

Screening Level Risk Assessment Package

Coast Trader



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Atmospheric Administration

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Photo: Photograph of *Coast Trader*

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Project Background

The past century of commerce and warfare has left a legacy of thousands of sunken vessels along the U. coast. Many of these wrecks pose environmental threats because of the hazardous nature of their cargoes, presence of munitions, or bunker fuel oils left onboard. As these wrecks corrode and decay, they may release oil or hazardous materials. Although a few vessels, such as USS *Arizona* in Hawaii, are well-publicized environmental threats, most wrecks, unless they pose an immediate pollution threat or impede navigation, are left alone and are largely forgotten until they begin to leak.

In order to narrow down the potential sites for inclusion into regional and area contingency plans, in 2010, Congress appropriated \$1 million to identify the most ecologically and economically significant potentially polluting wrecks in U.S. waters. This project supports the U.S. Coast Guard and the Regional Response Teams as well as NOAA in prioritizing threats to coastal resources while at the same time assessing the historical and cultural significance of these nonrenewable cultural resources.

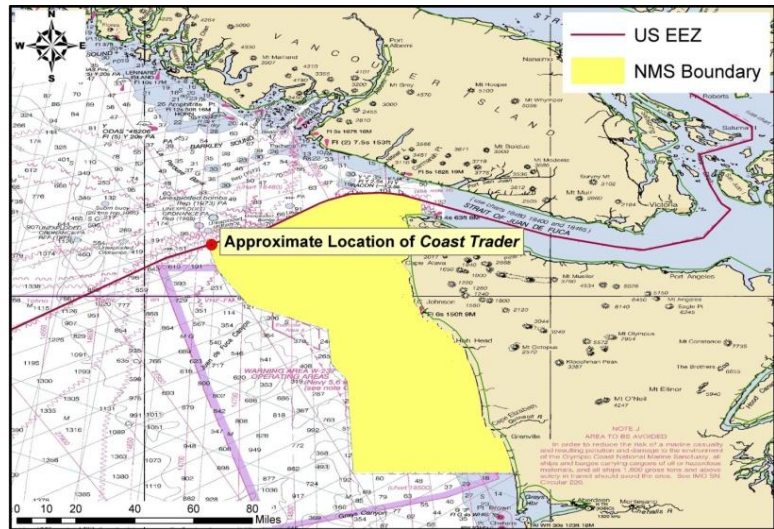
The potential polluting shipwrecks were identified through searching a broad variety of historical sources. NOAA then worked with Research Planning, Inc., RPS ASA, and Environmental Research Consulting to conduct the modeling forecasts, and the ecological and environmental resources at risk assessments.

Initial evaluations of shipwrecks located within American waters found that approximately 600-1,000 wrecks could pose a substantial pollution threat based on their age, type and size. This includes vessels sunk after 1891 (when vessels began being converted to use oil as fuel), vessels built of steel or other durable material (wooden vessels have likely deteriorated), cargo vessels over 1,000 gross tons (smaller vessels would have limited cargo or bunker capacity), and any tank vessel.

Additional ongoing research has revealed that 87 wrecks pose a potential pollution threat due to the violent nature in which some ships sank and the structural reduction and demolition of those that were navigational hazards. To further screen and prioritize these vessels, risk factors and scores have been applied to elements such as the amount of oil that could be on board and the potential ecological or environmental impact.

Executive Summary: Coast Trader

The freighter *Coast Trader*, torpedoed and sunk during World War II off the coast of Washington in 1942, was identified as a potential pollution threat, thus a screening-level risk assessment was conducted. The different sections of this document summarize what is known about the *Coast Trader*, the results of environmental impact modeling composed of different release scenarios, the ecological and socio-economic resources that would be at risk in the event of releases, the screening-level risk scoring results and overall risk assessment, and recommendations for assessment, monitoring, or remediation.



Based on this screening-level assessment, each vessel was assigned a summary score calculated using the seven risk criteria described in this report. For the Worst Case Discharge, *Coast Trader* scores Low with 11 points; for the Most Probable Discharge (10% of the Worst Case volume), *Coast Trader* also scores Low with 10 points. Given these scores, and the unknown location of the vessel, NOAA recommends that this site be noted in the Area Contingency Plans as necessary to answer future questions about the pollution risks associated with this particular vessel and so that if a mystery spill is reported in the general area, this vessel could be investigated as a source. Should additional information become available that would suggest a greater level of concern, then an active monitoring program could be implemented or an assessment undertaken. Outreach efforts with commercial and recreational fishermen who frequent the area would be helpful to gain awareness of localized spills in the general area where the vessel is believed lost.

Vessel Risk Factors		Risk Score	
Pollution Potential Factors	A1: Oil Volume (total bbl)	Med	
	A2: Oil Type		
	B: Wreck Clearance		
	C1: Burning of the Ship		
	C2: Oil on Water		
	D1: Nature of Casualty		
	D2: Structural Breakup		
Archaeological Assessment	Archaeological Assessment	Not Scored	
Operational Factors	Wreck Orientation	Not Scored	
	Depth		
	Confirmation of Site Condition		
	Other Hazardous Materials		
	Munitions Onboard		
	Gravesite (Civilian/Military)		
	Historical Protection Eligibility		
		WCD	MP (10%)
Ecological Resources	3A: Water Column Resources	Low	Low
	3B: Water Surface Resources	Med	Med
	3C: Shore Resources	Med	Low
Socio-Economic Resources	4A: Water Column Resources	Low	Low
	4B: Water Surface Resources	Med	Med
	4C: Shore Resources	Low	Low
Summary Risk Scores		11	10

The determination of each risk factor is explained in the document. This summary table is found on page 35.

SECTION 1: VESSEL BACKGROUND INFORMATION: REMEDIATION OF UNDERWATER LEGACY ENVIRONMENTAL THREATS (RULET)

Vessel Particulars

Official Name: *Coast Trader*

Official Number: 219588

Vessel Type: Freighter

Vessel Class: 5,340 gross ton class Cargo Ship

Former Names: *Yashi/Holyoke Bridge; Point Reyes*



Year Built: 1920

Builder: Submarine Boat Company, Newark, NJ

Builder's Hull Number: 108

Flag: American

Owner at Loss: Coastwise Line SS Co.

Controlled by: Unknown

Chartered to: U.S. Army

Operated by: U.S. Army

Homeport: Portland, OR

Length: 324 feet

Beam: 46 feet

Depth: 25 feet

Gross Tonnage: 3,286

Net Tonnage: 2,030

Hull Material: Steel

Hull Fastenings: Riveted

Powered by: Oil-fired steam

Bunker Type: Heavy fuel oil (Bunker C)

Bunker Capacity (bbl): 8,088

Average Bunker Consumption (bbl) per 24 hours: 130

Liquid Cargo Capacity (bbl): 0

Dry Cargo Capacity: 223,550 cubic feet

Tank or Hold Description: Unknown

Casualty Information

Port Departed: Port Angeles, WA

Destination Port: San Francisco, CA

Date Departed: June 7, 1942

Date Lost: June 7, 1942

Number of Days Sailing: 1

Cause of Sinking: Act of War (Torpedo) or Internal Explosion

Latitude (DD): 48.24978

Longitude (DD): -125.668

Nautical Miles to Shore: 40

Nautical Miles to NMS: 0 (Inside OCNMS)

Nautical Miles to MPA: 0

Nautical Miles to Fisheries: Unknown

Approximate Water Depth (Ft): 600

Bottom Type: Continental margin

Is There a Wreck at This Location? Unknown, the wreck has never been located or surveyed

Wreck Orientation: Unknown

Vessel Armament: Vessel was armed but the numbers and types are currently unknown

Cargo Carried when Lost: 1,250 tons of newsprint

Cargo Oil Carried (bbl): 0

Cargo Oil Type: N/A

Probable Fuel Oil Remaining (bbl): $\leq 8,088$

Fuel Type: Heavy fuel oil (Bunker C)

Total Oil Carried (bbl): $\leq 8,088$

Dangerous Cargo or Munitions: Yes

Munitions Carried: Munitions for onboard weapons

Demolished after Sinking: No

Salvaged: No

Cargo Lost: Yes

Reportedly Leaking: No

Historically Significant: Yes

Gravesite: No

Salvage Owner: Not known if any

Wreck Location

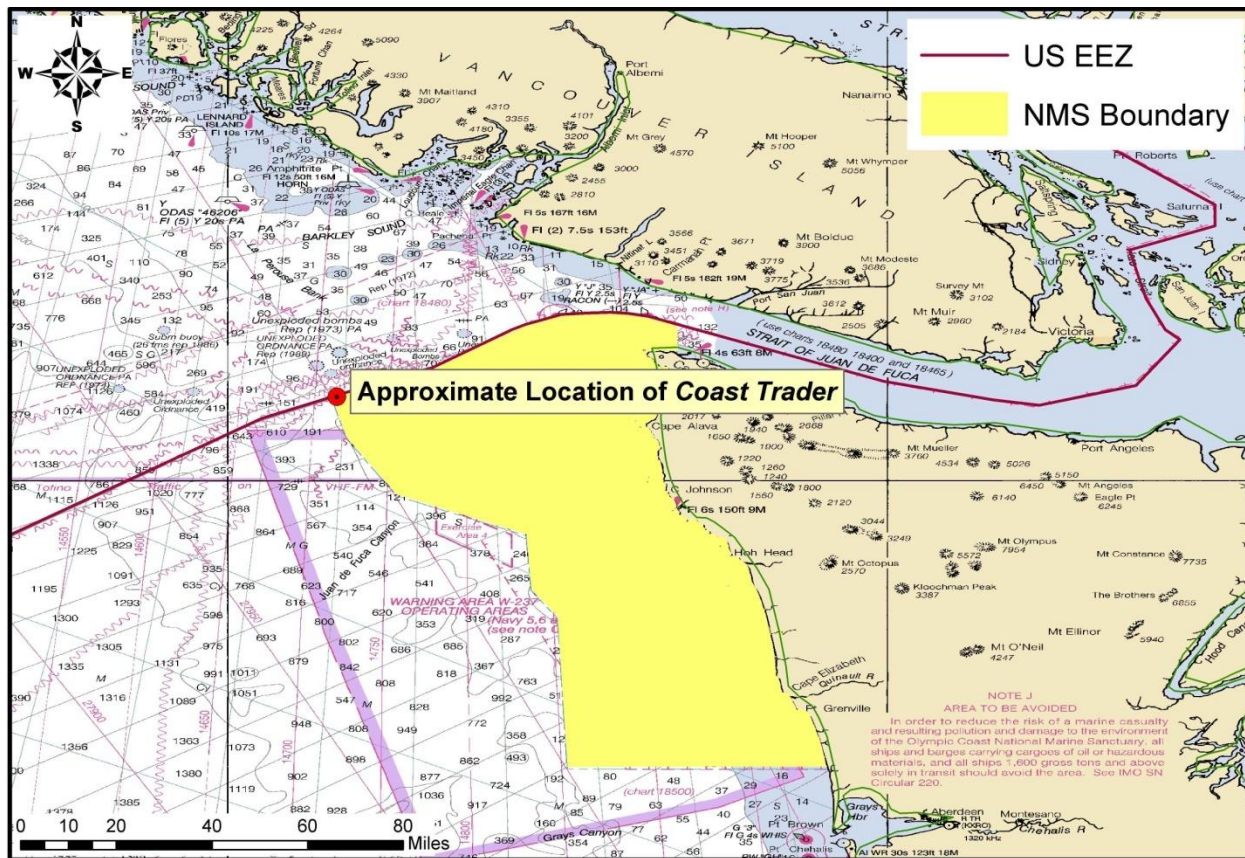


Chart Number: 18007

Casualty Narrative

"*Coast Trader* sailed from Port Angeles, WA, to San Francisco, CA. About thirty miles from the Strait of Juan de Fuca the *I-26* (Yokota) attacked the ship as she steered a nonevasive course. A torpedo blasted a six foot hole in the starboard side beneath the #4 hatch in the stern. The explosion blew the #4 hatch cover forty feet in the air, and scattered bits of paper from the 2,000-pound newsprint rolls over the deck. The engines immediately stopped and the hold filled with steam. The gun crew offered no counter offensive. Ammonia fumes leaking from the ship's refrigeration unit overcame some of the crew as they mustered at their boat stations. The men managed to launch one lifeboat and two rafts. The fishing vessel *Virginia I* towed the lifeboat to Neah Bay thirty hours after the attack. Ten hours later the Canadian corvette *Edmundston* (K-106) picked up the rafts carrying nine officers, twenty-eight men, and nineteen armed guards and landed them at Port Angeles. One man died from exposure before being rescued. The freighter sank stern first at 1435."

-Browning Jr., Robert M., U.S. Merchant Vessel War Casualties Of World War II, Naval Institute Press, Annapolis, Maryland, 1966

General Notes

NOAA Automated Wreck and Obstruction Information System (AWOIS) Data:
POSITION ACCURACY 1-3 MILES; REPORTED THRU 13ND 10/15/42.

