National Defence Défense nationale

Reviewed by ADM(RS) in accordance with the *Access to Information Act.*
Information UNCLASSIFIED.

Evaluation of Canadian Coast Guard Marine Navigation

Photo credit: Megan Sutton

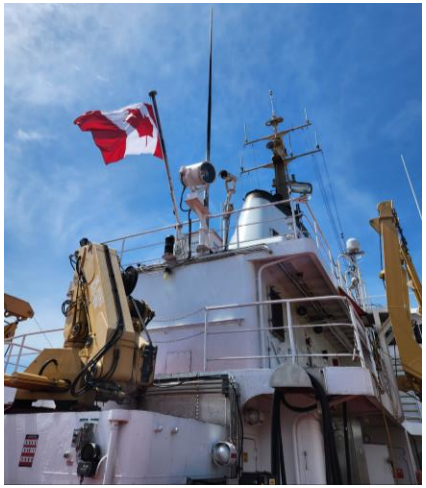


Photo credit: Hassina Docrat

Photo credit: Mick Tirilly

978-0-660-98726-2
D2-721/2026E-PDF
December 2025

Canada

Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.

Evaluation Context

Overview

This report presents the results of the Evaluation of Canadian Coast Guard Marine Navigation conducted by the evaluation division at the Department of Fisheries and Oceans Canada (DFO) and the Canadian Coast Guard (CCG) from February 2024 to March 2025. The evaluation complies with the Treasury Board's Policy on Results.

Evaluation Context, Scope and Objectives

In September 2025, pursuant to Order in Council 2025-0639, CCG was transferred from a special operating agency within DFO to the Department of National Defence (DND). This report focuses solely on findings related to CCG. A separate report on the Canadian Hydrographic Service's (CHS) contribution to marine navigation was prepared for DFO.

The original evaluation focused on one DFO-CCG core responsibility: marine navigation, which provides information and services to facilitate navigation in Canadian waters. This core responsibility is supported by CCG's Icebreaking Services, Aids to Navigation (AtoN), Marine Communications and Traffic Services (MCTS) and Waterways Management, along with DFO's CHS under Hydrographic Services, Data and Science. The Shore-based Asset Readiness (SBAR) program was not included in this evaluation as it was evaluated in fiscal year (FY) 2020/21. The evaluation covered FYs 2019/20 to 2023/24.

The scope of the evaluation was established through a planning phase, which included consultations with program representatives, senior management from all CCG regions, and national headquarters. The evaluation assessed the value that the marine navigation programs provide to Canadians, the resources invested in supporting these programs, the achievement of intended outcomes and the transition toward the digitalization of marine navigation services.

Evaluation Methodology and Evaluation Questions

To answer the evaluation questions listed in the following section, information from multiple lines of evidence was examined and triangulated to mitigate issues associated with using any singular line of evidence.

This triangulation method of data collection and analysis ensured that the recommendations made in this evaluation were robust and considered multiple points of view. The evaluation methodology, limitations and mitigation strategies are presented in Annex A.

Evaluation Questions

The evaluation examined the following four questions:

1. To what extent do the marine navigation programs provide value to Canadians?
2. What level of resources has been invested in support of the marine navigation programs?
3. To what extent are the marine navigation programs meeting their intended outcomes?
4. To what extent are the marine navigation programs preparing for the digitalization of marine navigation services?

44
Interviews

1
Case Study

3
Field Observations

170+
Documents Reviewed

Performance and Financial Data

**Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.**

Program Profiles

Overview of Marine Navigation

CCG has a broad mandate related to marine navigation, which is derived from several key pieces of legislation, including the *Oceans Act* and the *Canada Shipping Act, 2001*. This legislation aligns with international guidelines and conventions, such as those from the International Maritime Organization, to which Canada is a signatory.

The marine navigation programs are responsible for supporting Canada's economy through the efficient movement of maritime trade and for ensuring that Canada's waters are safe and navigable for mariners.

CCG has the responsibility of providing AtoN, channel maintenance, icebreaking, ice management services, and marine communications and traffic management services. The four CCG marine navigation programs fall under the Fleet and Maritime Services branch.

AtoN

The AtoN program provides mariners with approximately 17,000 visual, audible and electronic aids such as fixed and floating aids throughout Canadian waters. All CCG regions review their current aids and add new ones as needed. During the evaluation period, the Arctic region in particular was designing new systems of aids in the Arctic to assist with increased vessel traffic. These aids assist mariners in identifying vessel location, best or preferred routes, and underwater hazards.

In addition to the previously listed aids, the program has both manned and unmanned light stations on Canada's coasts. In 2024, there were 24 manned stations in the Atlantic Region and 27 on the British Columbia coast.

Some light stations are also federally-designated heritage lighthouses, and light station keepers often interact with the public in non-traditional ways, such as providing tours or assistance to pedestrians or non-motorized boat users.

At the national level, the AtoN program provides maritime safety information through a series of online publications, including the Notices to Mariners (NOTMAR). The program maintains national directives and standards that are delivered at the regional level.

In the four CCG regions, the AtoN program has two primary functions: design and review, as well as operations. These functions oversee the implementation of AtoN and review existing aids to maintain an effective navigation system (see example in Box 1) and operations, which manages the seasonal commissioning and decommissioning of buoyage systems.

Box 1 - Bay of Islands

In 2024, the AtoN program undertook a review of the AtoN system in the Bay of Islands on Newfoundland's west coast. The Design and Review Specialist conducted a site observation and quantified navigational risks to support the design of short-range marine navigational aid systems.

Key recommendations included establishing new aids such as the Cox's Point Light and Frenchman's Cove Wharf Light, repositioning existing aids and updating flash characteristics and intensities for several lights. These changes aim to mitigate navigation hazards, enhance visibility and ensure accurate positioning—which supports marine industries in the region, including shipping vessels, commercial fishing vessels and recreational boaters.

Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.

Program Profiles

Waterways Management

The Waterways Management Program ensures safe and efficient navigation of Canadian waterways by maintaining and managing key commercial shipping channels to their specified depth and width. It provides channel-maintenance dredging only in the St. Lawrence River and Great Lakes. The program monitors and manages channel bottom conditions and water level depths, providing up-to-date information to CHS and to clients for safe navigation.

MCTS

The MCTS program operates 12 centres continuously throughout the year to ensure the safe and efficient movement of marine traffic in Canadian waters through radio and electronic communications, including navigational warnings (NAVWARN), emergency assistance and weather broadcasts.

The services provided by the program include safety radio communication, vessel traffic management and regulation, information supporting marine activities, screening of vessels entering Canadian waters and a 24/7 commercial marine telephone call service. As a signatory to the International Convention for the Safety of Life at Sea, Canada is required to make provisions for safety radio communications services, which it provides through MCTS.

Icebreaking Services

The Icebreaking Services program ensures safe and efficient maritime navigation through ice-covered waters, supporting commercial shipping, fisheries and the resupply of northern communities. Icebreaking services are delivered with support from the CCG fleet in collaboration with the Canadian Ice Services through Environment and Climate Change Canada.

The program provides essential services, including route assistance, escorts, freeing beset vessels, ice routing, harbour breakouts and flood control. The program operates in the Great Lakes, the St. Lawrence River, the Gulf of St. Lawrence and the Atlantic regions in the winter, with summer operations taking place in the Canadian Arctic.

Photo credit: CCG Navigational Programs

CCG Marine Navigation Programs' Full-time Equivalents (FTE)

	2019/20	2020/21	2021/22	2022/23	2023/24
MCTS	298	296	324	311	313
AtoN	197	180	193	197	199
Waterways Management	24	23	38	45	49
Icebreaking Services	8	7	8	9	9
CCG Total	527	506	563	562	570

Source: Chief Financial Officer Sector
Note: The numbers in the table for 2021/22 to 2023/24 may differ from publicly reported numbers as they have been adjusted to address a coding issue.

