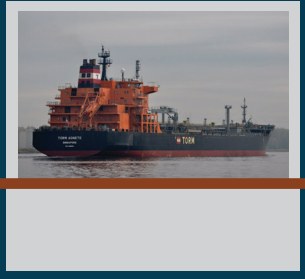
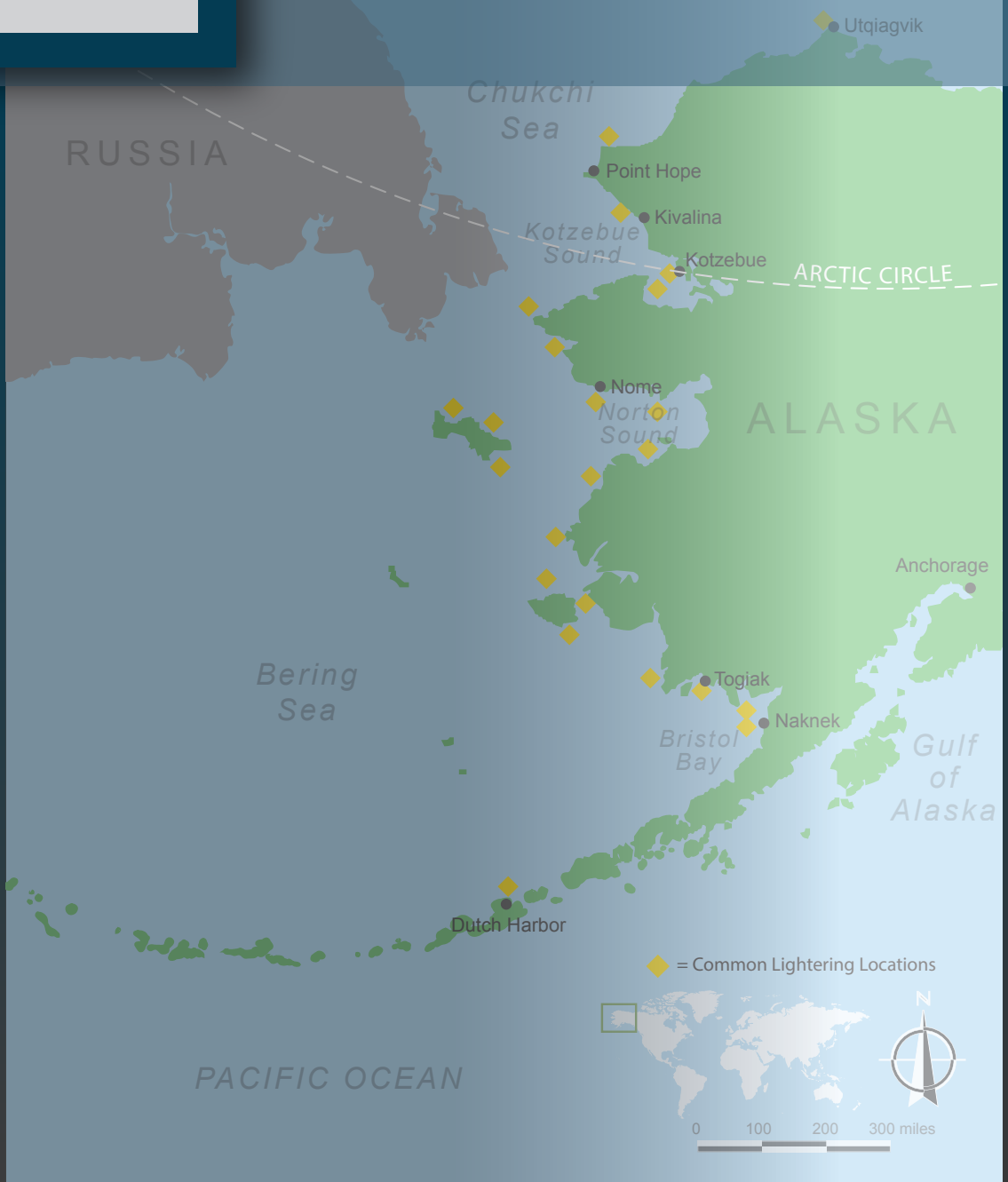
OVERVIEW of Tanker Lightering in ARCTIC ALASKA

FEBRUARY 27, 2019





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We have not attributed all comments at the request of those interviewed. Some interviewees preferred to provide information on background only without being identified. The fact that someone provided information does not indicate their endorsement of the report contents overall, nor the recommendations included in the report.

The companies chartering the tankers in Arctic Alaska that are the focus of this report all have a demonstrated commitment and track record for safe maritime operations and are delivering a vital service to communities and industry in the region. Nothing in this report is intended to imply otherwise. Recommendations proposed for consideration here are intended to enhance that level of safety for the protection of the marine environment and those who depend on it.

This report was funded by the Gordon and Betty Moore Foundation.

Photo used on cover, this page, title page, and back cover: The Torm Agnete is an example of a 600-foot long tanker that has delivered fuel to Arctic Alaska. It has a cargo capacity of 367,000 bbl. This size tanker commonly lighters outside state waters. (Photo by Marcel Coster; used with permission.)

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EXECUTIVE SUMMARY

Ocean Conservancy contracted Nuka Research to provide an overview of tanker lightering activity in Arctic Alaska and applicable regulations. This report also discusses risk mitigation measures applied in other parts of the country and recommends some which may be fruitful for consideration in Arctic Alaska. This report provides an introduction to these topics and does not constitute any type of risk assessment.

The most common means of delivering fuel to Arctic Alaska communities and local industry is via the sea. Most ports in the region are too small or shallow to take even a small tanker, and some communities have no port at all but are served by barges that navigate up rivers to land on shore. Deliveries can only happen during the ice-free months, which vary throughout the region but generally mean that a year's worth of fuel supplies must be provided between the months of May to September. These factors combined with the use of specialized equipment that can only be used for part of the year all contribute to the widely recognized high cost of fuel across the region.

In the past, barges of various sizes provided the bulk of the fuel deliveries, bringing gasoline, jet fuel, diesel, and other non-persistent oil products to Arctic Alaska communities from refineries in Alaska or Washington. Beginning around 2012, the practice began to shift to the use of tankers which bring product from East Asian refineries and may spend weeks or months transferring their much larger cargo off to barges for local deliveries. The tankers are typically foreign-flagged ships with a fuel capacity of around 300,000 bbl, mostly staying outside the 3-nautical mile boundary of state waters. This shift in practice does not mean that a larger volume of fuel is being delivered to the region, just that larger volumes are moved at one time.

Both the tanker operations and the actual transfers – commonly referred to as lightering – are subject to federal regulations and international norms. When they do occur in state waters, which happens in some cases, they are also subject to State of Alaska spill prevention and response planning requirements. When navigating certain waters, the tankers are required to have a state-licensed marine pilot on board. Tanker operators also apply their own maritime experience and knowledge of the region to determine the safest locations for lightering and routes between those locations. While there are some frequently used areas, there is no requirement that lightering be conducted in a particular location.

To date, there have been no recorded spills from lightering operations or the tankers involved. Community members point out that there are cases of observed sheens and oiled wildlife that remain unexplained. This does not necessarily mean that the oil came from fuel delivery operations. There are, however, some potential risk mitigation options that may be considered for application in the region. Drawing from examples in other locations, options for consideration by local mariners and communities relate to the sharing of information, identification of best practices, consideration of the suitability of the response equipment available on-scene during offshore transfers, enhancements to planning, and focused exercises and drills.

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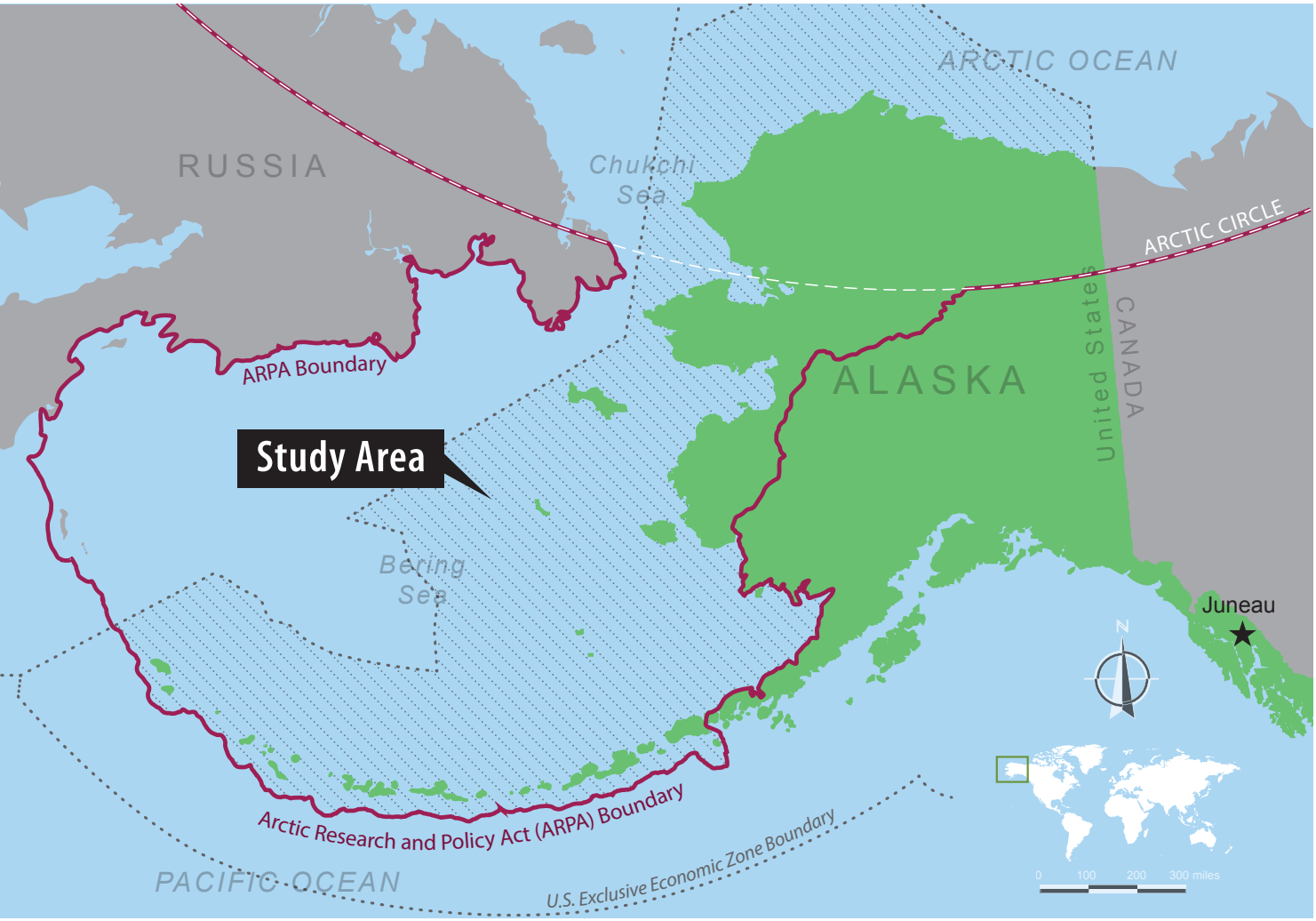


Figure 1. Geographic scope of study based in 1984 Arctic Research and Policy Act definition of "Arctic"

1. INTRODUCTION

Nuka Research and Planning Group, LLC developed this report for Ocean Conservancy to provide a general description of the tanker lightering operations conducted in Arctic Alaska, the applicable state and federal regulations, and risk mitigation procedures applied in Alaska and elsewhere. The report concludes with recommendations for consideration by the parties involved in lightering in Arctic Alaska.

This is a qualitative study that introduces the lay reader to the topics discussed. It is not a quantitative risk assessment of the practice of lightering or movement of tankers through the geographical area of focus.

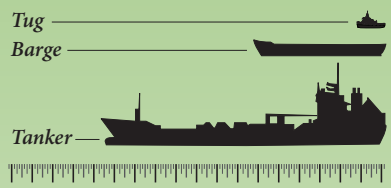
Geographic Scope

This study focuses on the U.S. waters included in the definitions of the "Arctic" defined in the Arctic Research and Policy Act of 1984 and depicted in Figure 1. This includes the U.S. waters in the Arctic Ocean; the Beaufort, Chukchi, and Bering Seas; and the Aleutian Island chain.

With respect to areas used in government oil spill response planning, the study area is within the Arctic and Western Alaska area.

Terminology

Lightering as discussed in this report is the process of transferring petroleum cargo from one vessel to another. Cargo transfers are sometimes used to offload oil from a large tanker to reduce its draft before it approaches a port (as in San Francisco; SF HSC, 2017) – essentially "lightening" or "lightering" the ship. However, in this case, we are focused on the transfer of petroleum cargo from tankers to barges for delivery. As described in Section 2, for larger vessels this process is called "ship to ship transfer" (STS) in regulations, or ship-to-barge (STB), though we found "lightering" to be commonly used for the practice discussed in this report. If a ship has grounded or is otherwise in jeopardy, emergency lightering may be used to minimize the potential release of oil to the environment. While this has been done in Alaska in the past, including the Exxon Valdez in 1989 (NTSB, 1990) and Selendang Ayu in 2005 (Unified Command, 2005), emergency lightering has many different logistics, constraints, and regulations, and is not the type of lightering considered in this study.



The tankers used in Arctic Alaska generally range from around 300 - 600-feet long. Barges vary widely in size depending on where they are designed to travel, but those active in the ocean (as opposed to rivers) are approximately 100-300 feet. However, there are outliers in each category and the largest barges may carry more fuel than the smallest tankers.