Wreck Condition/Salvage History

Unknown; the wreck has never been located or surveyed.

Archaeological Assessment

The archaeological assessment provides additional primary source based documentation about the sinking of vessels. It also provides condition-based archaeological assessment of the wrecks when possible. It does not provide a risk-based score or definitively assess the pollution risk or lack thereof from these vessels, but includes additional information that could not be condensed into database form.

Where the current condition of a shipwreck is not known, data from other archaeological studies of similar types of shipwrecks provide the means for brief explanations of what the shipwreck might look like and specifically, whether it is thought there is sufficient structural integrity to retain oil. This is more subjective than the Pollution Potential Tree and computer-generated resource at risk models, and as such provides an additional viewpoint to examine risk assessments and assess the threat posed by these shipwrecks. It also addresses questions of historical significance and the relevant historic preservation laws and regulations that will govern on-site assessments.

In some cases where little additional historic information has been uncovered about the loss of a vessel, archaeological assessments cannot be made with any degree of certainty and were not prepared. For vessels with full archaeological assessments, NOAA archaeologists and contracted archivists have taken photographs of primary source documents from the National Archives that can be made available for future research or on-site activities.

Assessment

The wreck of *Coast Trader* has never been located, so there are no site reports that would allow NOAA archaeologists to provide a condition based archaeological assessment of the shipwreck. Some additional analysis can be made based on the historic sinking reports of the ship that may be of utility to the U.S. Coast Guard. We know from archival research that the ship was struck by one torpedo beneath the number four cargo hold.

The explosion blew the hatch covers off the cargo hold and sent rolls of newsprint flying through the air. Survivors of the attack reported looking down into the hatches and seeing a "sea of oil and water" in and around the damaged portion of the ship and that "quite a bit of fuel oil surrounded ship." The vessel eventually sank by the stern and the survivors watched as each of the hatch covers were blown off in succession as the ship sank.

Based on the large degree of inaccuracy in the reported sinking location and the depths of water the ship was lost in, it is unlikely that the shipwreck will be intentionally located. Although the survivor reports of the sinking make it sound like substantial amounts of oil was lost when the vessel sank, it is not possible to determine with any degree of accuracy what the current condition of the wreck is and how likely the vessel is to contain oil since the shipwreck has never been discovered

The only way to conclusively determine the condition of the shipwreck will be to examine the site after it is discovered. Should the vessel be located in a survey of opportunity or due to a mystery spill attributed to this vessel, it should be noted that this vessel is of historic significance and will require appropriate actions be taken under the National Historic Preservation Act (NHPA) and the Sunken Military Craft Act (SMCA) prior to any actions that could impact the integrity of the vessel. This vessel may be eligible for listing on the National Register of Historic Places.

Background Information References

Vessel Image Sources: http://www.historylink.org/index.cfm?DisplayPage=output.cfm&File_Id=7166

Construction Diagrams or Plans in RULET Database? No

Text References:

-http://www.historylink.org/index.cfm?DisplayPage=output.cfm&File_Id=7166

-AWOIS database #50069

-NIMA database #36509

-MMS CA database

Vessel Risk Factors

In this section, the risk factors that are associated with the vessel are defined and then applied to the *Coast Trader* based on the information available. These factors are reflected in the pollution potential risk assessment development by the U.S. Coast Guard Salvage Engineering Response Team (SERT) as a means to apply a salvage engineer's perspective to the historical information gathered by NOAA. This analysis reflected in Figure 1-1 is simple and straightforward and, in combination with the accompanying archaeological assessment, provides a picture of the wreck that is as complete as possible based on current knowledge and best professional judgment. This assessment does not take into consideration operational constraints such as depth or unknown location, but rather attempts to provide a replicable and objective screening of the historical data for each vessel. SERT reviewed the general historical information available for the database as a whole and provided a stepwise analysis for an initial indication of Low/Medium/High values for each vessel.

In some instances, nuances from the archaeological assessment may provide additional input that will amend the score for Section 1. Where available, additional information that may have bearing on operational considerations for any assessment or remediation activities is provided.

Each risk factor is characterized as High, Medium, or Low Risk or a category-appropriate equivalent such as No, Unknown, Yes, or Yes Partially. The risk categories correlate to the decision points reflected in Figure 1-1.

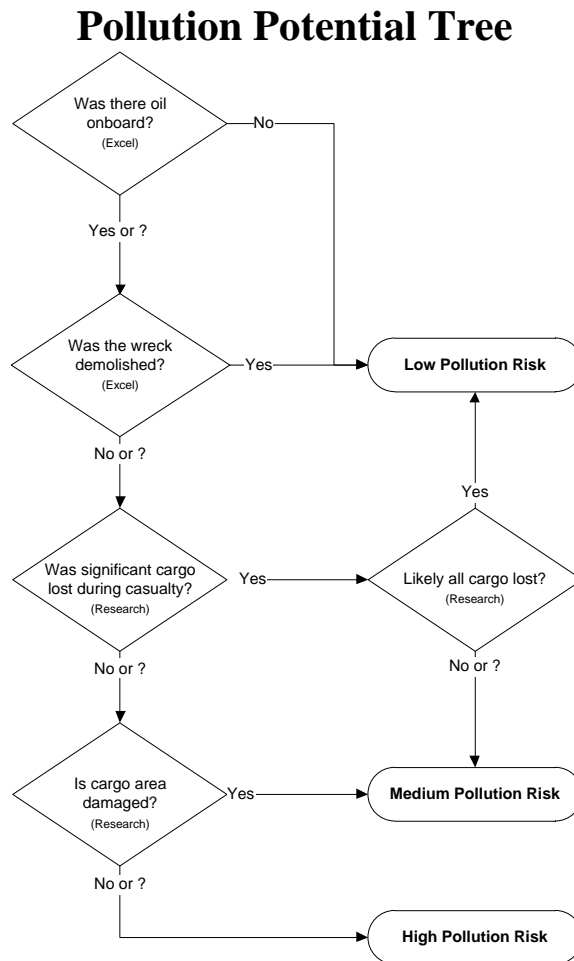


Figure 1-1: U.S. Coast Guard Salvage Engineering Response Team (SERT) developed the above Pollution Potential Decision Tree.

Each of the risk factors also has a “data quality modifier” that reflects the completeness and reliability of the information on which the risk ranks were assigned. The quality of the information is evaluated with respect to the factors required for a reasonable preliminary risk assessment. The data quality modifier scale is:

- **High Data Quality:** All or most pertinent information on wreck available to allow for thorough risk assessment and evaluation. The data quality is high and confirmed.
- **Medium Data Quality:** Much information on wreck available, but some key factor data are missing or the data quality is questionable or not verified. Some additional research needed.
- **Low Data Quality:** Significant issues exist with missing data on wreck that precludes making preliminary risk assessment, and/or the data quality is suspect. Significant additional research needed.

In the following sections, the definition of low, medium, and high for each risk factor is provided. Also, the classification for the *Coast Trader* is provided, both as text and as shading of the applicable degree of risk bullet.

Pollution Potential Factors

Risk Factor A1: Total Oil Volume

The oil volume classifications correspond to the U.S. Coast Guard spill classifications:

- **Low Volume: Minor Spill** <240 bbl (10,000 gallons)
- **Medium Volume: Medium Spill** ≥240 – 2,400 bbl (100,000 gallons)
- **High Volume: Major Spill** ≥2,400 bbl (≥100,000 gallons)

The oil volume risk classifications refer to the volume of the most-likely Worst Case Discharge from the vessel and are based on the amount of oil believed or confirmed to be on the vessel.

The *Coast Trader* is ranked as High Volume because it is thought to have a potential for up to 7,000 bbl (decreased from 8,088 to account for oil seen on the water at the time of the loss), although more may have been lost at the time of the casualty due to the explosion and breakup of the vessel. Data quality is medium.

The risk factor for volume also incorporates any reports or anecdotal evidence of actual leakage from the vessel or reports from divers of oil in the overheads, as opposed to potential leakage. This reflects the history of the vessel's leakage. There are no reports of leakage from the *Coast Trader*.

Risk Factor A2: Oil Type

The oil type(s) on board the wreck are classified only with regard to persistence, using the U.S. Coast Guard oil grouping¹. (Toxicity is dealt with in the impact risk for the Resources at Risk classifications.)

The three oil classifications are:

- **Low Risk: Group I Oils** – non-persistent oil (e.g., gasoline)
- **Medium Risk: Group II – III Oils** – medium persistent oil (e.g., diesel, No. 2 fuel, light crude, medium crude)
- **High Risk: Group IV** – high persistent oil (e.g., heavy crude oil, No. 6 fuel oil, Bunker C)

The *Coast Trader* is classified as High Risk because the cargo is heavy fuel oil, a Group IV oil type. Data quality is high.

Was the wreck demolished?

Risk Factor B: Wreck Clearance

This risk factor addresses whether or not the vessel was historically reported to have been demolished as a hazard to navigation or by other means such as depth charges or aerial bombs. This risk factor is based on historic records and does not take into account what a wreck site currently looks like. The risk categories are defined as:

¹ Group I Oil or Nonpersistent oil is defined as "a petroleum-based oil that, at the time of shipment, consists of hydrocarbon fractions: At least 50% of which, by volume, distill at a temperature of 340°C (645°F); and at least 95% of which, by volume, distill at a temperature of 370°C (700°F)."

Group II - Specific gravity less than 0.85 crude [API° >35.0]

Group III - Specific gravity between 0.85 and less than .95 [API° ≤35.0 and >17.5]

Group IV - Specific gravity between 0.95 to and including 1.0 [API° ≤17.5 and >10.0];

- **Low Risk:** The wreck was reported to have been entirely destroyed after the casualty
- **Medium Risk:** The wreck was reported to have been partially cleared or demolished after the casualty
- **High Risk:** The wreck was not reported to have been cleared or demolished after the casualty
- **Unknown:** It is not known whether or not the wreck was cleared or demolished at the time of or after the casualty

The *Coast Trader* is classified as High Risk because there are no known historic accounts of the wreck being demolished as a hazard to navigation. Data quality is high.

Was significant cargo or bunker lost during casualty?

Risk Factor C1: Burning of the Ship

This risk factor addresses any burning that is known to have occurred at the time of the vessel casualty and may have resulted in oil products being consumed or breaks in the hull or tanks that would have increased the potential for oil to escape from the shipwreck. The risk categories are:

- **Low Risk:** Burned for multiple days
- **Medium Risk:** Burned for several hours
- **High Risk:** No burning reported at the time of the vessel casualty
- **Unknown:** It is not known whether or not the vessel burned at the time of the casualty

The *Coast Trader* is classified as High Risk because there was no known report of fire at the time of casualty. Data quality is high.

Risk Factor C2: Reported Oil on the Water

This risk factor addresses reports of oil on the water at the time of the vessel casualty. The amount is relative and based on the number of available reports of the casualty. Seldom are the reports from trained observers so this is very subjective information. The risk categories are defined as:

- **Low Risk:** Large amounts of oil reported on the water by multiple sources
- **Medium Risk:** Moderate to little oil reported on the water during or after the sinking event
- **High Risk:** No oil reported on the water
- **Unknown:** It is not known whether or not there was oil on the water at the time of the casualty

The *Coast Trader* is classified as Medium Risk because the oil was reported to have spread across the water as the vessel went down. Data quality is high.

Is the cargo area damaged?

Risk Factor D1: Nature of the Casualty

This risk factor addresses the means by which the vessel sank. The risk associated with each type of casualty is determined by the how violent the sinking event was and the factors that would contribute to increased initial damage or destruction of the vessel (which would lower the risk of oil, other cargo, or munitions remaining on board). The risk categories are:

- **Low Risk:** Multiple torpedo detonations, multiple mines, severe explosion

- **Medium Risk:** Single torpedo, shellfire, single mine, rupture of hull, breaking in half, grounding on rocky shoreline
- **High Risk:** Foul weather, grounding on soft bottom, collision
- **Unknown:** The cause of the loss of the vessel is not known

The *Coast Trader* is classified as Medium Risk because there was one torpedo detonation. Data quality is high.

Risk Factor D2: Structural Breakup

This risk factor takes into account how many pieces the vessel broke into during the sinking event or since sinking. This factor addresses how likely it is that multiple components of a ship were broken apart including tanks, valves, and pipes. Experience has shown that even vessels broken in three large sections can still have significant pollutants on board if the sections still have some structural integrity. The risk categories are:

- **Low Risk:** The vessel is broken into more than three pieces
- **Medium Risk:** The vessel is broken into two-three pieces
- **High Risk:** The vessel is not broken and remains as one contiguous piece
- **Unknown:** It is currently not known whether or not the vessel broke apart at the time of loss or after sinking

The *Coast Trader* is classified as Unknown Risk because it is not known whether additional structural breakup occurred is unknown as location is unknown. Data quality is low.

