U.S. Arctic Marine Transportation System Infrastructure Risk Resource Compendium

March 2022

The U.S. Committee on the Marine Transportation System
Arctic Marine Transportation Integrated Action Team

This report is in response to a recommendation to the U.S Committee on the Marine Transportation System (CMTS) by the Government Accountability Office in Report #GAO-20-460. This report was developed by the CMTS Arctic Marine Transportation Integrated Action Team, which includes representatives from:

Bureau of Ocean Energy Management
Bureau of Safety and Environmental Enforcement
Environmental Protection Agency
National Geospatial-Intelligence Agency
National Maritime Intelligence-Integration Office
National Oceanic and Atmospheric Administration
Maritime Administration
Oceanographer of the Navy
Office of Science and Technology Policy
Office of Secretary of Transportation
U.S. Arctic Research Commission
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Department of Energy
U.S. Committee on the Marine Transportation System Executive Secretariat
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Suggested Citation: U.S. Committee on the Marine Transportation System (2022). Compendium of Risk Assessments and Reports Related to U.S. Arctic Marine Transportation System Infrastructure. Washington, D.C., 28 p.

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Executive Summary

The U.S. Arctic Marine Transportation System Infrastructure Risk Resource Compendium (Arctic Risk Resource Compendium) is a list of literature related to the identification, analysis and mitigation of risks derived from marine transportation system (MTS) infrastructure gaps in the U.S. Arctic to aid and inform federal investment priorities and decisions in the region for the safety and security of the MTS.

This report by the U.S. Committee on the Marine Transportation System (CMTS) Arctic Marine Transportation Integrated Action Team (IAT) is in response to a recommendation to CMTS in the Government Accountability Office (GAO) report GAO-20-460, "Maritime Infrastructure: A Strategic Approach and Interagency Leadership Could Improve Federal Efforts in the U.S. Arctic". GAO recommended the CMTS to complete a government-wide assessment of the economic, environmental, and safety risks posed by gaps in maritime infrastructure in the U.S. Arctic to inform investment priorities and decisions.

The CMTS responded with comments, noting that risks derived from infrastructure gaps are largely relative to mission and agency dependent. As to not supersede Office of Management and Budget (OMB) guidance and strategies informing Federal agency investment priorities or decisions, the CMTS carried out alternate actions to address GAO's findings. First, the U.S. MTS Arctic Infrastructure Table was amended to include more than 40 substantial additions and updates of physical and informational components of MTS infrastructure in the region. The table was published in April 2021 and serves as a quick reference for the current state of infrastructure in the region. This report serves as the second action.

U.S. Arctic Marine Transportation System Infrastructure Risk Resource Compendium is organized into five broad infrastructure categories derived from the GAO-20-460 report's table of maritime infrastructure gaps in the U.S. Arctic. The report is organized under the following headings:

- *Marine Infrastructure*
- *Response Services*
- *Environmental Information*
- *Operational Environment*
- *Navigation services*
- *Federal Arctic Strategies*

This report was compiled through an extensive review of gap analysis, literature reviews, risk assessments and other documents related to identification and mitigation of risks derived from Arctic MTS infrastructure gaps and needs, as well as through interagency review from CMTS member agencies within the Arctic IAT. Each resource

is cited with links to original documents and summaries to better inform users of content.

Documents listed under Maritime Infrastructure relate to multiple Arctic MTS infrastructure aspects and include various literature from previous CMTS reports and congressional research service (CRS) analyses to Arctic Council publications. Documents listed under Response Services include search and rescue assessments, oil spill response guidelines, and information on U.S. icebreaker development. Documents listed under Environmental Information include items relating to charting and mapping initiatives to water and sea ice forecasting. Documents listed under Operating Environment relate to Arctic vessel operations include overarching Arctic vessel requirements and guidelines (IMO Polar Code) and communications capabilities in the region. Navigational Resources includes deep draft port information, potential harbors of refuge, and areas of ecological significance. Furthermore, federal Arctic strategies are included.

The U.S. Arctic remains a difficult operating environment for vessels, with vast distances between communities, unpredictable weather conditions, accelerated rates of coastal erosion and permafrost melt, and lack of supporting maritime infrastructure[1]. As Arctic sea ice continues to diminish at a rate of 10.4 % per decade, Arctic shipping seasons have lengthened alongside increased access to mineral and biologic resources, leading to heightened national security, environmental, and economic concerns in the region[2,3]. To address these concerns and mitigate increasing risks from increased vessel traffic, a long term, systematic approach to improving marine infrastructure in the region is necessary. This compendium, alongside the updated U.S. Arctic MTS Infrastructure Table, serves as a valuable resource to better understand and identify risks from maritime infrastructure gaps in the region to inform federal decisions and investments for the safety, security, and improvement of the United States Arctic marine transportation system.

[1]Congressional Research Service. 2021. Changes in the Arctic: Background and Issues for Congress. May 2021. 143 p. https://fas.org/sgp/crs/misc/R41153.pdf

[2] U.S. National Snow and Ice Data Center. (NSIDC) 2021. Arctic Sea Ice News and analysis http://nsidc.org/arcticseaicenews/ (Accessed 8/31/2021)

[3] U.S. Coast Guard. 2019. Arctic Strategic Outlook: The United States Coast Guard's vision for the Arctic Region. April 2019. 48 p. https://www.uscg.mil/Portals/0/Images/arctic/Arctic_Strategy_Book_APR_2019.pdf

Introduction

The U.S. Committee on the Marine Transportation System (CMTS) is a federal cabinet-level, inter-departmental policy coordinating committee chaired by the U.S. Secretary of Transportation. The Committee serves as a partnership of federal departments and agencies to develop strategies and recommend actions for the improvement of the U.S. Marine Transportation System (MTS). In 2010, the CMTS was directed through legislation to coordinate transportation policy in the U.S. Arctic[4] for safety and security. In January 2010, the CMTS Coordinating Board established the CMTS Arctic Marine Transportation Integrated Action Team (Arctic IAT) to coordinate domestic transportation policies in the U.S. Arctic for safety and security and to address infrastructure requirements supporting the U.S. Arctic MTS. Through its recommendations and member agency actions, maritime transportation in the U.S. Arctic will be better managed and made more safe and secure, resulting in more efficient transits, greater protection of Arctic coastal and ocean resources, continuation of subsistence uses by native communities, and less risk to lives, property, and the environment. The IAT is co-led by the US Coast Guard, Maritime Administration, and National Oceanic and Atmospheric Administration.

In April of 2020, the Government Accountability Office (GAO) published report GAO-20-460: "Maritime Infrastructure: A Strategic Approach and Interagency Leadership Could Improve Federal Efforts in the U.S. Arctic," focused on improving Federal efforts on the safety and security of the U.S. Arctic MTS. Within this report, the GAO recommended the CMTS "complete a government-wide assessment of the economic, environmental, and safety risks posed by gaps in maritime infrastructure in the U.S. Arctic to inform investment priorities and decisions." Through the DOT Office of Auditing, the CMTS provided comments to GAO, partially concurring with the recommendation to complete an assessment of the economic, environmental, and safety risks posed by gaps in U.S. maritime infrastructure. However, the CMTS maintains that a risk assessment of respective investments and their impacts on the U.S. Arctic is the responsibility of each agency as directed by the Office of Management and Budget (OMB).