2. BACKGROUND ON FUEL DELIVERY IN ARCTIC ALASKA

Fuel is critical to community economies in general and in particular to the ability of people to meet their most basic needs as they fuel vehicles, snow machines, or boats, skiffs, and other watercraft for hunting, fishing, and other subsistence activities, along with heating and electricity generation for homes, businesses, schools, hospitals, and other community facilities. Fuel delivery by air is rare as it is prohibitively expensive, so almost all the fuel used in Western Alaska communities and industrial activities is delivered by vessel. Since sea ice prevents vessel traffic throughout the winter in most areas, all the fuel needed for the year is purchased and delivered in the ice-free season, roughly from May – October, though delivery timing varies as the sea ice retreats in the spring and returns in fall.

The high cost of fuel in Western Alaska communities is widely recognized (Bradner, 2012; Dodman, 2016). The price communities pay for fuel may depend in part on the price at the time the fuel is purchased, since it is bought in bulk a few times during the season and then distributed to storage facilities around the region (Bradner, 2012), though many communities opt for pricing tied to NYMEX or another commodity exchange. Thus, communities will be locked into higher prices when the cost is up at the time their fuel delivery is purchased, or lower prices if the opposite is true. Actual prices also vary significantly depending on the type of fuel, retailer, local taxes and subsidies, and logistics involved. As an example, average heating fuel prices have fluctuated from four to seven dollars per gallon in Western Alaska between 2005-2016, though there is considerable variation across communities as well (DCCED, 2016). Approximately 20-50% of the price comes from the cost of transport.

Fuel delivery by vessels has been standard in Arctic Alaska for years, done primarily with a network of tugs and barges of different sizes, some of which are designed to navigate up rivers and sometimes even land on beaches or river banks to make their deliveries (Pavellas, 2016). (Small tankers can go into the Ports of Nome and Dutch Harbor.) The combination of having fairly specialized assets combined with the fact that many of them are unable to be used for nearly half the year further contributes to the high transportation costs (Bradner, 2012). Delays in delivery due to weather or river/tide conditions are common, and safe navigation often relies heavily on the extensive local knowledge of the mariners involved due to the lack of recent hydrographic charting in many areas (Anderson, 2015).

In the past, most of the fuel sold in Arctic Alaska was loaded on barges from refineries in Alaska or Washington. Once in Arctic Alaska, fuel cargo would then be lightered to smaller barges as needed to reach remote communities (Bradner, 2012). However, since around 2012, both the source of the fuel and the method of delivery to the region have shifted. Today, fuel delivery companies serving Arctic Alaska charter tankers to bring fuel to the region from East Asian refineries, primarily in China, Japan, and South Korea. (While the companies typically own the tugs and barges, they do not actually own the tankers but will hire a tanker – with its master and crew – on a spot charter or time charter

basis.[1]) Once in the region, the tankers lighter to barges – sometimes to larger barges that then lighter to smaller barges – and conduct deliveries to communities as dictated by that community's location and associated logistics.

This shift from a strictly tug/barge-based system to using larger tankers has been driven by a variety of factors, including:

- **Source of the fuel:** One operator indicated that shifts in refining in both Alaska and Washington meant that the fuel products in demand in Western Alaska were no longer available.
- **Use of foreign-flagged tankers:** A foreign-flagged tanker costs tens of thousands of dollars less per day than a U.S.-flagged one, which would be required under the Jones Act if fuel was being delivered from another U.S. port.
- **Economy of scale created by bringing a larger delivery to the region:** The use of tankers also compensates for the lack of on-land storage capacity in the region – the ships can essentially serve as floating storage for the ice-free season.

The use of tankers changed how fuel is delivered to the region and means that larger volumes of fuel may be transported in one place at one time. It does not, however, represent an overall change in the volume of fuel transported over water. That quantity is determined by market demand in Alaskan communities.[2] At the same time that this transition has unfolded, there are still deliveries by barge only, as with the August 2018 delivery of fuel to the Prudhoe Bay oil fields by barge. This was covered in the press as the first marine fuel delivery in decades to the oil field operations, driven by an interest in reducing tank truck rollovers and lack of highway access due to road washouts (DeMarban, 2018).

1 Spot charters carry cargo from port to port. They differ from time charters, which are longer-term arrangements where a vessel or fleet of vessels is hired for regular service.

2 Shell also used a tanker for fuel storage in the Chukchi Sea during its exploration program there. The tanker offloaded fuel to barges for delivery (Shell Gulf of Mexico, Inc., 2013).

3. REGULATORY CONTEXT FOR LIGHTERING IN ARCTIC ALASKA

The vessels involved in lightering operations are subject to federal regulations implemented by the U.S. Coast Guard. When entering or leaving state waters, they are subject to Alaska Department of Environmental Conservation regulations. Alaska also requires foreign-flagged vessels to have marine pilots on board in certain waters.

Federal Requirements

The U.S. Coast Guard implements the federal regulations related to lightering, which include international requirements to which the U.S. adheres. These requirements cover the lightering operations themselves and spill response planning for the tankers and barges involved.

Requirements Related to Transfer

There are two sets of federal regulations related to the transfer of petroleum between vessels: (1) requirements related to the actual transfer operation, or spill prevention, and (2) requirements related to preparedness for a spill if it occurs. This subsection discusses the former; the requirements related to spill response are described in the following section.

Most transfer operations of oil or other hazardous materials to or from a vessel are subject to USCG regulations. [3] In 2015, the U.S. Coast Guard issued a final rulemaking to align its regulations for lightering with the IMO requirements for ship-to-ship transfer (80 FR 23). The new rules established different requirements for "ship-to-ship transfer" (STS) and lightering. In Coast Guard regulations, these are defined as:

- **Ship to ship transfer (STS):** Transfer of oil cargo carried in bulk from one oil tanker to another when at least one of the oil tankers is 150 GT or larger. Tank barges are considered oil tankers [33 CFR 156.400]. This terminology and these regulations were adopted to align with the International Maritime Organization (IMO).[4]
- **Lightering:** Transfer of a cargo of oil in bulk from one oil tanker less than 150 gross tons to another oil tanker less than 150 gross tons [33 CFR 156.205].

The practices in Alaska that are the focus of this study are considered STS transfer under federal regulations because of the size vessels involved. The tankers and tank barges of interest to this study must comply with Subpart A of the regulations (general practices for lightering or STS transfer operations) and Subpart D of the regulations (which focuses on a required STS Transfer Operations plan).[5]

Subpart A describes requirements to ensure that personnel conducting the transfer are qualified, able to communicate effectively, and present throughout the operation; equipment is adequate, functional, and

3 The exceptions are public vessels, including military, and any cases where the USCG grants an exception to an operator. The Captain of the Port also has discretion to approve alternative procedures if compliance is "economically or physically impractical" and the alternative provides "an equivalent level of safety and protection from pollution by oil or hazardous material." This equivalency must be documented in the operator's request to the Captain of the Port [33 CFR 156.107(a)(1-3]. This has not been done in the case of the lightering operations considered for this study.

4 Resolution MEPC.186(59), passed by the IMO's Marine Environment Protection Committee, added STS requirements to Annex I of MARPOL (the 1973 International Convention for the Prevention of Pollution from Ships).

5 Subpart B covers lightering and Subpart C refers only to operations in the Gulf of Mexico.

properly used; the oil/fuel cargo is safely managed and not frozen; and fire prevention measures are in place [33 CFR 156.120]. It also describes supervision of the operation; equipment use, tests, and inspections; actions in the event of a discharge of the cargo; and other measures related to ensuring safe operations [33 CFR 156.125-170].

Subpart D requires the vessel operators to have a USCG-approved STS Operations Plan that follows the best practice guidelines in the Manual on Oil Pollution and the Ship to Ship Transfer Guide (Petroleum) – and other documentation.[6] This includes a requirement to notify the Captain of the Port (COTP) 48 hours in advance of the planned transfer and immediately report any incidents that affect vessels engaged in STS operations (fire, explosion, collision, etc.) or oil spilled to water.

STS Operations Plans are not location-specific, but rather focus on the procedures, communications, and roles intended to ensure safe transfer operations anywhere the vessel engages in STS operations. Plan contents[7] include:

1. Ship identification information (Name, IMO number, size, etc.).
2. Notification requirements (volume and type of oil to be transferred, location and time of planned operation, duration of the transfer and contact information for the person in charge).
3. Identification of the person responsible for overseeing the operation and roles of other crew.
4. Communications protocols (language, information to be exchanged, navigational warnings to be used).
5. Ensuring that the equipment (hoses, fenders, mooring equipment, etc.) to be used is compatible with both vessels and the cargo to be transferred and meets applicable standards.
6. Considerations when choosing the location, such as prevailing or forecasted wind and sea conditions, availability of sheltered areas if conditions change, water depth, avoiding other vessel traffic in the area and offshore installations, spill response or other emergency resources, proximity to environmentally sensitive areas, safe anchorage, presence of underwater obstructions or infrastructure, onshore logistical support, security threats, and ice.
7. A risk assessment process that, at minimum, ensures consideration of the hazards, probability and consequences of failures, hazard prevention or mitigation measures, and procedures for handling unanticipated events. The scope of this risk assessment should include having an adequate number of trained crew, equipment condition, communications, weather conditions, positioning of the vessels and control over the vessels, and availability of a support vessel to deploy response equipment if needed.
8. Planning and procedures if an incident occurs, including emergency duties for crew and ensuring compliance with Shipboard Oil Pollution Emergency Plan (SOPEP) and Vessel Response Plan (VRP).
9. Operational safety checklists and considerations for mooring and maneuvering, cargo transfer,

6 Neither federal vessel response plans or STS plans are publicly available for review.
7 Based on Lloyd's Register Model Ship-to-Ship Transfer Operations Plan: www.lr.org/en/_images/229-78787_Model_STS_Plan.docx

completing the cargo transfer, and unmooring.

10. Conditions that would warrant stopping an operation, such as adverse changes in weather or sea conditions, unplanned tanker movements, release of oil or potential release of oil onto the deck or into the sea (e.g., equipment failure or unexplained difference between cargo volumes delivered and received), power failure, or fire danger. (Lloyd's Register, n.d.)

Additionally, the USCG Captain of the Port has the authority to designate lightering zones for lightering or STS transfer operations under 33 CFR 156.225. Zones may be designated based on other vessel traffic or routes; presence of offshore structures; fishing areas; environmentally sensitive areas; marine sanctuaries or federally protected areas; traditional use for lightering; typical weather and sea conditions and their effect on the fate of possible discharges; or other safety, environmental, or economic factors [33 CFR 156.230]. There are no formally designated lightering zones in Arctic Alaska.

Requirements Related to Spill Response

All ships or barges carrying oil as their primary cargo are subject to U.S. oil spill contingency planning requirements and required to have a vessel response plan [33 CFR 155.1050(a)]. For most vessels, operators are required to own or contract for a certain amount of response equipment that can be delivered to the areas where the vessel operates within set timeframes. These vary depending on the size of the vessel and type of oil carried. Vessel operators must have sufficient resources available (including for containment, recovery, and storage) to respond to different spill volumes depending on the size of the vessel [33 CFR 155 App. B, Parts 3-5].

Response planning requirements are indicated for the following potential spill volumes, as defined in the regulations:[8]

- ***Average most probable discharge:*** Either 50 bbl or 1 percent of cargo during transfer operations, whichever is less
- ***Maximum most probable discharge:*** 2,500 bbl of oil for vessels with a cargo capacity of 25,000 bbl or more
- ***Worst case discharge:*** Entire oil cargo of a vessel, in adverse conditions

A worst case discharge would require the most resources for a response, but regulations do not require the equipment to be on-scene until 24-72 hours after the spill occurs [33 CFR 1050(g)].[9] The same is true for the equipment required for a maximum most probable discharge volume [33 CFR 155.1050(e)].

Fewer resources are required to respond to an average most probable discharge, but these resources usually must be available within one or two hours, as shown in Table 1. (Lightering typically occurs within 12 miles of shore.) The resources identified are required to be available in the time required to any location where oil transfer – including lightering – occurs [33 CFR 155 App. B, Sec. 3.1].

8 33 CFR 155.1020

9 This time can be extended to allow for travel time from land, if the spill location is 50 nautical miles off shore or more.

Table 1. Response equipment requirements for transfer-related spill ("average most probable discharge") of 50 bbl, in federal regulations at 33 CFR 155.1050(d)

EQUIPMENT TYPE	EQUIPMENT REQUIREMENTS	TIMING REQUIREMENTS	
		Transfer location <= 12 miles from shore	Transfer location > 12 miles from shore
Boom	2x length of longest vessel involved	Deployed within 1 hour of spill detection	Deployed within 1 hour of spill detection + travel time from shore
Skimmer	At least 50 bbl of effective daily recovery capacity (EDRC)[10]	On-scene within 2 hours of spill	On-scene within 1 hour of spill + travel time from shore
Storage	At least 100 bbl of storage capacity	On-scene within 2 hours of spill	On-scene within 1 hour of spill + travel time from shore

Regulations also stipulate that the response equipment must be designed to function in the operating environment where the transfer occurs [33 CFR 155 App. B, Sec. 3.1]. "Operating environments" are also defined in regulations and are used to characterize the conditions for which skimmers and boom are suited. They are based on wave height, and defined as follows [33 CFR 155 App. B, Table 1]:

- Rivers and canals: ≤ 1 foot
- Inland: ≤ 3 feet
- Ocean: ≤ 6 feet

Finally, the regulations require that vessel operators have sufficient personnel, boats, and other critical elements such as sorbent and boom anchors on hand to sustain the intended response [33 CFR 155 App. B, Section 9]. All equipment must be both capable of functioning in the applicable operating environment and appropriate to the type of oil cargo carried [33 CFR 155.1050(c)]. The Captain of the Port has the discretion to reclassify an operating environment if prevailing wave conditions are better or worse than those defined for 35% of the year [33 CFR 155.1050(b)(1)]. None of Western Alaska's waters have been reclassified, but some unprotected waters may qualify.

