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Evaluation of the Hydrological Service and Water Survey

Final Report

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Acronyms used in the report

AANDC	Aboriginal Affairs and Northern Development Canada
ADM	Assistant Deputy Minister
BOM	Bureau of Meteorology (Australia)
CESD	Commissioner of the Environment and Sustainable Development
DG	Director General
EC	Environment Canada
FTE	Full Time Equivalent
F/P/T	Federal / Provincial / Territorial
HSWS	Hydrological Service and Water Survey
ISO	International Organization for Standardization
MSC	Meteorological Service of Canada
NAT	National Administrators Table
NHP	National Hydrometric Program
NGO	Non-Governmental Organization
NIWA	National Institute of Water and Atmospheric Research (New Zealand)
NHPCC	National Hydrometric Program Coordinators Committee
OGD	Other Government Department
PAA	Program Alignment Architecture
PMF	Performance Measurement Framework
QA	Quality Assurance
QC	Quality Control
QMS	Quality Management System
RHBN	Reference Hydrometric Basin Network
UNESCO	United Nations Educational, Scientific and Cultural Organization
USGS	United States Geological Survey
WMO	World Meteorological Organization
WSC	Water Survey of Canada

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The evaluation project team was led by Michael Callahan, under the direction of William Blois, Director of the Evaluation Directorate, Environment Canada, and included Lindsay Fitzpatrick.

The evaluation was conducted by Kelly Sears Consulting Group on behalf of the Evaluation Directorate, Audit and Evaluation Branch, Environment Canada.

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Executive Summary

This report presents the results of the evaluation of the relevance and performance of the Hydrological Service and Water Survey (HSWS) program (sub-program 1.2.3 of the departmental Program Alignment Architecture (PAA)) conducted by Kelly Sears Consulting Group and Environment Canada's Evaluation Directorate, Audit and Evaluation Branch, between January and November 2013. The evaluation covered the five years from 2008-2009 to 2012-2013.

This evaluation is part of EC's 2012 Risk-based Audit and Evaluation Plan which was approved by the Deputy Minister. The evaluation was conducted in order to meet the coverage requirements of the Treasury Board of Canada *Policy on Evaluation*, which require that all direct program spending be evaluated at least once every five years.

1. Program Profile

The HSWS consists primarily of the Water Survey of Canada (WSC), which is the federal component of the National Hydrometric Program (NHP). The WSC is overseen by EC's Meteorological Service of Canada (MSC). In addition, sub-program 1.2.3 includes the Hydrological Service, a smaller area of activity of the MSC which involves hydrological science, applications of hydrological data (including modeling) and related services.

The NHP is responsible for collecting, interpreting and disseminating standardized information about surface water levels and flows (water quantity) across Canada. Under the authority of the *Canada Water Act*, the federal, provincial and territorial governments entered into bilateral agreements, established in 1975 and currently being updated, to manage the funding and provision of water quantity monitoring services, on a cost-shared basis. The WSC operates 2,783 water gauging stations in partnership with the provinces, territories and other agencies, and maintains a database containing historic data from an additional 5,577 inactive stations for the country. Each water gauging station is designated as either federal, federal-provincial/territorial or provincial/territorial, according to national classification guidelines agreed to by all parties. The federal government pays for the operational costs and recovers the appropriate share from each party based on the station designations.

The WSC's hydrometric data are used in the analysis, modelling and forecasting of water flows and levels, and such information is used as an input to the design and management of water-related activities in a wide range of sectors. Examples of areas of application include flood risk management, emergency response management, water resources planning, water allocation, infrastructure planning and design, environmental monitoring and management, analysis of climate change and long-term weather effects, power generation and recreational uses of waterways.

Total annual expenditures by the HSWS during the period of the evaluation peaked at \$35.4 million in 2009-10 and fell in each of the subsequent years, to \$32.4 million in 2012-13. Over 40% of these costs were recovered from F/P/T partners each year, and the amounts recovered increased steadily, from \$13.3 million in 2008-09 to \$15.5 million in 2012-13.

2. Evaluation Methodology

The methodology for the evaluation involved:

- A review of program documents and performance data.
- A literature review of the rationale for, and benefits of, public sector delivery of hydrometric programs, and the design of comparable programs in selected other jurisdictions.

- Key informant interviews with 58 representatives of the program at headquarters and in the regions, F/P/T partners and secondary users of hydrometric data in the public, private and university sectors.

3. Findings and Conclusions

3.1 Relevance

All lines of enquiry found there to be a continuing need for timely, consistent and reliable hydrometric data, and that the demand for these data is increasing. Factors that contribute to the growth in demand include:

- An increased frequency and severity of extreme weather events, with implications for flood planning and emergency management.
- The complexity of climate change analysis.
- Increased rates of resource development, particularly in remote areas.
- Population growth giving rise to needs for new and renewed infrastructure.
- More intense use of agricultural land and water resources.

Responsibility for water resources is shared between federal, provincial and territorial governments. Federal collection and provision of hydrometric data supports the federal responsibilities for navigable waters, fisheries, international and intra-national boundary waters, federal lands, federal facilities, and First Nations reserves as well as duties under the *Fisheries Act* and *Canadian Environmental Protection Act*. Provincial and territorial governments have lead responsibility for water management and protection within their respective boundaries, and have requirements for hydrometric data similar to those of the federal government.

The *Canada Water Act* provides an enabling framework for the NHP, under which the WSC collects, interprets and disseminates hydrometric data on behalf of the federal, provincial and territorial signatories to bilateral agreements. Federal or shared F/P or F/T gauging stations in the national network (approximately 46% of the total) respond directly to federal government needs and priorities for hydrometric data. There is, however, some flexibility in the application of the *Canada Water Act* and the 1987 Federal Water Policy as to what constitutes federal obligations with respect to hydrology monitoring in Canada. Provision of hydrometric data by the HSWS aligns with EC's Strategic Outcomes relating to conservation and restoration of Canada's natural environment and enabling Canadians to make informed decisions on changing weather, water and climate conditions. These departmental outcomes are intended to contribute to the Government of Canada outcome, A Clean and Healthy Environment.

3.2 Performance – Efficiency and Economy

The design of the Hydrological Service and Water Survey program (hereafter referred to as “the program”) is widely considered to be appropriate for achieving its intended outcomes. The program's design and delivery focuses on a set of core activities that ensure appropriate hydrometric data are made available for use in water management decisions. These core activities and supporting systems, such as the Quality Management System (QMS), are consistent with published commentary regarding the requirements for an effective hydrological monitoring program.

Separation of responsibilities and budgetary authorities between headquarters and the regional operations of the MSC presents a challenge for the integration of HSWS planning and management. More broadly, at the level of the NHP, the WSC functions as a national organization working on behalf of the F/P/T partners to satisfy the separate and joint needs of the partners in a cost-effective way. This approach enables national and P/T priorities and directions to be integrated. The NHP governance structure is widely perceived as

being particularly effective, in that it provides a national framework to integrate national and P/T priorities while allowing for flexibility in arrangements with individual provinces and territories. Data collection and provision by a single national service provider enables economies of scale that could not be achieved by independent F/P/T entities. Also, and perhaps more importantly, because water flow is not directly measured and requires hydraulic interpretation, a single agency approach allows for consistency in estimation techniques, systematic improvements to the engineering and national standards for comparison across provinces and territories.

The introduction of digital data collection and telemetry technologies, and the deployment of the new hydrometric workstation for managing the production and interpretation of data are transforming the way hydrometric data are collected, interpreted and disseminated. The majority of the 1,875 real-time stations (67% of the stations in the NHP network) are capable of producing preliminary real-time data within 2-3 hours of initial data capture at these stations. These changes are having a major impact on the way the WSC operates and are expected to lead to improvements in the efficiency of the program as it completes the current transition.

Four areas of weakness were identified in the efficiency and economy of the HSWS:

- Gaps in the program's professional (engineering and scientific) staff and management/supervisory ranks are limiting the program's ability to produce the required hydrological reports, meet transboundary commitments, undertake critical data analysis projects, and provide support for operational activities.
- Program managers and staff have limited direct contact with secondary users, outside of major users such as the F/P/T partners, and do not have a good understanding of current and emerging needs amongst secondary users of hydrometric data, how and why they are using these data, and overall trends in demand. The role of liaison with the stakeholder community is currently being reformulated within the MSC and is largely the responsibility of performance and planning groups in the MSC, not the HSWS.
- Key performance measures and indicators for the program's principal outputs and outcomes have been defined but the program is not producing regular performance data to report on program-wide performance and does not have a logic model that could aid the selection or confirmation of performance measures and indicators.
- The program has not been able to fully achieve its target of delivering validated, archived water level and flow data within four months of the end of each calendar year.

3.3 Performance – Effectiveness

For the purposes of the evaluation, performance against three intended outcomes was assessed. In the absence of a program logic model, these outcomes were taken from the Expected Result in the Performance Measurement Framework for the PAA and the objectives of the QMS.

- (a) Canadians and their institutions have the hydrological data, information and knowledge they need to make water management decisions.** There are two dimensions to this outcome – performance of the current network and the extent to which the network density (number of stations and their locations) is sufficient to satisfy user needs. Users of data from the current network of gauging stations are highly satisfied with the quality and completeness of the available data, particularly the real-time data. Users of archived data were satisfied but would like to see more timely production of such data. At the same time, however, studies of network adequacy and feedback from the key informants indicate that network density is not keeping up with demand. The most recent such study, commissioned in response to a 2010 Commissioner of the Environment and Sustainable Development (CESD) audit recommendation to

determine the optimum number of stations, compared the current network density of the NHP to World Meteorological Organization (WMO) guidelines. This study, published in June 2013, concluded that about 12% of Canada's terrestrial area is adequately covered by the existing network of stations, 49% is poorly gauged and about 39% is ungauged. The study's authors estimated that over 5,000 additional stations could potentially be required.¹ Further work is necessary to develop a more refined assessment of optimal network density and gaps, taking into account additional parameters that were not included in the WMO physiographic units, such as ecological, social and economic factors that influence network planning. Analysis of this kind, in combination with a detailed analysis of the current and emerging demand for hydrometric data, could enable the program partners to establish network priorities.

(b) A credible, sustainable national hydrometric monitoring program is maintained and supported. The program was generally perceived to be credible by many of the program and partner representatives, in that it is producing data that satisfy quality assurance requirements and are consistent and comparable over time and between different parts of the country. The results of ISO audits also indicate that the program's QMS is meeting ISO certification requirements. The ability of the program and its F/P/T partners to maintain this credibility will depend, in part, on the extent to which the network of stations can be optimized and developed in response to current and expected future demand for hydrometric data.

(c) The National Hydrometric Program is well managed according to established international operational criteria. The program is generally perceived to be well managed, as evidenced by the effectiveness of the NHP governance structure and bilateral agreements, the technical expertise and responsiveness of staff, and the effective introduction and maintenance of its ISO certification. However, as noted in section 3.2, the HSWS is experiencing some challenges related to program management (e.g., human resources planning, performance reporting) that will need to be addressed.