Value

Finding 1: The marine navigation programs provided value to Canadians by delivering essential services, tools and infrastructure. These services enhanced marine safety and sovereignty and contributed to the $225 billion maritime economy in Canada. They ensured safe navigation and facilitated efficient trade: Icebreaking Services, Aids to Navigation, and Marine Communications and Traffic Services played essential roles in ensuring vessels could safely transit Canada's waters. Waterways Management worked with the Department of Fisheries and Oceans' Canadian Hydrographic Service to provide navigators with bathymetric[1] and hydrographic[2] survey data for mariners.

Marine navigation programs play a key role in supporting marine safety and Canada's sovereignty and maritime economy.

The evaluation found that the CCG marine navigation programs contributed to Canadian marine safety and the maritime economy. Document review and internal interviews indicated that the programs supported essential services, such as maintenance dredging of waterways, emergency communication and icebreaking services. These services are necessary for commercial shipping vessels, fishing vessels and recreational boaters to safely navigate Canadian waters. The programs developed various tools for navigation and risk avoidance, and they collaborated with stakeholders to ensure program expertise is available wherever it is needed, coast to coast to coast.

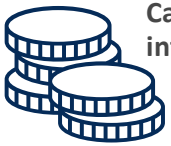
In addition to these services, the evaluation found that the CCG marine navigation programs, along with DFO's CHS, provided the necessary systems, tools, data and infrastructure for efficient maritime route coordination and planning. The marine navigation programs provided systems, such as short-range marine navigational aid systems, Automatic Identification System AtoN, and radio aids, to marine navigation.

Icebreaking Services supported the maintenance of Canadian Arctic sovereignty by keeping the tracks that foreign vessels use through Canadian Arctic waters ice-free. They also transported dry cargo and fuel during the annual resupply of northern settlements and DND sites when commercial carriers were not available.

Canada's broader marine sectors generated over 298,000 jobs and contributed more than $51 billion to the GDP in 2020. The fisheries industry represented Canada with 16,703 vessels in 2022, landed $4.8 billion in seafood and is expected to grow fivefold by 2035.

A DFO economic analysis report on Icebreaking Services indicated that, in 2020, Canada's marine international trade represented $225 billion. More than half ($119 billion) occurred on waters serviced by CCG's Icebreaking Services program. During the winter icebreaking season, 33 percent (or $39.9 billion) of the maritime trade occurred across the St. Lawrence, Great Lakes and Atlantic regions.

In the future, CCG's operations in the Arctic will shift from a seasonal icebreaking approach to year-round operations, enabled by investments in CCG's fleet and personnel. The maritime sector is expected to see significant growth in marine traffic with an increase of 50 percent by 2030, according to a Transport Canada report.



Canada's marine international trade in 2020:

$225 billion

53% **of Canada's maritime trade in 2020 occurred on waters serviced by CCG's Icebreaking Program.**

1. Bathymetric: relating to the measurement of depths of water in oceans, seas and lakes
2. Hydrographic: relating to hydrography, the science that deals with the measurements and description of the physical features of the oceans, seas, lakes, rivers, and their adjoining coastal areas, with particular reference to their use for navigational purposes

**Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.**

Value

The marine navigation programs provide the necessary services, products, data and expertise in support of marine safety.

The evaluation found that CCG marine navigation programs offer products and services that improve marine safety. Industry interviewees indicate that the CCG marine navigation programs, in collaboration with CHS, are important to ensure safe and efficient operations in Canadian waters. For example, navigational aids play a role in ensuring vessels can safely transit Canada's waters. This is especially important in areas like the St. Lawrence Seaway with high traffic volume, narrow channels and varying water levels that require precise navigation.

By ensuring aids are properly designed, placed and maintained, the AtoN program facilitates safe and efficient navigation. Document review indicated that AtoN collaborates with MCTS to ensure the timely and accurate dissemination of navigation communications, such as NAVWARNs.[3] AtoN consistently published their monthly NOTMARs between 2019 and 2024.

Staffed light stations were one area where the evaluation did not find clear evidence that activities directly supported program outcomes or departmental results focused on safe navigation and supporting Canada's maritime economy. Over the past 50 years, most of these locations were de-staffed as a result of automating operations, with little impact on mariner safety or service delivery.

A 2002 report of the Auditor General of Canada indicated that, due to automation, there is no operational need to keep light stations staffed for navigation safety. All AtoN functions at the 51 staffed light stations are fully automated and do not require on-site staff presence for their operation or maintenance.

Document review indicates that the Waterways Management Program conducts channel bottom surveys to provide bathymetric data to pilots, port authorities and fleet operators. These surveys support CCG's responsibilities by ensuring the safe and efficient navigation of Canadian waterways.

Waterways Management also performs maintenance dredging in the Canadian portions of two major commercial shipping channels within the Great Lakes under an international agreement with the U.S., and it provides this service within the St. Lawrence River. Additionally, Waterways Management, with support from DFO's CHS, provided channel bottom monitoring to navigators in specific waterways, ensuring safer navigation.

External industry interviewees indicated that their respective operations hinge on the products and services provided by the CCG marine navigation programs, in collaboration with DFO's CHS. These products were identified as critical for route planning, operational safety and vessel management. Without these services, mariners would face increased risks of accidents and delays due to the lack of accurate, real-time navigation and environmental data.

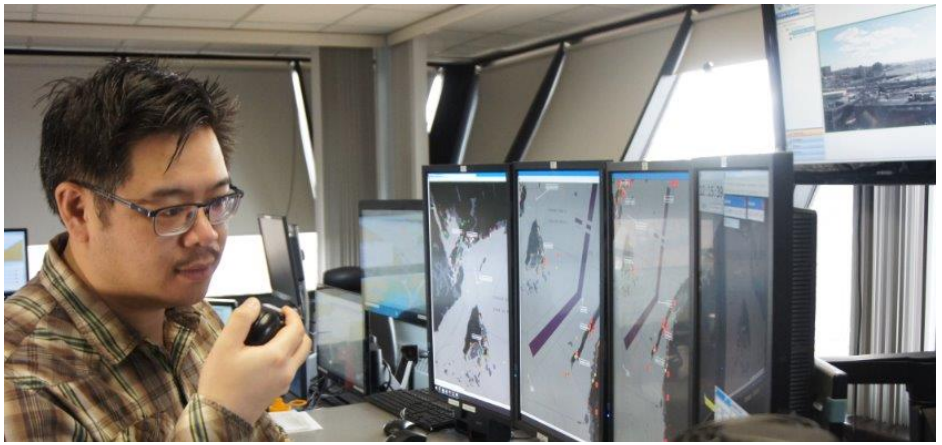


Photo credit: CCG

3. NAVWARNs are an immediate release to alert mariners to a new hazard. A NOTMAR is a long-term version of NAVWARNs and other marine safety information.

Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.

Effectiveness

Finding 2: The evaluation found that the marine navigation programs deliver services in support of marine safety and provide timely information to mariners as expected. Between 2019 and 2024, the CCG marine navigation programs made information available to mariners through 24/7 services and various navigational products, including Notices to Mariners, navigational warnings, ice charts, channel bottom monitoring and water level forecasts.

Marine navigation services that support the Canadian maritime economy show mixed results in achieving the expected departmental outcomes. The Aids to Navigation program faced challenges in meeting its target of completing planned reviews. Icebreaking Services fell slightly short of meeting its performance target for ship ice escort requests. Waterways Management was generally successful; however, it had challenges achieving its dredging targets in the Great Lakes.

Marine navigation programs provided timely information to mariners.

Internal interviewees indicated that the CCG marine navigation programs generally met the expected departmental outcomes related to marine safety.

MCTS

MCTS has played a role in ensuring marine safety across Canadian waters. The evaluation found that, despite the challenges of the COVID-19 pandemic, MCTS maintained uninterrupted, 24/7 operations, quickly adapting to new safety protocols while managing a surge in pleasure craft activity and subsequent distress calls.