Alternate Compliance

While the foregoing section described the applicable regulations as written, both tankers and tank barges satisfy federal spill response planning requirements in Arctic Alaska under a provision that gives the USCG the authority to approve "alternative planning" criteria in place of the planning criteria that would otherwise apply.[11] Operators of tankers, therefore, comply with federal spill response preparedness regulations by participating in an alternative planning criteria ("APC") program created by the Alaska Maritime Prevention & Response Network (hereafter, "the Network") for tankers (tank ships), while tank barge operators participate in an APC

10 Effective daily recovery capacity, or EDRC, is a regulatory metric. It is calculated as 20% of a skimmer's hourly pump rate as stated by the manufacturer, multiplied by 24 hours. With USCG approval, a lower efficiency factor than 20% may be used. (33 CFR 155, App B, Sec. 6)

11 Plan holders and the USCG may agree on alternative compliance measures if full compliance is not feasible, as specified at 33 CFR 155.1065(f). "When the owner or operator of a vessel believes that national planning criteria contained elsewhere in this part are inappropriate to the vessel for the areas in which it is intended to operate, the owner or operator may request acceptance of alternative planning criteria by the Coast Guard." [33 CFR 155.1065(f)]

created by the Alaska Petroleum Distributors & Transporters (APD&T). Both organizations require their participants to join a federally-approved oil spill removal organization, Alaska Chadux Corporation (hereafter, "Alaska Chadux")[12] which has response hubs throughout the study area.

The Network operates the only USCG-approved APC option for tankers in the Western Alaska Captain of the Port Zone (excluding Cook Inlet), which includes the entire study area. This option has been in place since 2012 and includes both tankers serving Alaskan communities or facilities -- whether through lightering or actual port calls -- as well as any passing through the region as long as their voyage includes a U.S. port or they fly a U.S. flag. The Network contracts the Marine Exchange of Alaska to monitor vessel activity around the clock based on their Automated Identification System (AIS) signals. Participants in the Network must follow a set of requirements approved by the USCG related to their general operations (broadcasting accurate AIS signals and monitoring ice conditions, for example) and routing (staying 75 miles offshore of the Aleutian Islands unless using an authorized pass).

Under the requirements of Network participation, tankers engaging in lightering activities must also:

- Provide 48 hours[13] advanced notice to the COTP and receive approval to conduct the operation.
- Proceed at minimum safe maneuvering speed for prevailing conditions when approaching or leaving a lightering area.
- Have oil spill response equipment available on-scene during lightering (containment boom, storage barge, skimmer, and personnel). This is met if an APD&T-approved barge is engaged in the operations or present on standby when a tanker is lightering to another tanker.
- Not conduct transfers when weather "preclude(s) the ability to conduct a safe oil spill response" (Alaska Maritime Prevention & Response Network, 2015).[14]

The APD&T APC has covered tank barges carrying non-persistent fuels around Alaska since 1991. (Fuel types are discussed further in Section 4.) Under this arrangement, participating barges carry the following minimum onboard response resources:

- Containment boom long enough to go around the barge three times
- Skimmers with an Effective Daily Recovery Capacity of half the vessel's Maximum Most Probable Discharge or 5% of cargo capacity of the barge
- Pumps to move cargo out of a damaged tank (enough to offload the largest cargo tank in 24 hours)
- A skiff to deploy equipment
- Space reserved in the barge capacity (or voids and ballast tanks) equal to 10% of the two largest cargo compartments

12 Alaska Chadux is a federally approved oil spill removal organization approved for the inland/rivers, nearshore, offshore, and open ocean operating environments. It was founded by the tank barge operators in 1993 to stage and manage spill response personnel and equipment, including vessels, as well as wildlife response resources in their areas of operation in Prince William Sound and Western Alaska (APD&T, 2015). Alaska Chadux also has dedicated oil spill response vessels in Dutch Harbor and Kodiak that could be deployed in the study area (Sobel, 2018).
13 This is the same time requirement as the STS Operations Plan described above.
14 Specific conditions are not imposed, but some of the operators stipulate limitations in their state-approved contingency plans or lightering notifications.

- Tow vessel crews trained to deploy containment and recovery equipment

Barges with a capacity of 25,000 bbl or more would have a regulated "Maximum Most Probable Discharge" of 2,500 bbl, and so under the APD&T APC they would carry skimming equipment with an effective daily recovery capacity of 1,250 bbl/day. This effectively exceeds the regulatory requirement, which calls for a higher volume of skimming capacity but does not require it to be on-scene for 24 hours. Different companies may use different skimmers, but the most common skimmer is the SkimPak 18000 with a Yanmar/Diesel America pump. The pump is designed for diesel and other light fuels, such as those being lightered and transported, and for use in calm waters (Alaska Chadux Corporation, 2015a). It is most often deployed from shore.

The APD&T APC requires that the barge carry 20-inch harbor boom, which one operator described as the largest that can be safely handled by personnel when being deployed or retrieved from the barge deck.[15] The length of boom will depend on the length of the barge, but typically will range from 1000-1200 feet including the length needed to go around the barge three times plus 300 feet of boom to be used with the skimmer if it is deployed outside a boomed area. Harbor boom is described as being appropriate for wave heights less than 3 feet and moderate currents (Alaska Chadux Corporation, 2015b).

Discussion

The APD&T APC has been in place for years and is designed for barges operating close to shore. The equipment is scaled to the size of the barge in terms of boom length and skimming capacity, and suited for calm waters. The application of this equipment to much larger tankers and transfers occurring more than 3 nautical miles from shore (as most do) creates some potential gaps regarding the type of skimmers and boom used and the potential volume, fuel type, and conditions of a spill.

Skimmers: Most barges carry skimmers with 1,250 bbl of effective daily recovery capacity. This exceeds the 50 bbl capacity required for transfer operations (the "Average Most Probable Discharge" volume in regulations, regardless of vessel type). However, the type of skimmer used is designed for calm waters and frequently deployed from shore. It may not be appropriate for use in the open water if conditions are anything other than perfectly calm.

Boom: The length of boom on board the barges is more than required in the regulations based on the length of the barge. Because the barges carry boom equivalent to three times their length, instead of the required two, depending on the barge there may well be the same length of boom present on board that would be required for the tanker during a transfer under the regulations as-written. As noted above, the larger barges will have 1,000-1,200 feet of boom. One typical tanker engaged in lightering, the *Challenge Prelude*, is 578-feet long and would require 1,156 feet of boom to be able to be deployed within an hour under the regulations as written. The potential disconnect exists in the *type* of boom used. Similar to the skimmers, 20-inch harbor boom is suited to calm waters. Ocean boom is more than twice the width and better able to withstand waves. Forty-two inch boom would be much better suited to the environment where transfers are taking place if the COTP

15 Barges that travel up rivers may also carry fast-water boom suitable to that environment, and some of the larger Kirby barges have boom reels enabling them to carry larger boom.

determined that waves exceed the 3-ft level more than 35% of the time (i.e., fall outside the "inland operating environment" as defined by federal regulations).

According to the inventories provided on their website,[16] Alaska Chadux response hubs located north of the Aleutians are primarily designed to support prompt response to small spills on land or in very protected waters. They all have the similar, 20-inch size boom that is suited for calm conditions. Alaska Chadux's only skimmer north of the Aleutians is located in Nome.

Otherwise, response resources are designed to be mobilized from Anchorage or Dutch Harbor, where they can be flown to remote locations as needed and as conditions and infrastructure allow. Dedicated response vessels are based in Dutch Harbor and Kodiak.

State Requirements

State of Alaska statutes and regulations apply when a vessel is in state waters (inside 3 nautical miles from the coast). Alaska requires tankers and tank barges to have state-approved Oil Discharge Prevention and Contingency Plans ("C-plans"). Marine pilotage is compulsory in Alaska's inland and coastal waters per Marine Pilot Statutes (AS 08.62) and Marine Pilot Regulations (12 AAC 56). These waters generally extend three nautical miles from the coastline if specific boundaries are not otherwise specified.

Oil Discharge Prevention and Contingency Plans

Crowley, Delta Western, and Vitus Marine all have Alaska Department of Environmental Conservation (ADEC)-approved Oil Discharge Prevention and Contingency Plans, or "C-plans," for the tankers they charter. as well as for the barges and on-shore facilities for which they are responsible. C-plans are posted on ADEC's website and available for public review and comment during their renewal every five years or in the case of a major amendment (18 AAC 75.425 and 18 AAC 75.445). C-plans address both spill prevention and response preparedness within the scope of the regulations. These include:

- Response scenarios describing a response for typical areas of operations
- Prevention measures in place
- Potential spill volumes, locations, and impacts
- Sensitive areas and how they will be protected
- Use of best available technology
- Response planning standard volume that the operator must demonstrate the ability to meet (through the response scenarios and other parts of the plan)

State C-plans must explain how the operator will comply with transfer regulations at 18 AAC 75.025. Regulations applicable to the lightering operations[17] considered in this study include:

- Taking all reasonable measures to prevent spills, including reducing transfer rates at the beginning or end of a transfer;
- Ensuring that all personnel involved in the transfer can communicate the need to stop the transfer at any time;

16 www.chadux.com

17 These regulations apply to oil terminal facilities under 18 AAC 75.280, which, as defined in statute, includes "a vessel, other than a nontank vessel, is considered an oil terminal facility only when it is used to make a ship-to-ship transfer of oil, and when it is traveling between the place of the ship-to-ship transfer of oil and an oil terminal facility" [AS 46.04.900(15)]

- Checking all valves and manifolds prior to conducting the transfer;
- Checking all hoses and piping at least once during the transfer (as feasible);
- Using the best available technology to stop the transfer if needed at any time; and
- Not conducting tank cleaning operations at the same time as the transfer.

The regulations also require pre-booming if conditions allow it[18] but only if crude oil, another persistent oil (including heavy fuel oil), or oily ballast water is being transferred [18 AAC 75.025(b)]. Vessels lightering non-persistent fuel cargo (as is commonly done in Arctic Alaska) are not required to deploy boom before they conduct a transfer.

The operators of tankers or tank barges engaged in lightering within the study are required to have plans in place to ensure that resources are available within the region to contain or control a spill in 48 hours and clean it up in the shortest possible time (18 AAC 75.440).[19] The spill volume used for planning purposes under state regulations is 15% of the vessel's total cargo capacity, as shown in Table 2. Because the timeline for actually cleaning up a non-persistent spill is open-ended, the state response planning requirements do not require any particular capacity for recovery or storage to be available by any particular time. They do require the operators to describe how all the necessary response elements, including people, would be brought together to respond to spills of the volumes shown in the table.

Table 2. Planning volumes for vessels-to-be-lightered based on state-mandated C-plans

	VESSEL CARGO CAPACITY USED FOR PLANNING VOLUME - TANKERS	ADEC PLANNING VOLUME (15% CARGO CAPACITY FOR NON-CRUDE TANK VESSELS)	PLAN
Crowley Fuels LLC	220,000 bbl	33,000 bbl[20]	Alaska Charter Tanker Operations ODPCP, ADEC # 15-CP-5121 (March 2018)
Delta Western	365,000 bbl 150,000 bbl	57,750 bbl (Dutch Harbor) 22,500 bbl (Adak, Bristol Bay, Western Alaska, Northwest Arctic)	Oil Discharge Prevention and Contingency Plan: Tankship (October 17, 2016)
Vitus Energy LLC (DBA Vitus Marine)	200,000 bbl 90,000 bbl	30,000 bbl (Port Clarence only) 13,500 bbl elsewhere in study area	Chartered Tanker Operations ODPCP, Rev 0 (May 2016)

18 Specific conditions are not identified in the regulations.

19 This planning standard differs from that applicable to tankers or tank barges transporting crude oil. Alaska regulations require crude oil tankers or tank barges to demonstrate in their plan that they have resources in the region of operations to contain, control, and clean up 300,000 bbl of oil (for vessels greater than 500,000 bbl capacity) or 50,000 bbl (for smaller vessels) in 72 hours. They must also demonstrate in their plan that they could contain, control, and cleanup a spill equaling 60% of their total tank volume drawing on resources both in and out of the region. (18 AAC 75.438)

20 Volume specified for Northwest Arctic (Port Clarence, Kotzebue Harbor), North Slope, Aleutians/Dutch Harbor, and Bristol Bay (of the areas within study area). Crowley Fuels, LLC Tanker ODPCP

The tanker operators are required to describe certain types of prevention provisions in their state C-plans. Table 3 summarizes what each operator states they will do when in state waters regarding the use of escort tugs, weather conditions in which they would not undertake a transfer, and other provisions. All tankers in state waters will also have a marine pilot on board, as discussed in the next section.

