals that contain plans, drawing and process descriptions sufficient to the safe and efficient operation of the facility. The owner shall ensure that the manuals are reviewed and updated at least once every two years;
- ensuring that records are maintained for the amount of time each operator works as an operator in charge;
- ensuring that logs or other record-keeping mechanisms are provided to record information concerning the operation of the facility;
- ensuring that logs and other record-keeping mechanisms are accessible in the facility for at least two years after the last entry; and
- ensuring that every operator employed in the facilities is given at least forty hours of training every year, and that records are kept of this training.

Operator-In-Charge

An operator-in-charge is defined by O.Reg. 435/93 as an operator who:

- has responsibility for the overall operation of a facility;
- sets operational parameters for a facility or for a process that controls the effectiveness of efficiency of a facility; or
- directs or supervises operators in a facility.

The operator-in-charge shall:

- take all steps reasonable necessary to operate the processes within his or her responsibility in a safe and efficient manner in accordance with the relevant operations manuals;
- ensure that the processes within his or her responsibility are measured, monitored, sampled and tested in a manner that permits them to be adjusted when necessary;
- ensure that records are maintained of all adjustments made to the processes within his or her responsibility;
- ensure that all equipment used in the processes within his or her responsibility is properly monitored, inspected and evaluated and that records of equipment operating status are prepared and available at the end of every operating shift; and
- record the required information in the logs or other record-keeping mechanisms in respect of each operating shift.

Operator in Overall Operational Responsibility

An owner must ensure that an "operator in overall operational responsibility" has been designated. This operator must be licensed to the class of the facility or higher. This requirement ensures that knowledgeable, experienced staff are available at all times to provide advice to any plant operator and to respond to any emergency.

If the operator responsible for overall operation is absent or unable to act, responsibility for the overall operation of the facility may be placed with an operator who holds a licence that is not more than one class lower than the class of facility.

3.1.9 CLASSIFICATIONS OF OPERATORS

There are 4 classes of operator licences plus an Operator-In-Training licence for Ontario Water Treatment Plants. Each Class has certain criteria that must be fulfilled before certification is granted. These criteria are explained in full in O.Reg. 435/93. A summary of each certification requirement is provided below.

Operators-in-Training

1. Must have completed Grade 12 in Ontario or have educational qualifications that the Director considers equivalent.

2. Must have obtained a mark that the Director considers satisfactory in an examination approved by the Director (relating to functions performed by operators in training).

Class I Operators

1. Must have completed Grade 12 in Ontario or have educational qualifications that the Director considers equivalent.
2. At least one year experience as an operator in that type of facility.
3. Must have obtained a mark that the Director considers satisfactory in an examination approved by the Director (relating to functions performed by operators with Class I licenses for that type of facility).

Class II Operators

1. Must have a Class I or Class II operator's licence for that type of facility.
2. Must have completed Grade 12 in Ontario or have educational qualifications that the Director considers equivalent.
3. Must have at least 3 years experience as an operator in that type of facility.
4. Must have obtained a mark that the Director considers satisfactory in an examination approved by the Director (relating to functions performed by operators with Class II licenses for that type of facility).

Class III Operators

1. Must have completed Grade 12 in Ontario or have educational qualifications that the Director considers equivalent.
2. Must have successfully completed at least two years of additional education or training that, in the opinion of the Director, is relevant to the functions performed by operators of facilities.
3. Must have at least four years experience as an operator in that type of facility, including at least two years as an operator-in-charge in a Class II, Class III, or Class IV facility.
4. Must have a Class II or Class III operator's licence for that type of facility.
5. Must have obtained a mark that the Director considers satisfactory in an examination approved by the Director (relating to functions performed by operators with Class III licenses for that type of facility).

NOTE: For the purpose of meeting the education and training qualification, an applicant may substitute up to one year of experience as an operator-in-charge in a Class II, Class III or Class IV facility for the equivalent length of education. This experience shall not be used to meet the requirement of two years as an operator-in-charge in a Class II, Class III or Class IV facility.

Class IV Operators

1. Must have a Class III or Class IV operator's licence for that type of facility.
2. Must have completed Grade 12 in Ontario or have educational qualifications that the Director considers equivalent.
3. Must have successfully completed at least four years of additional education or training that, in the opinion of the Director, is relevant to the functions performed by operators of facilities.
4. Must have at least four years experience as an operator in that type of facility, including at least two years as an operator-in-charge in a Class III or Class IV facility.
5. Must have obtained a mark that the Director considers satisfactory in an examination approved by the Director (relating to functions performed by operators with Class IV licences for that type of facility).

NOTE: For the purpose of meeting the education and training qualification, an applicant may substitute up to two years of experience as an operator-in-charge in a Class III or Class IV facility for the equivalent length of education. If an operator substitutes operator-in-charge experience for education/training qualifications it must be time worked in that position additional to the required two years.

Experience/Education Substitutions

Some substitutions are permitted for the operator's requirements. Substitutions may be made for up to one-half of the experience requirements for class II, III, or IV licences. Similarly there are some substitutions permitted for up to one-half of the post secondary education or training requirements for class III, or IV licences. The following information is a list of the substitutions that is considered when granting certification.

Experience Substitutions

Experience gained in other jobs may help an operator perform their duties. The Licensing Program recognizes other types of experience, based on the following rules.

Class I	No substitution permitted. (This will ensure that a Class I operator has actually worked in the type facility for which he/she has a licence.)
Class II, III or IV	Substitution may be made for up to one-half of the required experience. For example, a Class II licence requires 3 years of operating experience. An operator may substitute up to 1 1/2 years of those 3 years.

Eligible substitutions are listed below:

a. Relevant formal post secondary school education (Community College, Trade School, University) may be substituted for operating or OIC experience. One year of post secondary education is equal to one year of experience or 45 CEU's (1 CEU equals 10 hours of training).

b. Specialized operator training courses, seminars, workshops, technical conferences or in-service training may be substituted for experience requirements. All training must be verified by a certificate, transcript, or letter from the trainer.

c. Partial credit toward operating experience may be given for experience in other types of facilities, or in other job functions within a facility. For example, some operating experience in wastewater treatment plant can be used to apply for a Class II, III or IV water treatment plant. Other allowable substitutions include laboratory work, maintenance work, or other specified trades.

NOTE: Any education used to meet the experience requirement cannot be applied to meet the educational requirement.

Education Substitutions

Operating experience may be used to partially meet the education requirements.

a. A year of operating experience may be substituted for two (2) years of grade school, without limitation.

b. A year of operating experience may be substituted for one (1) year of secondary school, without limitation.

c. A maximum of one (1) year of OIC experience in a Class II (or higher) facility may be substituted for one (1) year of post secondary education to meet the Class III education requirement.

d. A maximum of two (2) years of OIC experience in a Class III (or higher) facility may be substituted for two (2) years of post secondary education to meet the Class IV education requirement.

NOTE: Any experience used in substitution for educational requirements cannot also be applied to meet the experience requirements.

The above education substitutions would allow an operator to obtain Class IV experience with a minimum of 2 years (90 CEUs) post secondary education/training, provided the operator has enough OIC experience.

Experience Exemption of Professional Engineer

A Professional Engineer accredited in Ontario, may obtain a licence without meeting the necessary operating experience requirements. In order for the experience to be waived the professional engineer must obtain a mark of 85% or higher on the appropriate operator licensing exam.

3.1.10 IDENTIFICATION OF OTHER STAKEHOLDERS

Although the individuals working in a water treatment plant have responsibility to ensure that drinking water is safe for consumers, there are other important stakeholders in this process. One key group of stakeholders that has been identified during this study is farmers; others may include: RV/campground owners, individual well owners, municipal councils, PUC commissioners, Health Unit staff, conservation authority members, etc. Agricultural practices conducted by farmers have the potential risk of indirectly affecting the quality of drinking water. As a result, this inventory has included the collection of data relating to existing courses, seminars and literature for farmers, and makes some recommendation on areas of additional training/education for them.

The Agricultural Adaptation Council (AAC) is a coalition of 47 agricultural, agri-food and rural organizations, incorporated in 1996 to administer Ontario's share of the

Canadian Adaptation and Rural Development (CARD) Fund. One CARD Fund project that started in 1998-99 was the Ontario Rural Wastewater Centre. The purpose of this Centre is to teach representatives from municipalities and agricultural operations as well as individual homeowners about the basics and the latest in wastewater treatment options. More details on this Centre and the research associated with in can be found in Appendix P.

