U.S. Arctic MTS Infrastructure Table: 2021 Update

April, 2021

Maritime activity in the U.S. Arctic continues to grow, making it necessary to understand the current state of infrastructure that supports the marine transportation system (MTS) in the region. Though the Arctic – and many who operate there – is inherently international, this table focuses on MTS infrastructure in the U.S. Arctic. The table enables a quick look at the MTS components. 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. Understanding the status of Arctic marine transportation infrastructure is a critical step to supporting, enhancing, and ensuring the safety and reliability of the U.S. Arctic MTS.

The U.S. Arctic MTS Infrastructure Table first appeared in the 2013 report, *U.S. Arctic Marine Transportation System: Overview and Priorities for Action*. It has been updated twice: first, in the 2016 report, *A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic*, and most recently in November 2018 as an Appendix of the *Revisiting Near-Term Recommendations to Prioritize Infrastructure Needs in the U.S. Arctic* report. This iteration includes more than 40 substantial updates, changes, and additions to the table. While these updates represent progress toward increasing the safety and security of Arctic shipping, significant opportunities remain to provide adequate safety, commercial and environmental infrastructure protection to the US Arctic MTS. The infrastructure table is categorized in the following manner:

MTS Component	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) & Automatic Identification System (AIS)
	Communications
	Marine Weather and Sea Ice Forecasts
	Real-Time Oceanographic Information
	VDatum
	Shore-based Radar
MTS Governance & Response Services	*Federal Icebreaking and Emergency Response Assets*
	Environmental Response Management
	Search & Rescue (SAR)/Emergency Response
Vessel Operations	*Mandatory Polar Code/ Guidelines*
	Crew Standards/Training

U.S. Arctic MTS Infrastructure Table

MTS Component	MTS Element	Current Status
Navigable Waterways	*Places of Refuge for Ships*	Currently there is no official Maritime Place of Refuge in the U.S. Arctic. The Alaska Regional Contingency Plan contains pre-identified, but not pre-approved Potential Places of Refuge (PPOR) and guidance for emergency designation of Places of Refuge.
		Although 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) that is designed to provide safer navigation for subsistence vessels, fuel barges, cargo vessels, and a limited commercial fleet. The St. George Harbor Improvement Chief's Report was signed in August 2020.
		There are a number of ports and natural harbors in the Aleutian Island Chain available for refuge for vessels operating in that area.
	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 2020 Arctic & Western Area Contingency Plan contains a comprehensive Alaska Sensitive Areas Compendium and Geographic Response Strategies (both with maps) to quickly identify and effectively respond to pre-prioritized areas with proven response tactics.
		Biological Important Areas for Cetaceans have been developed for Gulf of Alaska, Aleutian Island and Bering Sea Region, and the Arctic Region.
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, with the larger ports providing reception facilities for vessels' oily wastes and garbage.
		In May 2020, the Chief's Report for the Port of Nome Modification Feasibility Study was signed, furthering the plan to expand the Port of Nome and make it a deep-water port. A total of $2.7M was received in FY21 to initiate the preconstruction, engineering, and design phase. The current plan calls for expanding the length of the port's existing west causeway to reach approximately 2,100 feet farther into Norton Sound with a nearly 1,400-foot breakwater. The L-shaped barrier would also hold two new 450-foot and one new 600-foot dock. The existing east causeway-breakwater would be demolished and replaced with a larger, 3,900-foot causeway-breakwater. The bigger outer port basin would also be dredged deeper — from 22 feet currently to 28 feet — and the three new docks would be near the end of the longer west causeway-breakwater in an area dredged to at least 40 feet deep.
		One U.S. port facility exists north of the Bering Strait: Port of Kotzebue. The Kotzebue Port operates during sea ice free conditions and can receive shallow draft vessels and barges.
		USACE has a proposed project to deepen the entrance of the Dutch Harbor Channel. The final feasibility study recommends deepening the existing bar to -58 feet providing one-way access for ships with a draft up to 44 feet.
		The Little Diomede Feasibility Study was completed in 2014, and the project was authorized in 2016. Little Diomede was the first to use the Remote and Subsistence Authority to justify the project. However, the project has not yet received funds for the Preconstruction, Engineering and Design Phase.