Operators submit requests to ADEC to amend their C-plan to add each chartered vessel that will enter state waters for a specific operating area and time period. ADEC may approve a plan with limits on the volume of cargo covered: for example, as noted below in Table 3 which shows some variation in volumes used for planning purposes in different areas. ADEC may add conditions to the approval of a plan or amendment. Some recent conditions have included:

1) Specifying that lightering operations in Broad Bay (Unalaska Island) may only be conducted in daylight when seas are less than 2 feet and winds less than 15 knots (this was for a one-time operation and was removed following completion and approval of a response scenario for a hypothetical spill at that location);[21]
2) Notifying ADEC[22] and Alaska Chadux[23] prior to the tanker entering state waters;
3) Voluntarily notifying ADEC of any incident that occurs in transit to or from state waters even if it does not result in a legally reportable spill;[24] and
4) Ensuring that the tanker has onboard the Response Action Plan that is included within the state C-plan.[25]

Finally, state C-plans differ from federal vessel response plans in that new plans,

Table 3. Provisions related to spill prevention that are not explicitly required in regulations as described in state C-plans for the three operators chartering tankers for lightering operations in Arctic Alaska

	ESCORT TUG	WEATHER RESTRICTIONS ON LIGHTERING	OTHER
Crowley Fuels LLC	• Where required "due to local regulations or conditions" • "On standby" during transferring cargo to a barge at anchorage	Will not do if: • winds > 25 knots • seas > 3 feet • visibility < ½ mile • rip currents • sea ice (though operations are not done in winter) • tsunami warning	Will not enter state waters if winds > 25 knots or seas > 3 feet
Delta Western	If required by pilot	Will stop transfer in "extreme" conditions	None
Vitus Energy	When tanker in state waters, escort tug will be "positioned relative to the tank ship such that a timely response to a propulsion, steering, or navigation error can be accomplished"	Identifies seas > 3 feet and winds > 34 knots as limitations on spill response, but does not give explicit limits for transfer operations	None

21 Geoff Merrell, ADEC letter to Joe Pinipinch, Delta Western, Inc. (June 8, 2017)
22 Graham Wood, ADEC letter to Joe Pinipinch, Delta Western, Inc. (May 17, 2018)
23 Geoff Merrell, ADEC letter to Don Stone, Delta Western, Inc. (January 22, 2018). Alaska Chadux is notified of all planned lightering whether in state or federal waters, per M. Melton (July 25, 2018).
24 Graham Wood, ADEC letter to Joe Pinipinch, Delta Western, Inc. (May 17, 2018)
25 Graham Wood, ADEC letter to Steve Wilson, Crowley Fuels, LLC (May 3, 2017)

renewals, and major amendments are posted on ADEC's website with an opportunity for review and comment by interested parties. Plan documents are also shared with other agencies and organizations designated by ADEC, and access to documents may be requested by interested parties [18 AAC 75.408]. While the state response planning requirements do not compel the availability of more response equipment, they do provide an opportunity for interested parties to review and comment on the prevention and response planning for a particular operation that is described in a plan.

Marine Pilots

Foreign-flagged vessels are required to have a licensed marine pilot on board when navigating mandatory pilotage waters. This generally includes coastal water within three nautical miles from shore and some areas encircled by headlands as shown in Figure 2 (12 AAC 56.090). Marine pilots are licensed by a state board and undergo both testing and training specific to the area in which they are licensed to serve. Licenses also require a specific level of previous experience and, for renewals, a sustained level of pilotage activity (DCCED, 2018). The duty of a marine pilot is to safely navigate vessels under the pilot's direction and control and to protect life property and the marine environment. (Sec. 08.62.157). Marine pilots do not oversee the actual lightering and oil transfer operations.

Figure 2. Mandatory marine pilotage waters in the study area (based on NOAA, 2018a)

4. TANKER LIGHTERING IN ARCTIC ALASKA

Three companies, Crowley, Delta Western, and Vitus Marine, charter tankers and operate their own tugs and barges for fuel deliveries in Arctic Alaska. Kirby Offshore Marine also operates barges that may be hired to receive lightered fuel from a tanker, but does not charter tankers. This section provides a snapshot of activity focused on 2016-2017 based on information that was available in the summer of 2018.

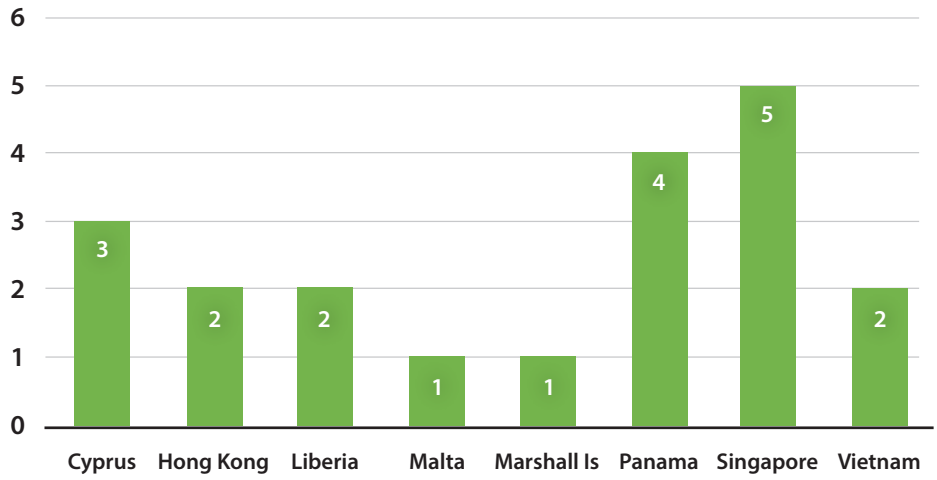
Vessels

Twenty different tankers engaged in lightering in the study area in 2016-2017 based on information provided by the Alaska Maritime Prevention & Response Network. The average cargo capacity was just under 295,000 bbl, with individual vessels ranging in size from around 87,000 bbl to more than 366,000 bbl.[26] These numbers are generally consistent with vessel activity reported in Norton Sound, Kotzebue Sound, and the Bering Strait from 2013-2015 (Nuka Research, 2016). Some tankers come only once, while others come back in different years.

The tankers lightering in 2016-2017 were constructed between 2002-2014, with three-quarters of them built in 2008 or later.

All ships are registered to a country (called the "flag state") responsible for ensuring their compliance with international requirements related to construction and safety. All of the tankers lightering in the study area in 2016-2017 are registered to foreign countries, and may be inspected by the U.S. Coast Guard upon entering U.S. waters. The use of foreign-flagged vessels is consistent with the fact that they are bringing fuel from Asian ports (if they were bringing fuel from another U.S. ports, they would need to be flagged to the U.S. under the Jones Act requirements). Figure 3 shows the number of tankers flagged to each country that were lightering in the region in 2016-2017.

Figure 3. Number of tankers lightering in the study area flagged to each country, 2016-2017



26 In addition, vessels with capacities greater than 540,000 bbl were identified as having engaged in lightering in 2013-2014 (Nuka Research, 2016) but these ships have not returned in more recent years.

In the same years of 2016-2017, more than twice as many tankers passed through the study area voyaging between U.S. ports in the Lower 48 and East Asia than were engaged in lightering in the study area. Tankers passing through the study area travel through or south of the Aleutian Islands. These vessels included tankers much larger than the ones that engage in lightering in Western Alaska; the largest had a capacity of more than 1 million barrels.[27] They also included tankers that carried a cargo of crude oil rather than distillates.

Voyages

Some tankers travel into the region once and stay for a few days, while others may spend weeks or months at a time (sometimes year after year during the summer season). The Alaska Maritime Prevention & Response Network reviewed AIS data and determined that for the 2017 season:

- Four tankers came into Arctic Alaska, offloaded their cargo at a single location over the course of days – or in one case, weeks – and departed. This included: (1) one tanker at Red Dog mine, (2) two at Dutch Harbor, and (1) one at Togiak.
- Three individual tankers came in and out of the area, making up to 10 lightering stops each in Arctic Alaska during the season.
- One tanker entered Arctic Alaska and offloaded cargo at three different locations before departing (Nome, Savoonga, and Deering).
- One tanker entered Arctic Alaska and stayed for months, lightering 17 times.

The tanker that spent the summer of 2017 lightering was one of the smaller tankers (around 87,000 bbl capacity) and one of the few that entered state waters. This tanker stayed in Arctic Alaska from May to October 2017. As would be expected, the tanker lightered to barges for delivery to communities. However, at four different times, other, larger tankers came alongside and lightered fuel cargo to refill it so to continue lightering to barges. This occurred three times in Togiak Bay and once off Good Hope Bay (Kotzebue Sound). Figure 4 shows that vessel's track during the season along with typical vessel routes into the region from East Asia in grey.

The use of a single tanker that is re-filled by other tankers is common among at least two of the three companies. In some cases, this may also require re-filling bunker fuels, which would necessitate pre-booming if done in state waters (though this would require state C-plans for both vessels and is not a common practice). The tankers, however, typically stay outside state waters, more than three-nautical miles offshore.

Locations

Common lightering locations are shown in Figure 5. Before lightering, vessel operators notify the U.S. Coast Guard – and other parties as appropriate – of the intended location, vessels involved, and volumes of different products to be lightered. The Alaska Maritime Prevention & Response Network receives these locations and identifies areas commonly used by the tankers included in their APC. The Network provided the information presented in the map on the following page.

27 Information provided by the Alaska Maritime Prevention & Response Network.

Figure 4. Typical tanker routes (source: Crowley's state C-plan) and track of one tanker that spent from May – October 2017 conducting lightering operations in the area (source: Alaska Maritime Prevention & Response Network)

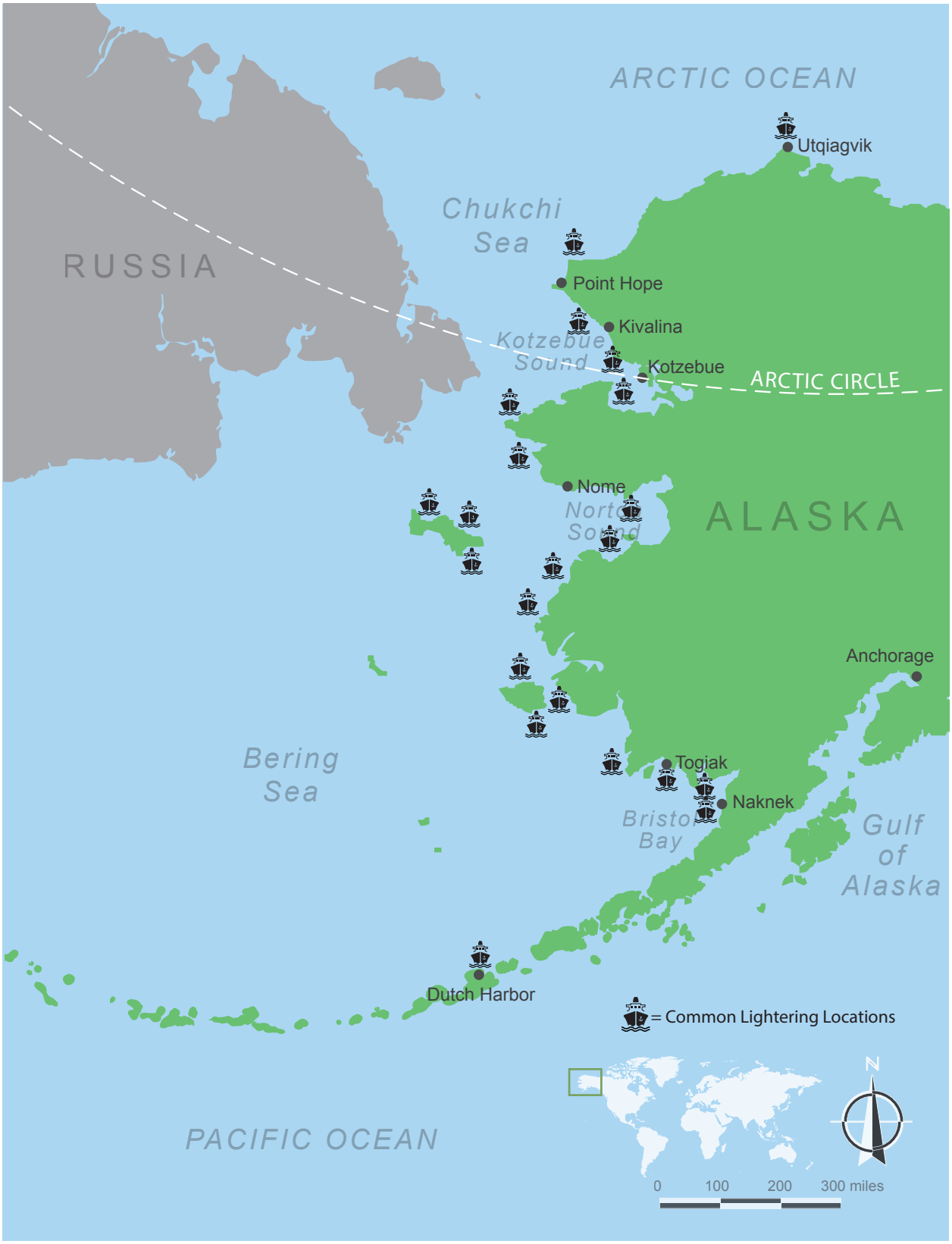


Figure 5. Common lightering areas (credit: Alaska Maritime Prevention & Response Network)

In September 2017, the U.S. Coast Guard began compiling lightering notifications. From this compilation, it is clear that while lightering often occurs in the same places, this is not always the case. Many times, vessel operators intend to lighter in different places than those identified in Figure 5.[28]

The fact that a ship may lighter outside a common lightering location does not mean that it is out of compliance: common lightering locations are not required lightering locations. It also does not mean that it is doing anything unsafe.