As an alternative response action, the CMTS first updated its "U.S. Arctic MTS Infrastructure Table", an easily referenced list of U.S. Arctic MTS physical and informational infrastructure components, as well as infrastructure gaps and potential impacts for different MTS elements in the region. This second and final document serves to complement the updated infrastructure table as a compendium of existing risk assessments, gap analysis and associated literature related to U.S. Arctic MTS infrastructure gaps and associated risks to inform federal investment and decisions in

[4] Arctic Research Policy Act of 1984, Section 112. "As used in this title, the term 'Arctic' means all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain."

the region. The Arctic Risk Resource Compendium is organized in a similar manner with the GAO report[5], with resources listed under environmental information, response services, operation environment and navigation services. Aside from these categories, literature that is broadly applicable to multiple infrastructure components is listed under Maritime Infrastructure. Federal Arctic strategies are also included within the document.

U.S. Arctic MTS Risk Resource Compendium

Maritime Infrastructure

1. U.S. COMMITTEE ON THE MARINE TRANSPORTATION SYSTEM, REVISITING NEAR-TERM RECOMMENDATIONS TO PRIORITIZE INFRASTRUCTURE NEEDS IN THE U.S. ARCTIC app. B (2018) (U.S. Arctic Transportation Infrastructure Table) (available at https://rosap.ntl.bts.gov/view/dot/60541).

   The U.S. Arctic Marine Transportation System (MTS) Infrastructure Table first appeared in the 2013 report, U.S. Arctic Marine Transportation System: Overview and Priorities for Action. It has been updated twice: first, in the 2016 report, A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic, and most recently in November 2018 as an Appendix of the Revisiting Near-Term Recommendations to Prioritize Infrastructure Needs in the U.S. Arctic report. This iteration includes more than 40 substantial updates and changes related to marine transportation system infrastructure additions in the region. Listed infrastructure is organized within MTS components: navigable waterways, physical infrastructure, information infrastructure, governance and response services, and vessel operations.

2. U.S. Coast Guard. 2021. Proceedings: The Coast Guard Journal of Safety and Security at Sea, Marine Safety and Security Council, 6-11: A Changing Climate – A shifting Arctic strategy. 124 pp. https://www.dco.uscg.mil/portals/9/DCO%20Documents/Proceedings%20Magazine/Archive/2021/Vol78_No1_Spr21.pdf?ver=qVPlunPf96lMd91l3vLA1g%3D%3D

   Proceedings magazine is published three times a year in the interest of safety at sea under the auspices of the Marine Safety and Security Council. The Spring 2021 edition focuses on the U.S. Arctic, containing 19 articles related to Arctic maritime competition, commerce, and capabilities. Valuable insight into search and rescue, Arctic shipping, the Arctic Council, infrastructure risks, and more are given by Arctic policy experts.

3. Congressional Research Service. 2021. Changes in the Arctic: Background and Issues for Congress. May 2021. 143 pp. https://fas.org/sgp/crs/misc/R41153.pdf

[5] GAO-20-460, MARATIME INFRASTRUCTURE: A Strategic Approach and Interagency Leadership Could Improve Federal Efforts in the U.S. Arctic. Table 1: Examples of Maritime Infrastructure Gaps in the U.S. Arctic

This report provides an overview of Arctic-related issues for Congress and refers readers to more in-depth CRS reports on specific Arctic-related issues. The report provides an extensive background on the U.S. Arctic and notes current issues for congress. Issues range from climate change and loss to sea ice to military forces, icebreaking, fisheries, and more.

4. Alvarez, J., Yumashev, D., Whiteman, G. 2020. A Framework for Assessing the Economic Impacts of Arctic Change. Ambio. 49:407-418. https://link.springer.com/content/pdf/10.1007/s13280-019-01211-z.pdf
   There is limited research on how Arctic change may affect economies and individual industry sectors around the world. The authors of this article suggest there is a pressing need for more research on this topic, presenting a conceptual framework to guide future research for assessing regional and global economic impacts of Arctic change, including both possible benefits and costs. This article stresses the importance of a transdisciplinary approach, including an integration of the natural sciences, economics and social sciences, as well as engagement with a wide range of stakeholders to better understand and manage implications of Arctic change.

5. The Cost of Doing Nothing: Maritime Infrastructure Vulnerabilities in an Emerging Arctic: Hearing before the Subcommittee on Coast Guard and Maritime Transportation. House of Representatives. 116 Cong. 2019. https://www.govinfo.gov/content/pkg/CHRG-116hhrg39647/pdf/CHRG-116hhrg39647.pdf

   This hearing summary begins with an overview of Arctic challenges related to climate change, the polar code and Arctic sovereignty. U.S. Coast Guard Arctic assets, Arctic infrastructure challenges, existing infrastructure and near-term recommendations are also noted. Several subject matter experts testified on proposed solutions to improving U.S. Arctic infrastructure.

6. Polar Institute, Woodrow Wilson Center for Scholars. 2021. Navigating the Arctic's 7C's. Washington, D.C. 168 pp. https://www.wilsoncenter.org/sites/default/files/media/uploads/documents/Polar%207Cs%206x9%20BOOK-FINAL_WEBr1%20%281%29.pdf

   The Wilson Center over time developed reflections on key issues and drivers in the Arctic, denoting them as the Arctic 7C's: climate, commodities, commerce, connectivity, communities, cooperation, and competition. This publication provides substance and background within each topic, including seven chapters that reflect the expertise, insights, and perspectives of experts in Arctic policy. This document provides insight and recommendations as background for decisions impacting the future of the region.

7. Emmerson, C., Lahn, G. 2012. Arctic opening: opportunity and risk in the High North. Lloyd's, Chatham House. Pp. 60. https://www.lloyds.com/~/media/Files/news-and-insight/360-risk-insight/arctic_risk_report_webview.pdf

   Risk management has a critical role to play in helping businesses, governments and communities manage the uncertainties of climate change in the Arctic by minimizing risks. Effective risk management requires the most up to date information to analyze and control risks; there is a clear need for sustained investment in Arctic research. This report explores how fluctuations in energy prices have driven and continues to drive the pace of exploration in the Arctic. The importance of political stability and public support in risk mitigation and uncertainties in attracting future investment in also discussed. This document further details Arctic environmental change, facets of the Arctic's economic and political future, and Arctic risks.

8. Gering, S., Zaki, M. 2020. Academic analysis on the Feasibility of shipping LNG from Alaska's North Slope. Arctic Domain Awareness Center. May 2020. 48 pp. https://arcticdomainawarenesscenter.org/Downloads/PDF/ADAC%20Publications/4%20May%202020%20ADAC%20Arctic%20Shipping%20Paper_v2.pdf

   This study provides a brief overview of the Yamal LNG project and the corresponding changes in shipping traffic and infrastructure development along the Northern Sea Route. Additionally, this study reviews the current infrastructure and physical conditions within the U.S. Arctic Exclusive economic Zone (EEZ). Unpredictable sea ice conditions combined with the remote, austere, and potentially hazardous conditions contribute to a difficult shipping environment. This report includes the benefits and negatives of investing in Arctic shipping, economic opportunities beyond shipping LNG, and the ecological and sociological considerations involved.