Physical Infrastructure	***Geospatial Infrastructure***	NOAA is establishing a network of Foundation Continuously Operating Reference Stations (CORS) throughout the Nation to provide alignment between the National Spatial Reference System and the International Terrestrial Reference Frame. NOAA has a goal to establish 5 Foundation CORS in Alaska. 1 of these 5 Foundation CORS in AK has been established to date.
		NOAA is collecting airborne gravity data through the GRAV-D Initiative, providing critical data to inform nautical charts, topographic mapping, inundation modeling, and many applications requiring accurate elevation data; Pending aircraft access and budget, complete remaining areas of GRAV-D project over the Aleutians in FY21 and FY22 for 100% Alaska coverage, with incorporation into a gravimetric geoid model by FY24.
		In cooperation with the International Hydrographic Organization's (IHO) Arctic Member States, NGA is leading an effort to incorporate Arctic Voyage Planning Guide (AVPG) themes and related data into a geospatial portal as part of a web-based AVPG. The group is currently assessing common datasets and web services available for use in the guide.
		Leveraging space-borne Automatic Identification Systems (AIS), NGA is developing a Global Maritime Traffic Density Service (GMTDS) to support hydrographic risk assessments at regional and global scales. The aim of the project is to make 1-kilometer monthly raster grids of historical maritime traffic accessible via web-map services such as the International Hydrographic Organization's (IHO) INToGIS website. The GMTDS product will soon be available at https://nga.maps.arcgis.com/home/index.html.
		NGA supports humanitarian and disaster response for natural or manmade disasters through publicly accessible web mapping applications. These sites provide consolidated tools and situational awareness to assist in understanding the extent of damage caused by natural disasters and essential information to protect and secure lives and infrastructure. Damage and flood assessments include current information about road closures, damaged structures and bridges, landslides, potential locations for helicopter landing zones, and additional information used in response and recovery efforts.
		ArcticDEM is an NGA-NSF public-private initiative to automatically produce a high-resolution, high quality, digital surface model (DSM) of the Arctic using optical stereo imagery, high-performance computing, and open source photogrammetry software.
MTS Information Infrastructure	***Hydrographic Surveys***	U.S. Arctic waters, as defined by ARPA, encompass approximately 583,600 square nautical miles (SNM), of which 50 SNM are characterized as top seaports and other highly trafficked shallow water areas, 5,225 SNM are characterized as less trafficked, shallow waters, and the remaining 578.375 SNM are characterized as deeper waters. When the quality of existing data is compared to quality of data necessary to support current surface navigation, 0% of the top seaports and highly trafficked shallow waters are adequately surveyed, 3% of the less trafficked shallow water areas are adequately surveyed, and 59% of the deeper water areas are adequately surveyed.
		The Alaska Ocean Observing System (AOOS) and the State of Alaska have purchased two single beam "hydroballs" to conduct bathymetric surveys of coastal nearshore and river mouths. A hydroball is an integrated bathymetric survey tool, which is lightweight, portable, streamlined, and easy to use.
		NOAA has two ice-strengthened hydrographic survey vessels, *Rainier* and *Fairweather*, that traditionally operate in Alaskan/U.S. Arctic waters during the summer season. At 53 years of age, these vessels have numerous systems no longer supported with spare or replacement parts, among other age-related modernization issues.

