Office of National Marine Sanctuaries
Office of Response and Restoration

Screening Level Risk Assessment Package

Oregon

March 2013

National Oceanic and
Atmospheric Administration

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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.S. 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.

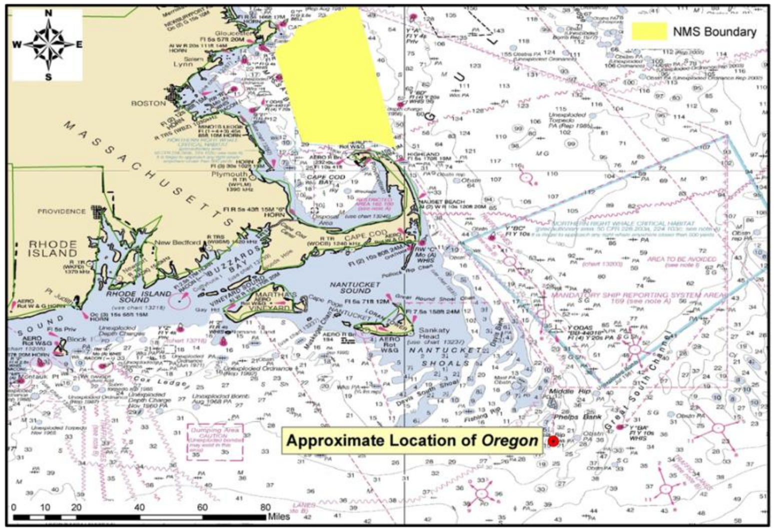
The potential polluting shipwrecks were identified through searching a broad variety of historical sources. NOAA then worked with Research Planning, Inc., RPS ASA, and Environmental Research Consulting to conduct the modeling forecasts, and the ecological and environmental resources at risk assessments.

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: *Oregon*

The freighter *Oregon*, sunk in severe weather after a collision off Cape Cod in 1941, 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 *Oregon*, 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, *Oregon* scores Medium with 14 points; for the Most Probable Discharge (10% of the Worse Case volume), *Oregon* scores Low with 9 points. Given these scores, and the medium level of data certainly, NOAA recommends that the general area be noted in the Area Contingency Plan as a potential source for a mystery spill, and that surveys of opportunity be used to attempt to gather more information on the vessel condition. Outreach efforts with commercial 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	Med	Low
	3B: Water Surface Resources	Med	Low
	3C: Shore Resources	Low	Low
Socio-Economic Resources	4A: Water Column Resources	Med	Low
	4B: Water Surface Resources	High	Med
	4C: Shore Resources	Med	Low
Summary Risk Scores		14	9

The determination of each risk factor is explained in the document.
This summary table is found on page 38.

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

Vessel Particulars

Official Name: *Oregon*

Official Number: 240892

Vessel Type: Freighter

Vessel Class: C1-B Cargo Ship (6,750 gross ton class)

Former Names: *Cape Cleare*/*Oregon*

Year Built: 1941

Builder: Seattle-Tacoma Shipbuilding, Tacoma, WA

Builder's Hull Number: 3

Flag: American

Owner at Loss: Pacific-Atlantic S.S. Co.

Controlled by: Unknown

Chartered to: Unknown

Operated by: Unknown

Homeport: Portland, OR

Length: 397 feet **Beam:** 60 feet **Depth:** 23 feet

Gross Tonnage: 6,759 **Net Tonnage:** 3,967

Hull Material: Steel **Hull Fastenings:** Welded **Powered by:** Oil engines

Bunker Type: Marine diesel **Bunker Capacity (bbl):** 8,436

Average Bunker Consumption (bbl) per 24 hours: Unknown

Liquid Cargo Capacity (bbl): 5,481 **Dry Cargo Capacity:** 446,951 cubic feet bale space

Tank or Hold Description: Unknown

Casualty Information

Port Departed: Unknown

Destination Port: Unknown

Date Departed: Unknown

Date Lost: December 10, 1941

Number of Days Sailing: Unknown

Cause of Sinking: Collision

Latitude (DD): 40.75013

Longitude (DD): -69.31609

Nautical Miles to Shore: 50

Nautical Miles to NMS: 91

Nautical Miles to MPA: 0

Nautical Miles to Fisheries: Unknown

Approximate Water Depth (Ft): 130

Bottom Type: Sand

Is There a Wreck at This Location? The exact accuracy of the listed coordinates is not known, but the wreck is believed to be in the vicinity

