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Water Quality Branch Strategy for Assessments of Aquatic Environmental Quality

G.D. Haffner



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WATER QUALITY BRANCH
OTTAWA, CANADA, 1986

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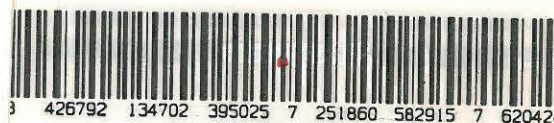
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Contents

	Page
ABSTRACT.....	v
RESUME.....	v
NEED FOR COMPREHENSIVE WATER QUALITY ASSESSMENTS.....	1
THE WATER QUALITY BRANCH STRATEGY FOR ASSESSMENTS OF AQUATIC ENVIRONMENTAL QUALITY.....	2
Purpose.....	2
The basin sampling unit.....	4
Design objectives and rationale.....	5
Index station network.....	6
Recurrent river-basin network.....	6
Station classification.....	7
Federal stations.....	7
Federal-provincial stations.....	8
Provincial stations.....	8
Special studies.....	8
Sampling considerations.....	8
Data management.....	9
Reporting.....	10
Basin reports.....	10
National assessment reports.....	11
Special studies reports.....	11
IMPLEMENTATION.....	11
RELATIONSHIP WITH OTHER INTEGRATED AND FEDERAL PROGRAMS.....	12
REFERENCES.....	13
APPENDIX A. Chemical parameters of common concern.....	14
APPENDIX B. Quality assurance guidelines.....	15

Abstract

Water quality assessments in Canada must address a multiplicity of water quality issues from a common scientific framework. This framework has to be sufficiently rigid to generate hard, scientifically sound data with distinct components for program design, quality assurance, data management and data interpretation, yet be sufficiently flexible to address and resolve emerging issues in many different types of aquatic environments.

The strategy presented herein is based on the river basin sampling unit using an index station network to acquire long-term water quality data sets and a recurrent basin network to address specific water quality concerns in a more dynamic manner. The combination of these two assessment tools would create a single, comprehensive water quality monitoring program across Canada, providing a data base for long-term trends, development and assessment of water quality objectives and environmental impact assessments.

Résumé

Au Canada, l'évaluation de la qualité de l'eau doit porter sur une multitude de questions dans ce domaine et se faire dans un même cadre scientifique. Ce cadre doit être assez rigide pour produire des données fiables et scientifiquement valables, avec des composantes distinctes pour la conception des programmes, le contrôle de la qualité, la gestion et l'interprétation des données, tout en étant suffisamment souple pour permettre de traiter et de résoudre les nouveaux problèmes concernant de nombreux types différents d'environnements aquatiques.

La stratégie présentée est fondée sur le bassin versant considéré comme unité d'échantillonnage qui, grâce à un réseau de stations indicatrices, permet d'obtenir des ensembles de données sur la qualité de l'eau à long terme, ainsi que sur un système de relevés périodiques par bassin ayant pour but d'étudier certains problèmes de qualité de l'eau d'une manière plus dynamique. Ces deux moyens d'évaluation, mis en oeuvre pour une même fin, amèneront la création, au Canada, d'un unique programme de contrôle de la qualité de l'eau qui sera complet et fournira une base de données rendant possible la mesure de tendances à long terme, l'élaboration et l'évaluation d'objectifs de qualité de l'eau ainsi que l'évaluation des incidences environnementales.

Water Quality Branch Strategy for Assessments of Aquatic Environmental Quality

G.D. Haffner

NEED FOR COMPREHENSIVE WATER QUALITY ASSESSMENTS

Despite the apparent abundance of water in Canada, several authors (Harvey, 1976; Johnson, 1980; Foster and Sewell, 1981) have repeatedly warned of the critical situation with respect to not only the quantity but also the quality of freshwater resources in Canada. Such warnings are a reflection of the increasing public awareness of the issues and concerns for the wise management of Canada's freshwater resources to protect and enhance their quality for use by present and future generations of Canadians. Professor F.E.J. Fry has summarized the Canadian perspective of our freshwater resources as "the great Canadian fallacy - half the world's freshwater" (Harvey, 1976). Such abundance should not preclude concern for the quality of the resource.