4. Recommendations

The recommendations of the evaluation of the Hydrological Service and Water Survey program are addressed to the Assistant Deputy Minister (ADM) Meteorological Service of Canada, as the ADM responsible for the two directorates accountable for program management and delivery, Weather and Environmental Monitoring, and Weather and Environmental Operations.

Recommendation 1: Develop a program logic model and performance measurement strategy to guide performance measurement and reporting.

Recommendation 2: Investigate and implement ways to improve the program's understanding of user needs and demand trends in order to support a risk-based approach for the ongoing management of the network of gauging stations.

Recommendation 3: Review the current approach to human resource planning and staffing for professional and management positions, and develop an integrated program-wide plan to guide the attraction, retention and deployment of such staff.

5. Management Response

The responsible ADM agrees with all three recommendations and has developed a management response that appropriately addresses each of the recommendations. The full management response can be found in section 6 of the report.

¹ Coulibaly, P., J. Samuel, A. Pietroniro, and D. Harvey, 2013, "Evaluation of Canadian National Hydrometric Network Density Based on WMO 2008 Standards", Canadian Water Resources Journal, v. 38, no. 2.

1.0 Introduction

This report presents the findings of the Evaluation of the Hydrological Service and Water Survey program, which was conducted between January and November 2013 by Kelly Sears Consulting Group and Environment Canada's (EC) Evaluation Directorate, Audit and Evaluation Branch. The evaluation covered a five-year period from 2008-2009 to 2012-2013.

The remainder of the document is organized as follows: Section 2.0 provides a brief profile of the Hydrological Service and Water Survey. Section 3.0 presents the evaluation design, including the purpose and scope of the evaluation, as well as the approach and methods used to conduct the evaluation. Section 4.0 contains the findings for each of the evaluation questions. Section 5 presents the conclusions regarding the relevance and performance of the program and Section 6 presents the recommendations and management response.

2.0 Context for the Evaluation

2.1 Program Profile

2.1.1 Sub-program 1.2.3

The Hydrological Service and Water Survey (sub-program 1.2.3 of the EC Program Alignment Architecture (PAA) and hereafter referred to as "the program") consists primarily of the Water Survey of Canada (WSC), which is the federal component of the National Hydrometric Program (NHP). The WSC is overseen by EC's Meteorological Service of Canada (MSC). In addition, sub-program 1.2.3 includes the Hydrological Service, a smaller area of activity of the MSC, which involves hydrological science, applications of hydrological data (including modeling) and related services.

2.1.2 EC's Mandate, Responsibilities and Key Clients for the Program

In Canada, the provinces, Yukon and Northwest Territories have the primary jurisdiction over most aspects of water management and the protection of water resources. The federal government's role in water management is established by proprietary rights over navigable waters, fisheries, inter-jurisdictional and boundary waters, federal lands and water, First Nations reserves, resource management in Nunavut, and some aspects of environmental protection. Additionally, the federal government may also intervene in water resources management matters, if it so chooses, using its residual powers under the Constitution. The Minister of the Environment has primary responsibility for leading the federal government's powers and duties with regard to water management. At the same time, a number of other Ministers and departments have secondary responsibilities for particular aspects of water management, including but not limited to Aboriginal Affairs and Northern Development Canada (AANDC), Agriculture and Agri-Food Canada, Fisheries and Oceans Canada, and Natural Resources Canada.

The basis for Environment Canada's mandate with regard to water quantity measurement is primarily established by the *Canada Water Act*. The Act specifies that the Minister of the Environment:

- May enter into collaborative arrangements with provincial governments relating to water resources and their utilization;
- May conduct, or provide for the conduct of research, collection of data, and establishment of inventories respecting any aspect of water resource management; and

- Shall directly undertake any water resources program with respect to federal waters, and inter-jurisdictional waters (within Canada) and international or boundary waters where there is a significant national interest.²

Other key federal legislation, arrangements, and initiatives that have a bearing on water management or require hydrometric data to inform actions include:

- *Fisheries Act*, 1985
- *Canada Shipping Act*, 2001
- *Canadian Environmental Protection Act*, 1999
- *Canadian Environmental Assessment Act*, 1992
- *Navigable Waters Protection Act*, 1882
- *Arctic Waters Pollution Prevention Act*, 1970
- *International Boundary Waters Treaty Act*, 1909
- *International River Improvements Act*, 1955
- Great Lakes Water Quality Agreement
- Federal Action Plan on Clean Water
- Canadian Environmental Sustainability Indicators initiative.

The current Federal Water Policy, established in 1987, noted that the need for reliable and cost-effective data gathering systems to support water management had increased, as too had the complexity of managing water resources. The policy included commitments to produce reliable and timely data and information on the quantity of water resources in collaboration with the provinces and territories, and to extend data programs into northern and remote regions of the country.

In November 2011 Environment Canada commissioned the Canadian Water Resources Association (CWRA) to review federal responsibilities and interest in water quantity monitoring and propose a risk-based approach for determining federal water monitoring priorities.³ The CWRA noted that federal roles in water quantity monitoring are either:

- *Federal* – encompassing monitoring requirements as specified in federal legislation, international commitments, and federal priorities requiring water quantity information.
- *Federal/Provincial or Federal/Territorial* – encompassing monitoring requirements under federal-provincial or federal-territorial agreements or to satisfy priorities requiring water quantity information.⁴

Four criteria were developed by CWRA to guide the review and allocation of federal, federal-provincial/territorial and provincial/territorial designations to water quantity monitoring stations – which then provide the basis for determining the sharing of costs. These criteria are: (1) legal or legislated obligations, (2) global (international) commitments, (3) inclusion in the existing Reference Hydrological Basin Network (RHBN)⁵, and (4) Environment Canada priorities.⁶ The WSC proposes to apply these criteria, in collaboration with its P/T partners, to review the current F/P/T designations of water gauging stations and underpin future planning and development of the national network of stations. However, in order to apply the criteria as intended, specific policy guidance from

² Sections 4, 5, 6 and 7, *Canada Water Act*, 1985. (laws-lois.justice.gc.ca/PDF/C-11.pdf)

³ Canadian Water Resources Association. December 2012. *Canada Wide Hydrometric Program: Federal Responsibilities and Interest*.

⁴ *Ibid*, p. 33.

⁵ The RHBN provides water availability information to support efforts to understand regional water supplies and the impacts of climate change.

⁶ Canadian Water Resources Association, December 2012. *Canada Wide Hydrometric Program: Federal Responsibilities and Interest*, pp. 34-35.

Environment Canada will be needed to clarify the departmental priorities to which the WSC should respond.

The WSC's hydrometric data are used in the analysis, modelling and forecasting of water flows and levels, and such information is used as an input to the design and management of water-related activities in a wide range of sectors. Common applications include flood planning, floodplain mapping, flood warnings and emergency response management, water resources planning and management, water allocation, infrastructure planning and design, environmental assessments, environmental monitoring and management, analysis of climate change and long-term weather effects, power generation, and navigation and recreational uses of inland waterways.

The primary users of the hydrometric data generated by the NHP are the federal, provincial and territorial (F/P/T) partners to the bilateral agreements established with Environment Canada. Each of the partners establishes data collection priorities that are based on assessments of data needs of the departments within the respective governments that then form the basis for annual work plans and the apportionment of operating costs. These F/P/T partners are Environment Canada's key clients for the program.

A significant amount of demand for hydrometric data originates with a secondary group of clients, including municipal governments, non-governmental organizations, private industry, academic researchers and the general public. In many instances, the needs for hydrometric data among these secondary users are a function of regulatory, planning and monitoring requirements established by federal, provincial and territorial governments. Other determinants of demand from secondary users include the planning, monitoring and emergency management needs of local and regional government bodies, data needs for water resources research and modelling, and data to improve planning for recreational uses of waterways. Secondary users are unlikely to be concerned whether the data they use come from a federal, federal-provincial/territorial or provincial/territorial gauging station as their data requirements are typically focused on a particular waterway or basin.

Secondary users are able to access the internet-based hydrometric data dissemination system that was established to serve the primary users. Access to, and data downloading from, the system by the secondary users has a minimal impact on the provision of data to primary users and a minimal cost to the program while leading to significant public benefits.

2.1.3 Operational Activities and Management

Under the authority of the *Canada Water Act*, the NHP is carried out through bilateral agreements between EC and each of the provinces and Yukon, and with AANDC on behalf of Nunavut and the Northwest Territories. The NHP is intended to provide a systematic and standardized approach to the collection, interpretation and dissemination of real-time and historical data on the velocity, discharge, volume and other physical parameters of surface waters and surface water bodies.⁷

Under the bilateral agreements, established in 1975 and now in the process of being updated, water quantity data collection and dissemination are co-funded in accordance with data priorities and the requirements established by the partners to each agreement. Each water gauging station is designated as either federal, federal-provincial/territorial or provincial/territorial, according to national classification guidelines agreed to by all parties.

⁷ Environment Canada, Background: National Hydrometric Program.

The federal government pays for the operational costs initially and then recovers the appropriate share from each party based on the station designations. Costs for stations classified as federal/provincial or federal/territorial are shared on a 50/50 basis. The program has been continuously operated, in general, by the federal government (i.e., the WSC) since 1908, except in Quebec, where the province took over the responsibility in 1963.

The WSC operates a network of 2,783 stations in Canada and maintains a database containing historic data for an additional 5,577 inactive (discontinued) stations for the country, in partnership with the provinces, territories and other agencies. Data from the 5,577 inactive stations are stored with the active-station data in the national hydrometric database. Most of the active stations are located in the southern half of the country, where the population and economic pressures are greatest. The WSC has a formal Quality Management System (QMS), certified by the International Organization for Standardization (ISO), to guide the planning and management of its operations. Data collected by the NHP are housed in two databases maintained by EC:

- HYDEX – contains inventory information pertaining to active and inactive water gauging stations in Canada including their locations, equipment and type(s) of data collected.
- HYDAT – contains all of the water data collected through the NHP for all active and inactive stations listed in HYDEX. These data include daily and monthly mean flow, water level and sediment concentrations for stations across Canada.

Management and delivery of the program is split between regional and headquarters units. At the regional level, the WSC offices in MSC Operations manage relationships with the P/T partners, undertake network planning and operation, serve on inter-jurisdictional committees and control boards, collect and produce data in accordance with national standards, disseminate preliminary and final (archived) data, and respond to user enquiries. At the headquarters level, the Water and Climate Services Division of the MSC provides national leadership for the program, development and maintenance of the QMS and data standards, equipment evaluation and selection, development of hydrological applications and services, website management, data archiving via HYDEX and HYDAT, and asset management services.

2.2 Governance Structure

2.2.1 Internal Governance

Overall accountability for PAA element 1.2.3 rests with the ADM of the MSC. Headquarters staff (Water and Climate Services Division) report to the Director General (DG) Weather and Environmental Monitoring, while regional staff report through their regional directors to the DG Weather and Environmental Operations. Functional management is provided by the DG Weather and Environmental Monitoring.