9. Maritime Transportation in the Arctic: The U.S. Role. Committee on Transportation and infrastructure. Hearing before Subcommittee on Coast Guard and Maritime Transportation. House of Representatives. 115 cong. 2018. https://www.govinfo.gov/content/pkg/CHRG-115hhrg38055/pdf/CHRG-115hhrg38055.pdf

   This hearing before the subcommittee on Coast Guard and Maritime Transportation was held to examine U.S. Arctic maritime infrastructure needed for safe and efficient maritime transportation in the region. The U.S. Coast Guard, National Oceanic and Atmospheric Administration, scientists, and policy experts gave testimony addressing infrastructure gaps in the region including limited satellite coverage supporting communications, lack of a deep draft port, unpredictability of ice flows, and lack of navigational aids as human activities and interest in the Arctic continues to increase.

10. Council on Foreign Relations. 2017. Arctic Imperatives: Reinforcing U.S. Strategy on America's Fourth Coast. Council on Foreign Relations Press. 83 pp. https://www.cfr.org/report/arctic-imperatives

    This in-depth report by an independent, bipartisan task force noted the absence of U.S. ice breaking capacity to serve both the Arctic and Antarctic, with recommendations to fund and build additional icebreakers. The task force also notes that the U.S. needs greater investment in Alaskan infrastructure including deepwater ports, roads and reliable telecommunications to support sustainable economic development in the region, as well as a sustained security presence. Recommendations for the U.S. government within the report include: ratify the UN convention on the Law of the Sea, fund and maintain polar icebreakers, improve Arctic infrastructure, strengthen cooperation with other Arctic nations, support sustainable development and Alaska Native communities, and fund scientific research.

11. U.S. Committee on the Marine Transportation System. 2018. Revisiting Near-Term Recommendations to Prioritize Infrastructure Needs in The U.S. Arctic. Washington, D.C., 43 pp. https://rosap.ntl.bts.gov/view/dot/60541

    This updated report from 2018 includes recommendations across five key categories integral to the Arctic marine transportation system including navigable waterways, physical infrastructure, information infrastructure, emergency response, and vessel operations. Updates are listed regarding recommendations from the original report and include Arctic MTS infrastructure strides made across the federal government. The report also highlights critical remaining gaps including weather forecasting and shore-side infrastructure.

12. Arctic Council. 2009. Arctic Marine Shipping Assessment 2009 Report. 194 pp. https://www.pame.is/images/03_Projects/AMSA/AMSA_2009_report/AMSA_2009_Report_2nd_print.pdf

    The Arctic Marine Shipping Assessment (AMSA) Report was approved by the Arctic Ministers in April 2009, at the Arctic Council Ministerial Meeting in Tromsø, Norway. The 17 negotiated AMSA recommendations were divided into three themes: Enhancing Arctic Marine Safety; Protecting Arctic People and the Environment; and Building the Arctic Marine Infrastructure. The AMSA effort can be viewed from three related perspectives: a baseline assessment of Arctic marine activity and an historic snapshot of Arctic marine use early in the 21st century; a strategic guide for a host of stakeholders and actors; as well as a policy framework of the Arctic states for protecting Arctic people and the marine environment.

Response Services

Search and Rescue

1. Arctic Council. 2011. Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic. 58 pp. http://hdl.handle.net/11374/531

   Signed in Nuuk, Greenland in 2011 by the eight member states of the Arctic Council, this treaty coordinated international search and rescue (SAR) coverage and response in the Arctic, establishing the area of SAR responsibilities for each Arctic state. The agreement reflects the Arctic region's increasing economic importance as a result of improved and increasing accessibility. The treaty entered force in January of 2013 after ratification.

2. Sheehan, R., Dalaklis, D., Christodoulou, A., Drewniak, M., Raneri, R., Dalaklis, A. 2021. The Northwest Passage in the Arctic: A Brief Assessment of the Relevant Marine transportation System and Current Availability of Search and Rescue Services. Logistics. 5: 23 – 37. https://doi.org/10.3390/logistics5020023

   This analysis and literature review provides a brief assessment of the United States' and Canada's marine transportation system and relevant search and rescue (SAR) support in relation to the Northwest Passage, with the purpose of examining to what extent these countries' relevant infrastructure resources are able to meet the expected growth of shipping operations and business activities in the Arctic. Important influences on the maritime transportation system is discussed alongside geographical details, capabilities of existing ports, and search and rescue assets and capabilities.

3. Tingstad, A., Savitz, S., Van Abel, K., Woods, D., Anania, K., Ziegler, M. D., Davenport, A., Costello, K. 2018. Identifying Potential Gaps in U.S. Coast Guard Arctic Capabilities. Homeland Security Operational Analysis Center. 117 pp. https://www.rand.org/content/dam/rand/pubs/research_reports/RR2300/RR2310/RAND_RR2310.pdf

   This report is derived from a research project, "Department of Homeland Security Evergreen Arctic Priorities", and focuses on identifying priority Arctic capability gaps related to U.S. Coast Guard regional operations in 2017. This analysis provides an additional perspective on how to characterize potential gaps to develop mitigation avenues regarding present and future U.S. Coast Guard activities in the Arctic, sponsored by the U.S. Coast Guard Office of Emerging Policy. The report is organized in six main sections: addressing Arctic planning challenges, an expert workshop identifying Arctic capability gaps, identifying potential USCG Arctic capability gaps, identifying vulnerabilities associated with gaps, and conclusions and recommendations.

4. Pew Charitable Trusts. 2014. Arctic Vessel Traffic in the Bering Strait: Key Measures for Developing Regulatory Standards. 7 pp. https://www.pewtrusts.org/-/media/assets/2014/04/18/arctic-vessel-traffic-in-the-bering-strait.pdf

   This brief provides a list of risks from increasing vessel traffic through the Bering Strait region alongside recommendations to improve vessel safety. Listed are several resources for safer travel, recommendations for prevention and mitigation measures, vessel routing, vessel traffic monitoring, compliance and communication, and emergency prevention and preparedness. In the absence of search and rescue infrastructure, authors recommend investing in local community training and response equipment.

Oil Spill Response

1. Arctic and Western Alaska Area Committee (AWA Area Committee). 2020. Arctic and Western Alaska Area Contingency Plan. 163 pp. https://dec.alaska.gov/media/17896/2018-1-awa-acp.pdf

   Alaska's federal and state government response planning obligations are met through the Alaska regional contingency plans and area contingency plans (ACP) including the Arctic and Western Alaska. This ACP is the primary guidance document for pollution response and contains strategies of a coordinated federal, state, tribal, and local response to a discharge or substantial threat of discharge of oil or a release of hazardous substance from a vessel or on/offshore facility operating within Alaska's boundaries and surrounding waters. References and tools are included in the website.