As most of the tankers engaged in lightering are foreign-flagged vessels, they are required to have a licensed marine pilot on board when in transit or maneuvering in mandatory pilotage waters of the state (per regulations at 12 AAC 56.960). Most often, however, the actual lightering operations occur outside pilotage waters.

Fuel Types and Volumes

Fuel cargoes delivered to communities via lightering operations in Western Alaska are exclusively non-persistent fuel products, including diesel, jet fuel, gasoline, and home heating fuel.

The tankers and tugs involved in lightering operations also have fuel on board for their own propulsion. Tankers may use non-persistent Marine Gas Oil (MGO) or persistent Intermediate Fuel Oil (IFO) while in the region, and will typically use IFO for the voyage to and from Asia. Tugs strictly use non-persistent diesel fuel for propulsion.

The National Oceanic and Atmospheric Administration (NOAA) categorizes crude and refined petroleum according to four types based on their predicted behavior when spilled to the marine environment and potential environmental impacts. Table 4 presents these four groups with the product types found in the lightering operations in Arctic Alaska referenced in the far-right column.

Table 4. Fuel types (based on NOAA, n.d.; except far-right column which is based on information provided by the USCG and interviews conducted for this project)

	FUELS	IMPACTS	APPLICABILITY TO LIGHTERING IN STUDY AREA
Non-persistent	Jet fuel, gasoline	Localized, severe impacts to water column and intertidal resources	Jet fuel and gasoline are among cargoes delivered to communities
	Diesel, No. 2 Fuel Oil, light crudes	Residue remaining may coat intertidal resources with potential for long-term contamination	Among cargoes delivered to communities (except light crude oils) Tugs engaged with barges use diesel Tankers use distillate fuels in this category when in the region
Persistent	Most crude oils	May be severe and long-term impacts to intertidal areas, waterfowl, fur-bearing mammals	Not applicable – no crude oil lightered in study area
	Heavy Fuel Oils (HFO), No. 6 Fuel Oil, Bunker C	Heavy contamination of intertidal areas likely; long-term contamination of sediments possible, severe impacts to waterfowl and fur-bearing mammals	Varies; tankers may use an HFO for the voyage to/from the study area or use HFO until they arrive in the region and then switch to a distillate fuel[29]

28 September-October 2017 and May-June 2018

29 The type of fuel used by tankers may change as vessels comply with a cap on the sulfur content of vessel fuels that will take effect in 2020. There is also a proposed phase out of the use or carriage of HFO north of 60˚N which would affect some, but not all, of the tankers engaged in lightering operations based on the locations identified to date.

5. RISK DISCUSSION

Potential environmental impacts associated with lightering operations as considered in this report may include oil spills resulting from the transfer operation, a grounding, or collision involving the tanker, tug, or barge. There may also be impacts associated with normal vessel operations.

Oil Spills

To date, there have been no recorded spills from tankers engaged in lightering in Western Alaska. But there have been lightering-related oil spills in other regions.

A 1998 study of lightering in U.S. waters identified valve failures, tank overflows, and hose ruptures as recurring causes of spills during lightering operations from 1984-1996, according to data collected by the U.S. Coast Guard. Data from that same period indicated an average spill volume of 26 bbl for spills associated with lightering. It also concluded that lightering operations in the U.S. overall have an "excellent safety record." (NRC, 1998) In addition to the potential for spills during the fuel transfer itself, the vessels involved could potentially suffer a casualty when present in the region to conduct lightering, including collisions/allisions, grounding, hull failure, fire/explosion, or weather damage (Crowley Fuels LLC, 2018).

Additional risk of an incident involves mooring and unmooring operations between two tankers or involving a tanker and fuel barge. This may be performed by the vessel master outside of pilotage waters or under the control of a state-licensed marine pilot when inside compulsory pilotage waters.

In 2009, an overflow occurred when a tanker was being refueled in San Francisco Bay and the tank was overfilled before the transfer stopped. This is an example of the type of spill that can occur during transfers (though in this case the transfer was "bunkering" or fueling a vessel rather than transferring cargo). Ten miles of shoreline were impacted when 400 gallons of IFO 380 (a heavy fuel oil) spilled as a result, resulting in the closure of fisheries and beaches in the area. A natural resources damage assessment totaled $850,000 (California Department of Fish and Wildlife, 2018). Heavy fuel oils are not transferred over water in Arctic Alaska, though the tankers involved in the operations use these fuels for their own propulsion coming to or from the area.

Soft Grounding in 2016

In 2016, a 598-foot Norwegian-flagged tanker engaged in fuel supply operations in the study area grounded off of Nunivak Island with 24 people and 11.5 million gallons of petroleum products on board. No spill resulted, no fault was found, and no rescue was required, as the vessel's crew were able to refloat it and move to deeper waters where the hull could be checked (a USCG C-130 overflight also confirmed that there was no oil sheen on the water). The vessel was outside state waters and moving slowly (3-4 knots) through the area due to concerns about shallow waters, and came into contact with an unidentified shoal in areas shown on charts to be 8-9 fathoms (48-72 feet) deep. As shown in Figure 6, much of the area between Nunivak Island and the mainland has not been surveyed for years, although plans

were already in place to do so. The depth information available at the time came from charts dating to the Russian ownership of Alaska in the 1800s.[30]

The size of an oil spill depends on the volume of oil on board, nature of the incident, and duration of the release. Very small amounts may be released regularly when hoses are disconnected. As discussed above, the smallest federal spill response planning volume is the 50 bbl "average most probable discharge" related to an oil transfer. The largest possible spill would be a release of the vessel's entire cargo and fuel resulting from with a grounding or collision.

Figure 6. Location of a brief tanker grounding in 2016 on an unidentified shoal. (A nearby shoal had been identified in 1977.)

Focus on the Bering Strait

In an analysis of 2013-2015 vessel traffic data for the Bering Strait region (Nuka Research, 2016), Nuka Research characterized the potential oil spill exposure represented by different vessel types in the region based on the estimated volume of non-persistent (cargo and fuel) and persistent (fuel) on board. These volumes were multiplied by the amount of time each vessel spent in the region during the three years studied. The study was based on Automated Identification System (AIS) data. Because barges are not required to transmit AIS signals, they were not included in this analysis (though some barge operators do use AIS voluntarily).

Overall, the oil exposure associated with tankers was prominent in the results (as shown in Figure 7). This is both because tankers carry a larger volume of petroleum than other vessels (because it is cargo and not just fuel for the vessel's own propulsion), and also because, as discussed, they can spend a relatively long time in the area compared to vessels that are just transiting through. The "weighted oil exposure" represented in the figure increased the "weighting" of persistent oils by a factor of 1.64 to represent the potential for longer-lasting impacts from persistent oil spills. As shown in Figure 7, tankers engaged in lightering and port calls on the U.S. side (the study included Russian waters as well) accounted for 46% of potential oil spill exposure. This is based strictly on the estimated volumes carried and time spent in the area – and does not consider the likelihood of an incident (Nuka Research, 2016).

To illustrate the potential fate and weathering of a spill, Nuka Research ran the weathering portion of five hypothetical spill scenarios in the publicly-available Response Options Calculator (ROC) developed by Genwest Systems, Inc (Genwest Systems, Inc., 2012). ROC applies an oil weathering

30 Based on information in USCG MISLE Incident Investigation Report and Case File. Information and figure provided by USCG under FOIA request.

model that uses oil type, wind speed, and water temperature to show how the slick may weather and the potential effects of countermeasures applied.[31]

These are not trajectory models which would indicate where and when a spill is predicted to move, but they do show how quickly the spilled petroleum would begin to spread, evaporate, or disperse into the water column.

Figure 8 shows how two hypothetical spills of home heating oil would begin to spread, evaporate, and disperse through the water column:

- The graphs on the left show the relevant ROC outputs for a 50 bbl spill. This is the Average Most Probable Discharge in federal regulations, and assumed to occur due to an error or equipment failure associated with the transfer itself.
- The graphs on the right show spreading, evaporation, and weathering for a larger spill of 2,500 bbl – the volume that is the federal regulatory Maximum Most Probable Discharge – and assumed to result from a collision or other accident.

Both hypothetical scenarios use similar winds: 75th percentile annual wind speeds from NOAA stations based on-land near Nome[32] and Kivalina[33], respectively (this means that winds are less than this about 75% of the time during the year). In both cases, these are wind speeds at which lightering operations would normally proceed (assuming no other risk factors) based on the various planning documents discussed above.

As the figures show, spreading, evaporation, and dispersion begin to happen immediately. By 24 hours after the spill, when the federal regulations would require the resources for a MMPD spill to be on-scene, the 2,500 bbl spill would have spread to cover nearly 2 square nautical miles and almost 200 barrels would have dispersed into the water column based on assumed conditions. The APD&T APC specifies that skimmers with an EDRC of half that volume (or possibly less, depending on the size of the barge involved) would be

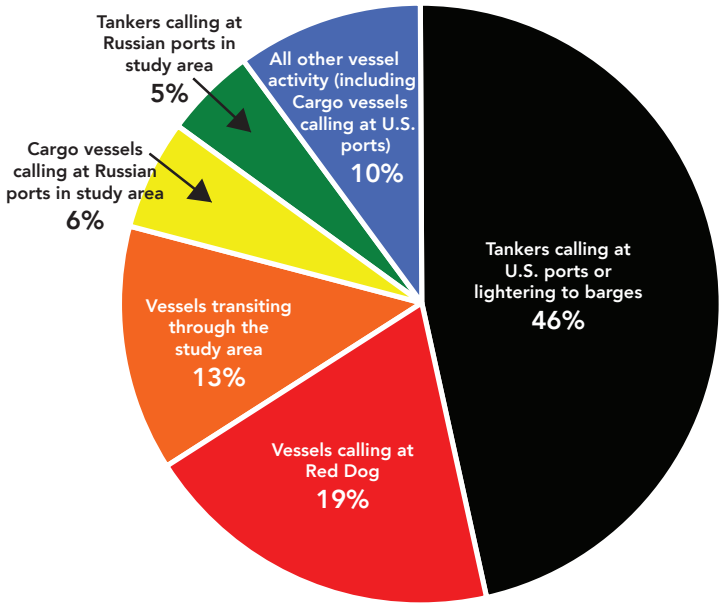


Figure 7. Percentage of weighted oil exposure associated with vessel activities based on 2013-2015 AIS data in the Bering Strait area. Tankers serving communities in Alaska represented the highest overall exposure at 46%. Tankers lightering fuel to Red Dog mine are included along with bulk carriers in the estimated19% of weighted oil exposure associated with serving the mine (Nuka Research, 2016).

31 ROC was not used here to model a response. Other inputs come into play if the program is used to model the deployment of equipment for oil recovery or treatment, but these were not applied. The program also outputs spill thickness, viscosity, and emulsification which relate to how readily it can be recovered.
32 Station NMTA2, retrieved from: https://www.ndbc.noaa.gov/view_climplot.php?station=nmta2&meas=ws
33 Station RDDA2, retrieved from: https://www.ndbc.noaa.gov/view_climplot.php?station=rdda2&meas=ws

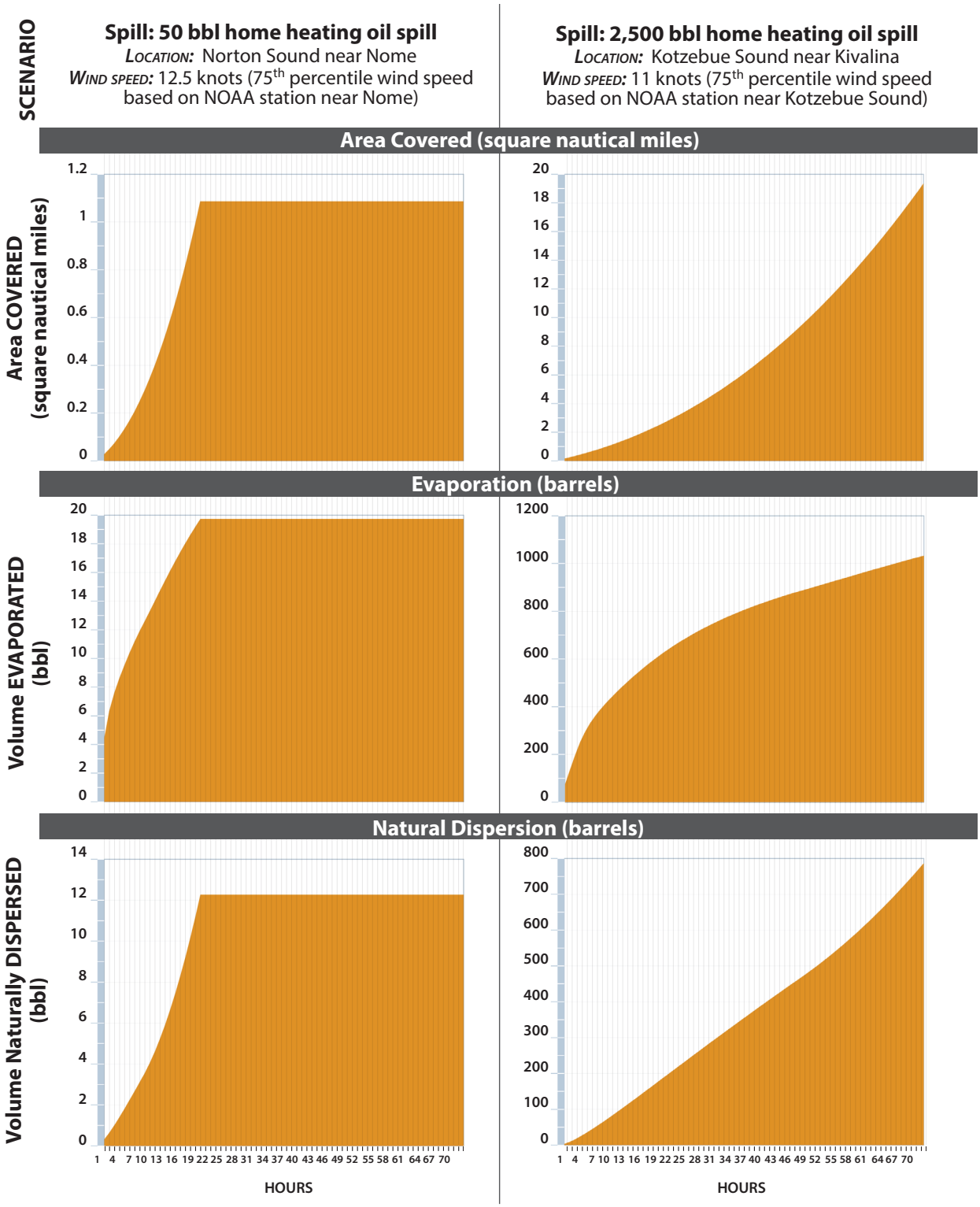


Figure 8. Spreading, evaporation, and dispersion of hypothetical home heating oil spills (ROC outputs). Note that while the x-axis is consistently 0-72 hours, the y-axis scales differ between the two scenarios (columns).

on-scene. Any equipment that is on-scene and able to be deployed immediately has a much greater chance of recovering spilled product before it has spread or dispersed, and is therefore likely to be more effective than equipment that must be transported to the scene from Anchorage or another more distant location.