2.2.2 External Governance

Under the 1975 bilateral agreements, there is a National Administrators Table (NAT) and coordinating committees for the management of the NHP. The NAT is made up of F/P/T administrators of the bilateral agreements on hydrometric monitoring and one national administrator designated by EC. Administrators (usually federal and provincial civil servants) set up a coordinating committee (with F/P/T representatives) in each province and territory to plan and oversee network operations. The roles and responsibilities of these structures are set out in the agreements. The following provincial, territorial and

federal departments participate in the work of the NAT and associated coordinating committees.

Provincial Partners:

- Alberta - Department of Environment
- British Columbia - Ministry of Environment
- Manitoba - Water Stewardship
- Newfoundland and Labrador - Department of Environment and Conservation
- New Brunswick - Department of Environment
- Nova Scotia - Department of Environment
- Ontario - Ministry of Natural Resources
- Prince Edward Island - Department of Environment, Energy and Forestry

- Quebec - Ministry of Sustainable Development, Environment and Parks
- Saskatchewan - Watershed Authority

Territorial Partners:

- Northwest Territories (NWT) - Department of Environment and Natural Resources
- Nunavut - Department of Environment¹
- Yukon Territory - Department of Environment

Federal Partner:

- Aboriginal Affairs and Northern Development Canada (AANDC)

1. AANDC currently represents Nunavut. Devolution of water rights to the NWT occurred on April 1, 2014.

2.3 Resource Allocation

The financial resources and full-time equivalents (FTEs) allocated to the Hydrological Service and Water Survey for the five-year timeframe of this evaluation are presented in Table 1.

Table 1: Hydrological Service and Water Survey – 2008-09 to 2012-13 Expenditures

	2008-09	2009-10	2010-11	2011-12	2012-13	Total
FTEs	212.74	227.43	234.3	219.83	230.23	
Salaries	\$8,015,953	\$9,491,339	\$9,117,623	\$8,906,437	\$8,982,652	\$44,514,004
O&M	\$8,156,666	\$8,396,369	\$7,434,793	\$7,427,771	\$6,849,073	\$38,264,672
Capital	\$2,366,124	\$3,420,848	\$3,724,244	\$2,946,344	\$1,065,351	\$13,522,911
Sub-total	\$18,538,743	\$21,308,556	\$20,276,660	\$19,280,552	\$16,897,076	\$96,301,587
VNR¹ - Salary	\$6,926,105	\$7,258,799	\$7,628,660	\$7,304,935	\$7,797,741	\$36,916,240
VNR - O&M	\$6,095,753	\$6,725,096	\$6,326,855	\$6,857,074	\$7,507,936	\$33,512,714
VNR - Capital	\$229,196	\$86,629	\$113,843	\$335,418	\$178,281	\$943,367
Sub-total	\$13,251,054	\$14,070,524	\$14,069,358	\$14,497,427	\$15,483,958	\$71,372,321
<i>(% of Total)</i>	<i>(42%)</i>	<i>(40%)</i>	<i>(41%)</i>	<i>(43%)</i>	<i>(48%)</i>	<i>(43%)</i>
Grand total	\$31,789,797	\$35,379,080	\$34,346,018	\$33,777,980	\$32,381,034	\$167,673,908

Source: Environment Canada, Finance Branch, January 14, 2013 (2008-09 expenditures and FTEs for 2008-09 to 2012-13) and *Annual Report – 2012-13*, presentation to the NAT by the Director, Water and Climate Services, October 2013 (2009-10 to 2012-13 expenditures).

1. Vote Netted Revenue (VNR) amounts are those that were cost-recovered from F/P/T partners.

2.4 Expected Results and Performance Measurement

As a program-specific logic model and performance measurement strategy for the Hydrological Service and Water Survey are not currently available, it was determined in consultation with program management that the program’s performance would be assessed against the existing outputs, outcomes and associated indicators as described below.

The department’s 2012-13 Performance Measurement Framework (PMF) includes performance indicators for one expected result and three outputs for this PAA element:

Expected Result:

- Canadians and their institutions have the hydrological data, information and knowledge they need to make water management decisions. (Performance indicator: Level of satisfaction of primary users with Environment Canada data and services.)

Outputs:

- Real-time hydrometric data. (Indicator: % of preliminary water level and discharge data that are available via the Internet for real-time hydrometric stations within 24 hours of occurrence.)
- Archived hydrometric data and streamflow statistics. (Indicator: % of water level data and estimated flow values for all active hydrometric stations within four months of collection.)
- Scientific studies and reports related to hydrological requirements for transboundary basins. (Indicator: Number of studies and reports published per year.)

In addition, performance data are collected as part of the MSC's QMS, which is a requirement of the MSC's ISO 9001 certification⁸ but independent of the departmental PMF. Key QMS objectives are:

- Canadians have reliable and timely access to hydrometric data and information from across Canada. (Primary indicators are the same as those for the production of real-time and archived data, above.)
- A credible, sustainable national hydrometric monitoring program is maintained and supported. (Primary indicators: feedback from user communities, focusing on satisfaction among F/P/T partners, and results of ISO and program quality assurance (QA) audits.)
- The National Hydrometric Program is well managed according to established international operational criteria. (Indicators relate to rate of life cycle management of infrastructure, maintenance of workforce competencies, timeliness of partner contribution arrangements for cost recovery, and timeliness of delivery of annual reports required by the bilateral agreements.)

3.0 Evaluation Design

3.1 Purpose and Scope

The evaluation assessed the relevance and performance (effectiveness, efficiency and economy) of the Hydrological Service and Water Survey and covered the five years from 2008-2009 to 2012-2013. An evaluation of the Hydrological Service and Water Survey is part of EC's 2012 Risk-based Audit and Evaluation Plan which was approved by the Deputy Minister. The evaluation was conducted in order to meet the coverage requirements of the Treasury Board of Canada *Policy on Evaluation*, which require that all direct program spending be evaluated at least once every five years.

The evaluation focused primarily on the Hydrological Service and Water Survey in the context of the WSC as the single national organization responsible for the collection, interpretation and dissemination of hydrometric data on behalf of EC, AANDC and the provincial and territorial government partners in the NHP. The operations of the WSC are jointly funded by EC and the F/P/T partners. The scope also included the WSC's role in

⁸ The ISO 9000 family addresses various aspects of quality management based on eight management principles: customer focus, leadership, involvement of people, process approach, system approach to management, continual improvement, factual approach to decision making, and mutually beneficial supplier relationships. ISO 9001 sets out the criteria for a quality management system.

the governance of the NHP, but excluded a detailed assessment of NHP management performed specifically by P/T jurisdictions. The evaluation follows two recent audits: Monitoring Water Resources (September 2010) conducted by the Commissioner of the Environment and Sustainable Development (CESD); and the Audit of the National Hydrometric Program (March 2010) conducted by the Internal Audit Directorate, Audit and Evaluation Branch of EC. The evaluation took the findings of these audits into account in order to avoid duplication of data collection activities and to minimize respondent burden. The nine evaluation questions examined, and associated indicators and data sources, are presented in Annex 1.

3.2 Evaluation Approach and Methodology

Data collection and analysis for the evaluation involved:

- **Document Review:** A review of documentation relating to the relevance and performance (effectiveness, efficiency and economy) of the Hydrological Service and Water Survey, building on the material contained in the two earlier audit reports published by EC's Internal Audit Directorate, Audit and Evaluation Branch, and the CESD in 2010. Documents included *Canada Water Act* annual reports, departmental planning and performance reports, internal planning and operational documents, financial data, and a limited amount of performance data extracted from program databases, in addition to the two 2010 audit reports. The document review addressed all nine evaluation questions.
- **Literature Review:** Published and grey literature relating to the rationale for, and benefits of, public sector delivery of hydrometric programs, and the design and performance of comparable programs in selected other jurisdictions. The literature review investigated aspects of the program's relevance, design and effectiveness (evaluation questions one, three, four and eight).
- **Key informant interviews:** A total of 50 individual and 4 joint interviews were conducted, giving a total of 58 participants, comprised of:
 - Program managers and staff at EC national and regional offices (15 interviews with 16 participants);
 - Program partners representing P/T governments and AANDC (11 interviews with 13 participants);
 - Representatives of hydrological service agencies in the US, Australia and New Zealand (3 interviews, 3 participants); and
 - A sample of secondary users of the WSC's hydrometric data (25 interviews with 26 participants) from the public and private sectors.

Potential participants in these interviews were drawn from suggestions provided by WSC managers, as well as additional candidates suggested by interviewees themselves. This data collection method addressed all nine evaluation questions except for the user interviews, which focused on program relevance, design and achievement of intended outcomes (evaluation questions one to four, and six). Interview guides were tailored for each type of participant, drawing on a master set of questions.⁹ Interviews were conducted by telephone or, in some cases, in person and lasted between 45 and 90 minutes. Qualitative analysis of the interview findings was conducted.¹⁰

⁹ All interview guides are available in the Data Collection Instruments Technical Appendix.

¹⁰ In summarizing the degree of consensus in interview findings, the following guidelines were used: No interviewees = 0%; A few interviewees = < 25%; Some / A minority of interviewees = 25% to 44%;

- **Analysis and Reporting:** Findings from each of the lines of enquiry were reviewed and integrated, and information relating to each of the evaluation questions synthesized. The synthesis used a triangulation process in which the findings from each line of enquiry were aligned to each of the evaluation questions and compared to identify areas of commonality, areas where divergent findings or opinions were observed, and possible reasons for such variations.

3.3 Limitations

Key informant interviews were the principal source of information on the program’s effectiveness and efficiency. While the program and partner samples were generally representative of the associated populations, it is possible that the user sample was not representative of the overall mix and distribution of different types of secondary users. This was a function of the program’s lack of information on users and the lack of published data or directories of potential users. However, the responses exhibited a high degree of uniformity and can be considered to be illustrative.

4.0 Findings

For each evaluation question, a rating is provided based on a judgment of the evaluation findings. The rating statements and their significance are outlined below in **Table 2**. A summary of ratings for all of the evaluation questions is presented in **Annex 2**.

Table 2: Definitions of Standard Rating Statements

Statement	Definition
Acceptable	The program has demonstrated that it has met the expectations with respect to the issue area.
Opportunity for Improvement	The program has demonstrated that it has made progress to meet the expectations with respect to the issue area, but attention is still needed.
Attention Required	The program has not demonstrated that it has made progress to meet the expectations with respect to the issue area and attention is needed on a priority basis.
Not applicable	A rating is not applicable.

4.1 Relevance

4.1.1 Continuing Need for Program

Evaluation Issue: Relevance	Rating
1. Is there a continued need for the program?	Acceptable

There is a continuing, and growing, need for reliable and consistent hydrometric data across Canada. This growth in demand is due to requirements for hydrometric data to inform the planning and management of socio-economic activities (such as, new resource development in more remote areas, expansion of population centres, and agricultural intensification), analysis of extreme weather events, and conduct of climate change analysis and research. Although capabilities to collect hydrometric data do exist outside the program, key informants perceive that these other providers are not equivalent to the WSC in that they are unlikely to have the same quality assurance standards or capability to operate in all regions and conditions.

