REVISITING NEAR-TERM RECOMMENDATIONS TO PRIORITIZE INFRASTRUCTURE NEEDS IN THE U.S. ARCTIC

The U.S. Committee on the Marine Transportation System
ARCTIC MARINE TRANSPORTATION INTEGRATED ACTION TEAM

2018

This report was developed by the U.S. Committee on the Marine Transportation System's Arctic Marine Transportation Integrated Action Team, which includes representatives from:

- Bureau of Ocean Energy Management
- Bureau of Safety and Environmental Enforcement
- Environmental Protection Agency
- Maritime Administration
- National Oceanic and Atmospheric Administration
- Oceanographer of the Navy
- National Maritime Intelligence-Integration Office
- Office of Science and Technology Policy
- Office of the Secretary of Transportation
- U.S. Arctic Research Commission
- U.S. Army Corps of Engineers
- U.S. Coast Guard
- U.S. Department of State
- U.S. Transportation Command

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Introduction

The U.S. Committee on the Marine Transportation System (CMTS) is a Federal Cabinet-level, inter-departmental committee chaired by the U.S. Secretary of Transportation. The purpose of the CMTS is to create a partnership of Federal departments and agencies with responsibility for the Marine Transportation System (MTS). In 2010, the CMTS was directed by statute to coordinate transportation policy in the U.S. Arctic 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 Marine Transportation System.

In 2014, the White House National Strategy for the Arctic Region (NSAR) Implementation Plan directed the U.S. Department of Transportation to execute three tasks under the objective Prepare for Increased Activity in the Maritime Domain. The Office of the Secretary delegated these tasks to the CMTS, and subsequently, the CMTS delivered *A 10-Year Projection of Maritime Activity in the U.S. Arctic*, in December 2014 (Action 1.1.1), *A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic* (Action 1.1.2) in April 2016, and *Recommendations and Criteria for Using Federal Public-Private Partnerships to Support Critical U.S. Arctic Maritime Infrastructure* (Action 1.1.3) in January 2017.[1,2,3] Taken together, these three reports provide a framework to support a growing Arctic MTS with an understanding of future vessel activity, infrastructure required to support future vessel activity, and mechanisms to support the development of such critical infrastructure.

The April 2016 report, *A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic* (2016 CMTS report) identified critical requirements for a safe and secure Arctic MTS. Of the 43 recommendations identified, 25 were categorized as near-term recommendations, to be implemented between 2016-2018 (Table 1). At the time of the original report, these recommendations were considered well suited for near-term planning and near-term implementation, such as specific infrastructure needs that were previously identified as mission critical for safe navigation in Arctic waters or that would require immediate investment and action.

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[1] Azzara, A. J., Wang, H., Rutherford, D., Hurley, B., and Stephenson, S. (2014). *A 10-Year Projection of Maritime Activity in the U.S. Arctic*. A Report to the President. U.S. Committee on the Marine Transportation System, Integrated Action Team on the Arctic Available at https://www.cmts.gov/downloads/CMTS_10-Year_Arctic_Vessel_Projection_Report_1.1.15.pdf as of October 4, 2018.

[2] U.S. Committee on the Marine Transportation System (2016). *A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic*. A Report to the President. Available at https://www.cmts.gov/downloads/NSAR_1.1.2_10-Year_MTS_Investment_Framework_Final_5_4_16.pdf as of October 4, 2018.

[3] U.S. Committee on the Marine Transportation System (2017). *Recommendations and Criteria for Using Federal Public-Private Partnerships to Support Critical U.S. Arctic Maritime Infrastructure*. A Report to the President. Available at https://www.cmts.gov/downloads/NSAR_1.1.3_Recommendations_and_Criteria_2017_FINAL.pdf as of October 4, 2018.

Near-Term Recommendations	
Navigable Waterways	Designate Port Clarence as an Arctic Maritime Place of Refuge.
Navigable Waterways	Review Port Clarence facilities to assess whether adequate support facilities are available at Port Clarence or in the region for a ship in need of assistance.
Navigable Waterways	Leverage existing data-sharing frameworks, such as Data.gov, the Alaska Regional Response Team, and Alaska Ocean Observing System, to facilitate waterways planning and response to environmental emergencies.
Navigable Waterways	Support Arctic Waterways Safety Committee efforts to bring stakeholders together.
Navigable Waterways	Work with stakeholders to coordinate research efforts to de-conflict research within commercial and subsistence use areas.
Navigable Waterways	Leverage international partnerships supporting waterways coordination.
Navigable Waterways	Designate M-5 Alaska Marine Highway Connector to connect the Arctic Ocean and the western section of the Northwest Passage.
Physical Infrastructure	Prioritize the need for Arctic port reception facilities to support international regulatory needs and future growth.
Physical Infrastructure	Expand Arctic coastal and river water-level observations to support flood and stormsurge warnings.
Physical Infrastructure	Co-locate new Continuously Operating Reference Stations and National Water Level Observation Network stations to significantly improve the Arctic geospatial framework with precise positioning and water levels.
Physical Infrastructure	Review U.S. Arctic maritime commercial activities to identifying major infrastructure gaps that should be addressed to promote safe and sustainable Arctic communities.
Information Infrastructure	Expand partnerships to provide new satellite Automatic Identification System (AIS) capabilities for offshore activity information.
Information Infrastructure	Advance Arctic communication networks to ensure vessel safety.
Information Infrastructure	Place hydrography and charting of the U.S. maritime Arctic among the highest priority requirements for agency execution.
Information Infrastructure	Improve weather, water, and climate predictions to an equivalent level of service as is provided to the rest of the nation.
Information Infrastructure	Implement short-range, sea-ice forecasting capability.
MTS Response Services	Continue collaboration with State and local authorities to ensure readiness of Arctic maritime and aviation infrastructure for emergency response and Search and Rescue (SAR).
MTS Response Services	Develop a plan to transport critical response equipment from the contiguous U.S. into the Arctic area in the event of a catastrophic event.
MTS Response Services	Continue coordination through international fora to provide significant opportunities for engagement across the Federal Government and the international Arctic response community.
MTS Response Services	Support Pan-Arctic response equipment database development, best practices recommendations, and information sharing for continued development of guidelines for oil spill response in the Arctic.
MTS Response Services	Evaluate facilities currently available on the North Slope for use as seasonal staging areas by those engaged in readiness exercises or research.
Vessel Operations	Expand U.S. icebreaking capacity to adequately meet mission demands in the high latitudes.
Vessel Operations	Finalize the Port Access Route Study for the Bering Strait and continue efforts to provide routes for vessel traffic in the U.S. Arctic.
Vessel Operations	Update domestic law to implement the mandatory provisions of the Polar Code and the Convention on Standards of Training, Certification and Watchkeeping for Seafarers.
Vessel Operations	Examine existing training and safety standards applicable to the U.S. fishing fleet with respect to the new Polar Code requirements.

Table 1: *Table of recommendations adapted from the 2016 CMTS report, A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic (p 6-7).*

As noted in Table 1, these recommendations span five key categories integral to the Arctic MTS, including: (1) navigable waterways, (2) physical infrastructure, (3) information infrastructure, (4) emergency response, and (5) vessel operations. Each recommendation has been revisited and updates since the publication of the 2016 report are included. The updates included in this report demonstrate the tremendous strides made across the federal government to support a growing Arctic MTS, but also highlight remaining critical gaps, such as in weather forecasting and shore-side infrastructure. The Arctic IAT intends to revisit the recommendations outlined in the 2016 report periodically, as more information becomes available.

To provide further context for these recommendations, this report also includes the third edition of the *Current Status of MTS Infrastructure in the U.S. Arctic*. This table documents the existing status of MTS infrastructure in the U.S. Arctic across the previously mentioned five key categories integral to a robust Arctic MTS. This inventory was first developed as part of the 2013 CMTS report, *U.S. Arctic Marine Transportation System Overview and Priorities for Action* and revisited in the 2016 report, *A Ten-Year Prioritization of Infrastructure in the U.S. Arctic*.[4,5]

Background

The United States is an Arctic Nation, with over 46,600 miles (75,000 km) of shoreline in Alaska, including the Aleutian Islands. [6] Three Arctic seas bound the State of Alaska: the Bering, the Chukchi, and the Beaufort (Figure 1). Historically, these seas are frozen for more than half the year, limiting the Arctic maritime season from June through October in a typical year, with unaided navigation within a more limited time frame. However, this pattern appears to be rapidly changing as ice-diminished conditions become more extensive during the summer months. On September 16, 2012, Arctic sea ice reached its lowest coverage extent ever recorded, paving the way for the longest Arctic navigation season on record.[7,8] The lowest winter maximum ice

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[4] U.S. Committee on the Marine Transportation System (2013). *U.S. Arctic Marine Transportation System: Overview and Priorities for Action 2013.* Available at https://www.cmts.gov/downloads/CMTS_US_Arctic_MTS_Report_07-30-13.pdf as of October 22, 2018.

[5] U.S. Committee on the Marine Transportation System (2016). *A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic*. A Report to the President. Available at https://www.cmts.gov/downloads/NSAR_1.1.2_10-Year_MTS_Investment_Framework_Final_5_4_16.pdf as of October 4, 2018.

[6] *Alaska ShoreZone: Mapping over 46,000 Miles of Coastal Habitat*. (2018) NOAA, Office of Response and Restoration, sourced from https://response.restoration.noaa.gov/about/media/alaska-shorezone-mapping-over-46000-miles-coastal-habitat.html on October 10, 2018.

[7] Jeffries, M. O., J. A. Richter-Menge and J. E. Overland, Eds., 2012: Arctic Report Card 2012. Available at: ftp://ftp.oar.noaa.gov/arctic/documents/ArcticReportCard_full_report2012.pdf as of October 4, 2018.