Wreck Orientation: Unknown

Vessel Armament: Unknown

Cargo Carried when Lost: 14,000 bales of wool

Cargo Oil Carried (bbl): 0

Cargo Oil Type: N/A

Probable Fuel Oil Remaining (bbl): ≤ 8,436

Fuel Type: Marine Diesel

Total Oil Carried (bbl): ≤ 8,436

Dangerous Cargo or Munitions: Unknown

Munitions Carried: Unknown

Demolished after Sinking: Unknown

Salvaged: No

Cargo Lost: Yes

Reportedly Leaking: No

Historically Significant: Unknown

Gravesite: Yes

Salvage Owner: Not known if any

Wreck Location

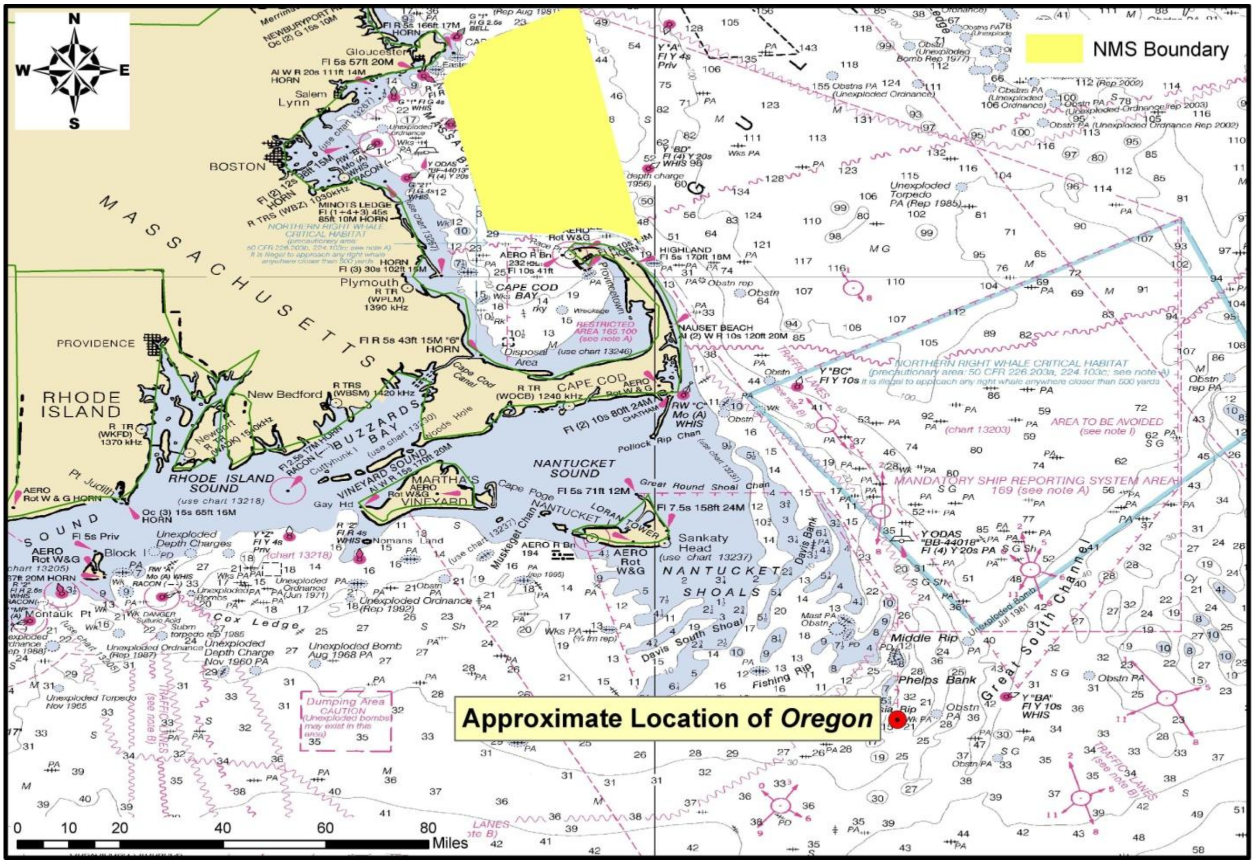


Chart Number: 13003

Casualty Narrative

The freighter *Oregon* was running blacked out in Long Island Sound on the night of December 10, 1941 when it was rammed by the U.S. battleship *New Mexico*. The freighter remained afloat with a large gash that ended before the vessel's waterline. Unfortunately the vessel's captain decided to continue around Cape Cod to Boston and the vessel was caught in severe weather. Soon waves began entering the gash in the vessel's side and they eventually caused the vessel to sink with the loss of 17 lives.

General Notes

AWOIS Data:
FTR, 3729 NT, SUNK 12/10/41, REPORTED THRU 1ST ND HQ WK LIST OF 9/20/4 CL924/50--DIVERS INVESTIGATED WK AND FOUND MAST RISING TO WITHIN 20 FT OF SURFACE; REPORTED TO BE SALVAGED THE NEXT SPRING (THE CHARTED NON-DANGEROUS SYMBOL WAS REVISED TO A 3 1/4 WRECK); LTR DATED DECEMBER 4, 1950. ANOTHER LTR FROM BOSTON OFFICE TO DIRECTOR DATED APRIL 6, 1956 INDICATES THAT LOCATION OF WK IS UNKNOWN. SALVAGE COMPANIES WERE UNABLE TO FIND IT. IT WAS REQUESTED THE WK BE SURVEYE CL753/60--LTR. FROM FIELD TO DIRECTOR; WK INVESTIGATED ON 8/10/60 WITH NEGATIVE RESULTS; HAD BEEN ASSIGNED AS PSR NO.2. CS-401; SHIP AND TWO LAUNCHES SEARCHED WITH ECHO SOUNDER SIMULTANEOUSL H8540/60--CS-401; 20 FT DEPTHS CONFIRMED; (SEE CL753/60). CL936/74--COPY OF DR FOR H8540/60; PA ADDED TO CHARTED SYMBOL.