2. Johannsdottir, L., Cook, D. 2019. Systemic Risk of Maritime Related Oil Spills Viewed from an Arctic and Insurance Perspective. Ocean and Coastal Management. 179 (1): e104853. https://www.sciencedirect.com/science/article/abs/pii/S0964569119300912?via%3Dihub

   This study is based on secondary data relating to major maritime-related oil spills from drilling and shipping. Two analytical frameworks are discussed, one explaining the scaling of risks, and another showing the interplay between subsistence and monetized economies within their institutional, environmental, social and cultural contexts. The findings suggest, if the worst-case scenario materializes, that maritime-related oil spills may have long term social/cultural, environmental, and economic impacts, in addition to security/policy implications, as well as affecting businesses involved in the disaster and their partners.

3. Nuka Research and Planning Group, LLC., Pearson Consulting, LLC. 2016. Aleutian Islands Risk Assessment Phase B. Final Program Report. 32 pp. https://ba5d8e27-22a6-4c7e-bfd1-86a9416f28e1.filesusr.com/ugd/cd25fe_99633e2f787a499685aaae7b4ce98b79.pdf

This is the final program report for Phase B of the Aleutian Islands Risk Assessment (AIRA). The project was conducted in two phases: Phase A resulted in recommended risk reduction options, and this report, phase B, includes further analysis and implementation from recommendations. This report references project deliverables for most tasks, with a greater level of detail provided on tasks not already documented through previous reports, and summarizes activities undertaken and results achieved. The AIRA was initiated to assess the risks and potential mitigation measures associated with maritime transportation in the Aleutian Archipelago and focuses on vessels of 300 gross tons or greater, or those with at least 10,000 gallons of fuel capacity.

4. Nuka Research and Planning Group, LLC. 2015. Aleutian Islands Risk Assessment: Recommending an Optimal response System for the Aleutian Islands: Summary Report. February 2015. 72 pp. https://ba5d8e27-22a6-4c7e-bfd1-86a9416f28e1.filesusr.com/ugd/cd25fe_1f004314bee64fd3984c01451c3b7ed0.pdf

   The Aleutian Islands Risk Assessment (AIRA) was conducted as part of a plea agreement from the *M/V Selendang Ayu* grounding and oil spill in 2004. AIRA was a multi-phase risk assessment of marine transportation in the Bering Sea and Aleutian archipelago that identified risk reduction and response measures for oil spills from large vessels transiting through the Great Circle Loop and Unimak Pass. This report synthesizes key take-aways from 13 supporting technical reports, as well as recommendations for oil spill response and regulatory standards.

5. RPS ASA, Environmental Research Consulting, Research Planning Inc., The Louis Berger Group, Inc. 2014 Assessment of Marine Oil Spill Risk and Environmental Vulnerability for the State of Alaska. National Oceanographic and Atmospheric Administration. 133 pp. https://media.fisheries.noaa.gov/dam-migration/alaska-oilspill-riskreport-akr.pdf

   This risk analysis assesses probabilities of marine oil spills occurring with respect to geographic region, oil type, and season. Potential spill impacts and are also analyzed utilizing oil characteristics and the vulnerability of the state's environmental resources. This assessment involved the development of a detailed model of region and season specific environmental vulnerability for Alaska by combining spill incident rates and potential volumes of oil spills to determine the regions/seasons of highest relative risk. All factors contributing to risk were assessed on a broad regional basis, considering the region of origination of a potential spill (rather than oil spill trajectory and fates)

6. Arctic Council. 2013. Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic. 275 pp. http://hdl.handle.net/11374/529

   This Arctic agreement was signed in Kiruna, Sweden in 2013 by the eight Arctic states to increase cooperation and coordination among signatories and strengthen emergency readiness and response for the protection of Arctic marine and coastal

environments from oil spills. States agree to provide mutual assistance to other countries as needed, to promote exchange of important information to improve success of response operations and carry out joint efforts on training and exercises in the Arctic environment. The agreement Entered into force on March 2016.

Icebreakers

1. Congressional Research Service. 2021. Coast Guard Polar Security Cutter (polar Icebreaker) Program: Background and Issues for Congress. 75 pp. https://crsreports.congress.gov/product/pdf/RL/RL34391/215

   This report provides background information and issues for Congress on the Polar Security Cutter (PSC) program—the Coast Guard's program for acquiring new PSCs (i.e., heavy polar icebreakers). The Coast Guard's proposed fiscal year 2022 budget requests $170.0 million in procurement funding for the PSC program. The operational U.S. polar icebreaking fleet currently consists of one heavy polar icebreaker, Polar Star, and one medium polar icebreaker, Healy. In addition to Polar Star, the Coast Guard has a second heavy polar icebreaker, Polar Sea. However, Polar Sea suffered an engine casualty in June 2010 and has been nonoperational since then.

2. National Academies of Sciences, Engineering, and Medicine. 2017. Acquisition and Operation of Polar Icebreakers: Fulfilling the Nation's Needs. Washington, D.C. The National Academies Press 106 pp. https://doi.org/10.17226/24834

   This document presents findings and recommendations of the Committee on Polar Icebreaker Cost Assessment advising the U.S. congress on assessing costs incurred by the federal government to carry out polar icebreaker missions and options to minimize life cycle costs. The document provides four general findings and recommendations regarding heavy and medium icebreaker acquisition and operations to protect interests and maintain leadership in polar regions by the U.S. government. Appendixes are provided for broader discussion and supporting material concerning U.S. icebreaking needs, the changing environment, and additional information on icebreaking capacities of other nations.

3. ABS Consulting, Potomac Wave Consulting, Systems Planning and Analysis, Inc. 2010. United States Coast Guard High Latitude Region Mission Analysis Capston Summary. 17 pp. http://assets.fiercemarkets.net/public/sites/govit/hlssummarycapstone.pdf

   To address the Coast Guard's present and future ability to conduct its missions in the Arctic and Antarctic regions, referred to as the high latitude regions, the Coast Guard commissioned an independent series of studies. This paper provides a synopsis of the three-volume body of literature of the following mission analysis topics: Polar Icebreaking Needs, Arctic Mission Area Needs, and Antarctic Mission Area Needs. Analysis provided within this report is intended to inform decision

makers evaluating acquisition and sustainment decisions for the U.S. Coast Guard's fleet of icebreaking vessels, associated aircraft, communications and forward operating areas.

4. National Academies of Sciences, Engineering, and Medicine. 2007. Polar Icebreakers in a Changing World: An Assessment of U.S. Needs. Washington, D.C. National Academies Press. 135 pp. https://doi.org/10.17226/11753

   As directed by Congress, the U.S. Coast Guard requested the National Research Council of the National Academies to convene the Committee on the Assessment of U.S. Coast Guard Polar Icebreaker Roles and Future Needs to provide a comprehensive assessment of the current and future roles of U.S. Coast Guard polar icebreakers. The committee was also asked to analyze changes in roles and missions of polar icebreakers in the support of all national priorities, including consideration of ongoing and predicted environmental change, and assess whether changes are needed to existing laws governing U.S. Coast Guard polar icebreaking operations to address potential new missions and new operating regimes. This report documents the findings and recommendations of the committee.