Many of the issues have resulted from the varied and often conflicting use of the freshwater resource, e.g., municipal and industrial water supply, waste disposal, energy production, irrigation, fishing. At least part of the problem, as Foster and Sewell (1981) point out, relates to the lack of a national policy on water resource use in Canada. Development of such a policy requires comprehensive assessments of the general state of water quality across Canada with regard to future needs and uses of the resource.

A comprehensive water quality monitoring network is a key element in any management strategy for Canada's inland water resources. In 1983, the Honourable John Roberts stated there is a "need to adopt a comprehensive ecosystem approach...a piecemeal approach to the environment simply won't work." This is obviously an area where the federal government, and specifically with water quality issues, the Water Quality Branch should take the lead initiative.

Historically, the Water Quality Branch has lacked a strategy by which each program could be implemented in a manner complementary with one another. As such, there was no integration towards a comprehensive ecosystem approach. The problem was in essence not having the resources to provide leadership and focus for water quality assessments in Canada.

Private sector and government policy decisions affecting the annual expenditure of billions of dollars are based on information derived from water quality monitoring data. Presently, these monitoring programs are conducted by numerous agencies within the federal and provincial governments. Federal monitoring activities are concentrated

in boundary areas addressing interjurisdictional issues, whereas provincial activities address local issues within provincial boundaries. The interdependence of these monitoring activities has been too often overlooked, most commonly because each is designed to meet different agency mandates, objectives and priorities.

One of the major shortcomings resulting from this lack of coordination has been the inability to provide overviews on issues of national priority such as mercury and PCBs in the Canadian aquatic environment. Such information was required as supportive material for the promulgation of regulations to control these substances nationally under federal legislation such as the Fisheries Act and the Environmental Contaminants Act.

As a result of mandate priorities, the present federal water quality monitoring network is currently limited almost exclusively to addressing water quality issues that arise in boundary areas, i.e., interjurisdictional waters. Issues, however, continue to arise which although interjurisdictional in nature, have an impact over a much larger geographical area within a particular river or lake basin. These issues cannot be adequately evaluated on a scientific basis by a network consisting of boundary water stations only.

Similarly, the present network alone cannot provide sufficient information for a Canada wide assessment of issues such as the effect of flood damage reduction, the degree of protection afforded to migratory species such as salmon or the relationship of water quality to possible future water shortages. Consequently, the 1979 Auditor General's report criticized DOE (Department of the Environment) for failing to provide assessments of "overall environmental conditions." Results from a recent study of water resources research needs in Canada identified the lack of adequate baseline data as a serious constraint on defining research needs and priorities. At least part of the problem relates to the present fragmented approach to monitoring activities among and within monitoring agencies.

A fundamental change in the federal approach to water quality assessment is proposed here. River basins are considered to be the basic sampling unit, and assessments of water quality within these units use both monitoring and survey techniques. Therefore assessments are not based on an array of sampling stations, but are based on the aquatic systems of federal and federal-provincial concern.

THE WATER QUALITY BRANCH STRATEGY FOR ASSESSMENTS OF AQUATIC ENVIRONMENTAL QUALITY

Purpose

The Water Quality Branch of Environment Canada is responsible for the development of comprehensive water quality assessments to provide scientific advice and information by

- (a) providing a continuing nation wide inventory of surface water quality,
- (b) providing data leading to an assessment of the state of aquatic ecosystem quality on local and regional scales throughout the country, and
- (c) determining trends in water quality and warning of changes or conditions that might be damaging to the aquatic environment and associated living species.