DESCRIPTION
NO.278; CARGO, 6745 GT, SUNK 12/10/41 BY MARINE CASUALTY, POS. ACCURACY 1-3 MILES AT 40-45N, 69-19W, LD 20 FT, REPORTED THRU 1ST ND HQ WK LIST OF 9/20/4 NO.178; CARGO, 3729 NT, SUNK 12/10/41.FTR, 6745 TONS, SANK AFTER COLLISION 12/10/41, IN 20 FT, CARGO VALUED AT $2 MILLION.

Wreck Condition/Salvage History

Unknown.

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 that 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

NOAA has located little additional historic documentation on the sinking of the freighter *Oregon* and no site reports that would allow NOAA archaeologists to provide a condition based archaeological assessment of the shipwreck.

The only additional obscure report NOAA archaeologists have been able to locate about the wreck that may be of use to the U.S. Coast Guard is an article written in Life Magazine on November 24, 1958 that discusses the attempts of multiple salvage companies trying to locate the wreck of *Oregon* and recover the cargo of wool that the ship carried. According to this article, one diver named Bill Griffith located the wreck and decided not to salvage the cargo. The article quotes the diver as referring to the wreck as the “Biggest mess I ever Saw” and states that “all the booms and rigging and part of the bridge structure of the *Oregon* had fallen on her forward hatch covers. The current was just as bad as Admiral Curtis [another individual referenced in the article] had suspected and swirling sand was everywhere.”

If this article is accurate, the vessel is resting upright in 130-140 feet, which is an orientation that has often led to loss of oil from vents and piping long before loss of structural integrity of hull plates from corrosion or other physical impacts of water. Thus, it may no longer contain oil. This may certainly be the case given the strong ocean currents in around Nantucket Shoals and the fact that the vessel was powered by a diesel engine. The overall condition of the wreck described by the diver in the Life Magazine article may also mean that the vessel was depth charged or aerially bombed during WWII or was simply being ripped apart by ocean currents.

Should the vessel be assessed, it should be noted that this vessel is potentially of historic significance and will require appropriate actions be taken under the National Historic Preservation Act (NHPA) 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. The site is also considered a gravesite and appropriate actions should be undertaken to minimize disturbance to the site.

Background Information References

Vessel Image Sources: No image of the vessel has been located by NOAA to date

Construction Diagrams or Plans in RULET Database? Yes, ONMS has paper capacity plans for a C1-B Cargo Ship

Text References:

-AWOIS database;

-Life Magazine November 24, 1958
http://books.google.pn/books?id=aD8EAAAAMBAJ&q=*Oregon*#v=snippet&q=*Oregon*&f=false

Vessel Risk Factors

In this section, the risk factors that are associated with the vessel are defined and then applied to the *Oregon* 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 date 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.

Pollution Potential Tree

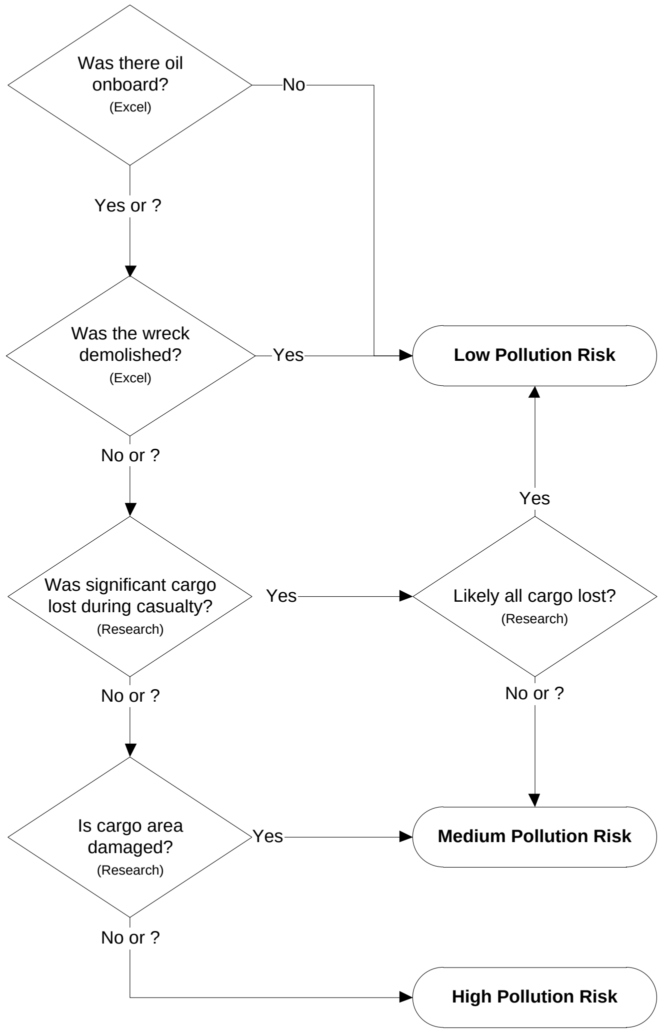


Figure 1-1: U.S. Coast Guard Salvage Engineering Response Team (SERT) developed the above Pollution Potential Decision Tree.

