13. MARINE TRANSPORTATION

This chapter discusses the regulatory setting, study area, and study methodology related to marine transportation, from the refinery wharf structure to the Pacific Ocean, via the marine vessel transportation route. The affected environment, potential impacts of the proposed project, potential impacts of the no action alternative, and additional mitigation measures are discussed in Section 13.3 for vessel traffic and Section 13.4 for vessel safety.

Section 13.5 discusses potential accidental marine spills associated with the proposed project, both from vessels in transit and during a product transfer at the wharf. Spills on land are not discussed here, and are instead discussed in other relevant chapters of this Draft EIS. Section 13.5 discusses the affected environment, the behavior of xylenes and reformate in the environment, the spill modeling methodology results, and a summary of the potential impacts of spills on various resources. Section 13.5 also discusses the likelihood of such an event happening, and the spill response plans and resources in place that would act to prevent or minimize exposure of sensitive resources to the spill.

Proposed project activities are evaluated for impacts related to construction, operations and maintenance, and spill response.

Impacts on marine transportation on other resources are described throughout the Draft EIS. Table 13-29 includes cross-reference to the relevant resource chapters. Impacts to tribal resources are discussed in Chapter 11, Social and Economic Environment, and Chapter 12, Cultural Resources.

13.1. LAWS, REGULATIONS, AND GUIDANCE FOR MARINE TRANSPORTATION

Table 13-1 provides a summary of the laws, regulations, and guidance applicable to marine transport. Unless otherwise specified, "oil" as used in this chapter, applies to all petroleum-based materials, including mixed xylenes and reformate, as provided in the Oil Pollution Act of 1990 (OPA 90, 33 USC 2701 et seq.).

Table 13-1: Relevant Laws, Regulations, and Guidance for Marine Transportation

Regulation, Policy, or Guideline	Description
Federal Regulations	
Oil Pollution Act of 1990 (33 USC 2701 et seq.)	Defines liability among responsible parties for oil spill removal and financial damages resulting from oil spills.
33 CFR Part 6: Protection and Security of Vessels, Harbors, and Waterfront Facilities	Gives the USCG Captain of the Port (COTP) the authority to issue orders to promote safety and security within the COTP jurisdiction.
33 CFR Part 104: Maritime Security, Vessels	Prescribes measures for the security of maritime vessels, personnel, and vessel operations. Requires vessel security drills, exercises, training, and implementation of a vessel security plan.
33 CFR Part 105: Maritime Security, Facilities	Prescribes measures for the security of maritime vessels, personnel, and vessel operations. Requires facility security drills, exercises, training, security measures, and implementation of a facility security plan.

Regulation, Policy, or Guideline	Description
33 CFR Part 133: Oil Spill Liability Trust Fund, State Access	Prescribes procedures for a state governor to request payments from the Oil Spill Liability Trust Fund (the Fund) for oil pollution removal costs under Section 1012(d)(1) of OPA 90. The fund is available to the president for payment of removal costs, including the costs of monitoring removal actions, as determined by the president to be consistent with the National Contingency Plan.
33 CFR Part 138: Financial Responsibility for Water Pollution (Vessels) and OPA 90 Limits of Liability (Vessels, Deepwater Ports and Onshore Facilities)	Requires the operators of applicable vessels to obtain and be able to demonstrate proof of the ability to meet to the combined Oil Pollution Act of 1990 (OPA 90) and the Comprehensive Environmental Response, Compensation, and Liability Act limits of financial liability arising from a single incident.
33 CFR Part 151: Vessels Carrying Oil, Noxious Liquid Substances, Garbage, Municipal or Commercial Waste, and Ballast Water	Enforces regulations on the management of multiple non-cargo waste streams and ballast water from vessels (MARPOL 73/78 Annexes I, II and V).
33 CFR Part 154: Facilities Transferring Oil or Hazardous Material in Bulk	Prescribes specific guidelines to prevent pollution from oil or hazardous materials as cargo and covers, including facility and wharf equipment, personnel qualifications, cargo transfer operations, pollution response plans, and marine salvage and firefighting.
33 CFR Part 154 Subpart F: Response Plans for Oil Facilities	Establishes oil spill response plan requirements for all marine transportation-related facilities that could reasonably be expected to harm the environment by discharging oil into or on the navigable waters, adjoining shorelines, or exclusive economic zone.
33 CFR Part 155: Oil or Hazardous Material Pollution Prevention Regulations for Vessels	Prescribes specific guidelines to prevent pollution from oil or hazardous materials as cargo and covers, vessel equipment, personnel qualifications, cargo transfer operations, pollution response plans, and marine salvage and firefighting.
33 CFR Part 155 Subpart D (§ 1010 to 1070): Vessel Response Plans for Oil	Establishes requirements for oil spill response plans for certain vessels. The planning criteria in this subpart are intended for use in response plan development and for identifying resources necessary to respond to the oil spill.
33 CFR Part 156: Oil and Hazardous Material Transfer Operations	Establishes specific requirements and operational procedures for bulk liquid oil and hazardous material transfer operations including equipment, personnel, inspections and testing, notifications, recordkeeping, and emergency procedures.
33 CFR Part 161: Vessel Traffic Management	Implements and enforces certain sections of the Ports and Waterways Safety Act and establishes the Vessel Traffic Services (VTSs) and VTS areas that would enhance navigation and marine environmental protection and promote safe vessel movement.
33 CFR 161.55: VTS Special Area Operating Requirements	Establishes special operating areas within the eastern San Juan Island Archipelago including areas of Rosario Strait, Guemes Channel, and Fidalgo Bay.
33 CFR Part 164: Navigation Safety Regulations	Establishes general requirements for vessel navigational safety and designates specific areas and operations that require enhanced measures to ensure navigational safety and security.
33 CFR 165.1301: Puget Sound, and Adjacent Waters in Northwestern Washington–Regulated Navigation Area	Establishes guidelines for fishing in and around the navigational channel and the vessel traffic separation zone between the inbound and outbound channels.
33 CFR 165.1303: Puget Sound and Adjacent Waters, Washington–Regulated Navigation Area	Tank vessel navigation restrictions: tank vessels larger than 125,000 deadweight tons bound for a port or place in the U.S. may not operate in the regulated navigation area.

Regulation, Policy, or Guideline	Description
33 CFR 165.1313: Security Zone Regulations, Tank Ship Protection, Puget Sound and Adjacent Waters, Washington	Establishes a tank ship security zone extending for a 500-yard radius around all tank ships located in the navigable waters of the U.S. in Puget Sound.
33 CFR 165.1317: Security and Safety Zone; Large Passenger Vessel Protection, Puget Sound and Adjacent Waters	Establishes a security zone extending for a 500-yard radius around any cruise ship over 100 feet in length carrying passengers for hire and any auto ferries and passenger ferries over 100 feet in length carrying passengers for hire such as the Washington State Ferries, M/V COHO, and Alaskan Marine Highway ferries.
33 CFR 165.1321: Security Zone; Protection of Military Cargo, COTP Zone Puget Sound, Washington	Establishes security zones for military cargo vessels transiting Puget Sound.
33 CFR 165.1327: Security Zone; Escorted U.S. Navy Submarines, COTP Zone Puget Sound, Washington	Establishes security zones for U.S. Navy submarines transiting Puget Sound.
33 CFR 167. 1310: Offshore Traffic Separation Schemes in the Strait of Juan De Fuca: General	Establishes five-part traffic separation scheme in the Strait of Juan de Fuca: the western lanes, southern lanes, northern lanes, eastern lanes, and precautionary area or traffic separation area.
33 CFR 167.1321 Offshore Traffic Separation Schemes: Rosario Strait	Establishes separation zones and traffic lanes in Rosario Strait.
40 CFR 110: Oil Pollution Prevention	Prohibits discharge of oil in waters of the U.S. and requires reporting in the case of a spill.
40 CFR 300: National Oil and Hazardous Substances Pollution Contingency Plan (NCP)	Requires the development of a series of regional plans to coordinate oil spill responses among federal, state, local, and tribal agencies and the private sector.
46 CFR 2.10-25	Defines the following terms, used throughout this Draft EIS: • *Tank vessel* means a vessel that is constructed or adapted to carry, or that carries, oil or hazardous material in bulk as cargo or cargo residue. • *Tank barge* means any tank vessel not equipped with means of propulsion. • *Tankship* means any tank vessel propelled by power or sail, including an integrated tug and barge designed to operate together only in the pushing mode.
46 CFR Chapter I: Coast Guard, Department of Homeland Security Subchapter D, Tank Vessels	Gives the USCG authority to enforce domestic and international standards for the engineering and design, certification and inspection, critical lifesaving and pollution prevention equipment, and operations of tank vessels in waters of the U.S.
International Laws and Treaties	
Convention on the International Regulations for Preventing Collisions at Sea, 1972	Establishes navigation safety regulations including the “rules of the road” or navigation rules to be followed by ships and other vessels at sea to prevent collisions between two or more vessels and implement traffic separation schemes.
International Convention on Civil Liability for Oil Pollution Damage (CLC)	Ensures that adequate compensation is available to persons who suffer oil pollution damage resulting from maritime casualties involving oil-carrying ships. Liability for such damage is on the owner of the ship from which the polluting oil escaped or was discharged and applicable ships must maintain insurance or other financial security in sums equivalent to the owner’s total liability for one incident. In the case of the proposed project, xylene and reformate would both meet the definition of oil and therefore transport of these chemicals would be subject to this regulation.
International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC)	Establishes measures for dealing with pollution incidents, either nationally or in cooperation with other countries. Ships are required to carry a shipboard oil pollution emergency plan.

Regulation, Policy, or Guideline	Description
International Convention on Load Lines	Ensures stability and the watertight integrity of ships' hulls below the freeboard deck by mandating minimum draughts for all vessels based on vessel type, size, and location. Allows a coastal state to report a pollution violation to the flag state of the vessel. The flag state, if it is a MARPOL 73/78 signatory, is then obligated under the convention to facilitate action against the offending ship. Parties to MARPOL 73/78 are obligated to enact national legislation that allows for the prosecution of vessels that spill oil or violate oil prevention regulations within their territorial waters *and* vessels that commit violations in other nation's waters or on the high seas while flying under the nation's flag.
International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)	MARPOL (short for marine pollution) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.
International Convention on Standards of Training, Certification and Watch-keeping for Seafarers	Promotes the safety of life and property at sea and the protection of the marine environment by establishing international standards of training, certification, and watch-keeping for seafarers.
International Oil Pollution Compensation Funds (IOPC Funds)	Provides financial compensation for oil pollution damage that occurs in member states resulting from spills of persistent oil from tankships.
International Standards Organizations Technical Committee	Standards for ships and marine technology for lifesaving and fire protection, piping and machinery, navigation, and design.
MARPOL 73/78, Annex I: Regulations for the Prevention of Pollution by Oil	Requires that all single-hull tankers in U.S. waters be phased out by January 1, 2015, and that all new tankers and tank barges be built with double hulls.
MARPOL 73/78, Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk	Control of pollution by noxious liquid substances carried in bulk (approximately 250 substances are listed).
Safety of Life at Sea Convention, 1960 (SOLAS)	Specifies minimum standards for the construction, equipment, and operation of ships, compatible with their safety. Flag states are responsible for ensuring that ships under their flag comply with its requirements, and a number of certificates are prescribed in the convention to prove compliance.
Washington State Laws and Regulations	
RCW 77.120 and WAC 220-150: Ballast Water Management	Establishes protections from the potential economic and environmental damage to the state that could be caused by the introduction of nonindigenous species from ballast water.
RCW 88.16.170 to 190	Requires all tankships over 5,000 gross tons to take on a state of Washington licensed pilot in Puget Sound, and requires all tankships over 40,000 deadweight tons to be escorted by tugs.
RCW 88.46.050: Vessel Screening; WAC 317-31: Cargo and Passenger Vessels Substantial Risk	Ecology rules for determining whether cargo vessels and passenger vessels entering the navigable waters of the state pose a substantial risk of harm to the public health and safety and the environment.
RCW 90.56.340: Duty to Remove Oil	Directs any person owning or having control over oil entering waters of the state in violation of RCW 90.56.320 to immediately collect and remove the same. If it is not feasible to collect and remove, said person must take all practicable actions to contain, treat, and disperse the same.
WAC 173-180: Facility Oil Handling Standards	Prescribes specific guidelines to prevent pollution from oil or hazardous materials as cargo and covers, vessel equipment, personnel qualifications, cargo transfer operations, pollution response plans, and marine salvage and firefighting.
WAC 173-182: Oil Spill Contingency Plan	Establishes covered vessel and facility oil spill contingency plan requirements.

Regulation, Policy, or Guideline	Description
WAC 173-183: Oil Spill Natural Resource Damage Assessment	Establishes procedures for convening a resource damage assessment committee, pre-assessment screening of resource damages resulting from oil spills to determine which damage assessment methods to use, and determining damages.
WAC 173-184: Vessel Oil Transfer Advance Notice and Containment Requirements	Establishes specific requirements and operational procedures for bulk liquid oil and hazardous material transfer operations including equipment, personnel, inspections and testing, notifications, recordkeeping, and emergency procedures.
WAC 317-40 Bunkering Operations	Enforces regulations on the management of multiple non-cargo waste streams and ballast water from vessels (MARPOL 73/78 Annexes I, II, and V).

13.2. Study Area and Methodology

13.2.1. Study Area

The study area for marine transportation includes the marine vessel transportation route and adjacent waters and shorelines from the Tesoro Anacortes Refinery wharf structure to the edge of U.S. territorial waters in the Pacific Ocean, approximately 12 nautical miles (nm) seaward of the entrance to the Strait of Juan de Fuca (see Figure 2-3 in Chapter 2, Proposed Actions and Alternatives). These waters lie mostly in the U.S. and partially in Canada. While marine transportation impacts could occur beyond these boundaries, the geographic extent of the Pacific Ocean and the unknown routes taken by vessels associated with the proposed project makes identifying impacts in international waters speculative. Individual waterways along the marine vessel transportation route are discussed in the sections below.

13.2.1.1. Strait of Juan de Fuca

The Strait of Juan de Fuca is an international waterway that separates the U.S. and Canada. The international boundary lies along the centerline of this Strait. Its width ranges from 12 to 16 nm, with deep water and few shoals, outcroppings, or other similar shoreline risks along most of its length. The Strait of Juan de Fuca extends east from the Pacific Ocean between Vancouver Island, British Columbia, and the Olympic Peninsula, Washington, to Haro Strait, San Juan Channel, Rosario Strait, and Puget Sound. The entrance to the Strait of Juan de Fuca at the Pacific Ocean boundary is formed by a line between Cape Flattery and Tatoosh Island, Washington, and Carmanah Point, Vancouver Island, British Columbia. The Strait of Juan de Fuca provides access to major U.S. ports, including Seattle and Tacoma, Washington, Canadian ports including Vancouver, British Columbia, as well as access to other British Columbian ports and southeastern Alaska via the Inside Passage at Vancouver Island (NOAA 2016).

13.2.1.2. Rosario Strait

Rosario Strait is the easternmost channel between the Strait of Juan de Fuca and the Strait of Georgia and is used primarily by marine vessels bound for Cherry Point, the city of Anacortes, and Bellingham. It ranges from 1.5 to 5 nm in width and has water depths of 78 feet or more. Vessels calling at the Tesoro Anacortes Refinery would pass through the southern entrance to Rosario Strait (NOAA 2016).

13.2.1.3. Guemes Channel

The Guemes Channel stretches from Rosario Strait in the west to Padilla Bay in the east. The channel is 3 nm long and 0.5 mile wide at its narrowest point, with depths from 48 to 108 feet (NOAA 2016).

13.2.1.4. Fidalgo Bay and Padilla Bay

Fidalgo Bay is a deep water area between Anacortes and March Point. It has three designated anchorages. Deep water docks are available at the Port of Anacortes and at the Tesoro and Shell terminals on March Point at the east side of the bay. Padilla Bay lies on the east side of March Point. Vessels calling at Tesoro Anacortes do not pass through Padilla Bay (NOAA 2016).

13.2.1.5. Tesoro Anacortes Refinery Wharf

March Point is a peninsula between Fidalgo and Padilla bays. The Tesoro Anacortes Refinery and Shell Puget Sound Refinery piers extend north from the north end of the point to deep water. Table 13-2 summarizes the characteristics of the refinery wharf. The wharf has two mooring dolphins;[1] the aft mooring dolphin extends from a 193.5-foot finger pier to the west, and the forward mooring dolphin extends from a 140-foot finger pier to the east. Three breasting dolphins are on the north side for tankships[2] spaced approximately 210 feet apart along the wharf. The north side of the pier has 974 feet of berthing space with dolphins and a depth of 45 feet reported alongside; the south side of the pier has 820 feet of berthing space with dolphins and a depth of 38 feet reported alongside.

Table 13-2: Refinery Wharf Characteristics

Length	Width	Water Depth	Mooring Dolphins	Breasting Dolphins	Berthing Space
650 feet	65 feet	North side: 45 feet South side: 38 feet	1 forward 1 aft	3	North side: 974 feet South side: 820 feet

13.2.2. Methodology

To evaluate potential impacts on and from marine transportation, baseline conditions were documented from proposed project plans and procedures (Chapter 2, Proposed Action and Alternatives); public records; data from USCG, NOAA, and other public agencies; and previously published reports regarding marine traffic in the study area.

The primary marine traffic studies used to support this analysis include the following:

- Gateway Pacific Terminal Vessel Traffic and Risk Assessment Study (Glosten Associates 2014a)
- Vessel Traffic Risk Assessment (VTRA) 2015: VTRA 2015 US232 Case and VTRA 2015 Base Case Comparison (Merrick and van Dorp 2016)

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[1] Dolphins are structures that extend above the waterline and are used to help moor/anchor vessels.
[2] Self-propelled vessels or tug-barge combinations carrying petroleum-related products, as defined in 46 CFR 2.10-25 (see Table 13-1).

- Tesoro Anacortes Refinery Clean Products Upgrade Project Vessel Traffic Assessment (CH2M Hill et al. 2016)

Potential impacts on marine transportation were evaluated as part of this analysis, and were determined through a public scoping process and by considering the proposed project's potential to impact these resources. Potential marine transportation impacts that could occur during both construction (short term) and operations (long term) of the proposed project were considered in this analysis. A series of scoping meetings were conducted during the scoping period for the proposed project, with the public, tribes, and government agencies providing verbal and written comments. The primary issues related to marine transportation that are addressed in this section include:

- Impacts on non-project waterway users due to increased proposed project-related vessel traffic
- Risk of "marine casualty" as defined in 46 CFR 4.03-1[3] or accident due to proposed project activities
- Marine spills

The methodologies and criteria for evaluating marine transportation impacts are described in the sections below. In addition to evaluating potential impacts associated with the above issues, other chapters in this document also evaluate the potential impacts associated with a spill event. A detailed discussion of these potential impacts is included in various resource chapters, as appropriate, and a summary of these potential impacts is also included in Section 13.5.8.

13.2.3. Summary of Potential Impacts from Spills

13.2.3.1. Marine Vessel Traffic

Potential impacts on marine vessel traffic could result from the presence of additional tanker vessels associated with the proposed project, specifically:

- Increased delays and navigational complexity in waterways and facilities used by vessels not associated with the proposed project
- Reduced public or non-project commercial access to waterways and maritime infrastructure (wharfs, maintenance areas, etc.)
- Reduced capacity of existing maritime infrastructure

A significant impact on marine vessel traffic is one that would result from substantial travel delays, changes in existing vessel traffic patterns, and/or economic impacts for public or non-project commercial vessels or businesses, such as loss of revenue due to restricted access to or delays reaching a particular destination; and would either impact all waterways and maritime infrastructure in the study area or would have an acute impact on one or more specific waterways or port facilities, occurring continuously or persisting permanently (i.e., over the long term).

[3] Per 46 CFR 4.03-1, a "marine casualty" is defined as: "Any casualty or accident involving any vessel other than a public vessel," including falls overboard; collisions, groundings, or other incidents related to vessels themselves; or injury or loss of life.

13.2.3.2. Marine Vessel Safety

Potential marine vessel safety related impact topics that were evaluated include potential impacts on vessel safety that could result from marine casualty events or other maritime incidents due to additional tanker trips associated with the proposed project, or due to marine spills.

A significant impact on marine vessel safety is one that would result in a substantially increased risk of marine casualty incidents—either some increase for all study area waterways and port areas, or acute impact on specific waterways or port areas—occurring either continuously, or persisting either permanently or over the long term.

13.2.3.3. Marine Spills

Section 13.5.2.1 discusses the historic and predictive data related to the likelihood of various spill events and associated spill volumes, and defines the spill volume categories evaluated in this Draft EIS. Section 13.5.2.2 provides a detailed description of spill modeling methodology. Section 13.5.2.3 defines the impact magnitude for criteria in terms of spill thickness. Potential marine spill related impact topics that were evaluated include:

- Air quality (see Chapter 4, Air Quality and Climate Change)
- Wildlife (see Chapter 6, Terrestrial Vegetation and Wildlife)
- Fish (see Chapter 7, Marine and Nearshore Resources)
- Human health (see Chapter 9, Environmental Health)
- Land and shoreline use (see Chapter 10, Land Use and Shoreline Use)
- Social and economic conditions of area resources (see Chapter 11, Social and Economic Environment)

A significant spill would have the potential to result in widespread environmental or human health damages, with impacts experienced within several miles of the spill, lasting for up to three days (the theoretical maximum time for 99.5 percent of spilled materials associated with the proposed project to dissipate; see Section 13.5.2 for a detailed discussion of spill characteristics).

Under normal operation of the refinery, mixed xylenes and the parent fluid (reformate) would not be released into the marine environment. Spills are therefore considered to be an unplanned event. Unplanned events are not intended, but could occur as a result of the proposed project activities. The methodology characterizes impact levels related to unplanned events using magnitude, geographic extent, and duration, with the added dimension of likelihood. Likelihood is expressed on a qualitative scale of probability categories described as Negligible, Low, Medium, or High (see Chapter 1, Section 1.7, Methodology).

13.3. VESSEL TRAFFIC

13.3.1. Affected Environment

Historical marine vessel traffic on waterways within the study area varies depending on the specific waterway, the activity being counted, and the type of vessel being considered. The areas of analysis for the impacts evaluated in this chapter are described in the following sections.

13.3.1.1. Regional Vessel Traffic

Table 13-3 summarizes annual vessel call data for the entire Salish Sea, as reported by Ecology. From 1999 to 2013, there was an annual average of 2,915 large commercial vessel entries (including large cargo and passenger vessels), of which tankships—including articulated tugs and barges (ATBs)[4]—comprised an average of 597 entries. Annual entries ranged from a high of 3,070 in 2008 to a low of 2,753 in 2012. These data count each marine vessel entry into the Salish Sea, but does not count multiple calls within the Salish Sea by an individual vessel[5] after its initial entry.