The Federal Government has recently completed a "Nutrient Report" and it is currently being printed. Once printed, this report will be available to the public and will contain valuable information to help educate farmers on current problems associated with agricultural practices (mainly nutrient applications).

The Ministry of Ontario Agriculture, Food and Rural Affairs (OMAFRA) has "Proposed Standards for Agricultural Operations in Ontario" which are in the process of approval and are planned for release early in 2001. More details on these agriculture operations standards can be found in Appendix Q.

OMAFRA has published a series of publications (free to all Ontario farmers) called "Best Management Practices" (BMPs), directed toward the agriculture / rural population. A list of existing BMPs is provided in Appendix R.

Reference material has also been developed by other government departments such as Health Canada and Agriculture and Agri-Food Canada. A list of available literature is found in Appendix S.

OMAFRA is presently helping rural communities deal with rural water issues through the "Healthy Futures for Ontario Agriculture" program. This program is funded by $90 million of provincial money to support projects relating to watershed concerns. More information can be found in Appendix T and on the OMAFRA website.

OMAFRA is offering courses to farmers on the "Fundamentals of Nutrient Management Planning" and "Nutrient Management Planning- Applications Using Nman 2000". Details of the course descriptions, cost, dates and locations are found in Appendix U.

3.2 WATER TESTING

3.2.1 INVENTORY OF EXISTING LABORATORIES

Prior to the implementation of the Ontario Drinking Water Standards in August 2000, there were no requirements for laboratories conducting water analysis to be accredited. Therefore, clients had no way of knowing if the laboratories were conducting correct sample analysis. The Ontario government currently requires any laboratory testing municipal water samples be accredited (a list of all accredited labs is attached as Appendix V). The Canadian Association of Environmental Analytical Laboratories (CAEAL) offers a certification program for water testing labs, and will assist laboratories in developing sound, scientifically-based, quality assurance procedures.

3.2.2 TRAINING PROGRAMS FOR LABORATORY TECHNICIANS

Currently, most college and university science programmes offer a general education on basic scientific principles, which is an important first step in training scientists for water testing. The following is a list of colleges that offer courses or programs for laboratory technicians. Details on course programs can be found in Appendix F:

- Cambrian College
- Conestoga College
- Confederation College
- Mohawk College
- Georgian College
- Loyalist College
- Sir Sandford Fleming College
- Sault College
- Royal Military College
- Algonquin College
- Canador College
- Centennial College
- Durham College
- Fanshaw College
- Humber College
- Lambton College
- Niagara College
- St, Clair College
- Seneca College
- Sheridan College

A broad scope of training is an advantage for future learning, and to create better scientists. Most individuals working in laboratories specialising in water testing have obtained training through job experience. There are no training centres available that offer a broad range of courses for laboratory personnel focussed on water production practices and testing. For this reason, it would be of great advantage to develop a centre that could provide these training programmes.

3.2.3 CURRENT TESTING METHODOLOGIES

To ensure the safety of potable water supplies, microbial water quality testing must be performed as defined by the Ontario Drinking Water Regulations. Contamination of water is assessed by testing for indicator bacteria, including coliforms, *E.coli* and heterotrophic bacteria. It is the responsibility of the laboratory conducting the analysis to ensure that the test methods and reporting systems are conducted properly. This is necessary not only to obtain the proper laboratory accreditation, but also to ensure that clients are receiving the best analysis available. To provide a high quality of analysis, a large number of factors need to be considered and monitored. This includes ensuring that the methods used are the most accurate and sensitive available. Quality control and quality assurance (QC/QA) procedures on each step of the analysis must be performed to ensure reliable results are obtained. Other tasks include provision and quality control of sample bottles, accurate sample reception, and rapid and proper reporting of results to the appropriate authorities. The responsibility to conduct these procedures must be defined, understood and endorsed at all levels of the company, including directors, managers, technicians and administrators.

3.3 RESEARCH AND DEVELOPMENT INVENTORY

The objective of this section is to provide an inventory of research and Development (R&D) facilities and activities relevant to water quality in Ontario. The purpose of the inventory is to identify existing R&D facilities and activities in Ontario that relate to water treatment, water quality and safety issues, including:

- water source integrity (surface and groundwater);
- farm nutrient practices;
- septic systems; and
- municipal wastewater treatment/facilities.

This inventory also includes information about research centres having current or recent activities on new technology development, equipment, or process applications for water treatment.

The R&D Inventory has been produced in a spreadsheet format to allow a review from the viewpoint of several areas of interest. In the overall view, R&D INVENTORY LIST 1, (following text) the Research Topics are listed alphabetically. Important subtopics are identified, particularly where a research centre may have projects in only

one subtopic, rather than the more general main topic. Non-academic R&D centres (government and private) are listed in the next column and the university research centres are in the next column. For the R&D Centres, the main responsible body is identified followed by the name of the division or sector. The semi-colon punctuation indicates a new name of an R&D Centre. Occasionally a consortium that sponsored the research is identified, even though not all members have research facilities. The university research centres listed under the university column are usually separately involved in research on the topic named, but may also be participating in the R&D of the "non-academic" group.

The five bulleted water quality issues are listed in separate columns, and where the issue applies, then the entry in that column is the number at the top of the column.

The source of the information is usually the website of the identified Research Centre. A website list is provided in Appendix C. Information from OCETA's databases, files, and staff and personal interview with contacts were also used. The material reviewed has been extensive, and a very broad overview has been presented here. Within the scope of Phase 1 of this project, detailed review of the nature of the research projects has not been possible. Therefore the inventory may have some omissions where universities and/or other research centres may have activity in some research topics, but are not listed.

4.0 DISCUSSION OF INVENTORY RESULTS

The purpose of this section is to discuss the inventory results presented in Section 3.0, to provide a comprehensive overview or "snapshot" of the *status quo* of the water quality management scene in Ontario. In addition to the discussion of results qualitative comments are offered on several aspects of the data, particularly where there are apparent deficiencies or gaps in the provision of training, certification, water quality testing and R&D activities.

The intent is not to analyze the information (that activity will be vigorously pursued in Phase II – Analysis of Conditions and Development of Alternative Options).

4.1 TRAINING AND CERTIFICATION

There are many courses that an operator could benefit from in order to do his/her job better. A full-time education/training program, consistently applied across Ontario, could be developed to give operators the necessary training. As the operator progresses in responsibilities, specialized courses could be developed getting into more details. The key issues with the area of Training and Certification appear to be:

- consistency of course material/curriculum;
- consistency/qualifications of trainers;
- ready availability of training courses across Ontario;
- high costs of course fees; and
- frequency/regularity of (and requirements for) upgrading.

4.1.1 HISTORY OF TRAINING PROGRAMS IN ONTARIO

Different groups have provided training for water treatment operators over the years. The MOE developed training programs and courses for water treatment operators and established a training centre. Courses offered by the MOE were subsidized making them affordable for everyone, resulting in good attendance. The instruction and content of these courses were overseen by the ministry and maintained to a certain standard. There was consistency in the delivery of the courses and the learning expectations.

Later on the MOE decided to hand over their training responsibilities to colleges and OCWA. Colleges were only able to offer the water treatment operator courses for the

first couple of years until it no longer became feasible for them. The colleges were not successful in obtaining a high enough enrollment for the courses since the number of operators did not equal the number of classroom positions.

While OCWA developed an internal training program for the operators that work under OCWA-operated plants those courses have never been offered to outside parties.

4.1.2 CURRENT TRAINING PROGRAMS IN ONTARIO

Today training for water treatment operators has been taken up by private organizations. As such there is little or no Provincial control over what should be taught or the qualifications of the instructors. Across Ontario, small and large companies are developing training courses for operators who determine their own curricula and course standards. Private training companies, if approved by OETC, are listed on the OETC website as trainers for water treatment operators. The level of difficulty, course content, fees, location and dates varies depending on the trainer. There appears to be inconsistency in the qualifications of the instructors that are suggested / recommended by OETC. Similarly, there are variations in course content, giving rise to the creation of gaps or variations in skill levels, depending upon which courses and which instructors one operator may have had, compared with another.

The OETC list of trainers and courses is not accurate (for example Pennsylvania State does not offer courses to Canada anymore but they are listed). There may be other trainers out there that are not listed on their site.