The need for such comprehensive assessments, as dictated by the cabinet in 1982, is common to the various activities of the Water Quality Branch, as described in the document "Business of the Water Quality Branch" (Water Quality Branch, 1985). These activities include interjurisdictional assessments, assessments of the quality of the Canadian environment, assessment of water quality on federal lands, governmental assessment for the development of water quality conservation practices, assessment of the exposure and effect of toxic chemicals in the aquatic system and effects of long-range transport of pollutants. The need for such information by the federal government in protecting and managing the quality of the environment, including the aquatic environment, is determined by constitutional considerations as well as legislative mandates (e.g. Government Organization Act, Fisheries Act, Environmental Contaminants Act). The Federal Policy Statement on Inland Waters (Department of the Environment, 1978) states clearly that monitoring is an essential element to the assessment and conservation of Canada's inland waters. Because of the broad mandates with respect to water quality issues and the multiplicity of data needs, data collection must be performed in a comprehensive, efficient manner, utilizing both monitoring and survey approaches.

Because of the multiplicity of data needs, the assessment strategy of the Water Quality Branch must be flexible. In general, however, there are three basic data sets that must be generated to respond to these many needs. These data sets are as follows:

- (1) Long-Term Trends. To assess change of water quality conditions over time.
- (2) Water Quality Objectives. To develop and compare the compliance of environmental quality with guidelines or objectives to protect water uses.
- (3) State of Environment and Environmental Impacts. To assess the status of water quality with respect to present issues, future concerns and/or developments.

These data requirements are best derived from joint federal and provincial activities, as both monitoring agencies have common requirements for such information. The purpose of the following strategy is to provide a framework by which such data sets can be cooperatively developed with the provinces and to improve the overall activities of the Water Quality Branch.

The Water Quality Branch of Environment Canada is the lead agency responsible for water quality assessments across Canada. The 1982 cabinet decision provided authority and resources to the Branch to negotiate federal-provincial monitoring agreements to implement efficiently a comprehensive national water quality network to improve interjurisdictional assessments and address nation wide water quality concerns. It is important to note that agreements were not intended to provide for a simple addition of monitoring stations but to be a means to improve the overall activities of the Water Quality Branch. The division of Branch activities and responsibilities between Headquarters and the Regions and between federal and provincial governments in carrying out this task is discussed in the section Implementation.

The Basin Sampling Unit

Historically, water quality assessments have been based on fixed monitoring stations where water samples were obtained at set frequencies (weekly, monthly or quarterly). Although useful as a means of developing an inventory of water chemistry data, these data were usually not adequate to determine the state of the aquatic environment or establish water quality objectives. An extension of these station arrays could eventually result in the "do everything-everywhere" syndrome of which assessment networks are commonly accused (Great Lakes Science Advisory Board, 1978), and more important, such an extension would not provide the flexibility required to determine or resolve the dynamic nature of water quality issues.

Environmental assessments can be made using either a fixed network approach or a survey (study) approach (GAO, 1981). Each method has distinct advantages and disadvantages. Often presented as exclusive alternatives, they are best considered as being complementary mechanisms to obtain environmental data. Instead of developing environmental assessments simply from fixed monitoring stations, it is better to focus on the river basin itself as the sampling unit so that assessments are based on the water bodies and the three basic data sets described earlier can be developed. The following strategy uses the river basin approach not only to provide comprehensive assessments but to assure that information will be appropriate to river basin planning and management activities (as developed under the Canada Water Act, 1970).

The strategy for water quality assessments of the Water Quality Branch is to use river basins of federal interest as the basic sampling units across Canada. Using river basins in this manner permits the use of fixed network and survey approaches as environmental quality assessment tools. Within the basin concept the two assessment tools are interactive and interdependent, permitting the comprehensive assessment of aquatic environmental quality. By this approach the data limitations discussed in the previous section are ameliorated, and a common negotiation premise (river basin) is developed on which to base federal-provincial water quality agreements. The following sections

describe the design objectives and rationale of the basin unit strategy along with data management, reporting and quality assurance components of the strategy.

Design Objectives and Rationale

The Federal Policy Statement on Inland Waters (1978) provides guidance for the development of the Water Quality Branch Assessments Strategy by stating specific areas which federal monitoring activities should address. These activities are outlined in a discussion accompanying Policy Statement Number 9.