[8] McGrath, M. (2012). Gas tanker Ob River attempts first winter Arctic crossing, BBC News. Available at: http://www.bbc.co.uk/news/science-environment-20454757

extent in the satellite record (1979-2017) occurred on March 7, 2017, and multi-year ice only comprises 21 percent of the ice cover in 2017 compared to 45 percent in 1985.[9]

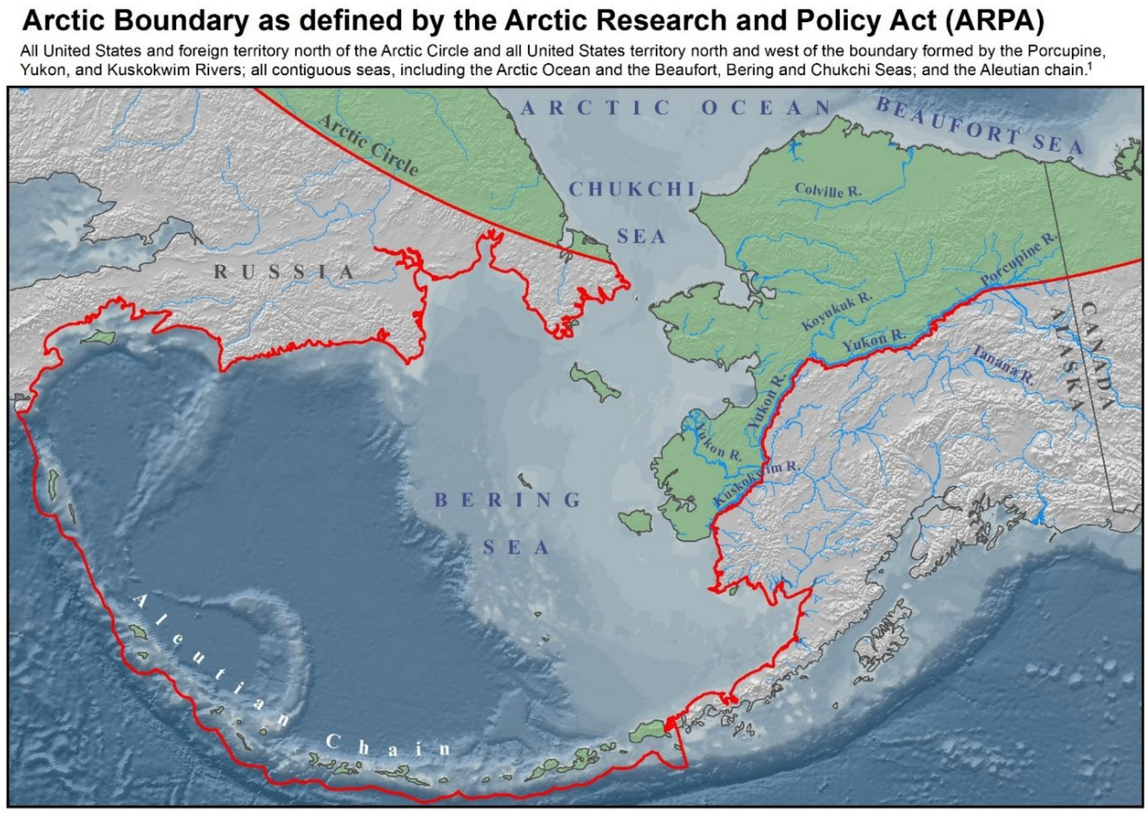

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Figure 1: The geographic area covered by this report consists of all U.S. territory north of the Arctic Circle and all U.S. territory north and west of the boundary formed by the Porcupine, Yukon, Kuskokwim Rivers; all contiguous seas including the Arctic Ocean and the Beaufort, Bering, Chukchi Seas, and the Aleutian Island chain, as defined in § 112 of the Arctic Research and Policy Act of 1984 (ARPA). Source: U.S. Arctic Research Commission

While decrease of sea ice may increase the time available for navigation in the Arctic, marine transportation in the region continues to be challenging and potentially hazardous, particularly due to variability of sea ice from year to year. Although transiting Arctic waters has greatly improved due to increasing summer ice retreat, there are still unpredictable ice floes, inclement weather (e.g., extreme cold, heavy fog, severe storms), and seasonal accessibility based on variation in ice location.

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[9] Richter-Menge, J., Overland, J.E., Mathis, J.T., and E. Osborne, Eds. 2017: Arctic Report Card, 2017. Available at ftp://ftp.oar.noaa.gov/arctic/documents/ArcticReportCard_full_report2017.pdf as of October 4, 2018

Status of Near-Term Recommendations on U.S. Arctic MTS Requirements

Navigable Waterways

Figure 2: Northern Sea Routes and Northwest Passage.
Source: Office of Naval Intelligence

In the Arctic, diminishing ice has led to the seasonal opening of navigable waterways that are sufficiently deep and wide for vessels to transit. In the U.S. Arctic, this specifically means additional traffic through the Bering Strait and along the North Slope of Alaska, driven by potential maritime traffic increases along the Northern Sea Routes and Northwest Passage (Figure 2). These Arctic navigable waterways are used to transport mineral, agricultural and bulk products, as well as other trade goods and passengers to, from, and within the United States. Moreover, these navigable waterways connect the U.S. Arctic region to the rest of the Nation and contribute to the movement of global commerce.

Harbors of Refuge

An integral part of waterways and MTS management is the availability of places of refuge for ships transiting U.S. waters; this is especially critical in U.S. Arctic waters. A "Harbor of Refuge" is defined as "a port, inlet, or other body of water normally sheltered from heavy seas by land and in which a vessel can navigate and safely moor."[10]

The 2016 CMTS report identified Port Clarence, located south of the Bering Strait on the Seward Peninsula, as an important location in the U.S. Arctic.

- *Near-Term Recommendations*
    - *Designate Port Clarence as an Arctic Maritime Place of Refuge*
    - *Review Port Clarence facilities to assess whether adequate support facilities are available at Port Clarence or in the region for a ship in need of assistance*

Port Clarence has historically been used by fishing and whaling vessels as a place of safe harbor, and its naturally deep harbor makes it a conduce place for distressed vessels to anchor in and prevent further damage or deterioration of the ship.

[10] Under 46 CFR 175.400.

Despite its naturally deep harbor, Port Clarence currently has no port facilities. U.S. Coast Guard (USCG) District 17 has designated Port Clarence as a Potential Port of Refuge in the Arctic, but is not aware of movement towards a formal declaration as an official Maritime Place of Refuge or Arctic Maritime Place of Refuge recognized internationally by the International Maritime Organization (IMO).

In its evaluation of support facilities in the region, the USCG found the existing runway at Port Clarence to be unusable for USCG fixed-wing aircraft, underscoring the limited access via air and land to Port Clarence to assist a ship in need.

Future development of further shore-side MTS infrastructure at Port Clarence remains unclear. In 2016, federal lands around Port Clarence were transferred to the Bering Straits Native Corporation (BSNC).

Marine Areas of Ecological Significance

Ecologically significant marine areas also fall under navigable waterways management. The 2009 *Arctic Marine Shipping Assessment* (AMSA) recommended "that the Arctic states should identify areas of heightened ecological and cultural significance . . . and, where appropriate, should encourage implementation of measures to protect these areas from the impacts of Arctic marine shipping." [11] The 2016 CMTS report recommended leveraging existing data sharing frameworks to not only better coordinate divergent uses of U.S. Arctic waters, but also to better protect the eighteen previously identified Large Marine Ecosystems in U.S. Arctic waters.

- *Near-Term Recommendation*
  - *Leverage existing data-sharing frameworks, such as Data.gov, the Alaska Regional Response Team, Ocean.gov, and Alaska Ocean Observing System (AOOS) to facilitate waterways planning and response to environmental emergencies*

Since the release of the 2016 CMTS Arctic MTS Infrastructure report, many agencies have released public data-portals to provide regional planners and emergency responders with critical information about the Arctic environment and relevant infrastructure.

The National Geospatial Intelligence Agency (NGA) created the NGA Arctic Open Data Application, a public facing Arctic data web portal, with contributions from the National Science Foundation (NSF), ESRI, the Polar Geospatial Center at the University of Minnesota, the Ohio State University, Cornell University, and Blue Waters at the University of Illinois at Urbana-Campaign.[12] This web portal provides 3D digital elevation models of the entire Arctic region,

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[11] Arctic Marine Shipping Assessment (2009). Protection of the Arctic Marine Environment Working Group, Arctic Council. Available at: https://oaarchive.arctic-council.org/handle/11374/54 as of October 4, 2018.

[12] National Geospatial Intelligence Agency. (2018). Web Application: *NGA Arctic Open Data Application*. Available at https://arctic-nga.opendata.arcgis.com/ as of October 4, 2018

along with information about airfields, maritime boundaries, sea ice extents, search and rescue (SAR) zones, and potential energy resources.

The National Oceanic and Atmospheric Administration's (NOAA) Office of Response and Restoration (OR&R) developed Arctic ERMA (Environmental Response Management Application), an Arctic-specific online mapping tool to bring together available geographic information needed for an effective emergency response (including: extent and concentration of sea ice; locations of ports, pipelines, and vulnerable environmental areas; currents, tides, wind, waves, and other pertinent physical oceanographic observations). [13] Arctic ERMA includes datasets sourced from Prince William Sound Oil Spill Recovery Institute, Coastal Response Research Center, the University of New Hampshire, the Alaska Ocean Observing System (AOOS), NOAA, Environmental Protection Agency (EPA), and the Bureau of Safety and Environmental Enforcement (BSEE). Arctic ERMA also supports the efforts of the Arctic Council's Emergency Prevention, Preparedness, and Response (EPPR) Working Group as a platform for data sharing, and is used during the council's international response training, as required under the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic.

AOOS launched an AOOS-operated, centralized regional data assembly center (DAC) and its Arctic Data Integration Portal to provide access to real-time, contemporary, and historical data assets to interested users, including emergency managers and regional planners.[14] The AOOS data portal was certified in 2018 by NOAA to meet federal standards for data management and quality control.[15]

In addition to these domestic web portals, the U.S. has contributed significantly to the Arctic Ship Traffic Data (ASTD) System, a priority of the Arctic Council's Protection of the Arctic Marine Environment (PAME) 2017-2019 Work Plan.[16] The ASTD System aims collect and share Arctic marine traffic data by leveraging a cooperative agreement among the Arctic States.[17] The ASTD System will allow the Arctic Council member governments, including the U.S., to facilitate trend analysis on ship traffic in the Arctic, including the number of ships in the

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[13] National Oceanic and Atmospheric Administration (2015). Web Application: *Arctic Environmental Response Management Application*. Retrieved from https://erma.noaa.gov/arctic/erma.html on October 4, 2018.

[14] Alaska Ocean Observing System. (2018). Web Application. Retrieved from https://portal.aoos.org/old/arctic.php#map on October 4, 2018.

[15] National Oceanic and Atmospheric Administration (2018, August 28). All IOOS regional networks now NOAA-certified. [Press Release]. Retrieved from https://www.noaa.gov/media-release/all-ioos-regional-networks-now-noaa-certified on October 4, 2018.

[16] Protection of the Arctic Marine Environment International Secretariat. (2017). *PAME Work Plan 2017-2019*. Arctic Council. Accessed from https://www.pame.is/images/01_PAME/Work_Plan/PAME_Work_Plan_2017-2019.pdf on October 4, 2018.

[17] Arctic Marine Shipping Database, Protection of the Arctic Marine Environment. Available at https://www.pame.is/index.php/projects/arctic-marine-shipping/astd as of October 4, 2018.

Arctic, types of ships, exact routes and other related and relevant information. This database is currently under construction and is scheduled for operationalization by 2019.

The launch of these data portals is the first step to put the latest information into the hands of planners, emergency responders, and other key decision makers. Further outreach is required to expand the awareness and proper use of these existing data portals to facilitate waterways planning and incorporate into planning response exercises.

Managing Arctic Waterways

U.S. Arctic waters have many users, and it is important that overarching frameworks are developed to incorporate all stakeholders, both locally and internationally. The 2016 CMTS report provided three specific near-term recommendations to better manage U.S. Arctic waterways. These recommendations urged the continued cooperation of the many stakeholders in the U.S. Arctic, through local partnerships, such as the Arctic Waterways Safety Committee (AWSC), and international dialogue, such as through the IMO, Arctic Council, and the International Hydrographic Organization (IHO).