There are numerous courses being offered relating to water treatment for operators in Ontario. Not all of these courses are available to operators, however. Most college courses are available only to the personnel enrolled in a particular program (e.g., Engineering Technology). Colleges could open up their programs to water treatment operators even if they are not in that particular program. Colleges offering these courses are situated throughout Ontario and are located within hours of most communities.

Correspondence courses are currently offered through the University of California, but they primarily use American calculations with only some metric and do not focus on Ontario legislation. The technical content of these courses is some of the best in North America. The only disadvantage for these courses is that they are written for an American operator instead of a Canadian. There is an opportunity to develop similar correspondence courses for Ontario operators. The textbooks and courses would

include Ontario legislation and metric calculations, rather than American proving to be more useful to an operator working in Ontario.

4.1.3 TRAINING REQUIREMENTS

Current regulations do not require a specific training for operator certification. Operators are required to have a minimum education level of grade 12, and as they apply for higher operator classifications the required education hours increases.

The regulation states that grade 12 is the minimum education required, unless there is adequate work experience to count toward this education. The education level for this position is very basic and should be higher.

Operators are required to have 40 hours of training annually according to O.Reg. 435/93. The types of training which are acceptable under this regulation are broad. There are no required or approved ministry courses which are mandatory for this 40 hour requirement.

There is a proposed amendment to the current O.Reg. 435/93, which would require all operators to complete an additional 36 hours of approved training within three years prior to the renewal of their licence. Proof of this training would be required every time a licence is renewed (every three years). Training must be approved by the ministry, and may include formal courses on topics related to operations, approved municipal training, correspondence courses, approved on-the-job training and computer based training. With this proposed additional training, there still is not a mandatory course or program for water treatment operators.

Without having a mandatory training regulation it is hard to get every operator to receive certain courses. This result creates a gap in the skill level of operators at each facility.

With a regulated water treatment operator program all operators would start their careers at an equal level and have necessary knowledge to perform their job better. A full time schooling program (for example - one year) could be developed to give operators the necessary training. As an operator progresses in his/her career, specialized courses relating to their responsibilities could be available to provide them with the necessary skills (more detailed courses for a position of higher responsibility).

As with any job, there are certain skills water treatment plant operators should have in order to perform their job. For each of the required skills, operators should have access to courses specific to their needs. Depending on their role in their plant, the level of detail required for each person will vary. A list of suggested courses for operators is provided below:

- grade 12 minimum with math & sciences;
- basic mathematics;
- English grammar;
- report writing skills;
- communications;
- basic water chemistry;
- basic water microbiology;
- computer skills - spread sheets, word processors, data bases;
- soil mechanics & foundations;
- hydraulics;
- theory of structures;
- construction fundamentals and theory;
- land survey fundamentals;
- ethics;
- basic environmental concerns;
- safety training;
- water treatment history;
- surface and ground water sources;
- water treatment methodology - unit operations - design parameters;
- small water system operation;
- water treatment process control, coagulation, flocculation, sedimentation, filtration, other treatment components and methodologies such as water softening, iron and manganese control, fluoridation;
- disinfection theory;
- corrosion control;
- instrumentation;
- taste and odour control;

- laboratory procedures;
- sampling procedures, testing methodologies and results interpretation;
- basic water testing, in-plant performance;
- distribution systems, design, operation, administration, maintenance, water quality considerations, disinfection;
- environmental law, OWR, EPA;
- compliance training;
- Ontario Drinking Water Standards;
- Applicable Ontario Regulations;
- handling and disposal of process wastes;
- spills and due diligence;
- maintenance concepts, electrical, mechanical, control systems & mechanisms;
- administrative theory and fundamentals;
- risk management;
- financial management;
- management skills;
- crisis management;
- human relations;
- problem solving techniques;
- political processes; and
- project management.

4.1.4 HISTORY OF WATER TREATMENT OPERATOR CERTIFICATION

Water treatment operators were not required to be certified until 1993 when O.Reg. 435/93 was approved. Prior to 1986, Ontario did not have any certification process requirements and anyone could become a water treatment operator. Between 1986 and 1993, a voluntary certification program was established based on the American model used today by ABC. During this period, operators were encouraged to seek certification but where not obligated to do so. Some operators were grandfathered during this period and were granted certification without meeting all the requirements.

In 1993 it became mandatory for operators to obtain certification in order to work in a water treatment plant. The second round of grandfathering occurred and many operators were granted certification without the training or education requirements. These two periods of grandfathering allowed some water treatment operators to continue performing their jobs without ever having received adequate training or education.

4.1.5 CURRENT WATER TREATMENT OPERATOR CERTIFICATION PROCESS

In Ontario, the MOE has contracted out the responsibility for certification of water treatment operators. OETC currently has this contract and is responsible for all aspects of the certification process.

Certification exams are held frequently and in various locations, and if that is not workable for a particular operator an on-site sitting of the exam can be arranged albeit on a limited basis.

Once the certification has been given to an operator he/she does not have to write another exam unless a different classification is being sought. Someone working in a Class II plant with a Class II licence could go years without any refresher testing. A licence is good for only 3 years and must be renewed. During this renewal stage no testing is required. If there was a mandatory refresher test this would force the operator to stay on top of his/her training and understanding of current practices/legislation. Operators who have been granted grandparenting would be required to write these exams every three years as well, which would demonstrate their ability and knowledge.

There is a proposed amendment to O.Reg. 435/93 to have a new certification licence for a Water Quality Analyst. Starting in January 2001, two training companies on the OETC list of trainers are offering a course to help people prepare for the Water Quality Analyst exam. Details on the exam content and study materials for a Water Quality Analyst are found in Appendix W.

The licensing requirements for this certification would include:

a. grade 12 education or equivalent;

b. successful completion of water lab analyst exam; and

c. 2 years of water operating experience or 1 year of lab experience or successful completion of 18 hours of approved training in water analysis.

The O.Reg. 459/00 Drinking Water Protection allows certain drinking water quality parameters to be tested in a water treatment facility by the holder of a Class I – IV water treatment license issued under O.Reg. 435/93.

4.1.6 STUDY MATERIALS

OETC is responsible for all aspects of the certification process including providing a list of study materials. Textbooks listed by OETC are priced similar to other college textbooks and are available through OETC. Study materials that are provided to operators for free are also helpful. In the Need-To-Know book, there is a detailed breakdown of the topics covered on the exam. The video provided is not just for water treatment operators, it explains how to write a multiple-choice exam.

4.1.7 FACILITY CLASSIFICATION

The level of classification an operator requires depends on the classification of facility he/she works in. Water treatment plants are classified similar to operators, Class I through IV and small water system. There are many factors used to determine what Classification a facility will be. In Ontario there are 554 classified water treatment plants with the majority of these being Class I and II (and, as noted above, not including 91 Small Water Systems). Out of the total 554 plants, OCWA operates 190 of them. That leaves 364 water treatment plants with operator(s) who need some form of training (since OCWA does its own internal training).

4.1.8 POSITIONS IN A WATER TREATMENT PLANT

Within every water treatment plant there are certain positions that must be filled – the owner, operator in charge and operator in overall operational responsibility. All these positions have designated responsibilities as defined by O.Reg. 435/93. There are no testing or certification procedures for these positions other than the regular operator certification. For positions of high importance, it would be useful to have specialized courses dealing specifically with their responsibilities.

4.1.9 CLASSIFICATIONS OF OPERATORS

There are five classifications of operators that cover all the necessary levels. An operator just starting in this career would obtain an "operator in training" license (valid for 3 years) until they have the all the requirements of a Class I operator. Operators move up license classifications as required, each time meeting the qualifications stated in the regulation.

The levels of classification appropriately reflect the classifications of the facilities. For the more complicated facilities (Class III and IV), operators require more experience and education in order to obtain their Class III and IV license.

4.1.10 IDENTIFICATION OF OTHER STAKEHOLDERS

Due to the nature of their work and practices, farmers have been identified as a stakeholder for water quality. In the past decade the potential risks on water quality from improper agricultural practices have become apparent. Both the Federal and Provincial governments have focused on these associated issues and are currently developing reports, guidelines and literature to educate farmers and the rural population.

Apart from literature available, there are seminars being held on nutrient management by OMAFRA. Smaller communities may be receiving funding to host their own workshops, but overall there is very little going on for education of these identified stakeholders. There are some agricultural/rural topics that do not seem to have any courses/seminars currently offered related to them. Some topics where potential courses, seminars or workshops could be developed and provided to farmers include wellhead protection, environmentally sustainable farm practices and practical information about groundwater contamination pathways and well decommissioning, to name a few.