Environmental Information

Charting and Mapping

1. Alaska Mapping Executive Committee. 2020. Mapping the Coast of Alaska: A 10-Year Strategy tin Support of the United States Economy, Security, and the Environment. 19 pp. https://iocm.noaa.gov/about/documents/strategic-plans/alaska-mapping-strategy-june2020.pdf

   This updated Alaska mapping strategy is focused on coastal and nearshore areas that can be mapped with airborne and satellite remote sensing, roughly two miles landward to the seaward extension depth of these optimal technologies for Alaska to have seamless coastal mapping data by 2030. This strategy defines four goals guiding near term action: building on existing mapping partnerships to meet Alaska's coastal mapping needs, expanding coastal data collection to deliver the priority geospatial products stakeholders require, leveraging innovation in mapping technology development, and conducting strategic communications to promote widespread stakeholder engagement. This strategy also includes coastal interests and mandates from Alaska mapping executive committee member agencies.

2. National Oceanic and Atmospheric Association Office of Coast Survey Marine Chart Division. 2016. U.S. Arctic Nautical Charting Plan: Supporting Sustainable Marine Transportation in Arctic Alaska. 46 pp. https://nauticalcharts.noaa.gov/hsrp/meetings/juneau-2018/reference-materials/arctic-nautical-charting-plan%202016.pdf

The 2016 U.S. Arctic Nautical Charting Plan provides information about existing, recently released, and proposed new charts and electronic navigation charts (ENC)s in three sections: proposed new electronic navigational chart (ENC) coverage, progress report on publishing new charts, and proposed new raster (traditional) charts. To ensure sustainable U.S. Arctic marine transportation, infrastructure supporting safety must be enhanced. Contents are organized through updates of infrastructure and specific areas identified needing charting improvements.

3. U.S. Army Corps of Engineers, Alaska District. 2009. Alaska Baseline Erosion Assessment: study findings and Technical Report. 65 pp. https://www.poa.usace.army.mil/Portals/34/docs/civilworks/BEA/AlaskaBaselineErosionAssessmentBEAMainReport.pdf

   The 2009 Alaska Baseline Erosion Assessment coordinates, plans, and prioritizes appropriate responses to erosion throughout Alaska, including coastal areas within the U.S. Arctic. This study began in April 2005, was completed in March 2009, and was specifically funded by the U.S. Congress. The report is intended to help Federal, State, Tribal, and local stakeholders develop strategies and plans for addressing erosion issues in Alaska. The document is organized in eight sections: introduction, efforts to manage erosion, study development and community risk rating, community prioritization, appropriate responses to erosion, flooding risks, conclusions, and references.

Weather and Sea Ice Forecasting

1. U.S. National Ice Center (USNIC) 2021. https://usicecenter.gov/

   The U.S. National Ice Center (USNIC) is a fully integrated multi-agency organization composed of contributions from the U.S. Navy (USN), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Coast Guard (USCG). The USNIC provides global to tactical scale ice and snow products, ice forecasting, and other environmental intelligence services for the United States government. The USN forms the core of USNIC with the Naval Ice Center, an Echelon V command under Naval Meteorology and Oceanography Command. The U.S. Coast Guard partners with USNIC through its Mobility and Ice Operations Division under the Office of Waterways and Ocean Policy.

2. U.S. National Snow and Ice Data Center. (NSIDC) 2021. http://nsidc.org/arcticseaicenews/

   NSIDC manages and distributes scientific data, creates tools for data access, supports data users, performs scientific research, and educates the public about the cryosphere. NSIDC began in 1976 as an analog archive and information center, the World Data Center for Glaciology. Since then, NSIDC has evolved to manage cryosphere-related data ranging from the smallest text file to terabytes of remote sensing data from NASA's Earth Observing System satellite program.

3. Stephenson, S.R. and Pincus, R. 2018. Challenges of Sea Ice Prediction for Arctic Marine Policy and Planning. Journal of Borderlands Studies. 33 (2): 255 – 272. Challenges of Sea Ice Prediction for Arctic Marine Policy and Planning.pdf

   Sea ice presents an important challenge for trans-border coordination of Arctic maritime infrastructure. Widespread summer sea-ice melt and anticipated expansion of shipping and offshore oil and gas drilling have highlighted a need for seasonal forecasts and decadal projections of sea ice for strategic planning efforts. This paper examines the potential of sea-ice prediction as a tool to support strategic planning, with a focus on the trans-border marine space of the U.S. and Canadian Arctic. The utility and limitations of seasonal and decadal sea-ice prediction are reviewed, followed by a discussion of the infrastructure and policy context within which sea-ice forecasts may be used to enhance safety and mitigate risk in the Arctic.

4. Wagner, P.M., Hughes, N., Bourbonnais, P., Stroeve, J., Rabenstein, L., Bhatt, U., Little, J., Wiggins, H., Fleming, A. 2020. Sea Ice Information and Forecast Needs for Industry Maritime Stakeholders. Polar Geography. 43 (2-3):160-187. https://doi.org/10.1080/1088937X.2020.1766592

   This research article demonstrates how multiple spatial and temporal resolutions for sea-ice information and forecasts are necessary to provide information to the marine operating community for safety, planning, and situational awareness. Although ship-operators depend on sea-ice information for tactical navigation, stakeholders working in route and capacity planning can benefit from climatological and long-range forecast information at lower spatial and temporal resolutions where the interest is focused on the open-water season. The advent of the Polar Code has brought with it additional information requirements, and exposed gaps in capacity and knowledge. Future satellite data sources should be at resolutions that support both tactical and planning activities.

5. Inoue, J. 2021. Review of forecast skills for weather and sea ice in supporting Arctic navigation. Polar Science. 27: 100523. https://doi.org/10.1016/j.polar.2020.100523

   In this synthesis paper, characteristics of the predictabilities of weather, sea ice, and ocean waves under extreme atmospheric conditions over the Arctic Ocean are presented, with particular focus on the impact of additional radiosonde observations on reducing uncertainties in forecasts. The usefulness of an onboard tool to share forecasting information with ship crew and researchers is also demonstrated and is recognized as an achievement of the Japanese Arctic research project. Finally, remaining issues with respect to a sustainable Arctic observing network are discussed.

6. National Oceanic and Atmospheric Administration Physical Sciences Laboratory. Experimental Sea Ice Forecasts. https://psl.noaa.gov/forecasts/seaice/

   These 0-10 day, experimental, sea ice forecasts are produced by the NOAA Physical Sciences Laboratory from a fully coupled ice-ocean-atmosphere model called CAFS. CAFS is run daily and posted online at 2 UTC. The model is initialized with the NOAA Global Forecast System (GFS) analyses and the Advanced Microwave Scanning Radiometer 2 (AMSR2) sea ice concentrations. The model is forced at the lateral boundaries by 3-hourly GFS forecasts of winds, temperature, and water vapor.

7. National Oceanographic and Atmospheric Administration (NOAA) Ocean Prediction Center: Experimental Freezing Spray Guidance Website. https://ocean.weather.gov/icing_rates/compare.php?area=ak&fhour=012

   This website provides experimental freezing spray guidance, that should be used with other data when making decisions impacted by weather forecasts. The Overland and Stallabrass images on the website depict forecast ice accumulation rate (in cm/hour) at 12 hours, 24 hours, and 36 hours. The rate is an instantaneous forecast, not cumulative. The guidance is based on the Global Forecast System (GFS) model data.