- *Near-Term Recommendation*
    - *Support Arctic Waterways Safety Committee efforts to bring stakeholders together*

The AWSC was formed in 2014 and aims to enhance marine safety, Indigenous Peoples' food security, and environmental stewardship via risk based decision-making. AWSC brings together local marine interests in the Alaskan Arctic in a single forum, and to act collectively on behalf of those interests to develop best practices to ensure a safe, efficient, and predictable operating environment for all current and future users of the waterways. Though challenged by funding limitations, the AWSC has continued to meet twice a year and make their meeting materials publicly available online; they last met in Anchorage, Alaska on October 18, 2018. NOAA's Regional Navigation Manager and USCG District 17 has and continue to remain actively involved with this group and specifically with efforts to update NOAA's Office of Coast Survey's *U.S. Coast Pilot* with information and recommendations to the AWSC. Other members of the Federal government, including MARAD and CMTS, are also engaged with AWSC and expect to continue active and regular engagement with this unique organization.

- *Near-Term Recommendation*
    - *Work with stakeholders to coordinate research efforts to de-conflict research within commercial and subsistence use areas*

In 2017, AWSC implemented Standards of Care for research survey operations as a component of the 2016 Arctic Waterways Safety Plan. This guidance outlines thresholds at which research participants should communicate with regional organizations, co-management organizations, or tribes prior to initiating activities in areas of active or anticipated subsistence activities. While adherence to this Standard of Care is voluntary, federal agencies made a commitment in the NSAR to coordinate and consult with Alaska Natives and to pursue responsible Arctic stewardship, with understanding through scientific research and traditional knowledge. This voluntary measure does not extend to foreign research vessels or to other Arctic regions, representing a sizable gap to de-conflict research and other uses of the marine environment.

- *Near-Term Recommendation*
    - *Leverage international partnerships supporting waterways coordination*

As an Arctic Nation, the U.S. has remained engaged in many international partnerships to support waterways coordination in the U.S. Arctic.

At the IMO's January 2018 meeting of the Subcommittee on Navigation, Communications, and Search and Rescue, the U.S. and Russian Federation jointly proposed a system of two-way routing measures in the Bering Strait and Bering Sea.[18] This proposal was discussed and approved at the May 2018 meeting of IMO's Maritime Safety Committee, and these voluntary routing measures go into effect December 1, 2018.

Within the Arctic Council, the U.S. has been an active member of the PAME Working Group. The U.S. PAME delegation, including representatives from USCG, NOAA, and MARAD, has been working to develop a cross-Arctic Maritime Corridors proposal, which as of June 2018, has not yet been released.

Finally, the U.S. continues to be an active member within the International Hydrographic Organization (IHO)'s Arctic efforts. NGA serves as the Chair of the IHO Arctic Regional Marine Spatial Data Infrastructures Working Group and Vice Chair of the IHO's Marine Spatial Data Infrastructures Working Group. The NGA and NOAA are also active members of the IHO Arctic Regional Hydrographic Commission, with the Hydrographer of the U.S. Navy supporting.

As of the publication of this report, all engaged agencies plan to continue their work with Arctic Council, IMO, IHO, and other intergovernmental projects.

Marine Highways

The America's Marine Highway (AMH) System consists of over 29,000 nautical miles of navigable waterways including rivers, bays, channels, the Great Lakes, the Saint Lawrence Seaway System, coastal, and open-ocean routes. The AMH program works to further recognize and incorporate the nation's waterways into the greater U.S. transportation system, especially where marine transportation services are the most efficient, effective, and sustainable transportation option.

[18] United States Coast Guard. (2018, January 25). U.S., Russia propose Bering Strait ship traffic routing measures. [Press Release]. Retrieved from https://content.govdelivery.com/accounts/USDHSCG/bulletins/1d5df97 on October 4, 2018.

The AMH is not currently reflective of the commercial shipping along the Arctic areas of the west and north coasts of Alaska. The nearest route to the U.S. Arctic is the M-5 Alaska Marine Highway Connector that currently consists of the Pacific Ocean coastal waters, including the Inside Passage. The M-5 connects commercial navigation channels, ports, and harbors from Puget Sound to Unalaska in the Aleutian Islands, spanning British Columbia, lower Alaska and connects at the Canadian border north of Bellingham, WA (Figure 2).

To further incorporate the high Arctic into the AMH System, the 2016 CMTS report recommended extending the M-5 Alaska Marine Highway Connector. This Arctic Addition would extend north from the Aleutian Islands along the west and north coasts of Alaska to connect the Bering, Chukchi, and Beaufort Seas.

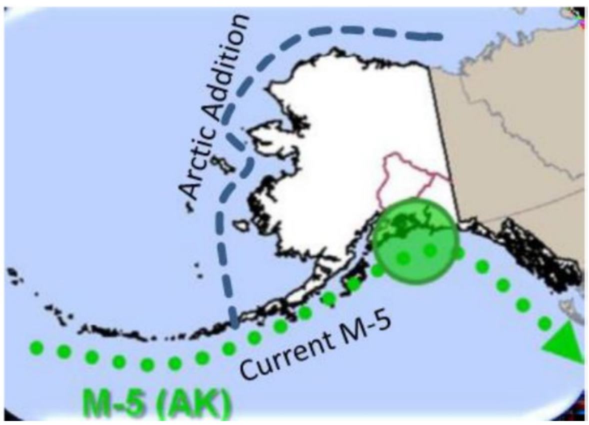

Figure 3: Current and proposed route for the extension of the M-5 Alaska Marine Highway Connector
Source: CMTS Arctic IAT

This extension would support shipping and cargo movements occurring north of the Aleutians including Port Clarence, Cape Romanzof, Dillingham, Bethel, Egegik River, Port Heiden, Togiak Bay, Arctic Ocean-Off Northern Alaska, Bering Sea Off Western Alaska, Port Moller, St. Paul Island, Pribilof Islands, Hooper Bay, Nunivak Island, Nome, St. Lawrence Island, Tin City, Shishmaref, Kivalina, Point Hope, Cape Lisburne, Point Lay, Wainwright, Barrow, Kaktovik, and Prudhoe Bay.

- *Near-Term Recommendation*
    - *Designate M-5 Alaska Marine Highway Connector to connect the Arctic Ocean and western section of the Northwest Passage*

MARAD has prepared a recommendation to extend the M-5 route north of the Aleutian Islands to cover the west and north coast of Alaska through the Bering, Chukchi, and Beaufort Seas to the Northwest Passage. This is on track to be submitted to the Secretary of Transportation for signature in 2018, using cargo volumes from 2016-2017.

Physical Infrastructure

Shore-based marine transportation infrastructure generally includes those land-side components that allow for quick and efficient transportation of cargo and passengers. Physical infrastructure for the MTS encompasses:

- Ports
- Terminals
- Piers
- Berths
- Intermodal connections and linkages to road, rail, and airport access routes and facilities
- Cargo handling and passenger/crew facilities
- Port Reception Facilities to receive and dispose of all ship generated wastes in an environmentally sound manner [19]
- Geospatial infrastructure and Continuously Operating Global Positioning System Reference Stations supporting accurate positioning, navigation, and development.

Physical infrastructure in the U.S. Arctic MTS is critical but lacking in many areas. This is due in part to small populations scattered across the landscape, and in part to the fact that the Arctic has not needed substantial MTS infrastructure until recently with diminishing sea ice. Additionally, improving infrastructure in the Arctic is more difficult than in the contiguous United States because of the narrow seasonal windows available for field work and high mobilization costs to remote Arctic areas. These existing challenges have been exacerbated by environmental change, including thawing of once frozen permafrost across the state and the rapid rates of shoreline erosion along the western and northern coasts.

Commercial transportation in Alaska is dominated by air and barge services. This makes the delivery of life-sustaining resources, such as fuel, to many Alaskan communities expensive and, because of seasonal considerations, restricted or limited for many months of the year.

Port Reception Facilities

Expanding vessel activity in the Arctic means that port reception facilities, particularly for the receipt of international waste, at ports in the Arctic will need to expand in tandem The 2016 CMTS Arctic MTS Infrastructure report identified the following waste management challenges: the difficulty in constructing new infrastructure on the coast; changing ice conditions that could prevent the practical use of reception facilities; and landside environmental concerns regarding waste processing and disposal facilities sited in Arctic ports (e.g. proximity to environmentally sensitive areas, protected habitats, designated refuges, and/or culturally sensitive areas). As a

[19] As required as required by the International Convention for the Prevention of Pollution from Ships MARPOL Annexes I, II, V, and VI, and sewage within the U.S. as required by U.S. Environmental Protection Agency regulations.

result of these challenges, the 2016 CMTS Arctic MTS Infrastructure report recommended this topic be addressed at appropriate international fora.

- *Near-Term Recommendation*
    - *Prioritize the need for Arctic port reception facilities to support international regulatory needs and future growth*

The U.S. and its Arctic Council partners (Canada, Denmark, Finland, Iceland, Norway, Sweden, and Russia) proposed amendments to the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V at the April 2018 meeting of the IMO's Marine Environmental Protection Committee (MEPC) that would allow for the establishment of a regional reception facilities plan to mitigate significant waste management challenges for Arctic ports. The Chairman of MEPC invited countries to submit a proposal for a new output at the next meeting of MEPC, scheduled for October 2018, bringing this important topic to the forefront of the international maritime community.

Accurate Positioning

An underlying aspect to physical infrastructure development is the need for accurate maritime positioning information. There are two major components to this kind of reference information: spatial reference (through geodetic datums) and vertical water-level reference (through tidal datums). Because the U.S. Arctic has been relatively inaccessible until recently, it lacks the same basic geospatial infrastructure NOAA has provided to the rest of the Nation (Figure 4). This lack of geospatial infrastructure can lead to considerable information gaps. For example, elevations relative to sea level can be off by more than a meter in the Arctic, whereas the rest of the Nation benefits from centimeter-level positioning accuracies.

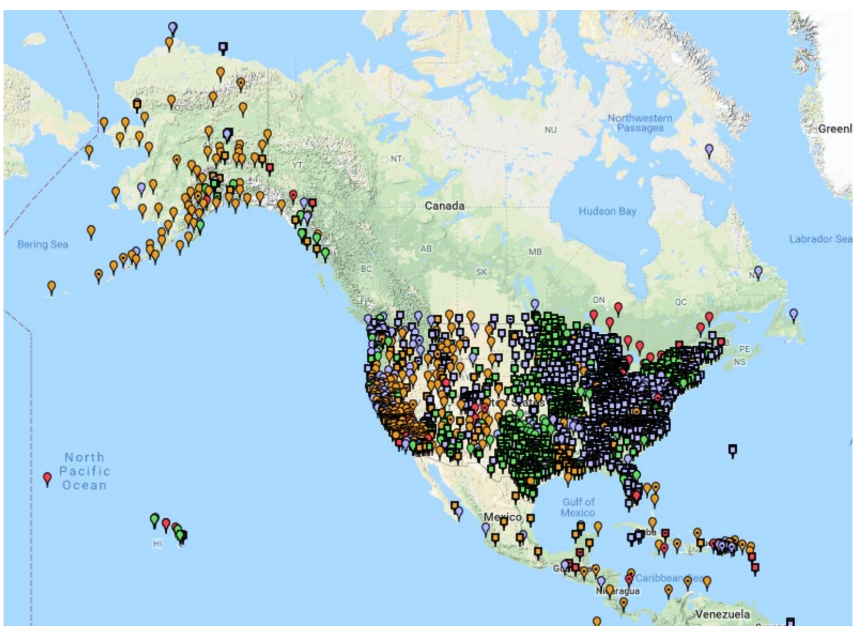

Figure 4 Map demonstrating unequal distribution of Continuously Operating Reference Stations Between Alaska and the contiguous United States. Source: National Geodetic Survey.