Factors That May Impact Potential Operations

Orientation (degrees)

This factor addresses what may be known about the current orientation of the intact pieces of the wreck (with emphasis on those pieces where tanks are located) on the seafloor. For example, if the vessel turtled, not only may it have avoided demolition as a hazard to navigation, but it has a higher likelihood of retaining an oil cargo in the non-vented and more structurally robust bottom of the hull.

The location of the *Coast Trader* is unknown. Data quality is low.

Depth

Depth information is provided where known. In many instances, depth will be an approximation based on charted depths at the last known locations.

The depth for *Coast Trader* is believed to be greater than 600 feet due to the last known location. Data quality is low.

Visual or Remote Sensing Confirmation of Site Condition

This factor takes into account what the physical status of wreck site as confirmed by remote sensing or other means such as ROV or diver observations and assesses its capability to retain a liquid cargo. This assesses whether or not the vessel was confirmed as entirely demolished as a hazard to navigation, or severely compromised by other means such as depth charges, aerial bombs, or structural collapse.

The location of the *Coast Trader* is unknown. Data quality is low.

Other Hazardous (Non-Oil) Cargo on Board

This factor addresses hazardous cargo other than oil that may be on board the vessel and could potentially be released, causing impacts to ecological and socio-economic resources at risk.

There are no reports of hazardous materials onboard. Data quality is high.

Munitions on Board

This factor addresses hazardous cargo other than oil that may be on board the vessel and could potentially be released or detonated causing impacts to ecological and socio-economic resources at risk.

The *Coast Trader* had munitions for onboard weapons, but the types of weapons the vessel carried is not known. Data quality is high.

Vessel Pollution Potential Summary

Table 1-1 summarizes the risk factor scores for the pollution potential and mitigating factors that would reduce the pollution potential for the *Coast Trader*. Operational factors are listed but do not have a risk score.

Table 1-1: Summary matrix for the vessel risk factors for the *Coast Trader* color-coded as red (high risk), yellow (medium risk), and green (low risk).

Vessel Risk Factors		Data Quality Score	Comments	Risk Score
Pollution Potential Factors	A1: Oil Volume (total bbl)	Medium	Maximum of 7,000 bbl, not reported to be leaking	Med
	A2: Oil Type	High	Bunker oil is heavy fuel oil, a Group IV oil type	
	B: Wreck Clearance	High	Vessel not reported as cleared	
	C1: Burning of the Ship	High	No fire was reported	
	C2: Oil on Water	High	Oil was reported on the water; amount is not known	
	D1: Nature of Casualty	High	One torpedo detonation	
	D2: Structural Breakup	Low	Unknown structural breakup	
Archaeological Assessment	Archaeological Assessment	High	Detailed sinking records exist, the assessment is believed to be very accurate	Not Scored
Operational Factors	Wreck Orientation	Low	Unknown	Not Scored
	Depth	Low	> 600 feet	
	Visual or Remote Sensing Confirmation of Site Condition	Low	Location unknown	
	Other Hazardous Materials Onboard	High	No	
	Munitions Onboard	High	Munitions for onboard weapons	
	Gravesite (Civilian/Military)	High	No	
	Historical Protection Eligibility (NHPA/SMCA)	High	NHPA and possibly SMCA	

SECTION 2: ENVIRONMENTAL IMPACT MODELING

To help evaluate the potential transport and fates of releases from sunken wrecks, NOAA worked with RPS ASA to run a series of generalized computer model simulations of potential oil releases. The results are used to assess potential impacts to ecological and socio-economic resources, as described in Sections 3 and 4. The modeling results are useful for this screening-level risk assessment; however, it should be noted that detailed site/vessel/and seasonally specific modeling would need to be conducted prior to any intervention on a specific wreck.

Release Scenarios Used in the Modeling

The potential volume of leakage at any point in time will tend to follow a probability distribution. Most discharges are likely to be relatively small, though there could be multiple such discharges. There is a lower probability of larger discharges, though these scenarios would cause the greatest damage. A **Worst Case Discharge** (WCD) would involve the release of all of the cargo oil and bunkers present on the vessel. In the case of the *Coast Trader* this would be about 7,000 bbl (decreased from 8,088 to account for oil seen on the water at the time of the loss) based on current estimates of the maximum amount of oil remaining onboard the wreck.

The likeliest scenario of oil release from most sunken wrecks, including the *Coast Trader*, is a small, episodic release that may be precipitated by disturbance of the vessel in storms. Each of these episodic releases may cause impacts and require a response. **Episodic** releases are modeled using 1% of the WCD. Another scenario is a very low chronic release, i.e., a relatively regular release of small amounts of oil that causes continuous oiling and impacts over the course of a long period of time. This type of release would likely be precipitated by corrosion of piping that allows oil to flow or bubble out at a slow, steady rate. **Chronic** releases are modeled using 0.1% of the WCD.

The **Most Probable** scenario is premised on the release of all the oil from one tank. In the absence of information on the number and condition of the cargo or fuel tanks for all the wrecks being assessed, this scenario is modeled using 10% of the WCD. The **Large** scenario is loss of 50% of the WCD. The five major types of releases are summarized in Table 2-1. The actual type of release that occurs will depend on the condition of the vessel, time factors, and disturbances to the wreck. Note that, the episodic and chronic release scenarios represent a small release that is repeated many times, potentially repeating the same magnitude and type of impact(s) with each release. The actual impacts would depend on the environmental factors such as real-time and forecast winds and currents during each release and the types/quantities of ecological and socio-economic resources present.

The model results here are based on running the RPS ASA Spill Impact Model Application Package (SIMAP) two hundred times for each of the five spill volumes shown in Table 2-1. The model randomly selects the date of the release, and corresponding environmental, wind, and ocean current information from a long-term wind and current database.

When a spill occurs, the trajectory, fate, and effects of the oil will depend on environmental variables, such as the wind and current directions over the course of the oil release, as well as seasonal effects. The

magnitude and nature of potential impacts to resources will also generally have a strong seasonal component (e.g., timing of bird migrations, turtle nesting periods, fishing seasons, and tourism seasons).

Table 2-1: Potential oil release scenario types for the *Coast Trader*.

Scenario Type	Release per Episode	Time Period	Release Rate	Relative Likelihood	Response Tier
Chronic (0.1% of WCD)	7 bbl	Fairly regular intervals or constant	100 bbl over several days	More likely	Tier 1
Episodic (1% of WCD)	70 bbl	Irregular intervals	Over several hours or days	Most Probable	Tier 1-2
Most Probable (10% of WCD)	700 bbl	One-time release	Over several hours or days	Most Probable	Tier 2
Large (50% of WCD)	3,500 bbl	One-time release	Over several hours or days	Less likely	Tier 2-3
Worst Case	7,000 bbl	One-time release	Over several hours or days	Least likely	Tier 3

The modeling results represent 200 simulations for each spill volume with variations in spill trajectory based on winds and currents. The spectrum of the simulations gives a perspective on the variations in likely impact scenarios. Some resources will be impacted in nearly all cases; some resources may not be impacted unless the spill trajectory happens to go in that direction based on winds and currents at the time of the release and in its aftermath.

For the large and WCD scenarios, the duration of the release was assumed to be 12 hours, envisioning a storm scenario where the wreck is damaged or broken up, and the model simulations were run for a period of 30 days. The releases were assumed to be from a depth between 2-3 meters above the sea floor, using the information known about the wreck location and depth. It is important to acknowledge that these scenarios are only for this screening-level assessment. Detailed site/vessel/and seasonally specific modeling would need to be conducted prior to any intervention on a specific wreck.

Oil Type for Release

The *Coast Trader* contained a maximum of 7,000 bbl of heavy fuel oil (a Group IV oil) as bunker fuel. Thus, the oil spill model was run using heavy fuel oil.

Oil Thickness Thresholds

The model results are reported for different oil thickness thresholds, based on the amount of oil on the water surface or shoreline and the resources potentially at risk. Table 2-2 shows the terminology and thicknesses used in this report, for both oil thickness on water and the shoreline. For oil on the water surface, a thickness of 0.01 g/m², which would appear as a barely visible sheen, was used as the threshold for socio-economic impacts because often fishing is prohibited in areas with any visible oil, to prevent contamination of fishing gear and catch. A thickness of 10 g/m² was used as the threshold for ecological impacts, primarily due to impacts to birds, because that amount of oil has been observed to be enough to mortally impact birds and other wildlife. In reality, it is very unlikely that oil would be evenly distributed on the water surface. Spilled oil is always distributed patchily on the water surface in bands or tarballs with clean water in between. So, Table 2-2a shows the number of tarballs per acre on the water surface for these oil thickness thresholds, assuming that each tarball was a sphere that was 1 inch in diameter.

For oil stranded onshore, a thickness of 1 g/m^2 was used as the threshold for socio-economic impacts because that amount of oil would conservatively trigger the need for shoreline cleanup on amenity beaches. A thickness of 100 g/m^2 was used as the threshold for ecological impacts based on a synthesis of the literature showing that shoreline life has been affected by this degree of oiling.² Because oil often strands onshore as tarballs, Table 2-2b shows the number of tarballs per m^2 on the shoreline for these oil thickness thresholds, assuming that each tarball was a sphere that was 1 inch in diameter.

Table 2-2a: Oil thickness thresholds used in calculating area of water impacted. Refer to Sections 3 and 4 for explanations of the thresholds for ecological and socio-economic resource impacts.

Oil Description	Sheen Appearance	Approximate Sheen Thickness		No. of 1 inch Tarballs	Threshold/Risk Factor
Oil Sheen	Barely Visible	0.00001 mm	0.01 g/m^2	~5-6 tarballs per acre	Socio-economic Impacts to Water Surface/Risk Factor 4B-1 and 2
Heavy Oil Sheen	Dark Colors	0.01 mm	10 g/m^2	~5,000-6,000 tarballs per acre	Ecological Impacts to Water Surface/ Risk Factor 3B-1 and 2

Table 2-2b: Oil thickness thresholds used in calculating miles of shoreline impacted. Refer to Sections 3 and 4 for explanations of the thresholds for ecological and socio-economic resource impacts.

Oil Description	Oil Appearance	Approximate Sheen Thickness		No. of 1 inch Tarballs	Threshold/Risk Factor
Oil Sheen/Tarballs	Dull Colors	0.001 mm	1 g/m^2	~0.12-0.14 tarballs/ m^2	Socio-economic Impacts to Shoreline Users/Risk Factor 4C-1 and 2
Oil Slick/Tarballs	Brown to Black	0.1 mm	100 g/m^2	~12-14 tarballs/ m^2	Ecological Impacts to Shoreline Habitats/Risk Factor 3C-1 and 2

Potential Impacts to the Water Column

Impacts to the water column from an oil release from the *Coast Trader* will be determined by the volume of leakage. Because oil from sunken vessels will be released at low pressures, the droplet sizes will be large enough for the oil to float to the surface. Therefore, impacts to water column resources will result from the natural dispersion of the floating oil slicks on the surface, which is limited to about the top 33 feet. The metric used for ranking impacts to the water column is the area of water surface in mi^2 that has been contaminated by 1 part per billion (ppb) oil to a depth of 33 feet. At 1 ppb, there are likely to be impacts to sensitive organisms in the water column and potential tainting of seafood, so this concentration is used as a screening threshold for both the ecological and socio-economic risk factors for water column resource impacts. To assist planners in understanding the scale of potential impacts for different leakage volumes, a regression curve was generated for the water column volume oiled using the five volume scenarios, which is shown in Figure 2-1. Using this figure, the water column impacts can be estimated for any spill volume.

² French, D., M. Reed, K. Jayko, S. Feng, H. Rines, S. Pavignano, T. Isaji, S. Puckett, A. Keller, F. W. French III, D. Gifford, J. McCue, G. Brown, E. MacDonald, J. Quirk, S. Natzke, R. Bishop, M. Welsh, M. Phillips and B.S. Ingram, 1996. The CERCLA type A natural resource damage assessment model for coastal and marine environments (NRDAM/CME), Technical Documentation, Vol. I - V. Office of Environmental Policy and Compliance, U.S. Dept. of the Interior, Washington, DC.