4.2 TESTING

4.2.1 INVENTORY OF EXISTING LABORATORIES

Since August 2000 many laboratories have been granted accreditation for water testing using the new Ontario Drinking Water Standard (ODWS) Parameters. As of mid November 2000, a total of 40 commercial laboratories and 8 municipal/provincial

laboratories have been accredited. The number of methods accredited for each laboratory varies; some labs have only 2 methods, while others have 28 and are expanding to more.

4.2.2 TRAINING PROGRAMS FOR LABORATORY TECHNICIANS

An important aspect for producing a successful analytical services laboratory is that staff are well trained in all aspects of municipal drinking water testing. Management personnel should be experienced in laboratory operations, methods and interpretation of results. This includes having sufficient background in the scientific principles of water testing to choose the appropriate test methods and QC/QA procedures. It would also require a full understanding of the benefits, limitations, biases, and interference with the method, as related to the type of water evaluated (i.e., surface water and/or groundwater). They must also have a solid background in microbiological principles, so that confirmation procedures and interpretation of results are performed properly. Senior level staff must also have sufficient knowledge of water treatment practices and principles to allow discussions with clients regarding sample submissions and basic interpretation of results. This will help greatly when adverse results occur, so that the significance of these results are understood and communicated to the client. The education level for management staff is at minimum a B.Sc. or 3 year college diploma in the appropriate field, plus significant training in the field of water testing.

Technical staff working in a water testing laboratory must be well trained in performing the specific test methods accurately, and they must also receive training in areas such as QC/QA, health and safety, and results interpretation. There is also a need for technical personnel to understand the basic principles of the test methods they are using, and to have a basic training in microbiology. A better understanding of these factors will allow staff to troubleshoot and work with managers on any problems that arise. It will also help them to understand the importance and significance of the work they are performing, and why the various procedures are implemented. Technical staff performing basic water testing procedures will be expected to have at minimum a high school diploma, but a college diploma would be an advantage in performing this type of work.

A municipal water testing/teaching facility could offer a range of courses for all levels of laboratory personnel, consisting of short or long term courses, seminars, workshops and conferences. New staff training courses could be offered in basic microbiology and water testing principles, techniques, QC/QA procedures and health and safety. Although most laboratories currently train new staff in all of these areas, certain areas

can be neglected or are not done to sufficiently high standards. A central teaching facility would allow laboratories to properly train staff without having to develop their own courses. This would be beneficial especially to small laboratories that may not have the time or facilities to offer a full range of training.

Courses could also be offered to train and update staff currently working in water testing laboratories. These courses would offer advanced training on the principles of water production and monitoring, and updates and training on new and current procedures. It is important to update and present new ideas to laboratory personnel on a regular basis. These courses would also allow for career development and more effective management practices to be implemented. Courses would be offered by experts in the field of drinking water of municipal water testing. Since new or improved methods are always being researched, it is important that results of collaborative studies are passed along to Ontario and Canadian laboratories. Technology transfer would be ensured by the establishment of a facility dedicated to this type of training.

In addition to management and technical staff training, a testing/teaching centre could offer a one or two-year diploma course. This course could be designed to cover all aspects of water supply and testing. Graduates of this programme would then be in a better position to obtain a job working in any field of water supply or testing. The diploma could also be offered on a part-time basis to staff currently working in the field. Many of the courses currently described could be offered as distance education packages, so they would be accessible to a wider audience.

4.2.3 CURRENT TESTING METHODOLOGIES

Although agencies such as CAEAL, the Ministry of the Environment, and the Ministry of Health are working hard to ensure that water testing laboratories are providing accurate and sensitive analysis, there remain a number of issues that have not been addressed. These issues are outlined in detail below. To resolve problems associated with analytical testing laboratories, the formation of an independent water testing/teaching organization would be of value in resolving these issues. This proposed centre (Centre) could act as a resource base, providing information and consultation on various aspects of municipal water testing. This Centre could also act to evaluate and recommend appropriate test methods and procedures to be used in laboratories. In addition, this Centre could provide a much needed training service, providing courses, seminars and workshops on test methods, QC/QA, and the basic scientific principles of water treatment and testing. It is predicted that funding for the

operation of a water testing/teaching service could be funded by a combination of government grants and user service fees.

A key problem with current water quality standards is that standard methods and media are not listed. There are many methods available for detecting and enumerating the different indicator bacteria (coliforms, *E.coli*, and heterotrophic bacteria). These methods can vary greatly in their ability to recover and enumerate the different types of bacterial groups. However, neither the drinking water standards or CAEAL have listed methods that are acceptable for use in microbial water quality testing. This can cause serious discrepancies between laboratories analyzing water samples. Until the analytical methodologies for all chemical, physical, and microbiological methods are agreed upon, this will remain a serious weakness in the accreditation process.

Although CAEAL is an excellent group that can ensure the proper QC/QA procedures are being performed, there are limitations on what it can address. The solution to problems such as method standardization could be resolved by the formation of an independent agency that might be part of or affiliated with the Centre. This proposed agency (Agency) could recommend standard methods that are acceptable for water testing analysis, and be included in drinking water regulations and certification guidelines. The Agency could advise and address potential problems that exist with current testing protocols, could act together with the Ministries of the Environment and Health to determine the best test methods available, and investigate and compare new methods as they are made available. Method development is an ongoing process, and by having a nonbiased Agency that is able to judge the effectiveness and reliability of new methods would be invaluable.

Similar problems are associated with QC/QA protocols and the development of new procedures. QC/QA for all areas of water testing is an enormous area, however procedures for conducting microbiology testing are often poorly designed, understood and implemented when compared with those for chemical testing. For example, CAEAL currently provides challenge tests to laboratories on a regular basis. These tests require labs to analyse samples containing known concentrations of bacteria. While this program is very useful in principal, it needs to be made more challenging, particularly in the area of microbiological samples. Atypical sample results can be a large problem in microbiology testing, and correct confirmation and interpretation procedures are required to ensure that accurate results are obtained. CAEAL must ensure that atypical bacteria and matrices are included as part of this testing. In this way, we can ensure that the necessary analytical skills required for the testing of municipal drinking water are in place at each participating laboratory.

Another issue that could require assistance for water testing laboratories is interpretation of the drinking water regulations and procedures for correct reporting of results, especially when adverse results are obtained. It is predicted that there will be more changes taking place in the drinking water standards in the coming years. An independent testing/teaching agency would be able to work with government agencies in advising on changes that are required, including specific quality procedures that could enhance testing/reporting procedures in the laboratory. This Agency would also be able to advise and train testing laboratories on interpretation and application of these new regulations, so that the appropriate changes can be made to their analysis and certification procedures.

4.3 RESEARCH AND DEVELOPMENT

4.3.1 INTRODUCTION

Many of the four research areas relevant to Ontario water issues are interrelated. The various institutions, universities and private organizations doing R&D on water quality are involved in endeavours, directly or indirectly, that apply to protection of surface water or groundwater. Therefore almost all of the R&D centres listed are shown as active in the category of Water Source Integrity. Each R&D centre, however, has its own particular focus and mandate.

With a few exceptions, the slate of research topics relevant to water quality is covered comprehensively by the group of government (all levels), university and private company research centres. There is not, however, a single resource or database facility, from which interested parties can review the status of research in Ontario. A list of Research Centres in Ontario (for water quality issues) is given in Appendix X.

4.3.2 WATER SOURCE INTEGRITY (SURFACE AND GROUNDWATER)

Major research centres working on water quality and source integrity issues in Ontario are:

- Canada Centre for Inland Waters (CCIW), part of Environment Canada's National Water Research Institute (NWRI);
- University of Waterloo, through its various on-campus Institutes and through its work with the Waterloo Centre for Groundwater Research (part of CRESTech, and

Ontario Centre of Excellence), and through the Drinking Water Chair (NSERC sponsored);

- University of Guelph, working on all aspects of water source integrity related to agricultural and food production activities; and
- United Nations University (based at McMaster University in Hamilton, Ontario) (see Appendix Z for details).

NWRI conducts a comprehensive program of research in the aquatic sciences, emphasizing eco-system research. Their twelve project areas include Conservation, Impacts, Protection and Restoration. At the universities, many departments participate in what is essentially interdisciplinary work. The Table below indicates the common research themes and areas of expertise of the three centres above, and also includes McMaster University, which has significant involvement in water source integrity research. The list is not intended to be definitive, but rather to indicate that more than one of the major research centres performs work on the various topics.