Given the importance of geospatial data and accurate positioning for the MTS, the 2016 CMTS report recommended increasing water-level observations and leveraging existing observational infrastructure to close critical information gaps.

- *Near-Term Recommendation*
    - *Expand Arctic coastal and river water-level observations to support flood and storm-surge warnings*

NOAA previously identified 20 gaps in the U.S. Arctic tidal datum and real-time information network, and has been working to fill those gaps. NOAA installed a new National Water Level Observing Network (NWLON) tide gauge station in Unalakleet, Alaska in 2018, which provides NOAA's National Weather Service (NWS) with key information for storm surge forecasts in the region. This recent addition brings the total number of NWLONs on the west and north coast of Alaska to 5 total, compared to 27 throughout the state of Alaska. Additionally, NWS and AOOS have been working on low-cost water level sensors (such as pressure transducers, acoustic gauges, and global navigation satellite system (GNSS) reflectometry sites) to collect real-time data for NWS forecast support coastal flood modelling efforts and mariners.

NOAA will continue to determine ways to fill NWLON and other water level observation gaps in Alaska, in coordination with AOOS and non-federal partners. For example, AOOS and NWS are supporting two pilot projects using GPS reflectometry to better fill the tide gauge data gap. Additionally, 15 real-time streamflow stations in the U.S. Arctic operated by the U.S. Geological Survey's National Water Information System (NWIS), which may be leveraged for river water-level observations, are documented in Appendix B, the 2018 update of MTS Infrastructure in the U.S. Arctic.[20]

Additionally, AOOS hosted the Alaska Water Level Observations Workshop in May 2018 to highlight the progress made to fill coastal water level observing gaps over the past 3 years. Participants identified and prioritized remaining gaps and potential solutions for increasing water level observing in Alaska. A workshop report, *Coastal & Nearshore Water Level Observation in Alaska: Challenges, Assets, Gaps, and Next Steps*, will be released to the public via Alaska Water Level Watch in late 2018.[21]

- *Near-Term Recommendation*
    - *Co-locate new Continuously Operating Reference Stations (CORS) and NWLON stations to significantly improve the Arctic geospatial framework with precise positioning and water levels*

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[20] United States Geologic Survey. (2018). National Water Information System Web Interface, *USGS Current Conditions for Alaska, v2.25*. Accessed from https://waterdata.usgs.gov/ak/nwis/current/?type=flow on October 4, 2018.

[21] Alaska Ocean Observing System. (2018). Alaska Water Level Watch. Accessed from http://www.aoos.org/alaska-water-level-watch/ on October 4, 2018.

The National Geodetic Survey (NGS) manages the CORS network. The NGS CORS network is comprised of over 1,800 partner-maintained GNSS stations. Since physical stations are maintained by partners, NGS does not determine the location of these stations, but rather provides detailed guidelines for partners to adhere. NGS will continue to adopt partner-maintained CORS that adhere to CORS guidelines and specifications. CORS with NWLONS within 1 km of the tide station are operationally defined as co-located. Two have been co-located in Alaska within the last two years, at Sitka and Seward. There are also five active NWLONS in Alaska that have a CORS within 1km of the tide station: Port Alexander, Unalaska, Kodiak Island, Seldovia, Cordova; and three tidal prediction points (not active tide stations) with a CORS within 1 km: Cape Hichinbrook, Kodiak (St. Paul's Harbor), and Cold Bay.

As an important next step, AOOS and NWS are supporting two separate pilot projects that utilize GPS reflectometry techniques, with additional locations now considered for potential deployments along low-infrastructure regions across the state. GPS reflectometry techniques may be the best way forward, as they are lower-maintenance, require less power, and are easier and less expensive to install and maintain; this approach uses reflected satellite GPS or GNSS signals to determine the height of a reflecting surface, relative to a stable GPS antenna of fixed local height, and could provide a cheaper, more efficient alternative to NWLON tide gauges.[22]

Commercial Arctic Uses

Since the days of the Gold Rush, the U.S. has looked to the high north for resources. AMSA noted that natural resource development and other commercial uses of the Arctic domain were critical to precipitating infrastructure in the Arctic, including infrastructure to support maritime transportation. Despite the late 2015 announcement about the cessation of oil exploration in the Chukchi Sea, interest in developing the Arctic has not waned. Other commercial interests, such as transshipment, mining, resupply, fisheries, and tourism, are all viable enterprises, and a comprehensive MTS is required to support these commercial Arctic uses. Additionally, emerging energy sector priorities relevant to marine transportation, such as renewable energy development, expanded distribution of North Slope natural gas, and the shipment of natural gas resources through the Arctic, may transform the Arctic MTS and Arctic marine infrastructure in unprecedented ways. The 2016 CMTS report recommended a thorough review of Arctic maritime commercial activities to identify infrastructure gaps in the U.S. Arctic.

- *Near-Term Recommendation*
    - *Review U.S. Arctic maritime commercial activities to identify major infrastructure gaps that should be addressed to promote safe and sustainable Arctic communities*

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[22] *Maritime Transportation in the Arctic: The U.S. Role: Hearing before Subcommittee on Coast Guard and Maritime Transportation,* House of Representatives, 115th Cong. (Testimony of Molly McCammon, June 2018) Accessed from https://transportation.house.gov/uploadedfiles/2018-06-07_-_mccammon_testimony.pdf on October 4, 2018.

A dedicated review of U.S. Arctic maritime commercial activities has yet to be completed, but many efforts are underway across the Federal government to identify major infrastructure gaps in the U.S. Arctic, including the Arctic MTS.

The 2017 National Defense Authorization Act (NDAA) required Department of Defense (DOD), USCG, and MARAD to create the designation and associated criteria for a 'Strategic Arctic Port'. Furthermore, the 2018 NDAA called for a report on DOD Arctic capability, resource gaps, and required infrastructure, and the 2019 NDAA requires the delivery of an updated Arctic strategy from the Secretary of Defense no later than June 2019.[23] This DOD report will include a description of US national security interests in the Arctic region, an assessment of threats and security challenges, and descriptions of each military service's role in the Arctic, near- and long-term training, capacity, and resource gaps, and the level of cooperation between DOD and other Federal departments, agencies, State and local governments working in the Arctic region.

As part of the semi-annual Hydrographic Services Review Panel (HSRP) meeting held in Juneau, AK in August 2018, NOAA held an Arctic-specific session to discuss Arctic-specific infrastructure gaps. Additionally, the National Academies of Science's Ocean Studies Board, Transportation Research Board, and Polar Studies Board, held a scoping session about U.S. Arctic Marine Infrastructure in September 2018.

The CMTS Arctic IAT remains engaged on this important topic, and later in 2018, together with the U.S. Arctic Research Commission, will host a technical workshop to identify drivers of marine vessel activity in U.S. Arctic waters, bringing together experts from industry, academia, government, and the Arctic region. This workshop is the first step towards a review of marine vessel activity in U.S. Arctic waters and will contribute to the update of the 2015 CMTS report, *A 10-Year Projection of Maritime Activity in the U.S. Arctic Region.*

[23] John McCain National Defense Authorization Act for Fiscal Year 2019, §1071 "Report on an Updated Arctic Strategy" Accessed from https://www.congress.gov/bill/115th-congress/house-bill/5515/text on October 4, 2018.

Information Infrastructure

Information is an essential component of any MTS, especially in the Arctic, where conditions are often hazardous due to the harsh and changing environment. These information services require dynamic inputs and are relied on by mariners and other MTS users for situational awareness and safe, secure, and efficient marine transits. MTS information infrastructure includes, but is not limited to, the following:

- Nautical charts built on updated hydrographic and shoreline mapping, water level and geodetic positioning data
- Channel delineation and dredge data
- Aids to navigation (ATONs)
- Accurate marine weather and sea ice forecasts
- Real-time global positioning and water levels
- Automatic Identification System (AIS), and
- Communications capabilities

Automatic Identification System (AIS) Framework

AIS is an automatic tracking and location system used on many vessels. The AIS device is a transponder used to communicate with other ship, shore, or satellite receivers. AIS works with vessel traffic systems to communicate critical information about vessels transiting an area such as name, identification number, speed, heading, and port of origin and destination. The system allows the ship-to-shore and ship-to-ship communication of positions that is critical for navigation and maritime situational awareness. It can also be used in a shore to ship mode to transmit information to ships from shore to make them aware of Notices to Mariners about changes to aids to navigation, changes in charts, or other hazards that may affect their voyage.

IMO's International Convention for the Safety of Life at Sea (SOLAS) requires AIS to be carried by all international vessels 300 gross tons or larger, and by all passenger ships regardless of size including those operating in the Arctic. USCG also requires approved AIS devices on vessels 65 feet and longer engaged in commercial service, including towing vessels greater than 26 feet, among others. [24] Beyond the direct safety applications of AIS, other applications of AIS for planning and commercial purposes have emerged as priorities in the current Administration.[25]

As of 2018, there are a total of 36 AIS receivers and 6 AIS ATON transceivers (Dutch Harbor, Wales, Barrow, and Prudhoe Bay), including 2 AIS ATON transceivers were installed in Nome and Akun Island in 2017.[26] In addition, 130 land-based AIS receiving stations are operated by

[24] 33 CFR part 164.46

[25] Executive Order No. 13,480 (2018).

[26] ATON transceivers are different than AIS receivers in that they can be used to transmit data directly to vessels via AIS frequency/protocols. This can include environmental data (weather, currents, ice

the Marine Exchange of Alaska (MXAK), most of which are in Southeast Alaska and the Gulf of Alaska, in Alaska's most heavily trafficked waters. Moving north, there are 40 land-based AIS receiving stations are in the Bering Sea region and 18 are in and north of the Bering Strait. USCG's partnership with MXAK has provided mariners with critical safety navigation further mitigating risks faced by mariners traveling through the Arctic region.[27]

Such local partnerships are critical, but as sea ice retreats further enhancement of marine domain awareness is needed. The 2016 CMTS report previously recommended further expanding partnerships to understand offshore vessel activity via satellite AIS.

- *Near-Term Recommendation*
    - *Expand partnerships to provide new satellite AIS capabilities for offshore activity information.*

Satellite AIS data provides key information about vessel locations beyond the range of land-based AIS facilities, and is paramount to have for further marine domain awareness. The USCG has been working very closely with Arctic Council member states to share AIS data via the ASTD, a project previously mentioned in this report. ASTD is a priority of the PAME 2017-2019 Work Plan, which aims collect and share Arctic marine traffic data by leveraging a cooperative agreement among the Arctic States.[28] The ASTD System will allow the Arctic Council member governments, including the U.S., to facilitate trend analysis on ship traffic in the Arctic, including the number of ships in the Arctic, types of ships, exact routes and other related and relevant information. This database is currently under construction and is scheduled for operationalization by 2019.