The findings from the document review and the key informant interviews indicate a continuing need for a hydrometric program to provide reliable data on water levels and

Approximately half of the interviewees = 45% to 55%; A majority of interviewees = 56% to 75%; Most interviewees = 76% to 94%; Almost all interviewees = 95% to 99%; and All interviewees = 100%.

flows in Canada's lakes and rivers. Common areas of activity requiring hydrometric data as an input include flood planning, floodplain mapping, flood warnings and emergency response management, water resources planning and management, water allocation, infrastructure planning and design, environmental assessments, environmental monitoring and management, analysis of climate change and long-term weather effects, power generation, and navigation and recreational uses of inland waterways.¹¹ In addition, changes in Canada's climate are occurring but it is not clear how specific watersheds will be affected and the analysis of associated risks, such as, drought and flood issues, depends on the availability of an appropriate breadth and depth of hydrologic data.¹²

Key informants also identified a range of factors that are increasing the demand for hydrometric data in these various areas of application. The most frequently cited contributory factors were an increased frequency and severity of extreme weather events, the analytical complexity of assessing climate change effects, increased rates of resource development in remote areas, population growth in urban centres giving rise to needs for new and renewed infrastructure, and more intense use of agricultural land. The ability to satisfy these needs depends, according to the key informants, on timely, consistent and reliable data on water flows and levels available at individual water basin levels and, increasingly, at more micro levels, such as sub-basins. Users emphasized that they need both real-time current data and long-term archived data in order to understand and forecast what is happening to water levels and flows.

When asked about the extent to which other providers of hydrometric data collection and dissemination services exist and could provide a similar service to that provided by the WSC, almost all key informants indicated that the program is the only national provider of hydrometric data. Many key informants also indicated that service providers with capabilities to collect hydrometric data do exist outside the program and could potentially be contracted to perform data collection activities. These other providers are not perceived by key informants as being equivalent to the WSC, however, in that they are unlikely to have the same quality assurance standards and quality management systems as the WSC nor do they have the capability to operate in all regions and operating conditions. Typically, these providers are contracted by third parties to collect data for limited term periods in response to specific project needs, for example, in order to prepare environmental assessments.

¹¹ Environment Canada, February 2013, Program Briefing: Hydrometric Monitoring in Canada.
Canadian Water Resources Association, December 2012, Canada Wide Hydrometric Program: Federal Responsibilities and Interest.
Environment Canada, March 2010, Audit of the National Hydrometric Program.
Indian and Northern Affairs Canada, 2010, Water Today: Water Quality and Quantity in the NWT, Information Sheet.
Environment Canada, June 2008, Program Brief – 2008 – Hydrometric, Internal document.
Environment Canada, June 2006, Hydrometric Monitoring Business Case V3: Towards an Optimal Hydrometric (Water Quantity) Program for Canada, Internal document prepared by T. Yuyzk.
Indian and Northern Affairs Canada, 2006, Water Monitoring Business Plan.
Environment Canada, 2004, Threats to Water Availability in Canada, National Water Research Institute, Burlington, ON. NWRI Scientific Assessment Report Series No. 3 and ACSD Science Assessment Series No. 1.
British Columbia Ministry of Sustainable Resource Management, April 2003, Water Quantity Monitoring in British Columbia: A Business Review of BC's Hydrometric Programs.

¹² Environment Canada (2004), Threats to Water Availability in Canada, National Water Research Institute Scientific Assessment Report.
Sellars D., 2008, Assessment of Water Monitoring Networks for the Detection of Climate Change in Canada: Report on Scoping Study, Prepared for the Canadian Council of Ministers of Environment.

4.1.2 Alignment with Federal Government Priorities

Evaluation Issue: Relevance	Rating
2. Is the program aligned with federal government priorities?	Acceptable

The HSWS is aligned with federal government and departmental priorities. It is aligned with two of EC’s Strategic Outcomes, relating to the conservation and restoration of Canada’s natural environment, and enabling Canadians to make informed decisions on changing weather, water and climate conditions. In turn, these outcomes are intended to contribute to the achievement of the Government of Canada Outcome, A Clean and Healthy Environment.

Within the structure of the PAA, two of EC’s three Strategic Outcomes are supported by the HSWS: Canada’s natural environment is conserved and restored for present and future generations, and Canadians are equipped to make informed decisions on changing weather, water and climate conditions.¹³

Departmental accountability reports (i.e., Report on Plans and Priorities, Departmental Performance Report) link these Strategic Outcomes to the achievement of the Government of Canada Outcome, A Clean and Healthy Environment. The HSWS also responds to a key dimension of the Federal Water Policy, namely the production of reliable and timely data on the quantity, quality and variability of water resources.¹⁴

Almost all of the program managers and staff who were interviewed agreed that the program is aligned with both of the above departmental Strategic Outcomes. Most felt that the program contributes most directly to enabling Canadians (as represented by users of hydrometric data) to make informed decisions in response to changing weather, water and climate decisions. Hydrometric data were seen as helping users to reduce the level of uncertainty and risks associated with surface water flows and events. The role of monitoring data, such as hydrometric data, was also recognized as being essential to the measurement of trends in the natural environment. In the words of one key informant, “if you don’t know where the water is going you can’t manage it”. Long-term monitoring data were seen to be essential to the achievement of both Strategic Outcomes, whereas more immediate real-time data were more likely to be associated with the second outcome.

Almost half of the gauging stations in the network are designated as federal or shared F/P or F/T stations due to their alignment with federal government priorities. The criteria used to designate stations include specific consideration of statutory obligations, international commitments to monitor discharges from major river basins to the oceans, and EC science policy and research priorities requiring water quantity information.¹⁵

4.1.3 Consistency with Federal Roles and Responsibilities

Evaluation Issue: Relevance	Rating
3. Is the program consistent with federal roles and responsibilities?	Acceptable

The federal government’s role in water management is established by its responsibilities for navigable waters, fisheries, international and intra-national boundary waters, federal lands, federal facilities, and First Nations reserves as well as duties under *the Fisheries Act* and *Canadian Environmental Protection Act*. The role of the WSC in collecting hydrometric data in response to F/P/T needs and

¹³ See, for example, Environment Canada, 2013, *Report on Plans and Priorities: 2013-2014*, p. 8 & p. 13.

¹⁴ Environment Canada, 1987, *Federal Water Policy*, p. 6 and p. 34.

¹⁵ The monitoring priorities/criteria are defined in: CWRA, *op cit*, pp. 33-35.

Environment Canada, March 2005, *Federal Priorities for Funding Hydrometric Stations*, pp. 2-3.

priorities was seen as consistent with federal roles and responsibilities by a large majority of the partner and user representatives. More broadly, the core rationale for public sector involvement in the collection of hydrometric data relates to the significant economic value of water and water information, and the difficulty of satisfying needs for water quantity information through private incentives.

Responsibility for water resources is shared between the federal and provincial/territorial governments.¹⁶ Federal collection and provision of hydrometric data supports the federal responsibilities for navigable waters, fisheries, international and intra-national boundary waters, federal lands, federal facilities, and First Nations reserves as well as duties under the *Fisheries Act* and *Canadian Environmental Protection Act*. The provinces and Yukon have the lead responsibility for water management and protection within their respective boundaries. The *Canada Water Act* provides an enabling framework for cooperation and collaboration regarding water resources among and between the federal, provincial and territorial governments.¹⁷ The *Department of the Environment Act* assigns national leadership for water management to the Minister of the Environment.¹⁸

The program is delivered under bilateral agreements (first established in 1975) with each of the provinces, Yukon, and AANDC, on behalf of the Northwest Territories and Nunavut. The program also supports the federal government's role in Canada's water-related international commitments, primarily to the International Joint Commission and other transboundary water agreements, the World Meteorological Organization's (WMO) Hydrology and Water Resources Program, and the UNESCO International Hydrological Program.

Most program staff, P/T partners and users who participated in key informant interviews saw the provision of hydrometric data services as being an appropriate and (for many) critical role for the federal government to play. In addition to highlighting the statutory obligations of the federal government, the key informants noted that:

- As a federal government program operating on a national level, the program is able to enjoy economies of scale that would be very difficult for other service providers to achieve and, as such, many key informants feel that the cost to collect and disseminate hydrometric data on par with the quality of WSC-generated data would be more expensive if it were not provided by Environment Canada. Moreover, because water flow is not directly measured and requires hydraulic interpretation, a single agency approach allows for consistency in estimation techniques, systematic improvements to the engineering and national standards for comparison across provinces and territories.
- Most users feel that having a neutral federal agency perform the collection, interpretation and dissemination of data minimizes the likelihood of variable rates of coverage and maximizes the availability of reliable, consistent and high quality short and long-term data. This federal role is considered to be very important when hydrometric data are used to inform water allocation between provinces.
- There is some flexibility in the application of the *Canada Water Act* and the 1987 Federal Water Policy as to what constitutes federal obligations and what is in the national interest with respect to hydrology monitoring in Canada (e.g., whether the

¹⁶ Responsibility for water rights in Yukon has been devolved. According to information on the GNWT and AANDC websites, federal responsibility for water rights in the Northwest Territories is expected to be transferred to the NWT government in April 2014 (devolution.gov.nt.ca/ and www.aadnc-aandc.gc.ca/eng/1372178557539/1372178592781). AANDC represents the interests of Nunavut.

¹⁷ Environment Canada, 2012, *Canada Water Act: Annual Report for April 2011 to March 2012*, Gatineau, p1.

¹⁸ Environment Canada website, *Water Governance and Legislation: Federal Policy and Legislation*, www.ec.gc.ca/eau-water/default.asp?lang=En&n=E05A7F81-1

federal government is responsible for ensuring that appropriate hydrometric data are in place to support future infrastructure development and environmental assessments).

More broadly, the rationale for public sector involvement in the collection of hydrometric data is strongly supported by the findings from the literature review. Hydrological information has significant economic value, and once produced, can have many users and be readily shared. Private sector producers of such information encounter significant challenges in receiving payment from all users for the cost of producing this information. The existence of such non-payers means that market forces are unlikely to produce the optimal amount of hydrometric information. This failure of market incentives to produce the best quantity of this type of information is the core rationale for government provision of hydrometric data.¹⁹ The value to society of water information and weak incentives for private sector providers to satisfy the demand for such information establishes a sound basis for public sector provision of water information as a public good.²⁰

4.2 Performance – Efficiency and Economy

4.2.1 Appropriateness of Program Design

Evaluation Issue: Efficiency & Economy	Rating
4. Is the program design appropriate for achieving its intended outcomes?	Acceptable

The structure and delivery processes of the HSWS are built around a set of core requirements and supporting systems that focus its activities on consistent and comparable data collection, interpretation and dissemination to users, and this design is appropriate for achieving intended outcomes. The shared approach to direction setting and management is strongly supported by the F/P/T partners and program managers, and provides an effective process to integrate national and P/T priorities and directions.