Table 13-3: Salish Sea Vessel Call Data 1999 to 2013

	Large Commercial Vessels (per year)	Tankships Only (per year)
Average annual vessel calls	2,915	597
Maximum annual vessel calls	3,070 (2008)	688 (2011)
Minimum annual vessel calls	2,753 (2012)	534 (1999)

Source: Ecology 2016

These vessel transits are regulated and controlled by the U.S. Coast Guard Puget Sound Vessel Traffic Service (USCG VTS) for the Salish Sea. Much like an airport traffic controller maintains clearance and positive control of aircraft at an airport, the USCG VTS maintains positive control of incoming and outgoing tankships and maintains navigational clearances and safe navigation for them from among other vessels.

The USCG VTS monitors and in most instances facilitates approximately 230,000 safe transits annually within the U.S. portion of the Salish Sea, including approximately 170,000 ferry transits in the state of Washington, which is approximately 74 percent of all transits. The Automatic Identification System (AIS) is an automatic tracking system used on ships and monitored by VTS to identify, locate, and track vessels (USCG 2016a).

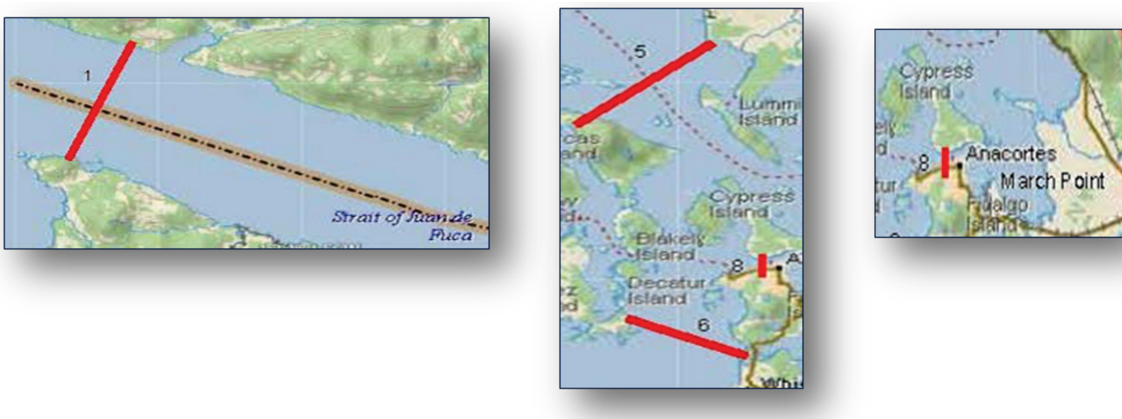
One method for using AIS to measure traffic volume is to measure crossings at passage lines, which are imaginary lines that distinguish the primary entrances/exits of distinct waterways. The following passage lines were used in this Draft EIS (see Figure 13-1):

- Strait of Juan de Fuca: from just west of Neah Bay to Port Renfrew

[4] Per 46 CFR 2.10-25, all tug-barge combinations are "tankships"—referred to as "tankers" in this Draft EIS. An ATB is a specific type of tug-and-barge system in which "a tank-barge that is mechanically linked with a paired tug that fits into a notch at the stern of the barge" (Tradewinds 2017).

[5] A vessel counted only once within a specified time period (such as a calendar year), even if the vessel calls in state of Washington waters more than once during the specified time period.

- Rosario Strait, south end: Decatur Island to Deception Pass
- Guemes Channel: Guemes Island to Fidalgo Island



1: Strait of Juan de Fuca; 6: Rosario Strait, 8: Guemes Channel
Source: CH2M Hill et al. 2016

Figure 13-1: Vessel Transit Service Passage Lines

Table 13-4 lists the number of vessel crossings through the waterways impacted by the proposed project. Table 13-5 summarizes annual vessel calls at March Point between 2010 and 2014. In 2014, 508 vessels called at March Point.

Table 13-4: Vessel Crossings by Waterway, 2010-2014

	Year	Strait of Juan de Fuca	Rosario Strait (Southern End)	Guemes Channel
All Large Vessels [a]	2010	8,589	4,509	13,921
	2011	9,219	5,504	16,130
	2012	9,494	5,292	15,765
	2013	9,310	5,523	15,821
	2014	10,594	6,162	17,654
	Average	9,441	5,398	15,858
Tankships Only	2010	NA	900	1,013
	2011	NA	1,006	989
	2012	NA	953	414
	2013	NA	1,024	316
	2014	NA	992	330
	Average	NA	975	612

Source: CH2M Hill et al. 2016
ATB = articulated tug and barge; NA = not available
[a] Includes cargo ships, large passenger ships, and tankships (as defined in 46 CFR 2.10-25—see Table 13-1).

Table 13-5: Vessel Calls at March Point, 2010-2014

	2010	2011	2012	2013	2014	Average	Total
Vessel Calls at March Point	395	481	490	491	508	473	2,365

Source: CH2M Hill, Rodino, Inc. 2016

13.3.1.2. Vessel Entries and Transits Data

Table 13-6 presents data from Ecology's Vessel Entries and Transits (VEAT) reports from 2005 to 2015 for Puget Sound as a whole.

Table 13-6: Selected VEAT Data

Year	Cargo and Large Passenger		Tankers [a]		ATB		Tug and Tank Barge (Other than ATB)	
	Individual Vessels	Transits	Individual Vessels	Transits	Individual Vessels	Transits	Individual Vessels	Transits
2005	603	1,670	NA	NA	103	556	64	3,913
2006	619	1,706	NA	NA	121	591	68	3,125
2007	603	1,679	NA	NA	112	589	58	2,472
2008	664	1,862	NA	NA	100	508	59	2,967
2009	699	1,721	NA	NA	107	607	70	3,569
2010	668	1,663	NA	NA	101	548	59	3,223
2011	690	1,609	9	311	131	448	51	3,096
2012	633	1,575	9	404	110	412	66	3,220
2013	590	1,676	9	742	122	391	58	3,430
2014	703	1,409	9	723	126	358	58	3,365
2015	637	1,401	14	887	117	310	53	3,275

Source: Ecology 2016
ATB = articulated tug barge; NA = not available
[a] A "tanker" in this Draft EIS is a tankship (as defined in 46 CFR 2.10-25—see Table 13-1) with its own propulsion source—as opposed to ATBs and tug-barge systems, wherein an unpropelled barge is tethered to a tug in a single unit.

13.3.1.3. Marine Vessel Anchorages

Marine vessels calling on ports and refineries in the Salish Sea may also visit other locations in the area to conduct non-cargo operations. These operations could potentially involve anchoring while waiting for an available berth and or bunkering (taking on fuel or lubricating oil). Table 13-7 summarizes information on anchorages in the study area. These anchorages typically have substantial unused capacity.

Table 13-7: Anchorage Areas near the Proposed Project Area

Name	Marine Vessel Capacity	Maximum Stay (days)	Radius (yards)
Cherry Point	1	30	1,620
Bellingham Bay	6	30	2,000
Anacortes West	1	6	600
Anacortes Central	1	10	600
Anacortes East	1	10	600
Vendovi Island	5	10	1,620
Port Angeles Harbor	5	10	506

Source: CH2M Hill et al. 2016

13.3.1.4. Bunkering Operations

Bunkering operations involve the delivery of fuels and lubricants necessary for marine vessel operations. Vessels transiting to and from the Tesoro Anacortes Refinery may or may not receive bunkers. Whether or not a vessel receives or requires bunkers is dependent on many factors including the vessel's next and last port of call, the availability of bunkers, and the price of the products and services offered in the area.

Vessels can potentially receive bunkers at three types of locations: at one of their ports of call, either by an "alongside" (i.e., barge) delivery or from an onshore source; at a separate terminal or port that specifically provides bunkering services; or alongside while at anchor. According to the Puget Sound Pilots Association and historical bunkering data provided by Ecology, the most common location for bunkering along the marine vessel transportation route from the Pacific Ocean to the Tesoro Anacortes Refinery is in Port Angeles (PSHSC 2016).

13.3.1.5. Tesoro Anacortes Refinery Vessel Traffic

Table 13-8 summarizes historical vessel call activity at the Tesoro Anacortes Refinery from 2002 through 2014. These data represent a physical count of the vessels (including all tankers and tug-barges) that actually called at the refinery wharf. The refinery received an average of 317 vessel calls per year from 2002 to 2014, with a high of 486 vessel calls in 2003 and a low of 133 vessels in 2010. The years of 2009 and 2010 had the fewest vessel calls (184 and 133 respectively), due to the global recession, as well as a 6-month shutdown of refinery operations in 2010. These data include tankships,[6] with ATBs and other tug-barges accounting for approximately 75 percent of the total traffic volume.

Table 13-8: Vessel Traffic Levels at the Tesoro Anacortes Refinery

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Vessels	103	124	123	110	102	94	72	58	42	81	88	60	75
Barges	381	362	281	291	301	292	221	126	91	169	162	155	161
Total	484	486	404	401	403	386	293	184	133	250	250	215	236

Source: CH2M Hill et al. 2016

13.3.2. Potential Impacts on Vessel Traffic

This section evaluates the potential direct and indirect impacts on vessel traffic as a result of construction and operation of the proposed project. Impacts are summarized in Section 13.3.2.4. The impacts of proposed project traffic on vessel safety are discussed in Section 13.4. The potential impacts of the proposed project on the likelihood and severity of spills, including spill modeling, are discussed in Section 13.5.

Projections of future vessel traffic volumes for the Salish Sea and the marine vessel transportation route vary, but no consensus projection of future vessel traffic volumes exists. Assuming that the proposed project and other proposed terminals or similar marine facilities were not constructed, Glosten Associates (2014a) projected increases in vessel-days (days of operation by vessels, as opposed to the vessel crossings listed in Table 13-4) between 4 and 13 percent by 2019. The VTRA (Merrick and van Dorp 2016) evaluated scenarios, based on the proposed project and other similar projects becoming operational that included between 232 and 1,600 new vessels per year. Section 13.6, Marine Transportation, evaluates the cumulative

[6] Each tug and barge combination is considered one vessel call.

impacts of the proposed project's vessel traffic, in combination with various scenarios of other vessel traffic in the Salish Sea.

13.3.2.1. Impacts on Vessel Traffic from Construction

As described in Chapter 2, Section 2.7.3, Construction Vessel Traffic, proposed project components would be delivered via ship to the Port of Anacortes. Proposed project construction would result in four cargo vessel calls. This includes a single heavy lift cargo vessel with the NHT and Isom Unit modules and three heavy lift cargo vessels carrying the components of the ARU. Delivery times for the ARU equipment would be staggered at intervals of between 2 to 4 weeks. All four heavy cargo vessels would be expected to range from 110 to 160 meters (360 to 525 feet) in length.

The cargo vessels used to deliver these materials would be similar in size and type to those already found in the study area. The number of vessel calls represents less than 0.1 percent of the existing vessel traffic along the marine vessel transportation route (as listed in Table 13-4), and would therefore result in no perceptible delay or changes in existing vessel traffic patterns and schedules. Construction-related vessel traffic would likely impact multiple waterways (depending on the origin of proposed project components), although these impacts would occur rarely and would be spread across the construction period. As a result, impact on marine vessel traffic from construction would be ***less than significant***.

13.3.2.2. Impacts on Vessel Traffic from Operations

Operation of the proposed project would result in added calls by three types of marine vessels:

- Tankers: Tankships (as defined in 46 CFR 2.10-25—see Table 13-1) with their own power source that carry petroleum-based products. Tankers for the proposed project would transport mixed xylenes product from the refinery after being loaded at the refinery and exported to global markets.
- Tug-barges, including: A tank barge (as defined in 46 CFR 2.10-25—see Table 13-1) tethered to and propelled by a dedicated tug. Articulated Tug Barges (ATBs) are a specific type of tug-barge combination (Tradewinds 2017). ATBs would be used to transport reformate to the refinery from Pacific Northwest sources.
- Assist tugs: Assist tugs would provide maneuvering assistance to tankships during transit and during mooring and unmooring operations.

These vessel types and sizes are comparable to those currently found in waterways within the study area.

As described in Chapter 2, Section 2.8.2, Marine Vessel Traffic, proposed project operations would add a total of 60 new vessel calls per year, or an average of 5 vessel calls per month. Tankships outbound from the proposed project are expected to use the proposed marine vessel transportation route (Fidalgo Bay to Guemes Channel, Rosario Strait, and Strait of Juan de Fuca).

The point of departure for ATBs (and tug and barges) transiting to the Tesoro Anacortes Refinery may be another port or terminal in the greater Salish Sea. Additionally, ATBs may call on other ports after departing the refinery. In these cases, the vessel route would vary from the primary marine vessel transportation route. Empty or partially empty ATBs may call on another port or terminal to load more cargo before departing the study area. In such cases, the vessel could potentially make more than one additional call before departing. These additional calls could result in additional crossings of the waterways described in Section 13.2.1, as well as other waterways in the greater Salish Sea. The last and next ports of call for ATBs associated with the proposed project are not known, and may vary throughout the life of the proposed project. Factors including economics, logistics, and vessel availability may impact the proposed transit path for ATBs associated with the proposed project.

As a result, it is difficult to determine how many ATB entries into the study area would be directly caused by the proposed project. Many of the ATBs serving the proposed project would already be in the study area; their calls at the Tesoro Anacortes Refinery would constitute an additional set of movements, but not a new entry into or out of the study area.

Table 13-9 summarizes the vessel traffic impacts of the 60 proposed project-related vessel shipments of xylenes and reformate, plus the corresponding 60 arrivals at the refinery wharf (120 total vessel movements per year), compared to historical vessel traffic in specific waterways in the study area.

Even if all 120 proposed project-related vessel movements were entirely new movements within the study area, total proposed project-related activity would result in an increase of 2.2 percent or less compared to current large vessel activity in the study area. The increase in vessel traffic as a result of the proposed project would represent a traffic increase of 0.1 percent, 2.2 percent, and 1.3 percent of large vessel activity within the three major waterways along the proposed marine vessel transportation route: the Guemes Channel, the south end of Rosario Strait, and the Strait of Juan de Fuca, respectively (see Table 13-9). These numbers are based on an increase of 120 vessel movements for the proposed project as compared with historical data for large vessels transiting in and out of these waterways.

In terms of impacts on marine vessel traffic, as defined in Section 13.2.2, and not including vessel safety or spill impacts, there is no meaningful difference between tankships and the other large vessels included in Tables 13-4 and 13-9. The relative increase in tanker and ATB traffic cited in Table 13-9, a 12.3 percent increase in Rosario Strait and a 19.6 percent increase in Guemes Channel, is relevant to the increased likelihood of a spill occurring within these channels, as discussed in Section 13.5.6.

Table 13-9: Proposed Project Vessel Movements Compared to Historical Data

Vessel Type/Traffic		Annual Vessel Traffic (Movements)		
		Strait of Juan de Fuca	Rosario Strait (Southern End)	Guemes Channel
All Large Vessels [a]	Historical Traffic [b]	9,441	5,398	15,858
	Project Traffic	120	120	120
	Percent Change [c]	1.3%	2.2%	<0.1%
Tankships	Historical Traffic [b]	NA	975	612
	Project Traffic	120	120	120
	Percent Change [c]	NA	12.3%	19.6%

ATB = articulated tug and barge; NA = not applicable
[a] Includes the vessel categories listed in Table 13-4: cargo ships, large passenger ships, and tankships (as defined in 46 CFR 2.10-25—see Table 13-1).
[b] Annual average vessel movements, 2010-2014; see Table 13-4.
[c] Represents 120 total proposed project-related vessel movements per year, compared to historical vessel traffic.

Vessel traffic from the proposed project would impact the primary waterways and port areas in the study area. These impacts would be highest in Guemes Channel, where proposed project related vessels and other vessels would conduct maneuvering operations (mooring and unmooring), and in Rosario Strait, where both the overall waterway and the width of the channel are smaller than the Strait of Juan de Fuca and the open waters of central Puget Sound (the marine vessel transportation route is shown on Figure 13-2).

These considerations notwithstanding, the proposed project's overall impacts on vessel traffic would be minor. The 120 total movements per year represent approximately two to three vessel movements per week throughout operation of the proposed project. Such activity is unlikely to significantly alter marine vessel traffic patterns and schedules or to create additional stress on marine facilities or infrastructure. As a result, the marine transportation impacts from proposed project operations would be ***less than significant***.

13.3.2.3. Impacts on Vessel Traffic from Spills and Spill Response

Under the worst-case spill scenario along the marine vessel transportation route (see Section 13.5.2.3), vessel traffic could be restricted from an area estimated at up to 23.5 square miles within the study area for up to 3 days due to a spill and spill response. Under the worst-case scenario at the refinery, vessels could be restricted from an estimated area of up to 9.3 square miles for up to 16 hours. In extreme cases, such an event could result in the temporary, complete blockage of one or more waterways, such as the Rosario Strait or Guemes Channel, or one or more port facilities (including the refinery wharf structure). Other spill scenarios would result in smaller blockages. As discussed in Section 13.5.4, such events would be extremely unlikely to occur. Nonetheless, the temporary impacts of a worst-case spill on vessel traffic would be ***potentially significant***.

Under the maximum most probable spill volume and average most probable spill scenarios (referred to as "discharge" scenarios in the regulations), marine vessels would be required to navigate around a smaller impacted area, and could experience some delays entering specific ports or marine facilities due to spill response. These additional movements or delays would likely be within the range of unexpected occurrences already experienced by vessels in the Salish Sea. Accordingly, the impacts on vessel traffic would be ***less than significant*** from the maximum most probable spill volume or average most probable spill volume associated with a marine vessel spill event related to the proposed project.

13.3.2.4. Summary of Potential Impacts on Vessel Traffic

The potential impacts of the proposed project discussed in this section are summarized in Table 13-10.

Table 13-10: Summary of Vessel Traffic Impacts

Impact Topic	**Impact Summary**	**Potential Impact Significance**	
		Less than Significant	***Potentially Significant***
Construction			
Marine vessel traffic delays, access restrictions, or strains on marine services	Construction requires 4 total marine vessel calls over a 4-week period at the existing port in Anacortes. These additional vessels will not be a noticeable increase over existing traffic levels(less than 0.1 percent). Marine vessels used for the proposed project would be comparable to those commonly present in the Salish Sea.	√	
Operations			
Marine vessel traffic delays, access restrictions, or strains on marine services	Operations requires up to 120 annual marine vessel movements (60 vessel arrivals and 60 departures, based on a monthly average of 5 inbound and 5 outbound vessels) at the refinery wharf, via the marine vessel transportation route. Additional vessels represent an increase in traffic of 2.2 percent or less. Vessels would be similar to those already present in the Salish Sea.	√	
Unplanned Events			
Impact of spills on marine navigation and maritime facilities	A worst-case spill could result in temporary closures of individual waterways or port facilities. The other two spill scenarios would be unlikely to result in closures, but could result in marine traffic delays. An uncontrolled worst-case spill could cover up to 23.5 square miles along the marine vessel transportation route and up to 9.3 square miles at the refinery wharf. Spills would last up to 3 days along the vessel route and less than a day at the wharf under worst-case conditions before spilled materials have completely evaporated or dispersed.	√ (Maximum most probable spill and average most probable spill volumes)	√(Worst-case spill volume)

13.3.3. Potential Impacts of the No Action Alternative

Under the no action alternative, Tesoro would not proceed with the proposed project. Because increased vessel activity for construction and operation would not take place under the no action alternative, there would be no new impact on vessel traffic as a result of the proposed project.

13.3.4. Additional Mitigation Measures

No additional mitigation measures are recommended beyond the embedded controls that are already incorporated into the proposed project design.

13.4. VESSEL SAFETY

This section discusses the affected environment and potential impacts of the proposed project on marine vessel safety. Impacts on vessel traffic and congestion are discussed in Section 13.3. Spills of materials carried by proposed project marine vessels are one potential outcome of marine vessel incidents, and are discussed in more detail in Section 13.5.

13.4.1. Affected Environment

13.4.1.1. Marine Casualty and Vessel Incident Data

As described in Section 13.2.2, 46 CFR 4.03-1 defines a *marine casualty* as “any casualty or accident involving any vessel other than a public vessel”, including falls overboard, collisions, groundings, or other incidents related to vessels themselves; or injury or loss of life. Applying this definition, Table 13-11 summarizes available marine casualty and vessel incident data for the study area from 1995 to 2010. Table 13-12 cross-references these data to show the distribution of incident types by marine vessel type.

Between 1995 and 2010 (the most recent years for which data are available), an average of 74.4 incidents of all types occurred per year. Discharges and “unknown” other incidents (defined in 46 CFR 4.03-1 as “Any other circumstance that might impact or impair a vessel’s seaworthiness, efficiency, or fitness for service or route”) were the most common among all vessels. Structural failures (defined in 46 CFR 4.03-1 as “Failures or occurrences, regardless of cause, which impair any aspect of a vessel’s operation, components, or cargo”) were the most common incident among VTS vessels (i.e., large vessels such as cruise ships, cargo vessels, and tankships). An average of 2.5 discharges per year of any kind from VTS vessels occurred during this period, while an average of 8.6 VTS vessel incidents of all types per year occurred in the Guemes Channel or Rosario Strait.

Table 13-11: Summary of Vessel Incidents, 1995 to 2010

Cause Type	**Incidents All Vessels**	**Incidents VTS Vessels[a]**
Allision (vessel in motion striking a stationary object)	23	18
Bunker Error	91	36
Collision (two vessels striking each other)	13	7
Discharging	278	37
Equipment Failure	73	45
Fire/Explosion	20	11
Grounding	42	15
Operator Error	27	7
Other	34	10
Structural Failure	176	132
Transfer Error	47	40
Unknown	292	71
Total	**1,116**	**429**
Vessel Type	**Incidents, All Vessels**	**Incidents, VTS Vessels**
Bulk	15	15
General Cargo	40	Not available
Tanker – Crude Oil and Product	90	90

Cause Type	Incidents All Vessels	Incidents VTS Vessels[a]
Tug and Tank Barge	36	36
Other	238	238
Miscellaneous	687	Not available
Total	**1,116**	**429**
Location	**Incidents, All Vessels**	**Incidents, VTS Vessels**
Juan de Fuca West	173	53
Juan de Fuca East	201	103
Guemes Channel	226	108
Rosario Strait	21	11
Cherry Point	251	83
Total	**872**	**358**

Sources: Glosten Associates 2014a, USCG 2016b, Ecology 2016
[a] VTS vessels include all large passenger and cargo vessels, but may exclude smaller marine vessels that do not report data.
[b] Structural failures are defined as failures or occurrences, regardless of cause, which impair any aspect of a vessel's operation, components, or cargo (46 CFR 4.03-1).