There are ongoing efforts across multiple fronts to rapidly implement a multilateral AIS data sharing system, including system design, approval, documentation, user and data-sharing agreements, and system construction. A cooperative agreement between Arctic countries to share vessel traffic data became operational in 2018, and the monitoring system itself is expected to be delivered by the end of 2018. [29]

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conditions, etc.), safety information (whale/marine mammal sighting locations, whaling fleet activity/location, etc.), other "safety zones", and general Broadcast Notice to Mariners information.

[27] Haring, L. (2017). "Research, Development, Testing, and Evaluation: Arctic Navigational Safety Information System" Blog Post from *Coast Guard Compass: Official Blog of the U.S. Coast Guard*. Accessed from http://coastguard.dodlive.mil/2017/11/rdte-arctic-navigational-safety-information-system/ on October 4, 2018.

[28] Protection of the Arctic Marine Environment International Secretariat. (2017). *PAME Work Plan 2017-2019*. Arctic Council. Accessed from https://www.pame.is/images/01_PAME/Work_Plan/PAME_Work_Plan_2017-2019.pdf on October 4, 2018.

[29] Arctic Marine Shipping Database, Protection of the Arctic Marine Environment. Available at https://www.pame.is/index.php/projects/arctic-marine-shipping/astd as of October 4, 2018.

Communications

Communication in the Arctic is critical to a safe and efficient MTS, but difficult because of an inherent lack of communications architecture and the challenging polar environment. Previous CMTS reports have documented limited Line of Sight communications above 65°N and limited Satellite Communications (SATCOM) above 70°N.[30] Advancing communications and exchange of information is critical when sailing through such a dynamic environment, particularly when access to route, chart, weather, and ice information is critical for navigation safety and compliance.

- *Near-Term Recommendation*
  - *Advance Arctic communication networks to ensure vessel safety.*

The USCG has entered an agreement with MXAK to support vessel communication capabilities. Specifically, MXAK monitors AIS positional data transmitted from ships in Alaskan waters in the event the ship loses power, enters an Area to be Avoided, or incurs some other kind of casualty. MXAK is working to expand the benefits of AIS technology to digitally transmit weather and other safety information to mariners.[31] Additionally, the Arctic Economic Council, supported by the Arctic IAT participants, has produced a report on Arctic telecommunications and the regional disparity of infrastructure across the entire Arctic region.[32]

Nautical Charting

Nautical charts based on modern hydrography and at adequate scales are essential for voyage planning, safe navigation, and safe marine operations in any maritime environment. This is especially true in the U.S. Arctic, and the need for modern and adequate nautical charts has been listed as an urgent priority for safe navigation in nearly every Arctic MTS-related report since 2009, including the 2016 CMTS report.

- *Near-Term Recommendation*
  - *Place hydrography and charting of the U.S. maritime Arctic among the highest priority requirements for agency execution.*

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[30] U.S. Committee on the Marine Transportation System (2016). *A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic*. A Report to the President. Available at https://www.cmts.gov/downloads/NSAR_1.1.2_10-Year_MTS_Investment_Framework_Final_5_4_16.pdf as of October 4, 2018.

[31] Haring, L. (2017). "Research, Development, Testing, and Evaluation: Arctic Navigational Safety Information System" Blog Post from *Coast Guard Compass: Official Blog of the U.S. Coast Guard*. Accessed from http://coastguard.dodlive.mil/2017/11/rdte-arctic-navigational-safety-information-system/ on October 4, 2018.

[32] https://arcticeconomiccouncil.com/wp-content/uploads/2017/02/AEC-Report_Final-LR.pdf

The NOAA Arctic Nautical Charting Plan lays out the need for charting updates and new charts.[33] Surveys continue to occur as resources available and as the season permits; for example, NOAA's hydrographic survey vessel, *Fairweather*, conducted a hydrographic survey around Point Hope (north of Kotzebue on the northwestern coast of Alaska) and the surrounding vicinity in late summer 2018. Additionally, as part of the semi-annual HSRP meeting in August 2018, NOAA discussed ocean observations integral to accurate weather forecasting during an Arctic-specific session. Other agencies are waiting for the Administration to lay out its Arctic and MTS priorities.

Weather and Sea Ice Forecasting

The ability to transmit timely weather information and sea ice forecasts depends heavily on the ability to predict inclement weather and changes in currents or ice cover and extent. One side effect of an ice-diminished Arctic is a reduction in the dampening effect of ice on waves. As spring and fall storms intensify, wave action increases due to a lack of ice cover. Evidence of this is apparent in the rate of coastal erosion from the intensity of the breaking waves against the shores as well as an increase in wave conditions for vessels at sea. Thus, early warning of impending storms is that much more important, for both ships and coastal communities.[34] Yet, the dearth of observational and communications infrastructure in the Arctic compounds combined with such an extreme environment makes accurate weather and sea ice forecasting a continual challenge in the U.S. Arctic.

Previously the CMTS recommended improving weather, water, and climate predictions to match the service provided to the rest of the nation, and to expand weather forecasting to include sea-ice forecasting to enhance the safety of marine transportation in U.S. Arctic waters.

- *Near-Term Recommendation*
    - *Improve weather, water, and climate predictions to an equivalent level of service as is provided to the rest of the nation.*

NOAA's NWS is increasing targeted in-situ observations, both surface based and aloft, to improve model assimilation of observed data, situational awareness, and the basic science understanding in the Arctic. NWS is also leveraging new remote sensing capabilities, such as unmanned aerial systems (UAS), unmanned aerial vehicles (UAV), and satellite technology. As a critical step to meeting this goal, NOAA declared NOAA-20, the first of four in NOAA's next generation Joint Polar Satellite System series, operational in May 2018. The satellite was launched November 2017 and has passed a series of rigorous tests of its on-board instruments and data systems. Data from the satellite will improve the timing and accuracy of weather and hazard forecasts out to seven days, including better predictions for fog, ice formations, and ice breaking in the Arctic. The NWS has submitted a new set of observational requirements into its

[33] https://nauticalcharts.noaa.gov/publications/docs/arctic-nautical-charting-plan.pdf
[34] Sea Level Rise and Storm Surge, Sea Grant Alaska Advisory Program (2014). Available at: https://seagrant.uaf.edu/map/climate/docs/sea-level.php as of January 2016.

Capabilities and Requirements Decision Support process, which will be reviewed and validated by NWS's Mission Delivery Council to help identify a potential solution or a variety of solutions to address out observational gaps.

Moreover, NOAA is focusing on the science fundamentals to improve coupled water, ice, atmosphere models. Much of the focus of model improvements have been on the mid- and lower-latitudes. Areas of specific improvement are the stable Arctic boundary layer, interactions between the oceans, ice, and atmosphere in the marginal ice zone, riverine impacts to ice, and troposphere-stratosphere interactions.

- *Near-Term Recommendation*
    - *Implement short-range, sea-ice forecasting capability*

The NWS Alaska Sea Ice Program currently produces a short-range, sea-ice forecasting capability with our 5-day sea ice graphical and text forecasts. The National Ice Center produces a daily, 48-hour Marginal Ice Zone forecast in text format. Complementing these ocean modeling efforts, Navy continues to prepare and assimilate emergent U.S. and foreign environmental satellite data for sea ice analyses and prediction. Navy's Global Ocean Forecasting System (GOFS) v3.1 was operationalized summer of 2017; GOFS v3.1 increases the vertical resolution in the near surface to better resolve the upper ocean, adds two-way coupling with the Los Alamos-developed Community Ice Model (CICE) sea ice model to provide an ice forecasting capability in both hemispheres, and adds an improved methodology to project surface information down into the water column using Improved Synthetic Ocean Profiles (ISOP).

Additional work is underway to incorporate the CICE into future fully coupled atmosphere-ice-ocean-land global circulation models. Additionally, Navy's GOFS v3.5 is expected to be released later in 2018. GOFS v3.5 will deliver increased horizontal resolution to 1/25° while additionally incorporating tidal forcing. GOFS v3.5 will provide boundary conditions for even higher resolution coastal and Arctic regional models, and is scheduled for operational testing and transition in FY19.

MTS Response Services

MTS Response Services are those services necessary to respond to marine transportation-related emergencies. These include the following services:

- SAR to find and provide aid to people who are in distress or imminent danger;
- Environmental response management, including oil spill prevention, preparedness and response, and the response technologies and MTS capabilities (vessels, personnel, materials, and equipment) necessary to effectively plan for, prepare for, prevent, respond to, and clean up oil and other hazardous wastes spilled at sea; and
- Ice-breaking capability to free vessels beset in ice or in danger; ice-breakers also support SAR efforts, spill response, emergency marine delivery of life-sustaining resources to Alaskan communities, and research.

Emergency Response

The USCG is the primary Federal agency responsible for SAR in U.S. maritime regions. Emergency response in the Arctic is made even more difficult by the remoteness and vast distances of the region, impacts of intense and extended cold, and a lack of onshore infrastructure and reliable communication networks. From the northernmost point of land at Point Barrow, Alaska, the nearest USCG air facility is at Kodiak, which is 820 nautical miles away (a 6-hour flight), and the closest refueling site for vessels is Dutch Harbor, located 1,000 nautical miles away in the Aleutian Islands.

SOLAS, among other provisions, obligates all vessel masters to offer assistance to those in distress. In addition, on May 12, 2011, all the Arctic states signed an Arctic Search and Rescue Agreement, coordinating international SAR coverage and response in the Arctic. It establishes the area of SAR responsibility of each state party in addition to coordinating response assistance.

The 2016 CMTS report previously highlighted the success of USCG's annual Operation ARCTIC SHIELD which extends USCG's presence in the high latitudes in summer months and helps to supplement regional emergency response with the State of Alaska and private companies in the region. The 2016 CMTS report also urged continued collaboration with State of Alaska and local authorities to leverage emergency response resources, especially given the unique risks of the Arctic environment and the increasing traffic in the region.

- *Near-Term Recommendation*
    - *Continue collaboration with State and local authorities to ensure readiness of Arctic maritime and aviation infrastructure for emergency response and SAR.*

For maritime SAR, the USCG is assisting the Alaska's Boroughs and municipalities to stand up Search & Rescue infrastructure, administrative entities/port authorities, and volunteer USCG Auxiliary flotillas. While planning and collaboration occur throughout the year, most interactions occur as part of the ARCTIC SHIELD surge period every summer. In summer 2017, USCG cutters conducted 10 Boating Safety Events in Pt. Lay, Pt. Hope, Wainwright, Utqiagvik, Savoonga, Gambell, Kaktovik, Kotzebue, Nome, with 723 total participants. USCG District 17 assisted 34 villages and towns in collaboration with the State of Alaska's "Kids Don't Float" program, reaching 4,014 participants. Additionally, USCG completed 28 search-and-rescue cases, saving 20 lives and assisting 27 others, and logging over 350 flight hours from Forward Operating Location Kotzebue.[35] Operation Arctic Shield 2018 began in July 2018, and included USCG stationing 2 MH-60 Jayhawk helicopters and crews in Kotzebue to assist with search-and-rescue operations throughout the season.