The program does not currently have a logic model that depicts its design in terms of the causal linkages among its key inputs, activities, outputs, intended outcomes. Instead, the design and delivery of the program is built around the achievement of three objectives set in the program’s QMS, as well as one expected result and three outputs in the departmental PMF. These outcomes (listed in section 2.4) relate to the provision of hydrometric information to Canadians, the maintenance of a credible and sustainable national hydrometric monitoring program, and managing the program well.

According to a number of publications reviewed, an effective hydrometric data program is one that is designed around a set of core activities that ensure appropriate hydrometric data are made available for use in water management decisions. These articles suggest that the core processes in an appropriate hydrometric information lifecycle are as follows:

¹⁹ Gardner Pinfold Consulting Economists [with S. Renzetti, R. Cairns, and Q. Grafton], 2002, *Monitoring the Value of Natural Capital: Water*, for Environment Canada and Statistics Canada.
 Council of Canadian Academies, 2013, *Water and Agriculture in Canada: Towards Sustainable Management of Water Resources*, Report of the Expert Panel on Sustainable Management of Water in the Agricultural Landscapes of Canada.
 Houghton, J., 2011, *Costs and Benefits of Data Provision, Report to the Australian National Data Service*, Centre for Strategic Economic Studies, Melbourne.
 Olewiler, N., 2004, *The Value of Natural Capital in Settled Areas of Canada*, Published by Ducks Unlimited Canada and the Nature Conservancy of Canada.

²⁰ Hanemann, W.M., 2006, “The Economic Conception of Water” in Martinez-Cortina, L., P. Rogers and M. Llamas (eds.), *Water Crisis: Myth or Reality?* Taylor and Francis.
 Stigler, G., 1961, “The Economics of Information,” *Journal of Political Economy*, v. 69, no.3.

- Monitoring and network design;
- Data sensing and recording;
- Data validation and archival;
- Data synthesis and analysis;
- Information dissemination; and
- Information usage and decision-making.²¹

Key supporting systems and success factors are a formal quality management system, ongoing network design, use of monitoring technologies appropriate to the characteristics of station locations, training of technicians, and sound data management after acquisition.²² The program documents review and key informant interviews with program and partner representatives found that the program is designed to meet the above requirements and incorporates key support systems similar to those cited above.

Almost all of the WSC and F/P partner representatives interviewed strongly supported the shared approach to the management and funding of the NHP, which also enables it to integrate national and P/T priorities and directions.

Evidence to support this model is also found in the international comparisons. In Australia, the majority of the gauging stations are controlled by state government and non-governmental organizations but legally obligated to share their data with the Bureau of Meteorology (BOM) for use in water monitoring and analysis activities. These data collection organizations independently determine what hydrometric data they will collect, what standards will be followed, and whether gauging stations will be established or discontinued. Variations in data quality, consistency and continuity reportedly arise due to variations in approach. A similar situation applies in New Zealand (NZ), where regional councils (local government entities) operate the majority of gauging stations and determine the extent of gauging activities, outside of the reference network of the National Institute of Water and Atmospheric Research (NIWA). The frameworks for data collection and dissemination in Australia and NZ suggest that Canada's shared approach, combined with the application of national data standards and quality assurance and control (QA/QC) systems, would result in better coordinated priority setting, planning and collection of hydrometric data. Findings from the international interviews indicated that the WSC is perceived to be very effective in ensuring data consistency and data quality.

4.2.2 Clarity, Appropriateness and Efficiency of Governance Structure

Evaluation Issue: Efficiency & Economy	Rating
5. To what extent is the governance structure clear, appropriate and efficient for achieving expected results?	Acceptable

Separation of responsibilities and budgetary authorities between headquarters and the regional operations of the MSC presents a challenge for the integration of HSWS planning and management. The governance structure for the NHP is widely perceived by program managers and F/P/T partner representatives as being particularly effective, able to provide a national framework while allowing for flexibility in arrangements with individual provinces and territories.

The HSWS's governance structure is appropriate for the most part. However, approximately half of the WSC representatives noted that the ability to plan and manage in an integrated way across the program is a challenge because responsibilities are split

²¹ Dixon H., Hannaford J. H. and Fry M. J, 2013, "The Effective Management of National Hydrometric Data: Experiences from the United Kingdom", *Hydrological Services Journal*, 58:7, pp. 1383-1399.

²² Hamilton S., 2012, "The 5 Essential Elements of a Hydrological Monitoring Programme", *WMO Bulletin*, 61 (1), pp. 26-32.

between the Water and Climate Services Division at national headquarters and regional operations through the Weather and Environmental Operations Directorate. The challenge arises because national strategies and priorities for the program are set by headquarters but budget allocation decisions and operational directions are set through the regional operations of the MSC.

The 2010 EC internal audit of the NHP concluded that the governance structure for the program was functioning well with the NAT and National Hydrometric Program Coordinators Committee (NHPCC) providing a sound basis for joint direction setting and oversight of program delivery. Further, responsibilities and authorities for delivering the NHP were found to be clear and consistent among the F/P/T partners and well defined in the bilateral agreements. Comments by almost all program and partner representatives interviewed were consistent with the audit conclusions. They also indicated that the bilateral agreements provide for flexibility in the arrangements with different P/T partners while providing a consistent overall framework.

The 2010 internal audit also identified five aspects of the governance structure that could benefit from improvement, relating to strategic planning, integration of the management of water quantity and quality monitoring, clarification of the respective roles of EC and AANDC regarding water quantity management, strengthening monitoring of client satisfaction, and bringing annual reporting up to date as required by the *Canada Water Act*.²³ The follow-up process of EC's Internal Audit Directorate, Audit and Evaluation Branch indicates that acceptable progress has been made and all five of these recommendations are now closed. Updated bilateral agreements for the collection, interpretation and dissemination of hydrometric data have also been signed with five provinces (British Columbia, Alberta, Manitoba, Ontario, Quebec) and with AANDC on behalf of Nunavut. Updated agreements with the remaining provinces and territory are pending.

4.2.3 Efficiency and Economy of Program Activities

Evaluation Issue: Efficiency & Economy	Rating
6. Is the program undertaking specific activities and delivering products at the lowest possible cost? How could the program's activities be more efficient? Are there alternative, more economical ways of delivering program outputs?	Attention Required

The available evidence indicates that the HSWS is efficient and economical in some respects. For example, the program is cost-shared under the bilateral agreements with F/P/T partners and over 40% of program costs were reimbursed by these partners each year. Partners and users also noted that all stakeholders benefit from the economies of scale of a national entity compared to multiple P/T entities. No alternative, more economical program models were identified. The program's current transition to new data collection technologies and data management tools has made near real-time data dissemination possible and is expected to enable incremental efficiencies in the operation and maintenance of stations in the near future.

Nevertheless, some challenges related to efficiency and economy were identified. Difficulties in recruiting and retaining professional and management staff have limited the program's ability to deliver key products within targeted timeframes and

²³ Environment Canada, March 2010, *Audit of the National Hydrometric Program*, prepared by Audit and Evaluation Branch, pp. ii-iii.

to undertake needed analytical support tasks and associated reporting. In addition, the program has not been able to fully meet its target of delivering validated, archived data within four months of the calendar year end. User feedback suggests that the efficiency of program delivery and service would improve if the understanding of user needs and demand trends were strengthened and the website updated to improve data access and downloading.

The analysis of the efficiency and economy of activities examined trends in program expenditures and resources, the capacity of the program to undertake required activities, user satisfaction with program activities, and potential opportunities to improve efficiency.

Cost-sharing and trends in program expenditures and resources. The program is cost-shared under the bilateral agreements with its F/P/T partners, which supports an efficient and economical approach to program delivery (e.g., through additional oversight of program operations by partners). Data on the program's FTE levels and expenditures on salaries and operating and maintenance (O&M) costs for the period from 2008-09 to 2012-13 (shown in Table 1, section 2.3) indicate that total annual costs and costs per FTE were relatively stable over the period of the evaluation. Over 40% of these costs were reimbursed by F/P/T partners each year and the amounts recovered increased steadily, from \$13.3 million in 2008-09 to \$15.5 in 2012-13. At the same time, the program was investing in new gauging and data management equipment and tools, reflected in the rate of capital spending, and recruiting and training a significant number of new technicians to address gaps due to retirements and departures.

Capacity to undertake required activities. Deployment of new equipment and tools has enabled the program to increase the timeliness of data availability, which is important to the majority of users, by moving to providing provisional near real-time data for the majority of its stations. Program managers indicated that this change is also expected to lead to incremental efficiencies in operations, for example, by improving the scheduling of station checks and routine maintenance work. Findings from the international interviews indicate that the move to real-time data provision combined with implementation of new data collection and telemetry technologies is considered to be the current state-of-the-art.

Many of the partner and user representatives noted that the joint F/P/T approach to program management and delivery means that all stakeholders and data users benefit from the data consistency and economies of scale provided by a national entity compared to multiple P/T entities. Some cited the arrangement as being an exemplary model for what can be achieved by an effective shared approach. No alternative, more economical program models were identified.

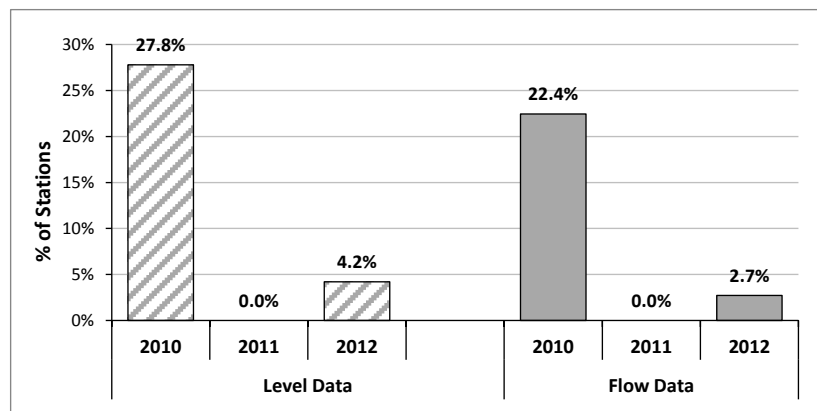
Internal analyses prepared by the program and feedback from key informants indicate that shortages of professional staff (engineers and scientific officers) and gaps in program management, as exemplified by prolonged delays in appointing permanent staff to vacant management positions, are limiting operational performance in a number of key areas. For instance, the program has experienced difficulties in recruiting qualified hydrologists (e.g., due to competition from the oil sands industry in western Canada). These gaps were reported to have limited the program's capacity in such areas as producing required hydrological reports, meeting transboundary commitments, undertaking critical data analysis projects, providing engineering support for network planning and design, finalizing the program's new costing model, and supporting the work of technicians.²⁴

²⁴ Analyses and presentations prepared by program management at various times between 2007 and the present, starting with a proposed *Human Resources Strategy: Water Survey of Canada*, prepared in March 2007.