"Federal monitoring activities are designed to identify pollution problems; to establish baseline information; to identify water quality trends on a national and regional scale; to determine whether water quality objectives are being met; to assess the effectiveness of regulatory measures in achieving the desired level of water quality; and to provide a basis for revising effluent control requirements where necessary."

Federal Policy Statement No. 9 committed DOE to monitoring the quality of water at international and interprovincial sites, Indian reserves, national parks and in other areas where there is a significant national interest. The cabinet directive of 1982, however, broadened this mandate to link federal and provincial monitoring activities to generate comprehensive aquatic environmental quality assessments. Nevertheless, monitoring activities must still meet the specific objectives of the policy statement.

To be consistent with the Policy Statement, the specific objectives of the Water Quality Branch Assessments Strategy can be stated as follows:

- (1) to determine changes and long-term trends in the aquatic ecosystem,
- (2) to detect emerging problems on a local, regional and national scale,
- (3) to determine the effectiveness of regulatory actions related to legislative controls (e.g., phosphorus limitation in detergents; bans on the importation, use and manufacture of PCBs),
- (4) to determine compliance with water quality objectives (where these have been implemented), and
- (5) to determine the need for special (cause and effect) studies.

Although it is recognized that these objectives are interrelated and that results from assessment activities might address two or more objectives simultaneously, there is a need for more than one assessment approach. For objectives 1 and 3, fixed stations are required, whereas objectives 2, 4 and 5 require a survey component in the monitoring design. Therefore, to fulfill its mandate under Federal Policy Statement 9, the Water Quality Branch has determined that the basin sampling

strategy, using both fixed station and survey approaches, is essential to fulfill its duties as described in "The Business of the Water Quality Branch" document. Therefore, the Water Quality Branch Strategy for Assessments of Aquatic Environmental Quality consists of two interdependent approaches:

- (1) Index Station Network
- (2) Recurrent River Basin Network.

The main difference between these approaches is that the former provides an assessment of long-term, average water quality conditions and seasonality, whereas the latter provides information on the environmental significance of water quality conditions. Stations to address international or interprovincial water quality issues will normally belong to the Index Station Network depending on the type of information required. Other stations developed to monitor water quality issues on federal lands or intraprovincially can belong to either category. The two approaches are to be complementary as described below.

Index Station Network

The Index Station Network consists of a network of fixed stations geographically distributed across Canada at strategic locations within key river basins and along interjurisdictional boundaries. They are sampled at regular intervals (quarterly to monthly) each year over the long term to provide baseline data on water quality conditions and an indication of changes and long-term trends in water quality at a particular location within a particular river basin system. The stations are called index stations because their location within each river basin or water body should be such that they provide an indication of change in water quality within the basin which may warrant more comprehensive water quality monitoring to determine the cause and effect of the change. Index stations should also provide an indication of improvements in water quality over the long term as a result of implemented remedial actions. Stations which are part of this network are also an integral part of the River Basin Surveys approach within each region in that basins identified for survey will usually have an index station to maintain continuity between the periods of the recurrent surveys.

Recurrent River Basin Network

A comprehensive network of fixed (permanent) stations throughout Canada would be very expensive, and similar approaches have been criticized as being relatively inefficient to meet the dynamic nature of water quality issues (GAO, 1981). Although the need for a limited fixed station (index) network exists particularly in relation to interjurisdictional monitoring activities and the need for long-term data sets, it is important that such a network be complemented by periodically recurrent surveys in individual river basins. In general, basin monitoring is directed toward understanding the behaviour of the basin

system (i.e. cause/effect relationships), determining the sources and impacts of pollution and identifying existing or emerging water quality concerns. The strategy of recurrent river basin surveys provides the capability of assessing water quality problems in a dynamic, comprehensive manner. Most important, the development of water quality objectives and the assessment of aquatic environment with respect to these objectives require a survey approach to determine areal extent, frequency of compliance and the identification of possible remedial efforts.