Table 13-12: Distribution of VTS Vessel Incident Types by Vessel Type

	Percentage of All VTS Vessel Incidents					
Cause	**Bulk**	**General Cargo**	**Tanker**	**Tug and Tank Barge**	**Other**	**Total**
Allision (violent striking)	0.2	0.2	0.5	0.2	3.0	4.2
Collision	0.2	0.0	0.2	0.9	0.2	1.6
Grounding	0.0	0.0	0.5	0.0	3.0	3.5
Transfer Error	0.5	0.7	6.3	2.8	7.5	17.7
Other	2.6	10.7	13.5	4.4	41.7	73.0
Total, All Causes	3.5	11.7	21.0	8.4	55.5	100.0

Sources: Glosten Associates 2014a, USCG 2016b, Ecology 2016

The generalized categories listed in Table 13-11 (unknown cause, other, or miscellaneous vessel type) accounted for the largest share of incidents. Aside from these categories, discharges and structural failures were the most common incident types. Table 13-12 shows the distribution of incident types by vessel type. Incident frequency was spread relatively evenly across various VTS vessel types. Excluding the "other" incident type, transfer errors (i.e., spills that occur during transfer of petroleum products or other materials due to operator error or equipment failure) comprised the largest share of incident types for tankers and tug-and-barge vessels.

13.4.1.2. Waterway Management

This section describes the policies, procedures, and organizations that manage safety and operations in the waterways within the study area.

Tanker Prohibitions

33 CFR 165.1303 prohibits tank vessels (as defined in 46 CFR 2.10-25—see Table 13-1) greater than 125,000 deadweight tons from entering into Puget Sound beyond a line extending from Discovery Island light (near Victoria, British Columbia) south to New Dungeness light (near Port Angeles, Washington).

Pilot and Escort Tug Requirements

The Washington State Pilotage Act (RCW 88.16.170 to 190) requires all "tankers" (assumed here to include all "tankships", as defined by 46 CFR 2.10-25—see Table 13-1) over 5,000 gross tons to take on a Washington state licensed pilot (see Puget Sound Pilots Association below) in Puget Sound. All tankers over 40,000 deadweight tons, possessing specified equipment and characteristics (such as double hulls) must be escorted by a tug or tugs with combined horsepower of equivalent to at least 5 percent of the deadweight tonnage of the escorted tanker.

Puget Sound Pilots Association

Pilots are state-licensed professional mariners who provide navigational expertise and direction to marine vessels in the waterways where their respective associations are located. The presence of a pilot on board does not guarantee that an incident would never occur; however, a pilot's navigational expertise is intended to reduce the risk of an incident.

As described above, and per RCW 88.16.170, proposed project vessels calling at the refinery require a pilot from the Puget Sound Pilots Association. The pilot station is at Ediz Hook at Port Angeles.

Puget Sound Harbor Safety Committee

The Puget Sound Harbor Safety Committee (PSHSC) provides a "proactive forum for identifying, assessing, planning, communicating, and implementing operational and environmental measures beyond statutory and regulatory requirements that promote safe, secure, and efficient use of Puget Sound and adjacent waters" (PSHSC 2016). The committee is made up of delegates appointed by broadly based organizations representing a span of interests focused on Puget Sound. Various governmental agencies also formally support PSHSC in advisory roles (PSHSC 2016).

Traffic Separation Scheme

A key regulatory element of traffic management systems for major ports is the Traffic Separation Scheme (TSS). The TSS for the greater Salish Sea encompasses the waters of the study area (see Figures 13-3 through 6). The TSS, jointly managed by the USCG and the Canadian Coast Guard, separates inbound and outbound marine vessel traffic into designated "lanes." The intent of the TSS is to minimize the potential for traffic interactions that could result in collisions.

In the Strait of Juan de Fuca, the inbound traffic separation lane is on the south (U.S.) side of the international border and the outbound lane is on the north (Canadian) side (PSPA 2016). Each TSS lane is 0.5 miles wide, with at least a 0.25-mile separation zone between the lanes (PSPA 2016). Other, generally narrower TSS lanes identify navigation routes through other waterways in the Salish Sea, as shown on Figures 13-3 through 13-6.

Once a TSS has been established, the waters within the TSS coverage area become a Regulated Navigation Area under the jurisdiction of federal regulations (33 CFR 165). In those waters, the right of navigation by commercial marine vessels takes precedence over all other waterway uses (including commercial fishing and recreational activities) (33 CFR 165).

Rescue Tug

An emergency response towing vessel (commonly referred to as the “rescue tug”) is stationed in Neah Bay, staffed continuously, and available 24 hours a day/7 days a week to assist all vessels in the vicinity of the mouth of the Strait of Juan de Fuca (including in international waters in the Pacific Ocean). The rescue tug is funded by the petroleum, cargo, and passenger ship industries. Tankships of any size and commercial vessels greater than 300 gross tons that transit the Strait of Juan de Fuca must include in their Oil Spill Contingency Plans detailed procedures to notify the rescue tug in the event of an emergency.

Safety Zone

Navigational safety zones are created and enforced by the USCG. Safety zones are water areas, shore areas, or water and shore areas where access is limited to authorized persons, vehicles, or vessels. The purpose of safety zones are generally for safety and or protection of the environment. Safety zones may be stationary and described by fixed limits, or it may be described as a zone around a moving vessel (33 CFR 165.1313).

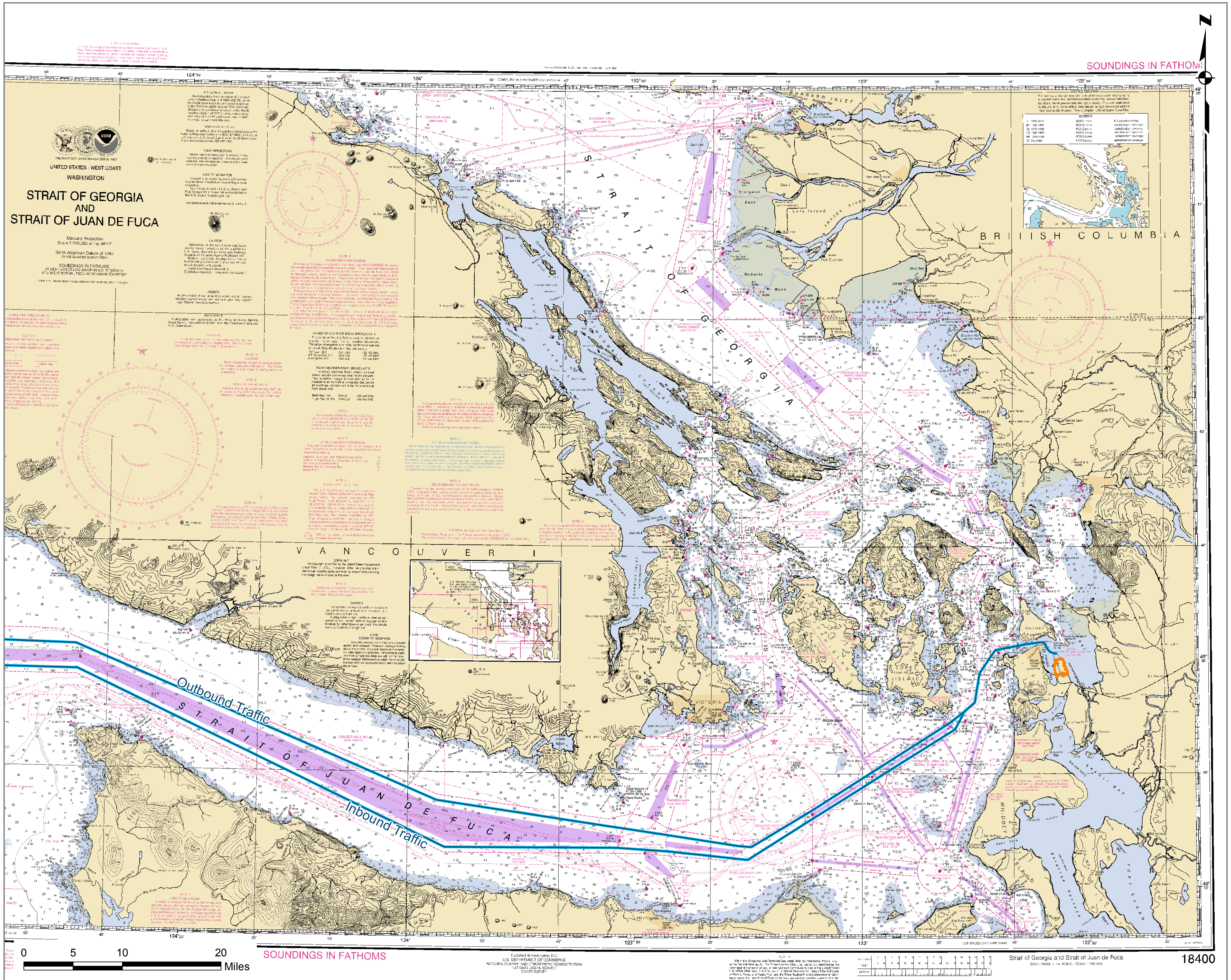
Tank Ship Security Zone

The USCG has established a permanent security zone for all transiting tank ships in the Puget Sound region. The tank ship security zone is a regulated area of water established by 33 CFR 165.1313, extending 500 yards in all directions from a tank ship (whether stationary or moving). Security zones may be enforced by USCG patrol boats.[7]

Other Navigation Areas and Requirements

Other features of the TSS include Precautionary Areas and Special Operating Areas. These designations identify areas where TSS lanes converge, where traffic volumes may trigger special operating criteria, or where special operating procedures may apply.

[7] The term “tank ship” is used throughout 33 CFR 165.1313, and is assumed to be the same as “tankship” as defined in 46 CFR 2.10-25—see Table 13-1.



Legend

- Marine Vessel Transportation Route
- Tesoro Refinery Boundary

Notes:
Data provided by NOAA Chart 18400
NAD 1983 UTM Zone 10N

Figure 13-2
Navigation Routes Through the Salish Sea
Tesoro Anacortes Refinery
Clean Products Upgrade Project
Draft Environmental Impact Statement
Anacortes, Washington

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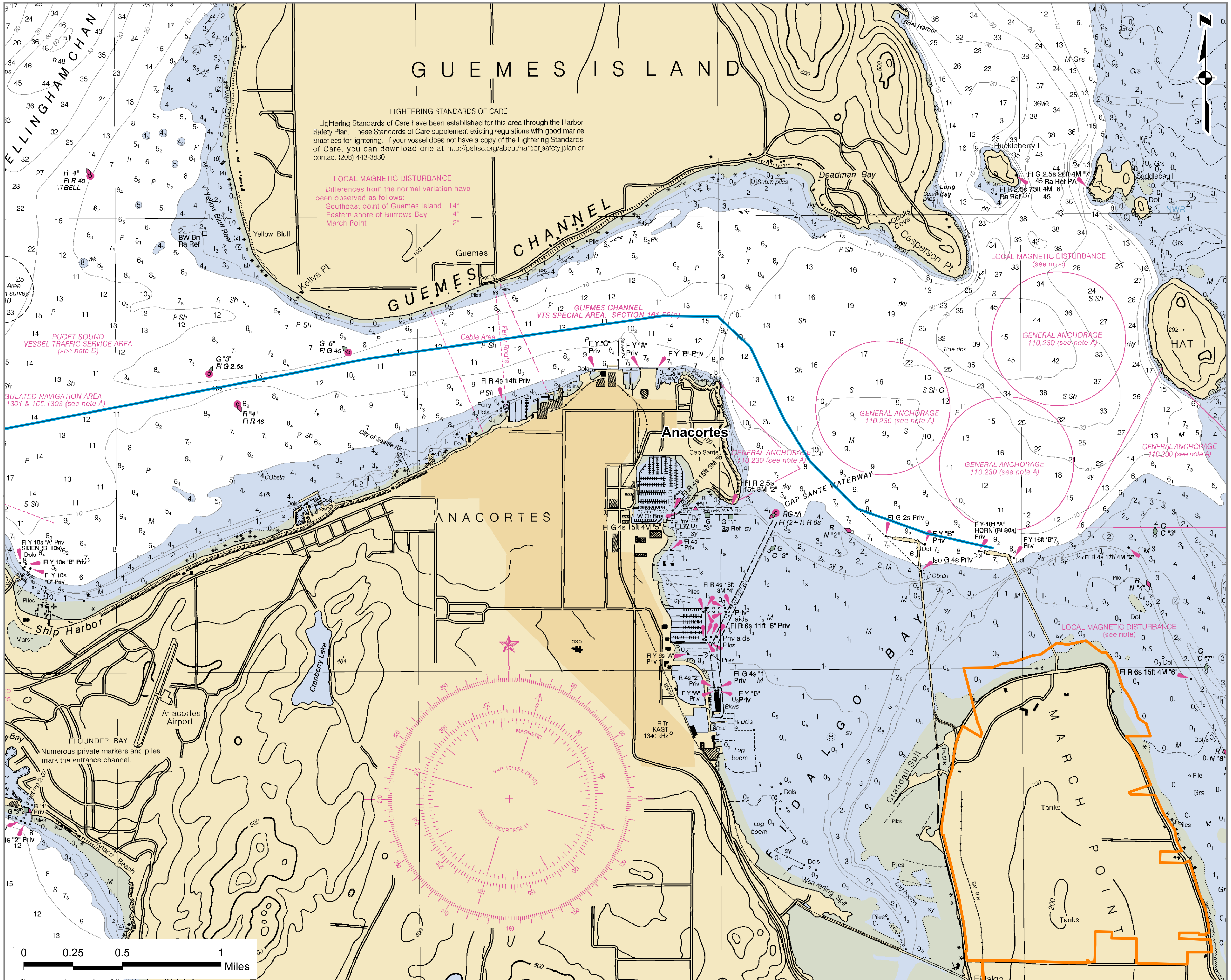

Legend

- Marine Vessel Transportation Route
- Tesoro Refinery Boundary

Notes:
Data provided by NOAA Chart 18427
NAD 1983 UTM Zone 10N

Figure 13-3
Navigation Routes From March Point to Guemes Channel
Tesoro Anacortes Refinery
Clean Products Upgrade Project
Draft Environmental Impact Statement
Anacortes, Washington

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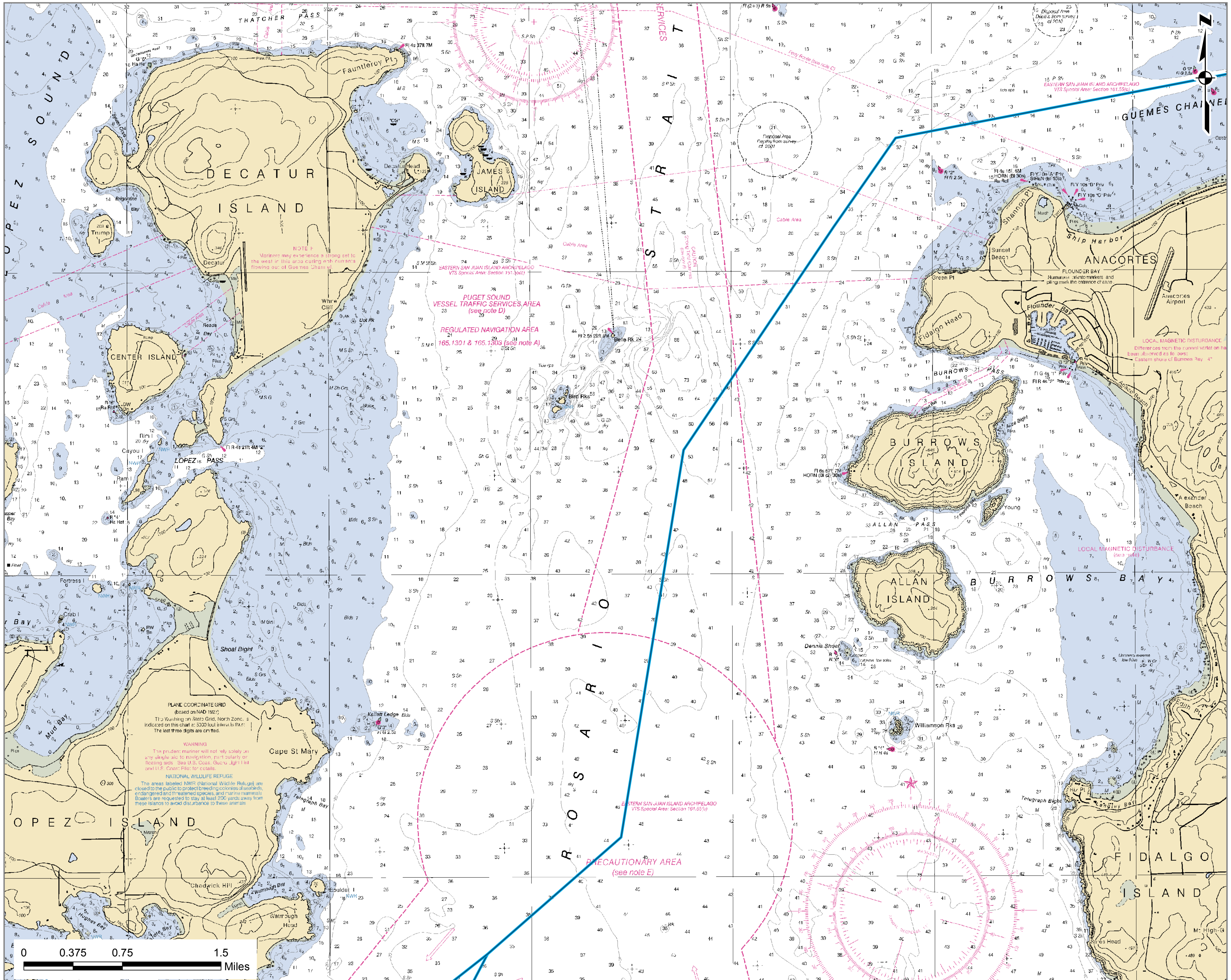

Legend

Marine Vessel Transportation Route

Notes:
Data provided by NOAA Chart 18429
NAD 1983 UTM Zone 10N

Figure 13-4
Navigation Routes
Through Rosario Strait
Tesoro Anacortes Refinery
Clean Products Upgrade Project
Draft Environmental Impact Statement
Anacortes, Washington

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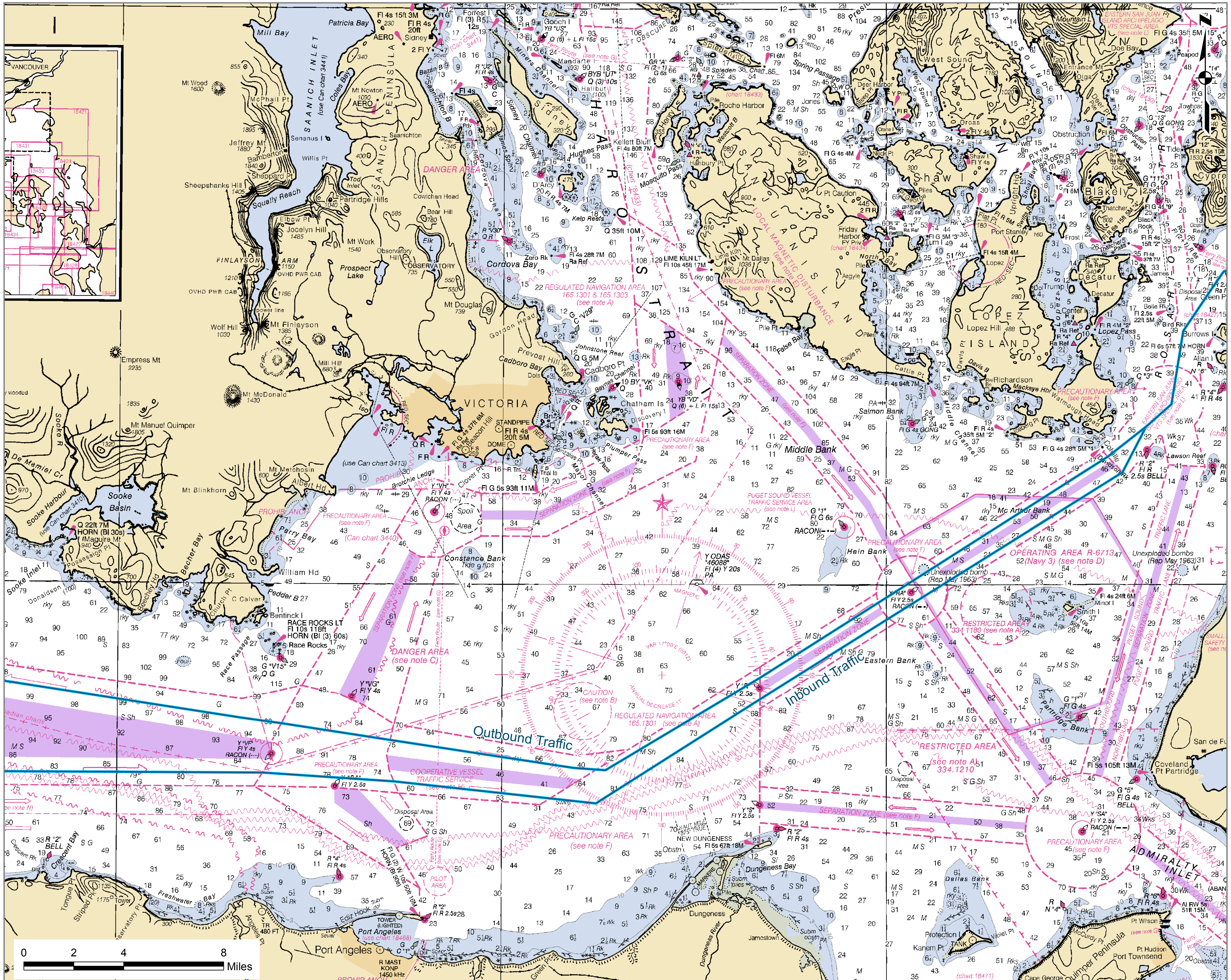

Legend

Marine Vessel Transportation Route

Notes:
Data provided by NOAA Chart 18400
NAD 1983 UTM Zone 10N

Figure 13-5
Navigation Routes Through the Strait of Juan de Fuca, East
Tesoro Anacortes Refinery Clean Products Upgrade Project
Draft Environmental Impact Statement
Anacortes, Washington

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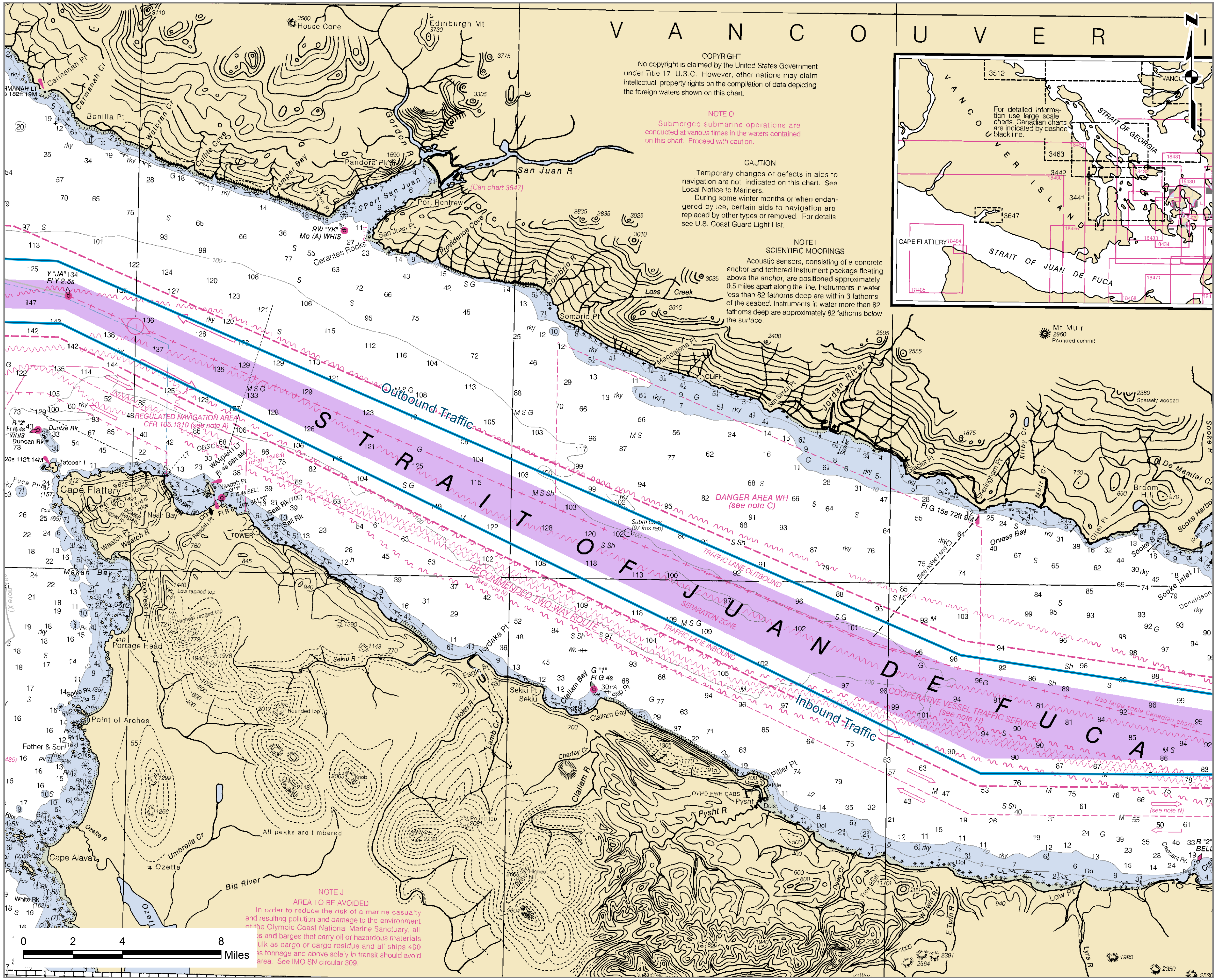

Legend

- Marine Vessel Transportation Route

Notes:
Data provided by NOAA Chart 18400
NAD 1983 UTM Zone 10N

Figure 13-6
Navigation Routes Through the Strait of Juan de Fuca, West
Tesoro Anacortes Refinery
Clean Products Upgrade Project
Draft Environmental Impact Statement
Anacortes, Washington

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13.4.2. Potential Impacts on Vessel Safety

This section evaluates the potential direct and indirect impacts on marine vessel safety as a result of construction and operation of the proposed project. Impacts are summarized in Section 13.4.2.4. Spills are discussed in this section as one of many types of potential marine vessel incidents. Section 13.5 provides a detailed discussion of the likelihood, magnitude, and impacts of spills from proposed project vessels.