By 2020, all MCTS centres, except for Iqaluit, had been paired as part of a business continuity strategy. This pairing allowed one centre to operate the other remotely during disruptions, ensuring continuous service. Each centre could access its counterpart's communication and information systems, providing a resilient operational framework.

MCTS also advanced modernization through the development of the Collaborative Voyage Management System, streamlining offshore reporting and reducing administrative burdens. Between 2019 and 2024, MCTS supported the marine navigation core responsibility by delivering timely and accurate information to an average of 430,000 vessel movements per year through NAVWARNs, NOTMARs and continuous marine broadcasts, including weather updates and water levels, as per its levels of service (LoS) in support of safe and efficient navigation in Canadian waters.

When asked whether the services provided by the programs in the past five years had been delivered as expected by the Department, the majority (56 percent) of internal interviewees said they had. However, just over half (52 percent) of the internal interviewees identified issues when asked about the effectiveness of AtoN, Waterways Management and Icebreaking Services in supporting the maritime economy. Performance data indicated that these programs did not meet their expected departmental outcomes. The nature of the challenges differed by program and are discussed in the following paragraphs.

AtoN

National directives for the AtoN program indicate that each AtoN system should undergo a complete review at least once every five years. According to the program, the goal is to try and evaluate approximately 20 percent of their inventory annually and to align with the Department's investment cycle. However, performance indicator data showed that between 2019 and 2024, the AtoN program did not achieve its annual target of executing 100 percent of its planned reviews (see Figure 1).

Planned reviews for an FY include reviews from previous years that are not yet completed, as well as reviews that are starting in that FY.

Effectiveness

AtoN (continued)

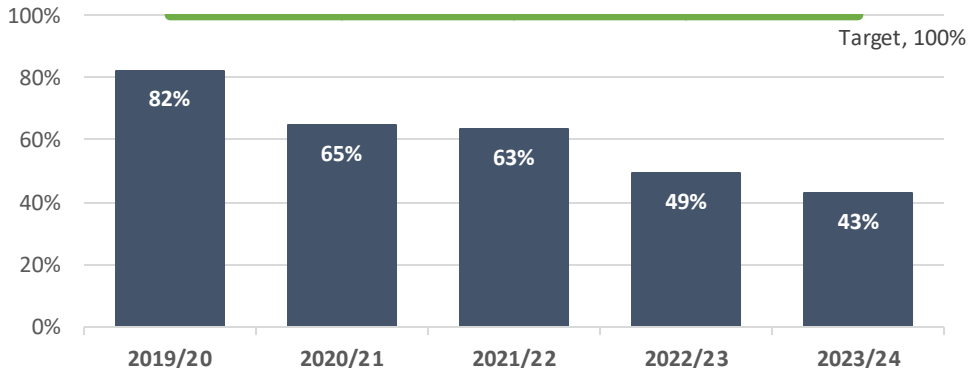
The evaluation found that achieving this goal has been challenging due to resource limitations and fleet availability. To mitigate this, superintendents in each CCG region created annual work plans to establish AtoN system review priorities to meet the needs of the public. AtoN also faced difficulties due to factors such as COVID-19 travel restrictions, ongoing staffing shortages, a lack of experienced personnel and an increasing workload.

The evaluation did not find evidence that the low and declining number of completed reviews affected marine safety. According to program officials, AtoN did not receive any negative feedback from the public or industry through their various consultation forums.

The CCG Integrated Technical Services (ITS) is responsible for the SBAR program, which ensures the availability and reliability of non-fleet assets. The SBAR program supports the AtoN program by maintaining AtoN. Consequently, the evaluation did not assess the availability, state or reliability of AtoN equipment.

The *Canada Shipping Act, 2001* states that mariners have an obligation to report an uncharted hazard to navigation—or an AtoN that is missing, out of position or malfunctioning—to an MCTS officer or a CCG officer. The programs did not track data on which reports originated from the public.

Percentage of Planned AtoN Reviews Completed per FY



Waterways Management

The Waterways Management Program maintains and manages key commercial shipping channels to their specified depth and width, ensuring these waterways remain accessible, safe and efficient. It met its service standard for dredging in the St. Lawrence 100 percent of the time in 2023/24. However, in 2021, it did not achieve its dredging targets in the Great Lakes connecting channels due to the unavailability of a confined disposal facility for contaminated materials. At the time of writing this report, CCG was focused on finding long-term solutions for the disposal of contaminated sediment.

From 2019/20 to 2023/24, the Waterways Management Program completed an average of 94 percent of its planned channel surveys. In FYs 2020/21 and 2021/22, the program fully met its target rate of 100 percent. However, in 2022/23, the Atlantic region was unable to perform all its planned surveys due to a reduced budget, leading to a 93 percent completion rate over the three regions.

By maintaining navigable depths in key channels like the St. Lawrence River and Great Lakes connecting channels, Waterways Management reduces the risk of encounters with underwater hazards, prevents vessel grounding and ensures the uninterrupted flow of marine traffic, which is vital for trade, industry and regional economic stability.

In this same period, the Waterways Management Program successfully achieved 100 percent of its target for weekly water level forecasts available to the public, apart from the 2019/20 period. During that particular year, a staffing issue at Environment and Climate Change Canada, the organization responsible for communicating these forecasts, resulted in the public release of only 32 out of 36 forecasts specific to the Mackenzie River (despite the CCG western region completing all forecasts for the Fraser River).

Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.

Effectiveness

Icebreaking Services

The Icebreaking Services program played a significant role in supporting the maritime economy by assisting vessels through ice-covered waters and freeing beset vessels. However, it fell slightly short of meeting its expected performance outcomes due to challenges related to resource constraints, environmental conditions and operational demands.

The evaluation reviewed a sample of archived ice charts from 2019 to 2024, which showed that Icebreaking Services provided daily charts in areas of operational interest to CCG.

From FY 2019/20 to 2023/24, the Icebreaking Services program did not achieve its aspirational target of 0 percent delays[4] in ship ice escort requests south of Canada's Arctic. The number of requests varied from a high of 415 in FY 2021/22 to a low of 93 in 2023/24.

The number of requests is directly linked to ice conditions and the volume of traffic in ice-infested areas. The percentage of ship ice escort requests south of the 60th parallel north that were delayed beyond the LoS response time standards fluctuated between 1.41 percent (in FY 2019/20) and 4.82 percent (in FY 2021/22).

Between 2019 and 2023, the Icebreaking Services program met its response time targets for harbour breakouts 96 percent of the time in the Great Lakes and 98 percent in the St. Lawrence.

Data on harbour breakouts is no longer being reported as of FY 2024 following an update in the CCG LoS (see Box 2) as too many weather and environmental variables out of their control are influencing this service.

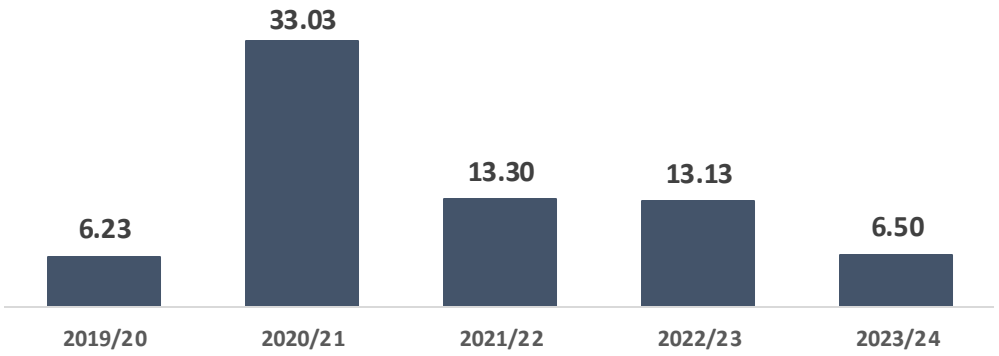
The average delay time in hours for ice escort requests south of the 60th parallel north fluctuated between 2019 and 2024, exceeding the LoS response time standards (see bar chart following Box 2). Icebreakers are placed in zones where assistance is needed to maximize vessel availability and minimize response time. Most of the delays in icebreaking are due to a lack of assets or an asset being already tasked and conducting a service in another area.