Basins to be surveyed and priority for implementation will be based on:

- (1) the probability that changes in water quality are occurring or will occur because of increased material input or modifications of the water course,
- (2) the need to develop background information concerning the status of ecosystem quality,
- (3) the information generated from the index station network, or other information sources such as the research community or other environmental assessment programs identifying an emerging issue,
- (4) the importance of the basin with respect to real or potential water quality concerns in boundary areas (i.e. priority issues).

Station Classification

Stations within each of these networks will be classified into three categories according to federal, federal-provincial, and provincial responsibilities.

The Index Station Network consists of federally supported stations in boundary areas and on federal lands. Jointly supported (federal/provincial) stations will be developed under the auspices of federal-provincial agreements at key locations throughout Canada. The number and location of the latter will be determined on a co-operative, cost-shared basis with each province (see Implementation).

Basin Surveys can consist of all three station categories. Data from provincial and federal-provincial stations designated under the agreements will be available to develop more comprehensive water quality assessments within a basin perspective. These data would also be useful to supplement data from the Index Station Network (particularly interjurisdictional stations) and would allow for scientific assessments of water quality at key boundary or transboundary waters.

Federal Stations

Federal stations are established by existing federal programs or requested by other federal agencies according to statutory mandates (e.g. Fisheries Act, Canada Water Act) or deemed essential for National Water

Quality Assessments. They are also established in association with interjurisdictional waters, federal lands or international commitments.

Federal-Provincial Stations

These stations are designated in joint federal/provincial agreements or where continued operation of a station would be in the common interest of both parties.

Provincial Stations

Provincial stations are necessary for provincial programs where water quality information is required for specific provincial mandates.

Special Studies

It is recognized from time to time that it may be necessary to conduct more in-depth investigations in various river basins throughout Canada to address priority national issues or regional issues within particular river basins. The rationale, design and funding mechanisms for these studies will be separate from the strategy mentioned above. The data collected as a result of these studies, however, will be useful in augmenting information developed as part of the strategy (see section on Reporting).

Sampling Considerations

Historically, federal and provincial agencies have concentrated their monitoring efforts on the measurement of ambient physical and chemical parameters using a more or less "standardized" parameter list (e.g. nutrients, major ions, metals). Although such routine monitoring has been well established in many parts of Canada, the need to expand the rationale and scope of these activities to provide a more holistic perspective and meaningful interpretation of the data has been recognized for some time. Under recommendations for monitoring in his perspectives paper on Aquatic Environmental Quality, Harvey (1976) states:

"A disproportionately large effort is devoted to monitoring water chemistry and fish physiology/toxicology and this could be reduced. The effort expended on ecosystem approaches is small and should be increased."

The concept of the "ecosystem approach" and the modified and expanded role of monitoring in such a systems approach have gained wide acceptance over the last six or seven years (Department of Fisheries and the Environment, 1978; Great Lakes Science Advisory Board, 1982; International Joint Commission, 1978). It must be emphasized that the monitoring of water quality conditions is not an end in itself and that results must ultimately be related back to the uses of the resource, the

efforts to protect these uses and the impact of water uses on the resource itself (e.g. fish and other biota). To this end assessments of the quality of aquatic environments must include physical and chemical measurements as well as biological parameters (Appendix A). This is consistent with the operation of the Water Quality Branch, as noted by Shindler (1981):

"To address environmental contamination and degradation problems, the Branch must continue to use, on a selective basis, biological techniques to complement chemical measurements and enhance water quality evaluations."

Furthermore, the use of biota and sediments to measure trends in toxic substances in aquatic systems has become a well-established analytical technique largely because of their ability to bioconcentrate these compounds that are often undetectable by routine methods in water.

Appendix A lists a series of parameters that can be used as a *general guide* in the development of the more technical design details at each monitoring station, although media sampled may be dictated by the parameters of major concern (Chapman *et al.*, 1982). This parameter list will provide coverage of the priority environmental issues of concern to DOE including nutrient enrichment (eutrophication), toxic substances and acid rain. It should, however, be emphasized that the list is not all inclusive and that there may be issues of a more local or regional concern that would require other parameters to be added to the list. Conversely, there may be no need to sample all these parameters at some stations.