A 2014 Vessel Traffic and Risk Assessment concluded that vessel incident rates "follow the expected trend of a linear increase in number of incidents with number of traffic days" (Glosten Associates 2014a). Similarly, this Draft EIS assumes that the number of marine vessel incidents changes in proportion to changes in maritime traffic; in other words, increased vessel activity, such as project-related vessel trips, would result in increased risk of maritime accidents or casualty events.

13.4.2.1. Impacts on Vessel Safety from Construction

Increased marine vessel traffic during construction could increase the risk of vessel incidents, such as those discussed in Section 13.4.1.1, in the waterways and port facilities used by the proposed project. As discussed in Section 13.3.2.1, proposed project construction would result in four cargo vessel calls to the Port of Anacortes. This number of vessels represents a negligible amount of the existing vessel traffic in the Salish Sea (as listed in Table 13-6). The proposed project construction would lead to a minimal increase in the potential for marine vessel incidents. During construction, the impacts from the proposed project on marine vessel safety would be ***less than significant***.

13.4.2.2. Impacts on Vessel Safety from Operations and Maintenance

Increased marine vessel traffic during operations could increase the risk of marine vessel incidents, such as those discussed in Section 13.4.1.1, in the waterways and port facilities used by the proposed project. As described in Section 13.4.1.2, tankships require tug escorts and licensed pilots within the study area. All large vessels are considered for purposes of evaluating overall marine vessel incident rates.

As described in Section 13.3.2.2, the proposed project-related vessel movements would represent 0.1 percent, 2.2 percent, and 1.3 percent of large vessel activity in Guemes Channel, the south end of Rosario Strait, and the Strait of Juan de Fuca, respectively. Accordingly, project-related vessel activity could lead to an increase of 2.2 percent or less in overall marine vessel incidents. The protections provided by the vessel traffic management systems described in Section 13.4.1.2 would minimize project-related vessel safety risks, inclusive of marine accidents and marine casualty events. As such, the proposed project's impacts would be ***less than significant*** during operations.

The impact determination above is applicable to overall marine safety and marine casualty events. Spills, a specific type of marine casualty event, are discussed in detail in Section 13.5.

13.4.2.3. Impacts on Vessel Safety from Spills and Spill Response

As described in Section 13.5.2.3, a worst-case spill scenario could result in the temporary, complete blockage of one or more waterways or port facilities, while the other spill scenarios would result in smaller blockages Vessels in the Salish Sea may be required to take alternate routes or to temporarily halt their journeys. Because the number of vessel incidents changes in proportion to vessel activity (see Glosten Associates 2014a), these unanticipated changes to navigation could temporarily increase the risk of marine vessel incidents in those waterways. Overall, the temporary increases in marine vessel safety risk would be within the range of current risk experienced by marine vessels in the Salish Sea. The extent of the overall navigation system in Puget Sound (i.e., the waterways available for alternative navigation) and the protections provided by the vessel traffic management systems described in Section 13.4.1.2 would minimize project-related vessel safety risks during spill response activities. As a result, the impacts on marine vessel safety from response to all spill scenarios would be ***less than significant***.

13.4.2.4. Summary of Impacts on Vessel Safety

The potential impacts of the proposed project discussed in this section are summarized in Table 13-13.

Table 13-13: Summary of Potential Impacts on Vessel Safety

Impact Topic	Impact Summary	Potential Impact Significance	
		Less than Significant	***Potentially Significant***
Construction			
Increase in the likelihood of a marine casualty or accident, proportional to the increase in traffic	Four addition vessels during construction will not be a noticeable increase in traffic (less than 0.1 percent), and therefore would represent an unnoticeable increase in the risk of marine casualty or accident. Marine vessels used for the proposed project would be comparable to those commonly present in the Salish Sea.	√	
Operations			
Increase in the likelihood of a marine casualty or accident, proportional to the increase in traffic	Additional vessels (60 vessel arrivals and 60 vessel departures per year) represent an increase in traffic of 2.2 percent or less, and therefore would represent a minor increase in the risk of a marine casualty or accident. Vessels would be comparable to those already present in the Salish Sea.	√	
Unplanned Events			
Impact of spills on marine vessel traffic safety	A worst-case spill could result in temporary navigational changes in individual waterways or delays in entering specific port facilities. Resultant increases in vessel safety risk would be within the range of current risk experienced by marine vessels in the Salish Sea. The other two spill scenarios would be unlikely to result in such changes.	√	

13.4.3. Potential Impacts of the No Action Alternative

Under the no action alternative, Tesoro would not proceed with the proposed project. Because increased vessel activity for construction and operation would not take place under the no action alternative, there would be no new impact on vessel safety as a result of the proposed project.

13.4.4. Additional Mitigation Measures

No additional mitigation measures are recommended beyond the embedded controls that are already incorporated into the proposed project design.

13.5. Marine Spills and Spill Response

This section discusses the affected environment and environmental impacts of unplanned releases (i.e., spills) of mixed xylenes, reformate feedstock, and reformate backhaul associated with the proposed project. Impacts are summarized in Section 13.5.8.

Xylenes and reformate are classified chemically and by federal regulation (OPA 90) as "oils"; however, these materials do not look or behave like a crude oil spill. The chemical properties of xylenes and reformate are described in Appendix 2-A, Existing Programs and Operations. The behavior of xylenes and reformate in the environment is described throughout this section.

Except where specifically defined otherwise, "oils," as used in this section, refers collectively to xylenes and reformate, while "oil spill modeling" (and similar terms) refers to the software and modeling process used to evaluate spills of xylenes and reformate (as well as other kinds of petroleum-based materials).

The transfer of mixed xylenes and reformate to and from vessels docked at the facility, and the current transportation of oil, gasoline, and other petroleum products over the water by vessels traveling to and from the facility via the Salish Sea carries an inherent risk of a spill through events such as hose disconnects, collision between moving vessels, allision between a vessel and a stationary object, or vessel grounding into shallow waters causing a hull rupture. This section describes the methodology used and modeling results of potential marine spills.

13.5.1. Affected Environment

The affected environment for marine spills includes the marine vessel transportation route and adjacent waters and shorelines from the Tesoro Anacortes Refinery wharf to the Pacific Ocean seaward of the entrance to the Strait of Juan de Fuca, as described in Section 13.2.1. Other chapters in this Draft EIS describe these waters and shorelines including Chapter 6, Terrestrial Vegetation and Wildlife; Chapter 7, Marine and Nearshore Resources; Chapter 9, Environmental Health; Chapter 10, Land and Shoreline Use; and Chapter 12, Cultural Resources.

13.5.2. Behavior of Xylenes and Reformate in the Marine Environment

The risk of, and impacts related to, a petroleum-based spill are complex. Impacts are a function of the location of the spill, the volume spilled, the physical and toxicological nature of the material spilled, and the tendency for the spilled material to persist in the environment. In terms of behavior in the marine environment, xylenes and reformate are comparable to gasoline, and behave differently than crude oil.

Unlike crude oil, xylenes and reformate would not cause a viscous coating on the shoreline, vegetation, or wildlife. The surface plume from a crude oil spill may linger by floating on the water surface and may be submerged with winds and tides. Xylenes and reformate quickly evaporate from the water surface and break down into carbon dioxide and water. Crude oil, xylenes, and reformate are not considered miscible substances (i.e., substances that can completely combine with water); however, all three substances may have soluble fractions that could result in potentially toxic concentrations. Xylenes and reformate would more easily volatilize and degrade into non-lethal forms than the more complex compounds contained within crude oil. The rate of xylene volatilization would increase with higher temperatures and sunlight.

As a result of these different properties, a spill of crude oil would generally cause a more substantial impact than a spill of xylenes or reformate.

Further discussion of the behavior of mixed xylene spills and xylene toxicity in the environment are discussed in Chapter 4, Air Quality and Climate Change; Chapter 6, Terrestrial Vegetation and Wildlife; Chapter 7, Marine and Nearshore Resources; and Chapter 9, Environmental Health.

13.5.3. Spill Scenarios and Regulatory Requirements

As stated above, the behavior of xylenes and reformate in the marine environment depends in part on the volume spilled. To characterize the impacts of various spill volumes, this Draft EIS evaluates three theoretical spill scenarios of volumes consistent with volumes used for spill response planning purposes: a worst-case spill, a maximum most probable spill, and an average most probable spill. The volumes used at the refinery wharf are those used in Tesoro's OSCP (approved by the USCG, Ecology, and USEPA) in accordance with the definitions in 33 CFR 154.1020, while the ones used in the shipping channel are federal spill planning volumes in accordance with the definitions in 33 CFR 155.1020. These regulations use the term "discharge" when defining volumes for the different scenarios. In this Draft EIS, these discharges are also referred to as spills.

The following three spill scenarios are evaluated in this section:

- The "worst-case scenario" spill refers to a spill of 5,045 barrels (bbl) at the refinery wharf (an estimate based on the use of a 16-inch pipeline at the wharf to transfer reformate and mixed xylenes) or 330,000 bbl (the entire contents of a tankship cargo of mixed xylene,) along the marine vessel transportation route.
- The "maximum most probable spill" is a moderate probability event whereby 1,200 bbl are spilled at the refinery wharf structure or 2,500 bbl along the marine vessel transportation route.
- The "average most probable spill" is the most probable spill event of the three scenarios, whereby 50 bbl are spilled in any location.

Federal and state regulations prescribe requirements for the safe handling, transportation, and storage of mixed xylenes. These regulations specify the types of containers or barges in which xylenes can be shipped, as well as design and construction of storage containers. Procedures for conducting safe over-water transfers of mixed xylenes are similar to those prescribed for other oils and hazardous materials, and cover topics including personnel, communications, equipment, and emergency response. The refinery's production of mixed xylenes does not constitute a significant change in the type or amount of necessary safety equipment, emergency response, or worker training.

13.5.4. Spill Modeling Assessment Methodology

13.5.4.1. Spill Modeling Software

An analysis of several marine vessel spill scenarios was performed using computational models to simulate hypothetical, uncontrolled releases using oil spill modeling software. An uncontrolled release is one in which spill response measures are not taken into account. The results of the release scenarios, therefore, intentionally ignore the potential for spill response activities, which would limit the overall impacts to the environment. The estimated potential impacts presented in this section are therefore conservatively high. The full technical report describing the modeling is provided in Appendix 13-A, Fate and Behavior Analysis in the Marine Environment: Mixed Xylenes and Reformate. This report examines model results for two seasons: winter and spring. A supplemental report was also issued in which an additional meteorological condition is examined for spills under an annual average wind velocity (see Appendix 13-A).

The spill modeling required the use of two software packages, both produced by NOAA: GNOME and the Automated Data Inquiry for Oil Spills model (ADIOS 2.0). GNOME is a spill trajectory model used as a tool for spill predictions and to assist in strategic decisions during an emergency response. The model can estimate evaporative loss for six types of oils. Xylene and reformate are not among the choices available in GNOME; the oil type most similar to xylene and reformate within GNOME was gasoline – so gasoline was used as a surrogate for modeling purposes. ADIOS 2.0 was used to more accurately understand the rate of evaporation of xylene and reformate. Specifically, ADIOS 2.0 permits the user to input parameters to simulate the fate of various chemicals. Values were entered to represent mixed xylenes, reformate, and backhaul reformate. ADIOS 2.0 does not simulate the trajectory and spreading of the oil within a geographical representation like GNOME. The resulting spill modeling therefore combined the geographical capabilities of GNOME with the evaporative computations of ADIOS 2.0.

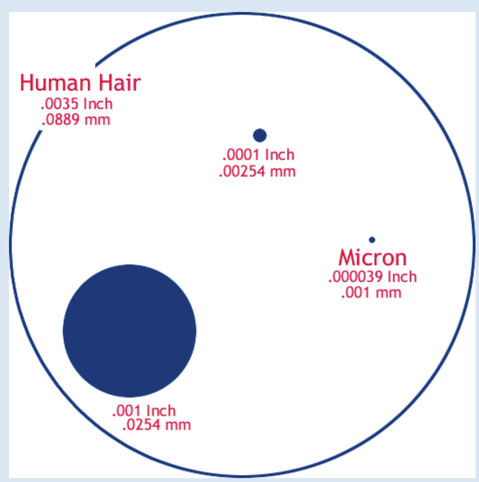
13.5.4.2. Spill Volumes

Tesoro's spill analysis report (Appendix 13-A) described spill volumes matching several spill-size classifications, including the average most probable spill and maximum most probable spill, but focused the modeling effort on the worst-case discharge volumes. While the worst-case spill scenario is considered very unlikely, it does provide a conservative estimate of potential spill dispersion in the unlikely event of a worst-case spill event. These worst-case spill volumes used in this analysis were 5,045 bbl at the refinery wharf, and 330,000 bbl along the three locations selected within the Salish Sea: Neah Bay, Port Angeles, and Rosario Strait (see Figure 13-7). These simulated volumes represent the worst-case spill volumes based on the details of the proposed project, such as the size of the vessels that would be used to transport xylenes and reformate (see Appendix 13-A for details on how these volumes were calculated). In contrast, the USCG under 33 CFR 155.1020 defines the maximum most probable spill and average most probable spill volumes based on generic assumptions applicable to all spill modeling. At the refinery wharf, the average most probable spill volume is 50 bbl and the maximum most probable spill volume is 1,200 bbl. For a release in the Salish Sea, the maximum most probable spill volume is 2,500 bbl. Although these smaller, more probable spill volumes were not part of Tesoro's modeling study, the impacts associated with them were also estimated and examined in this analysis to provide results on what are considered by the USCG to be the most probable spill scenarios.

13.5.4.3. Spill Thickness

The output from the GNOME model shows the spill trajectory but does not indicate the thickness of the spilled material. In some areas depicted as having spilled materials present, the amount or thickness of those materials may be limited. To address this discrepancy, an additional analysis of the GNOME model output was conducted, using NOAA's GNOME Analyst tool (related to, but separate from the GNOME model itself) to convert the computed spilled mass into thickness contours. First, the minimum thickness threshold was computed, delineating where spilled material becomes visible and below which aquatic plants or animals are at near zero risk of injury due to contacting the spill. The first clearly visible spill material typically appears as a silvery sheen at a thickness between 0.04 micrometer (µm)[8] and 0.3 µm based on values cataloged in the 2006 BAOAC (Lewis 2007).

Micrometers (µm), also called microns, are much, much smaller than a human hair, as shown in the graphic.



Source: http://www.jus-rite.com/howbigisamicron.html

Three categories of thickness were developed to help characterize potential risk to birds and mammals as it relates to the thickness of the spill plume. Research estimating the exposure thresholds for birds and mammals contacting a crude oil plume found that plumes less than 1 µm were not harmful to seabirds (Peakall et al. 1985 and French 2009). Additional studies found that aquatic birds and marine mammals may be impacted at plume thicknesses in the range of 10 µm and 25 µm (Engelhardt 1983; Clark 1984; Geraci and St. Aubin 1988; Jenssen 1994; and Scholten et al. 1996). See Chapter 7, Section 7.4, Potential Impacts on Marine and

[8] A micrometer, also called a micron, is a unit of length equal to one millionth of a meter. A human hair is about 50 microns.

Nearshore Resources, for more information. From these studies, 0.1 µm, one order of magnitude less than the literature threshold of 1 µm, was selected as the thickness threshold value for when some minor impacts due to exposure could occur, although such impacts would be less than significant. The majority of the studies reviewed did not report adverse impacts on aquatic life, including birds, until thickness levels were greater than 10 µm; therefore, use of 1 µm is a conservative measure for potentially significant impacts. In summary, the spill plume thicknesses used to characterize potential risk included:

- Potentially significant: visible oil with a thickness of greater than 1 µm
- Less than significant: visible oil with a thickness between 0.1 µm and 1 µm
- Negligible: oil (whether visible or not) with a thickness of less than 0.1 µm

These findings are incorporated into the impact criteria for this section (see Table 1-B.11 in Appendix 1-B, Impact Criteria Tables).

The above studies are based on crude oil exposures, rather than xylenes or reformate. As previously noted, xylene and reformate spills do not create viscous layers like crude oil and other heavier petroleum products, and would not coat a bird's feathers or mammal's fur to the extent that viscous crude oil does. Xylenes and reformate products on the water surface have the potential for direct toxicity related to feather/skin coating, as well as inhalation, as described in Chapter 6, Section 6.4.3, Unplanned Events (Geraci 1990; Geraci and Williams 1990; St. Aubin 1990a as referenced in NRC 2003). Additional toxicity discussions for marine birds and aquatic marine life are included in Chapter 6, Terrestrial Vegetation and Wildlife, and Chapter 7, Marine and Nearshore Resources, respectively. Chapter 7, Marine and Nearshore Resources, also includes a discussion of the toxicity of xylenes based on concentrations that could dissolve slightly into the water column.

To determine the thickness of each simulated spill, the modeled mass of spilled material was converted into representative masses of reformate, backhaul reformate, and mixed xylenes for analysis in this Draft EIS. The GNOME modeling was performed using the assumption that the spilled material is gasoline, the closest analogous substance available in the modeling program. The mass conversion was performed by multiplying the mass of gasoline in the model output by the ratio of each product's density to gasoline's density. The density of gasoline in GNOME is 0.75 grams per milliliter (g/mL). The densities of reformate, backhaul reformate, and mixed xylenes are 0.86 g/mL, 0.85 g/mL, and 0.87 g/mL respectively. The mass of each particle was then converted into units of volume by dividing the mass by the density. GNOME Analyst was used to compute the thickness based on the computed volume, divided by the area of product spread across the water surface.

13.5.4.4. Modeled Spill Locations

Four spill modeling locations were chosen to represent a spill at the refinery wharf and at three locations along the marine vessel transportation route through the Salish Sea, including Rosario Strait, near Port Angeles, and near Neah Bay (see Figure 13-7). These locations were selected from a list of recommended project-specific modeling locations provided by Ecology of potential spill origin points (Ecology 2016). These points are described by the state as theoretical locations where spills are likely to occur and that are used by Ecology to develop spill response strategies. The four modeled locations were selected to demonstrate a range of conditions in terms of local currents, winds, and shorelines at risk. Neah Bay represents the junction between Pacific Ocean currents and the northwest/southeast currents in the Strait of Juan de Fuca. Port Angeles offers an example of a spill within the length of the Strait close to a populated area of concern. The Rosario Strait location was chosen for its proximity to many islands and more complex current movements in the vicinity of the refinery.

Variations in the currents and winds at these four locations were accounted for by simulating average wind conditions during summer and winter, and by also using an annual average wind speed and direction. The selected wind speeds and directions are provided in Table 13-14. Winds speeds were held constant at these values during the simulations. For the ADIOS 2.0 model runs, wind speed could only be input as whole numbers. Therefore, the model was run at 0 mph, 5 mph, and 10 mph to demonstrate evaporation under a range of typical wind speeds.