Box 2: Updated LoS

In 2021, CCG conducted a review of its 2010 LoS to better align them with the current operating environment. Public input was gathered using an online survey of various stakeholders, including mariners, tourism industry workers, port authorities, law enforcement, recreational boaters, Indigenous Peoples and CCG personnel.

The survey results were reviewed for their practicality and potential for implementation, leading to the creation of the updated 2024 LoS document. The updated LoS introduced several changes, such as Indigenous engagement and increased target response time for icebreaker assistance in some areas to align with transit time reality.

Average Time (in Hours) Beyond LoS Response Time Standards for Ice Escort Requests South of the 60th Parallel North, per FY



4. In FY 2020/21, two of the delays in the Great Lakes were related to U.S. Coast Guard vessels, which provide services alongside CCG icebreakers in Canadian waters.

**Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.**

Effectiveness

Finding 3: The Canadian Coast Guard marine navigation programs engaged with Indigenous Peoples in various ways, but engagement could be improved by ensuring meaningful and timely information sharing. The evaluation found a need for centralized guidance that would build on the existing Canadian Coast Guard's Indigenous Relations Strategic Framework. This guidance would support the Canadian Coast Guard marine navigation programs in advancing reconciliation with and enhancing participation of Indigenous Peoples.

CCG marine navigation programs are seeking some opportunities to engage with Indigenous Peoples.

Communities in the Canadian North rely on icebreaking operations in the summer to clear paths for commercial sealift operations. The Icebreaking Services program supported these remote communities by providing route assistance to vessels in ice-covered waters, ensuring essential goods are more affordable and accessible.

Icebreaking work can affect the traditional ways of life of Indigenous communities. Many internal interviewees (73 percent) provided broader examples of how CCG marine navigation programs engaged with Indigenous Peoples. Key activities included collaboration between Waterways Management and the Walpole Island First Nation on several projects aimed at enhancing maritime safety and environmental stewardship, as well as the geographical renaming of specific areas on navigational charts in partnership with Indigenous groups. Icebreaking Services held Indigenous engagement sessions outside of the Arctic region as part of the 2023–2028 Client Icebreaking Requirements.

Some internal interviewees (38 percent) emphasized the need for improved engagement with Indigenous groups. Their suggestions primarily focused on clarifying the needs of Indigenous communities and ensuring timely information sharing. There are opportunities for marine navigation programs to enhance participation, particularly in the areas of AtoN and Icebreaking Services. Initiatives, such as those with Walpole Island First Nation, serve as examples of improved relationships.

There is a need for guidance to advance reconciliation.

Interactions between CCG marine navigation programs and Indigenous groups often occurred through the regional Indigenous Relations and Partnerships teams. As a result, some internal interviewees (23 percent) pointed out that, at the time of data collection in fall 2024, their programs had limited direct engagement with these communities.

Interviewees stated that they did not do targeted engagement, apart from those in the Arctic Region, when engaging or seeking feedback from Indigenous groups. The evaluation did not find evidence of a policy or directive to guide program staff on how to work with Indigenous Relations and Partnerships nor how engagement should be done to advance reconciliation.

During the evaluation period, CCG had committed to working toward renewed relationships with Indigenous Peoples through the DFO-Coast Guard Reconciliation Strategy and CCG's Indigenous Relations Strategic Framework. As part of this effort, the Fleet and Maritime Services branch set specific objectives to work toward in the 2023–2024 CCG Reconciliation Action Plan. While some incremental efforts, such as training, have been implemented, the evaluation did not identify processes or directives adopted by the programs to meet CCG's objectives.

In the context of the *United Nations Declaration on the Rights of Indigenous Peoples Act*, it is important for the CCG marine navigation programs to be aware of their legal obligations. AtoN, for example, has fixed assets located on Indigenous lands.

**Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.**

Effectiveness

Gender-based Analysis Plus

A Gender-based Analysis Plus lens was applied throughout the evaluation.

Some internal interviewees (32 percent) indicated that the programs are not considering accessibility and inclusivity in their navigational products. Overall, while the CCG marine navigation programs strive to consider accessibility and inclusivity in general, there are inherent limitations to product accessibility due to international standards and the nature of navigational products.

The evaluation found that products and services are available in both official languages and accessible in different formats, such as PDF and digital formats. However, some internal interviewees (48 percent) noted that navigational products must adhere to international standards (e.g., the colour of physical aids on the water), which may be considered a limiting factor to inclusivity.

CCG planned a Gender-based Analysis Plus analysis and an accessibility study of its programs and services, but it has not yet been completed.

Due to the nature of the work conducted by the CCG marine navigation programs, data regarding the impact of this program on demographic groups is not available, resulting in a lack of gender-disaggregated data for the evaluation.

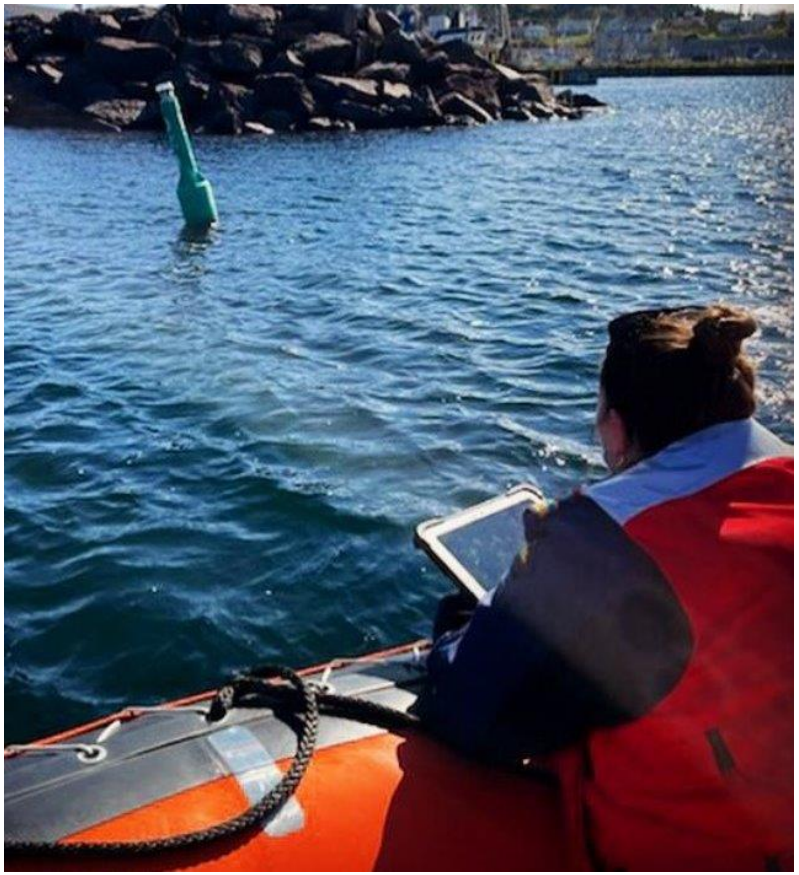


Photo credit: CCG

Effectiveness

Finding 4: The evaluation found that, despite limited resources, the Canadian Coast Guard marine navigation programs were making efforts to meet their intended outcomes. To address challenges, they focused on priority needs such as icebreaking requests, Aids to Navigation reviews or high-risk areas for surveys.

CCG used a risk-based approach to address gaps.

Overall, the evaluation found that while the programs were making efforts to meet their intended outcomes, they faced several challenges that impacted their ability to fully achieve their goals. Some respondents (40 percent) highlighted that the programs were performing to the best of their abilities, given limitations in resources and various contextual factors, such as fleet availability, unexpected weather and materiel gaps.