R&D Topic	***NWRI***	***Waterloo***	***Guelph***	***McMaster***
Agricultural Wastewater			Y	
Air Water Interaction	Y			Y
Analysis	Y	Y		
Aquatic Ecosystems	Y	Y		Y
Climate Change*	Y			Y
Complex Effluents	Y		Y	
Conservation	Y	Y	Y	
Drinking Water		Y	Y	
Farm Runoff	Y		Y	
Groundwater	Y	Y		
Hydrology and Hydrogeology	Y			Y
International Network	Y			Y
Land Use	Y	Y	Y	
Manure Management			Y	
Modelling	Y	Y	Y	Y
Municipal Wastewater	Y			Y
Nitrogen and Nutrient Management	Y		Y	
Point and NonPoint Source Contamination	Y	Y	Y	
Septic Systems		Y	Y	
Soil Management			Y	

R&D Topic	*NWRI*	*Waterloo*	*Guelph*	*McMaster*
Wastewater	Y	Y		
Watershed Management	Y	Y		
Water Policy	Y			Y
Wetlands	Y	Y		

* Climate change is a relatively new research topic as related to water quality. The number of projects is not large.

4.3.3 FARM NUTRIENT PRACTICES

The University of Guelph is a major centre for R&D on farm nutrient practices. Assays and screening research is done at the main campus. At the main campus, there are a number of R&D projects relating to biosolids from industrial, farm and sewage sources as applied to land. University of Guelph, Land Resources Science, and also the Ontario Government, through OMAFRA, are involved in land use research. At the Alfred College location, there is research on abattoir wastewater and milkhouse washwater. Manure management, including land spreading and composting for land spreading, is researched at Guelph main campus, Ridgetown College and Alfred College. Parasites and pathogens in soil and water, is also a research topic at the University of Guelph.

The University of Waterloo, Wetlands Research Centre, concerns itself with farm nutrient practices as related to wetlands. The University of Waterloo Institute for Groundwater Research does research on farm nutrient practices.

Ontario Ministry of Natural Resources, OMAFRA, and Agriculture and Agri-Food Canada, Eastern Region, all do research related to sufficiency of water supply, and its relationship to farm nutrient practices.

Agriculture and Agri-Food Canada, in London, is also involved in manure management research. Agriculture Canada has researched and created a Hog Manure Management database listing all present, pre-commercial and proposed methods for management, thus providing a means of tracking research past and present in this area. Agriculture and Agri-Food Canada, Harrow has a major research focus on nitrogen as a nutrient to be managed, including sources from fertilizers and farm waste.

The UNU International Network on Water Environment and Health is at McMaster University, and brings international cooperative efforts in R&D, some of which relate to farm nutrient practices.

The focus of the Aquatic Ecosystem Restoration Branch (AEMRB), a major division of the Canada Centre for Inland Waters (part of NWRI) is surface and groundwater systems degraded by anthropogenic activities, and the Aquatic Ecosystem Impacts Research Branch (AEIRB) concentrates research on stresses on ecosystems, including effects of land use, and development of groundwater remediation approaches. These areas of research are directly and indirectly part of the topic of farm nutrient practices. Environment Canada, through work at NWRI and at other laboratories, does research related to the effect of farm nutrient practices on the Great Lakes.

CRESTech, an Ontario Centre of Excellence, sponsors research jointly with industrial and other partners on many areas related to groundwater. This includes farm nutrient practices as related to groundwater source integrity.

In relation to farm runoff, NWRI, and Agriculture and Agrifood Canada are separately involved in work on runoff problems related to application of pesticides. OMAFRA research on farm runoff is extensive.

The disciplines of hydrology, hydrogeology and hydrogeochemistry have been applied in a number of research centres, particularly Waterloo and McMaster, to develop information on movement and fate of agricultural waste and applied chemicals.

4.3.4 SEPTIC SYSTEMS

There is little current R&D on septic systems, but some nutrient loading research relates to effluent from septic systems. An annual series of conferences to present research results was held in the period 1992 to 1997, known as the Waterloo Septic System Conferences. These were under the sponsorship of the Waterloo Centre for Groundwater Research (now part of CRESTech). However, the universities (Guelph, Waterloo) have R&D continuing at a modest level. Private companies such as Waterloo Biofilter also do research related to their own products. An ongoing project on Innovative and Operational Management Techniques of Septic Systems, at the University of Guelph, is supported by a partnership of Agriculture and Agrifood Canada, through the Ontario Agricultural Adaptation Council, OMAFRA and several Conservation Authorities in the province.

4.3.5 MUNICIPAL WASTEWATER TREATMENT FACILITIES

All Ontario universities having engineering schools have part of their civil engineering research relating to municipal wastewater treatment facilities. McMaster, Toronto, Carleton, Guelph, Western Ontario, among others do research on this topic. Spreading of municipal sludge on agricultural land is researched at Guelph, main campus and at Alfred College. Trojan Technologies supports several university research projects on UV disinfection of municipal wastewater, e.g., the impact of upstream processes on the disinfectability of wastewaters, and also has in-house research.

Environment Canada, Wastewater Technology Centre (WTC), has a significant proportion of its research on municipal wastewater. Assessment and restoration of groundwater and surface water contaminated by municipal wastewater is a focus of research at CCIW (Environment Canada, NWRI). Groundwater, surface water and lakes management is another topic of research at NWRI and CRESTech.

Risk assessment research at Lakehead University, with the City of Thunder Bay, allows development of operational procedures for municipal water and wastewater treatment.

4.3.6 TECHNOLOGY, EQUIPMENT AND APPLICATIONS FOR WATER TREATMENT

Some research centres solve problems in water treatment by developing new water treatment technology, or deriving a new variation of an existing technology. The technology implementation may be in the form of new equipment or new processes or both.

A number of government laboratories are involved in research on acid mine drainage, and have developed equipment and processes. These research centres include NRCan's CANMET laboratories, Lakefield Research and Environment Canada, WTC. Falconbridge Inc. is involved in some of this research. Individual locations of this water treatment problem determine whether or not water source integrity is threatened. Laurentian University and University of Western Ontario, among others, are doing research related to acid mine drainage.

The University of Guelph, including Alfred College, is a research centre for treatment of agricultural wastewater and treatment processes are under development. The National Research Council has research on development of analytical processes; GAP Environmental has been involved in research on new technology for analysis of taste

and odour. Equipment for destruction of zebra mussels has been developed by Sparktec Environment, Stoney Creek, ON.

Equipment and processes applicable to drinking water treatment have been the subject of research at many centres, including the universities of Waterloo and Toronto, Health Canada, and several Ontario companies. Generally the topics have been disinfection byproducts, nitrification, protozoan cysts, microcystins, filtration and ultraviolet disinfection.

NWRI, universities of Waterloo, Queens, Toronto and others have studied processes applicable to groundwater remediation and groundwater management. Hydrology, hydrogeochemistry and hydrogeology are areas of research strength at Waterloo and McMaster. Waterloo's Centre for Advancement of Trenchless Technology has developed models, standards, data and procedures to support their industry partners.

Manure management technology and processes have been developed by projects between the private sector (Global Earth Products Inc. is one example), the University of Guelph, and Agriculture and Agri-Food Canada. Nitrogen management research has resulted in processes or strategies intended to be used for water treatment or pollution prevention. The same type of result applied to research on point and non-point source pollution.

Septic systems research at the University of Waterloo has resulted in at least one spin off company, Waterloo Biofilter.

Spill response equipment and management techniques has been the subject of research at the Environment Canada's Environmental Technology Centre, Emergencies Engineering Division. The same group has researched and prototyped a number of different water treatment technologies.

4.3.7 STANDARDS AND POLICY DEVELOPMENT

Various government departments are responsible for standards development and are therefore involved in research related to that topic. These departments include Health Canada, e.g., Drinking Water Guidelines, Environment Canada, e.g., CAEAL (Canadian Association for Environmental Analytical Laboratories).

Policy development is aided by in house and external research projects. Not for profit organizations such as CIELAP (Canadian Institute for Environmental Law and Policy) also contribute research that can be applied for policy development needs.