This situation suggests that, building on the current high-level MSC People Plan, a better integrated human resource strategy and staffing plan would help to optimize the recruitment, training and deployment of these categories of staff. Comments by program and partner representatives suggest that, as part of any efforts to strengthen professional resources, the program should review the nature and extent of the analysis and research work they perform and determine, where practical, if an alternative approach would be more efficient, such as taking an integrated program-wide approach to the allocation and conduct of work by professional staff versus looking at needs within each region independently. The approach to training technicians was widely seen to be highly successful; similar thinking may be desirable to support the attraction, deployment and development of professional staff and managers.

Delivering the output on archived hydrometric data and streamflow statistics is a challenge for the program. It has not been able to fully meet its target for archiving final water level and flow data (that is, data that have been validated through QA/QC systems) within four months of the end of each calendar year, as shown in Chart 1. In 2011, resource pressures meant that program technicians did not archive any water level or flow data, as they gave priority to the production and dissemination of real-time data (which is provisional until validated) during the deployment of new equipment and tools and to training significant numbers of newly hired technicians. In 2012, some of the regional offices were able to re-commence archiving work, leading to water flow and level data for only 3% and 4% of stations, respectively, meeting the four-month target. Work on the backlog of prior year data also increased, with 2011 data for 16% of the real-time stations archived by September 2012, 39% by January 2013, and 79% by October 2013.²⁵

Chart 1: Proportion of Stations for Which Water Level and Flow Data Were Archived Within Four Months of Calendar Year-end – 2010 to 2012



Source: Data extracts provided by Water and Climate Services Division (*Monitoring Quality Objectives-for Update (2013-10)_wcsA*), October 2013.

User satisfaction with program activities. Secondary users of hydrometric data who participated in the key informant interviews were asked to rate their satisfaction with the delivery of program activities as a means of assessing aspects of program efficiency. The resulting ratings indicate that:

- The WSC is highly responsive to user-initiated questions about the availability and/or interpretation of hydrometric data. Some users noted, however, that in the absence of established contacts with program staff, the enquiries process (via email requests to a central email address) is not user friendly.

²⁵ Information on the rate at which 2011 hydrometric data was being archived was obtained from a *WSC Station Ingest Check for 2011 by Province* report.

- The program is less active in proactively communicating with users. Approximately one-third of the users interviewed indicated that they had received no communications initiated by the program.
- Users exhibited a high degree of satisfaction with the technical knowledge and expertise of program staff. Analysis and application of the data (over and above what is required to support WSC operations) are more likely to be seen as the job of users rather than the WSC.

The ratings of these activities and supporting comments by key informants indicate that the program has limited interactions with the many secondary users of hydrometric data. The WSC has minimal information on the numbers and types of secondary users it serves because they access and download data from the WSC website (www.wateroffice.ec.gc.ca) without having to register on the site and the site does not have any mechanisms to solicit their feedback. Note also that there is some lack of clarity within the program and the MSC in general as to who is assigned responsibility for assessing the needs and satisfaction of these secondary users.

This is in contrast to the regular consultations the WSC has with primary users – its F/P/T partners – via the operation of the NAT and NHPCC, and associated annual work planning processes. Without regular contacts with the many different types of users (beyond the major users), program managers have only a limited understanding of who is using hydrometric data, how the data are being used, and the overall structure of, and trends in, demand and usage. The needs of the majority of these users are focused on specific waterways or basins, and they are not concerned whether the data they use come from a federal, federal-provincial/territorial or provincial/territorial station. The marginal cost to serve these secondary users through the WSC website is minimal and does not compete directly with data access by the primary users.

Opportunities to improve efficiency. Opportunities to improve efficiency and economy suggested by partner and/or program representatives were as follows:

- Maximize the deployment of stations with real-time data collection and telemetry capabilities.
- Improve the speed with which potential new data collection technologies and tools are assessed and decisions made regarding adoption and deployment.
- Update the WSC website and make it easier to access and download data, including the use of a datamart facility to improve the ease and efficiency of storing and transferring large data sets to F/P/T partners.

4.2.4 Collection and Reporting of Performance Data

Evaluation Issue: Efficiency & Economy	Rating
7. Are performance data being collected and reported? If so, is this information being used to inform senior management/ decision-makers?	Attention Required

Measures of performance have been defined for the departmental PMF and the objectives of the QMS but the HSWS is unable to readily generate national data on key performance measures and indicators. With respect to regional data, regional managers and supervisors closely monitor the availability of real-time data and data archiving rates as part of their management and tracking of operational activities.

Key performance measures and indicators for the program’s principal outputs and expected results have been defined and included in the departmental PMF and the program’s QMS objectives. These measures and indicators were presented in section 2.4.

Findings from the document review and key informant interviews with program representatives indicate that the program is not reporting on its overall performance against the indicators for the outputs and expected result in the departmental PMF on a regular basis. In addition, the program does not have a formal performance measurement strategy linked to a program logic model.

With regard to the availability of performance data for specific outputs and outcomes, program managers at headquarters indicated the following:

- **Expected result – Canadians and their institutions have the hydrological data, information and knowledge they need to make water management decisions:** Initial information on the key indicator for this outcome – satisfaction among primary users of hydrometric data and services (F/P/T partners) – was unavailable at the time of data collection for this evaluation but planned to be collected by the program using a survey of F/P/T partner representatives. Measurement of satisfaction among a wider sample of users is seen to be desirable but is not currently planned due to budgetary constraints. As such, the program was unable to report any survey results on the degree of progress toward this intended outcome.
- **Output – real-time hydrometric data:** The current data management system allows program technicians and managers to track the status of preliminary real-time data for individual stations but it is difficult to extract and compile aggregated data showing the extent to which these data are made publicly available within 24 hours of initial collection on a national level. Program managers report that this target is consistently exceeded, in that the majority of the 1,875 real-time stations (67% of the stations in the NHP network) are capable of producing preliminary real-time data within 2-3 hours of initial data capture at these stations.
- **Output – archived hydrometric data and streamflow statistics:** Preliminary data on the extent to which the target of producing archived data within four months of calendar year-end are available from the HYDEX database. Data on performance at the national level, summarized in section 4.2.3, show that the program's performance fell well below target in recent years.
- **Output – scientific studies and reports related to hydrological requirements for transboundary basins:** Program managers indicated that resource gaps among professional staff meant that many scientific studies and reports relating to transboundary basins are not being completed within expected timeframes, if at all. Data on the number of such studies completed annually during the timeframe for the evaluation were unavailable.
- **Objectives of the QMS:** The performance indicators for the QMS objectives focus on the production of real-time and archived data, ISO and QA audits of offices and stations, recruitment of technicians and professional staff, and training of technicians, and are intended to provide focus for the operational management of WSC activities at the regional and provincial levels. Regional program managers and supervisors pay close attention to the operational activities that contribute to these objectives as well as comparisons of expenditures to budgets. Periodic reporting on performance against these objectives at a program-wide level has not been implemented, which limits the ability of the HSWS to monitor and report on overall performance.

4.3 Performance – Effectiveness

4.3.1 Achievement of Intended Outcomes

Evaluation Issue: Effectiveness	Rating
8. To what extent have intended outcomes, listed below, been achieved as a result of the program? (a) Canadians and their institutions have the hydrological data, information and knowledge they need to make water management decisions. (b) A credible, sustainable national hydrometric monitoring program is maintained and supported. (c) The National Hydrometric Program is well managed according to established international operational criteria.	Attention Required Acceptable Acceptable

(a) Canadians and their institutions have the hydrological data, information and knowledge they need to make water management decisions. Most users of hydrometric data and F/P/T partners are very satisfied with the quality and completeness of currently available hydrometric data. However, they also strongly believe that the network density is insufficient to meet current and emerging needs for more intensive coverage of Canada’s water basins and water flows. Studies of the adequacy of network density, including recent work for EC, indicate gaps in network density for the overall NHP compared to WMO guidelines.

Findings from the literature, in combination with feedback from the key informants, indicate that the current network of gauging stations is unable to fully meet the objective of satisfying Canadian needs for hydrological data. Key observations include:

- Studies of network adequacy in different regions of Canada, and at the national level, indicate that network density is not sufficient to meet the needs of users or WMO guidelines on gauge density.²⁶
- Feedback from users of hydrometric data indicated that increased numbers of data collection points are considered to be necessary to improve water resources monitoring, planning and forecasting; aid the development and validation of water resources models; and, reduce uncertainties in the design of new and renewed infrastructure. Some users also indicated that data from discontinued stations are now becoming less applicable in light of cyclical and/or climate changes.
- Organizations undertaking water resources planning and management activities need more information related to risks, uncertainties and better management practices in the use of water (for example, quantity of fresh water resources in less populous areas, water currently used by agriculture and needed for future agricultural purposes).²⁷
- Better monitoring information on Canada’s water resources is required, and a better understanding of water interactions with other elements of agriculture is required.

²⁶ Coulibaly, P., et al, *op cit.*
 Council of Canadian Academies, 2013, *Water and Agriculture in Canada: Towards Sustainable Management of Water Resources, The Expert Panel on Sustainable Management of Water in the Agricultural Landscapes of Canada.*
 Kerr Wood Leidal, November 2010, *Nunavut Hydrometric Network Review*, prepared for Indian and Northern Affairs Canada.
 Sellars D., 2008, *op cit.*
 Pryce RS, March 2004, *Review and Analysis of Stream Gauge Networks for the Ontario Stream Gauge Rehabilitation Project*, prepared for Ontario Ministry of Natural Resources, Water Resources Section.
 M. Miles & Associates, September 2003, *British Columbia’s Climate-Related Observation Networks: An Adequacy Review*, prepared for the BC Ministry of Water, Land and Air Protection.

²⁷ Council of Canadian Academies, 2013, *op cit.*

This should include a focus on the value of ecosystems services related to land and water interactions.²⁸

Secondary users of hydrometric data who were interviewed were asked to rate the performance of the program in collecting, interpreting and disseminating hydrometric data. These findings indicate:

- High levels of satisfaction with the quality and completeness of data made available from the current network of stations.
- Moderate levels of satisfaction with the numbers and locations of active gauging stations. Many commented that the distribution and density of stations is insufficient to meet current and emerging demands for hydrometric data in all regions of Canada.
- Users are generally satisfied with the timeliness of data updates on the WSC website. Many users noted, however, that the time taken to produce archived data is too long for their needs, particularly when they need data on extreme high and low water levels and flows.
- Most users are “satisfied” or “completely satisfied” with the ease of access to hydrometric data on the WSC website.

In 2010, the CESD audit of EC’s water monitoring programs recommended that the department determine the optimum number of gauging stations required across Canada, identify gaps in network coverage, and apply a risk-based approach to establishing new stations.²⁹ The Department accepted this recommendation and commissioned a study to assess the current network density against the WMO’s 2008 guidelines.³⁰ The findings of this study were published in June 2013. The authors concluded that:

... only about 12% of Canadian terrestrial area is covered by hydrometric networks that meet the WMO (2008) minimum standards, while 49% of the terrestrial area is poorly gauged and about 39% is ungauged. ... An estimated total of about 5041 new hydrometric stations is needed to upgrade the CNHN [Canadian National Hydrometric Network] to the WMO (2008) standards.³¹

In addition, they suggested that optimizing the network density and location of stations within ecozones could also lead to some opportunities to relocate stations. The authors also noted that the findings should be treated with some caution due to their reliance on the physiographic units³² used in the WMO guidelines without consideration of social, economic, population density and other factors that influence network planning.