To address gaps, internal interviewees indicated that the marine navigation programs used a risk-based approach that aligned programs with priority needs and constraints. This approach, though limiting preventive work, helped mitigate budget constraints. For example, Icebreaking Services prioritized requests in its service standards for ice operations (see Box 3), and AtoN superintendents in each CCG region created annual work plans to establish AtoN system review priorities.

In addition to the risk-based approach, the evaluation found that several short-term strategies have been implemented to support programs, such as chartering vessels, using supporting technological tools (e.g., drones for AtoN) and using casual staff and overtime in Icebreaking Services.

Additionally, both AtoN and Waterways Management maintained warnings to manage operational limitations. Typically, shoal[5] warnings are temporary navigational alerts that inform mariners about changes to navigational aids or hazards caused by shoals that may affect navigation safety. Once the situation is resolved or the hazard is no longer present, these warnings are cancelled. However, for AtoN, budget constraints and limited vessel time caused delays in reviewing and maintaining aids.

To mitigate this challenge, continuous AtoN warnings have been issued. The Waterways Management Program has also used shoal warnings as a mitigation strategy when facing challenges with dredging in the Great Lakes. In the Pacific region, Waterways Management conducted only the minimum number of surveys required. The prioritization of these surveys depended on available funding and the individual risk rating of each channel.

5. A shoal is any relatively shallow place in a stream, lake, sea or other body of water.

Box 3 - 2019 Lake Saint-Pierre Ice Jam

Icebreaking services are essential to ensure the continuity of the supply chain, and the St. Lawrence River is a critical commercial waterway in Canada. The Icebreaking Services program operates in the region to ensure that, even during harsh winter weather, the flow of goods continues.

In 2019, severe weather conditions caused an ice jam that lasted for six days, requiring CCG to stop traffic on Lake Saint-Pierre. This resulted in a delay of 33 ships and caused a recorded loss of $8 million across various stakeholders.

To expedite the ice breakout, CCG retasked three icebreakers from other areas of Quebec to assist: CCGS *Amundsen,* CCGS *Martha L. Black* and CCGS *Pierre Radisson*. The retasking of these vessels highlights the reactive nature of the program, as it currently lacks the capacity to proactively manage such situations.

This ice jam subsequently caused two further delays resulting from ice sheets breaking off the shoreline, creating a bottleneck downriver.

Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.

Design and Delivery

Finding 5: Internal interviewees noted that, in addition to materiel and financial gaps, environmental factors and issues related to organizational structure are hindering delivery. Climate change and extreme weather events are impacting maritime traffic and increasing the demand for related programs and services. On the other hand, they highlighted that strong collaboration among Canadian Coast Guard groups, regions and external partners is a key facilitating factor. They also pointed out that modernization opportunities exist in the future.

Impact of Climate Change on Program Delivery

Environmental factors, particularly climate change and increased maritime traffic, are significantly affecting CCG's operations. Some internal interviewees (31 percent) noted that climate change posed a significant challenge to program delivery. Document review highlighted the urgent need for CCG marine navigation programs to adapt to more frequent and severe weather events, earlier seasonal demands and heightened navigational hazards.

Rising maritime traffic and unpredictable ice conditions, especially in the Arctic, have increased demand for Icebreaking Services and AtoN. These pressures are compounded by earlier fishing seasons and longer ice-free periods, requiring earlier deployment of buoys and extended operational windows.

In the central region, warmer winters and fluctuating water levels have lengthened the navigation season, increasing the need for port and waterway maintenance. The Atlantic region faces more intense storms and shifting ice patterns, complicating resource planning.

Severe weather has also led to travel delays for CCG personnel; increased overtime; and higher transportation costs. Interviewees noted that climate variability makes it difficult to establish consistent operational patterns, underscoring the need for flexible planning. The 2023/24 Fleet Operations Plan reported that environmental delays caused 37.75 days of delay for the AtoN program.

Document review and interviewees revealed capacity gaps in icebreaking services, exacerbated by increased storm activity, unpredictable ice conditions and growing traffic. These evolving challenges are placing sustained pressure on CCG marine navigation programs to adapt and maintain safe, effective maritime operations.

Organizational Factors That Hindered the Delivery

When asked about factors that hindered program delivery, some internal interviewees (34 percent) viewed DFO-CCG's organizational structure as a hindering factor. For instance, some interviewees (24 percent) mentioned that CHS reports to the Ecosystems and Oceans Science Sector despite having many similarities and complementary operational functions with CCG. Aligning priorities between CCG and CHS was identified by program officials as an area for improvement.

Additionally, there are challenges in accessing information, such as bathymetric data, survey data and Automatic Identification System data, both between CCG and CHS, and within CCG itself.

Impacts of Travel Caps on Program Delivery

Travel restrictions hindered maintenance operations and international commitments that required in-person attendance. For instance, AtoN travel spending was reduced by 59 percent from FY 2019/20 to 2023/24. An AtoN interviewee noted that the travel cap limited comprehensive engagement with clients and direct observations (visual factors including buoys' condition and position). Other AtoN interviewees noted the travel cuts impacted work plans, and attempts at virtual stakeholder engagement sessions have been inefficient.

In-person engagement with industry and the community is especially important in the Arctic region. These travel limitations have also affected participation in international committees and working groups for the S-100 standards, which are central to the digitalization of marine navigation services.

Reviewed by ADM(RS) in accordance with the *Access to Information Act.*
Information UNCLASSIFIED.

Design and Delivery

Collaboration facilitated the delivery of the marine navigation programs' activities.

A key facilitating factor identified by half of the internal interviewees (55 percent) was the collaboration between internal CCG and CHS groups (between regions, programs, ITS, etc.) and external partners (industry and other government organizations). For instance, internal interviewees regarded the ITS team as particularly helpful, even referring to them as the "magicians" and praising them for ensuring the CCG marine navigation programs consistently had what they needed. This includes optimizing the design integrity of all AtoN and MCTS assets as well as the life-cycle materiel management of nationally managed assets, equipment and systems.

There was also a strong collaboration between CCG regions, such as the partnership between the central and Atlantic offices in coordinating Icebreaking Services and programs as well as MCTS superintendents meeting monthly to resolve issues and support one another.

CHS interviewees stressed that they worked closely with CCG marine navigation programs and that the relationship was positive. For an example of how the programs work together, see Box 4.

Internal interviewees and external respondents noted that marine navigation programs collaborate closely with pilotage and port authorities, as well as fleet operators, to improve navigational safety. Half of the internal interviewees (50 percent) indicated positive relationships with the industry.

Digital transformation acts as both a facilitating and hindering factor.

Upgrades to software and IT infrastructure were cited as facilitating factors by internal interviewees. While overall positive, program management noted that it was a lot of change for staff as services continued to be modernized.

As marine navigation transitioned toward the digitalization of program delivery, internal interviewees indicated that a dual-fuel approach was used during the transition period. This approach involved continuing to deliver programs while also improving them to be more effective and digital. However, the dual-fuel approach presented challenges as employees were struggling to manage both the current workload and the requirements for modernization.

Most interviewees (52 percent) noted a lack of a common vision for service delivery and the transition toward digitalization.

Box 4 - Baker Lake

An example of the collaboration between CHS and the CCG marine navigation programs to support safe navigation can be seen in the swift reaction to the *Kivalliq W.* incident on October 18, 2022, which involved an oil and chemical tanker contacting an uncharted object in Chesterfield Narrows, Nunavut.

Following the incident, MCTS quickly issued a NAVWARN, alerting other vessels to the hazard. MCTS then notified Waterways Management and CHS to review and update nautical charts to begin discussions to accelerate knowledge of bathymetry in Baker Lake. CCG provided an icebreaker escort for the *Kivalliq W.* as it departed Arctic waters, ensuring the vessel's safe passage to its dry-docking destination.

The quick reaction of the programs and coordination demonstrated how they worked together in maintaining safe and efficient marine operations and preventing future incidents.

Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.