4.3.8 RESEARCH CENTRES AT GOVERNMENT INSTITUTIONS

In order to fulfill their mandate of protecting the public, and developing appropriate policy, it is usual and necessary for government departments to do their own research. Thus, some of the major research centres for water quality are government laboratories. This would include the laboratories of Environment Canada, Health Canada, Agriculture and Agri-Food Canada and the National Research Council. The laboratories of the Province of Ontario are working at a much-reduced level compared to former levels of research work in the Ministry of the Environment and the Ministry of Natural Resources (MNR). The regional Stewardship Committees sponsor some active research, a program of the MNR. Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), often combining their own resources with the University of Guelph sponsors active research.

4.3.9 RESEARCH CENTRES AT UNIVERSITIES

Virtually all Ontario universities have research ongoing on some aspect of water quality (as defined for this report). The expertise available through the universities allows the performance of some fundamental research that is best done in an academic setting. Funding of much of this work is through NSERC (National Science and Engineering Research Council). The universities also do research of interest to the private sector, and also work on projects with government laboratories. The major efforts and resources for water quality research are focussed at the University of Waterloo, McMaster University and University of Toronto.

The Ontario Centres of Excellence include CRESTech (Centre for Research in Earth and Space Technology). CRESTech supports cooperative projects at universities that have private sector involvement and funding. Their focus is on groundwater and groundwater/surface interaction, including assessment, protection, remediation and management of water resources.

A consortium of (large) Canadian companies supports environmental research at universities. This organization is ESTAC (Environmental Science and Technology Alliance Canada), and its membership consists of private companies and universities,

including the large Ontario universities. A number of the ESTAC projects relate to water quality

4.3.10 RESEARCH CENTRES IN THE PRIVATE SECTOR

There are Ontario-based companies that sell equipment, products and processes for water treatment that have been developed in Ontario. These companies have substantial research interests, and utilize both in-house laboratories for product development and external laboratories in the universities. The larger companies include Trojan Technologies Inc., London, ON, and Zenon Environmental, Burlington, ON, and some environmental engineering consulting companies. Trojan Technologies[1] has optimized reactor designs for UV disinfection of potable water, has invented proprietary cleaning systems and control algorithms. They have sponsored a research collaboration among three universities to better understand the application of UV for control of protozoan pathogens. In house, Trojan continues to optimize UV technologies for disinfection of wastewaters. Smaller companies, e.g., Waterloo Biofilter, Sparktec Environmental, UV Pure (a few of many examples) also do research relating to their product and process development interests, utilizing research centres when in house resources are insufficient.

The work of private sector companies as research centres is important as these are the likely receptors for technology transfer from the larger research centres in government and academia. In specific cases such as Walkerton, where water quality improvement is required, many of the goods and services for this purpose are delivered by the private sector.

4.3.11 ROLE OF OTHER STAKEHOLDERS

Industry organizations, stakeholder groups, working groups are formed to meet the needs of certain stakeholders, e.g., the Canadian Water Resources Association – Ontario Branch. A list of some of these organizations is given in Appendix Y. Often, these are the sponsors of research conferences and workshops where researchers can communicate results and learn about the work of others. These organizations, (e.g., the Ontario Pork Producers Association) may or may not contribute funding and expertise to research projects, but generally have no research facilities and are therefore not classified as research centres.

[1] Dr. Bill Cairns, personal interview

4.3.12 CONSOLIDATION, COORDINATION AND NEEDS ANALYSIS RESEARCH

On topics relating to water quality, much research has been accomplished in Ontario to date, and research projects are continuing. There are a number of cooperative efforts between various stakeholders. There are some dedicated-purpose databases such as Great Lakes Information Management Resource (GLIMR). GLIMR is an index of Environment Canada's Great Lakes Programs, Publications and Databases. A new Canadian Water Network is proposed to operate under the NCE (National Centres of Excellence) Program, that has the objective of research for meeting the environmental challenges for clean water. Partners include many of the public and private research centres listed here. In all, the research topics covered in Ontario appear to be comprehensive with respect to the four major areas identified in this report, and research centres are in place to perform the research.

A number of research programs sponsored through the Federal and Provincial governments have achieved very useful results relating to water quality, per the interests of this inventory. However, a number of programs are now closed/completed. An example is the Agriculture and AgriFood Canada Great Lakes Water Quality Program (1989-1994), based at the London Research Centre. This program included non-point source pollution from agricultural chemicals, liquid manure handling systems and many other topics relating to environmentally sustainable agriculture, but the research group that performed this work is presumably assigned to other work at this time.

Even though research results are extensive, there is not a consolidation of research information on water quality research in Ontario. In other words, there are no research programs to synthesize and assemble the results that have already been achieved. This type of research is the foundation for needs analysis, identification of gaps or duplication of effort in water quality research. The Inventory of research centres includes major facilities and personnel resources but there is no formal mechanism in either the public or private sector for coordination of the centres on the specific topic of water quality research.

4.3.13 REPORTS RELATING TO THE RESEARCH STATUS OF WATER QUALITY ISSUES IN ONTARIO

Some reports of interest:

De Kimpe, C. The health of our water: toward sustainable agriculture in Canada. Agriculture and Agri-Food Canada (2000?).

MacDonald, K.B., *et al*. Regional agricultural practices and their potential for land and water contamination. Agriculture Canada (1995?).

MacRitchie, S.M., *et al*. (1994). Groundwater in Ontario: hydrogeology, quality concerns and management.

Cherry, J.A., *et al*. (1993). Groundwater issues and research in Canada. Task Force on Groundwater Resources Research.

Gilliland, J.A. (1992). Background on a Canadian Groundwater Strategy. A management approach to the groundwater issue. Environment Canada.

5.0 NEXT STEPS

With the information contained in this inventory report in hand the path is now better prepared for the CWQC to begin, in Phases II and III, to develop and evaluate a number of alternative options in answer to the following key feasibility questions:

- What, precisely, is the **need** for a Centre for Water Quality?
- What would be the key **roles/functions** that a Centre for Water Quality would fulfil, that are not being met by other bodies now?
- Where would the Centre for Water Quality **fit** within the landscape of Ontario government, quasi-government, educational, professional and other agencies? Would the Centre duplicate or conflict with the mandate / work of existing bodies?
- What would be the **product/service** that a Centre for Water Quality would deliver?
- How would a Centre for Water Quality be best **structured** to carry out its defined roles / functions?
- Who would be **participants** (e.g., business, government, other) in a Centre for Water Quality?

…..and a very critical question having major short and long-term implications:

- How would a Centre for Water Quality establish and maintain sound **financial stability**?

As indicated in Section 1.0 of this report it will be imperative that the completion of the feasibility study pay close heed to the ongoing work of the Walkerton Commission of Inquiry, for two key reasons. On the one hand, without presuming to anticipate Inquiry findings, the proposed Centre for Water Quality may prove to be a mechanism (one of several) for acting upon Inquiry recommendations. On the other hand it will be important that plans for the proposed Centre for Water Quality complement the Inquiry's findings. It is recommended, therefore, that the contents of this report (and the work to be done under Phases II and III during coming weeks) be communicated to the Inquiry for its information, and that the work of the Inquiry continue to be regularly monitored.

5.1 PHASE II (DETAILED FEASIBILITY ASSESSMENT)

Phase II will provide a detailed assessment / analysis of the inventory results in relation to the stated objectives of CWQC for a proposed Centre for Water Quality and will constitute the primary feasibility assessment Phase of the study. To be truly comprehensive this assessment must involve extensive consultation with CWQC members and other potential participants / partners, including political and administrative branches of government (Federal, Provincial and municipal), the private sector, bodies currently involved in various aspects of water quality management (as discussed in this Phase I report) and other stakeholders.

Once a preferred feasibility option is identified the CWQC can then move forward to Phase III, as follows.

5.2 PHASE III (IMPLEMENTATION)

Once a preferred organizational and operational option has been identified by the CWQC during Phase II the next step will be to undertake the detailed development of mechanisms for implementation of the proposed Centre, including the preparation of a detailed Business Plan on the basis of the outline presented in Section 6.0, below. Other Phase III tasks will include the development and securement of partnerships and the development of detailed work plans and schedules for the creation and development of the Centre.

6.0 BUSINESS PLAN OUTLINE

It is imperative that the Centre for Water Quality have a comprehensive Business Plan to provide a solid foundation for the fledgling organization and to provide a clear picture of the organization's structure, mandate and management for prospective partners and funding sources.