- *Near-Term Recommendation*
    - *Develop a plan to transport critical response equipment from the contiguous United States into the Arctic area in the event of a catastrophic event.*

USCG D17 recommended integrating partners from the Federal Emergency Management Agency (FEMA) into this work item, since FEMA has a national project wherein they are asking their emergency support function partners to input their respective transportation requirements into the U.S. Transportation Command's Time Phased Force Deployment Data (TPFDD) system prior to any major contingency event in which FEMA is engaged. This would allow FEMA to bring pre-determined 'packages' into the theater on a streamlined basis based on State needs. Further coordination between agencies is required to ensure that data requirements are met. The CMTS Arctic IAT has identified a point of contact at FEMA Region 10 and will reach out and include in future discussions.

Oil Spill Response

Responding to oil spills is a challenge in any condition, but is especially so in the Arctic marine environment characterized by extreme cold, extensive ice, intense storms, and limited industrial infrastructure. These challenging response conditions are compounded with unique spill challenges in the Arctic, which include difficulty with tracking oil slicks in ice fields, ice interference with mechanical, chemical, and burning response methods, and longer persistence of hazardous compounds found in oil due to the slower biodegradation rates.

Responding to oil spills in ice-covered waters requires a combination of tactics rarely tested in real Arctic marine and ice environments. There is currently an ongoing effort to increase preparedness and oil pollution response capabilities domestically and internationally. Established through the National Oil and Hazardous Substance Pollution Contingency Plan (40 CFR Part 300), the National Response System operates through a network of Federal agencies, through which USCG, NOAA, U.S. Fish and Wildlife Service, and EPA oversee and enforce oil spill response. Additionally, the Federal/State Preparedness Plan for Response to Oil and

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[35] United States Coast Guard District 17 (2018) *Arctic Shield 2017 Fact Sheet*. Accessed from https://www.pacificarea.uscg.mil/Portals/8/District%2017/Arctic%20Shield/Arctic%20Shield%20fact%20sheet_final.pdf?ver=2018-02-06-161421-003 on October 4, 2018.

Hazardous Substances Discharges and Releases (the Unified Plan), was developed jointly among the State of Alaska, USCG, and EPA. These frameworks integrate with the Alaska Incident Management System Guide for Oil and Hazardous Substance Response, which provides standardized oil spill response management guidelines to responders in Alaska.[36] The Alaska Management System coordinates with the national response frameworks (e.g., National Response System), but is specific to the State's interests.[37] The U.S. response framework intersects with other Arctic countries' authorities through the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic.[38] This agreement's operational guidelines were developed and are maintained by the Arctic Council's EPPR Working Group, which facilitates exercises to test the agreement and guidelines.[39]

- *Near-Term Recommendation*
    - *Continue coordination through international fora to provide significant opportunities for engagement across the Federal Government and the international Arctic response community*

The interagency regularly engages with the Arctic Council, the IMO, and relevant working groups including the IMO's MEPC and Arctic Council's PAME Working Group. Engagement and collaboration will continue as appropriate, including continued coordination through EPPR and the Arctic Coast Guard Forum on joint drills and exercises for the Arctic Council binding agreements.

- *Near-Term Recommendation*
    - *Support Pan-Arctic response equipment database development, best practices recommendations, and information sharing for continued development of guidelines for oil spill response in the Arctic*

Under the U.S. chairmanship of the Arctic Council, BSEE co-funded a technical report, *Circumpolar Oil Spill Response Viability Analysis*, for Emergency Prevention, Preparedness,

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[36] Alaska Incident Management System Guide (AIMS) *For Oil and Hazardous Substance Response, Alaska Department of Environmental Conservation,* (November 2002). Available at: https://dec.alaska.gov/spar/ppr/docs/AIMS_Guide-Complete(Nov02).pdf as of December 2015.
[37] Operations, Logistics, and Coordination in an Arctic Oil Spill (2014). Transportation Research Board and National Research Council, Responding to Oil Spills in the U.S. Arctic Marine Environment. Washington, DC. The National Academies Press, doi: 10.17226/18625.
[38] Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic (2013). Available at: http://www.state.gov/r/pa/prs/ps/2013/05/209406.htm as of January 2016.
[39] Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, Arctic Council (Revision 1: January 28, 2014). Available at: http://arctic-council.org/eppr/wp-content/uploads/2014/03/NCR-5979727-v1-OPERATIONAL_GUIDELINES_ENGLISH_FINAL_WITH_UPDATE_PROCEDURES_NO_PHONE_NR.pdf as of January 2016.

and Response (EPPR).[40] BSEE also created the "Arctic Spill Response Database Query Tool" and supporting User Guide for EPPR.[41] Both projects were accepted by the Ministers in May 2017. Both projects are complete and available online through BSEE's website, as well as the Arctic Council's website. The Arctic Council's EPPR Working Group is now examining the proof of concept from the BSEE project to determine if a more robust system can be funded through international cooperation and maintained under real-time conditions. Proposals for a potential Phase 2 project were examined during the summer 2018 EPPR meeting.

Arctic ERMA also provides foundational datasets in support of oil spill response in the U.S. Arctic.[42]

- *Near-Term Recommendation*
    - *Evaluate facilities currently available on the North Slope for use as seasonal staging areas by those engaged in readiness exercises or research.*

In July 2017, USCG D17 participated in Operation Arctic Guardian, an oil spill response seminar, which brought together tribal, local, state, and industry groups together to discuss and exercise pollution response capabilities available on the North Slope of Alaska. In addition, USCG D17 Area Contingency Plan has sub-area plans/sections for the North Slope, included in which are an inventory of facilities, equipment inventories, and locations. USCG D17 has suggested that this information would be starting point for identifying staging areas critical for oil spill response and other emergency response operations.

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[40] Emergency Prevention, Preparedness, and Response. (2017) *Circumpolar Oil Spill Response Viability Analysis: Technical Report*. 134pp. Accessed from https://www.bsee.gov/sites/bsee.gov/files/2017-circumpolar-oil-spill-response-viability-analysis.pdf on October 4, 2018.

[41] Emergency Prevention, Preparedness, and Response. 2017. *Arctic Spill Response Database Query Tool, Version 1.03.* Accessed from https://oaarchive.arctic-council.org/handle/11374/1949 on October 4, 2018.

[42] Previously defined on p. 11 of this report.

Vessel Operations

Vessels are the mobile platforms necessary to move goods and people throughout the MTS. In the past, there has been limited vessel activity in the U.S Arctic. With the lengthening of the open-water season due to climate change and loss of sea ice, vessel activity has increased dramatically, as has the diversity of vessels operating in the region. A variety of vessel types operate in, or transit through, the U.S. Arctic annually, including the following:

- Commercial and oceangoing vessels
- Coastal and inland vessels
- Barge vessels
- Tug boats
- Towing vessels
- Bulk carrier ships
- Container ships
- Military vessels
- Fishing boats
- Marine mammal hunting craft
- Scientific research vessels
- Recreational boats
- Offshore structures

U.S. Icebreaking

The current Federal fleet of Polar icebreakers consists of one medium icebreaker, USCG Cutter (USCGC) Healy, and one heavy icebreaker, USCGC Polar Star. The Polar Star is the only active heavy icebreaker and is primarily used in the Antarctic. USCGC Healy is used primarily to support science missions in the Arctic, but may also be used to support other USCG statutory missions such as SAR or to provide persistent command and control capability, as required. It is important to note that capabilities of USCG icebreakers often far exceed minimum international standards for icebreaking vessels, such as International Association for Classification Societies. These standards identify minimum power and structural survivability requirements of a single purpose vessel operating in ice infested waters. Unlike commercial vessels that are built to perform single missions with minimal crews, USCG assets are multi-purpose vessels that incorporate aviation support, command and control, and additional power and endurance requirements necessary to perform all missions. USCG has assessed all available commercial icebreakers and has determined no currently operating vessel meets these critical mission and performance requirements for either a heavy or medium icebreaker, and as a result, acquisition of new assets is the only viable option for obtaining additional icebreaking capacity.

- *Near-Term Recommendation*
  - *Expand U.S. icebreaking capacity to adequately meet mission demands in the high latitudes.*

The USCG polar icebreaker program has received about $359.6 million in acquisition funding through FY2018, including $300 million provided through the Navy's shipbuilding account and $59.6 million provided through the Coast Guard's acquisition account. The USCG has stood up an Integrated Program Office (IPO) with the U.S. Navy to build the first three USCG heavy icebreakers, the first of which is expected to be delivered in 2023. Through the collaborative

IPO, the USCG is leveraging DOD's and the nation's collective shipbuilding expertise to deliver a fleet of highly capable icebreakers in the most cost-effective and timely manner possible. In March 2018, USCG and the US Navy released a Request for Proposals through the IPO for the advance procurement and detail design for a heavy polar ice breaker (HPIB), with options for detail design and construction for up to three HPIBs.[43] The IPO plans to award a detail design and construction contract in FY2019.

Waterway Usage Coordination

As more vessels transit U.S. Arctic waterways, planning, communication, and situational awareness will become more important to protect waterway users, the environment, and the people that live in the region. For example, subsistence-harvest activities use small vessels to access hunting grounds throughout the U.S. Arctic in and between coastal areas and islands. Though larger commercial vessels have the equipment and obligation to inform regional authorities of their plans, these smaller vessels are not bound by the same requirements. As such, maritime use and safety conflicts are serious issues for the region. The USCG Bering Strait Port Access Route Study (PARS) outlines initial steps for waterways management recommendations to facilitate possible channels of communication for small- and large-vessel operators.

The 2016 CMTS report recommended federal agencies continue their respective efforts to formalize communication channels among waterways users so that all parties using the regional resources are aware of activities that may create conflicts for voyage routes or whaling and fishing activities. Incorporating regional bodies, such as the Arctic Waterways Safety Committee, is critical to facilitate dialogue among communities and vessel operators to communicate voyage planning and waterways-use management, and to reduce conflicts that may arise from a crowded waterway during particularly sensitive times, such as marine mammal migrations and the whaling season.

This need for transparency among waterways users extends outside commercial and resource use vessels and includes activities from research vessels as well. Each summer, a number of research voyages transit the Arctic either pursuing science in U.S. waters or on routes through the region to other areas of interest. These research vessels provide a unique challenge because they, unlike commercial vessels, can spend extended periods of time within a limited area. This can create conflicts if research waters are also locations of traditional harvest or fishing for subsistence purposes. The extended presence of large research vessels creates a safety consideration for small vessels and may have consequences for marine mammal and bird populations competing for use of the same areas. The CMTS recommends the continuation of efforts to improve planning and transparency of research missions in order to include and

[43] Heavy Polar Icebreaker (HPIB) Detail Design and Construction Solicitation. Accessed from https://www.fbo.gov/index.php?s=opportunity&mode=form&id=8bfe58952dcb8836951b3b4d604520fc&tab=core&tabmode=list&= on October 23, 2018.

inform Arctic communities, fostering cooperative planning that would minimize disruptions to subsistence activities while promoting scientific research in the region.