Design and Delivery

Finding 6: The evaluation found, through internal interviews and performance data analysis, that some program indicators were not useful for program officials to monitor and assess the results of their programs.

The evaluation reviewed the CCG marine navigation performance indicators, including program-specific indicators (such as the indicator for AtoN[6]) and departmental indicators (such as the MCTS indicator[7]).

Some interviewees (32 percent) expressed that some performance indicators are not sufficiently relevant or meaningful. For example, the program indicator for MCTS is a target ratio of "at or below 1 percent for the rate of marine incidents to vessel movements." However, using that ratio of marine incidents versus vessel movements to measure their program success is not accurate because MCTS is not solely responsible for the number of incidents that occur in Canada's waters. A new program indicator for MCTS would better reflect their work. A way to improve the program indicator would be to focus on the intended program outcomes, such as the timely issuance of NAVWARNs to prevent incidents.

Secondly, the program indicator for AtoN[6] was raised by Design and Review staff as not being an accurate reflection of the work they do. This indicator assumes that reviewing all aids requires the same amount of effort, even though they vary in complexity and the time needed for review. It also does not capture new systems or aids that do not yet exist, such as new systems being designed in the Arctic region.

Additionally, a review is only completed when the superintendent signs off. In the Arctic region, this requires community engagement beforehand, which could add months or years to the timeline. A new program indicator for AtoN, reflecting their ability to respond to requests based on their risk profile, would better reflect their objectives.

Implementing more meaningful and useful performance measures will enable program officials to better monitor and assess the program's ability to achieve results.

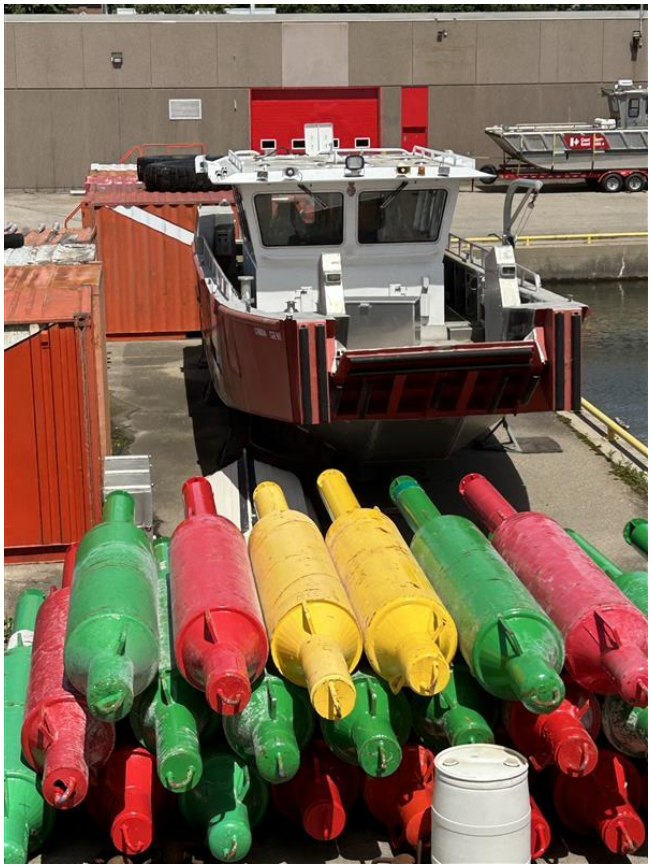


Photo credit: Becky Gillam

6. Indicator for AtoN: percent of AtoN reviews completed (planned and ad hoc) versus planned.
7. Indicator for MCTS: rate of marine incidents versus vessel movements.

Resources

Finding 7: Despite investments in Canadian Coast Guard marine navigation programs, expenditures exceeded budgets, particularly for Aidsto Navigation and Icebreaking Services, due to fuel costs for vessel operations. Canadian Coast Guard marine navigation programscharge service fees under the *Oceans Act*, which helps reduce their expenditures.

CCG marine navigation programs' expenditures exceeded budgets, but programs remained within budget when fuel costs were excluded.

Between FY 2019/20 and 2023/24, the four CCG marine navigation programs spent over $371 million, with average annual expenditures of approximately $74 million (see following table). This amount included fuel costs for vessel operations and was reduced by revenues collected through service fees. For example, in FY 2023/24, AtoN spent $12.2 million on vessel fuel to support programs, including light stations that depend on the fleet to resupply and maintain.

Of the four CCG marine navigation programs, MCTS and Waterways Management were the only two to remain in budget throughout the five-year period. However, once fuel costs are removed, the marine navigation programs were only over budget in FY 2019/20 and were within budget for the subsequent years of 2020/21 to 2023/24 (see following figure).

Additionally, AtoN, MCTS, Icebreaking Services and Waterways Management generated more than $189 million in revenues from fees during this period. The service fees were amended in 2019 and were adjusted annually for inflation but did not cover the full cost of all the services.

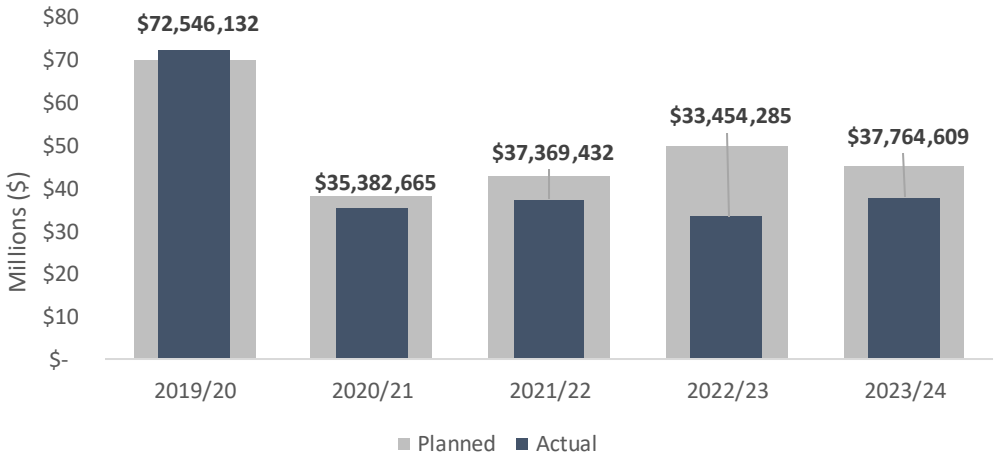
In FY 2023/24, Waterways Management's maintenance dredging services generated over $7 million in revenue within the St. Lawrence River, for a surplus of $1.8 million (see Annex B for more details on fees received by the CCG marine navigation programs).

CCG Marine Navigation Programs' Actual Expenditures (Including Net Voted Revenues and Fuel Costs) by FY

	2019/20	2020/21	2021/22	2022/23	2023/24
Marine Navigation	$98.7 M	$53.3 M	$63.9 M	$81.8 M	$73.9 M

Source: Chief Financial Officer Sector

CCG Marine Navigation Programs' Planned and Actual Expenditures (Excluding Fuel) by FY



Source: Chief Financial Officer Sector
Note: Fuel costs for vessel operations were removed from actual expenses as they are planned and paid for in a separate budget.

Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.

Resources

Finding 8: The evaluation identified that Canadian Coast Guard marine navigation programs faced significant challenges due to limited access to Canadian Coast Guard vessels, which hindered the delivery of essential marine navigation services. Additionally, the programs faced human resources challenges, and outdated systems and equipment further impeded the programs' operations, necessitating modernization.

CCG marine navigation programs experienced human resources challenges.

Between FYs 2019/20 and 2023/24, the CCG marine navigation workforce grew by 8 percent, from 527 to 570 FTEs, mainly in Waterways Management and MCTS. Despite this, nearly half (48 percent) of internal interviewees reported that limited funding constrained hiring capacity, adversely affecting program delivery.