Table 13-14: Wind Speed and Direction Selections for Spill Modeling Scenarios

Scenario	Modeled Wind Speed (mph)		
	Summer	Winter	Annual Average
Neah Bay	7.9 WSW	14.4 ESE	5.1 SSE
Port Angeles	7.5 NW	4.9 SSW	5.1 SSE
Rosario Strait	10.4 WSW	12.0 SE	5.1 SSE
Refinery Wharf	7.5 SSW	9.2 SW	5.1 SSE

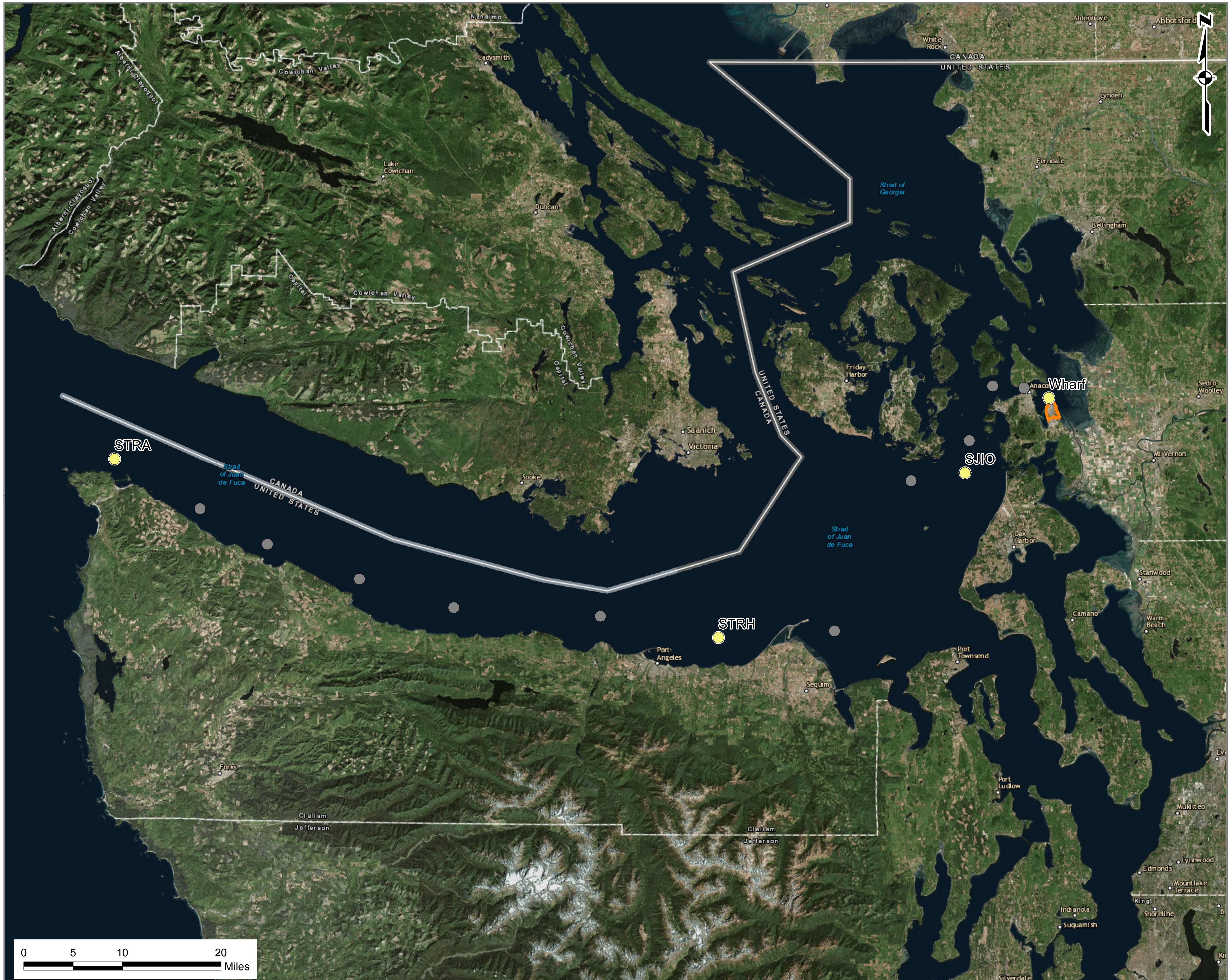
ESE = east-southeast; NW = northwest; SSE = south-southeast; SSW = south-southwest; WSW = west-southwest

13.5.5. Spill Modeling Results

The spill modeling results described in this section were estimated by using computational models used to simulate hypothetical, uncontrolled releases of mixed xylene and reformate into the environment. An uncontrolled release is one in which spill response measures are not taken into account. The computer modeling does not include or account for embedded controls, including spill response, which would be implemented to avoid or minimize environmental impacts from a spill; model results assume no response to a spill event. The estimated potential impacts presented in this section are therefore conservatively high.

13.5.5.1. Worst-Case Spill Modeling Results

The results of the worst-case spill scenario modeling discussed in this section are presented in the Tesoro spill modeling report (see Appendix 13-A and supplemental reports). It includes descriptions of potentially impacted shorelines and the time it would take for 99.5 percent of the spilled material on the water surface and shorelines to evaporate and disperse. The evaporation and dispersion estimates discussed in this section were generated from modeling simulations using ADIOS 2.0. The shoreline length is defined as the linear distance exposed to spilled material during the GNOME spill simulation. In some cases, the spilled material contacted no shorelines before it evaporated or dispersed. A summary of these results are provided in Table 13-15.



Legend

- Tesoro Refinery Boundary
- Spill Model Release Location
- Other Washington State Coastal Atlas Map Spill Locations

Notes:
STRA - Strait - A
STRH - Strait - H
SJIO - San Juan Islands - O
Wharf - Tesoro Wharf

Source:
ESRI Imagery Web Mapping Service
NAD 1983 UTM Zone 10N

Figure 13-7
Oil Spill Modeling Release Locations
Tesoro Anacortes Refinery
Clean Products Upgrade Project
Draft Environmental Impact Statement
Anacortes, Washington

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Table 13-15: Spill Modeling Output Summary

Spill Scenario Location	Volume Spilled (bbl)	Season	Tide	Linear Distance of Shoreline Impacted (miles)	Elapsed Time For Dispersal/Evaporation of 99.5% of Spilled Material (hours)
Neah Bay	330,000	Summer	Spring	0.3	48
		Summer	Neap[b]	0.3	48
		Winter	Spring	0.3	39
		Winter	Neap	0.0	39
		Annual Average	Spring	0	60
		Annual Average	Neap	0	60
Port Angeles	330,000	Summer	Spring	6.2	55
		Summer	Neap	9.3	55
		Winter	Spring	0	60
		Winter	Neap	0.3	60
		Annual Average	Spring	0	60
		Annual Average	Neap	0	60
Rosario Strait	330,000	Summer	Spring	9	48
		Summer	Neap	8.7	48
		Winter	Spring	11.1	43
		Winter	Neap	11.5	43
		Annual Average	Spring	6.2	60
		Annual Average	Neap	8.1	60
Refinery Wharf	5,045	Summer	Spring	6.5	16
		Summer	Neap	11.1	16
		Winter	Spring	7.1	14
		Winter	Neap	6.8	14
		Annual Average	Spring	7.7	14
		Annual Average	Neap	8.3	14

[a] E+D = evaporation and dispersion
[b] A neap is a tide just after the first or third quarters of the moon when there is the least difference between high and low water.

The Tesoro spill analysis report included GNOME model output containing estimates of spilled materials on the water surface and shoreline every 12 hours of the model simulation, starting at time 0-hour when the spill event occurs. At each scenario's 12-hour timestep, the thickness was filtered to display only thickness above the 0.1 µm minimum threshold, and then results were categorized into low, medium, or high categories, based on thickness:

- Low thickness: 0.1 – 1 µm
- Medium thickness: 1 – 10 µm
- High thickness: > 10 µm

As described in Section 13.5.4.3 above, spills with a thickness below the minimum threshold value of 0.1 µm, may or may not be visible and could result in some minor impacts due to exposure to a particular resource, although such impacts would be less than significant. Spills in the low thickness category correspond to visible product with a visible oil thickness of between 0.1 µm and 1 µm and a ***less than significant*** impact. Spills with a product thickness greater than 1 µm, inclusive of the medium and high thickness categories, is a conservative measure for potentially significant impacts. The inclusion of a category of greater than 10 µm on the figures addresses the literature on ecological harm where greater than 10 µm found clear evidence of impact.

Summaries of the areas covered by spills with a thickness of at least 0.1 µm and the mass of each of the three materials following a worst-case spill scenario, are provided for Neah Bay (Table 13-16), Port Angeles (Table 13-17), Rosario Strait (Table 13-18), and the refinery wharf (Table 13-19). These tables include results for the timesteps that had a thickness above the 0.1 µm minimum threshold filter for display. In the majority of cases, no product above the 0.1 µm filter was present at the 36-hour timestep. No product above the 0.1 µm minimum threshold filter for display was present at the 48-hour timestep.

In the majority of the cases in the GNOME model simulations, the modeled plume was present at an initial thickness greater than 10 µm for a 12- to 24-hour period before evaporating and dispersing into the levels below the minimum thickness threshold of 0.1 µm. As shown in Table 13-15, Tesoro's ADIOS 2.0 modeling estimates that evaporation and dispersion of 99.5 percent of the entire spilled material could take up to 60 hours in some cases. That modeling estimate notwithstanding, it typically would only take up to 24 hours for the amount present to be below the 0.1 µm thickness level. The residual product present after 24 hours is assumed to be so sparse as to have *a* ***less than significant*** impact.

Table 13-16: Neah Bay Scenario—Worst-Case Maximum Potentially Impacted Areas and Mass

Time After Spill (hours)	Area Covered by Spill (square miles)[a]	Mass (kg) of Spilled Material, 330,000 bbl Spill[a]		
		Reformate	Backhaul Reformate	Xylenes
Summer/Neap Tide[b]				
12	5.65	4,602,292	4,548,777	4,655,807
24	5.55	631,687	624,342	639,032
Summer/Spring Tide				
12	5.87	4,602,292	4,548,777	4,655,807
24	5.51	721,928	713,534	730,323
Winter/Neap Tide				
12	5.71	4,602,292	4,548,777	4,655,807
Winter/Spring Tide				
12	4.87	4,060,846	4,013,627	4,108,065
Annual Average/Neap Tide				
12	4.91	4,602,292	4,548,777	4,655,807
24	3.30	631,687	624,342	639,032
Annual Average/Spring Tide				
12	5.18	4,602,292	4,548,777	4,655,807
24	5.86	496,326	490,554	502,097

bbl = barrels; kg = kilogram (1 kg = 2.2 lb)
[a] Model results assume an uncontrolled spill without embedded controls, spill response, or mitigation that would be implemented to avoid or minimize environmental impacts from a spill.
[b] Neap tide occurs just after the first or third quarters of the moon when there is the least difference between high and low water.

Table 13-17: Port Angeles Scenario—Worst-Case Maximum Potentially Impacted Areas and Mass

Time After Spill (hours)	Area Covered by Spill (square miles)[a]	Mass (kg) of Spilled Material, 330,000 bbl Spill[a]		
		Reformate	Backhaul Reformate	Xylenes
Summer/Neap Tide[b]				
12	4.35	1,804,820	1,783,834	1,825,807
24	1.13	180,482	178,383	182,581
Summer/Spring Tide				
12	5.24	2,526,749	2,497,368	2,556,129
24	3.87	451,205	445,959	456,452
Winter/Neap Tide				
12	7.83	4,602,292	4,548,777	4,655,807
24	23.54	676,808	668,938	684,678
Winter/Spring Tide				
12	11.25	4,602,292	4,548,777	4,655,807
24	3.46	586,567	579,746	593,387
Annual Average/Neap Tide				
12	5.97	4,602,292	4,548,777	4,655,807
24	3.68	676,808	668,938	684,678
Annual Average/Spring Tide				
12	11.57	4,602,292	4,548,777	4,655,807
24	19.95	676,808	668,938	684,678

bbl = barrels; kg = kilogram (1 kg = 2.2 lb)
[a] Model results assume an uncontrolled spill without embedded controls, spill response, or mitigation that would be implemented to avoid or minimize environmental impacts from a spill.
[b] Neap tide occurs just after the first or third quarters of the moon when there is the least difference between high and low water.

Table 13-18: Rosario Strait Scenario—Worst-Case Maximum Potentially Impacted Areas and Mass

Time After Spill (hours)	Area Covered by Spill (square miles)[a]	Mass (kg) of Spilled Material, 330,000 bbl Spill[a]		
		Reformate	Backhaul Reformate	Xylenes
Summer/Neap Tide[b]				
12	5.30	4,602,292	4,548,777	4,655,807
24	0.14	90,241	89,192	91,290
Summer/Spring Tide				
12	4.33	3,248,677	3,210,901	3,286,452
Winter/Neap Tide				
12	2.77	1,714,579	1,694,642	1,734,516
Winter/Spring Tide				
12	4.19	3,248,677	3,210,901	3,286,452
24	0.33	270,723	267,575	273,871
Annual Average/Neap Tide				
12	7.09	4,376,690	4,325,798	4,427,581
24	2.14	406,085	401,363	410,807
Annual Average/Spring Tide				
12	7.14	4,602,292	4,548,777	4,655,807
24	5.49	721,928	713,534	730,323
36	1.80	180,482	178,383	182,581

bbl = barrels; kg = kilogram (1 kg = 2.2 lb)
[a] Model results assume an uncontrolled spill without embedded controls, spill response, or mitigation that would be implemented to avoid or minimize environmental impacts from a spill.
[b] Neap tide occurs just after the first or third quarters of the moon when there is the least difference between high and low water.

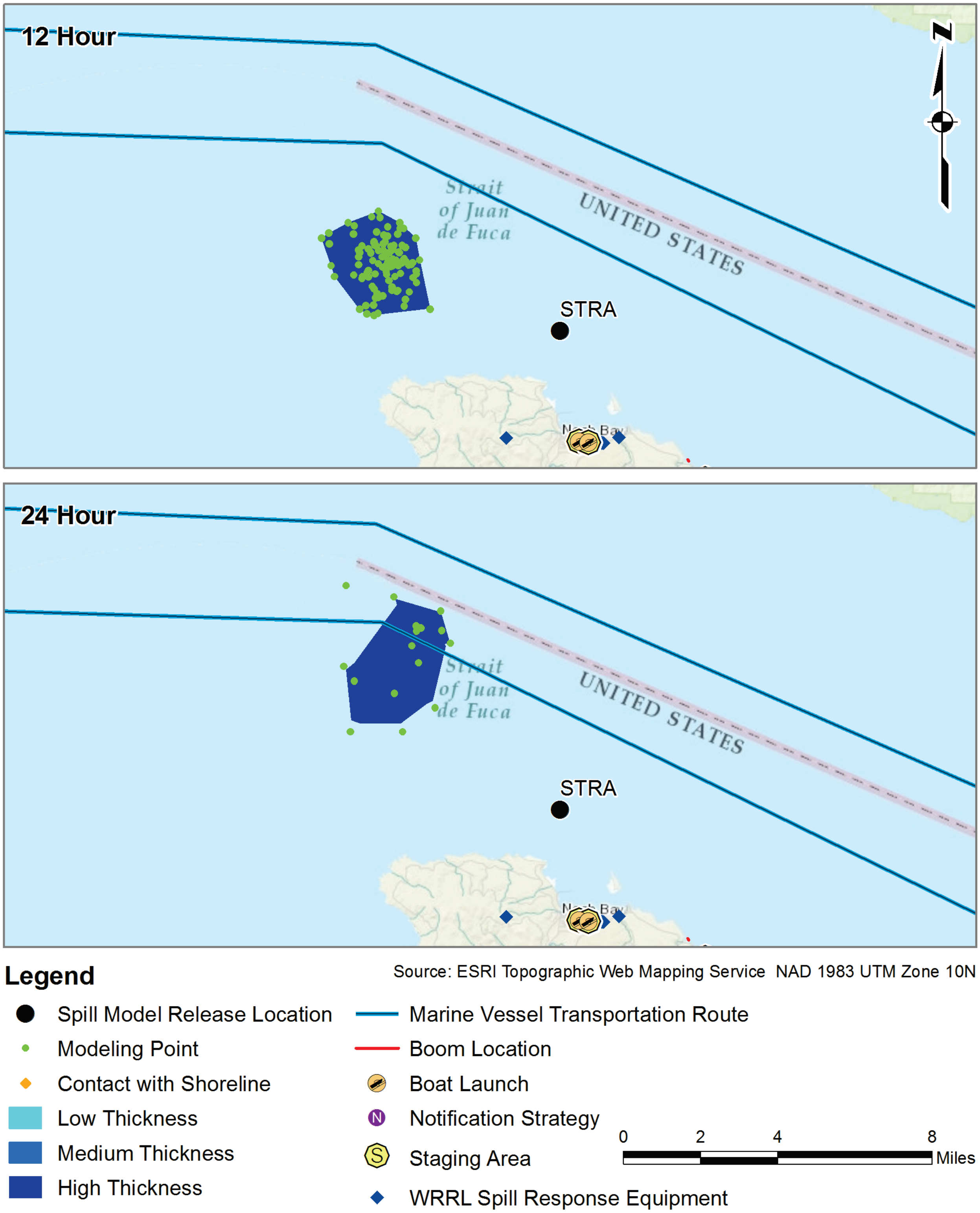
Table 13-19: Refinery Wharf Scenario—Worst-Case Maximum Potentially Impacted Areas and Mass

Time After Spill (hours)	Area Covered by Spill (square miles)[a]	Mass (kg) of Spilled Material, 330,000 bbl Spill[a]		
		Reformate	Backhaul Reformate	Xylenes
Summer/Neap Tide[b]				
12	3.43	21,384	21,135	21,632
24	3.72	1,380	1,364	1,396
Summer/Spring Tide				
12	9.34	20,004	19,772	20,237
24	3.63	2,759	2,727	2,791
Winter/Neap Tide				
12	1.63	6,898	6,818	6,978
24	1.56	2,069	2,045	2,093
Winter/Spring Tide				
12	All on land			
Annual Average/Neap Tide				
12	3.72	31,041	30,680	31,402
24	2.37	2,759	2,727	2,791
Annual Average/Spring Tide				
12	4.81	22,074	21,817	22,330
24	2.30	2,759	2,727	2,791

bbl = barrels; kg = kilogram (1 kg = 2.2 lb)
[a] Model results assume an uncontrolled spill without embedded controls, spill response, or mitigation that would be implemented to avoid or minimize environmental impacts from a spill.
[b] Neap tide occurs just after the first or third quarters of the moon when there is the least difference between high and low water.

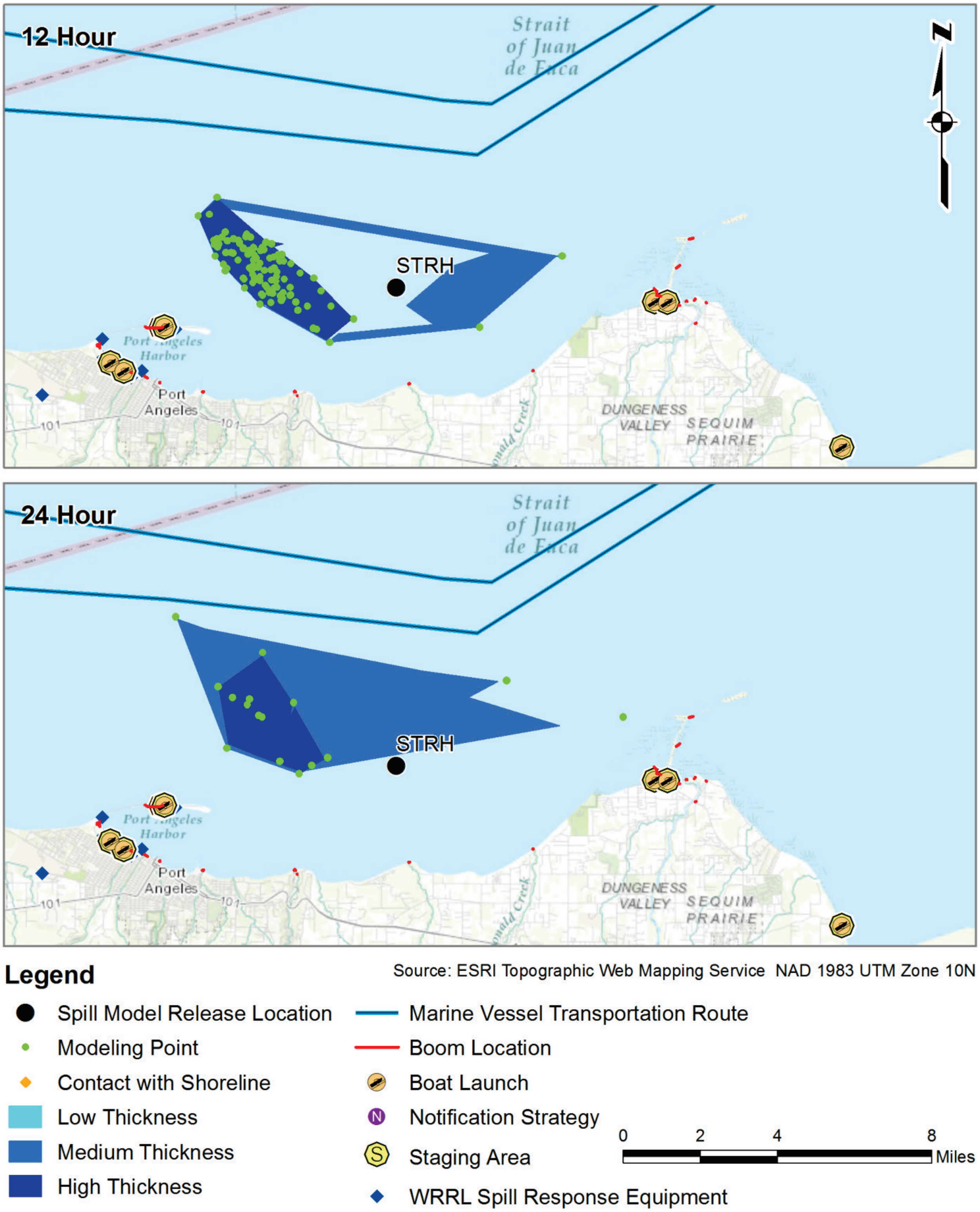
Figures 13-8 through 13-11 are selected diagrams generated by GNOME, showing the worst-case areas on the water surface, colored to represent various thickness-based risk values. Each figure includes one image for the 12-hour oil spill extent and the 24-hour oil spill extent, depicting the area that would be covered by a spill with a minimum thickness of 0.1 μm (i.e., thickness sufficient to qualify as having *less than significant* impacts, as defined in this chapter). Each figure also includes the location of spill response equipment which are cached throughout the Puget Sound region. Spill response equipment and spill response strategies are discussed in Section 13.5.7.

In some cases, the model predicted a spill spread such that varying degrees of thickness were predicted, as seen in the presence of low, medium, and high thickness contours. At other times, the spill is more clustered together as a thick patch. The full set of diagrams are presented in Appendix 13-B, Figures. Each figure includes up to six sub-parts, one for each of the tidal and wind scenarios listed in Appendix 13-B.