- *Near-Term Recommendation*
  - *Finalize the Port Access Route Study for the Bering Strait and continue efforts to provide routes for vessel traffic in the U.S. Arctic*

The Bering Strait PARS was completed by the USCG in early 2017.[44,45] The PARS team is developing their work plan in close coordination with Canada Coast Guard counterparts for the North Slope PARS. A major objective is to focus on engagements with indigenous communities in both countries. The Arctic Waterways Safety Committee (AWSC) will also be consulted as a source of input into the PARS to ensure that all waterways user groups are represented.

In a joint submission, the U.S. and Russia proposed voluntary two-way routing measures in the Bering Strait and Bering Sea to the International Maritime Organization in November 2017, consisting of six two-way routes and six precautionary areas. Located in U.S. and Russian Federation territorial waters off the coasts of Alaska and the Chukotka Peninsula, the routes are being recommended to help ships avoid the numerous shoals, reefs and islands outside the routes and to reduce the potential for marine casualties and environmental disasters. This proposal was accepted at the May 2018 meeting of the IMO Maritime Safety Committee and are the first internationally recognized measure for navigation in polar waters approved by IMO. The approved voluntary routing measures for the Bering Sea will go into effect December 1, 2018.

The Human Element

On January 1, 2017, the International Code for Ships Operating in Polar Waters (Polar Code) entered into force to address the unique challenges posed by operations in Arctic waters. Specifically, the IMO developed training amendments to the Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) Convention, which were adopted in May 2016 and entered into force on January 1, 2018. The 2016 CMTS report noted the ongoing challenge to implement the Polar Code and harmonize the mandates of the Polar Code with existing U.S. legislation and regulatory requirements. As with other international regulations, the Coast Guard derives its regulatory authority through implementing acts such as the Act to Prevent Pollution from Ships (APPS, 33 U.S.C. §§1905-1915) which implements MARPOL through domestic Coast Guard regulations.

- *Near-Term Recommendation*

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[44] United States Coast Guard. (2016). *Preliminary Findings of Port Access Route Study: In the Chukchi Sea, Bering Strait, and Bering Sea*. Docket Number USCG-2014-0941 and USCG-2010-0833. Accessed from https://www.navcen.uscg.gov/pdf/PARS/Bering_Strait_PARS_General.pdf on October 4, 2018.

[45] United States Coast Guard. (2017). *Bering Strait Port Access Route Study Conclusions and Recommended Alternatives*. Accessed from https://www.navcen.uscg.gov/pdf/PARS/Bering_Strait_PARS_Conclusions.pdf on October 4, 2018.

- *Update domestic law to implement the mandatory provisions of the Polar Code and the STCW Convention.*

Regulatory amendments granting the USCG authority to issue Polar Ship Certificates and to designate that authority to authorized class societies entered into force on October 23, 2017. In late June 2018, the USCG published CG-MMC Policy Letter No. 02-18, "Guidelines for Qualifications of Personnel for Issuing STCW Endorsements for Basic and Advanced Polar Operations" in the Federal Register.[46] The policy is effective June 22, 2018, but the USCG requests public comments on it on or before September 20, 2018. To support this policy, the National Maritime Center posted a bulletin with further information, including guidance on obtaining endorsements from the USCG electronically.

Near-Term Recommendation

- *Examine existing training and safety standards applicable to the U.S. fishing fleet with respect to the new Polar Code requirements*

As of 2018, fishing vessels and vessels less than 500 GT are not subject to the regulations of the Polar Code. Further discussion at appropriate international fora (e.g. IMO) is required to move forward on this item.

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[46] CG-MMC Policy Letter No. 02-18. June 19, 2018. *Guidelines for Qualifications of Personnel for Issuing STCW Endorsements for Basic and Advanced Polar Code* Operations. Accessed from https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/5ps/MMC/CG-MMC-2%20Policies/2018%20CG-MMC%2002-18%20Polar%20Policy%20(June%2025.2018).pdf on October 15, 2018.

Appendices

Appendix A: List of Acronyms

AIS	Automatic Identification System
AMH	America's Marine Highway
AMSA	Arctic Marine Shipping Assessment
AOOS	Alaska Ocean Observing System
ARPA	Arctic Research and Policy Act
ASIP	Alaska Sea Ice Program
ASTD	Arctic Ship Traffic Data
ATON	Aids to Navigation
AWSC	Arctic Waterways Safety Committee
BSNC	Bering Strait Native Corporation
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CICE	Los Almos Sea Ice Model
CMTS	U.S. Committee on the Marine Transportation System
CORS	Continuously Operating Reference Stations (CORS)
DAC	Data Assembly Center
DOD	Department of Defense
EPA	Environmental Protection Agency
EPPR	Emergency Prevention, Preparedness, and Response Working Group
ERMA	Environmental Response Management Application
ESF	Emergency Support Function
FEMA	Federal Emergency Management Agency
GNSS	Global Navigation Satellite System
GOFS	Global Ocean Forecasting System
GPS	Global Positioning System
HSRP	Hydrographic Services Review Panel
IAT	Integrated Action Team
IHO	International Hydrographic Organization
IMO	International Maritime Organization
IPO	Integrated Program Office
ISOP	Improved Synthetic Ocean Profiles
JPSS	Joint Polar Satellite System
LOS	Line of Sight
MARAD	Maritime Administration
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environmental Protection Committee
MTS	Marine Transportation System
MXAK	Marine Exchange of Alaska
NDAA	National Defense Authorization Act

NGA	National Geospatial Intelligence Agency
NGS	National Geodetic Survey
NIC	National Ice Center
NMIO	National Maritime Intelligence-Integration Office
NOAA	National Oceanic and Atmospheric Administration
NSAR	National Strategy for the Arctic Region
NSF	National Science Foundation
NTM	Notice to Mariners
NWIS	National Water Information System
NWLON	National Water Level Observing Network
NWS	National Weather Service
OR&R	Office of Response and Restoration
OST	Office of the Secretary of Transportation
OSTP	Office of Science and Technology Policy
PAME	Protection of the Arctic Marine Environment Working Group
PARS	Port Access Route Study
Polar Code	International Code for Ships Operating
RRFP	Regional Reception Facilities Plan
SAR	Search and Rescue
SATCOM	Satellite communications
SOLAS	International Convention for the Safety of Life at Sea
State	U.S. Department of State
TPFDD	Time Phased Force Deployment Data
UAS	Unmanned aircraft system
UAV	Unmanned aerial vehicle
USACE	U.S. Army Corps of Engineers
USARC	U.S. Arctic Research Commission
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
USTRANSCOM	U.S. Transportation Command

Appendix B: 2018 Update of MTS Infrastructure in the Arctic

Purpose

The CMTS Arctic IAT's *U.S. MTS Arctic Infrastructure Table* enables a quick look at current conditions of CMTS agency infrastructure in the Arctic. The Arctic IAT has updated the table for 2018. Infrastructure is defined broadly to include the most essential physical and informational components of an MTS, from ports, vessels and emergency response capacities to nautical charts, tides and marine weather.

Background

The "Status of U.S. Arctic MTS Infrastructure" table was first published by the CMTS in the 2013 Report to the President on the *U.S. Arctic Marine Transportation System: Overview and Priorities for Action*. Since then, the Arctic IAT subsequently updated the table as part of the 2016 CMTS report, *A Ten-Year Prioritization of Infrastructure in the U.S. Arctic.* Understanding the status of Arctic MTS infrastructure is a critical step to supporting, enhancing, and ensuring the safety and reliability of the U.S. Arctic MTS.

MTS Components	MTS Element
Navigable Waterways	Places of Refuge for Ships
	Areas of Heightened Ecological Significance
Physical Infrastructure	Ports and Associated Facilities
	Geospatial Infrastructure
MTS Information Infrastructure	Hydrographic Surveys
	Shoreline Mapping
	Nautical Charts
	Aids to Navigation (ATON)
	Communications
	Marine Weather and Sea Ice Forecasts
	Real-Time Oceanographic Information
	U.S. Integrated Ocean Observing System/Alaska Ocean Observing System
	Automatic Identification System (AIS)
MTS Response Services	Federal Icebreaking and Emergency Response Assets
	Environmental Response Management
	Search & Rescue (SAR)/ Emergency Response
Vessels	Mandatory Polar Code/Voluntary Polar Guidelines
	Crew Standards/ Training

Table 2: *Outline of Current Status of MTS infrastructure in the Arctic.*

U.S. MTS Arctic Infrastructure Table		
MTS Component	**MTS Element**	**Current Status for the U.S. Arctic**
Navigable Waterways	Places of Refuge for Ships	Currently there is no official Maritime Place of Refuge in the U.S. Arctic.
		USCG-D17 has designated Port Clarence as a potential Port of Refuge in the Arctic, a formal declaration as an official Maritime Place of Refuge has yet to be determined
		State of Alaska has identified 13 sites along the North Slope as potential places of refuge.
		USACE has a project underway in St. George (in the Bering Sea) to provide safe, protected moorage for subsistence and few commercial fishing boats.
		Sufficient number of ports and natural harbors are available in the Aleutian Island Chain for refuge.
	Areas of Heightened Ecological Significance	There are currently three areas of heightened ecological significance identified: St. Lawrence Island, portions of the Bering Strait, and the Chukchi Beaufort Coast.
		The May 2015 Subarea Contingency Plan for the Aleutian Islands was completed by the Federal/State Alaska Regional Response Team, including maps specifying environmentally sensitive areas. Subarea Contingency plans for other Arctic areas are scheduled for cyclic updating: North Slope (2017), Northwest Alaska (2016), Western Alaska (2018) and Bristol Bay (2018).
		Biological Important Areas for Cetaceans have been developed for Gulf of Alaska, Aleutian Island and Bering Sea Region, and the Arctic Region.

U.S. MTS Arctic Infrastructure Table		
MTS Component	**MTS Element**	**Current Status for the U.S. Arctic**
Physical Infrastructure	Ports and Associated Facilities	Ten U.S. port facilities exist south of the Bering Strait: Port of Nome, St. Michael Harbor, Port of Bethel, St. Paul, St. George, Dillingham, Port of Bristol Bay, Dutch Harbor/Unalaska, Adak, and King Cove.
		The U.S. Army Corps of Engineers – Alaska District entered an agreement with the City of Nome in February 2018 to examine the feasibility of constructing navigation improvements at the Port of Nome. The feasibility study will examine an array of benefits, including Nome's role as a regional hub for surrounding communities that rely on fuel and goods. The budget, schedule, and scope of the study were discussed at a planning charrette held in Nome in April, 2018.
		One U.S. port facility exists north of the Bering Strait: Port of Kotzebue
		As of summer 2018, USACE has a project to deepen the entrance of the Dutch Harbor Channel.
	Geospatial Infrastructure	There are 10 operational National Oceanic and Atmospheric Administration (NOAA) Continuously Operating Reference Stations (CORS) Network sites along the Aleutian Chain; 15 CORS Network sites along the Arctic coastal areas of the Bering and Chukchi Sea; and 4 CORS Network sites on the North Slope in Arctic coastal areas along the Beaufort Sea.
		NOAA is collecting airborne gravity data through the GRAV-D Initiative, providing critical data to inform nautical charts; in FY 2018, NOAA expects to have 95% coverage of Alaska (excluding the Aleutian Islands) and complete coverage by the end of 2020.