According to the performance data, human resource capacity challenges in FY 2023/24 resulted in three regions having low completion rates for AtoN reviews. MCTS recruitment and retention issues were also cited by interviewees. Icebreaking Services, reliant on seasonal staff, faces budget uncertainties and staffing issues.

Limited fleet availability impacted program delivery.

The evaluation found that marine navigation programs depend heavily on CCG's fleet and SBAR for program delivery. Although the indirect costs associated with using CCG's fleet and SBAR are not accounted for in program expenditures, AtoN and Icebreaking Services are the main contributors to these indirect costs, which totalled more than $1.13 billion between FYs 2019/20 and 2023/24.

Internal interviewees identified limited access to ship time as the main materiel gap for marine navigation programs. As detailed in DFO's 2024 Evaluation of Fleet Procurement and Maintenance, the gaps in vessel availability hinder the acquisition of essential bathymetric data and the creation and updating of navigational products and services.

Additionally, the 2024 evaluation found that delays in fleet availability affect both the timely placement and maintenance of short-range AtoN. AtoN interviewees reported that they had to charter vessels for buoy work due to the lack of access to CCG vessels. This situation directly impacted service delivery and led to approximately $3.6 million per year in contracts for buoy servicing.

Moreover, delays in fleet availability also impact the icebreaking activities necessary to access ports and fishing harbours, affecting the navigation of both CCG and commercial vessels. The National Shipbuilding Strategy is making progress in delivering both large and small vessels to CCG, as well as in repair, refit and maintenance, which could help alleviate these issues.

Technological gaps impacted program delivery.

Half of the internal interviewees believed that the delivery of CCG marine navigation programs was hindered by outdated systems and equipment that required modernization. For example, some (29 percent) of the internal interviewees who reported technological gaps indicated that the Aids Program Information System, which is used to track information related to the operation and maintenance of all AtoN, was obsolete and needed replacement.

According to the interviewees, funding has been received for the Aids Program Information System, and CCG is expected to update it in the next few years as part of the modernization strategy.

The evaluation found that modernization opportunities have the potential for increased efficiency in some programs. For example, advances in both digital and physical technologies related to AtoN, along with the automation of processes in MCTS, can significantly enhance operations.

Furthermore, e-navigation and the development of the Waterways Information System can contribute to standardization, improved data access and better visualization. For more information on e-navigation and CCG's transition to digitalizing marine navigation services, please refer to the digitalization and conclusion sections of this report.

**Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.**

Digitalization

Finding 9: While the transition to the S-100 standard presents significant technological and capacity challenges, the evaluation found that communication, collaboration and information sharing were generally effective, particularly among teams from the Canadian Coast Guard marine navigation programs, the Canadian Hydrographic Service and Integrated Technical Services. However, there were areas for improvement, particularly concerning governance and interdepartmental coordination.

The evaluation team conducted a case study to explore the readiness of CCG and DFO to transition toward the digitalization of marine navigation services, focusing on the implementation of the S-100 standard, a global international data standard for electronic navigation charts.

The case study specifically examines two S-100 products: the S-124 NAVWARNs (led by CCG) and the S-102 Bathymetric Surface (led by CHS). S-124 was selected based on input and guidance from the CCG marine navigation programs. It covers international requirements, implementation challenges and interdependencies. The findings related to S-102 are detailed in a separate report for DFO.

Since the S-100 standard was still in its early stages during the evaluation period, the evaluation focused on examining the processes, tools, governance and mechanisms that support CCG's transition toward the digitalization of these navigation services.

Context for Digitalization and Implementation of S-100 in Canada

The marine industry has experienced rapid technological advancements and a data-driven environment over the past two decades. This transformation, known as e-navigation, involves the harmonized collection, integration, exchange, presentation and analysis of marine information to enhance navigation safety and security. One of CCG's five priorities for e-navigation is to advance the digitalization of marine services.

A major development in this digitalization is the S-100 standard created by the International Hydrographic Organization. Both CHS and CCG are actively working on this standard, which is set to pave the way for a new era in marine cartography by incorporating dynamic capabilities for hydrographic products, including charts, water level readings and current information. This is critical to the maritime economy, marine safety and response.

The S-100 data framework supports the development and interoperability of digital products and services for hydrographic, maritime and geospatial data. It is divided into three phases: route monitoring (which includes S-102 and S-124), route planning and voyage reporting.

S-124 NAVWARNs

The purpose of S-124 is to streamline the NAVWARN service, reducing the administrative burden on mariners and minimizing safety-related risks. It is based on a standardized, structured format and compatible systems that can exchange NAVWARNs seamlessly. S-124 is intended to be used as an overlay to electronic navigational charts within the vessel's navigation system.

CCG is the lead for S-124 implementation in Canada and the international S-124 development. The product application is being developed internally by CCG's e-navigation team and ITS. Ongoing collaboration and coordination across CCG and CHS are required for data production, validation, portrayal and dissemination.

The S-124 product is in an advanced stage of development in a lab environment, with the operational version due in November 2025. The application will also be used to test and optimize other S-100 products in preparation for operationalization.

**Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.**

Digitalization

S-100 Progress and Benefits

CCG is progressing toward getting the Phase 1 S-100 products ready by 2026: S-124 is in advanced development and is expected to be operational by November 2025. In summer 2025, Canada will make all Phase 1 S-100 products available for a limited test period to users in the designated International Hydrographic Organization S-100 Sea Trial Area, which is the St. Lawrence River. The sea trials are a significant milestone and one of Canada's major contributions to the implementation of the S-100 standard.

These structured sea trials are designed to test S-100 products and technologies in an operational environment, ensuring that the standards meet the end users' expectations. The trials will involve various stakeholders, including maritime shipping companies, pilotage associations and port authorities, who would provide input to adapt S-100 products to the Canadian maritime environment and operational specifics.

Overall, the S-100 transformation is designed to enable direct transmission of data from credible producers to users, leading to improved safety, efficiencies for mariners, ecological benefits and increased operational efficiency for the Canadian shipping industry. The goal is to enhance maritime domain awareness and provide benefits at national, regional, local and community levels.

Processes Supporting the Digitalization of Marine Navigation Services

Effective collaboration, communication and coordination are critical to the digital transition of marine navigation services. The evaluation found that several committees and working groups are actively supporting this effort. These included the National Marine Advisory Board Subcommittee on e-navigation, which has representatives from the federal government and the marine industry, as well as four CCG regional e-navigation committees.

Additionally, a cross-departmental director-level working group made up of six departments focuses on the digitalization of marine navigation services. According to half the interviewees (50 percent), collaboration and information sharing are generally effective, particularly among CCG marine navigation, CHS and ITS teams working on S-100 initiatives.

Informal communication and strong inter-team relationships were also seen as strengths. Interviewees noted that informal communication among teams and the existing relationships are working well. While processes are improving, interviewees noted room for enhancement in cross-regional communication, broader collaboration within CCG marine navigation programs and increased awareness of S-100 across all levels.

Photo credit: DFO

**Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.**

Digitalization

Challenges in Implementing S-100

According to internal interviewees and document review, the implementation of S-100 faced significant capacity, technological and governance challenges. The transition to S-100 requires a dual-fuel approach, which involves the simultaneous operation of legacy and new systems. Interviewees noted that, although they received some funding, human resource capacity was stretched, raising concerns about long-term sustainability.

Interviewees noted that significant changes across sectors are required, but there is no common understanding of the need for change. Governance issues included a lack of a consistent approach and clarity on roles and responsibilities.

The recent delayed implementation of the Maritime Single Window Initiative, led by the Canada Border Services Agency and Transport Canada, highlighted the critical need for strong leadership and coordination to avoid reputational risks and meet international commitments.

Finally, interviewees mentioned that DFO and CCG depend on industry partners as manufacturing companies produce the specialized technology and systems needed for S-100. Interviewees also noted that bureaucratic processes, data availability and supply chain issues are additional challenges that hinder S-100 implementation.