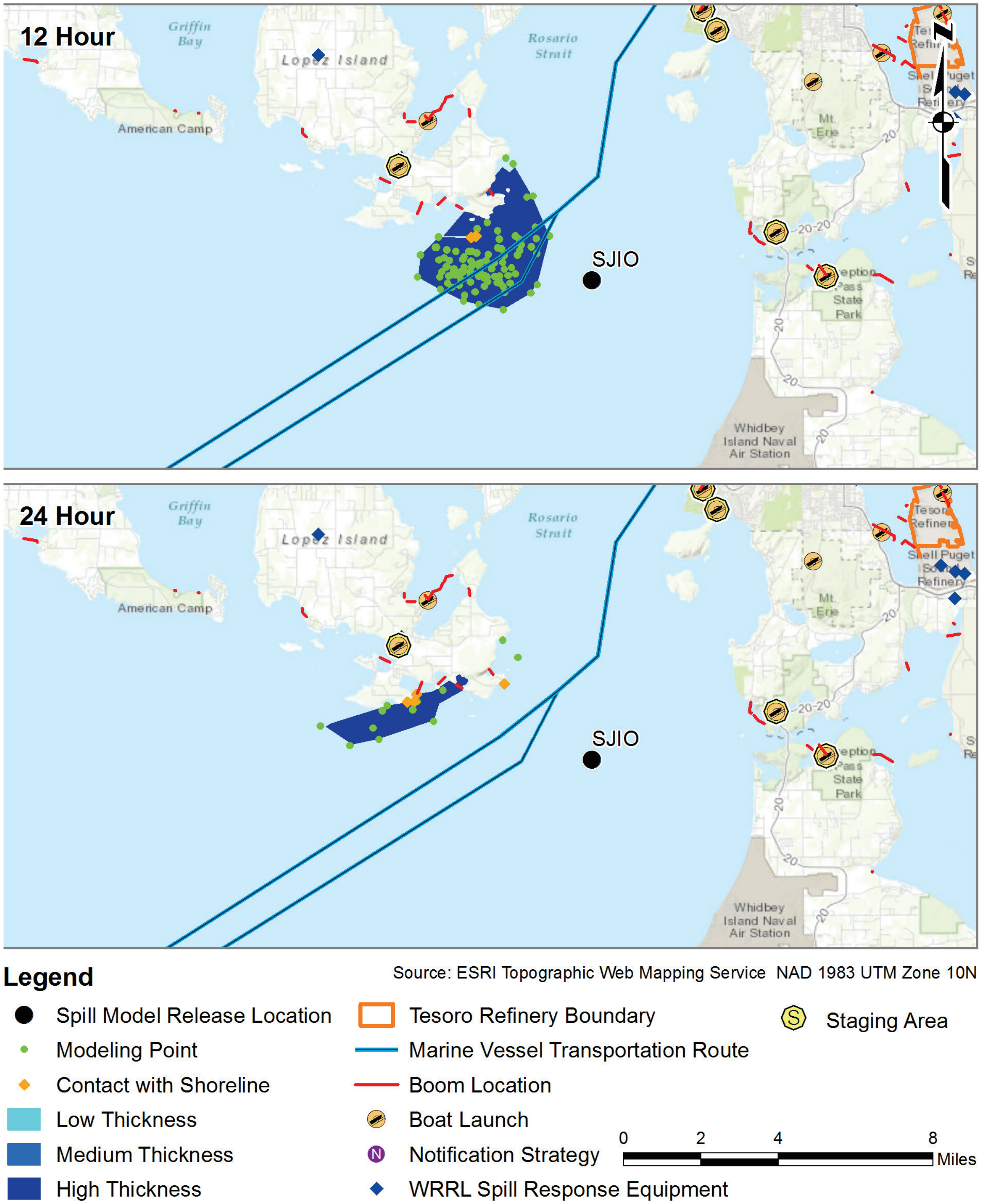
Source: WRRL Undated

Figure 13-8: Worst-Case Spill (330,000 bbl), Neah Bay, Annual Average Spring Tide



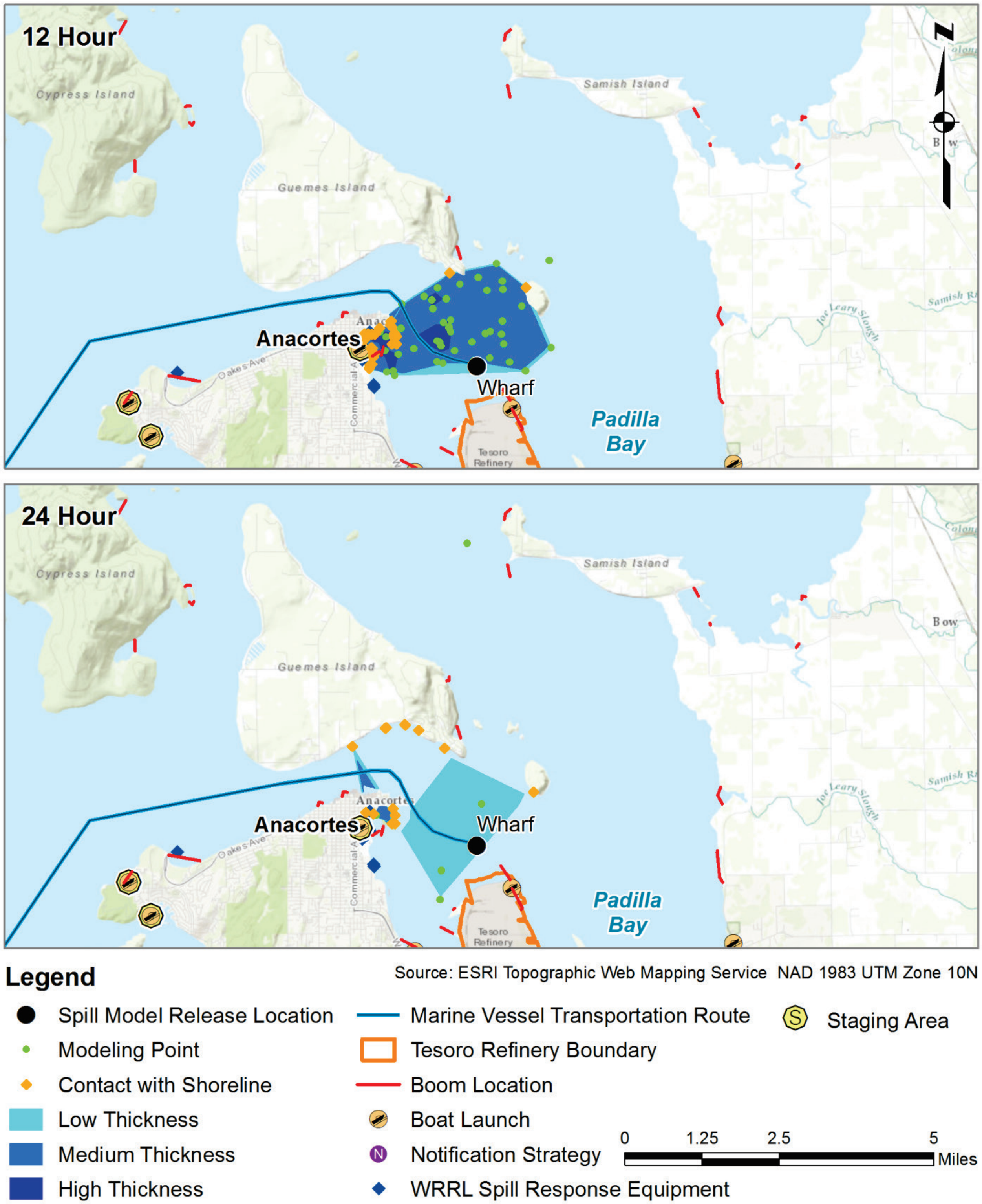
Source: WRRL Undated

Figure 13-9: Worst-Case Spill (330,000 bbl), Port Angeles, Annual Average Spring Tide



Source: WRRL Undated

Figure 13-10: Worst-Case Spill (330,000 bbl), Rosario Strait, Annual Average Neap Tide



Source: WRRL Undated

Figure 13-11: Worst-Case Spill (330,000 bbl), Refinery Wharf, Annual Average Neap Tide

Table 13-20: Extent and Thickness of Floating Spilled Material for a Worst-case Scenario

Season	Tide	Area of Spill for each Spill Thickness at each Timestep (Square Miles)								
		12-Hour Timestep			24-Hour Timestep			36-Hour Timestep		
		>10µm	1 µm - 10 µm	0.1 µm - 1 µm	>10µm	1 µm - 10 µm	0.1 µm - 1 µm	>10µm	1 µm - 10 µm	0.1 µm - 1 µm
Neah Bay										
Summer	Spring	5.87			4.43		1.08			
	Neap	5.65			5.55					
Winter	Spring	4.87								
	Neap	5.71								
Annual Average	Spring	5.18			5.86					
	Neap	4.91			3.30					
Port Angeles										
Summer	Spring	5.21	0.03		3.87					
	Neap	4.35			0.40	0.56	0.16			
Winter	Spring	8.23	3.03		3.46					
	Neap	7.83			3.61	19.93				
Annual Average	Spring	5.31	6.26		4.55	15.39				
	Neap	5.97			3.68					
Rosario Strait										
Summer	Spring				4.33	0.00				
	Neap	5.30			0.14	0.14	0.14			
Winter	Spring	4.19			0.33					
	Neap	2.77								
Annual Average	Spring	7.14			2.37	2.24	0.87	1.30	0.40	0.11
	Neap	7.09			2.14					
Refinery Wharf										
Summer	Spring	0.06	6.03	3.24		0.89	2.74			
	Neap	0.59	2.12	0.72		0.51	3.21			
Winter	Spring									
	Neap		1.63				1.56			
Annual Average	Spring	0.15	3.98	0.68		0.46	1.74			
	Neap	0.31	3.06	0.35		0.09	2.28			

Note: Blue cells indicate no spilled material over the 0.1 µm thickness threshold was present.

13.5.5.2. Maximum Most Probable and Average Most Probable Spills

To depict the potential spills plume for the maximum most probable spill and average most probable spill scenarios, which are considered by entities such as the USCG to be more likely, the size and duration of these spill events were estimated using the GNOME model's worst-case spill scenario output.

GNOME simulates the transport and spreading of spilled material using representative modeling points called "splots." The total mass spilled is divided equally among the splots; in this case 1,000 particles were used in each simulation. Regardless of the volume spilled, GNOME will simulate the same spill trajectory. Different spill volumes can be modeled by assigning different masses per splot; therefore, the output from the worst-case spill scenario can be scaled proportionally to represent the thickness contours of the maximum most probable spill and average most probable spill scenarios. Based on the properties of xylenes and reformate, the length of shorelines contacted by the maximum most probable spill and average most probable spill scenarios would be essentially the same as the worst-case spill scenario, except with less mass contacting the shore.

In all scenarios, the average most probable spill scenario (50 bbl) resulted in no significant surface oiling by 12 hours (i.e., all product on the water surface was below the minimum thickness threshold of 0.1 μm).

For the maximum most probable spill scenario (1,200 bbl at the refinery wharf and 2,500 bbl in the Salish Sea), the areas impacted were typically smaller in size and shorter in duration than the worst-case spill scenario. Within 24 hours after the spill, the majority of cases had a plume thicknesses in the low to medium categories (0.1 to 10 μm), instead of above the high thickness threshold (10 μm). In no case was oil thicker than 0.1 μm present at 36 hours.

Summaries of the areas covered by uncontrolled spills with a thickness of at least 0.1 μm, as well as the mass of each of the three products present at 12 and 24 hours following a maximum most probable spill if 2,500 bbl are provided for Neah Bay (Table 13-21), Port Angeles (Table 13-22), Rosario Strait (Table 13-23), and 1,500 bbl at the refinery wharf (Table 13-24). Summaries of the thickness of floating spilled material are presented in Table 13-20.

Table 13-21: Neah Bay Scenario—Maximum Most Probable Spill Potentially Impacted Areas and Mass (2,500 bbl)

Neah Bay (hours)	Area (square miles)	Reformate Mass (kg)	Backhaul Reformate Mass (kg)	Xylene Mass (kg)
Summer/Neap Tide[a]				
12	5.64	32,473	32,096	32,851
24	5.47	3,076	3,041	3,112
Summer/Spring Tide				
12	5.86	31,448	31,082	31,813
24	4.37	3,076	3,041	3,112
Winter/Neap Tide				
12	5.70	32,131	31,758	32,505

Neah Bay (hours)	Area (square miles)	Reformate Mass (kg)	Backhaul Reformate Mass (kg)	Xylene Mass (kg)
Winter/Spring Tide				
12	4.86	27,688	27,366	28,010
Annual Average/Neap Tide				
12	4.91	31,448	31,082	31,813
24	3.26	3,076	3,041	3,112
Annual Average/Spring Tide				
12	5.16	30,422	30,068	30,776
24	5.77	2,735	2,703	2,766

kg = kilogram (1 kg = 2.2 lb)
[a] Neap tide occurs just after the first or third quarters of the moon when there is the least difference between high and low water.

Table 13-22: Port Angeles Scenario—Maximum Most Probable Spill Potentially Impacted Areas and Mass (2,500 bbl)

Port Angeles (hours)	Area (square miles)	Reformate Mass (kg)	Backhaul Reformate Mass (kg)	Xylene Mass (kg)
Summer/Neap Tide[a]				
12	4.30	12,647	12,500	12,794
24	0.40	342	338	346
Summer/Spring Tide				
12	5.22	16,066	15,879	16,252
24	3.81	2,051	2,027	2,075
Winter/Neap Tide				
12	6.38	31,106	30,744	31,468
24	13.19	3,076	3,041	3,112
Winter/Spring Tide				
12	5.59	29,739	29,393	30,084
24	4.49	3,760	3,716	3,804
Annual Average/Neap Tide				
12	4.70	31,106	30,744	31,468
24	3.56	3,418	3,378	3,458
Annual Average/Spring Tide				
12	5.27	30,764	30,406	31,122
24	4.51	2,393	2,365	2,421

kg = kilogram
[a] Neap tide occurs just after the first or third quarters of the moon when there is the least difference between high and low water.

Table 13-23: Rosario Strait Scenario—Maximum Most Probable Spill Potentially Impacted Areas and Mass (2,500 bbl)

Rosario Strait (hours)	Area (square miles)	Reformate Mass (kg)	Backhaul Reformate Mass (kg)	Xylene Mass (kg)
Summer/Neap Tide[a]				
12	5.30	30,764	30,406	31,122
24	0.14	684	676	692
Summer/Spring Tide				
12	4.33	23,244	22,974	23,514
Winter/Neap Tide				
12	2.76	10,255	10,135	10,374
Winter/Spring Tide				
12	4.17	22,218	21,960	22,477
24	0.32	684	676	692

Rosario Strait (hours)	Area (square miles)	Reformate Mass (kg)	Backhaul Reformate Mass (kg)	Xylene Mass (kg)
Annual Average/Neap Tide				
12	7.07	29,397	29,055	29,739
24	0.32	1,709	1,689	1,729
Annual Average/Spring Tide				
12	7.12	32,473	32,096	32,851
24	4.96	3,418	3,378	3,458

kg = kilogram (1 kg = 2.2 lb)
[a] Neap tide occurs just after the first or third quarters of the moon when there is the least difference between high and low water.

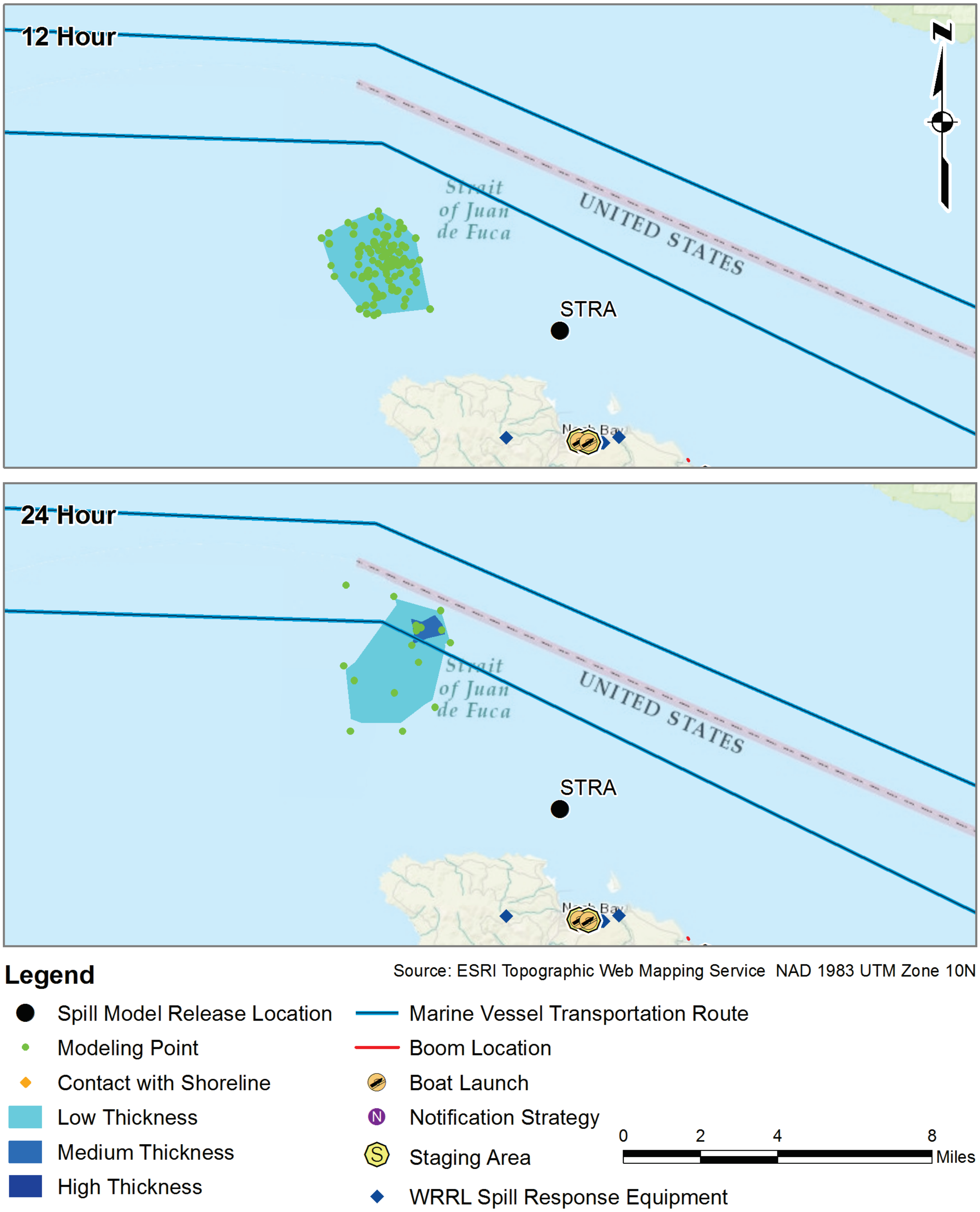
Table 13-24: Refinery Wharf Scenario—Maximum Most Probable Spill Potentially Impacted Areas and Mass (1,200 bbl)

Refinery Wharf (hours)	Area (square miles)	Reformate Mass (kg)	Backhaul Reformate Mass (kg)	Xylene Mass (kg)
Summer/Neap Tide[a]				
12	3.43	4,922	4,865	4,979
24	3.72	328	324	332
Summer/Spring Tide				
12	9.34	4,266	4,216	4,316
24	3.63	492	487	498
Winter/Neap Tide				
12	1.63	1,313	1,297	1,328
24	1.56	164	162	166
Winter/Spring Tide				
12	All on land			
Annual Average/Neap Tide				
12	3.72	6,563	6,487	6,639
24	2.37	492	487	498
Annual Average/Spring Tide				
12	4.81	4,266	4,216	4,316
24	2.30	164	162	166

kg = kilogram (1 kg = 2.2 lb)
[a] Neap tide occurs just after the first or third quarters of the moon when there is the least difference between high and low water.

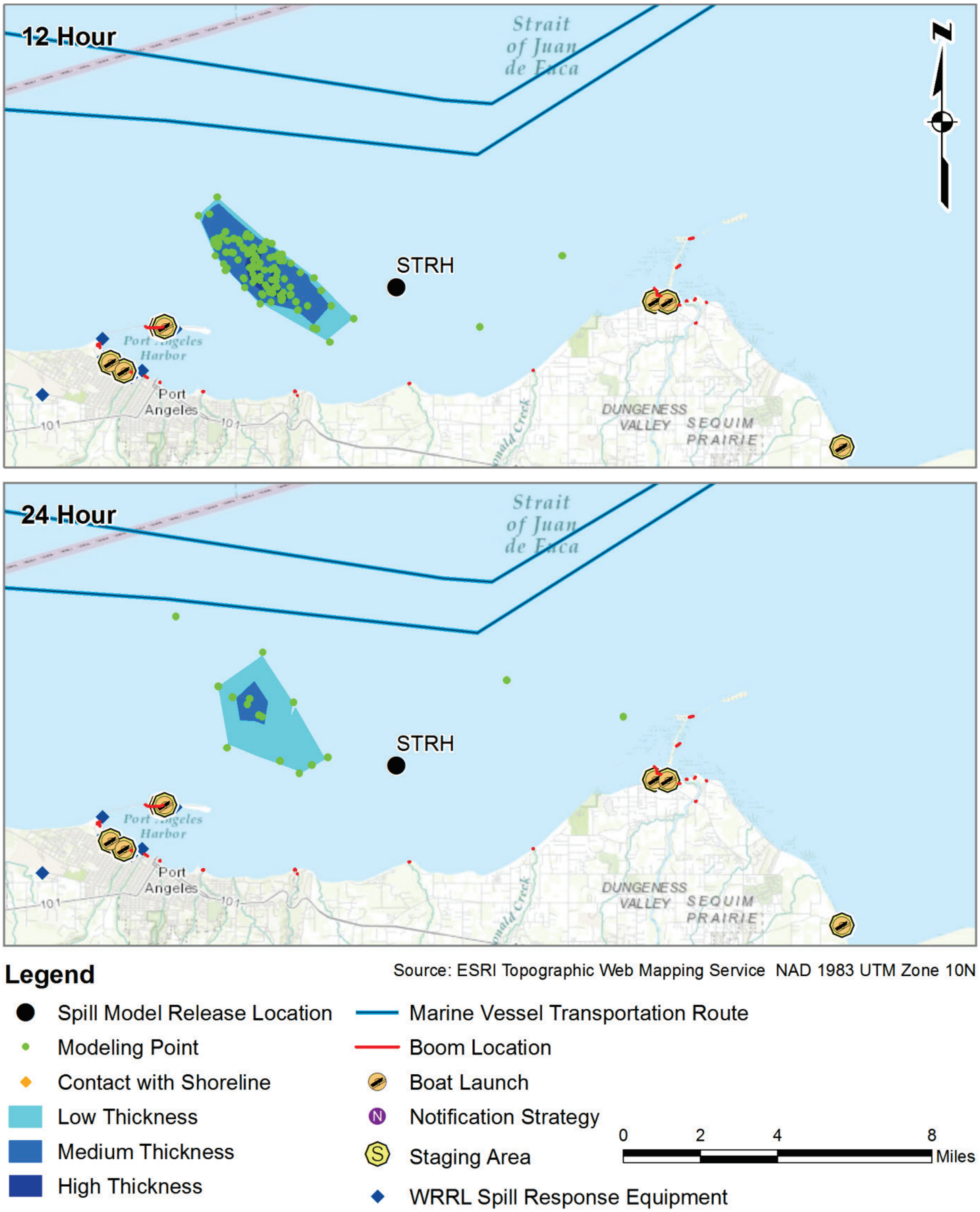
Figures 13-12 through 13-15 are selected diagrams generated by GNOME, showing the maximum most probable spill areas on the water surface, colored to represent various thickness-based risk values. Each figure includes one image for the 12-hour oil spill extent and one for the 24-hour oil spill extent, depicting the area that would be covered by a spill with a minimum thickness of 0.1 µm. Each figure includes up to six sub-parts, one for each of the tidal and wind scenarios listed in Tables 13-18 through 13-21.