U.S. MTS Arctic Infrastructure Table		
MTS Component	**MTS Element**	**Current Status for the U.S. Arctic**
MTS Information Infrastructure	Hydrographic Surveys	6,084 square nautical miles (nm^2) surveyed of 38,000 nm^2 of Arctic waters identified by NOAA as highest priority navigationally significant Arctic waters (out of 242,400 nm^2 navigationally significant) to survey for nautical charts, maritime commerce, and coastal resilience.
		NOAA has two 50-year-old ice strengthened hydrographic survey vessels, *Rainier* and *Fairweather* that can operate in U.S. Arctic waters during the summer season.
	Shoreline Mapping	Of the 33,900 official shoreline miles of Arctic Alaskan coastline (measured by NOAA from 1:80,000 scale), only 12,882 of which have been mapped since 1988 using contemporary methods.
	Nautical Charts	124 NOAA Electronic Navigational Charts and 106 traditional raster charts, with a minimum of 11 new charts needed based on annual assessment of stakeholder needs
	Aids to Navigation (ATON)	262 ATONs located throughout the Bering Sea and Aleutian Islands as of July 2018.
		Eight ATONs, mostly in Kotzebue Sound.
		Nine privately maintained aids along the North Coast (near oil and gas facilities at Prudhoe Bay).
		Six AIS ATON transceivers (Dutch Harbor, Wales, Barrow, and Prudhoe Bay).
		Two AIS ATON transceivers installed in 2017 (Nome and Akun Island).
	Communications	Line of Sight (LOS) and satellite communications (SATCOM) architecture is sufficient to support voice and data communication needs in the Bering Sea.
		There is limited LOS communications above 65°N.
		There is limited SATCOM above 70°N.
	Marine Weather and Sea Ice Forecasts	The NOAA NWS Alaska Sea Ice Program provides a 5-day sea ice forecast every Monday, Wednesday, and Friday throughout the year in both a text and graphical format. The sea ice forecasts focus on changes to the main ice pack, marginal ice zone, shore-fast ice, and sea ice free waters

MTS Information Infrastructure	Marine Weather and Sea Ice Forecasts *(continued)*	NWS operates three Weather Forecast Offices (WFOs) in Anchorage, Fairbanks, and Juneau, which operate 24 hours/day, 7 days/week, 365 days/year. The WFOs produce daily wind, wave, freezing spray, and swell (both direction and height) forecasts in support of marine activities. The forecasts are available in text and graphical formats.
		NOAA's National Centers for Environmental Prediction provides forecast guidance from operational atmosphere, ocean, and wave model four times daily. NCEP also provides forecast guidance for sea ice motion, daily to day 16. The global operational Real Time Ocean Forecast System is run once per day. The National Ice Center (NIC) provides year-round Arctic-wide sea ice analysis, seasonal sea ice outlooks, and special product support for USCG vessels operating near or within the sea ice.
		The U.S. Navy operational Arctic Cap Nowcast/Forecast System, transitioning to their Global Ocean Forecast System v3.1, provides 17 day forecasts of Arctic ice concentration, ice thickness, ice velocity, sea surface temperature, sea surface salinity, and sea surface velocities used operationally by the NIC.
	Real-Time Oceanographic Information	10 NOAA National Water Level Observation Network (NWLON) tidal stations in the Arctic, located at Unalaska, Nikolski, Atka, Adak, Port Moller, Village Cove, Nome, Red Dog, Prudhoe Bay, and at Unalakleet, which was added in May 2018; 20 additional gaps identified through analysis and stakeholder engagement
	U.S. Integrated Ocean Observing System/Alaska Ocean Observing System	Three long-range High Frequency radar stations at Wainwright, Point Barrow, and Cape Simpson; gap of 10 more identified by AOOS analysis of stakeholder needs for navigation
	Automatic Identification System (AIS)	130 land-based AIS receiving stations operated by the Marine Exchange of Alaska, most of which are located in Southeast AK and the Gulf of Alaska, 40 are located in the Bering Sea region, 18 are located in the Bering Strait and north.
		Six AIS ATON transceivers (Dutch Harbor, Wales, Barrow, and Prudhoe Bay).
		Two AIS ATON transceivers installed in 2017 (Nome and Akun Island).

U.S. MTS Arctic Infrastructure Table		
MTS Components	**MTS Element**	**Current Status for the U.S. Arctic**
MTS Response Services	Federal Icebreaking and Emergency Response Assets	USCG vessels are used to support and facilitate the execution of national missions in the Arctic, which include enhancing marine domain awareness, national security, and emergency response (SAR, Oil Spill Federal On Scene Coordinator, etc.), in addition to Arctic science operations when needed.
		USCGC Polar Star – Heavy Icebreaker (60,000 HP); Commissioned in 1978 and currently used in the Antarctic
		USCGC Healy – Medium Icebreaker (30,000 HP); Commissioned in 2000 and currently the primary icebreaker used in the Arctic
		FY2017 and FY2018 Congressional appropriations included a total of $300 million towards polar icebreaker acquisition; President's Budget for FY2019 requests $750 million to construction of new, heavy polar icebreaker.
		Nathaniel B. Palmer – National Science Foundation leased science-support vessel (Light Icebreaker 12,720 HP), currently used to support science missions to the Antarctic.
		USCG vessels and aircraft have historically operated in the Bering Sea year-round. Operation Arctic Shield extends operational area farther north during ice-free months (summer and early fall).
	Environmental Response Management	All federally-permitted oil and gas activities require operators to have approved oil spill contingency plans, which includes tank and non-tank vessel response plans requiring owner/operators to maintain oil spill response equipment and trained personnel both onsite and able to respond within specified timeframes based upon their operating environment and proximity to land.
		The USCG has issued regulations for commercial non-tank vessels that are greater than 400 gross tons, regardless of participation in oil and gas activities, to enroll with Alternative Planning Criteria (APC) providers.
		Oil Spill Removal organizations (pollution response contractors) capable of responding to a pollution event are located in Dutch Harbor, Kodiak, and Deadhorse (near Prudhoe Bay).

MTS Response Services	Environmental Response Management (*continued*)	Some Oil Spill Response Organizations that service the North Slope, Western Alaska, and the Aleutian Islands have only a little or no open-ocean capability, very limited wildlife response equipment, and limited experience responding to Arctic spills.
		Aerial Dispersant Delivery System (ADDS) staged in Anchorage
		US Navy spill response equipment (SUPSALV) staged in Anchorage
		State of Alaska has seven response equipment sites south of the Bering Strait (Nome, Unalakleet, Toksook Bay, Bethel, Dillingham, King Cove, and Dutch Harbor) and one north in Kotzebue. Two Emergency Towing Systems (ETS), located at Dutch Harbor and Cold Bay
		USCG District 17 maintains four Spilled Oil Recovery Systems (SORS) equipped on 225' buoy tenders homeported in Alaska (*Spar*, *Maple*, *Sycamore*, and *Hickory*), and one Vessel of Opportunity Skimming System (VOSS) split between Anchorage and Ketchikan.
		USCG District 17 maintains 51 caches of Coast Guard-owned response equipment in 18 cities/ villages throughout Alaska. Ten of these caches are in C-130 compatible containers, located near Anchorage, for deployment to Arctic locations. In addition, three of the caches are located in the Alaskan Arctic towns of St. Paul, Unalaska, and King Cove.
		Arctic Environmental Response Management Application (ERMA) GIS for common operating picture in event of incident (web version and stand-alone version)
		As part of the Emergency Prevention, Preparedness, and Response (EPPR) Workgroup of the Arctic Council, BSEE funded and created an Arctic Spill Response Database and accompanying User Guide.
	Search & Rescue (SAR)/ Emergency Response	Limited SAR infrastructure and air support in the region
		The National Weather Service is available 24/7 to provide informational support for marine, aviation, and land SAR/Emergency response in the Alaska Arctic
		USCG forward deploys surface and aviation assets to Arctic regions based on activity levels (commonly highest during the summer season)
		The nearest USCG air station is in Kodiak, 820 nautical miles from Point Barrow (northernmost point of land)
		The 11th Air Force has three rescue squadrons capable of providing refuellable H60s, C130s, and para-rescuemen throughout Alaska

MTS Response Services	Search & Rescue (SAR)/ Emergency Response (*continued*)	The closest refueling site to Alaska's North Slope for vessels is Dutch Harbor, which is 1,000 nm away
		USCG currently forward deploys helicopters from Air Station Kodiak to Cold Bay, and to St. Paul Island, in support of the red king crab and opilio crab fisheries, respectively, to ensure adequate SAR response
		USCG maintains seasonal forward operating locations for H60 helicopters in the Arctic as part of U.S. Arctic Shield. These seasonal forward operating locations have included: Barrow in 2014, Deadhorse in 2015, and Kotzebue in 2016-2018.
		NOAA Search and Rescue Satellite Aided Tracking satellites relaying distress signals from emergency beacon contributions appear satisfactory
		The North Slope Borough Search and Rescue Department has a Critical Care Air Ambulance Service performing medevac, SAR and emergency missions throughout the North Slope Region
		All Federally-permitted oil and gas activities require operators to have approved contingency plans and maintain capabilities for emergency response, including SAR

U.S. MTS Arctic Infrastructure Table		
MTS Components	**MTS Element**	**Current Status for the U.S. Arctic**
Vessels	Mandatory Polar Code/Voluntary Polar Guidelines	International Maritime Organization (IMO) has adopted an International Code for Ships Operating in Polar Waters (Polar Code) that includes mandatory and voluntary provisions which entered into force January 1, 2017 through amendments to the International Convention for the Safety of Life at Sea (SOLAS) and the International Convention for the Prevention of Pollution from Ships (MARPOL).
		The Polar Code builds upon previous IMO recommended guidelines including “Guidelines for ships operating in Arctic ice-covered waters” (2002) and “Polar Waters” (2009) which are available for vessels not subject to the Polar Code.
		The International Standards Organization Technical Committee 67 has developed design and materials standards for offshore oil and gas structures in ice-covered waters.
		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, 2017
	Crew Standards/ Training	Crew standards and training are found in the IMO’s International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW).
		The United States has worked closely with U.S. industry through the Merchant Marine Personnel Advisory Committee and with other IMO Member States to develop amendments to the STCW that provide for a standardized training regime for personnel employed on vessels subject to the Polar Code. These amendments were adopted in May 2016 and entered into force on July 1, 2018.
		USCG promulgated an interim policy letter in 2016 and plans to promulgate regulations in the future to implement these STCW amendments into the U.S. domestic credentialing regime, publication of which is pending on analysis of how expanding regulations comports with new Executive Orders on regulatory reform.
		As of 2018, fishing vessels, fixed offshore features, and vessels less than 500 GT are not subject to the environmental regulations or STCW elements included in the Polar Code.