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.

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 *Oregon* 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 *Oregon i*s ranked as High Volume because it is thought to have a potential for up to 8,436 bbl, although some of that was lost at the time of the casualty. 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 *Oregon*.

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 grouping[1]. (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 *Oregon* is classified as High Risk because the bunker oil is diesel fuel oil, a Group II oil type. Data quality is high.

[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]

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:

- **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 *Oregon* 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 *Oregon* is classified as High Risk because there was no 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 *Oregon* is classified as High Risk because there are no known reports of oil spreading 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 *Oregon* is classified as High Risk because it sank as a result of a collision and foul weather, and the vessel is broken into two sections. 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 *Oregon* is classified as Unknown Risk because it is not known if additional structural breakup occurred after the vessel sank. 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 vessel is believed to rest upright on an even keel based on a Life Magazine article about the wreck written in 1958. Data quality is medium.

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 *Oregon* is 130 feet. Data quality is high.

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 *Oregon* is known but there is no known recent confirmation of site status. 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.

It is not known if the *Oregon* had onboard weapons. Data quality is low.

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 *Oregon*. Operational factors are listed but do not have a risk score.

Table 1-1: Summary matrix for the vessel risk factors for the *Oregon* 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 8,436 bbl, not reported to be leaking	**Med**
	A2: Oil Type	High	Bunker fuel is diesel, a Group II 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	No oil known to have been reported on the water	
	D1: Nature of Casualty	High	Collision and storm	
	D2: Structural Breakup	Low	Unknown structural breakup	
Archaeological Assessment	Archaeological Assessment	Medium	Little additional information is known about this wreck, assessment is believed to be moderately accurate	**Not Scored**
Operational Factors	Wreck Orientation	Medium	Believed to be upright	**Not Scored**
	Depth	Low	130 ft	
	Visual or Remote Sensing Confirmation of Site Condition	Low	No known recent assessment	
	Other Hazardous Materials Onboard	High	No	
	Munitions Onboard	Low	Unknown	
	Gravesite (Civilian/Military)	High	Yes	
	Historical Protection Eligibility (NHPA/SMCA)	High	NHPA	

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 *Oregon* this would be about 9,000 bbl (rounded up from 8,436 bbl) 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 *Oregon*, 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 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 *Oregon*.

Scenario Type	Release per Episode	Time Period	Release Rate	Relative Likelihood	Response Tier
Chronic (0.1% of WCD)	9 bbl	Fairly regular intervals or constant	100 bbl over several days	More likely	Tier 1
Episodic (1% of WCD)	90 bbl	Irregular intervals	Over several hours or days	Most Probable	Tier 1-2
Most Probable (10% of WCD)	900 bbl	One-time release	Over several hours or days	Most Probable	Tier 2
Large (50% of WCD)	4,500 bbl	One-time release	Over several hours or days	Less likely	Tier 2-3
Worst Case	9,000 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.

As discussed in the NOAA 2013 Risk Assessment for Potentially Polluting Wrecks in U.S. Waters, NOAA identified 87 high and medium priority wrecks for screening-level risk assessment. Within the available funds, it was not feasible to conduct computer model simulations of all 87 high and medium priority wrecks. Therefore, efforts were made to create “clusters” of vessels in reasonable proximity and with similar oil types. In general, the wreck with the largest potential amount of oil onboard was selected for modeling of oil release volumes, and the results were used as surrogates for the other vessels in the cluster. In particular, the regression curves created for the modeled wreck were used to determine the impacts to water column, water surface, and shoreline resources. The *Oregon*, with up to 8,436 bbl of light fuel onboard, was clustered with the *Norness*, which was modeled at 99,000 bbl of light fuel oil. Figure 2-1 shows the location of both vessels.

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.