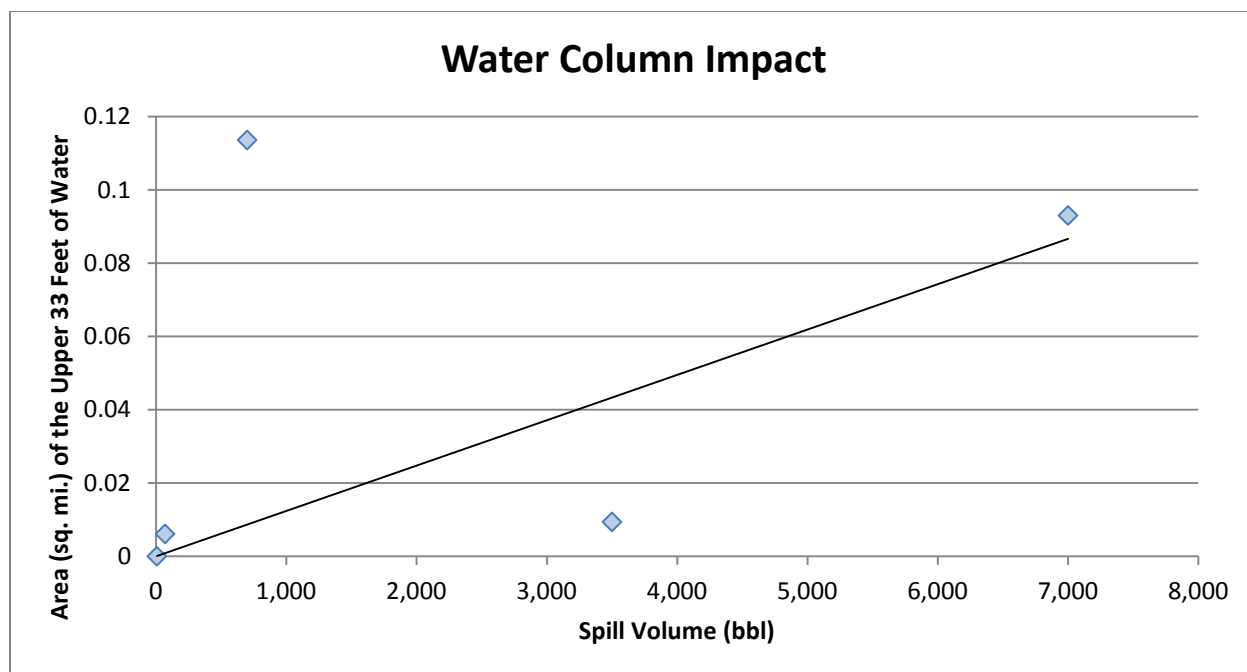


Figure 2-1: Regression curve for estimating the volume of water column at or above 1 ppb aromatics impacted as a function of spill volume for the *Coast Trader*.

Potential Water Surface Slick

The slick size from an oil release from the *Coast Trader* is a function of the quantity released. The estimated water surface coverage by a fresh slick (the total water surface area “swept” by oil over time) for the various scenarios is shown in Table 2-3, as the mean result of the 200 model runs. Note that this is an estimate of total water surface affected over a 30-day period. In the model, the representative heavy fuel oil used for this analysis spreads to a minimum thickness of approximately 975 g/m², and is not able to spread any thinner. As a result, water surface oiling results are identical for the 0.01 and 10 g/m² thresholds. The slick will not be continuous but rather be broken and patchy due to the subsurface release of the oil. Surface expression is likely to be in the form of sheens, tarballs, and streamers.

Table 2-3: Estimated slick area swept on water for oil release scenarios from the *Coast Trader*.

Scenario Type	Oil Volume (bbl)	Estimated Slick Area Swept Mean of All Models	
		0.01 g/m ²	10 g/m ²
Chronic	7	120 mi ²	120 mi ²
Episodic	70	370 mi ²	370 mi ²
Most Probable	700	1,200 mi ²	1,200 mi ²
Large	3,500	2,900 mi ²	2,900 mi ²
Worst Case Discharge	7,000	4,200 mi ²	4,200 mi ²

The location, size, shape, and spread of the oil slick(s) from an oil release will depend on environmental conditions, including winds and currents, at the time of release and in its aftermath. The areas potentially affected by oil slicks, given that we cannot predict when the spill might occur and the range of possible wind and current conditions that might prevail after a release, are shown in Figure 2-2 and Figure 2-3 using the Most Probable volume and the socio-economic and ecological thresholds.

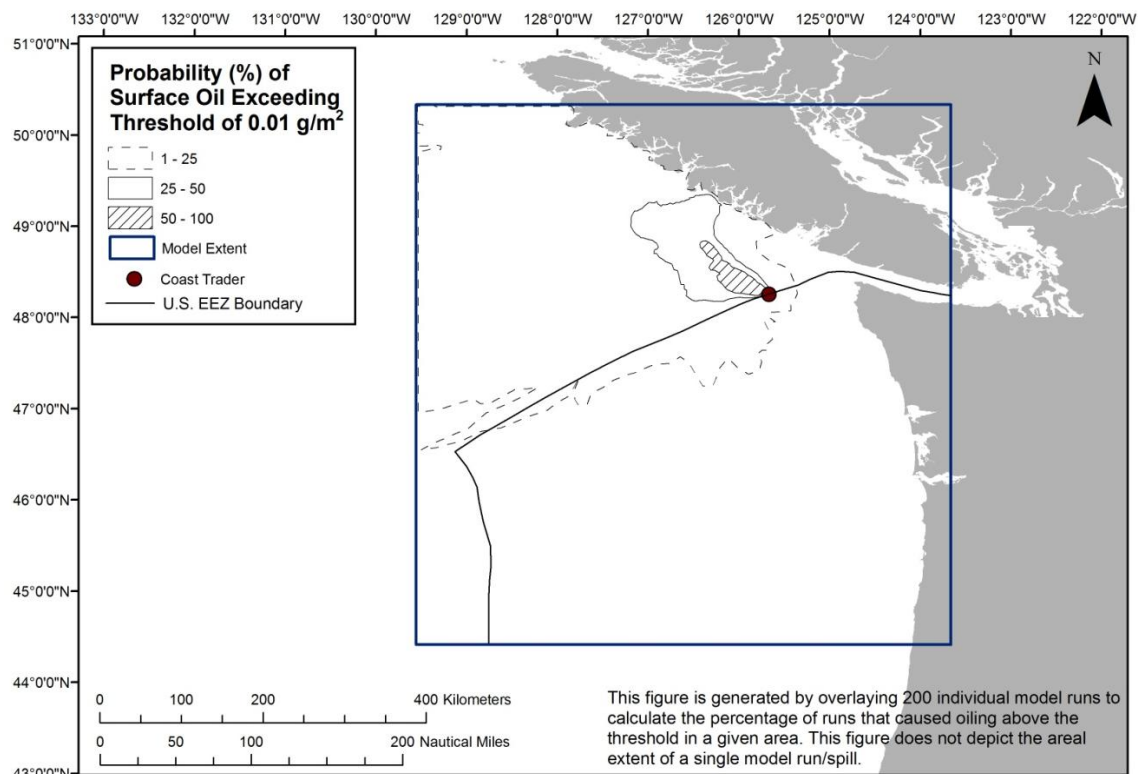


Figure 2-2: Probability of surface oil (exceeding 0.01 g/m^2) from the Most Probable spill of 700 bbl of heavy fuel oil from the *Coast Trader* at the threshold for socio-economic resources at risk.

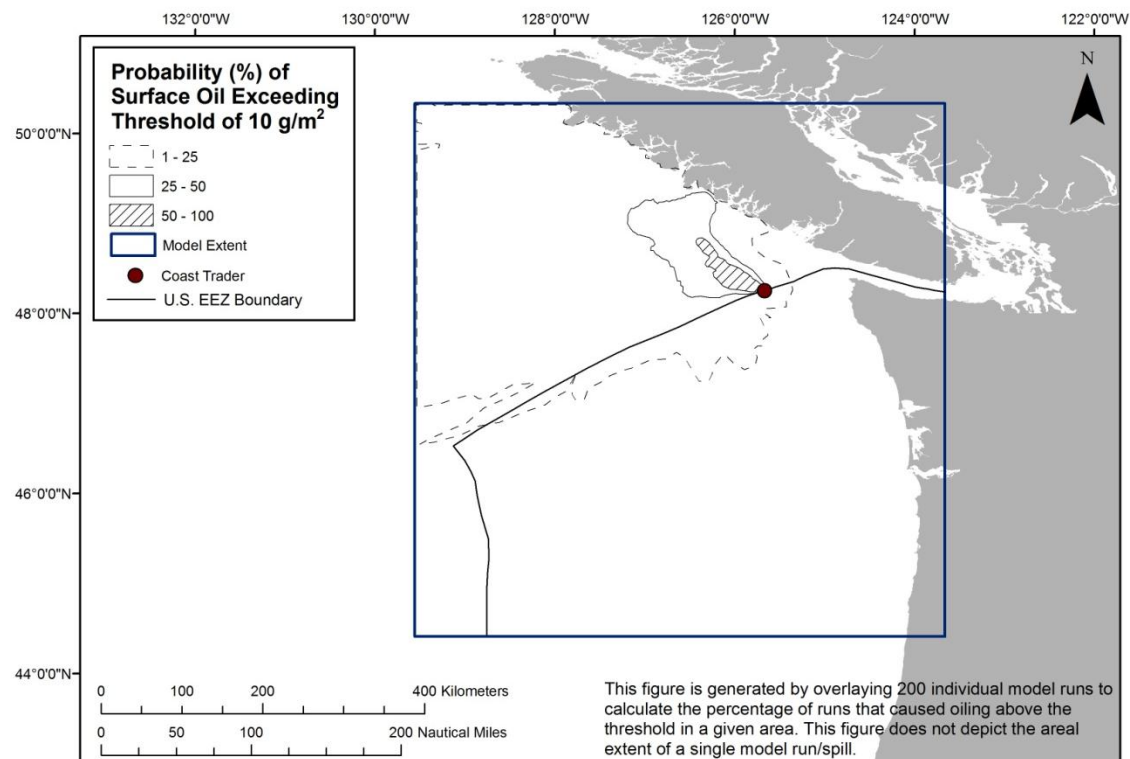


Figure 2-3: Probability of surface oil (exceeding 10 g/m^2) from the Most Probable spill of 700 bbl of heavy fuel oil from the *Coast Trader* at the threshold for socio-economic resources at risk.

The maximum potential cumulative area swept by oil slicks at some time after a Most Probable Discharge is shown in Figure 2-4 as the timing of oil movements.

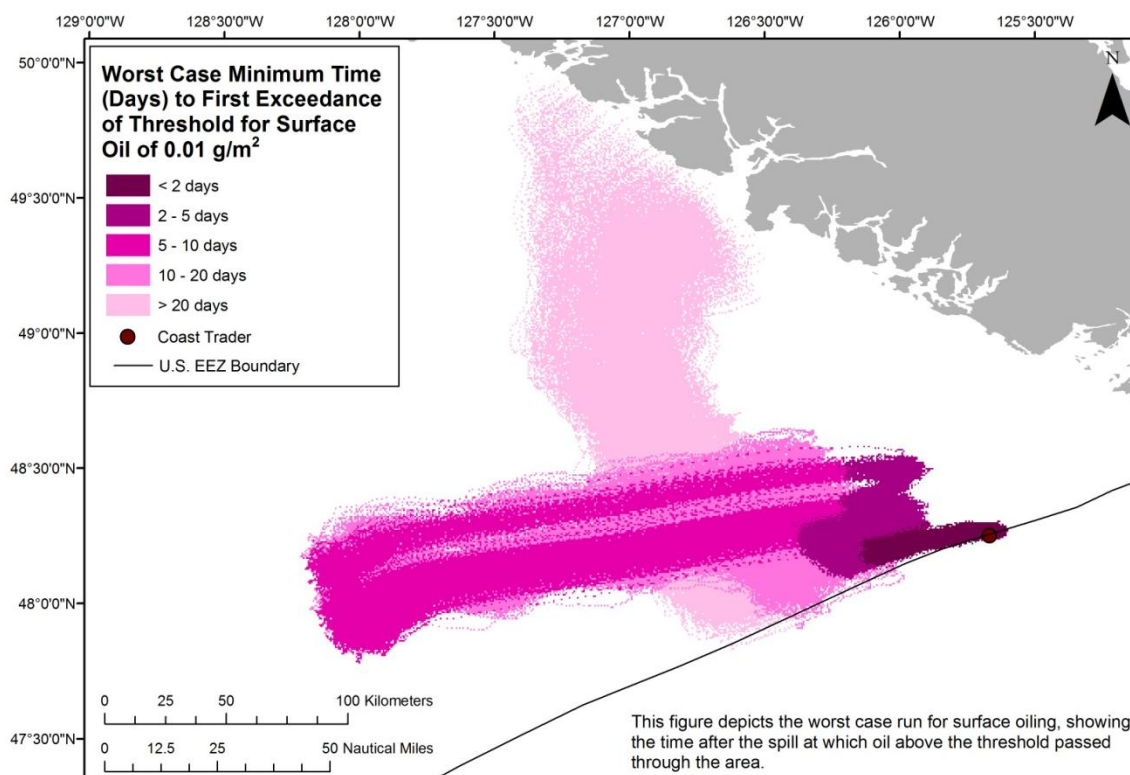


Figure 2-4: Water surface oiling from the Most Probable spill of 700 bbl of heavy fuel oil from the *Coast Trader* shown as the area over which the oil spreads at different time intervals.

The actual area affected by a release will be determined by the volume of leakage, whether it is from one or more tanks at a time. To assist planners in understanding the scale of potential impacts for different leakage volumes, a regression curve was generated for the water surface area oiled using the five volume scenarios, which is shown in Figure 2-5. Using this figure, the area of water surface with a barely visible sheen can be estimated for any spill volume.