8. Thoman, R. L., J. Richter-Menge, and M. L. Druckenmiller, Eds., 2020. Arctic Report Card 2020. 143 pp. https://doi.org/10.25923/mn5p-t549.

   The 15th National Oceanic and atmospheric Administration's Arctic report card gives an annual update on the state of the Arctic's climate and environment, including the most recent Arctic science news of the past year (2020). The 2020 report showcases 16 essays on a wide range of Arctic science topics including bowhead whale research, air temperatures, sea ice conditions, and modeling of observational data examining environmental connections. Within the marine environment the report focuses on sea ice loss, sea surface temperatures, ocean primary productivity, bowhead whale populations, and coastal permafrost erosion rates.

Operating Environment

Vessel Requirements

1. IMO Secretariat. 2020. Report to the Marine Environment Protection Committee: Annexes 1 to 22 to the report of the Sub-Committee on Pollution Prevention and Response on its seventh session. (No. PPR 7/22/Add.1). International Maritime Organization. 143 pp. https://imoarcticsummit.org/wp-content/uploads/2020/09/PPR_7-22-Add.1_Annex_9_PPR_7_Report_to_MEPC_75.pdf

In February 2020, delegates at the seventh session of the United Nations International Maritime Organization's (IMO) Pollution Prevention and Response Sub-Committee agreed on draft amendments to the International Convention for the Prevention of Pollution from Ships (MARPOL) that would ban the carriage and use of heavy fuel oil (HFO) as fuel in Arctic waters beginning on July 1, 2024 (IMO Secretariat, 2020).

2. International Maritime Organization (IMO). 2016. Shipping in Polar waters: Development of an International Code of Safety for Ships Operating in Polar Waters (Polar Code). 54 pp. https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/POLAR%20CODE%20TEXT%20AS%20ADOPTED.pdf

   The goal of the Polar Code is to provide for safe ship operation and the protection of the polar environment by addressing risks present in polar waters and not adequately mitigated by other instruments of the International Maritime Organization (IMO). The Code acknowledges that polar water operation may impose additional demands on ships, ship systems and operation beyond the existing requirements of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) of 1978, the International Convention for the Safety of Life at Sea (SOLAS) of 1974, the International Convention for the Prevention of Pollution from Ships ((MARPOL) of 1973, as modified by the Protocol of 1978 relating thereto as amended by the 1997 Protocol, and other relevant binding IMO instruments.

3. Williams, J.F. 2016. Implementation of the international code for ships operating in Polar waters (Polar Code). U.S. Coast Guard CVC Policy Letter 16-06. 11 pp. https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/CG-5PC/CG-CVC/Policy%20Letters/2016/CG-CVC_pol16-06.pdf?ver=2016-07-06-120605-907

   This policy letter provides guidance regarding the implementation of the Polar Code on U.S. Flag ships and incorporates verification of compliance on foreign ships into the Coast Guard's Port State Control (PSC) Program. Regulatory amendments granting the USCG authority to issue Polar Ship Certificates and to designate that authority to authorized class societies entered force on October 23rd, 2018.

Communications

1. U.S. Committee on the Marine Transportation System. 2020. Inventory of Federal Communications Capabilities in the U.S. Arctic. April 2020. 1 pp. https://rosap.ntl.bts.gov/view/dot/61060

This document lists an inventory of federal communications capabilities in the U.S. Arctic as of 2020 by agency, including the U.S. Coast Guard, National Oceanic and Atmospheric Administration, the Federal Aviation Administration, and the U.S. Army Corps of Engineers. Communications infrastructure includes satellite, high frequency radio (UHF and VHF), automated identification systems (AIS), and weather radio all hazards.

2. Arctic Council Task Force on Improved Connectivity in the Arctic. 2019. Improving Connectivity in the Arctic. Arctic Council Secretariat. 50 pp. https://oaarchive.arctic-council.org/bitstream/handle/11374/2369/SAOXFI205_2019_RUKA_06_TFICA_Report-3rd-Draft%206%20May.pdf?sequence=1&isAllowed=y

   This report builds off of a previous document, "Telecommunications Infrastructure in the Arctic: a circumpolar assessment", and focuses specifically on evolutions in industry that can or will serve users in the Arctic, financial and other models that may help stimulate investment in Arctic telecommunications infrastructure, and relationships that may lead to further collaboration and cooperation on Arctic telecommunications. Within this document, industry representatives also note that lack of power supply, difficulties in maintaining facilities and significant hurdles to achieving financial profitability represent additional challenges in the Arctic.

3. Arctic Council Task Force on Telecommunications Infrastructure in the Arctic (TFTIA), 2017. Telecommunications Infrastructure in the Arctic: a circumpolar assessment. Arctic Council Secretariat. 90 pp. https://oaarchive.arctic-council.org/bitstream/handle/11374/1924/2017-04-28-ACSTelecomsREPORTWEB-2.pdf?sequence=1

   From 2015-2017, the TFTIA worked to assemble and assess information about the available telecommunications infrastructure in the Arctic and the present-day needs of users living, working, or traveling in the Arctic. It examined the technologies presently available to meet the needs of these users, identified gaps in the infrastructure that is essential in providing acceptable connectivity to users, and examined some measures for the future development of telecommunications infrastructure in the Arctic. This report presents this investigation and analysis, including maps showing the extent of telecommunications coverage in each of the eight Arctic States. The report also provides an overview of each State's telecommunications priorities, and findings are summarized.

4. Ocean Conservancy and the Maritime Exchange of Alaska. 2020. Implementation of e-NAV in Arctic Waters: Enhancing Safe and Environmentally Sound Maritime Operations. 24 pp. https://oceanconservancy.org/wp-content/uploads/2020/09/Enav-Summary-Report_FINAL_web_singlepages.pdf

   This report highlights advances in electronic navigation technologies to improve maritime safety and efficiency in the U.S. Arctic. Response to maritime incidents in the Arctic is hampered by the fact there are few ports, harbors of safe refuge, towing

vessels, communications, and emergency response resources available. These factors, compounded by the remoteness and extreme weather conditions in the Arctic, warrant elevated prevention measures and the use of new tools. E-navigation (or e-NAV for short) is one such tool. E-NAV harnesses new and emerging technologies to efficiently enhance maritime domain awareness and maritime domain management.

Navigation Services

Deep Draft Port

1. Overbeck, J.R., Buzard, R.M., Turner, M.M., Miller, K.Y., Glenn, R.J. 2020. Shoreline change at Alaska coastal communities: Alaska Division of Geological & Geophysical Surveys Report of Investigation. 43 pp. http://doi.org/10.14509/30552

   This report summarizes statewide analyses of long-term shoreline change at 48 Alaska communities. Shoreline datasets were compiled from previously published U.S. Geological Survey assessments for northern Alaska, and were created from historical and recent aerial images by the Alaska Division of Geological & Geophysical Surveys for western Alaska. Shorelines were analyzed to calculate rates of shoreline change every 82 feet (25 meters) along coastlines and tidally influenced riverbanks. In northern and western Alaska, 57 percent (27 of 48 total) of communities were found to have erosion rates greater than 3.3 feet per year (1 meter per year) over the past 60 years.