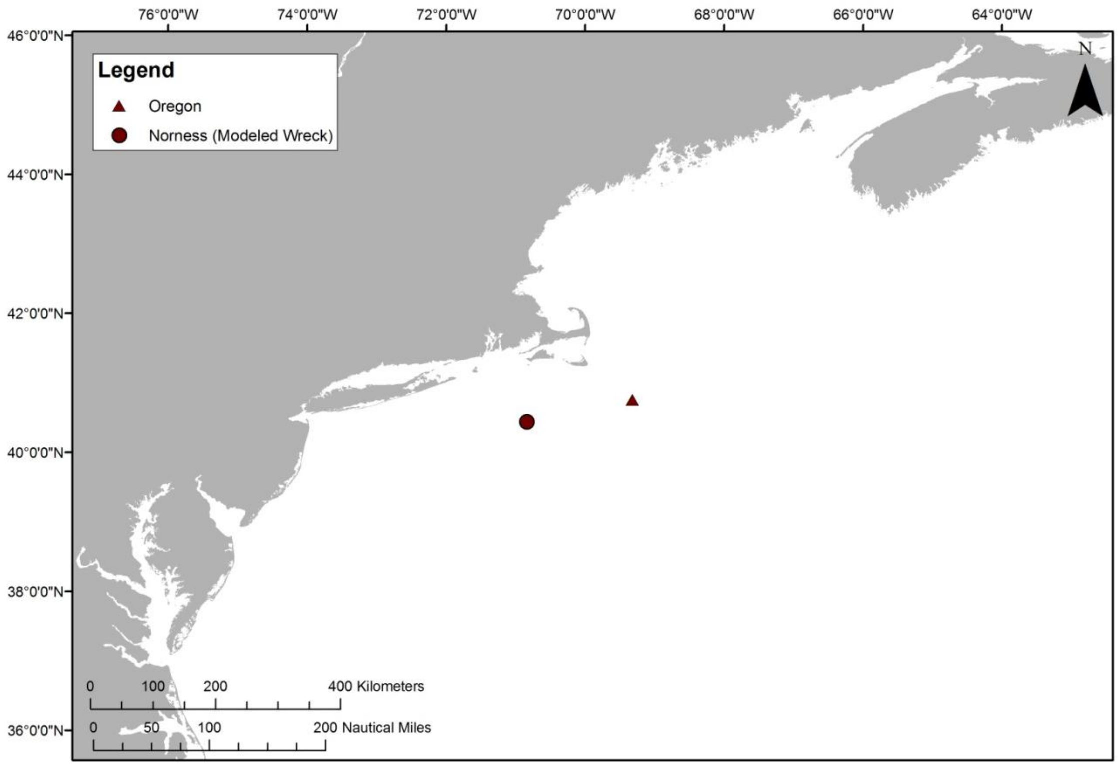


Figure 2-1: Location of the *Oregon* (red triangle), the wreck discussed in this package, and the *Norness* (red circle) which was the wreck that was actually modeled in the computer modeling simulations. The results for the *Norness* are used to estimate the impacts of releases from the *Oregon*, as discussed in the text.

Oil Type for Release

The *Oregon* contained a maximum of 8,436 bbl of diesel as fuel (a Group II oil). Thus, the spill model for the *Norness*, which was run using light fuel oil, was used for this assessment of the *Oregon*.

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/m^2, 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/m^2 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 2-2a 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 *Oregon* 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 2-2, which is the regression curve for the *Norness*. Using this figure, the water column impacts can be estimated for any spill volume. On Figure 2-2, arrows are used to indicate the where the WCD for the *Oregon* plots on the curve and how the area of the water column impact is determined.

[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. Interior, Washington, DC.