Sampling frequency at each of the stations within the network will be dependent on the issue of priority concern which will dictate the location of the station, the nature of the samples (e.g., rivers vs. lakes or reservoirs) and the parameters being measured. As conditions vary considerably across the country and issues of priority concern differ from one system to another, it is not possible in this document to recommend standard sampling frequencies. These must be determined and reported in the technical designs. As a general guideline, however, sampling should reflect the seasonality and hydrology of the system to provide information to distinguish trends over the longer term from changes of a shorter term nature (Appendix B). Essentially, issues are to be addressed in an ecosystem context, and priority given to collect and integrate relevant information to provide an ecosystem perspective to environmental issues.

Data Management

A major requirement of the Water Quality Branch Assessments Strategy is the need for timely, efficient data exchange including compatible systems for storage and retrieval of information in a format

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that is useful to users of the information. It is known that a variety of independent data storage and retrieval systems already currently exist in federal and provincial monitoring agencies and that these are continuing to proliferate. Presently, there are no formal arrangements to assure uniformity and compatibility among these systems. To initiate a common approach to data management, it is recommended that NAQUADAT (National Water Quality Data Base) function as the main data storage and retrieval system for the Water Quality Branch Assessments Strategy. This will require that other systems presently in use (or being proposed) become compatible with NAQUADAT. Water Quality Branch Headquarters will be responsible for providing all participating agencies with instructions on the use of NAQUADAT and advice on how to interface the various systems. Headquarters will also be responsible for ensuring that the NAQUADAT system is modified so that data can be retrieved in a format which is useful to data users.

Development of compatible interpretive reports will also require a common format for gathering and reporting information including the application of common statistical analyses of the data so that information can be quickly assimilated.

Reporting

One of the major deficiencies of on-going routine monitoring activities in Canada has been that "a large effort is being expended on gathering data that are not fully analyzed or used. The interpretation of water chemistry data is especially weak and should be given higher priority" (Harvey, 1976).

The major products of the Water Quality Assessments Strategy of Aquatic Environments are interpretive reports of ambient water quality conditions of Canada's inland waters and the impact of water quality on uses of the water resource. These reports will provide water quality managers with information on local, regional and national water quality concerns to assist them in making rational and effective decisions with respect to the wise management of Canada's freshwater resources.

Three main types of reports are envisioned as part of the National Program.

Basin Reports

These reports will be developed using survey and fixed station data to reflect water quality conditions in the basin systems that are investigated on a recurrent basis. In particular, emphasis is placed on integrating federal and provincial data to provide a comprehensive report on basin behaviour, ambient changes in water quality, and the identification of existing or emerging water quality issues. These reports will be prepared by the Regional Offices of the Water Quality Branch in co-operation with provincial agencies. Apart from their

individual merit, the reports will serve as technical support documents for the National Assessment Reports described below.

National Assessment Reports

National Assessment Reports will be prepared annually from data collected as part of the Index Station Network, the Basin Surveys and Special Studies (where and when available). They will focus on identifying emerging problems, national trends in water quality, identification of areas where water quality has been degraded at an accelerated rate (or conversely improved as a result of implemented remedial programs), the need for remedial programs, and the development of a reference list of water quality reports written by federal and provincial agencies. National Overview Reports will not attempt to compare basins, but will focus on assessing the state of water quality conditions with regard to priority interbasin water quality issues across Canada. These reports will be developed by Water Quality Branch Headquarters personnel.

Special Studies Reports

Special studies to determine more comprehensive information on basin behaviour, localized conditions or national issue (e.g., drinking water, habitat suitability) reviews may be implemented from time to time at different locations across Canada. Although these studies may be implemented in response to concerns identified through this strategy, the rationale, design and funding of these studies may be independent. Special study reports outline the objectives of the study, rationale, design and results. Quality assurance and data management protocols, similar to those outlined below for the Water Quality Branch Assessments Strategy, must also apply to these studies so that data are compatible and may be integrated with data collected as part of a cohesive effort to provide more comprehensive assessments of areas in which these studies have been implemented.