In some cases, the model predicted a spill spread such that varying degrees of thickness were predicted, as seen in the presence of low, medium, and high thickness contours. At other times, the spill is more clustered together as a thick patch. The full set of diagrams are presented in Appendix 13-B.



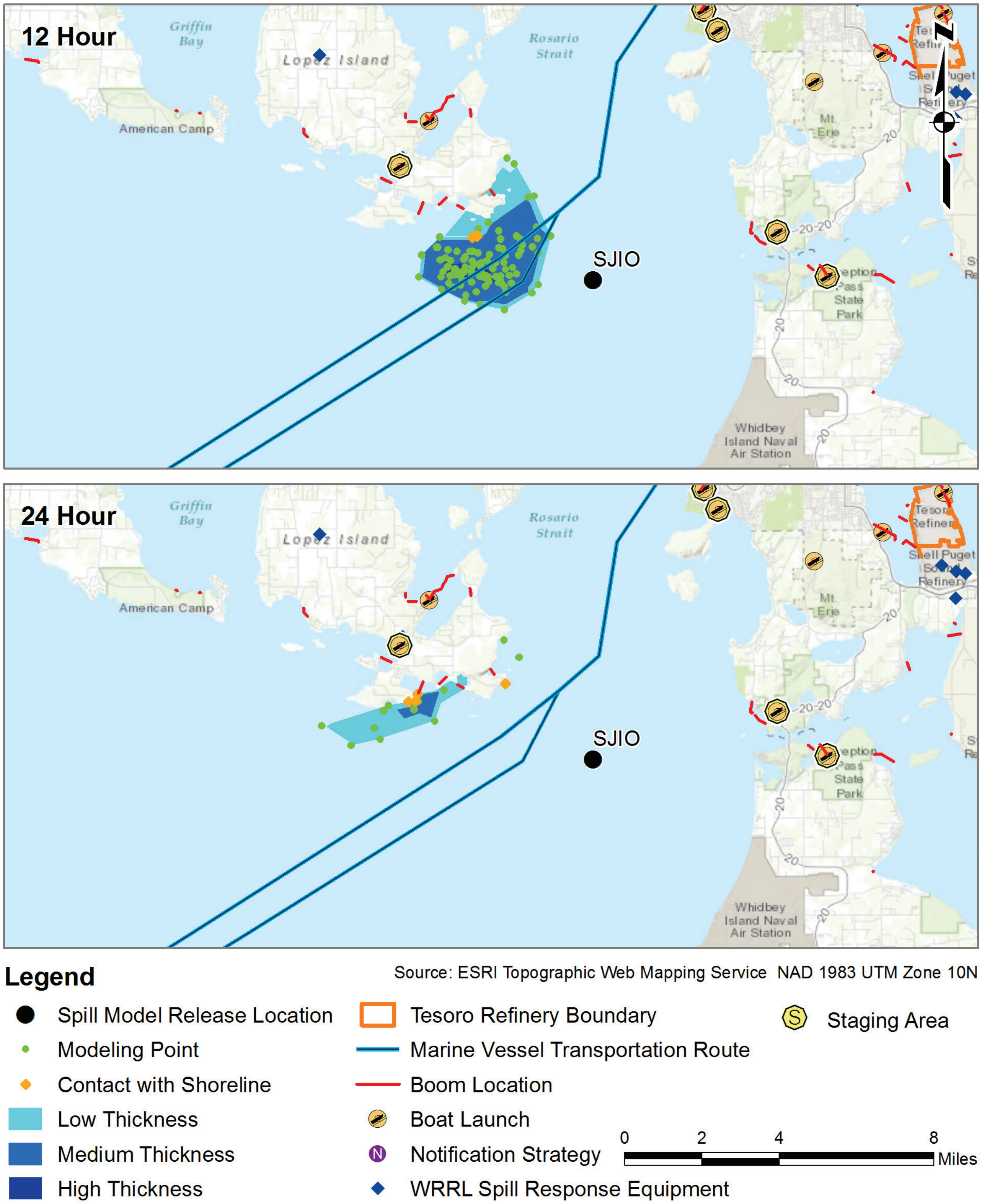
Source: WRRL Undated

Figure 13-12: Maximum Most Probable Spill, 2,500 bbl, Neah Bay, Annual Average Spring Tide



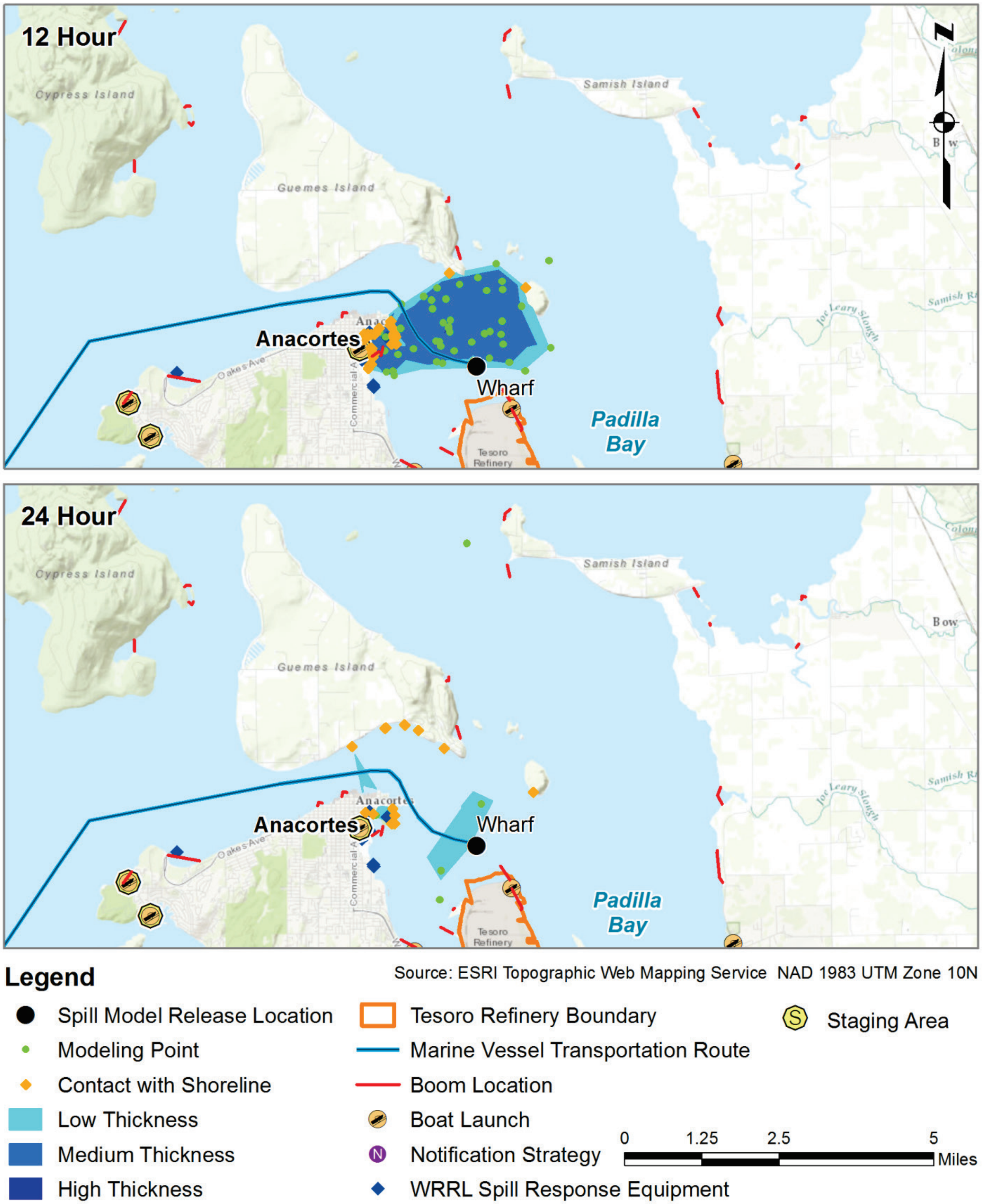
Source: WRRL Undated

Figure 13-13: Maximum Most Probable Spill, 2,500 bbl, Port Angeles, Annual Average Spring Tide



Source: WRRL Undated

Figure 13-14: Maximum Most Probable Spill, 2,500 bbl, Rosario Strait, Annual Average Neap Tide



Source: WRRL Undated

Figure 13-15: Maximum Most Probable Spill, 1,200 bbl, Wharf, Annual Average Neap Tide

Table 13-25: Extent and Thickness of Floating Spilled Material for a Maximum Most Probable Spill Scenario

Season	Tide	Area of Spill for each Spill Thickness at each Timestep (Square Miles)								
		12-Hour Timestep			24-Hour Timestep			36-Hour Timestep		
		>10µm	1 µm - 10 µm	0.1 µm - 1 µm	>10µm	1 µm - 10 µm	0.1 µm - 1 µm	>10µm	1 µm - 10 µm	0.1 µm - 1 µm
Neah Bay										
Summer	Spring	0.67	4.12	1.07		1.28	3.09			
	Neap	0.73	3.45	1.46		1.00	4.48			
Winter	Spring	0.35	3.67	0.84						
	Neap	0.64	3.79	1.27						
Annual Average	Spring			5.16		0.36	5.41			
	Neap	0.72	3.40	0.78		1.12	2.13			
Port Angeles										
Summer	Spring	0.08	3.86	1.28		0.31	3.49			
	Neap	0.03	1.63	2.63		0.00	0.39			
Winter	Spring	2.56	1.98	1.05	1.84	1.50	1.15			
	Neap	2.04	2.20	2.14	2.64	5.09	5.45			
Annual Average	Spring	0.59	3.33	1.35		0.58	3.93			
	Neap	0.64	4.03	0.03		0.99	2.57			
Rosario Strait										
Summer	Spring	0.38	2.68	1.24						
	Neap	0.58	3.92	0.02		0.07	0.06			
Winter	Spring	0.50	2.59	1.08		0.08	0.24			
	Neap	0.08	1.92	0.77						
Annual Average	Spring	0.25	5.41	1.46		1.39	3.57			
	Neap	0.47	4.59	2.01		0.36	1.75			
Refinery Wharf										
Summer	Spring		6.01	1.67		1.97	0.07			
	Neap	0.00	2.40	1.14			1.24			
Winter	Spring									
	Neap		0.47	1.46			0.08			
Annual Average	Spring		2.26	2.14			0.67			
	Neap	0.01	2.72	0.79		0.00	0.69			

Note: Blue cells indicate no spilled material over the 0.1 µm thickness threshold was present.

13.5.5.3. Spill Modeling Summary

Table 13-26 presents a summary of the spill modeling results for the worst-case, maximum most probable spill and average most probable spill scenarios.

Table 13-26: Summary of Spill Modeling Results

Scenario	Spill volume used for Scenario	Duration and Thickness of Spilled Material	Extent of Spilled Material
Worst-case Spill	330,000 bbl in the marine vessel transportation route	• The thickness of floating spilled material was initially greater than 10 µm. • The thickness of floating product was then reduced to less than 0.1 µm within 48 hours. • 99.5 percent of spilled material was dispersed/evaporated within 60 hours.	• The average extent of floating spilled material on the water surface was 5.9 square miles. • The maximum extent of floating spilled material on the water surface was 23.5 square miles. • Spilled materials reached up to 11.5 miles of shoreline.
	5,045 bbl at the refinery wharf structure	• The thickness of floating spilled material was initially greater than 10 µm. • The thickness of floating spilled material was reduced to less than 0.1 µm within 36 hours. • 99.5 percent of spilled material was dispersed/evaporated within 16 hours.	• The average extent of floating spilled material on the water surface was 3.7 square miles. • The maximum extent of floating spilled material on the water surface was 9.3 square miles. • The maximum length of shoreline that spilled materials reached was 11.1 miles.
Maximum Most Probable Spill	2,500 bbl in the marine vessel transportation route	• The thickness of floating spilled material was initially greater than 10 µm. • The thickness of floating spilled material was reduced to less than 0.1 µm within 36 hours.	• The average extent of floating spilled material on the water surface was 4.7 square miles. • The maximum extent of floating spilled material on the water surface was 13.2 square miles of water surface. • The maximum length of shoreline that spilled materials reached was 11.5 miles.
	1,200 bbl at the refinery wharf structure	• The thickness of floating spilled material was greater than 10 µm over an area of 0.1 square miles after 12 hours. • The thickness of floating spilled material was reduced to less than 0.1 µm within 24 hours.	• The average extent of floating spilled material on the water surface was 3.7 square miles. • The maximum extent of floating spilled material on the water surface was 9.3 square miles. • The maximum length of shoreline that spilled materials reached was 11.1 miles.
Average Most Probable Spill	50 bbl at the refinery wharf structure or marine vessel transportation route	The thickness of floating spilled material was reduced to less than 0.1 µm within 12 hours.	No geographic extent of spilled material seen/present under this modelling scenario at 12 hours, because the thickness of floating spilled material was below the threshold for mapping.

13.5.6. Spill Likelihood

Based on the historical record, the likelihood of a spill of any petroleum-based material decreases in proportion to the size of the spill: the larger the spill, the less likely it is to occur. Of more than 10,000 spills related to tankships across the world since 1967, 81 percent were less than 50 bbl (ITOPF 2016) (data specific to xylenes and reformate were not available).

The probability of large spill events—defined by Merrick and van Dorp (2016) as more than 10,000 gallons—approximately 238 bbl—is low, based on historic data. Since 1985, the state of Washington and USCG records document four such large spill events that are known to have occurred in the Salish Sea in this period of time (Merrick and van Dorp 2016):

- A 5,690 bbl spill from a single-hull tanker that grounded while anchoring in Port Angeles in 1985
- A 1,670 bbl spill from a capsized tank barge in the Guemes Channel in 1988
- A 8,600 bbl spill resulting from a collision between a fishing vessel and a cargo vessel near Cape Flattery in 1991
- A 640 bbl spill from a grounded tank barge near Anacortes in 1994

A 330,000 bbl spill (the volume of the worst-case spill scenario) would be two orders of magnitude larger than the largest recorded spill in the Salish Sea, and would rank among the top 35 spills in history (regardless of material spilled). By comparison, the Exxon Valdez released approximately 250,000 bbl of crude oil in 1989.

The nonprofit International Tanker Owners Pollution Federation (ITOPF) reports that, although seaborne oil trade has increased steadily since the 1970s, the number of spills worldwide has trended in the opposite direction, decreasing from an annual average of 24.5 spills per year between 1970 and 1979 to an annual average of 1.8 spills per year between 2010 and 2015 (ITOPF 2016).

Between 1995 and 2010 in the Salish Sea, a total of 7 collisions (two or more vessels in motion striking each other), 18 allisions (a vessel in motion striking a stationary object), and 15 groundings (grounding incidents that lead to large spills) involved large vessels such as tankships and cargo ships (Glosten Associates 2014a).

Spill probabilities based on historic data, such as those cited above, may actually overestimate future spill likelihood. Since the 1970s, federal laws and international conventions (such as those discussed in Section 13.1) have resulted in safer vessel designs (use of multiple independent tanks within the tankship, rather than one single large tank, double hulls, improved navigation systems), improved oil spill readiness and response, and coordinated vessel traffic management (see 33 CFR 161) in congested areas such as Puget Sound. These regulatory changes tend to reduce overall spill likelihood and minimize the impacts associated with spills. For example, mandatory use of double hulls in tankships (following major U.S. regulatory changes in the 1990s), has been shown to decrease the size of spills from tankers and tank barges (Merrick and van Dorp 2016). Other safety improvements and technological advances help prevent or reduce the frequency of marine accidents (e.g., events that could cause spills in the first place). These include safer ship designs, improved navigation systems, vessel traffic systems, and double pilotage (33 CFR Part 161).

Table 13-27 summarizes the findings of a recent vessel traffic risk assessment (VTRA) study for the region including the Strait of Juan de Fuca, portions of the Salish Sea south of the Canadian border, and all of Puget Sound. This study evaluated the likelihood of four size categories of spill events from vessels based on historical spill data from 1990 to 2015 (Merrick and van Dorp 2016). The study's "base case," as summarized in Table 13-27, projects future spill likelihoods with no additional marine vessel traffic (i.e., from the proposed Tesoro project or other proposed projects in the region). The spill likelihoods shown in Table 13-27 exist today, for every tankship that carries petroleum-based materials in the region studied.

Table 13-27: Summary of VTRA Base Case Spill Probabilities

Spill Volume Category (barrels)	Average Spill Size in Category (barrels)	Likelihood of at Least One Spill (All Tankships) (percent)		
		In the next 25 years	In the next 10 years	In any single year
>15,725	42,758	1.24	0.50	0.05
6,290 – 15,725	10,183	1.52	0.61	0.06
6.3 – 6,290	295	85.8	54.2	7.5
<6.3	0.05	100.0	100.0	98.7

Source: Merrick and van Dorp 2016

The VTRA found that, in the base case a spill greater than approximately 15,725 bbl had a 1.24 percent (slightly more than one-in-100) chance of occurring once in a 25-year period, a 0.5 percent chance (1-in-200) of occurring in the next 10 years, and a 0.05 percent (1-in-2,000) chance of occurring in any given year (Merrick and van Dorp 2016). Overall, as shown in Table 13-27, the VTRA found that larger spills were less likely to occur than smaller spills.

The data in Table 13-15 are thus helpful in predicting the potential for spill events of various sizes, using historic data, and for providing a relative perspective on the likelihood of occurrence for each of the three modeled spill events. No other readily available information allows for a specific calculation of the probability of a spill event occurring specifically for the three modeled spill scenarios. Based on the findings in Table 13-27, and the inverse relationship between spill size and spill likelihood, the following assumptions have been made:

- The likelihood of a worst-case spill at sea (330,000 bbl) is lower than reported for the ">15,725 bbl" category in Table 13-27, because the size of this spill is more than one order of magnitude larger than the VTRA category average.
- The likelihood of a worst-case spill at the wharf (5,045 bbl), or a maximum most probable spill in any location (2,500 bbl at sea, 1,200 bbl at the wharf) is lower than reported for the "6.3 to 6,290 bbl" category, because these spill scenarios are all substantially larger than the category average.
- The likelihood of an average most probable spill (50 bbl anywhere) is higher than reported for the "6.3 to 6,290 bbl" category, because this spill volume is lower than the category average.

The VTRA did not evaluate how spill likelihoods would change with the addition of project-related marine vessel traffic (i.e., 120 total vessel movements per year carrying xylenes and/or reformate); however, the VTRA did evaluate a scenario that included several other potential projects, generating 232 additional tanker and ATB trips from U.S. ports (referred to as "What-If Scenario: US232"). The VTRA's findings for this scenario included (Merrick and van Dorp 2016):

- A 4 percent overall increased spill likelihood
- Negligible increase in the likelihood of a "6.3 – 6,290 bbl" category spill
- An increase in the 10-year likelihood of a ">15,725 bbl" spill, from 0.5 percent to 0.8 percent

The proposed project would add approximately half as many vessels as the VTRA's US232 scenario. Based on the information cited above, it can therefore be inferred that the proposed project would result in:

- No discernible change in the overall likelihood of a worst-case spill at the wharf (5,045 bbl), of a maximum most probable spill at sea or at the wharf (2,500 bbl or 1,200 bbl, respectively), or of an average most probable spill (50 bbl) anywhere in the study area.
- A negligible increase in the overall likelihood of a worst-case spill at sea (330,000 bbl). This increment would likely be less than 0.3 percent in a 10 year period (the increment created by the VTRA's US232 scenario).

Section 13.6 evaluates the cumulative impacts of the overall increased risk of a spill in the Salish Sea. This section evaluates the incremental spill risk attributable only to the increased risk of a potential spill as a result of the increase in project-related vessels. Based on the VTRA analysis of future spill risks, the proposed project's vessel traffic increases, and the marine vessel transportation route that would be used by the proposed project, the changes in spill risks due to the proposed project do not represent a significant increase in spill risks above the risks currently present.

This finding applies to the proposed marine vessel transportation route as a whole, but must also be understood in context of the individual waterways within the Salish Sea, and specifically the individual waterways within the study area of this Draft EIS. The VTRA identified relative risk factors for various waterways within the Salish Sea. Notable VTRA base case findings relevant to this Draft EIS include (Merrick and van Dorp 2016):

- The likelihood of a ">15,725 bbl" spill in the Guemes Channel (including the refinery wharf) and Rosario Strait was approximately twice the overall likelihood for the Salish Sea.
- The likelihood of a "6.3 to 6,290 bbl" spill in the Guemes Channel was an order of magnitude lower than the overall likelihood for the Salish Sea (a 5 percent chance of such a spill in Guemes Channel within 10 years, compared to a Salish Sea-wide 54.1 percent chance).

- The likelihood of a "6.3 to 6,290 bbl" spill in Rosario Strait was *more than* an order of magnitude lower than the overall likelihood for the Salish Sea (a 1 percent chance of such a spill in Rosario Strait within 10 years, compared to a Salish Sea-wide 54.1 percent chance.
- The likelihood of a ">15,725 bbl" or "6.3 to 6,290 bbl" spill in the Strait of Juan de Fuca was generally slightly lower than the overall likelihood for the Salish Sea.

These findings are particularly relevant when considering the relative increase in just tanker and ATB traffic cited in Table 13-9: a 12.3 percent increase in tanker/ATB traffic in Rosario Strait and a 19.6 percent increase in tanker/ATB traffic in Guemes Channel. These factors clearly indicate that the likelihood of a spill is higher in Guemes Channel and Rosario Strait.

Considering these location-specific findings along the marine vessel transportation route, there would be a ***low likelihood*** of a spill (of any scenario) in Guemes Channel and Rosario Strait. The spill likelihood in the Strait of Juan de Fuca would remain a ***negligible likelihood.***

As described in Section 14.1.1.1, spills are more likely to occur during product transfers, such as those at the refinery wharf. In considering spills at the wharf, Tesoro's OSCP includes spills of any size that have occurred at the wharf since 1999. From 1999 to 2016, Tesoro recorded 11 spills. Ten of those spills were less than one gallon and one spill was two gallons. All of these recorded spills were substantially less than one barrel (42 gallons). Tesoro has reported that no vessels carrying their products have had any spills in the Strait of Juan de Fuca or greater Salish Sea from vessels in transit to/from the refinery. Considering these findings, there would be a ***low likelihood*** of an average most probable spill (50 bbl), and a ***negligible likelihood*** of any of the other scenarios occurring at the refinery wharf.