Readiness for S-100 relies on significant changes across sectors, which had not yet started at the time of writing this report. Some interviewees (40 percent) noted that there is a lack of internal change management, posing a challenge for the implementation of S-100.

One of the primary difficulties is understanding the implications of S-100. At the time of data collection in fall 2024, S-102 and S-124 were still in their early stages, making them abstract concepts, and it was challenging to justify their future benefits before they were integrated.

Electronic charts in the Arctic region remain limited due to insufficient infrastructure and ongoing challenges in acquiring better data needed for creating S-100 products.

While CCG and DFO are making significant strides toward the digitalization of marine navigation services, they face many challenges in transitioning to S-100. Interviewees said that there was an absence of a consistent approach at both the departmental and government levels. There is a need for an interdepartmental governance structure with clearly defined roles and responsibilities as there is a lack of governance mechanisms to oversee and make decisions consistently. This is true particularly for aspects beyond technical ones and integrated operationalization, involving all departments with a role in S-100.

**Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.**

Conclusions

Overall, the evaluation found that the CCG marine navigation programs delivered essential services that enhance marine safety, sovereignty and economic activity.

Evaluation evidence showed that, despite limited resources, the CCG marine navigation programs were making efforts to meet their intended outcomes. While the programs consistently provided timely information to mariners, their performance in supporting economic outcomes is mixed: AtoN and Icebreaking Services did not fully meet their respective targets. The CCG marine navigation programs engaged with Indigenous Peoples in various ways, but there is a need for centralized guidance.

Program delivery is constrained by materiel, financial and technological challenges, including climate change impacts, limited vessel access and outdated equipment. Strong collaboration among CCG groups, regional offices and external partners was identified as a key enabler, though ineffective performance indicators limited the ability to monitor and assess outcomes.

The transition to the S-100 standard introduced technological and capacity challenges, but communication and collaboration among CCG marine navigation programs, ITS, and CHS teams were generally effective. Nonetheless, governance and interdepartmental coordination require improvement to support modernization and long-term program sustainability.

Based on evaluation findings, the delivery of marine navigation programs could be strengthened by:

- establishing formal guidance to support the marine navigation programs' reconciliation efforts;
- implementing a change management strategy and governance framework to clarify roles and responsibilities for S-100 adoption and enhance coordination across departments;
- reviewing the activities of the AtoN program to identify areas for improvement and enhance its effectiveness; and
- improving performance measurement frameworks for AtoN and MCTS to enable more informed decision making.

Photo credit: DFO

**Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.**

Recommendations

Based on the evaluation findings, four recommendations are suggested for continuous program improvement.

Recommendation 1:

It is recommended that the Deputy Commissioner, CCG Programs—in collaboration with the Director General, CCG Planning, Engagement and Priorities and the Director General, CCG ITS—develop and implement national guidance to support the CCG marine navigation programs in advancing reconciliation, building off CCG's and DND's Indigenous relations strategic frameworks.

Recommendation 2:

It is recommended that the Deputy Commissioner, CCG Programs develop and implement a change management strategy to support the modernization of marine navigation services and advance digitalization. This strategy should enhance internal collaboration, clarify roles and responsibilities and improve communication. Additionally, it should leverage existing committees and foster collaboration with other government departments and agencies involved in S-100.

Recommendation 3:

It is recommended that the Deputy Commissioner, CCG Programs undertake a review of the AtoN program. This review should examine the program's activities and expected outcomes to identify areas for improvement and enhance the effectiveness of the program, including opportunities for modernization and prioritization.

Recommendation 4:

It is recommended that the Deputy Commissioner, CCG Programs—in collaboration with the Director General, Chief of Programmes—review and improve performance measurement for the AtoN and MCTS programs.

Photo credit: DFO

Annex A: Methodology, Limitations and Mitigation Strategies

The evaluation was conducted using an evaluation framework, which included the evaluation questions and indicators. The evaluation used multiple lines of evidence to collect and triangulate data to mitigate, where possible, any methodological challenges and limitations. This approach was taken to establish the reliability and validity of key findings and to ensure that conclusions and recommendations were based on objective and documented evidence.

Interviews

The evaluation team conducted a total of 44 internal and external interviews with representatives from DFO and CCG program staff and senior management, and from external stakeholders.

Internal interviewees were selected to ensure that input was received from across all regions and the national headquarters. Interviews were structured to discuss a range of questions related to the programs' value, resources, effectiveness and readiness for digitalization.

Limitations and Mitigation

The evaluation team encountered limitations with external interviews due to insufficient representation from the maritime industry. To address this lack of representation, industry stakeholders were given the option to provide written responses. Despite these efforts, the evaluation secured only one interview and two written responses from industry representatives, and it did not generalize from these limited responses.

Document Review

The evaluation team reviewed over 170 documents to understand the operational context and background of the CCG marine navigation programs and to assess value, resource allocation and effectiveness. Reviewed documents included, but were not limited to, program documentation, service level agreements, human resource plans, meeting minutes, legislation and regulatory documents, and mandate documentation.

The review also included other Government of Canada publications and some external websites. The document review was used to triangulate findings from other lines of evidence.

Site Visits

The evaluation team visited a total of three locations: two sites in the CCG central region (Prescott and Quebec City) and one at DFO national headquarters. The purpose of these visits was to conduct interviews with program representatives, to observe and hold informal discussions with relevant personnel and to gain a comprehensive understanding of operations unique to each facility.

Limitations and Mitigation

The geographic scope of the site visits was limited to the central region. To mitigate a focus on the central region, regional perspectives were obtained through other lines of evidence, namely interviews with regional representatives. The evaluation team recognizes that one region does not reflect the diversity of experiences across all CCG regions, and the evaluation did not generalize any findings from the visits in the central region.

**Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.**

Annex A: Methodology, Limitations & Mitigation Strategies

Performance and Financial Data

The evaluation team conducted a review of performance data provided by the Results Division team and retrieved from the Transportation Safety Board of Canada website relating to performance information profiles and LoS to analyze and understand program effectiveness. The period covered was FY 2019/20 to 2023/24.

The evaluation team completed an analysis of financial data from the Chief Financial Officer Sector, including budgets, expenditures and FTEs associated with the marine navigation programs, to understand resource allocation. The period covered was FY 2019/20 to 2023/24.

Case Study

The evaluation team conducted an in-depth review of the digitalization of marine navigation services. The case study included 19 documents and an academic literature review exclusively for the case study, along with additional documents that also contributed to the core evaluation. It also included 11 interviews dedicated to the case study with program staff to assess the transition to digitalized marine navigation services (S-100 standard). One interview with another government department had half of the interview focus on the case study.

Limitations and Mitigation

As it is an emerging technology, S-100 has limited documentation. This limitation was partially mitigated with interviews of people in leading roles behind the transition to the S-100 standard.

Reviewed by ADM(RS) in accordance with the *Access to Information Act*.
Information UNCLASSIFIED.

Annex B: Financial Information

Revenues From Service Fees and Costs of Marine Navigation Programs

Marine Navigation Services Fee

MCTS and AtoN	2019/20	2020/21	2021/22	2022/23	2023/24
Revenue	$33,413,487	$28,604,202	$30,138,773	$33,572,934	$33,060,957
Cost	$168,455,696	$332,394,620	$245,130,452	$246,361,218	$279,751,467

Icebreaking Services Fee

Icebreaking	2019/20	2020/21	2021/22	2022/23	2023/24
Revenue	$5,936,440	$5,090,500	$4,742,361	$5,241,588	$5,825,705
Cost	$203,473,587	$180,656,696	$119,896,579	$210,506,823	$251,050,782

Maintenance Dredging Services Tonnage Fee

Waterways Management	2019/20	2020/21	2021/22	2022/23	2023/24
Revenue	$7,742,968	$6,456,331	$6,696,815	$6,544,158	$7,330,927
Cost	$7,889,404	$6,819,546	$6,961,755	$6,705,120	$5,580,383

Source: DFO Fees Reports