IMPLEMENTATION

The development and implementation of the Water Quality Branch Strategy are based on the premise that both federal and provincial levels of government have overlapping responsibilities and need for collecting water quality monitoring data. Through the coordination and integration of these monitoring activities there is the opportunity to make more rational and effective use of existing resources. The product of this coordination and integration is to provide both levels of government with a more comprehensive picture of water quality conditions and problems on a local, regional and national scale. Providing a national overview of water quality conditions across Canada requires that there be some commonality in approach among the many federal and provincial monitoring activities to ensure data compatibility for interpretive and reporting purposes.

As a result of the cabinet directive of 1982 it is important that the Water Quality Branch assures its monitoring activities (international interprovincial, federal lands etc.) are implemented in a manner consistent with the need for comprehensive assessments. Water quality monitoring stations developed under each activity will be identified as part of the index station network or the recurrent basin surveys. Data collection, analysis and interpretation will be performed such that results are compatible and useful not only for site specific problems but also for national issues or concerns. The success of comprehensive assessments will be dependent on determining federal and provincial monitoring concerns, and on the awareness of the provincial agencies of how national or interjurisdictional assessments can be of use in addressing their own water quality issues.

Recently, a number of provinces made requests for federal-provincial cost-sharing agreements for water quality monitoring networks, analogous to the agreements now in effect for hydrometric and meteorological networks. The federal government in its 1978 Policy Statement on Inland Waters declared its willingness to negotiate agreements with all the provinces to share the cost of monitoring networks according to the proportionate value of the data to the federal government and to the province. Such agreements would inevitably provide for the exchange and use by both levels of government of all water quality data, whether funded by the provincial or federal government or both.

Specific technical design details for the Recurrent Basin Networks and the Index Station Network will be developed jointly by Regional and Headquarters staff of the Water Quality Branch in cooperation with the provinces in accordance with the general framework, objectives and design considerations outlined in this document. In addition to the responsibilities with respect to reporting previously outlined, the Regional Offices of Water Quality Branch will be responsible for operation of that portion of the networks within their region in cooperation with provincial agencies. The main responsibility at Headquarters will be to ensure overall compatibility and co-ordination of this strategy and the maintenance of a centralized data storage, and to report on the quality of Canada's water resources.

RELATIONSHIP WITH OTHER INTEGRATED AND FEDERAL PROGRAMS

The implementation of the foregoing strategy will generate comprehensive assessment of water quality issues in a basin perspective. Although this strategy will provide a common foundation and information base for more specific assessments such as the long-range transport of airborne pollutants, toxic chemicals, and environmental impact statements, these activities will need to be supported by resources assigned specifically to them.

Information collected within the basin strategy will be complemented as noted in the text by special studies which might be used to provide linkage to other monitoring activities to assure compatibility of overall assessments. Generally, aquatic environmental assessments developed from this strategy will provide managers of environmental programs and managers of renewable resources programs with overview water quality information from national, regional and provincial perspectives. Additional monitoring is required to advance these other programs and must be supported by new resources.