Figure 9 shows the behavior of both non-persistent cargo fuel and the tanker's own bunker fuels. The total loss of cargo as from a powered grounding or similar accident represents a Worst Case Discharge in federal regulatory terms, but the additional loss of the fuel being used for the vessel's own propulsion should also be considered. While the loss of all cargo and bunkers is extremely unlikely, given the remoteness of the locations in which these vessels operate it is instructive to consider how a large, unmitigated spill may behave.

Mounting a significant spill response – anything that escapes containment and cannot be readily controlled – requires the prompt execution of a number of different response tasks. While containing the spill as close to the source as possible is key, depending on the nature of the incident, such as a grounding when there is no barge with response resources on hand, this is unlikely to occur given the distances across which resources would need to be mobilized. A response requires boom, skimmers, and vessels suited to the conditions on-scene, as well as trained people, storage capacity for recovered oil and water, and aerial surveillance of some kind to track the movement of the spill. While there are efforts underway to enhance spill response capacity in the Arctic generally, at this point even barring weather delays it would take 24 hours or more to reach many of the areas where lightering tankers operate.

When considering a hypothetical complete loss of cargo and fuel oil, it is also notable that the skimming equipment carried onboard the APD&T barges, while well positioned to respond to a relatively small spill of the petroleum products carried, would be overwhelmed by the scale of this much larger spill and may not be on-scene anyway since this type of incident would not happen while the tanker was anchored to conduct a transfer. The APD&T equipment also is designed for use on non-persistent fuels such as the cargo carried and would not effectively skim a persistent fuel oil such as bunker fuel. Skimming persistent oil requires a skimmer capable of recovering a very viscous oil, as the oil would be expected to begin to solidify in the 42˚F water, as assumed in the ROC model outputs. (If in the future vessels no longer use persistent fuels due to restrictions on air emissions, this may no longer be an issue.)

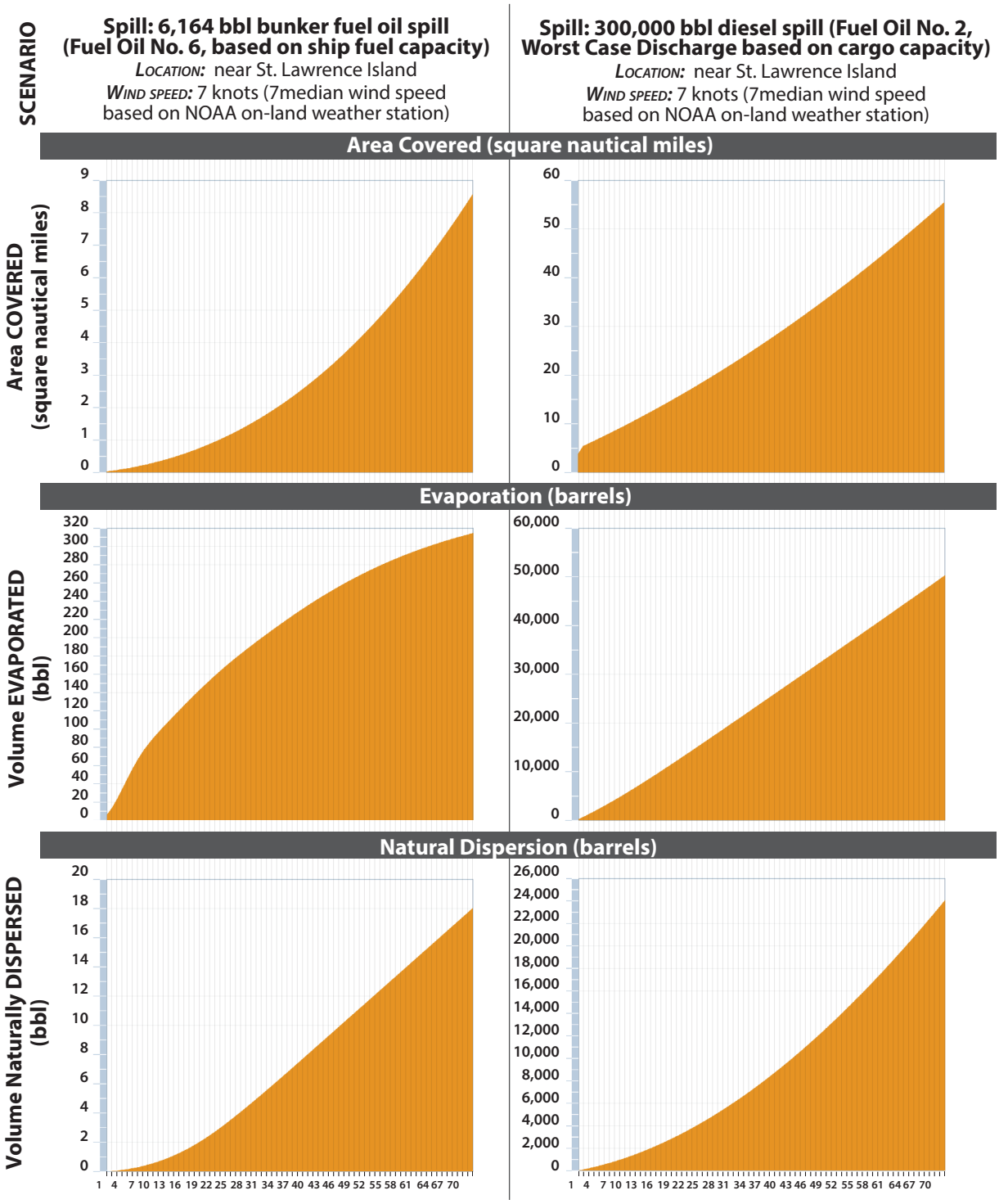


Figure 9. Spreading, evaporation, and dispersion of hypothetical worst-case discharge of full diesel cargo and vessel bunker fuel near St. Lawrence Island over 72 hours

Other Possible Impacts

Aside from oil spills, tankers engaged in lightering activities may impact the environment and communities that depend on it in other ways. The potential for impacts will depend greatly on where and when a vessel is operating. These may include the release of sewage, greywater, food waste or cargo residues outside of 12 nautical miles from shore (U.S. EPA, 2013), air pollutants (Arctic Council, 2009; U.S. EPA, 2016), or the disturbance of or injury to marine mammals due to noise (Peng et al, 2015) or vessel strikes which tend to be a function of vessel size and speed (Laist et al., 2001). In general, the volume of vessel traffic is much greater in the Aleutian Islands than farther north in the study area. While lightering does occur off Unalaska Island, the vast majority of ship traffic through the study area goes through the Aleutians and is unrelated to the lightering operations discussed in this report. These other possible impacts are acknowledged but are not the focus of this report.

Areas to be Avoided

This study does not attempt to document the vast environmental, cultural, and socioeconomic values and resources of the study area – these are widely recognized and well documented elsewhere (Smith et al. 2017; Oceana and Kawerak, Inc., 2014; Huntington et al. 2013; Bering Sea Elders Group, 2011). Based on information submitted by the U.S. government, the International Maritime Organization has identified areas to be avoided where large vessel activity has been deemed to pose a significant risk. In 2015, voluntary areas to be avoided took effect for waters around the Aleutian Islands, except for selected passages between the islands (MAREX, 2015). Beginning in December 2018, voluntary areas to be avoided will also surround King Island, Nunavik Island, and St. Lawrence Island in the northern Bering Sea (MAREX, 2018). See Figure 10.

Areas to be avoided are intended to minimize risks due to hazards such as outdated charts, the presence of reefs, shoals, and shallow waters, or due to the potential for particular consequences to subsistence communities, commercial fisheries, or wildlife. While these areas to be avoided are intended for vessels passing through the area instead of engaging in local trade (and are voluntary even for vessels to which they do apply), it is relevant to note that they do overlap with some of the locations where tankers conduct lightering.

The objectives for submitting the proposed areas to be avoided (ATBA) are to:

1) increase ship safety by mitigating the heightened risk created from increasing traffic and shipping activity by maintaining a safe distance between ships and the shoreline;

2) help ships avoid numerous shoals, reefs and islands, particularly where the areas have not been surveyed thoroughly;

3) reduce the risk of shipping accidents and incidents;

4) provide more time to mount a response to a developing maritime emergency, e.g. a ship suffering breakdown of its propulsion machinery;

5) prevent and reduce the risk of pollution or other damage to the marine environment, including national and international recognized habitat and species; and

6) avoid the key areas of fishing activities and avoid the presence of subsistence activities.

- ***Excerpted from U.S. proposal to IMO for Bering Sea Areas to be Avoided***

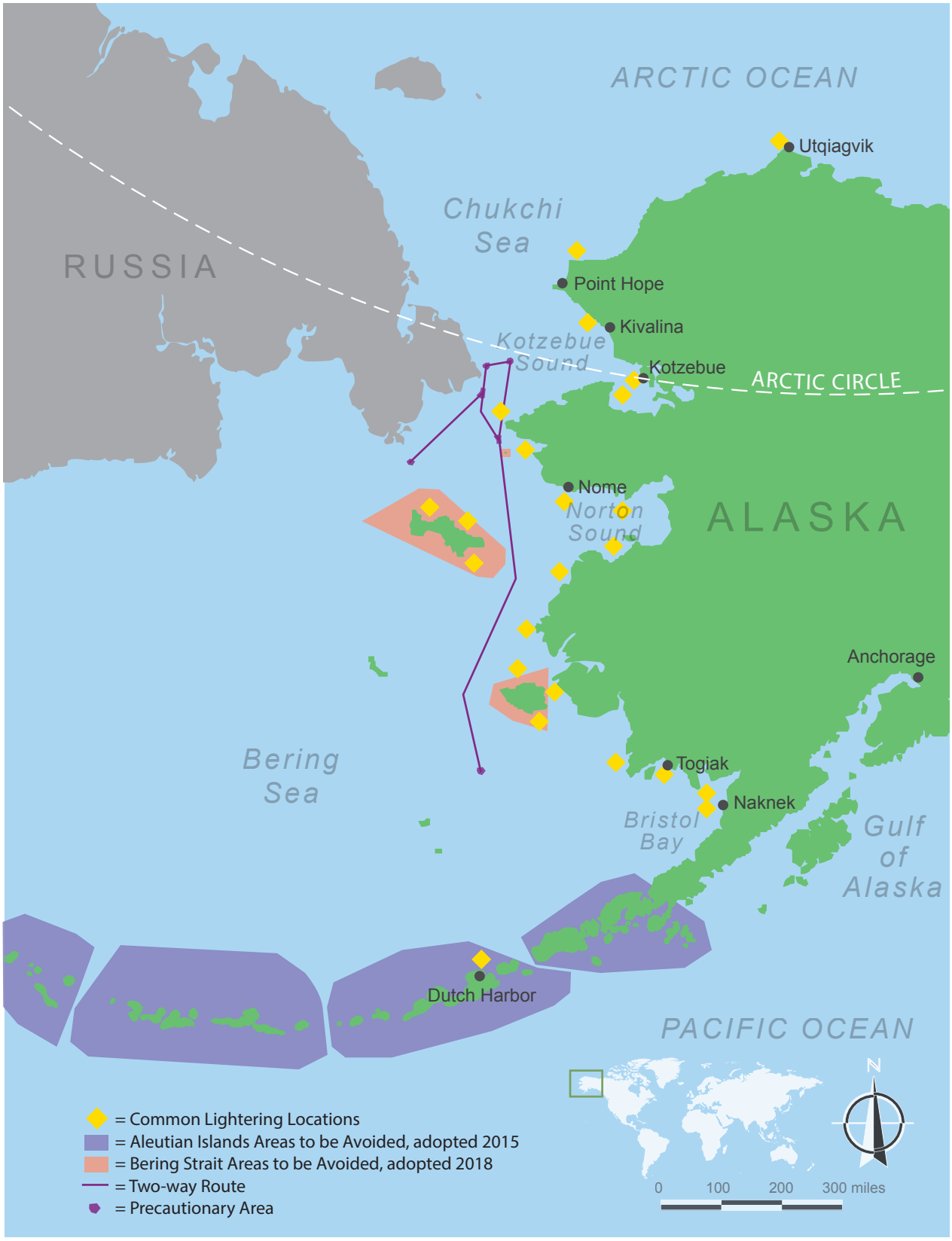


Figure 10. International vessel routing measures and common lightering locations

6. EXAMPLES OF LIGHTERING PROCEDURES FROM OUTSIDE THE STUDY AREA

Examples of lightering procedures used in areas other than Arctic Alaska were reviewed to identify additional protective measures that might be considered. The purpose of reviewing examples from other areas is to identify options for reducing risk from lightering (or similar) operations that have been identified elsewhere. However, in doing so it is important to consider that there are many aspects of the context that are different across different locations, including the frequency of the practice, types and volumes of fuels transferred, prevailing conditions, and nature of the accessibility and infrastructure in the surrounding area.