2. U.S. Army Corps of Engineers, Alaska District. 2020A. Chief's Report for Unalaska (Dutch Harbor) Channels, Alaska. 7 pp. https://planning.erdc.dren.mil/toolbox/library/ChiefReports/UnalaskaDutchHarbor-2020.pdf

   This Chief's report recommends the National Economic Development (NED) plan to improve access to Unalaska, Alaska through construction of deep draft navigation improvements.

3. U.S. Army Corps of Engineers, Alaska District. 2020B. Chief's Report for Port of Nome Modifications: Nome, Alaska 8 pp. https://planning.erdc.dren.mil/toolbox/library/ChiefReports/PortofNome_2020.pdf

   This report includes recommendation of a plan that results in a safe, reliable, and efficient waterborne transportation system for the movement of commerce, national security benefits, and recreation at the Port of Nome that allows for economic opportunities in the region and supports the long term viability of surrounding villages. This plan utilizes authority provided by Section 2006, Water Resources

Development Act of 2007 as amended, remote and subsistence harbors, which provides that in conducting a study of harbor and navigation improvements the Secretary may recommend a project without demonstrating that the improvements are justified solely by National Economic Development benefits, if the Secretary determines that the improvements meet certain criteria.

4. U.S. Army Corps of Engineers, Alaska District. 2020C. Integrated Feasibility Report and Final Environmental Assessment: Port of Nome Modification Feasibility Study. 305 pp. https://www.poa.usace.army.mil/Portals/34/docs/civilworks/publicreview/portofnome/FinalNomeIFREA29May2020signed.pdf?ver=2020-06-02-192545-533

   This study was carried out to identify a feasible solution that provides safe, reliable, and efficient navigation and mooring for vessels serving the hub community of Nome, Alaska. The Port of Nome includes two general areas, typically referred to as the Inner and Outer Basins. The Inner Basin is not part of this study, and improvements to the Inner Basin are being studied under the Continuing Authority Program (CAP) (Section 107). The project is needed to alleviate existing vessel restrictions that are imposed by insufficient channel depths and harbor area.

5. University of Alaska Fairbanks Institute of Northern Engineering, U.S. Army Corps of Engineers Alaska District, U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory. 2019. Statewide Threat Assessment: Identification of Threats from Erosion, Flooding, and thawing Permafrost in Remote Alaska Communities. Denali Commission Report # INE 19.03. 99 pp. https://www.denali.gov/wp-content/uploads/2019/11/Statewide-Threat-Assessment-Final-Report-20-November-2019.pdf

   The goals of this study were to assess individual threats to public infrastructure associated with erosion, flooding, and thawing permafrost in Alaska communities; evaluate the combined threat imposed by interactions between erosion, flooding, and thawing permafrost in Alaska communities; and provide guidance to decision makers regarding the technical information required to develop mitigation or adaptation strategies related to those threats. Information in this report represents an effort to provide guidance to planners and decision makers regarding the relative threat to Alaska rural infrastructure based upon readily available information collected primarily during or before February 2018. Evaluation techniques, as well as the data collected, are intended to be incorporated into ongoing and future efforts to understand and mitigate threats to Alaska's rural infrastructure and communities.

6. U.S. Army Corps of Engineers, Alaska District. 2019. Feasibility Report: Barrow, Alaska Coastal Erosion. 102 pp. https://www.poa.usace.army.mil/Portals/34/docs/civilworks/publicreview/Barrow/BarrowAlaskaCoastFinalFeasibilityReportsigned.pdf?ver=2020-02-14-191257-430

   This feasibility report examines the need for a coastal storm risk management project in Barrow, Alaska addressing coastal erosion and flooding to determine the feasibility of federal participation in a potential project. The study evaluated a number of alternatives based on economic, engineering, environmental, and other factors. The recommended plan would reduce the risk of storm damages to approximately five miles of coastline. The analysis resulted in community resilience units derived from community feedback, existing data, and existing knowledge.

7. U.S. Army Corps of Engineers, Alaska Department of Transportation and Public Facilities. 2013. Alaska Deep-Draft Arctic Port System Study. 76 pp. 1ADDAPSReportweb.pdf (army.mil)

   With this document, the U.S. Army Corps of Engineers and the Alaska State Department of Transportation and Public Facilities are reporting on the first year (2012) of their co-sponsored three-year study to enhance the Alaska Deep-Draft Arctic Port System. The Alaskan Arctic has many existing ports, from rudimentary barge landings and community docks to ingenious solutions for bulk export of lead-zinc at Red Dog and international trans-shipment at Dutch Harbor. There is a need to invest further in port development for the Alaskan Arctic to be able to respond to the changes in conditions.

8. U.S. Army Corps of Engineers, Alaska District. 2004A. Chief's Report for Unalaska. 6 pp. https://planning.erdc.dren.mil/toolbox/library/ChiefReports/Unalaska%2022%20Dec%2004.pdf

   This report is a recommendation by the U.S. Army Corps of Engineers for navigation improvements through construction of one rubble-mound breakwater and two floating breakwaters at Unalaska, Alaska.

9. U.S. Army Corps of Engineers, Alaska District. 2004B. Integrated Feasibility Report and Final Environmental Impact Statement for Navigation Improvements, Unalaska, Alaska. 106 pp. https://www.poa.usace.army.mil/Portals/34/docs/civilworks/currentproj/unalaskaharborfinalfeasrptandeisvol1part1.pdf

   The deep-water natural harbors in Unalaska do not offer adequate protection to ensure that most Unalaska commercial fishing vessels can be protected from

damage if left unattended for extended periods. This integrated feasibility report and environmental impact statement examines a full range of alternatives that could meet both local needs and contribute to meeting National Economic Development (NED) objectives. The selected alternative recommended construction of a harbor on the southwestern shore of Amaknak Island. This alternative offered the greatest net annual benefits.

10. U.S. Army Corps of Engineers, Alaska District. 1999. Chief's Report for Nome, Alaska. 5 pp. https://planning.erdc.dren.mil/toolbox/library/ChiefReports/Nome%20Harbor%20Improvements,%20AK%208%20Jun%2099.pdf

    Recommendation and project costs of improvements to navigation through construction of a new entrance to Nome Harbor in Nome, Alaska.

Harbors of Refuge

1. Alaska Department of Environmental Conservation Division of Spill Prevention and Response. 2020. Arctic and Western Alaska Area Contingency Plan. 163 pp. https://dec.alaska.gov/spar/ppr/response-resources/ppor/

   The AWA Area Contingency Plan (AWA ACP) is an operational plan prepared by the AWA Area Committee for and in consultation with the responders responsible for implementation. Plan content is intended to support the individuals that fill a response role and to achieve a coordinated and effective response to a pollution event. Additional references and tools to support a response linked within the ACP are available on the ADEC's website, including description of potential places of refuge in the Western Alaskan Geographic Zone, Northwestern Arctic Alaska Geographic zone, and North Slope Geographic Zone. These references and tools provide valuable information used to support a response to an oil discharge or hazardous substance release anywhere in Alaska.