These spill likelihoods are summarized in Table 13-28.

Table 13-28: Overview of the Likelihood of a Spill Occurring at Selected Locations within the Study Area

Spill Scenario	Strait of Juan de Fuca	Guemes Channel	Rosario Strait	Refinery Wharf
Worst-case Spill	Negligible likelihood	Low likelihood	Low likelihood	Negligible likelihood
Maximum Most Probable Spill	Negligible likelihood	Low likelihood	Low likelihood	Negligible likelihood
Average Most Probable Spill	Negligible likelihood	Low likelihood	Low likelihood	Low likelihood

Note: This table summarizes the likelihood of a spill occurring at a selection of locations within the study area. This table isn't specific to the modeling locations outlined in Section 13.4.4.2. Instead, this table outlines the likelihood of a spill occurring anywhere within these four broad locations.

13.5.7. Spill Response

The computer modeling used to simulate hypothetical, uncontrolled releases of mixed xylene and reformate into the environment did not consider embedded controls, including spill response, which would be implemented to avoid or minimize environmental impacts in the event of a spill. An uncontrolled release is unlikely given embedded controls in place to prevent a spill and local and regional response capabilities available to contain a spill in the event of a spill.

Regional and Tesoro-specific operations have embedded controls in place to aid in responding to spill events. Pursuant to the National Oil and Hazardous Substances Pollution Contingency Plan, the Northwest Area Contingency Plan identifies spill response coordination measures in Washington, Oregon, and Idaho (RRT10/NWAC 2017). To implement the Northwest Area Contingency Plan, the Ecology publishes and maintains Geographic Response Plans (GRPs) (Ecology 2014). Prepared for individual bodies of water (or segments of a large body of water such as Puget Sound), the objectives of GRPs are to “pre-identify sensitive resources at risk of injury from oil spills” and to “help direct response actions related to sensitive resource protection during the initial hours of a response”:

> Strategies in the plan are deployed by responders after the immediate concern of controlling and containing the source of a spill has been addressed. GRPs contain maps and descriptions of natural, cultural, and economic resources, and then identify strategies to reduce harm to those resources. GRPs also prioritize which response strategies should be implemented based on the location of the spill, and are used along with spill trajectory and real-time information when available. (Ecology 2014)

In conjunction with GRPs, caches of spill response equipment are maintained throughout the Puget Sound region. These caches are shown in the spill modeling diagrams in Section 13.5.2.2.

Tesoro’s embedded controls address small or large spill events at the refinery wharf. These controls include a robust wharf management program to address transfer operations at the wharf to help prevent spills (see Appendix 2-A, Existing Programs and Operations). OPA 90 and regulations promulgated by the state of Washington under WAC 173-182 require Tesoro to prepare an OSCP and to update the OSCP annually or more frequently if warranted by changes at the facility (Tesoro 2016). The purpose of the OSCP is to help minimize the likelihood of such occurrences, and to be prepared to minimize or mitigate the impacts if they do occur. The plan is written in conjunction with other plans including the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 300), the Northwest Area Contingency Plan (RRT10/NWAC 2016), and the Washington Statewide Master Oil and Hazardous Substance Spill Contingency Plan (Chapter 90.56 RCW). Tesoro’s OSCP (Tesoro 2016b) must be reviewed and updated annually or more frequently if changes at the facility warrant it.

The safety equipment and operational protocols required by 33 CFR 154 and 156 during marine terminal transfers make larger spills statistically less likely. The impact of spills is also mitigated by the readiness and the response capabilities required by Oil Spill Response Organizations (OSROs) certified by the USCG under 33 CFR 154 Subpart F. Tesoro is required to have under contract, and to have identified in their Oil Spill Contingency Plan, an OSRO with the capabilities to respond not only to their average most probable spill (50 bbl or less) but also to the maximum most probable spill, and in the extremely unlikely event that of a worst-case spill volume would be released. Among the OSRO readiness criteria in 33 CFR 154.F, there are equipment standards to reduce the time required to halt a wharf-side spill, boom deployment times, and provide for the availability of oil skimming equipment and response equipment and logistics. Appendix 2-A, Existing Programs and Operations, includes additional detail regarding spill response time expectations and requirements.

Spills at the refinery wharf would not spread far, because of the specific safety measures in place on the wharf (i.e., those provided in Tesoro's OSCP and related national and statewide plans) to prevent and contain spills (Tesoro 2016). In the event that a control failed, Tesoro would immediately take steps to control and clean up the spill. Tesoro is required by federal regulations to have on-site 1,000 feet, or two times the length of the largest tankship, of boom available to deploy to protect sensitive areas in the event of a spill (33 CFR 154 Appendix C).

Unlike heavier oils, mixed xylenes evaporate quickly. Spill response in the marine environment does not involve the use of booms to contain the spill, except to protect resources. Mixed xylenes do not pose a risk of contaminating shorelines the way that persistent, heavier oils do. Mixed xylenes evaporate quickly, and the vapors are degraded and broken down by sunlight and atmospheric conditions.

If booming is needed to protect a sensitive area, such as the city of Anacortes or the Padilla Bay National Estuarine Research Reserve, deployment would begin immediately; regulations require that boom deployment occurs within one hour. In addition to the refinery's on-site trained personnel and equipment, the refinery also maintains spill response contracts with Marine Spill Response Corporation and Global Diving and Salvage. Both of these companies maintain personnel and equipment in Anacortes that are available 24 hours a day, 7 days a week and would be called out in the event of a spill. These OSROs are required to be trained to the readiness criteria identified above in accordance with 33 CFR 154 Appendix D. Tesoro's Oil Spill Contingency Plan lists the following actions that would be taken in the event of a spill of xylenes or reformate (in the "gasoline/light hydrocarbons" section of the Oil Spill Contingency Plan; Tesoro 2016):

1. Identify the source and stop the release.
2. Eliminate/reduce the fire hazard due to vapors (eliminate sources of ignition, use water fog to knock down vapors).
3. Evacuate nonessential personnel.
4. Communicate with potentially affected people in area, including boats (call names and numbers are listed in the Contingency Plan).
5. Determine the direction and expected duration of spill movement using tide and current information (included in the Contingency Plan).
6. Call the U.S. Coast Guard to request they establish vessel traffic control as needed in the area.
7. Assess whether any environmentally or economically sensitive areas might be impacted based on #5 above, the spill trajectory analysis in the Contingency Plan, and the list of sensitive areas identified in the Contingency Plan. Tesoro personnel or spill response contractors would then be directed to place boom to protect the sensitive areas at risk when the spill occurs.

As discussed in Appendix 2-A, Existing Programs and Operations, Tesoro regularly conducts oil spill response drills to ensure that they can quickly and efficiently follow the response methods detailed in the Contingency Plan. Firefighters, hazardous materials response organizations, and emergency medical personnel are familiar with mixed xylenes and its hazard classification. Because xylenes are a part of gasoline fuels, local responders trained in the existing petroleum response procedures are already properly trained in spill response activities; they would already have experience participating in response simulation exercises relevant to mixed xylenes.

Spills in the shipping channel would also have a rapid response and would be managed by the ship’s crew and their contracted oil spill response organization. The contracted OSRO would be responsible for deploying booms, supplying tug support (for example, to safely evacuate a crew or to provide support in the event of a steering failure), and for supporting vessel firefighting assets. This deployment would begin immediately if needed according to the OSCP, and would be requested through the Coast Guard’s Captain of the Port. The VTS would be immediately contacted on VHF channel 16 (an Emergency channel monitored by the USCG and all shipping) in the event of an accident, as legally required under 33 CFR 153; helicopter support would be deployed quickly within a matter of minutes, depending upon when and where in the shipping channel they are located. USCG small boat and cutter deployment would take more time since the closest marine vessels available for spill response deployment are at USCG Station Bellingham. The Bellingham station has 44 USCG assigned personnel, three special purpose marine vessels (search and rescue/law enforcement and patrol/homeland security), and the larger USCG Cutter Sea Lion. In 2015, the USCG Station Bellingham conducted 150 search and rescues and 300 law enforcement patrols.

The location of spill response equipment, including boat launch locations, staging areas, and an identification of whether the location has a specific spill notification strategy, are included on the figures in Section 13.5.2.4 and 13.5.2.5. The spill equipment shown on the figures is from the Ecology Western Response Resource List (WRRL) database that stores data on various types of oil spill response equipment in the Pacific Northwest. The boom symbols on the maps represent locations where booms would be deployed in the water as part of the initial response strategy to protect sensitive resources in accordance with the GRP strategies provided in the OSCP.

13.5.8. Summary of Potential Impacts from Spills

Computer models were used to simulate hypothetical, uncontrolled releases of mixed xylene and reformate into the marine environment. Xylenes and reformate are classified as insoluble since only small amounts are able to dissolve. In addition, both products are less dense than water and, being insoluble, would therefore mostly float on the surface as a thin layer (as a “plume” or “sheen”). If churned into the water by wind and wave action, the products would occur as tiny undissolved droplets. Spill modeling used these physical characteristics to evaluate the geographic extent and the thickness of the material on the water surface.

Four spill modeling locations were selected for the modeling from a list locations provided by Ecology as theoretical locations where spills are likely to occur; one at the refinery wharf and three locations along the marine vessel transportation route. Three spill scenarios based theoretical volumes of material released were then modelled at each location. The theoretical volumes that were selected were based on spill response planning scenarios and included a worst-case, maximum most probable, and average most probable spill scenario. The spread and thickness of each spill scenario's release volume was analyzed at 12-hour increments from the time of the spill. Results from the spill modeling, including the volume, thickness, extent and duration of a potential marine spill, were then used to support the impact assessments in the other resource chapters.

Potential impacts from marine spills are addressed in the following resource chapters: Chapter 4, Air Quality and Climate Change; Chapter 6, Terrestrial Vegetation and Wildlife; Chapter 7, Marine and Nearshore Resources; Chapter 9, Environmental Health; Chapter 10, Land and Shoreline Use; and Chapter 11, Social and Economic Environment. The conclusions from these chapters for the worst-case, maximum most probable, and average most probable spill scenarios are summarized in Tables 13-25 and 3-26, respectively.

Depending on the resource, the impacts of a worst-case spill or maximum most probable spill could be ***potentially significant*** if such a spill was to occur and response actions were not taken. Impacts from an average most probable spill would be ***less than significant*** for the resources evaluated.

Table 13-29: Summary of Potential Impacts from the Worst-case and Maximum Most Probable Spill Scenarios

Impact Topic	Impact Summary[a]	Potential Impact Significance	
		Less Than Significant	***Potentially Significant***
Impacts on air quality	Air emissions would temporarily increase during a spill into the marine environment, and HAPs would evaporate into the atmosphere from the surface of the water. Increased emissions of ozone and GHGs could cause an *exceptional event* of greater than 87,400 metric tons of GHG.[9] However, increases in GHG and air emissions would be temporary and short term. See Chapter 4, Section 4.4.4, Impacts on Air Quality and GHG from Spills.	✓	
Impacts on marine birds	The presence of xylene and reformates for up to two days presents a risk of potentially sub-lethal impacts on marine birds due to inhalation, ingestion, and dermal irritation. However, neither xylene or reformate are expected to bioaccumulate and therefore would not cause longer term impacts. See Chapter 6, Section 6.4.3, Unplanned Events.		✓
Impacts on threatened and endangered marine fish	Marine spills during operation could result in mortality of fish, and threatened and endangered fish species are known to occur in the study area. Plume thickness would reduce to a level reported to not typically be harmful to marine wildlife within the first two days of the spill occurring. See Chapter 7, Section 7.4.3, Impacts on Marine and Nearshore Resources from Marine Spills.		✓

[9] An *exceptional event* is defined by USEPA as unusual or naturally occurring events that can affect air quality, but are not reasonably controllable using techniques that air agencies may implement in order to attain and maintain the AAQS.

Impact Topic	Impact Summary[a]	Potential Impact Significance	
		Less Than Significant	***Potentially Significant***
Impacts on marine life	Marine spills during operation could result in mortality of microorganisms present within the upper marine water column, invertebrates, fish and marine vegetation in the surface and sub-surface layers, and potential health impacts on fish, marine mammals and marine turtles. However, under all spill scenarios, the spilled material would be a thin layer that would float on the surface of water. Plume thickness would reduce to a level reported to not typically be harmful to marine wildlife within the first two days. See Chapter 7, Section 7.4.3, Impacts on Marine and Nearshore Resources from Marine Spills.	✓	
Impacts on public health	A worst-case spill or maximum most probable spill scenario could result in public exposures exceeding health-based air quality criteria for up to 24 hours if people were located near a spill. See Chapter 9, Section 9.6.2, Potential Impacts on Health from Spills		✓
Impacts on land and shoreline use	A spill occurring close to the shoreline could result in temporary restricted shoreline access for a few days until the xylene or reformate evaporate (no persistent residue would remain). See Chapter 10, Section 10.3.2, Potential Impacts on Land Use and Shoreline Use.	✓	
Impacts on recreation	Temporary restrictions or prohibitions on the use of shoreline or open water recreation areas or activities could occur for up to 3 days in the event of a marine spill. See Chapter 10, Section 10.4.2, Potential Impacts on Recreation.	✓	
Aesthetic and visual resources	Spills could result in a temporary visible sheen on the surface of the water, and could represent a short-term violation of the aesthetics component of the water quality standards for surface waters of the state. In addition, there may be visual impacts from spill response activities. Impacts would last for up to 3 days. See Chapter 10, Section 10.5.2, Potential Impacts on Aesthetics and Visual Resources.	✓	
Public services	Spills, particularly those that impact the shoreline, could require assistance from local first responders at specific impacted locations within the spill area. The maximum duration of response would be 2 to 3 days. See Chapter 11, Section 11.4.2, Potential Impacts on Public Services.	✓	
Economic condition	There is potential for a minimally perceptible reduction in commercial fishing, aquaculture production, and spending on tourism and recreation due to temporary restrictions following a spill event. These interruptions could last for a maximum of 2 to 3 days. See Chapter 11, Section 11.5.2, Potential Impacts on Employment Income.	✓	
Tribal fisheries and aquaculture	There is potential for reductions in tribal fishing due to temporary restrictions on fishing and mortality of finfish or shellfish. Potential impacts include lower than expected wages for a 2 to 3 day catch period. Given the short duration of the potential impact on catch, there would be no measurable impact on processing industries. See Chapter 11, Section 11.5.2, Potential Impacts on Employment Income.	✓	

Impact Topic	Impact Summary[a]	Potential Impact Significance	
		Less Than Significant	*Potentially Significant*
Cultural Resources	In the event of a marine spill, xylene and reformate would evaporate quickly and would not stain shorelines. Therefore, the impact on submerged marine or shoreline cultural resources in marine environments from a xylene or reformate spill would be less than significant. See Chapter 12, Section 12.4.2, Impacts on Cultural Resources from Marine Spills.	✓	
Impacts on vessel traffic	In a worst-case spill scenario, response activities would result in temporary closures of individual waterways and port facilities for up to three days, up to a 23.5 square mile area. A maximum most probable spill is unlikely to result in such changes (see Section 13.3.2.3).	✓ (maximum most probable scenario)	✓ (worst case scenario)
Vessel safety	A worst-case spill could result in temporary navigational changes in individual waterways or delays entering specific port facilities. Resultant increases in vessel safety risk would be within the range of current risk experienced by marine vessels in the Salish Sea. A maximum most probable spill is unlikely to result in such changes (see Section 13.4.2.3).	✓	

[a] Assuming no spill response

Table 13-30: Summary of Potential Impacts from the Average Most Probable Spill Scenario

Impact Topic	Impact Summarya	Potential Impact Significance	
		Less Than Significant	*Potentially Significant*
Impacts on all resources/impact topics from the average most probable spill scenario	Modeling of the average most probable spill scenario indicated that spilled xylene or reformate on the water surface would be below 0.1 µm thickness after 12 hours. Due to the short duration of the disturbance, the average most probable spill would have a less than significant impact on each resource evaluated.	✓	

[a] Assuming no spill response

The findings described above indicate that, under the worst-case and maximum most probable spill scenario, an uncontrolled spill in the marine environment could be potentially significant to some resources if a spill were to occur. The analysis also determined that the probability of such a spill occurring at the refinery wharf or along the marine vessel transportation route is negligible to low. Because a spill is an unplanned event, the significance of a spill is examined within the context of the likelihood of a spill occurring and the potential for a change to the current spill risk as a result of increased vessel traffic associated with the proposed project. Based on both the historical record and Ecology's spill risk analysis study, there is a negligible to low likelihood of a spill occurring, depending on the specific location in the study area (see Section 13.5.6). In addition, the risk of a spill occurring at the refinery wharf or along the marine vessel transportation route would not significantly change from existing conditions as a result of the proposed project.

The potential impacts and significance of a spill described above were derived from an uncontrolled spill scenario (i.e., no spill response) of mixed xylenes or reformate into the marine environment. The estimated potential impacts presented above and in the resource chapters are therefore conservatively high.

Safety measures are in in place at the refinery and on vessels transiting along the marine vessel transportation route to prevent a spill. Measures in place at the refinery to prevent a spill include spill prevention and response plans, operational protocols for storing materials and handling equipment, maintenance and control procedures, operator training, and response personnel training (see Section 13.5.7 and Appendix 2-A, Existing Programs and Operations). Marine vessel safety measures are in place that would minimize project-related vessel safety risks along the marine vessel transportation route and for loading/unloading products from vessels at the refinery wharf, respectively (see Section 13.4).

If an actual spill were to occur, response measures governed by regulatory agencies and provided by the refinery, local and regional response organizations would be implemented to contain the spill and in turn minimize the potential impacts from a spill. Response plans and procedures are in place for responding to a spill and sufficient existing resources (both equipment and trained personnel) are available for spill response throughout the study area (see Section 13.5.7 and Figures 13-8 through 13-15). For example, for every spill event, booms are locally available to be rapidly deployed to protect sensitive areas and contain the spread of the material such that it would not reach sensitive areas for birds, aquatic life, or people. In the event of a spill, therefore, many of the potential impacts described above and in the other resource chapters would be further minimized below those risk levels described through the implementation of spill response procedures.

13.5.9. Potential Impacts of the No Action Alternative

Under the no action alternative, Tesoro would not proceed with the proposed project. Because increased vessel activity for construction and operation would not take place under the no action alternative, there would be no new impact on marine spills and spill response as a result of the proposed project.

13.5.10. Additional Mitigation Measures

No additional mitigation measures are recommended beyond the embedded controls that are already incorporated into the proposed project design.

13.6. Cumulative Impacts from Marine Transportation

As described above, construction and operation of the proposed project could result in less than significant impacts on marine vessel traffic and vessel safety. Future marine vessel traffic in the Salish Sea is expected to increase. Although it would only represent an increase of 2.2 percent or less in future marine vessel traffic, the proposed project, when considered with past, present, and reasonably foreseeable future actions, would contribute to cumulative impacts on vessel traffic, vessel safety, and the risk of a marine spill, as detailed below.

13.6.1.1. Vessel Traffic and Safety

As noted in Table 1-2, the Trans Mountain expansion project in British Columbia has been approved, and there are other possible projects that could contribute to increased tanker traffic in the study area. Future marine vessel traffic could increase in the study area, due to both increased marine cargo through existing facilities (driven by economic growth) and/or increased cargo through new facilities. The EIS for the proposed BP Cherry Point marine vessel traffic study estimated that all marine vessel traffic through the study area (the Strait of Juan de Fuca, Rosario Strait, and Guemes Channel) could increase by 20 to 40 percent by 2030 (Glosten 2014b). That same study estimated that adding the marine vessel traffic from the BP project, the Trans Mountain Expansion in British Columbia, and the Gateway Pacific Terminal to this baseline growth would increase marine vessel traffic by 60 to 120 percent by 2030 (Glosten 2014b).

Absent new projects being constructed, tanker traffic in the study area is forecast to remain relatively flat or to decline (Glosten 2014b). The declining production in crude oil from Alaska's North Slope, along with increased expected crude oil deliveries via pipeline and rail would tend to decrease the tanker vessel traffic. If crude oil exports increased from facilities in the Salish Sea, or if crude by rail deliveries to terminals elsewhere for onward delivery to Puget Sound refineries increased, those factors would tend to increase total tanker traffic.

If total tanker traffic remains at current levels, then the impacts of the proposed project's marine vessel traffic (including increased risk of vessel incidents and marine spills) combined with existing and future traffic would remain largely as described in Chapter 13, Marine Transportation.

13.6.1.2. Spill Risks

To assess the increased risks associated with additional marine vessel traffic, particularly tanker traffic, the VTRA sponsored by Ecology[10] modeled several scenarios of increases in tanker and cargo vessel traffic in Puget Sound and the impact on probabilities of spills occurring with the increased traffic. The study does not make forecasts of future vessel traffic, but examines several "what-if" scenarios of possible increases, based on possible new projects going forward. Among the scenarios considered is the "USKMCA1600" scenario, which included an increase in vessel traffic of approximately 600 tanker and ATBs per year. This level of increased vessel traffic would accommodate the proposed project's vessel traffic (60 vessel calls under scenario US232), the Trans Mountain expansion project in British Columbia (348 vessel calls under scenario KM348), a collection of 23 tankers from other terminal projects (CA1020), plus an additional 169 tanker and ATB calls at other possible project expansions. The same scenario also included an increase of 1,000 non-tanker bulk carrier and cargo vessel calls in the Salish Sea (for a total of approximately 1,600 vessels). The BP Cherry Point maximum traffic scenario was 85 additional vessel calls. This level of vessel traffic increase is of a similar magnitude to that in the Glosten study (Glosten 2014b).

[10] The final report was released in early February 2017, any updates will be included in the Final EIS.

The study results in Table 13-31 show the percent chance of a spill occurring for the base case at 2015 traffic levels and under the USKMCA1600 what-if scenario, with the 1,600 additional vessels described above.

Table 13-31: Increase in Spill Likelihood–Puget Sound 2015 Vessel Traffic Risk Assessment

Spill Volume Category	Likelihood of Occurring (All Tankers/ATBs)	
	Chance of Occurring in any Single Year – Base Traffic Levels	Chance of Occurring in any Single Year – 1,600 Additional Vessels
> 16,000 bbl (42,758 bbl category average)	0.05%	0.14%
6,300 – 16,000 bbl (10,183 bbl category average)	0.6%	0.9%
6 -6,300 bbl (295 bbl category average)	7.5%	8.2 %
< 6 bbl (0.05 bbl category average)	99%	99%

As shown in Table 13-32, additional annual vessel calls in the greater Salish Sea could increase the risk of spills. Chapter 13, Marine Spills and Spill Response, Section 13.5.5 found spill likelihood to be slightly higher ("low" as opposed to "negligible") when the Guemes Channel and Rosario Strait were considered separately from the entire Salish Sea. Because much of the cumulative traffic would use the Haro Strait instead of the Guemes Channel or Rosario Strait, cumulative traffic would not increase the low spill likelihood for Guemes Channel or the Rosario Strait.

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