Examples are gleaned from the following sources:

- **Federal requirements:** USCG regulations that are specific to lightering operations in a given location (e.g., Gulf of Mexico, Long Island Sound) and Bureau of Safety and Environmental Enforcement requirements for fuel transfers associated with Arctic operations
- **State regulations:** Washington and California
- **Standards of Care:** In this case, guidance developed by harbor safety committees that represents the best recommendation of industry, USCG, and state government (or other parties as particular to the committee)

Mitigation/safety measures identified which may be more protective than those at play in Arctic Alaska/Western Alaska are described in the following categories, all of which relate to the general safety of lightering operations and mitigation of oil spill risks:

1. Designated locations
2. Weather-related limits
3. "Pre-booming" of the transfer operation
4. On-scene spill response equipment
5. On-site agency oversight

Designated Locations

Current Practice in Arctic Alaska	No locations designated in regulation or policy
Additional Measures Identified	Requirement or recommendation that lightering be conducted at designated anchorages or in designated locations

Arctic Alaska

There is no specific policy or regulation that requires all companies to conduct lightering operations in certain locations in Arctic Alaska. (As shown in Figure 5, above, the Network has identified areas commonly used, but these are not recommendations put forward by the Network.) The companies apply their knowledge of the region to determine where tankers they charter should go.

Other Locations

USCG regulations designate specific lightering zones in the Gulf of Mexico. They also stipulate general prohibitions on conducting lightering within one nautical mile of an offshore structure or mobile drilling unit, or over subsea pipelines or reefs [33 CFR 156.300]. USCG regulations also designate specific anchorages at which lightering

operations may be conducted in Long Island Sound [33 CFR 110.146(b)(4)]. The USCG has the authority to designate areas for lightering in other places, but there are no other locations identified in federal regulations.

The Harbor Safety Plans for both Puget Sound and the Lower Columbia River identify areas or specific anchorages where lightering operations should occur; however, exceptions are allowed with USCG approval if a request is submitted one month in advance.

In Puget Sound, relatively few lightering operations take place at this time. However, lightering would be permitted in certain areas named in the Puget Sound Harbor Safety Plan's Standard of Care and may be approved by the USCG on a case-by-case basis in others. Requests to lighter in other locations must be submitted to the USCG Sector Puget Sound one month in advance (Puget Sound HSC, 2017). On the Lower Columbia River, lightering is allowed only at pre-approved anchorages and requests to do otherwise must be submitted one month before the intended operation (Lower Columbia River HSC, 2017). Lightering is allowed at one anchorage only in San Francisco Bay (San Francisco HSC, 2017).

Weather-related Limitations

Current Practice in Arctic Alaska	No mandated requirement (except at Broad Bay) but operators may specify limits in state C-plans and, as they choose, on lightering notifications submitted to the Coast Guard Network APC indicates that transfers should not be conducted when weather precludes an effective spill response
Additional Measures Identified	Specific limitations in terms of wind speed, wave height, or visibility limits that would indicate some necessary modification of lightering plans or operations

Arctic Alaska

Currently there is no one set of weather limits that would prevent a company from conducting a lightering operation. (This does not prevent personnel involved from deciding to delay or relocate lightering based on conditions, though.) The Network APC states that tankers will not conduct lightering in conditions that would preclude effective oil spill response, but leaves it up to the operators to determine what these would be. The three operators chartering tankers have described somewhat different approaches in their state C-plans. Crowley lists specific conditions in which they would not conduct a transfer (see Table 3, above). Delta Western refers to not conducting lightering in "extreme" conditions and Vitus Marine identifies conditions that would preclude a response but does not explicitly say that transfers wouldn't occur in these conditions. For federal waters, Crowley specifies a wave height limits of 1 m (3.3 feet) in their lightering notifications based on the capability of the response equipment. Vitus Marine makes decisions based on the capabilities of the receiving barge, generally using a wave height limit, depending on exact conditions, of 4-5 feet for articulated tug/barges or 2-3 feet for conventional tugs and barges.

Other Locations

Table 5 summarizes the weather limitation guidelines for lightering identified in other locations which primarily focus on wind and waves (in some cases referring to "sustained winds" or other nuances omitted from the table for simplicity). This table refers to the transfer activity itself; weather limitations on pre-booming are discussed in the next section. Overall, the limitations are less restrictive than those

Table 5. Weather conditions AT or ABOVE which lightering/bunkering operations must stop per best practices or regulation applicable to lightering in the Gulf of Mexico (GOM),[34] Puget Sound,[35] Lower Columbia River (LCR),[36] or Long Island Sound (LIS)[37] and bunkering California (CA)

CONDITION*	ACTIVITY							
	Vessels Should Not Approach		Operation Should Not Begin		Operation Should Stop if Already in Progress		USCG will Engage Operator Intending to Lighter	
Wind speed (knots)	GOM CA	30 34	Puget Sound LCR CA	30 30 34	Puget Sound LCR CA GOM	40 40 34 44	LIS	25
Wave height (feet)	GOM	10	CA	5	Puget Sound GOM	3 (if barge involved) >16	LIS	4
Visibility (miles)	n/a		n/a		n/a		LIS	Less than 1

**There are also limits on the current in which lightering may be conducted on the Lower Columbia River.*

specified in Crowley's ADEC-approved C-plan and exceed the limitations for the response equipment that is on-scene on the APD&T barges used in Western Alaska.

Pre-booming

Current Practice in Arctic Alaska	Not required
Additional Measures Identified	Required if conditions allow safe and effective boom deployment (Washington and California)

Arctic Alaska

The deployment of boom around vessels engaged in a transfer even when there is no identified spill or immediate threat of a spill, or "pre-booming," is not required of the tankers and barges discussed in this project (except when persistent fuels are transferred in state waters).[38]

Other Locations

In Washington, operators engaged in transfers of "jet fuels, diesels, heating oils, and any other oils that are recoverable when spilled to water" must pre-boom around transfers of > 500 gallons/minute if it is "safe and effective" to do so. If it is not considered "safe and effective," then the regulations allow the transfer to proceed without the boom deployed in advance. Most of the transfers in Washington occur at shore-facilities, but the regulations also apply for offshore lightering between vessels. The regulations specify that the boom must be:

- At least four times the length of the

34 33 CFR 156.320
35 Puget Sound Harbor Safety Committee, 2017
36 Lower Columbia River Harbor Safety Committee, 2017
37 USCG Long Island Sound MSIB 2-17
38 During Shell's offshore exploration in the Chukchi Sea the U.S. Bureau of Safety and Environmental Enforcement required that boom be deployed prior to transferring fuel from a fuel storage tanker to a barge. This requirement, stipulated in the conditions of the lease, was unique to the Arctic and is not a standard requirement (Shell Gulf of Mexico, Inc., 2013; Dept. of Interior, 2013).

largest vessel involved in the transfer (or 2,000 feet maximum);

- Deployed with at least a five-foot space between the boom and the vessel at the water line;
- Checked periodically and adjusted as necessary. [WAC 173-184]

The responsibility rests with the entity delivering the oil to provide the personnel and equipment necessary for pre-booming [RCW 88.46.160]. "Safety and effectiveness" are established in reports that operators submit to the Washington Department of Ecology for public comment, review, and approval. These reports define the conditions that will be considered when the operator is determining whether to deploy boom based on the conditions at the lightering location and nature of the equipment used. "Conditions" in this case include environmental conditions such as wind and waves, but also vessel traffic and other activities such as fishing in the area of the transfer (Dept. of Ecology, 2006). In addition to specifying thresholds, the reports also characterize the relevant conditions in the area where transfers are conducted. In one example, for BP's Cherry Point refinery, the safe and effective thresholds are defined in three categories: green, orange, and red, as shown in Table 6.

Department of Ecology staff indicate that the pre-booming thresholds used by different operators are similar around the state, including for the limited offshore transfers that occur, even if the conditions at the different locations vary (personal communication with Jason Reichert, August 2, 2018).

Table 6. Pre-booming thresholds established for BP's Cherry Point refinery (Polaris Applied Sciences, 2007)

	GREEN: If all conditions are green, pre-boom	ORANGE: If one condition is orange, Dock Master determines whether to pre-boom	RED: If one condition (other than currents) is red, do not pre-boom[39]
Wind (knots)	0 to 10	10 to 20	> 20
Wave height (feet)	0 to 2	2 to 4	>4
Wave type	Calm, low swells, or ripples	Slight chop, steeper swells, or white caps	Steep, choppy, breaking waves
Currents (knots)	0 to 0.5	0.5 to 1	>1*
Visibility	Unlimited	<2 miles	<1000 feet

Washington Department of Ecology's rulemaking process under the statute setting out pre-booming requirements included a stakeholder advisory committee and extensive research and discussion regarding the feasibility of pre-booming in different conditions, transfers conducted in Washington, and other places where pre-booming was already used. Information provided in transfer notifications includes whether or not pre-booming will be used. This is provided via an online portal and the data are tracked over time for each location.

39 The table indicates that if currents are at 1 knot or greater, other factors should be considered when determining whether to pre-boom (Polaris Applied Sciences, 2007).

California's regulations require that either boom be positioned around the receiving vessels engaged in a transfer (with a 4-ft swath) or that it be on hand and able to be deployed within 30 minutes should a release occur [14 CCR 844(b-c)]. An additional 600 feet of boom must be located such that it can be deployed within 1 hour if needed [14 CCR 844(d)]. The best management practices for bunkering in California (transfers of fuel) state that boom must be deployed around the vessel before the transfer occurs (California Harbor Safety Committees, 2011).

On-scene Spill Response Equipment

Current Practice in Arctic Alaska	Barge will have: harbor boom, skimmer suited to non-persistent fuels, storage, skiff
Additional Measures Identified	Sorbents, etc. for 7 bbl spill to deck Skimming capacity for both persistent and non-persistent spill OSRO on site (sometimes)

Arctic Alaska

The spill response equipment on-scene for fuel transfers in Alaska was described in Section 3. While additional equipment is staged around the region or could be deployed from a hub (Anchorage or Dutch Harbor), the focus for this section is on equipment that is on-scene at the time of a fuel cargo transfer, which is the equipment on the receiving barge under the APD&T APC.

Other Locations

When comparing Western Alaska to other locations, there is not a significant difference in the response equipment required to be on-scene. However, in most locations outside of Western Alaska, the overall volume of response equipment available to respond to vessel or facility spills (not just from transfers) is much greater, and the area is not as remote and is therefore more readily accessible to response personnel and equipment.

Washington regulations require a small amount of equipment to be on-scene for transfers if pre-booming is not conducted, including containers for temporary storage of recovered oil and water; non-sparking hand scoops, shovels, and buckets; and sorbent material for a 7 bbl spill [WAC 173-184-115(7)].

California requires equipment onboard both the discharging and receiving vessels to respond to a 7 bbl spill on deck. This includes sorbent, containers to hold oily waste, personal protective equipment, a deck cleaning agent, and appropriate pumps and hoses [14 CCR 844(b)(1)]. As noted above, California's regulations require that enough boom be on hand to surround the receiving vessel (with an additional 4-ft swath) – and that the equipment, personnel, and procedures be in place to do so in 30 minutes, if not deployed in advance. An additional 600 feet of boom (or more) must be able to be deployed after another 30 minutes (1-hour total from identification of a spill). Skimming capacity is not specified, but regulations require that operators engaged in a transfer have equipment on board to contain and remove both persistent and non-persistent spills [14 CCR 844(b-c)]. Bunkering best management practices in California state that if an OSRO is not providing this response capacity, the vessel crews must conduct bi-annual boom deployment which involves demonstrating the ability to deploy at least 1200 feet of boom within 30 minutes (California Harbor Safety Committees, 2011).

On-site Agency Oversight

Current Practice in Arctic Alaska	U.S. Coast Guard receives and compiles notifications U.S. Coast Guard overflights in 2018 ADEC reviews C-plans (state waters only)
Additional Measures Identified	On-site monitoring of transfers

It is relevant to note the differences in on-site agency presence at transfers in Arctic Alaska and elsewhere, but at the same time the vastly different context must be acknowledged. The Washington Department of Ecology sends inspectors to observe 5-7% of the nearly 14,000 oil transfers that happen in the state each year (many of them crude oil being delivered to refineries). Currently, the vast majority of these do not occur between two vessels on the open water, but at a dock that is readily accessible on the road system. California also has state inspectors that observe transfers, and the U.S. Coast Guard in both places will make both announced and unannounced inspections during a transfer.