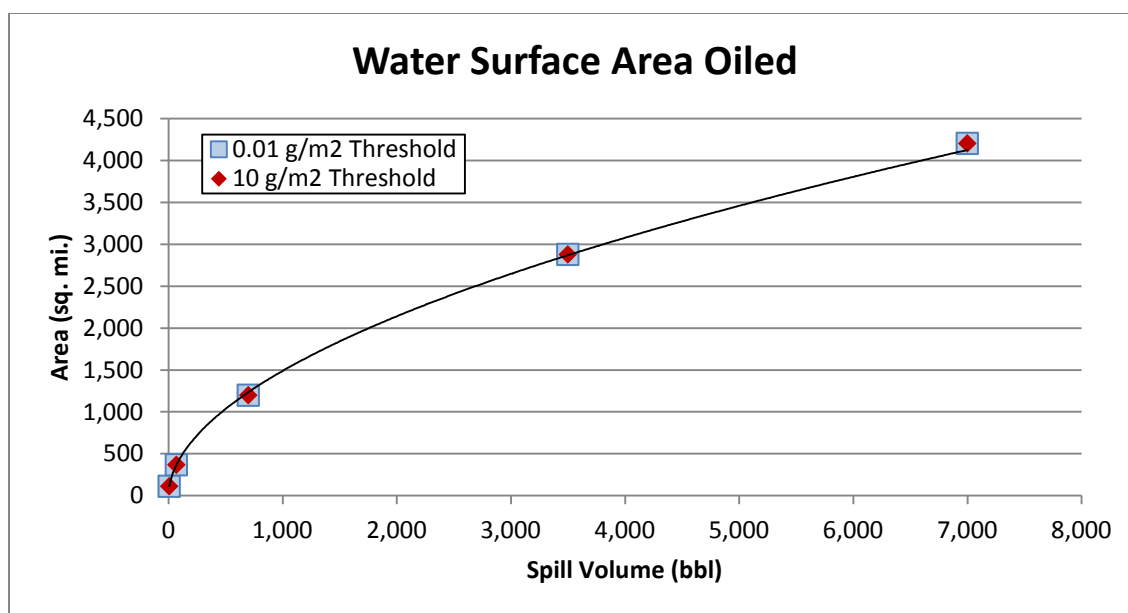


Figure 2-5: Regression curve for estimating the amount of water surface oiling as a function of spill volume for the *Coast Trader*, showing both the ecological threshold of 10 g/m² and socio-economic threshold of 0.01 g/m². The curves are so similar that they plot on top of each other.

Potential Shoreline Impacts

Based on these modeling results, shorelines along the southern half of the outer coast of Vancouver Island, Canada are at risk. Figure 2-6 shows the probability of oil stranding on the shoreline at concentrations that exceed the threshold of 1 g/m², for the Most Probable release of 700 bbl. However, the specific areas that would be oiled will depend on the currents and winds at the time of the oil release(s), as well as on the amount of oil released. Figure 2-7 shows the single oil spill scenario that resulted in the maximum extent of shoreline oiling for the Most Probable volume. Estimated miles of shoreline oiling above the threshold of 1 g/m² by scenario type are shown in Table 2-4.

Table 2-4a: Estimated shoreline oiling from leakage from the *Coast Trader*. (U.S. and Canada).

Scenario Type	Volume (bbl)	Estimated Miles of Shoreline Oiling Above 1 g/m ²			
		Rock/Gravel/Artificial	Sand	Wetland/Mudflat	Total
Chronic	7	4	0	0	4
Episodic	70	8	1	0	9
Most Probable	700	11	2	0	13
Large	3,500	37	4	0	41
Worst Case Discharge	7,000	23	4	0	27

Table 2-4b: Estimated shoreline oiling from leakage from the *Coast Trader*. (U.S. only).

Scenario Type	Volume (bbl)	Estimated Miles of Shoreline Oiling Above 1 g/m ²			
		Rock/Gravel/Artificial	Sand	Wetland/Mudflat	Total
Chronic	7	0	0	0	0
Episodic	70	0	0	0	0
Medium	700	0	0	0	0
Large	3,500	0	0	0	0
Worst Case Discharge	7,000	0	0	0	0

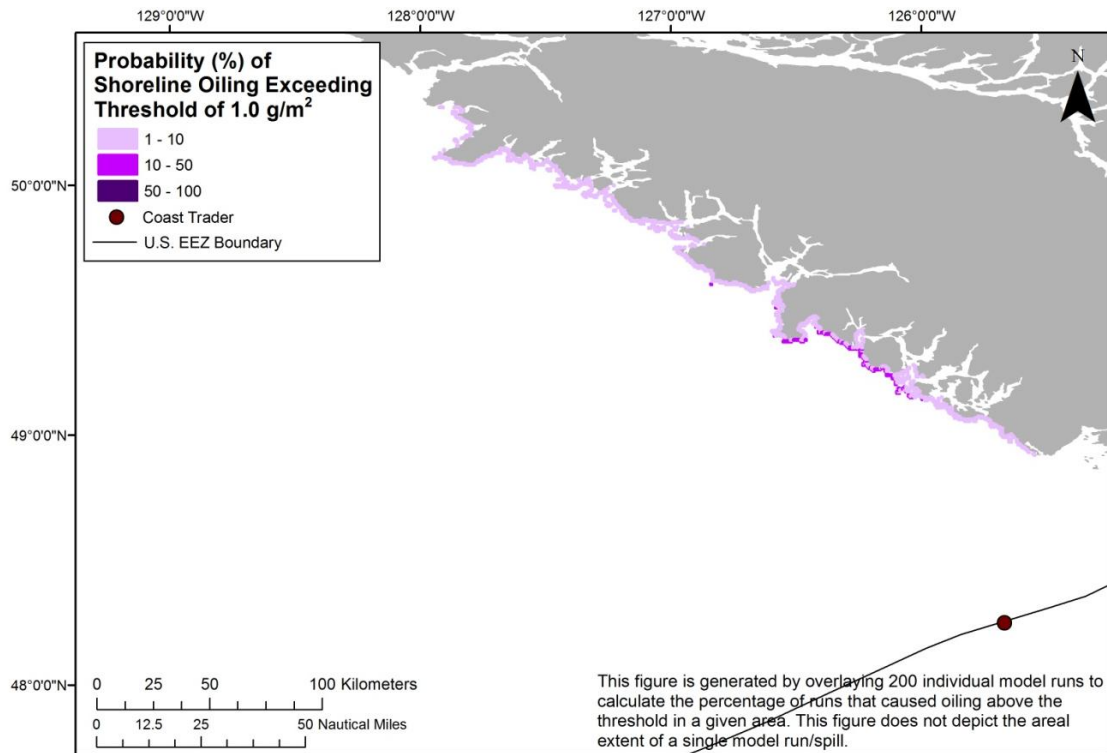


Figure 2-6: Probability of shoreline oiling (exceeding 1.0 g/m²) from the Most Probable Discharge of 700 bbl of heavy fuel oil from the *Coast Trader*.

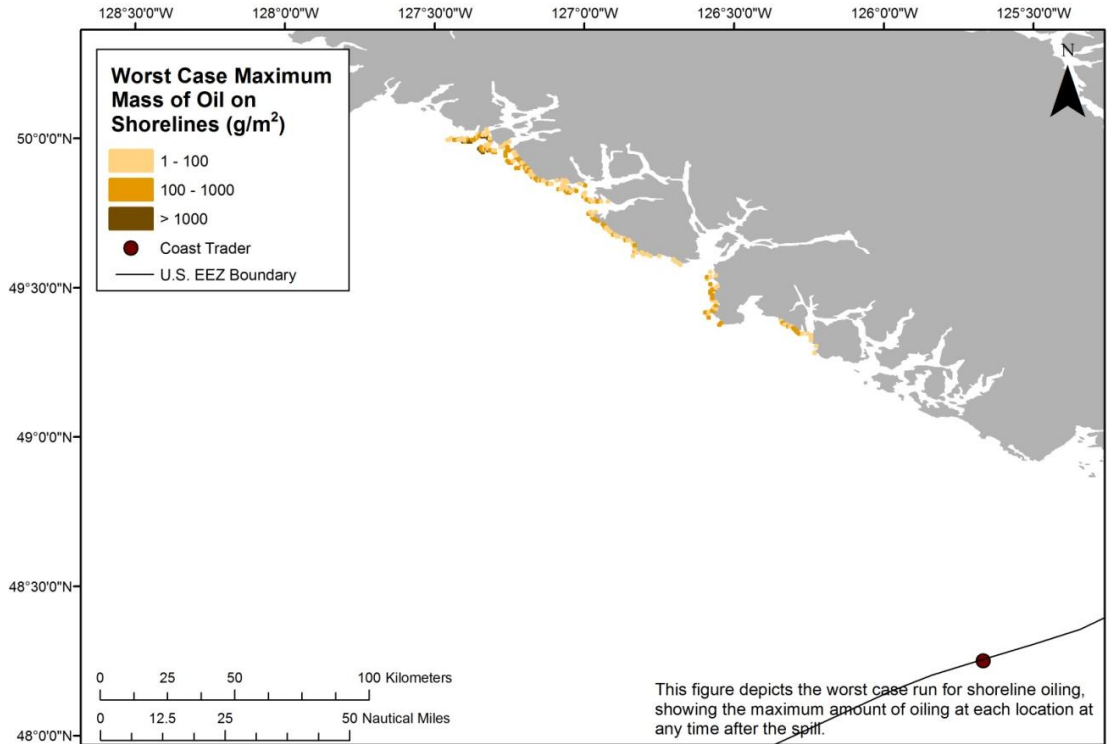


Figure 2-7: The extent and degree of shoreline oiling from the single model run of the Most Probable Discharge of 700 bbl of heavy fuel oil from the *Coast Trader* that resulted in the greatest shoreline oiling.

The actual shore length affected by a release will be determined by the volume of leakage and environmental conditions during an actual release. To assist planners in scaling the potential impact for different leakage volumes, a regression curve was generated for the total shoreline length oiled using the five volume scenarios, which is shown in Figure 2-8. Using this figure, the shore length oiled can be estimated for any spill volume.

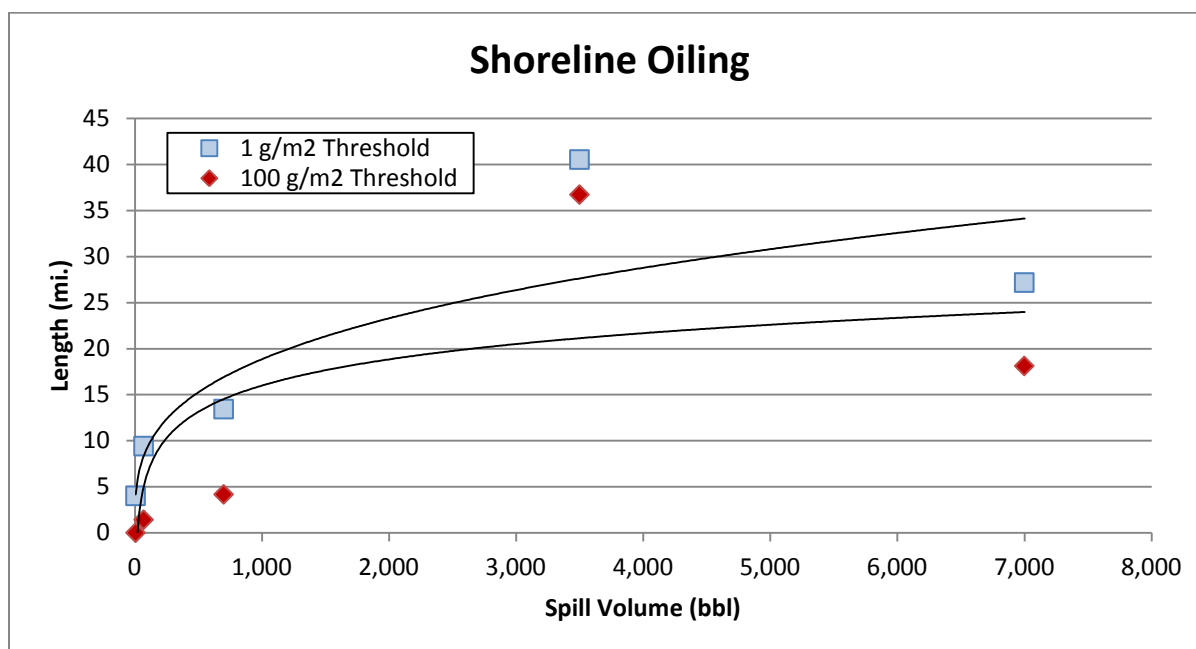


Figure 2-8: Regression curve for estimating the amount of shoreline oiling at different thresholds as a function of spill volume for the *Coast Trader*.

The worst case scenario for shoreline exposure along the potentially impacted area for the WCD volume (Table 2-5) and the Most Probable volume (Table 2-6) consists primarily of rocky shores and gravel beaches.