It is early in the feasibility study to develop a Business Plan in detail. That exercise is one that can only be undertaken as part of Phase III (implementation) once the full feasibility of the proposed Centre has been established. However it is appropriate at this time to begin thinking about what a Business Plan for the Centre for Water Quality should contain. While Phases II and III are being completed in the weeks to come Team members can proceed on a parallel track to develop the detailed information necessary to complete the Plan. Members of the CWQC Board and Steering Committee will, of course, have significant experience in the development of Business Plans and that experience will be invaluable in the development of the Centre's Business Plan. At this time the following preliminary outline for a Business Plan is presented to provide a framework for the development of the Plan.

6.1 BUSINESS PLAN CONTENTS

The following is a suggested list of contents for a business plan for the proposed Centre for Water Quality. As noted above, a full Business Plan will be a significant and detailed undertaking that may include some or all of the following items and may include others not listed here. At this point in time it is provided here as a contribution to the "transitioning" of Team and CWQC thinking from Phase I into Phases II and III.

6.1.1 EXECUTIVE SUMMARY

6.1.2 PROFILE OF WALKERTON CENTRE FOR WATER QUALITY

6.1.2.1 BUSINESS NAME AND ADDRESS

6.1.2.2 TELEPHONE/FAX/E-MAIL NUMBERS

6.1.2.3 TYPE OF ORGANIZATION

6.1.2.4 REGISTRATION AND LICENCES

6.1.2.5 MANAGEMENT STRUCTURE

6.1.2.6 ADVISORS (E.G., ACCOUNTING, LEGAL, ETC.)

6.1.3 MARKET

6.1.4 TRENDS

6.1.5 POLITICAL AND LEGAL

6.1.6 COMPETITION / OTHER ORGANIZATIONS IN FIELD

6.1.7 BARRIERS / CONSTRAINTS

6.1.8 MARKETING PLAN

6.1.8.1 CLIENT BASE

6.1.8.2 PRICING

6.1.8.3 SERVICE TARGETS / OBJECTIVES

6.1.8.4 SERVICE ORGANIZATION

6.1.8.5 PROVISIONS FOR CLIENT ANALYSIS / FEEDBACK

6.1.9 ADVERTISING AND PROMOTION

6.1.9.1 ADVERTISING AND PROMOTION PROGRAM

6.1.9.2 ADVERTISING AND PROMOTION BUDGET

6.1.10 OPERATING PLAN

6.1.10.1 FACILITIES

6.1.10.2 EQUIPMENT

6.1.10.3 SUPPLIES / INVENTORY

6.1.11 HUMAN RESOURCES PLAN

6.1.11.1 ORGANIZATION CHART

6.1.11.2 RELEVANT FEDERAL AND PROVINCIAL HUMAN RESOURCES STATUTES, REGULATIONS, POLICIES AND GUIDELINES

6.1.11.3 PERSONNEL POLICY

6.1.11.4 COMPENSATION

6.1.12 FINANCIAL PLAN

6.1.12.1 CASH FLOW FORECAST

6.1.12.2 PROJECTED INCOME

6.1.12.3 PROJECTED BALANCE SHEET

6.1.12.4 FIXED ASSETS

6.1.12.5 DEPRECIATION SCHEDULE

6.1.12.6 DEBT SUMMARY

6.1.12.7 LOAN BALANCES

6.1.12.8 FINANCIAL PERFORMANCE INDICATORS

7.0 SUMMARY AND CONCLUSIONS

At the conclusion of the inventory exercise conducted during the past seven weeks a number of conclusions are evident:

7.1 TRAINING AND CERTIFICATION

Training:

- The training of water system management personnel appears to be in a disjointed and diffuse state, with considerable inconsistency in the availability and delivery of courses and course materials across the province and the potential for some personnel to legitimately avoid training and upgrading of skills. On the face of it there is a great deal of training activity – or, rather, potential training activity - and most of the activity that is occurring is apparently of suitable quality. But currently in Ontario no one body has responsibility for delivery of training programs for water system management personnel. As a result there are many players, having differing motivations for delivery of training. This can only contribute to major inconsistencies in training standards and program delivery. Similarly, the "economics" of the situation (see Section 3.1.1) seem to militate against any body, be it a community college or a private sector deliverer of training, from conducting training programs on a purely for-profit (or even cost-recovery) basis.

  In short, there seems to be no one body that is "in charge" of training; no one entity that has the big picture clearly in view; no one 'authority' that is clearly responsible for ensuring a consistent, high quality training regime across Ontario.

Certification:

- With regard to certification, while the OETC is currently the body responsible for certification of water management system personnel and while requirements for water system management certification are set out by provincial regulation there appears to be an absence of clear direction as to how those standards are to be met. In other words, there seems to be a "disconnect" between the training and certification functions. And, notwithstanding the good work of the OETC, it appears that there is no one "in charge" of certification from a broad public interest perspective.

7.2 TESTING

The inventory has shown that there are many private laboratories across Ontario capable and qualified to conduct water testing. As with training and certification, however, it appears that all laboratories are not of equal quality, in that they use differing and in some cases inferior procedures that may or may not be adequate to identify water quality problems, particularly under exceptional circumstances. Notwithstanding some individual laboratories' high quality work these shortcomings, inconsistencies and the lack of an overall "big picture" oversight or co-ordination function by a senior body constitute a fundamental problem with the Ontario water testing scene.

7.3 RESEARCH AND DEVELOPMENT

In the area of R&D the picture is similar to that in the Training and Certification and Testing areas: there is considerable research and development activity occurring within a number of universities and private sector organizations. That activity seems, however, to be proceeding in a fragmented manner, with relatively little co-ordinated transfer of new information directly to water quality practitioners on a timely basis.

This is not entirely true, of course; many qualified water quality system personnel do regularly monitor new advancements in their craft by way of personal communications and journals distributed by their respective professional organisations. There is much room for improvement in the area of monitoring and co-ordinating the work of academic researchers in many aspects of water quality

7.4 BUSINESS PLAN OUTLINE

See the comments set out in Section 6.0, above.

In the past the Ontario government was the primary player in the role of regulating and overseeing the management of water quality on behalf of the people of Ontario. In recent years, however, as governments have steadily moved away from their traditional regulatory and oversight responsibilities and these activities have become increasingly transferred to quasi-government agencies and to the private sector, control and vision of the "big picture" somehow seems to have been lost. It seems that there is no longer anyone in charge of "keeping the flame".

In view of these trends the results of this inventory suggest that there may be significant potential for some body, organization, agency or entity to play a valuable role in the co-ordination and oversight of activities relating to the training and certification of water system management personnel, the testing of water quality and the monitoring and dissemination of information derived from R&D activities relating to water quality.

What, precisely, such an organization or body should be and what its role and mandate might be will be explored in Phase II. One thing is clear, however: the people in any community in Ontario in the post-Walkerton water supply age will demand a much higher level of assurance that their water supply is safe in the years to come. A Walkerton Centre for Water Quality could have a significant role to play in serving that very legitimate public expectation.