As noted above, in Western Alaska, operators submit lightering notifications to the Coast Guard, and – for state waters – ADEC reviews C-plans submitted by operators. While the Coast Guard may inspect tankers entering U.S. waters under port state controls, on-scene observation of lightering operations by government regulators or agency personnel generally does not happen in Arctic Alaska. That said, the Coast Guard did conduct some overflights during lightering operations in the summer of 2018 as part of their Arctic Shield operations.

7. DISCUSSION AND RECOMMENDATIONS

Alaska has a long tradition of maritime activity, but lightering from tankers in Arctic Alaska is relatively new. The use of tankers means there are now larger ships with larger petroleum cargoes as compared to the previous system based entirely on tugs and barges. The use of tankers also means that ships are moving through areas where charting is known to be outdated. At the same time, tankers have an advantage over barges in that they have integrated steering, propulsion, and cargo in one vessel rather than relying on the connection to a tug.

Risks associated with lightering tankers include the potential for an operational or equipment failure during the lightering operation itself, or an incident involving a tanker as it is moving through the area but not lightering. The response resources that are on-scene during a transfer are oriented towards those smaller spills during a transfer since they rely on response resources located on barges. Mounting a larger response would require mobilizing resources from Dutch Harbor, Anchorage, or other locations which takes time even when responders are as well-positioned as they can be for a rapid deployment.

Most lightering occurs outside state waters, very often just outside the 3 nautical mile boundary. This means operators are not required to submit a request to ADEC to amend their state C-plan. The state-required C-plans bring the benefit of transparency and clarification regarding various practices (such as the conditions in which a transfer would not be conducted). They also provide a picture of how the various assets needed for a response – including people – would be brought to bear in different spill response scenarios. However, they do not compel the availability of any greater capacity of response resources on-scene or in the area. Entering state waters means that an operator engaged in chartering a tanker and purchasing fuel must also anticipate the time it takes to get the state approval of their proposed plan amendments if the tanker is not already included in their plan. (They must also provide a Certificate of Financial Responsibility to enter state waters.) The time required to get an amendment approved to bring a tanker into state waters, and the possibility that it may not be approved or may warrant additional information, represents a business risk for the companies. State C-plans may also only be approved for a limited cargo volume, whereas much larger ships can be used outside state waters. For these reasons, most tankers engaged in lightering stay outside state waters. Of the tankers identified by the Network as engaging in lightering in 2016-2017, just three had state-approved C-plan amendments available for review on the ADEC website as of July 2018.

The companies that conduct lightering operations in Western Alaska have an excellent safety record and to date, no lightering-related spills have been reported in the region. Nonetheless, some of the protective measures related to lightering operations identified in areas outside the study area warrant consideration for Arctic Alaska. Overall, in considering any changes to current operations it will be important to be mindful of the potential for unintended consequences such as increasing the cost of fuel to communities. Wherever possible, recommendations should be implemented

with the widest possible input including from operators, communities, subsistence users, and regulators.

Recommendations

Continue to compile – and share – information about actual lightering locations used and routes.

The USCG is now compiling lightering reports – location, types/volumes of fuel to be transferred, date and time of planned transfer, etc. This information can help to understand where lightering is occurring to inform charting updates or identify potential conflicts with local uses or sensitive species if shared with communities. If amenable to the operators who provide the reports, they could also be sent to communities (if there was interest), or other groups such as the Network or Alaska Chadux could compile and share the information with interested parties instead of the USCG playing this role.

Consider costs, logistics, and expected effectiveness of remotely monitoring transfer operations via onboard cameras.

Arctic Alaska is far more remote than most other parts of the U.S. where fuel transfers occur over water, which challenges agency oversight. Electronic monitoring similar to fisheries monitoring may be a viable alternative depending on the costs and logistics.

Continue to update hydrographic surveys of the area.

Lightering activity brings tankers to many areas of the Bering Sea and the U.S. waters of the Chukchi and Beaufort Seas as well. The issues of outdated or inadequate charting information are widely recognized, and highlighted by the brief soft grounding in 2016 of a tanker that was moving – with caution – through an area shown to be deep enough on charts when in fact there was an unidentified shoal.

As noted in the USCG's joint submittal with Russia to the IMO when proposing vessel routing measures,

> *The shallow depths of the eastern Bering Sea are especially problematic for mariners because some nautical charts for this area are utilizing hydographic data obtained over 100 years ago with a leadline at spacing intervals in excess of a mile apart.*

IMO routing measures will encourage most deep draft traffic through designated corridors leading to and from the Bering Strait. While this minimizes the hazard for those ships, the only way to address the issue for the tankers moving about serving different communities in Arctic Alaska will be to continue the on-going process of updating charts. This responsibility rests with the National Oceanic and Atmospheric Administration (NOAA), which is actively working to update this information around Alaska and to advance the use and access to digital charting and contribute to marine spatial planning (NOAA, 2017). In the summer of 2018, 565 square nautical miles were to be surveyed near Point Hope. Other focus areas in 2018 are outside the study area (NOAA, 2018b). Prioritizing areas where lightering occurs – or, as in the suggestion below – focusing lightering on areas with recent charting – could be considered with operator input. Areas tankers transit between lightering locations should also be considered. One operator noted also the need for better information about the rivers in the region as well.

Identify preferred lightering locations – or areas to avoid lightering – with input from communities.

The marine pilots and companies operating lightering tankers bring extensive knowledge of the waterways through which lightering tankers travel in Arctic Alaska; at the same time, so do the coastal communities around the region. The common lightering locations identified by the Network and Marine Exchange of Alaska indicate areas mariners have identified, though lightering takes place outside those areas, as well. Those engaged in subsistence harvests or commercial fisheries may also have knowledge of areas where a spill or disturbance by tankers and barges could pose a particular risk to their activities. This may vary somewhat throughout the season, as well. Bringing this knowledge together could result in a set of preferred lightering locations that would help mitigate risks associated with the activity. If lightering were to be shifted to a smaller range of locations than currently used, the potential for impacts to the ocean floor from repeated anchoring should be considered as this could be an unintended consequence.

Identify best practices regarding conditions in which lightering should proceed.

While the Network's APC states the intent that transfers should not be conducted if a response could not be mounted, the actual decision regarding what those conditions look like is left to the operators. Because they all rely on the same set of response equipment – that based on the barges participating in the APD&T APC – it seems reasonable that they should also share an understanding of what those conditions may be. A set of conditions may be able to be agreed upon by all operators and then documented (see below discussion of mechanisms). It should also be made clear that these conditions apply regardless of whether the transfer occurs in federal or state waters. (The C-plans cover state waters only; the APC covers federal waters. The response equipment – and thus also the conditions in which response would not be possible – remains the same.)

A similar process could be applied to consider conditions which may make the mooring of vessels alongside each other – prior to the actual transfer – less safe.

The responsible persons can always make the final determination of whether it is safe to moor alongside another vessel or conduct a transfer, and this will necessarily include consideration of other factors such as crew fatigue, forecasted weather, or other extenuating circumstances. A potential unintended consequence would be adding to delays in fuel deliveries.

Consider "pre-booming" during transfers.

If a spill occurs during a transfer, the same people that are resolving whatever issues have resulted in the spill in the first place will also need to deploy boom from the barge. While having the equipment on-scene on the barge is crucial, it does not guarantee that crew will be able to contain the spill. Pre-booming is required elsewhere in Alaska when persistent fuels, such as crude oil, are transferred over water and has been identified as effective even for non-persistent products in Washington and California. Implementation would require more boom to be carried in order to encircle the vessels involved in lightering, or magnetic boom anchors that could attach the boom to the tanker (thus

requiring this equipment and training in its use but not necessarily any more boom). Pre-booming would not be effective if the boom was overcome by wind or waves, but if transfers are not conducted in conditions in which the boom would fail, then pre-booming appears to provide an excellent protective measure. However, deploying the boom before each transfer – and then collecting it to return to the barge – requires time, effort, and the appropriate equipment. Both practical considerations and the potential for this type of operation to increase cost are not analyzed here but should be considered.

Ensure that response equipment on scene is suited to the conditions in which a spill may occur.

The equipment that will be immediately available on scene will be most critical to mitigating the impacts of a response. A tanker accident resulting in a spill will require equipment to be mobilized from Dutch Harbor and Anchorage, but if a barge is on-scene – as would be the case during a fuel transfer – the equipment on that barge would be critical. As barges generally carry equipment suited to calm, protected waters, the applicability of the equipment in the offshore environment in which transfers occur (and the conditions in which operators indicate that transfers will be conducted) should be considered and potential enhancements considered to better align the spill response resources with the potential operating environment.

Continue to demonstrate response capability through drills and exercises.

Given the distances involved and the potential for weather delays, the spill response resources that are immediately on-scene are of paramount importance to mitigating impacts should a spill occur. As the APCs are structured, the spill response resources for a tanker-to-barge lightering operation are located on the barge receiving the fuel transfer (or, if the transfer occurs between two tankers, on a barge that is standing by). The rapid and effective deployment of these resources should be demonstrated, preferably through unannounced drills, in the conditions in which they would be used.

Plan for possible outcomes if a tanker loses its mooring or anchorage at a common lightering area.

Although likely a low probability, operators should ensure they prepare for a tanker grounding in the remote areas of Arctic Alaska, including how long it may take for the tanker to drift ashore and feasibility of achieving a self-arrest and/or emergency tow (and the availability and capability of potential emergency tow vessels at different locations used for lightering). While oil spill response scenarios are required in operators' C-plans required by the state, these apply only to state waters (and thus only tankers with a cargo volume approved to enter state waters, while larger tankers are used outside state waters). This could be done as part of updating content in the new Arctic and Western Alaska Area Contingency Plan and/or via a table top or field exercise.

Conduct a tabletop or field exercise to test preparedness for an incident related to a tanker grounding resulting from loss of steering or propulsion while approaching a lightering location.

Such a scenario should consider the location and capability of tugs/barges and whether these may be away from the tanker making deliveries when an incident occurs. (The Network can – and does – provide this information real-time from its

Monitoring Center.) It may also consider the role community-based first responders could play in deploying protective booming of sensitive areas, or expose gaps in local preparedness. This should include demonstrating the ability to deliver and deploy the necessary containment, recovery, and primary storage systems from suitable vessel platforms, as well as initiating aerial observation.

Possible Mechanisms

Consider developing appropriate best management practices for offshore lightering via the waterways safety committees.

The study area for this project benefits from two organizations that exist to promote safe maritime operations: the Arctic Waterways Safety Committee (founded in 2015[40]) and the Aleutian Islands Waterways Safety Committee (founded in 2017[41]). Waterways safety committees provide one forum for different stakeholders to bring together their expertise in maritime activities and local knowledge of subsistence activities, habitat and environment, and navigational issues. In Washington and California, among others, similar groups have developed standards of care for lightering and bunkering operations. While on the West Coast of the Lower 48 there has been an effort to provide consistency for operators by aligning these practices, the unique circumstances in Arctic Alaska should be considered.

Continue to improve procedures and resources under Alternative Planning Criteria programs.

Given the unique context and geography of Western Alaska, alternative compliance with federal oil spill preparedness regulations is clearly reasonable.[42] Procedural modifications could include identifying preferred lightering areas with broader stakeholder input, as described above, since all the tankers are covered under the Network APC. The Network APC could also determine options for incorporating pre-booming (and under what circumstances), or investing in skimmers and boom designed for the offshore environment in conjunction with APD&T. This could be done through a build-out plan over time.

Address tanker lightering operations and potential oil spill risks and response in government oil spill response planning.

ADEC, the USCG, and the Environmental Protection Agency are in the process of revising the government response plans for Alaska. These plans were recently reorganized from 10 subarea plans and an overarching Unified Plan to four area plans and an overarching regional contingency plan. The new area plans will be maintained by Area Committees going forward. The study area for this project is now included in the Arctic and Western Alaska Area Contingency Plan, which replaced the subarea plans for the North Slope, Northwest Arctic, Western Alaska, Bristol Bay, and Aleutians – as well as Kodiak and

40 http://www.arcticwaterways.org/
41 https://www.aleutianislandswsc.org/
42 In the Aleutian Islands Risk Assessment, which considered risk mitigation options for the large volume of ship traffic moving through the southern part of the study area for this project, the Advisory Panel concluded that alternative compliance was appropriate there (Nuka Research, 2015). The small number of tankers and even larger geographical area considered for the whole of Arctic Alaska makes this even more true, but does not have to mean a lesser degree of protection, just a shift to emphasis on prevention and immediate response to small spills.

Cook Inlet (ADEC, 2018). Tanker lightering was not an issue previously included in the subarea plans covering the study area, but this practice and considerations for oil spill response could be incorporated into the appropriate sections of the Arctic and Western Alaska Area Plan as the Area Committee for that region begins the process of content updates. As noted above, one of the scenarios in the plan could consider a tanker grounding or other spill of cargo occurring with a vessel that is not approved to enter state waters.

8. CONCLUSION

A network of tankers, barges, and tugs delivers a vital service to communities throughout Arctic Alaska, bringing the fuel used to heat homes; power boats, vehicles, and aircraft; fuel industrial activity; and generate electricity. Shifts in this practice in recent years have brought foreign-flagged tankers into the region, bringing not only larger volumes of fuel into place but also the fuel used for the tanker's own propulsion as well. While there have been no recorded spills from these operations to date, there may still be opportunities for operators and communities to explore risk mitigation measures that may be achievable without adding undue cost to the fuel deliveries. This report describes some options for consideration gleaned from reviewing current regulations and practices and considering what is done in on-water transfer operations in other places.

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