The ability to attract funding to further develop and optimize the network of gauging stations is a challenge for both WSC and its F/P/T partners. In addition, the program does not have detailed information on the characteristics of the user community and their various needs that could be used to underpin further risk analysis and priority setting for the management of the network. As part of its response to the 2010 CESD audit, the program has developed and is now testing a risk assessment model for water quantity monitoring, and is supporting work at McMaster University to develop a “decision support tool for integrated water monitoring network design and evaluation” to enable the partners

²⁸ *Ibid.*

²⁹ Office of the Auditor General of Canada, Fall 2010, *Chapter 2 – Monitoring Water Resources. Report of the Commissioner of the Environment and Sustainable Development.*

³⁰ World Meteorological Organization (WMO), 2008, *Guide to Hydrological Practices, Vol. 1, Hydrology – From Measurement to Hydrological Information*, Sixth edition, Geneva, Switzerland: WMO No 168.

³¹ Coulibaly P., et al, *op cit.*

³² The study assessed the network density for seven different types of topographical areas where each of these units can be expected to have differing climatic conditions and network design requirements. These “physiographic units” used in the WMO guidelines are coastal, mountainous, interior plains, hilly/undulating, small islands, and polar/arid.

in the program to refine the estimates of the number of additional stations that may be desirable. This tool is intended to take into account the different types of needs for, and uses of, hydrometric data as well as the estimates derived from the application of the WMO guidelines in its network planning.

The evaluation findings suggest that the HSWS and its partners should build on the work responding to the CESD's recommendation regarding the identification of gaps in network coverage and the application of a risk-based approach to the establishment of new stations by assessing the current and emerging demand for hydrometric data in more detail, to assist in setting priorities for the optimization and development of the network in response to user needs as funding permits.

(b) A credible, sustainable national hydrometric monitoring program is maintained and supported. The effectiveness of current operations and data quality assurance processes underpin the credibility of the program. Some key informants feel that the maintenance of this credibility will depend, to a significant extent, on ensuring the network is able to keep pace with the growth in demand for data and addressing gaps in its professional and management resources.

Many of the key informants believed that the monitoring program is credible, in that it is producing data that satisfy national standards and QA/QC requirements and thus are consistent and comparable over time and between different parts of the country. The results of ISO audits also indicate that the program's QMS is functioning in accordance with requirements and meets ISO certification requirements.³³ Some key informants also noted that the program's longer-term credibility depends on the extent to which it is, or could be, funded to improve the network's density, and gaps in the program's professional and management resources addressed. Key informants also noted that some users are undertaking, or contracting, hydrometric data collection to meet their own specific needs. While hydrometric data collection activities have always been undertaken by some types of users outside of the program, some key informants suggested that the incidence of such work may be increasing.

(c) The National Hydrometric Program is well managed according to established international operational criteria. The program is well managed in the sense that its operations are focused on maintaining a capability to maintain the network, collect raw data and translate these data into information products that meet users' needs in a timely manner. Key informants also perceived it to be well managed and the governance and funding structure for the NHP is widely viewed by partners as an exemplary approach to delivering services within a shared jurisdiction context. However, the program is experiencing some challenges related to program management (e.g., HR planning, performance reporting) that will need to be addressed.

The analysis in section 4.2.1 regarding the appropriateness of the program's design summarized the characteristics of an effective hydrometric data program, based on the capabilities required to design and maintain a network of stations and to collect raw hydrometric data and convert it into timely information products that satisfy users' needs. The program is focused on meeting these requirements and, as noted, the ISO certification has been successfully introduced and maintained. From this perspective, the NHP is well managed. Findings from the key informant interviews also indicate that the program is well managed. Most partner and program representatives interviewed perceived the performance of the NHP governance structure to be particularly effective. Users of hydrometric data were highly likely to rate the operational activities as being well

³³ 2013 Report of the Recertification Audit of the WSC quality management system.

run, aided by the technical knowledge and expertise of staff and the general responsiveness of the program to partners and users.

Some of the partner and user representatives also suggested that the gaps in professional and management resources point to opportunities to further improve the program's performance against this outcome. In addition, as noted in sections 4.2.2 and 4.2.3, the program is experiencing some challenges related to program management (e.g., integration of HSWS planning and management between headquarters and regional operations, human resources planning and performance reporting) that will need to be addressed.

4.3.2 Unintended Outcomes

Evaluation Issue: Effectiveness	Rating
9. Have there been any unintended (positive or negative) outcomes?	Not Applicable

No significant unintended outcomes were identified.

5.0 Conclusions

5.1 Relevance

Hydrometric data are critical to planning for, and management of, water resources. The provision of hydrometric data by public agencies is widely accepted and managed as a public good where the cost involved in making such data freely available is outweighed by the significant value to society of such information, for example, by reducing uncertainties and risks associated with surface water flows and events. All lines of enquiry found there to be a continuing and growing need for timely, consistent and reliable hydrometric data. Factors that contribute to the growth in demand include:

- An increased frequency and severity of extreme weather events, with implications for flood planning and emergency management.
- The complexity of climate change analysis.
- Increased rates of resource development, particularly in remote areas.
- Population growth giving rise to needs for new and renewed infrastructure.
- More intense use of agricultural land and water resources.
- Increasing availability of real-time hydrometric data (with almost two-thirds of the water gauging stations in the network now capable of such operation).

Responsibility for water resources is shared between the federal and provincial/territorial governments. Federal collection and provision of hydrometric data supports federal responsibilities for navigable waters, fisheries, international and intra-national boundary waters, federal lands, federal facilities and First Nation reserves as well as duties under the *Fisheries Act* and *Canadian Environmental Protection Act*. Note, however, that there is some flexibility in the application of the *Canada Water Act* and the 1987 Federal Water Policy as to what constitutes federal obligations with respect to hydrology monitoring in Canada. The provision of hydrometric data aligns with the Department's Strategic Outcomes relating to conservation and restoration of Canada's natural environment, and enabling Canadians to make informed decisions on changing weather, water and climate conditions. In turn, these outcomes are intended to contribute to the achievement of the Government of Canada Outcome, A Clean and Healthy Environment.

5.2 Performance - Efficiency and Economy

The design of the HSWS is widely considered to be appropriate for achieving its intended outcomes. The program's design and delivery focuses on a set of core activities that ensure appropriate hydrometric data are made available for use in water management decisions. These core activities and supporting systems, such as the QMS, are consistent with published commentary regarding the requirements for an effective hydrological monitoring program.

Separation of responsibilities and budgetary authorities between headquarters and the regional operations of the MSC presents a challenge for the integration of HSWS planning and management. More broadly, however, at the level of the NHP, the WSC functions as a national organization working on behalf of the F/P/T partners to satisfy the separate and joint needs of the partners in a cost-effective way. This approach enables national and P/T priorities and directions to be integrated. The NHP governance structure is widely perceived as being particularly effective, in that it provides a national framework to integrate national and P/T priorities while allowing for flexibility in arrangements with individual provinces and territories. Data collection and provision by a single national service provider enables economies of scale that could not be achieved by independent F/P/T entities.

The introduction of digital data collection and telemetry technologies, and the deployment of the new hydrometric workstation for managing the production and interpretation of data are transforming the way hydrometric data are collected, interpreted and disseminated. This transition to near real-time data provision is having a major impact on the way the WSC operates and is expected to lead to improvements in efficiency, for example, by improving the scheduling of stations checks and routine maintenance work.

Four areas of weakness were identified in the efficiency and economy of the HSWS:

- Gaps in the program's professional (engineering and scientific) staff and management/ supervisory ranks are limiting the program's ability to produce the required hydrological reports, meet transboundary commitments, undertake critical data analysis projects, and provide support for operational activities.
- Program managers and staff have limited direct contact with secondary users, outside of major users such as the F/P/T partners, and do not have a good understanding of current and emerging needs amongst secondary users of hydrometric data, how and why they are using these data, and overall trends in demand.
- Key performance measures and indicators for the program's principal outputs and outcomes have been defined but the program is not producing regular performance data to report on program-wide performance and does not have a logic model that could aid in the selection or confirmation of performance measures and indicators.
- The program has not been able to fully achieve its target of delivering validated, archived water level and flow data within four months of the end of each calendar year.

5.3 Performance - Effectiveness

Performance in achieving three program outcomes was assessed.

(a) *Canadians and their institutions have the hydrological data, information and knowledge they need to make water management decisions.* Users of data from the current network of gauging stations are highly satisfied with the quality and completeness of these data, particularly the real-time data. Users of archived data were satisfied but would like to see faster production of such data. At the same time, however, studies of network adequacy and feedback from the key informants indicate that network density

is not keeping up with demand. The most recent such study, commissioned in response to a 2010 CESD audit recommendation, compared the current network density of the NHP to WMO guidelines. The study concluded that about 88% of Canada's terrestrial area is either poorly covered by water gauging stations or has no coverage at all. It also noted that network planning and optimization would need to consider ecological, social and economic factors when determining the optimal number and distribution of stations needed.

- (b) *A credible, sustainable national hydrometric monitoring program is maintained and supported.* The program was generally perceived to be credible by many of the program and partner representatives, in that it is producing data that satisfy quality assurance requirements and are consistent and comparable over time and between different parts of the country. The results of ISO audits also indicate that the program's QMS is meeting ISO certification requirements. The ability of the program and its F/P/T partners to maintain this credibility will depend, in part, on the extent to which the network of stations can be optimized and developed in response to current and expected future demand for hydrometric data.
- (c) *The National Hydrometric Program is well managed according to established international operational criteria.* The program is generally perceived to be well managed, as evidenced by the effectiveness of the NHP governance structure and bilateral agreements, the technical expertise and responsiveness of staff, and the effective introduction and maintenance of its ISO certification. However, the HSWS is experiencing some challenges related to program management (e.g., human resource planning, performance reporting) that will need to be addressed.

6.0 Recommendations and Management Response

The recommendations of the evaluation of the Hydrological Service and Water Survey program are addressed to the ADM Meteorological Service of Canada, as the ADM responsible for program management and delivery for both Weather and Environmental Monitoring, and Weather and Environmental Operations.