Table 2-5: Worst case scenario shoreline impact by habitat type and oil thickness for a leakage of 7000 bbl from the *Coast Trader*.

Shoreline/Habitat Type	Lighter Oiling Oil Thickness <1 mm Oil Thickness >1 g/m ²	Heavier Oiling Oil Thickness >1 mm Oil Thickness >100 g/m ²
Rocky and artificial shores/Gravel beaches	86 miles	79 miles
Sand beaches	4 miles	2 miles
Salt marshes and tidal flats	0 miles	0 miles

Table 2-6: Worst case scenario shoreline impact by habitat type and oil thickness for a leakage of 700 bbl from the *Coast Trader*.

Shoreline/Habitat Type	Lighter Oiling Oil Thickness <1 mm Oil Thickness >1 g/m ²	Heavier Oiling Oil Thickness >1 mm Oil Thickness >100 g/m ²
Rocky and artificial shores/Gravel beaches	68 miles	8 miles
Sand beaches	1 mile	0 miles
Salt marshes and tidal flats	0 miles	0 miles

SECTION 3: ECOLOGICAL RESOURCES AT RISK

Ecological resources at risk from a catastrophic release of oil from the *Coast Trader* (Table 3-1) include numerous guilds of birds, particularly those sensitive to surface oiling while rafting or plunge diving to feed and are present in nearshore/offshore waters. Many seabirds and shorebirds use the estuaries and offshore islands as foraging and nesting habitat. Pinniped rookeries and haul-outs are common. In addition, this region is important for commercially important fish and invertebrates.

Table 3-1: Ecological resources at risk from a release of oil from the *Coast Trader*
(FT = Federal threatened; FE = Federal endangered; ST = State threatened; SE = State endangered).

Species Group	Species Subgroup and Geography	Seasonal Presence
Birds	<p>Pelagic waters are productive foraging hotspots for pelagic birds</p> <ul style="list-style-type: none"> Common inshore (<6 km from shore): sooty shearwater, California gull, glaucous-winged gull, common murre, rhinoceros auklet Common offshore (>6 km from shore): sooty shearwater, northern fulmar, fork-tailed storm-petrel, California gull, glaucous-winged gull, common murre, Cassin's auklet, rhinoceros auklet Northern fulmars common (flocks of 5-10,000) around factory ships late fall Majority of the birds using these areas are migratory or wintering Short-tailed (FE), black-footed (SSC) and Laysan albatross present High densities of sooty and short-tailed shearwaters (flocks of thousands), California gull (thousands), Sabine's gull (hundreds) recorded Other species include tufted puffins, herring and Thayers gull, black-legged kittiwake, jaegers, phalaropes <p><i>Hesquiat Lake Area</i></p> <ul style="list-style-type: none"> High concentration of marbled murrelets (FT) nesting <p><i>Cleland Island/Southeast Clayoquot Sound:</i></p> <ul style="list-style-type: none"> Nesting: Black oystercatcher (50s), pigeon guillemot (hundreds), Leach's storm-petrel (5-6,000), Cassin's auklet, rhinoceros auklet, tufted puffin, fork-tailed storm-petrel, marbled murrelet Black brant use eelgrass beds in large numbers White-winged and surf scoters molting/migrating in spring Potentially >10,000 wintering waterfowl use this area in the spring <p><i>Tofino mudflats</i></p> <ul style="list-style-type: none"> Important stopover for migratory western sandpiper (10,000s; highest concentrations on west coast of Canada) and other shorebirds (dowitcher, dunlin, least sandpiper, black-bellied plover, greater yellowleg, sanderling, whimbrel, black oystercatcher) Wintering trumpeter swan, mallard, northern pintail, American wigeon, surf scoter bufflehead, loons/grebes Late summer foraging area for great blue heron <p><i>Barkley Sound</i></p> <ul style="list-style-type: none"> Islands and rocks are habitat for nesting marbled murrelet Migratory habitat for surf scoter, western grebe, and surfbird, all feeding on spawning herring Majority of the Canadian populations of Brandt's cormorant nest here Nesting black oystercatcher (on 13 islets), glaucous-winged gull (728 pairs) 	<p>Shearwaters present May-Sep</p> <p>Fulmars present summer-fall</p> <p>Black-footed albatross common May-Oct</p> <p>Common murrelets present May-Jun</p> <p>Gulls May-Nov</p> <p>Sandpipers present spring and fall</p> <p>Waterfowl Oct-Apr</p> <p><i>Nesting months</i> Murrelets: Apr-Sep Alcids: Apr-Aug Oystercatcher: Apr-Oct Storm petrel: May-Oct Cormorants: Mar-Aug Gulls: Apr-Sep</p>

Species Group	Species Subgroup and Geography	Seasonal Presence
Pinnipeds	<p><i>Resident species</i></p> <ul style="list-style-type: none"> Steller sea lions (SSC) pup on offshore islands, including Solander Island, Cleland Island, Oleary Islets, Barrier Rocks, Ferrer Point, Escalante Point, Raphael Point, Plover Reefs, Long Beach Rocks, Wouwer Island, Folger Island, Pachena Point Harbor seal (100s at a site) present along Pacific coast of Vancouver Island Sea otter (SSC) populations present (>2,000 on Vancouver Island) from Hesquiat Harbor north/west along the shoreline <p><i>Migratory species</i></p> <ul style="list-style-type: none"> Northern fur seals (~125,000) winter in Canadian waters; main wintering area is La Perouse Bank off SW Vancouver Island California sea lions haulout at Solander Island, Wouwer Island, Folger Island; British Columbia is the northern limit of their distribution 	<p>Steller sea lions present year round, pup Jun-Jul</p> <p>Harbor seals present year round, pup Apr-Jul</p> <p>California sea lions present Sep-May</p> <p>Fur seals present Dec-Jun, peak abundance during fall and spring migration</p>
Cetaceans	<p><i>Cetaceans</i></p> <p><i>Coastal:</i> Gray whale (SSC), harbor porpoise (SSC), killer whale (FE/FT) all present in nearshore waters</p> <p><i>Common offshore:</i> Dall's porpoise, northern right-whale dolphin, Pacific white-sided dolphin, Risso's dolphin</p> <p>Other species present offshore can include sei whale (FE), blue whale (FE), <i>Kogia</i> spp., Baird's beaked whale, Cuvier's beaked whale, <i>Mesoplodon</i> spp., long-beaked common dolphin, fin whale (FT), humpback whale (FT), minke whale, northern right whale (FE), short-beaked common dolphin, short-finned pilot whale</p> <p><i>Concentration information</i></p> <ul style="list-style-type: none"> Resident population of killer whale (87 animals) common in coastal waters, disperse to coastal ocean during the winter, when both northern and southern residents can be found in the area of impact Transient killer whales can be present Vancouver Island is the northern limit of the range of a resident population of gray whale (35-50), and a migratory pathway for other populations (travel from 4-100 km offshore along Vancouver Island) Harbor porpoises are more common in nearshore habitats in summer months Humpback whales present during migration, foraging at La Perouse, Swiftsure, and Amphitrite banks 	<p>Gray whales present Feb-Dec (peak Mar-May), calves present in spring</p> <p>Killer whales mate Jul-Aug and calve fall-winter</p> <p>Harbor porpoises present year round, calve Jun-Aug</p> <p>Dall's porpoise calves year round</p> <p>Humpback and blue whales present spring & fall</p>
Sea Turtles	<p>Leatherback sea turtles (FE) can be present in coastal waters in low numbers. Critical foraging habitat occurs in coastal waters of Washington</p> <p>Loggerhead and green sea turtles can also occur in ocean currents</p>	<p>Leatherbacks present May-Nov</p>
Fish & Inverts	<p><i>Anadromous</i></p> <ul style="list-style-type: none"> Chinook salmon, coho salmon, steelhead, chum salmon, pink salmon, sockeye salmon, coastal cutthroat trout, green sturgeon (SSC) and white sturgeon (FE) populations spawn in coastal rivers Green sturgeon spawning are present Canada but spawning is not documented Use coastal and estuarine environments as juveniles and adults <p><i>Estuarine</i></p> <ul style="list-style-type: none"> Eelgrass beds are important nursery grounds for many species, including California halibut Olympia oysters (SSC) can be present in shallow and intertidal waters 	<p>Juvenile salmon migrate to coastal waters in the spring but are present year round</p> <p>Chum adults present in coastal waters Jul-Oct</p> <p>Smelt spawn year round</p>

Species Group	Species Subgroup and Geography	Seasonal Presence
	<ul style="list-style-type: none"> Pacific herring spawn adhesive eggs on nearshore seagrass and algae <p><i>Intertidal/nearshore subtidal</i></p> <ul style="list-style-type: none"> Sandy intertidal species: starry flounder, staghorn sculpin, sand lance, sand sole, redbelt surfperch, sanddab <ul style="list-style-type: none"> Surf smelt spawn in the upper intertidal zone of protected coarse sand/gravel beaches; eggs adhere to the substrate Sand lances burrow into sand beaches Rocky intertidal areas are habitat for tidepool sculpin, wolf eel, juvenile lingcod and greenling, gunnels, eelpouts, pricklebacks, cockcombs, warbonnets Rocky intertidal habitats have high invertebrate diversity, including some species of edible clams Dungeness crab move nearshore to spawn on sand beaches Several species of shrimp and clams can be found in nearshore waters Northern abalone (FE) occur in nearshore subtidal areas along exposed shores <p><i>Demersal</i></p> <ul style="list-style-type: none"> Many species of rockfish (>20), lingcod, kelp greenling, cabezon, kelp perch, wolf eel, and red Irish lord are found in the area and can be associated with rocky reef habitats and kelp beds Halibut can be found along the shelf region 8 rockfish conservation areas are located in the potential impact area <p><i>Pelagic</i></p> <ul style="list-style-type: none"> Important habitat for forage fish (sardine, anchovy) and large predators (white shark) and other ecologically important species 	<p>Herring spawn Jan-Apr</p> <p>Oysters spawn in the summer</p> <p>Dungeness crabs mate in the spring and spawn in the fall</p> <p>Rockfish and halibut spawn in deeper offshore waters in winter/spring</p>
Benthic Habitats	<p>Rockweed can be present in rocky intertidal areas</p> <p>Kelp beds (bull kelp and giant kelp) along shoreline, more common north of Tofino, especially at Solander Island, Nootka Island, Hesquiat Peninsula</p> <p>Eelgrass is present sheltered, shallow habitats around Ucluelet and Bligh Island. Large beds present around Clayoquot and Stubbs Island and Tofino mudflats</p>	<p>Kelp canopy is fullest Mar-Nov</p>

The Environmental Sensitivity Index (ESI) atlases for the potentially impacted coastal areas from a leak from the *Coast Trader* are generally available at each U.S. Coast Guard Sector. They can also be downloaded at: <http://response.restoration.noaa.gov/esi>. These maps show detailed spatial information on the distribution of sensitive shoreline habitats, biological resources, and human-use resources. The tables on the back of the maps provide more detailed life-history information for each species and location. The ESI atlases should be consulted to assess the potential environmental resources at risk for specific spill scenarios. In addition, the Geographic Response Plans within the Area Contingency Plans prepared by the Area Committee for each U.S. Coast Guard Sector have detailed information on the nearshore and shoreline ecological resources at risk and should be consulted.

Ecological Risk Factors

Risk Factor 3: Impacts to Ecological Resources at Risk (EcoRAR)

Ecological resources include plants and animals (e.g., fish, birds, invertebrates, and mammals), as well as

the habitats in which they live. All impact factors are evaluated for both the Worst Case and the Most Probable Discharge oil release from the wreck. Risk factors for ecological resources at risk (EcoRAR) are divided into three categories:

- Impacts to the water column and resources in the water column;
- Impacts to the water surface and resources on the water surface; and
- Impacts to the shoreline and resources on the shoreline.

The impacts from an oil release would depend greatly on the direction in which the oil slick moves, which would, in turn, depend on wind direction and currents at the time of and after the oil release. Impacts are characterized in the risk analysis based on the likelihood of any measurable impact, as well as the degree of impact that would be expected if there is an impact. The measure of the degree of impact is based on the median case for which there is at least some impact. The median case is the “middle case” – half of the cases with significant impacts have less impact than this case, and half have more.

For each of the three ecological resources at risk categories, risk is defined as:

- The **probability of oiling** over a certain threshold (i.e., the likelihood that there will be an impact to ecological resources over a certain minimal amount); and
- The **degree of oiling** (the magnitude or amount of that impact).

As a reminder, the ecological impact thresholds are: 1 ppb aromatics for water column impacts; 10 g/m² for water surface impacts; and 100 g/m² for shoreline impacts.

In the following sections, the definition of low, medium, and high for each ecological risk factor is provided. Also, the classification for the *Coast Trader* is provided, both as text and as shading of the applicable degree of risk bullet, for the WCD release of 7,000 bbl and a border around the Most Probable Discharge of 700 bbl.