Managing Waterways | Marine Areas of Ecological Significance

1. Fletcher, S, Bretwood, H, Chartier, A, Robertson, T. 2020. Adherence to Bering Strait Vessel Routing Measures in 2019. Nuka Research and Planning Group LLC. Seldovia, AK. 39 pp. 200131nukaberingstraitroutingstudy.pdf (pewtrusts.org)

   This paper provides a first review of the extent to which vessels adhered to the measures in 2019, the first shipping season after the measures took effect. It found that transiting ships were generally adhering to the routing measures. This included bulk carriers, LNG/LPG tankers, and some other cargo and tanker traffic that appeared to be moving through the study area rather than trading there. In cases in

which cargo vessels and tankers were going off the recommended two-way routes or into an ATBA, many times it appears likely based on general knowledge of vessel activity in the region that they were calling at a port or “lightering” (transferring) fuel to barges. On the other hand, passenger vessels, tugs, and fishing vessels— all of which were engaged in local trade or activities—generally did not follow the IMO routing measures and would not necessarily be expected to do so.

4. National Geospatial-Intelligence Agency (NGA), Maritime Safety Office. 2020. Pub. 180: Sailing Directions (Planning Guide): Thirteenth Edition, Arctic Ocean. Ed. 13. 192 pp. https://msi.nga.mil/api/publications/download?key=16694492/SFH00000/Pub180bk.pdf&type=view

   Sailing Directions (Planning Guides) are published periodically by NGA. They are intended to assist mariners in planning ocean passages and eliminate duplication by consolidating useful information about countries adjacent to a particular ocean basin in one volume. Pub 180 is the Planning Guide for the Arctic Ocean and includes critical information to mariners navigating the Arctic, including sea ice extents and other physical characteristics, recommended routes for navigation, and pollution management strategies. Updated monthly, Pub 180 ensures that mariners have access to timely, relevant information to ensure their safety ahead of a voyage to the Arctic.

2. U.S. Coast Guard Seventeenth District. 2016. Bering Strait Port Access Route Study: Conclusions and Recommended Alternatives. 15 pp. https://www.navcen.uscg.gov/pdf/PARS/Bering_Strait_PARS_Conclusions.pdf

   The United States Coast Guard's (USCG) Seventeenth District conducted a Port Access Route Study (PARS) of the Bering Sea, Bering Strait and Chukchi Sea to evaluate the applicability and the need for creation of new vessel routing measures. The overarching goal of the Port Access Route Study is to determine if ship routing measures can help reduce the risk of marine casualties and their impact on the environment, increase the efficiency and predictability of vessel traffic, and preserve the paramount right of navigation while continuing to allow for other reasonable waterway uses. The Bering Strait Port Access Route Study developed seven alternatives for routing measures that have been determined to have merit.

Federal Arctic Strategies

1. NORAD and USNORTHCOM. 2021. NORAD and USNORTHCOM: Strategy and Executive Summary. March 2021. 16 pp. https://www.northcom.mil/Portals/28/(U)%20NORAD-USNORTHCOM%20Strategy%20EXSUM%20-%20Signed.pdf

The North American Aerospace Defense Command (NORAD) and United States Northern Command (USNORTHCOM) are separate commands that leverage their commander's singular vision and guidance; develop plans to meet challenges in the same strategic and operational environments; build complementary mission approaches; and share a common goal of defense of the United States and Canada. This NORAD and USNORTHCOM Strategy is a combined strategy that aligns with objectives identified in the Interim National Security Strategic Guidance, National Defense Strategy, and Canada's Strong, Secure, Engaged policy.

2. U.S. Navy. 2021. A Blue Arctic: A Strategic Blueprint for the Arctic. January 2021. 28 pp. https://media.defense.gov/2021/Jan/05/2002560338/-1/-1/0/ARCTIC%20BLUEPRINT%202021%20FINAL.PDF/ARCTIC%20BLUEPRINT%202021%20FINAL.PDF

   This forward-looking regional blueprint describes how the Department of the Navy will apply power as the United States continues to prepare for a more navigable Arctic Region over the next two decades. It stresses an approach that integrates American naval power with joint forces, interagency teammates, allies, and partners to preserve peace and protect this northern maritime crossroads and gateway to our shores. This regional blueprint focuses on cooperation, but ensures America is prepared to compete effectively and efficiently to maintain favorable regional balances of power.

3. U.S. Department of Homeland Security. 2021. Strategic Approach for Arctic Homeland Security. January 2021. 25 pp. https://www.dhs.gov/sites/default/files/publications/21_0113_plcy_dhs-arctic-strategy_0.pdf

   This strategic approach outlines DHS's unique role in the region and three goals the Department will endeavor to achieve in it: Securing the Homeland through Persistent Presence and All Domain Awareness, strengthening Access, Response, and Resilience in the Arctic, and advancing Arctic Governance and a Rules-Based Order through Targeted National and International Engagement and Cooperation. The Arctic's expanded relevance, coupled with the Department's significant regional investments, requires DHS to have a unified, deliberate, and forward-looking approach. The Strategic Approach for Arctic Homeland Security fully leverages the broad range of DHS authorities, capabilities, capacity and partnerships to achieve the goals laid out in this document.

4. U.S. Army. 2021. Regaining Arctic Dominance. January 2021. 54 pp. https://api.army.mil/e2/c/downloads/2021/03/15/9944046e/regaining-arctic-dominance-us-army-in-the-arctic-19-january-2021-unclassified.pdf

   This Army strategy builds on objectives from the 2019 strategy to identify the ways the Army will ensure land dominance and continue to complete its missions as part of the Joint Force. To do this, the Army must understand the Arctic's role in defending the homeland, the complicated geopolitical landscape within the context of great power competition, and how accelerated environmental change impacts future operations. This strategy communicates the Army's objectives and plan to build an Army capable of Multi-Domain Operations and regaining Arctic dominance.

5. U.S. Air Force. 2020. Arctic Strategy. July 2020. 20 pp. https://www.af.mil/Portals/1/documents/2020SAF/July/ArcticStrategy.pdf

   The U.S. Air Force 2020 Arctic strategy outlines the Department's unique role and optimizes Air Force and Space Force capabilities for the region. The Arctic's increasing strategic importance, coupled with the Services' significant regional investment, requires the Department to have a unified, deliberate, and forward-looking approach, ensuring the Air and Space Forces can compete and defend the nation's interests in the Arctic region. The report also provides recommendations in light of the Arctic's most significant strategic threats and opportunities, based on Combatant Commander requirements and the Air and Space Forces' missions.

6. U.S. Coast Guard. 2019. Arctic Strategic Outlook: The United States Coast Guard's vision for the Arctic Region. April 2019. 48 pp. https://www.uscg.mil/Portals/0/Images/arctic/Arctic_Strategy_Book_APR_2019.pdf

   The U.S. Coast Guard Arctic Strategic Outlook reaffirms commitment to American leadership in the region through partnership, unity of effort, and continuous innovation. This document establishes three lines of effort crucial to achieving long-term mission success: (1) Enhance capability to operate effectively in a dynamic Arctic domain, (2) Strengthen the rules-based order, and (3) Innovate and adapt to promote resilience and prosperity.