Recommendation 1: Develop a program logic model and performance measurement strategy for the Hydrological Service and Water Survey (sub-program 1.2.3) to guide performance measurement and reporting. Performance indicators for the program's principal outputs and expected results have been defined and included in the departmental PMF and program QMS. However, the program has not confirmed that all relevant HSWS outputs and outcomes have been identified and is not able to readily report on the production of key outputs and results, which limits its ability to report on its performance. There is a need for a logic model of the HSWS (sub-program 1.2.3), which defines clear and realistic outputs and outcomes for which the program can reasonably be held accountable. The logic model should also specify the program's primary and secondary clients. This will help to clarify EC's specific responsibilities under this program. In addition, the logic model should incorporate longer term, ultimate outcomes to which EC's program is intended to contribute, along with other players/factors. The model should document the influence of key external players/factors in order to accurately set the context for EC's activities and intended outcomes including the ultimate aspirational goals. Development of a program logic model and associated performance measurement strategy should aid in reporting on the production of key outputs and progress toward the achievement of intended outcomes.

Management Response to Recommendation 1

The ADM of the Meteorological Service of Canada agrees with the recommendation.

Management Action		
Our QMS already serves as the basis for a logic model and performance measurement strategy for the program. We will use the QMS core processes, sub-processes and metrics to generate a model that meets the departmental and Treasury Board standards for logic model development for the national program outcomes and we will implement program-level performance measurement and reporting.		

Timeline	Deliverables	Responsible Party
March 31, 2015	Develop a logic model and a performance measurement strategy for hydrometric production and hydrometric data services.	Director WSC, as supported by DG Corporate Management Directorate (CMD)

Recommendation 2: Investigate and implement ways to improve the program’s understanding of user needs and demand trends in order to support a risk-based approach for the ongoing management of the network of gauging stations. To supplement the program’s current consultations with its primary users – its F/P/T partners in the NHP – greater breadth and depth of understanding of demand and users will be necessary if the program is to continue to develop its products and services to ensure it maintains its relevance to the Crown under its obligation outlined in the *Canada Water Act* and other federal mandates.

Management Response to Recommendation 2

The ADM of the Meteorological Service of Canada agrees with the recommendation.

Management Action		
Historically, the Water Survey of Canada (WSC) program held stakeholder engagement workshops and conducted surveys to collect information about stakeholder data and service requirements as well as the uses for hydrometric data. Our current Quality Management System (QMS) processes require regular stakeholder engagement to assess stakeholder requirements. Engagement of the provinces and territories is substantially met through the monthly teleconferences and annual meetings of the National Administrators Table (NAT) and their sub-committees. Nonetheless, we can always improve and enhance our engagement interactions with the NAT and the broader stakeholder community through the revitalization of specific activities such as workshops and surveys, as well as the Canada Water Resources annual meeting. This approach will allow the program to meet its current obligation as part of the CESD risk assessment requirement. Moreover, the risk-based analysis on network design and hydrometric products and services will allow the program to ensure it is meeting its departmental obligations and priorities. Regular updates of the risk-based assessment will also allow the program to synchronize its monitoring priorities with departmental priorities.		

Timeline	Deliverables	Responsible Party
1. March 31, 2015	1. Annual client satisfaction metrics will be rolled up and followed on an annual basis and will be reported to NAT (note: first one	1. Director WSC

2. June 15, 2014	<p>completed March 31, 2014).</p> <p>2. A plan for broader stakeholder and user engagement is being developed by the Weather and Environmental Monitoring (WEM) Directorate.</p>	2. Director Monitoring Strategies and Data Management (MSDM)
3. March 31, 2015	3. Develop a plan for recurring risk-based network assessment and review to meet departmental plans and priorities.	3. Director WSC

Recommendation 3: Review the current approach to human resource planning and staffing for professional and management positions, and develop an integrated program-wide plan to guide the attraction, retention and deployment of such staff. Maintaining a sufficient level of professional (engineering and scientific) staff and staffing of management positions has been a persistent challenge for the program. The resulting gaps have affected the program’s ability to perform certain key tasks and produce outputs required under transboundary agreements. In this context, an integrated approach to tasks undertaken by professional staff may be more effective than having each region manage their activities and staffing independently. Moving beyond the existing strategic MSC People Plan, this would require integrated planning at a more operational level.

Management Response to Recommendation 3

The ADM of the Meteorological Service of Canada agrees with the recommendation.

Management Action
Under the WSC re-organization launched April 1, 2014, all the MSC hydrometric and hydrology activities have been consolidated under one director, where previously six directors shared in the delivery of the programs. This simplification in the organisational structure should translate into streamlined integrated business and HR planning. As part of the MSC People Plan, which provides branch-wide strategic direction for human resource planning, a human resource strategy has been developed to ensure the sustainability of the hydrological services within MSC.

Timeline	Deliverable	Responsible Party
December 31, 2014	Finalize and confirm a multi-year integrated HR plan for the national hydrological services to inform the Directorate’s annual staffing plan.	Director WSC

Annex 1 Evaluation Questions, Indicators and Data Sources

Relevance Does the program remain consistent with and contribute to the federal government priorities and address actual needs?			
Question	Indicators	Sources/Methods	TB Policy Issue Addressed
1. Is there a continued need for the program?	1.1 Evidence of/views on the existence of societal/environmental need 1.2 Presence/absence of other programs that complement or duplicate the objectives of the program 1.3 Degree to which gaps would exist in addressing societal/environmental need in absence of the program	<ul style="list-style-type: none"> • Document review • Key informant interviews • Literature review 	Issue #1: Continued Need for Program
2. Is the program aligned with federal government priorities?	2.1 Evidence of/views on the degree to which program's objectives correspond to recent/current federal government priorities 2.2 Evidence of/views on the degree to which the program's objectives are aligned with current departmental strategic outcomes	<ul style="list-style-type: none"> • Document review • Key informant interviews 	Issue #2: Alignment with Federal Government Priorities
3. Is the program consistent with federal roles and responsibilities?	3.1 Program mandate aligned with federal government jurisdiction	• Document review	Issue #3: Consistency with Federal Roles and Responsibilities
	3.2 Views on the appropriateness of federal involvement	• Key informant interviews	

Performance – Efficiency and Economy Are the most appropriate, efficient and economic means being used to achieve outcomes?			
Question	Indicators	Sources/Methods	TB Policy Issue Addressed
4. Is the program design appropriate for achieving its intended outcomes?	4.1 Logical link between program activities, outputs, and intended outcomes 4.2 Comparison of program activities and products with those delivered by other similar programs 4.3 Evidence of/views on whether there are alternative program models that would achieve the same expected outcomes at a lower cost	<ul style="list-style-type: none"> • Document review • Key informant interviews • Financial analysis 	Issue #5: Demonstration of Efficiency and Economy

Question	Indicators	Sources/Methods	TB Policy Issue Addressed
<p>5. To what extent is the governance structure clear, appropriate and efficient for achieving expected results?</p>	<p>5.1 Clearly defined and understood governance structure, including roles, responsibilities, accountabilities, and processes for prioritization and decision-making</p> <p>5.2 Evidence of/views on the appropriateness and efficiency of governance structure</p>	<ul style="list-style-type: none"> • Document review • Key informant interviews 	<p>Issue #5: Demonstration of Efficiency and Economy</p>
<p>6. Is the program undertaking specific activities and delivering products at the lowest possible cost? How could the program's activities be more efficient? Are there alternative, more economical ways of delivering program outputs?</p>	<p>6.1 Degree to which the program is delivered as designed and intended</p> <p>6.2 Evidence of /views on appropriateness and efficiency of administrative and operational processes</p> <p>6.3 Evidence of/views on effectiveness of communications and collaboration with partners and stakeholders</p> <p>6.4 Evidence of use of technologies that may impact efficiency</p> <p>6.5 Evidence of/views on the existence of program design elements that facilitate efficient delivery (e.g., benchmarking, service standards)</p> <p>6.6 Degree of progress in implementing management responses to recommendations from previous evaluations and audits</p> <p>6.7 Evidence of/views on reasonableness of program resources/capacity in light of intended outcomes</p> <p>6.8 Evidence of/views on whether the program utilized the least amount of resources needed to produce its outputs</p> <p>6.9 Evidence of/views on whether opportunities for cost recovery are being pursued</p> <p>6.10 Evidence of/views on how the program's activities could be more efficient</p> <p>6.11 Evidence of/views on whether there are alternative, more economical ways of delivering program activities and outputs</p>	<ul style="list-style-type: none"> • Key informant interviews • Document review <ul style="list-style-type: none"> • Key informant interviews • Document review • Financial analysis <ul style="list-style-type: none"> • Key informant interviews • Document review 	<p>Issue #5: Demonstration of Efficiency and Economy</p>

Question	Indicators	Sources/Methods	TB Policy Issue Addressed
7. Are performance data being collected and reported? If so, is this information being used to inform senior management/ decision-makers?	7.1 Evidence that outputs and outcomes are well-articulated, and a performance measurement strategy/plan has been developed and implemented 7.2 Extent to which performance data are reliable, timely and valid 7.3 Extent to which performance data are reported 7.4 Extent to which performance data inform/support EC's decision-making processes	<ul style="list-style-type: none"> • Document review • Performance data analysis • Key informant interviews 	Issue #5: Demonstration of Efficiency and Economy

Performance – Effectiveness			
Has the program achieved its intended outcomes?			
8. To what extent have intended outcomes been achieved as a result of the program?	8.1 Evidence of/views on the extent to which intended outcomes have been achieved as a result of the program (PMF and QMS outcomes) 8.2 Evidence of/views on factors outside the program which have influenced the achievement of intended outcomes	<ul style="list-style-type: none"> • Key informant interviews • Document review • Performance data analysis 	Issue #4: Achievement of Intended Outcomes (Effectiveness)
9. Have there been any unintended (positive or negative) outcomes?	9.1 Evidence of/views on the presence/absence of unintended outcomes	<ul style="list-style-type: none"> • Key informant interviews • Document review 	Issue #4: Achievement of Intended Outcomes (Effectiveness)

Annex 2 Summary of Findings¹

Evaluation Question	Acceptable	Opportunity for Improvement	Attention Required	Not Applicable
Relevance:				
1. Is there a continued need for the program?	●	-	-	-
2. Is the program aligned with federal government priorities?	●	-	-	-
3. Is the program consistent with federal roles and responsibilities?	●	-	-	-
Performance – Efficiency and Economy				
4. Is the program design appropriate for achieving its intended outcomes?	●	-	-	-
5. To what extent is the governance structure clear, appropriate and efficient for achieving expected results?	●	-	-	-
6. Is the program undertaking specific activities and delivering products at the lowest possible cost? How could the program's activities be more efficient? Are there alternative, more economical ways of delivering program outputs?	-	-	●	-
7. Are performance data being collected and reported? If so, is this information being used to inform senior management/ decision-makers?	-	-	●	-
Performance – Effectiveness				
8. To what extent have intended outcomes been achieved as a result of the program? (a) Canadians and their institutions have the hydrological data, information and knowledge they need to make water management decisions. (b) A credible, sustainable national hydrometric monitoring program is maintained and supported. (c) The National Hydrometric Program is well managed according to established international operational criteria.	- ● ●	- - -	● - -	- - -
9. Have there been any unintended (positive or negative) outcomes?	-	-	-	●

1. The rating symbols and their significance are outlined in Table 2 in Section 4.0.