Risk Factor 3A: Water Column Impacts to EcoRAR

Water column impacts occur beneath the water surface. The ecological resources at risk for water column impacts are fish, marine mammals, and invertebrates (e.g., shellfish, and small organisms that are food for larger organisms in the food chain). These organisms can be affected by toxic components in the oil. The threshold for water column impact to ecological resources at risk is a dissolved aromatic hydrocarbons concentration of 1 ppb (i.e., 1 part total dissolved aromatics per one billion parts water). Dissolved aromatic hydrocarbons are the most toxic part of the oil. At this concentration and above, one would expect impacts to organisms in the water column.

Risk Factor 3A-1: Water Column Probability of Oiling of EcoRAR

This risk factor reflects the probability that at least 0.2 mi² of the upper 33 feet of the water column would be contaminated with a high enough concentration of oil to cause ecological impacts. The three risk scores for water column oiling probability are:

- **Low Oiling Probability:** Probability = <10%
- **Medium Oiling Probability:** Probability = 10 – 50%
- **High Oiling Probability:** Probability > 50%

Risk Factor 3A-2: Water Column Degree of Oiling of EcoRAR

The degree of oiling of the water column reflects the total volume of water that would be contaminated by oil at a concentration high enough to cause impacts. The three categories of impact are:

- **Low Impact:** impact on less than 0.2 mi² of the upper 33 feet of the water column at the threshold level
- **Medium Impact:** impact on 0.2 to 200 mi² of the upper 33 feet of the water column at the threshold level
- **High Impact:** impact on more than 200 mi² of the upper 33 feet of the water column at the threshold level

The *Coast Trader* is classified as Low Risk for oiling probability for water column ecological resources for the WCD of 7,000 bbl because 2% of the model runs resulted in contamination of more than 0.2 mi² of the upper 33 feet of the water column above the threshold of 1 ppb aromatics. It is classified as Low Risk for degree of oiling because the mean volume of water contaminated was 0.1 mi² of the upper 33 feet of the water column. For the Most Probable Discharge of 700 bbl, the *Coast Trader* is classified as Low Risk for oiling probability for water column ecological resources because 9% of the model runs resulted in contamination of more than 0.2 mi² of the upper 33 feet of the water column above the threshold of 1 ppb aromatics. It is classified as Low Risk for degree of oiling because the mean volume of water contaminated was 0.1 mi² of the upper 33 feet of the water column.

Risk Factor 3B: Water Surface Impacts to EcoRAR

Ecological resources at risk at the water surface include surface feeding and diving sea birds, sea turtles, and marine mammals. These organisms can be affected by the toxicity of the oil as well as from coating with oil. The threshold for water surface oiling impact to ecological resources at risk is 10 g/m² (10 grams of floating oil per square meter of water surface). At this concentration and above, one would expect impacts to birds and other animals that spend time on the water surface.

Risk Factor 3B-1: Water Surface Probability of Oiling of EcoRAR

This risk factor reflects the probability that at least 1,000 mi² of the water surface would be affected by enough oil to cause impacts to ecological resources. The three risk scores for oiling are:

- **Low Oiling Probability:** Probability = <10%
- **Medium Oiling Probability:** Probability = 10 – 50%
- **High Oiling Probability:** Probability > 50%

Risk Factor 3B-2: Water Surface Degree of Oiling of EcoRAR

The degree of oiling of the water surface reflects the total amount of oil that would affect the water surface in the event of a discharge from the vessel. The three categories of impact are:

- **Low Impact:** less than 1,000 mi² of water surface impact at the threshold level
- **Medium Impact:** 1,000 to 10,000 mi² of water surface impact at the threshold level
- **High Impact:** more than 10,000 mi² of water surface impact at the threshold level

The *Coast Trader* is classified as High Risk for oiling probability for water surface ecological resources for the WCD because 100% of the model runs resulted in at least 1,000 mi² of the water surface affected above the threshold of 10 g/m². It is classified as Medium Risk for degree of oiling because the mean area of water contaminated was 4,200 mi². The *Coast Trader* is classified as High Risk for oiling probability for water surface ecological resources for the Most Probable Discharge because 70% of the model runs resulted in at least 1,000 mi² of the water surface affected above the threshold of 10 g/m². It is classified as Medium Risk for degree of oiling because the mean area of water contaminated was 1,200 mi².

Risk Factor 3C: Shoreline Impacts to EcoRAR

The impacts to different types of shorelines vary based on their type and the organisms that live on them. In this risk analysis, shorelines have been weighted by their degree of sensitivity to oiling. Wetlands are the most sensitive (weighted as “3” in the impact modeling), rocky and gravel shores are moderately sensitive (weighted as “2”), and sand beaches (weighted as “1”) are the least sensitive to ecological impacts of oil.

Risk Factor 3C-1: Shoreline Probability of Oiling of EcoRAR

This risk factor reflects the probability that the shoreline would be coated by enough oil to cause impacts to shoreline organisms. The threshold for shoreline oiling impacts to ecological resources at risk is 100 g/m² (i.e., 100 grams of oil per square meter of shoreline). The three risk scores for oiling are:

- **Low Oiling Probability:** Probability = <10%
- **Medium Oiling Probability:** Probability = 10 – 50%
- **High Oiling Probability:** Probability > 50%

Risk Factor 3C-2: Shoreline Degree of Oiling of EcoRAR

The degree of oiling of the shoreline reflects the length of shorelines oiled by at least 100 g/m² in the event of a discharge from the vessel. The three categories of impact are:

- **Low Impact:** less than 10 miles of shoreline impacted at the threshold level
- **Medium Impact:** 10 - 100 miles of shoreline impacted at the threshold level
- **High Impact:** more than 100 miles of shoreline impacted at the threshold level

The *Coast Trader* is classified as High Risk for oiling probability for shoreline ecological resources for the WCD because 53% of the model runs resulted in shorelines affected above the threshold of 100 g/m². It is classified as Medium Risk for degree of oiling because the mean weighted length of shoreline contaminated was 33 miles. The *Coast Trader* is classified as Medium Risk for oiling probability to shoreline ecological resources for the Most Probable Discharge because 32% of the model runs resulted in shorelines affected above the threshold of 100 g/m². It is classified as Low Risk for degree of oiling because the mean weighted length of shoreline contaminated was 8 miles.

Considering the modeled risk scores and the ecological resources at risk, the ecological risk from potential releases of the WCD of 7,000 bbl of heavy fuel oil from the *Coast Trader* is summarized as listed below and indicated in the far-right column in Table 3-2:

- Water column resources – Low, because the area of highest exposure occurs in open shelf waters without any known concentrations of sensitive upper water column resources
- Water surface resources – Medium, because of the seasonally very large number of wintering, nesting, and migratory birds that use ocean, coastal, and estuarine habitats at risk and resident and migratory concentrations of seals, sea lions, and sea otters. It should be noted that oil on the surface will not be continuous but rather be patchy and in the form of tarballs and streamers
- Shoreline resources – Medium, because of some of the shoreline at risk consists of sheltered rocky shores where a heavy fuel oil is more likely to persist, and there are many sensitive shoreline resources present

Table 3-2: Ecological risk factor scores for the **Worst Case Discharge of 7,000 bbl** of heavy fuel oil from the *Coast Trader*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
3A-1: Water Column Probability EcoRAR Oiling	Low	Medium	High	2% of the model runs resulted in at least 0.2 mi ² of the upper 33 feet of the water column contaminated above 1 ppb aromatics	Low
3A-2: Water Column Degree EcoRAR Oiling	Low	Medium	High	The mean volume of water contaminated above 1 ppb was 0.1 mi ² of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	Low	Medium	High	100% of the model runs resulted in at least 1,000 mi ² of water surface covered by at least 10 g/m ²	Med
3B-2: Water Surface Degree EcoRAR Oiling	Low	Medium	High	The mean area of water contaminated above 10 g/m ² was 4,200 mi ²	
3C-1: Shoreline Probability EcoRAR Oiling	Low	Medium	High	53% of the model runs resulted in shoreline oiling of 100 g/m ²	Med
3C-2: Shoreline Degree EcoRAR Oiling	Low	Medium	High	The length of shoreline contaminated by at least 100 g/m ² was 33 mi	

For the Most Probable Discharge of 700 bbl, the ecological risk from potential releases of heavy fuel oil from the *Coast Trader* is summarized as listed below and indicated in the far-right column in Table 3-3:

- Water column resources – Low, because of the likely very small volume of water column impacts
- Water surface resources – Medium, because the area affected is smaller, but there are still a large number of birds and marine mammals at risk. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of tarballs and streamers
- Shoreline resources – Low, because few miles of shoreline are at risk

Table 3-3: Ecological risk factor scores for the **Most Probable Discharge of 700 bbl** of heavy fuel oil from the *Coast Trader*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
3A-1: Water Column Probability EcoRAR Oiling	Low	Medium	High	9% of the model runs resulted in at least 0.2 mi ² of the upper 33 feet of the water column contaminated above 1 ppb aromatics	Low
3A-2: Water Column Degree EcoRAR Oiling	Low	Medium	High	The mean volume of water contaminated above 1 ppb was 0.1 mi ² of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	Low	Medium	High	70% of the model runs resulted in at least 1,000 mi ² of water surface covered by at least 10 g/m ²	Med
3B-2: Water Surface Degree EcoRAR Oiling	Low	Medium	High	The mean area of water contaminated above 10 g/m ² was 1,200 mi ²	
3C-1: Shoreline Probability EcoRAR Oiling	Low	Medium	High	32% of the model runs resulted in shoreline oiling of 100 g/m ²	Low
3C-2: Shoreline Degree EcoRAR Oiling	Low	Medium	High	The length of shoreline contaminated by at least 100 g/m ² was 8 mi	

SECTION 4: SOCIO-ECONOMIC RESOURCES AT RISK

In addition to natural resource impacts, spills from sunken wrecks have the potential to cause significant social and economic impacts. The potential economic impacts include disruption of coastal economic activities such as commercial and recreational fishing, boating, vacationing, commercial shipping, and other activities that may become claims following a spill.

Socio-economic resources in the areas potentially affected by a release from the *Coast Trader* include the coastline of Vancouver Island. There are no U.S. socio-economic resources at risk.

In addition to the ESI atlases, the Geographic Response Plans within the Area Contingency Plans prepared by the Area Committee for each U.S. Coast Guard Sector have detailed information on important socio-economic resources at risk and should be consulted.

Spill response costs for a release of oil from the *Coast Trader* would be dependent on volume of oil released and specific areas impacted. The specific shoreline impacts and spread of the oil would determine the response required and the costs for that response.

Socio-Economic Risk Factors

Risk Factor 4: Impacts to Socio-economic Resources at Risk (SRAR)

Socio-economic resources at risk (SRAR) include potentially impacted resources that have some economic value, including commercial and recreational fishing, tourist beaches, private property, etc. All impact factors are evaluated for both the Worst Case and the Most Probable Discharge oil release from the wreck. Risk factors for socio-economic resources at risk are divided into three categories:

- **Water Column:** Impacts to the water column and to economic resources in the water column (i.e., fish and invertebrates that have economic value);
- **Water Surface:** Impacts to the water surface and resources on the water surface (i.e., boating and commercial fishing); and
- **Shoreline:** Impacts to the shoreline and resources on the shoreline (i.e., beaches, real property).

The impacts from an oil release from the wreck would depend greatly on the direction in which the oil slick moves, which would, in turn, depend on wind direction and currents at the time of and after the oil release. Impacts are characterized in the risk analysis based on the likelihood of any measurable impact, as well as the degree of impact that would be expected if there is to be any impact. The measure of the degree of impact is based on the median case for which there is at least some impact. The median case is the “middle case” – half of the cases for which there are significant impacts have less impact than this case, and half have more.

For each of the three socio-economic resources at risk categories, risk is classified with regard to:

- The **probability of oiling** over a certain threshold (i.e., the likelihood that there will be exposure to socio-economic resources over a certain minimal amount known to cause impacts); and

- The **degree of oiling** (the magnitude or amount of that exposure over the threshold known to cause impacts).