MTS Information Infrastructure	***Shoreline Mapping***	NOAA has mapped 56% of the shoreline in AK (35.3% has been used to update NOAA nautical charts), supporting the 2020 Alaska Coastal Mapping Strategy and many requirements for coastal mapping data.
	Nautical Charts	NOAA currently has 421 electronic navigational chart (ENC) cells in Alaska. The plan to rescheme ENCs will result in 1817 new ENC cells as the existing cells are replaced and retired. The effort to rescheme started in 2020 and 141 ENC new cells covering AK have been created and made public thus far. The effort is expected to be completed in 2025.
	Aids to Navigation (ATON) & Automatic Identification Systems (AIS)	263 ATONs are located throughout the Bering Sea and Aleutian Islands as of July 2018.
		Eight ATONs exist north of the Bering Strait, 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, Utqiagvik (Barrow), and Prudhoe Bay).
		Two AIS ATON transceivers installed in 2017 (Nome and Akun Island).
		131 land-based AIS receiving stations operated by the Marine Exchange of Alaska (MXAK), 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.
	Communications	Line of Sight (LOS) and satellite communications (SATCOM) architecture is sufficient to support voice and data communication needs in the Bering Sea. However, there is limited LOS communications above 65°N and limited SATCOM above 70°N.
		As of January 2019, Iridium completed the deployment of its new generation of satellites, Iridium NEXT, which included 75 new polar-orbiting satellites. In 2020, Iridium started integrating into the Global Maritime Distress and Safety System (GMDSS) as the second satellite communications services provider for GMDSS.
MTS Information Infrastructure	***Marine Weather and Sea Ice Forecasts***	The NOAA National Weather Service (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. They also issue a 3-month sea ice outlook at the end of each month focused on timing of freeze up and break up for Alaska waters in a text format.
		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 (NCEP) 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 model guidance from NCEP is limited in forecasting applications due to the discontinuity of ice analysis and initial ice conditions at analysis time. The model biases or inaccuracies make it difficult to rely on for ice forecasting. the ice charting is labor intensive and needs additional efforts to reduce production time. This has the impact of reducing the frequency of charting and reduce time for ice forecasting. Additionally, Arctic Observations from Satellites and in-situ measurements need improvement to provide consistent and reliable coverage.

MTS Information Infrastructure	***Marine Weather and Sea Ice Forecasts***	The U.S. Navy operational Arctic Cap Nowcast/Forecast System, transitioning to its 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.
		AOOS and Marine Exchange of Alaska (MXAK) have added 11 weather stations (with 2 more planned) to land-based AIS sites to relay real time weather conditions to enhance weather observations for mariners in local areas.
		AOOS and MXAK, in collaboration with Port of Nome, have deployed a season wave buoy outside the port and are working at deploying a current meter to provide real-time conditions for vessels entering and exiting the port.
	Real-Time Oceanographic Information	There are 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 Unalakleet; 21 additional gaps identified through analysis and stakeholder engagement.
		NOAA operates models in the Arctic (e.g., Extratropical Surge and Tide Operational Forecast System –ESTOFS and GNOME, the NOAA spill transport-fate model) that with enhancements could bring improved NOAA forecast services to Alaska by increasing community engagement and developing better tools based on existing observations and models.
	VDatum	NOAA's National Vertical Datum Transformation (VDatum) tool has tidal datum coverage in SE Alaska, but the remaining areas of the state lack this coverage. VDatum enables the conversion of diverse geospatial data (including hydrography, bathymetry, shorelines) that may be on different horizontal and vertical references into a consistent and common framework. The tool removes one of the most serious impediments to data integration, allowing enhanced interoperability between the maritime- and land-based components of national spatial data infrastructures. VDatum relies on Foundational Geodetic (CORS and GNSS observations on tidal benchmarks) and water level observations to improve transformational components and uncertainties.
MTS Information Infrastructure	***Shore-based Radar***	The U.S. Integrated Ocean Observing System/Alaska Ocean Observing System operate and maintain three long-range High Frequency radar stations at Wainwright, Point Barrow, and Cape Simpson. Three additional radars are being deployed in the Bering Strait region, with test sites at Shishmaref, Wales, and one additional location still to be determined. A gap of four more identified by AOOS analysis of stakeholder needs for navigation for eastern Beaufort and Unimak Pass in the Aleutians.
MTS Governance & Response Services	***Federal Icebreaking and Emergency Response Assets***	The USCG cutters execute USCG statutory missions and support the execution of national missions. This includes upholding U.S. sovereignty and international rule of law, emergency response, naval/military operations, aids to navigation, marine safety, and research/science support.
		USCGC Polar Star – Heavy Icebreaker (60,000 HP); Commissioned in 1978 and primarily used in the Antarctic.
		USCGC Healy – Medium Icebreaker (30,000 HP); Commissioned in 2000 and currently the primary icebreaker used in the Arctic.
		The USCG has three multi-mission, ice-strengthened buoy tenders in Alaska that conduct maritime law enforcement, homeland security, and defense operations, as well as provide search and rescue assistance should the need arise
		In FY19 the U.S. Navy and USCG awarded a contract for the detail design and construction of the Polar Security Cutter (PSC), a new national heavy polar icebreaker. The initial award included non-recurring engineering, detail design and construction of the lead PSC, and options for the construction of two additional PSCs. Construction of the lead PSC is scheduled to begin in 2021, with delivery scheduled for 2024. The President's Budget for FY2021 requests $515 million to fully fund construction of the 2nd PSC.