	A	B	C	D	E	F	G	H	I
1	**TOPIC**		**Name of R&D Centre**		**Water Quality Issue**				
2	**RESEARCH & DEVELOPMENT TOPIC**	**SUB TOPICS in R&D**	**R&D Centres (Non-Academic)**	**R&D Centres - University**	**1. Water Source Integrity Surf. & Grdwtr.**	**2. Farm Nutrient Practises**	**3. Septic Systems**	**4. Municipal Wastewater Treatment Facilities**	**5. Technology, equipment, applications for water treatment**
3	**Acid Rain**		NWRI (National Water Research Institute (at Canada Centre for Inland Waters))						
4	**Acid Mine Drainage**		Natural Resources Cda, Minerals and Metals Sector and CANMET; Falconbridge; Lakefield Research; Wastewater Technology Centre (WTC)	Laurentian; Western; Waterloo	1				5
5	**Agricultural Wastewater**								
6		Abattoir wastewater and milkhouse washwater		Guelph, Alfred College;		2		4	5
7	**Air Water Interaction**		NWRI; Env Cda, Ont. Region;IAEA/WMO Global Network for Isotopes in Precipita	McMaster, Civil Eng.;	1				
8	**Analysis**								
9		Assays and screening	NWRI;	Guelph	1	2			
10		Disinfection ByProducts	National Research Council						5
11		Pathogens and Contaminants		Guelph					
12		Taste and Odour	GAP Enviromicrobial		1				5
13	**Anthropogenic Contamination**		NWRI		1				
14	**Aquatic Ecosystems**		NWRI; GLIER (Great Lakes Institute for Environmental Research)	Waterloo, Wetlands Res.Ctr.; Windsor	1				
15		Aquatic ecotoxicology	NWRI; GLIER, Env. Cda	McMaster;	1				
16		Bioaccumulation of Contaminants	NWRI; GLIER, Env Cda						
17		Chemical Fate and effects	NWRI; GLIER						
18		Endocrine Disrupting Substances (EDS)	NWRI; Health Cda; Agri and Agrifood Cda; Env Cda; WTC;	Trent; Guelph;	1				
19		Persistent Organic Pollutants (POPs)			1				
20		Zebra mussels	NWRI; Sparktec Env.;	Guelph; Toronto;	1				5
21	**Climate Change**		Env Cda, Ont Reg; Grand River Conserv. Auth.; Agric&AgriFood Canada,OSWARSC; NWRI;	McMaster;	1				
22	**Complex Effluents**		NWRI; Ontario MOE; Agric&Agrifood Cda;	Guelph; Queens; Ottawa	1				
23	**Conservation and Protection**		NWRI; Env Cda; Crestech; Agricultural Adaptation Council, National Soil and Water Conservation Program (NSWCP);	Waterloo, Civil Eng., Wetlands Research Centre	1				
24	**Databases**		Environment Canada, Ontario Region; NWRI, GEMS /Water Collab Ctr;		1				
25	**Drinking Water**			Waterloo, Civil Eng.					
26		Disinfection Byproducts	Health Canada; Zenon Environmental	Toronto, Civil Eng.	1				5
27		Materials	Health Canada						
28		Microbial Contamination	OMAFRA, Health Canada	Toronto, Civil Eng;	1	2	3		
29		Nitrification		Waterloo, Civil Eng.; Guelph, Land Res. Sc.;	1				
30		Protozoan Cysts, Microcystins	Health Canada; Trojan Technologies; Bolton Photosciences; UV Pure; Zenon Environmental	Waterloo, Civil Eng.;	1				5
31		Toxic Substances	Environment Canada; Health Canada						
32		Ultraviolet Disinfection	Trojan Technologies; UV Pure;	Waterloo, Civil Eng; Toronto, Mech Eng;					5
33	**Environmental Fluid Dynamics**			Toronto, Mech. Eng.;	1				
34	**Farm Runoff**		Ontario Ministry of Agriculture Food and Rural Affairs (OMAFRA)			2			
35		Industrial Biosolids		Guelph					
36		Farm Waste and Sewage Biosolids to Applied to Land		Guelph		2			
37		Pesticides,Herbicides Runoff	NWRI, Agric&Agrifood Cda; OMAFRA		1	2			

	A	B	C	D	E	F	G	H	I
38	**Groundwater**		Crestech	Waterloo, Institute for Groundwater Research; Toronto, Scarborough	1	2	3	4	5
39		Assessment and Restoration	NWRI, Aquatic Ecosystem Resoration Branch (AERB)		1	2	3	4	5
40		Flow		Toronto, Geology,env.Sc.;	1				
41		Insitu Treatment		Waterloo, Civil Eng.;					5
42		Nitrates	OMAFRA	Carleton	1	2			
43		Solvents in Groundwater	Solvents in Groundwater Industrial Consortium	Waterloo, Queens;consortium;	1				5
44	**Groundwater Management**		Regional Municipality of Waterloo (RMOW);	Guelph					
45		Aquifer Management		Waterloo, Civil Eng	1				
46		Chemical Contamination	OMAFRA, RMOW						
47		Groundwater Allocation			1				
48		Planning - Grdwater and Surface			1	2	3	4	
49		Resource Evaluation			1				
50	**Hydrology**		NWRI; Indian and Northern Affairs Cda; Canadian Geophysical Union	Waterloo, McMaster, Hydrogeology; Toronto; Brock	1	1			
51	**Hydrogeochemistry**			Waterloo, Geography;	1				
52	**Hydrogeology**			Waterloo, Civil Eng,Earth Sc.; McMaster;\	1		3		5
53	**Infrastructure**		CATT(Centre for Advancement of Trenchless Technologies);	Toronto, Civil Eng.; Waterloo,Earth Sciences;					5
54	**International Network**		UNU International Network on Water Environment and Health, UNU/INWEH; UNEP and WHO Global Env. Monitoring Sys., NWRI; Canadian Space Agency	McMaster	1	2	3		
55	**Lakes**		Environment Canada; NWRI;		1	2	3	4	
56		Great Lakes water levels, flow regulation	International Joint Commission		1				
57	**Land Use**		OMAFRA; NWRI	Guelph, Land Res. Sc.; Waterloo, Wetlands Res. Ctr.;	1	2	3		
58	**Manure Management**		OMAFRA, Agric& Agri-Food Cda; Agric Canada, London; Agric Cda, Agricultural Adaptation Council; Global Earth Products	Guelph, Ridgetown, Alfred College;	1	2			5
59	**Modelling**		NRC, Canadian Hydraulics Centre;	Trent; Waterloo, McMaster, Civil Eng; Windsor; Guelph;	1	2			
60		Hydrodynamic Pollutant Transport		McMaster, Civil Eng;	1				
61	**Municipal Wastewater**		NWRI; WTC;	Toronto, Civil Eng.;	1			4	5
62		Flocculation		Ryerson				4	
63		Hydraulics		McMaster, Civil Eng;					
64		Sludge Spreading, Biosolids		Guelph	1	2		4	
65		UV Disinfection	Trojan Technologies;					4	5
66	**Nitrogen Fertilization Management, Nutrient Management**		Agric Cda, Harrow; Agri Cda, London; Ontario Farm Environmental Coalition, Water Quality Working Group; Agric. Adaptation Council; OMAFRA		1	2			5
67									
68	**Parasites and pathogens**		Trojan Technologies	Guelph		2			
69	**Point and NonPoint Source - Agricultural and Other**		NWRI; Agric and Agrifood Canada, London;	Guelph	1				5
70	**Pollution Prevention**		NWRI, Pollution Probe	Guelph; Ottawa	1				
71	**Radioactive Contamination**		AECL		1				
72	**Remediation**		Env Cda, EED;						5
73	**Remote Sensing**		NRCan; Industry Canada;	Waterloo, Wetlands Research Centre; McMaster, Civil Eng; Waterloo, Geography;+D14	1				
74	**Risk Assessment**		NWRI; City of Thunder Bay; Azimuth Environmental Consulting;	Lakehead;	1			4	
75	**Road Salt**		NWRI; Ont Ministry of Transp; Env Cda;		1				

	A	B	C	D	E	F	G	H	I
76	**Septic Systems**		OMAFRA; Waterloo Biofilter; Env. Cda;Crestech; Agri Adaptation Council, Upper Thames River Consv Auth., Rideau Valley Consv. Auth, North Bay-Mattawa Consv. Auth, Ontario Soil and Crop Improvement Association (OSCIA)	Guelph, Eng.; Waterloo			3		5
77	**Soil Management**		Agri Cda, Harrow;		1				5
78		Nitrogen input		Guelph, Ridgetown;		2			
79		Organic/Metal Contaminants	NWRI; GSI Environment		1	2			
80	**Spill Response/Mgmt**		Env Cda, Emergencies Engineering Div, Emergencies Science Div	Ryerson, Civil Eng;	1				5
81	**Standards**		Health Canada, Env Canada; NWRI, NLET;		1				
82	**Wastewater- municipal**			Western Ont,				4	
83	**Water Management**		NWRI		1				
84	**Watershed Management**		NWRI, OMAFRA	Toronto; Waterloo	1				
85	**Water Policy - Legislation Related**		Env Cda, Environmental Technology Centre;						
86		Policy and Governance	NWRI; Canadian Institute for Environmental Law And Policy (CIELAP);Great Lakes Commission Transportation and Economic Development Program; Pollution Probe	McMaster	1				
87	**Water Supplies (Quantity)**		OMAFRA;OMAFRA, OHCRSAC; Agric&Agri Food Cda, Eastern Reg; Agri Res Instit of Ont; Ontario MNR		1	2			
88	**Water Treatment**		Env Cda, Emergency Engineering Div.; SAIC Canada;						5
89	**Wetlands**		OMAFRA;Agric&Agri-Food Cda, Eastern Reg; Agri Res Instit of Ont; Ontario MNR	Waterloo, Wetlands Research Centre; Guelph	1	2			