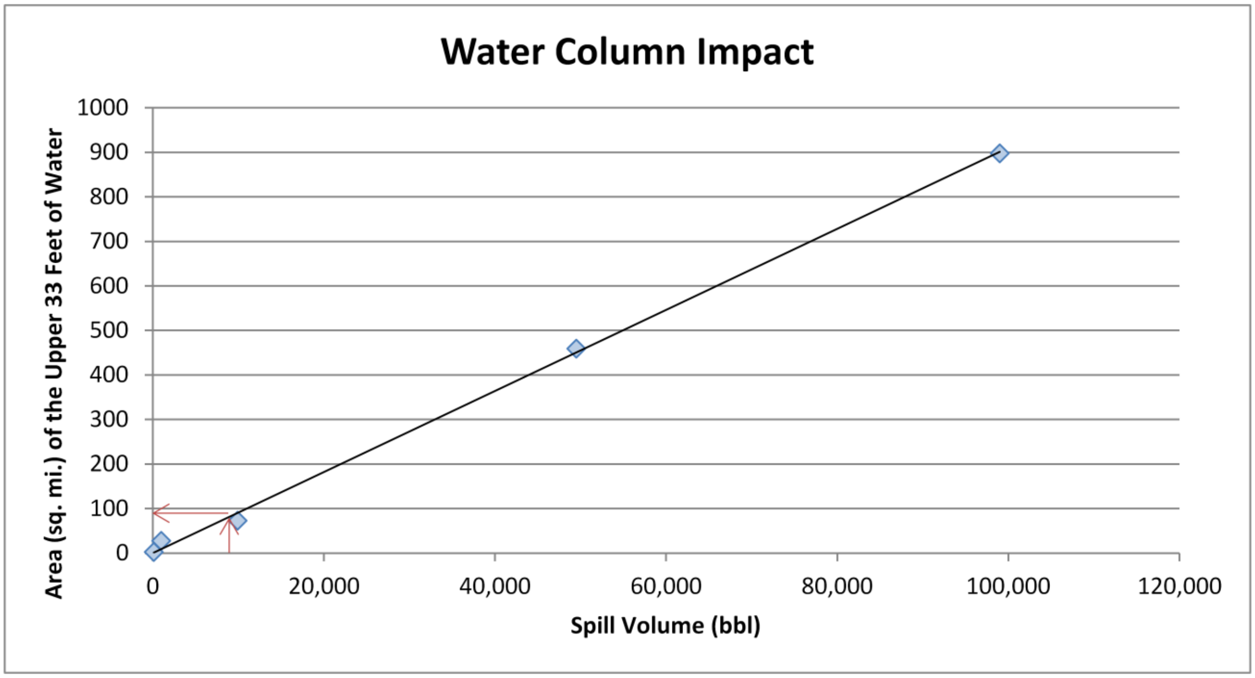


Figure 2-2: Regression curve for estimating the area of water column at or above 1 ppb aromatics impacted as a function of spill volume for the *Oregon*. This regression curve was generated for the *Norness*, which has the same oil type and similar volume of potential releases as the *Oregon*. The arrows indicate where the WCD for the *Oregon* falls on the curve and how the area of water column impact can be determined for any spill volume.

Potential Water Surface Slick

The slick size from an oil release 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 for the *Norness* then using the regression curve shown in Figure 2-3 to calculate the values for the different release scenarios for the *Oregon*. Note that this is an estimate of total water surface affected over a 30-day period. The slick will not be continuous but rather be broken and patchy. Surface expression is likely to be in the form of sheens, tarballs, and streamers. The location, size, shape, and spread of the oil slick(s) from an oil release from the *Oregon* will depend on environmental conditions, including winds and currents, at the time of release and in its aftermath. Refer to the risk assessment package for the *Norness* for maps (Figs. 2-2 and 2-3) showing the areas potentially affected by slicks using the Most Probable volume and the socio-economic and ecological thresholds.

Table 2-3: Estimated slick area swept on water for oil release scenarios from the *Oregon*, based on the model results for the *Norness*.

Scenario Type	Oil Volume (bbl)	Estimated Slick Area Swept Mean of All Models	
		0.01 g/m²	10 g/m²
Chronic	9	380 mi²	10 mi²
Episodic	90	1,400 mi²	53 mi²
Most Probable	900	5,300 mi²	280 mi²
Large	4,500	13,000 mi²	880 mi²
Worst Case Discharge	9,000	20,000 mi²	1,400 mi²

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 for the *Norness*, which is shown in Figure 2-3 and referenced in Table 2-3. Using this figure, the area of water surface with a barely visible sheen can be estimated for any spill volume from the *Oregon*.