Risk Factor 4A-1: Water Column: Probability of Oiling of SRAR

This risk factor reflects the probability that at least 0.2 mi² of the upper 33 feet of the water column would be contaminated with a high enough concentration of oil to cause socio-economic impacts. The threshold for water column impact to socio-economic resources at risk is an oil concentration of 1 ppb (i.e., 1 part oil per one billion parts water). At this concentration and above, one would expect impacts and potential tainting to socio-economic resources (e.g., fish and shellfish) in the water column; this concentration is used as a screening threshold for both the ecological and socio-economic risk factors. The three risk scores for oiling are:

- **Low Oiling Probability:** Probability = <10%
- **Medium Oiling Probability:** Probability = 10 – 50%
- **High Oiling Probability:** Probability > 50%

Risk Factor 4A-2: Water Column Degree of Oiling of SRAR

The degree of oiling of the water column reflects the total amount of oil that would affect the water column in the event of a discharge from the vessel. The three categories of impact are:

- **Low Impact:** impact on less than 0.2 mi² of the upper 33 feet of the water column at the threshold level
- **Medium Impact:** impact on 0.2 to 200 mi² of the upper 33 feet of the water column at the threshold level
- **High Impact:** impact on more than 200 mi² of the upper 33 feet of the water column at the threshold level

The *Coast Trader* is classified as Low Risk for both oiling probability and degree of oiling for water column socio-economic resources for the WCD of 7,000 bbl because 2.5% of the model runs resulted in contamination of more than 0.2 mi² of the upper 33 feet of the water column above the threshold of 1 ppb aromatics, and the mean volume of water contaminated was 0.1 mi² of the upper 33 feet of the water column. For the Most Probable Discharge of 700 bbl, the *Coast Trader* is classified as Low Risk for oiling probability for water column socio-economic resources because 9% of the model runs resulted in contamination of more than 0.2 mi² of the upper 33 feet of the water column above the threshold of 1 ppb aromatics. It is classified as Low Risk for degree of oiling because the mean volume of water contaminated was 0.1 mi² of the upper 33 feet of the water column.

Risk Factor 4B-1: Water Surface Probability of Oiling of SRAR

This risk factor reflects the probability that at least 1,000 mi² of the water surface would be affected by enough oil to cause impacts to socio-economic resources. The three risk scores for oiling are:

- **Low Oiling Probability:** Probability = <10%
- **Medium Oiling Probability:** Probability = 10 – 50%
- **High Oiling Probability:** Probability > 50%

The threshold level for water surface impacts to socio-economic resources at risk is 0.01 g/m² (i.e., 0.01 grams of floating oil per square meter of water surface). At this concentration and above, one would expect impacts to socio-economic resources on the water surface.

Risk Factor 4B-2: Water Surface Degree of Oiling of SRAR

The degree of oiling of the water surface reflects the total amount of oil that would affect the water surface in the event of a discharge from the vessel. The three categories of impact are:

- **Low Impact:** less than 1,000 mi² of water surface impact at the threshold level
- **Medium Impact:** 1,000 to 10,000 mi² of water surface impact at the threshold level
- **High Impact:** more than 10,000 mi² of water surface impact at the threshold level

The *Coast Trader* is classified as High Risk for oiling probability and Medium Risk for degree of oiling for water surface socio-economic resources for the WCD because 100% of the model runs resulted in at least 1,000 mi² of the water surface affected above the threshold of 0.01 g/m², and the mean area of water contaminated was 4,200 mi². The *Coast Trader* is classified as High Risk for oiling probability for water surface socio-economic resources for the Most Probable Discharge because 70% of the model runs resulted in at least 1,000 mi² of the water surface affected above the threshold of 0.01 g/m². It is classified as Medium Risk for degree of oiling because the mean area of water contaminated was 1,200 mi².

Risk Factor 4C: Shoreline Impacts to SRAR

The impacts to different types of shorelines vary based on economic value. In this risk analysis, shorelines have been weighted by their degree of sensitivity to oiling. Sand beaches are the most economically valued shorelines (weighted as “3” in the impact analysis), rocky and gravel shores are moderately valued (weighted as “2”), and wetlands are the least economically valued shorelines (weighted as “1”). Note that these values differ from the ecological values of these three shoreline types.

Risk Factor 4C-1: Shoreline Probability of Oiling of SRAR

This risk factor reflects the probability that the shoreline would be coated by enough oil to cause impacts to shoreline users. The threshold for impacts to shoreline SRAR is 1 g/m² (i.e., 1 gram of oil per square meter of shoreline). The three risk scores for oiling are:

- **Low Oiling Probability:** Probability = <10%
- **Medium Oiling Probability:** Probability = 10 – 50%
- **High Oiling Probability:** Probability > 50%

Risk Factor 4C-2: Shoreline Degree of Oiling of SRAR

The degree of oiling of the shoreline reflects the total amount of oil that would affect the shoreline in the event of a discharge from the vessel. The three categories of impact are:

- **Low Impact:** less than 10 miles of shoreline impacted at threshold level
- **Medium Impact:** 10 - 100 miles of shoreline impacted at threshold level
- **High Impact:** more than 100 miles of shoreline impacted at threshold level

The *Coast Trader* is classified as High Risk for oiling probability for shoreline socio-economic resources for the WCD because 55% of the model runs resulted in shorelines affected above the threshold of 1 g/m².

It is classified as Medium Risk for degree of oiling because the mean length of weighted shoreline contaminated was 58 miles. The *Coast Trader* is classified as High Risk for oiling probability and Medium Risk for degree of oiling for shoreline socio-economic resources for the Most Probable Discharge as 53% of the model runs resulted in shorelines affected above the threshold of 1 g/m², and the mean length of weighted shoreline contaminated was 29 miles.

Using the definitions of the socio-economic risk factors as described above, Table 4-2 shows the risk ranking as well as the value of the metric generated from the oil spill modeling data that was used to assign the risk ranking for the WCD; Table 4-3 shows the same information for the Most Probable Discharge.

Considering the modeled risk scores and the socio-economic resources at risk, the socio-economic risk from potential releases of the WCD of 7,000 bbl of heavy fuel oil from the *Coast Trader* is summarized as listed below and indicated in the far-right column in Table 4-2:

- Water column resources – Low, because there is very little impact to the water column
- Water surface resources – Medium, because there would potentially be some impact to U.S. shipping lanes. Most of the impact would be in Canadian waters. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of sheens, tarballs, and streamers
- Shoreline resources – Low, because there is a moderate amount of shoreline impact, though no U.S. resources are at risk

Table 4-2: Socio-economic risk factor ranks for the **Worst Case Discharge of 7,000 bbl** of heavy fuel oil from the *Coast Trader*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
4A-1: Water Column Probability SRAR Oiling	Low	Medium	High	2.5% of the model runs resulted in at least 0.2 mi ² of the upper 33 feet of the water column contaminated above 1 ppb aromatics	Low
4A-2: Water Column Degree SRAR Oiling	Low	Medium	High	The mean volume of water contaminated above 1 ppb was 0.1 mi ² of the upper 33 feet of the water column	
4B-1: Water Surface Probability SRAR Oiling	Low	Medium	High	100% of the model runs resulted in at least 1,000 mi ² of water surface covered by at least 0.01 g/m ²	Med
4B-2: Water Surface Degree SRAR Oiling	Low	Medium	High	The mean area of water contaminated above 0.01 g/m ² was 4,200 mi ²	
4C-1: Shoreline Probability SRAR Oiling	Low	Medium	High	55% of the model runs resulted in shoreline oiling of 1 g/m ²	Low
4C-2: Shoreline Degree SRAR Oiling	Low	Medium	High	The length of shoreline contaminated by at least 1 g/m ² was 58 mi	

For the Most Probable Discharge of 700 bbl, the socio-economic risk from potential releases of heavy fuel oil from the *Coast Trader* is summarized as listed below and indicated in the far-right column in Table 4-3:

- Water column resources – Low, because there is very little impact to the water column
- Water surface resources – Medium, because there would potentially be some impact to U.S. shipping lanes. Most of the impact would be in Canadian waters. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of sheens, tarballs, and streamers
- Shoreline resources – Low, because there is a moderate amount of shoreline impact, though no U.S. resources are at risk

Table 4-3: Socio-economic risk factor ranks for the **Most Probable Discharge of 700 bbl** of heavy fuel oil from the *Coast Trader*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
4A-1: Water Column Probability SRAR Oiling	Low	Medium	High	9% of the model runs resulted in at least 0.2 mi ² of the upper 33 feet of the water column contaminated above 1 ppb aromatics	Low
4A-2: Water Column Degree SRAR Oiling	Low	Medium	High	The mean volume of water contaminated above 1 ppb was 0.1 mi ² of the upper 33 feet of the water column	
4B-1: Water Surface Probability SRAR Oiling	Low	Medium	High	70% of the model runs resulted in at least 1,000 mi ² of water surface covered by at least 0.01 g/m ²	Med
4B-2: Water Surface Degree SRAR Oiling	Low	Medium	High	The mean area of water contaminated above 0.01 g/m ² was 1,200 mi ²	
4C-1: Shoreline Probability SRAR Oiling	Low	Medium	High	53% of the model runs resulted in shoreline oiling of 1 g/m ²	Low
4C-2: Shoreline Degree SRAR Oiling	Low	Medium	High	The length of shoreline contaminated by at least 1 g/m ² was 29 mi	

SECTION 5: OVERALL RISK ASSESSMENT AND RECOMMENDATIONS FOR ASSESSMENT, MONITORING, OR REMEDIATION

The overall risk assessment for the *Coast Trader* is comprised of a compilation of several components that reflect the best available knowledge about this particular site. Those components are reflected in the previous sections of this document and are:

- Vessel casualty information and how the site formation processes have worked on this vessel
- Socio-economic resources at risk
- Socio-economic resources at risk
- Other complicating factors (war graves, other hazardous cargo, etc.)

Table 5-1 summarizes the screening-level risk assessment scores for the different risk factors, as discussed in the previous sections. The ecological and socio-economic risk factors are presented as a single score for water column, water surface, and shoreline resources as the scores were consolidated for each element. For the ecological and socio-economic risk factors each has two components, probability and degree. Of those two, degree is given more weight in deciding the combined score for an individual factor, e.g., a high probability and medium degree score would result in a medium overall for that factor.

In order to make the scoring more uniform and replicable between wrecks, a value was assigned to each of the 7 criteria. This assessment has a total of 7 criteria (based on table 5-1) with 3 possible scores for each criteria (L, M, H). Each was assigned a point value of L=1, M=2, H=3. The total possible score is 21 points, and the minimum score is 7. The resulting category summaries are:

Low Priority	7-11
Medium Priority	12-14
High Priority	15-21

For the Worst Case Discharge, the *Coast Trader* scores Low with 11 points; for the Most Probable Discharge, the *Coast Trader* scores Low with 10 points. Under the National Contingency Plan, the U.S. Coast Guard and the Regional Response Team have the primary authority and responsibility to plan, prepare for, and respond to oil spills in U.S. waters. Based on the technical review of available information, NOAA proposes the following recommendations for the *Coast Trader*. The final determination rests with the U.S. Coast Guard.

<i>Coast Trader</i>	Possible NOAA Recommendations
	Wreck should be considered for further assessment to determine the vessel condition, amount of oil onboard, and feasibility of oil removal action
	Location is unknown; Use surveys of opportunity to attempt to locate this vessel and gather more information on the vessel condition
	Conduct active monitoring to look for releases or changes in rates of releases
✓	Be noted in the Area Contingency Plans so that if a mystery spill is reported in the general area, this vessel could be investigated as a source
✓	Conduct outreach efforts with the technical and recreational dive community as well as commercial and recreational fishermen who frequent the area, to gain awareness of changes in the site

Table 5-1: Summary of risk factors for the *Coast Trader*.

Vessel Risk Factors		Data Quality Score	Comments	Risk Score	
Pollution Potential Factors	A1: Oil Volume (total bbl)	Medium	Maximum of 7,000 bbl, not reported to be leaking	Med	
	A2: Oil Type	High	Bunker oil is heavy fuel oil, a Group IV oil type		
	B: Wreck Clearance	High	Vessel not reported as cleared		
	C1: Burning of the Ship	High	No fire was reported		
	C2: Oil on Water	High	Oil was reported on the water; amount is not known		
	D1: Nature of Casualty	High	One torpedo detonation		
	D2: Structural Breakup	Low	Unknown structural breakup		
Archaeological Assessment	Archaeological Assessment	High	Detailed sinking records exist, the assessment is believed to be very accurate	Not Scored	
Operational Factors	Wreck Orientation	Low	Unknown	Not Scored	
	Depth	Low	> 600 feet		
	Visual or Remote Sensing Confirmation of Site Condition	Low	Location unknown		
	Other Hazardous Materials Onboard	High	No		
	Munitions Onboard	High	Munitions for onboard weapons		
	Gravesite (Civilian/Military)	High	No		
	Historical Protection Eligibility (NHPA/SMCA)	High	NHPA and possibly SMCA		
				WCD	Most Probable
Ecological Resources	3A: Water Column Resources	High	Very small volume of water impacted by either release scenario	Low	Low
	3B: Water Surface Resources	High	Persistent tarballs can impact the seasonally very high concentrations of marine birds and mammals	Med	Med
	3C: Shore Resources	High	Mostly exposed rocky shores affected, but also sheltered rocky shores where heavy fuel oil can persist and access for shoreline cleanup is limited	Med	Low
Socio-Economic Resources	4A: Water Column Resources	High	Very little impact to the water column	Low	Low
	4B: Water Surface Resources	High	There would potentially be some impact to U.S. shipping lanes; most of the impact would be in Canadian waters	Med	Med
	4C: Shore Resources	High	Low to moderate amount of shoreline impact, though no U.S. resources are at risk	Low	Low
Summary Risk Scores				11	10