MTS Governance & Response Services	***Federal Icebreaking and Emergency Response Assets***	*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 periods of increased maritime activity and national security risks.
	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).
		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.
		U.S. 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 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.
		NOAA maintains the Arctic Environmental Response Management Application (ERMA) GIS for common operating picture in event of incident (web version and stand-alone version). Environmental Sensitivity Index Maps and digital products are also available for Alaska emergency responders and contingency planners but many regions are in need of updates.
MTS Governance & Response Services		NOAA staffs a Scientific Support Coordinator for Alaska/Arctic Region.
	Environmental Response Management	Under its Humanitarian Assistance and Disaster Relief (HADR) mission, NGA provides access and coordination for new geospatial information requests globally and arctic-wide (w/in but not just U.S. areas) with the lead federal agency overseeing the government response. NGA may support many agencies that lead under the HADR framework.
		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. The multilateral Arctic Council Marine Oil Spill Pollution Response Agreement (MOSPA) and the bilateral Russia - U.S. Joint Contingency Plan for Maritime Pollution Response in the Arctic are also relevant environmental management tools.
		U.S. Government response in the U.S. Arctic is constrained by the region's limited infrastructure. The size of the response area, the environmental changes occurring in the region, and the evolving types/location/timeframe of human

MTS Governance & Response Services	***Search & Rescue (SAR)/Emergency Response***	activity challenge the types, timeframe, location, and physical development of infrastructure.
		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 USCG air station in Kodiak supports all USCG aviation operations in Alaska. Note that it is 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 pararescuemen throughout Alaska.
		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 provide SAR response.
		USCG maintains seasonal forward operating locations for H60 helicopters in the Arctic as part of Operation Arctic Shield. These seasonal forward operating locations have included: Utqiagvik (Barrow) in 2014, Deadhorse in 2015, and Kotzebue from 2016-2020.
		NOAA Search and Rescue Satellite Aided Tracking satellites relay distress signals from emergency beacons; with our international partners within the International Cospas-Sarsat Programme, 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.
		The AOOS High Frequency Radar data is incorporated into the U.S. Coast Guard's Search and Rescue (SAR) model.
		All Federally-permitted oil and gas activities require operators to have approved contingency plans and maintain capabilities for emergency response, including SAR.
Vessel Operations	***Mandatory Polar Code/ 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), the International Convention for the Prevention of Pollution from Ships (MARPOL). The Standards of Training, Certification and Watchkeeping Convention (STCW) came into force 1 July 2018.
		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, 2018.
		In 2020, IMO's Sub-Committee on Pollution Prevention and Response agreed draft amendments to MARPOL Annex I (addition of a new regulation 43A) to introduce a prohibition on the use and carriage for use as fuel of heavy fuel oil (HFO) by ships in Arctic waters on and after 1 July 2024. The amendments will need to be approved by the Marine Environment Protection Committee.
	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).

Vessel Operations	***Crew Standards/Training***	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.