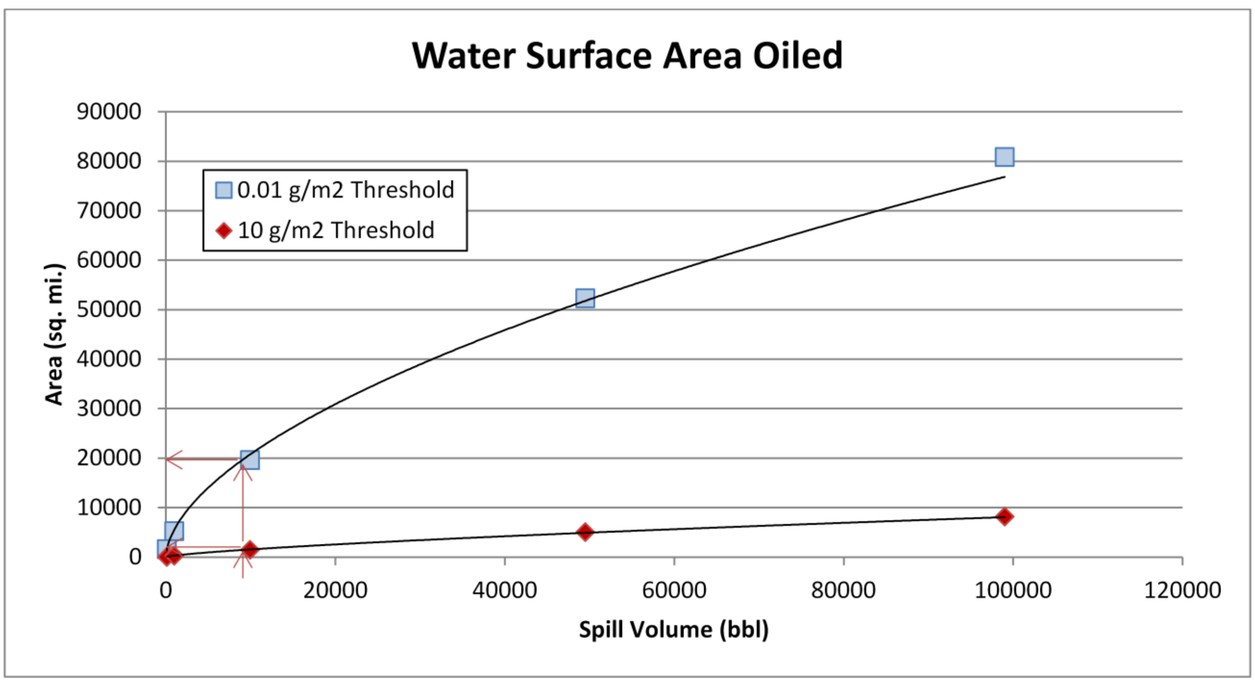


Figure 2-3: Regression curve for estimating the amount of water surface oiling as a function of spill volume for the *Oregon*, showing both the ecological threshold of 10 g/m² and socio-economic threshold of 0.01 g/m², based on the model results for the *Norness*. The arrows indicate where the WCD for the *Oregon* falls on the curve and how the area of water surface impact can be determined for any spill volume.

Potential Shoreline Impacts

Based on these modeling results, shorelines from as far north as Cape Cod, to as far south as Onslow Bay, North Carolina, are at risk. (Refer to Figure 2-6 in the *Norness* package to see the probability of oil stranding on the shoreline at concentrations that exceed the threshold of 1 g/m^2, for the Most Probable release). 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. Estimated miles of shoreline oiling above the socio-economic threshold of 1 g/m^2 and the ecological threshold of 100 g/m^2 by scenario type are shown in Table 2-4.

Table 2-4: Estimated shoreline oiling from leakage from the *Oregon*, based on the modeling results for the *Norness*.

Scenario Type	Volume (bbl)	Estimated Miles of Shoreline Oiling Above 1 g/m^2	Estimated Miles of Shoreline Oiling Above 100 g/m^2
Chronic	9	1	0
Episodic	90	3	0
Most Probable	900	6	0
Large	4,500	11	1
Worst Case Discharge	9,000	14	3

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 for the *Norness*, as detailed in Table 2-4 and shown in Figure 2-4. Using this figure, the shore length oiled can be estimated for any spill volume from the *Oregon*.

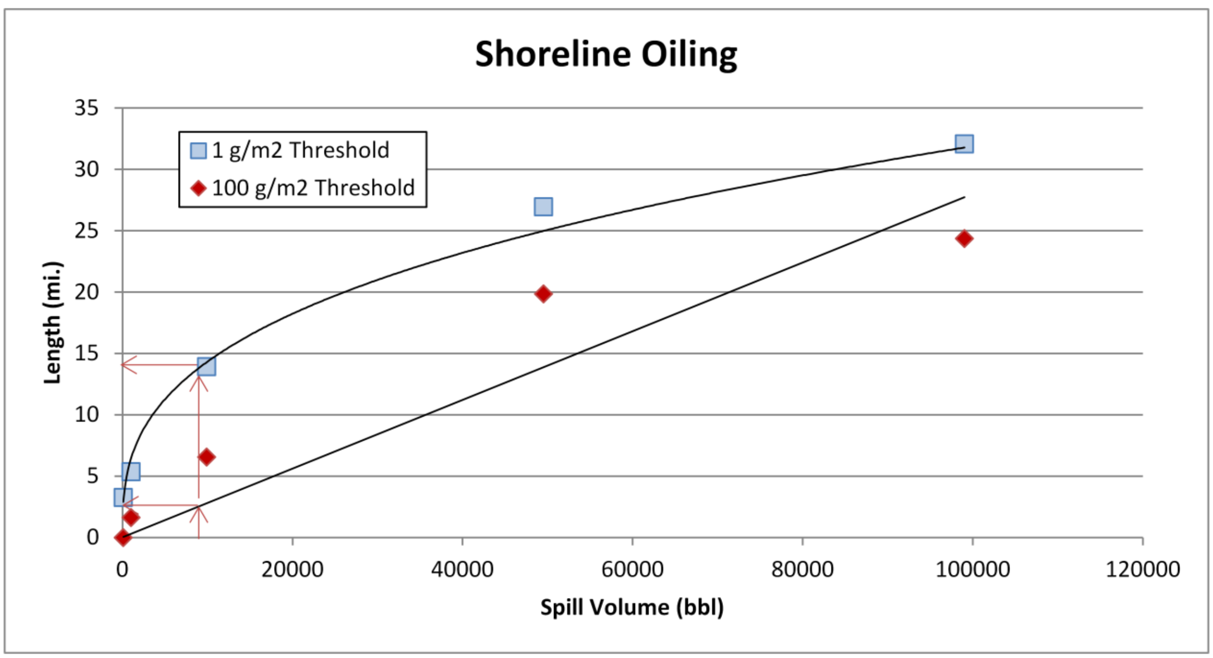


Figure 2-4: Regression curve for estimating the amount of shoreline oiling at different thresholds as a function of spill volume for the *Oregon*, based on the model results for the *Norness*. The arrows indicate where the WCD for the *Oregon* falls on the curve and how the length of shoreline impact can be determined for any spill volume.