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APPENDIX A

CHEMICAL PARAMETERS OF COMMON CONCERN

Group	Parameters	Issues addressed		
		Eutrophication	Contaminants	Utility
Physical	Temperature	W	-	W
	Dissolved oxygen	W	-	W
	Transparency	W	-	W
	Colour	W	-	W
	Turbidity	W	-	W
Major ions	Suspended solids	W	W	W
	Conductivity	W	-	W
	pH	W	W	W
	Alkalinity	W	W	W
	Total N (TKN + NO ₃ + NO ₂)	W	-	W
Nutrients	Total P	W	-	W
	SiO ₂	W	-	W
	Ca	W	-	W
	Mg	W	-	W
	Na	W	-	W
	K	W	-	W
	Cl	W	-	W
	SO ₄	W	-	W
	Fe	-	W/S/B	-
	Mn	-	W/S/B	-
Metals	Al	-	W/S/B	-
	Hg	-	W/S/B	-
	As	-	W/S/B	-
	Cd	-	W/S/B	-
	Cu	-	W/S/B	-
	Pb	-	W/S/B	-
	Ni	-	W/S/B	-
	Zn	-	W/S/B	-
	PCBs	-	W/S/B	-
	Phenols	-	W/S/B	-
Organics	εDDT	-	W/S/B	-
	Aldrin/dieldrin	-	W/S/B	-
	Endrin	-	W/S/B	-
	Parathion	-	W/S/B	-
	Diazinon	-	W/S/B	-
	Chlordane	-	W/S/B	-
	Lindane	-	W/S/B	-
	Heptachlor	-	W/S/B	-
	Methoxychlor	-	W/S/B	-

Media sampled: W - Water
 S - Sediment
 B - Biota

APPENDIX B

QUALITY ASSURANCE GUIDELINES

Monitoring data must be of acceptable quality. The dissemination and use of data of poor or unknown quality can lead to confusion and incorrect decisions with regard to environmental standards and regulatory actions. Sound and viable quality assurance is an essential element of this program.

Each co-operating agency must implement certain quality assurance elements to ensure data credibility for every monitoring project. A monitoring project includes all monitoring effects generating data to address a specific objective, e.g., a whole lake assessment or trend analysis for all lakes. Quality assurance ensures uniform and acceptable data for all aspects of a monitoring program.

The duties and responsibilities of those managing or supervising quality control must be defined within the agency for the National Water Quality Assessment Program. Each agency is responsible for the definition and implementation of quality control in its contracted monitoring projects.

1. A quality assurance co-ordinator(s) shall be designated by each agency for each monitoring project to participate in the evaluation of quality control and to ensure that it is being performed.
2. Documented sample collection procedures shall be available for and implemented by each agency to assure valid and representative samples for surface waters, point source discharges, fish, sediments and other components.
3. Approved field measurement methodologies for each monitoring project shall be used. Calibration and preventive maintenance will be established and maintained by each co-operating agency. Records are to be kept of such calibrations and maintenance.
4. Sample preservation protocol will be established and documented by each agency.
5. A uniform source of sample containers shall be established by each co-operating agency and sufficient quality control will be established to assure the appropriateness of the containers for each monitoring project.
6. Sufficient numbers of field and laboratory personnel trained in the quality control practices shall be available for each project.
7. A co-operating laboratory will keep records on sample handling practices, consistent with the field record-keeping practices (6) to maintain data credibility.

8. Each agency will maintain documentation and records of instrument calibration and maintenance in its laboratory. Protocol will be established and upheld to ensure the use of designated laboratory materials (distilled water) and purchased materials (microbiology media and membrane filters for dissolved chemical constituents).
9. Each co-operating agency will utilize and document appropriate methodologies for each monitoring project.
10. Intralaboratory audits of "two sample controls," "spiked" samples, replicate analyses and reagent blanks are to be utilized, recorded, summarized and documented by each laboratory to ensure intralaboratory audits can be used to document data quality.
11. Interlaboratory audits of independently prepared standard reference samples are to be used. These samples may be used as often as three times per month. Interlaboratory materials examine the accuracy of a laboratory's daily intralaboratory quality control program.
12. Each agency laboratory must participate in the testing of performance sample programs. Results should be documented as part of an agency's quality assurance program and they can often replace one of the intralaboratory audits (10).
13. A quality assurance program should ensure that only data meeting the acceptance criteria are used and reported for each monitoring project. Data in computerized storage systems must be verified just as the actual field and laboratory results.
14. Each project should be properly described in the data base so that historical information on project objectives, rationale, sampled media and project officer, and project report will remain pertinent for future data interpretation (e.g. long-term trends).