SECTION 3: ECOLOGICAL RESOURCES AT RISK

Ecological resources at risk from a catastrophic release of oil from the *Oregon* (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. As can be noted in the table, large numbers of birds winter in both coastal and offshore waters, and many of the beaches are very important shorebird habitat. 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 *Oregon*.
(FT = Federal threatened; FE = Federal endangered; ST = State threatened; SE = State endangered).

Species Group	Species Subgroup and Geography	Seasonal Presence
Pelagic Birds and Waterfowl	• North and Mid-Atlantic inshore/offshore waters: 150,000 loons (RI is critical wintering habitat for a significant number of loons); 2,000 grebes; 1,000s of petrels; millions of shearwaters, storm-petrels, gulls; 300,000 boobies; 6,000 pelicans; 100,000s of cormorants, phalaropes, and terns; 10,000s of alcids; 1,000s of raptors, jaegers, and skimmers • Pelagic/waterbird bird use of RI waters is most diverse and abundant fall through spring, but 10,000s of birds have been observed feeding some summers • Mouths of DE Bay and Chesapeake Bay, and Nantucket Island have high concentrations of species that are abundant over shoals (e.g., loons, pelicans, cormorants, sea ducks, gulls, terns, alcids); shoals off of Nantucket Island are largest on East Coast and concentrate millions of birds (very important for scoters and other sea ducks); shoals also occur off of Long Island • Audubon's shearwater (50-75% of population) concentrate along the Continental Shelf edge off NC extending northward to the VA border (~3,800 pairs) • Northern gannet are abundant fall-spring throughout the coastal zone (often >3 km from shore) • Outer Banks, Inshore Ocean NC to VA: key foraging area for gulls and terns; key migration corridor for loons; NC's largest population of northern gannet and red-breasted merganser • Outer Continental Shelf (OCS) offshore of Cape Hatteras, NC: greatest diversity of seabirds in SE U.S.; greatest density of tropical seabirds in SE U.S. Species include: shearwaters, storm petrels, Bermuda petrels • Significant percentage of the global population of black-capped petrels (FE) may be present in *Sargassum* mats off Cape Hatteras • Pelagic/waterbird bird use of RI waters is most diverse and abundant fall through spring, but 10,000s of birds have been observed feeding some summers • RI: Critical wintering areas for harlequin ducks, hosting 11-23% of southern New England population	Terns, gulls present in spring/summer; Loons, sea ducks present in spring/fall Use of shoals and offshore waters varies by species group and occurs throughout the year; Summer shoal use more common on northern shoals Shearwaters off of NC/VA in late summer Terns, gulls present in spring/summer; Loons present in spring/fall; Gannets and red-breasted mergansers present in winter OCS: Ranges by species but Mar-Nov peak Petrels off NC/VA summer through early fall Harlequins present during winter
Sea Ducks	Sea ducks (includes mean and max distance of flocks to shore, 2009-2010 data) • Scoters (black, surf, and white-winged; 2 nm/8-13 nm) ○ Cape Cod/Nantucket: 51-55K ○ Nantucket Shoals: 9-36K ○ Off LI south coast: 8-19K ○ Off NJ coast: 1K ○ Off MD/DE: 18-111K	Sea ducks surveyed in winter (peak abundances); Migration from fall to spring (Oct-Apr)

Species Group	Species Subgroup and Geography	Seasonal Presence
	○ Chesapeake Bay: 34-73K ○ Off NC: 4-43K • Long-tailed duck (2 nm/25 nm) ○ Cape Cod/Nantucket: 31K ○ Nantucket Shoals: 71-128K ○ LI Sound: 3-7K ○ Off LI south coast: 1-38K ○ Off NJ coast: 1-6K ○ Off MD/DE: 2K ○ Chesapeake Bay: 17-31K • Common eider (<1 nm/19 nm) ○ Cape Cod/Nantucket: 92-201K ○ Nantucket Shoals: 2-6K ○ Off LI south coast: 3.5K • Bufflehead, mergansers, goldeneyes (<1 nm/7-14 nm) ○ Cape Cod/Nantucket: 11K ○ Off NJ Coast: 9K ○ Off MD/DE: 3K ○ Chesapeake Bay: 14K ○ Off NC: 12K	
Shorebirds and Colonial Nesting Birds	Shorebirds and colonial nesting birds are abundant on small islands, beaches, and marshes throughout the region • Outer Banks and Cape Hatteras: regionally important for coastal birds with 365+ species including species of concern such as piping plover, willet, black skimmer, and American oystercatcher • VA Barrier Island/Lagoon System: most important bird area in VA and one of most along Atlantic Coast (of global/hemispheric importance): piping plover (FT), Wilson's plover, American oystercatcher, gull-billed tern, least tern, black skimmer (many of these species are state listed or of special concern in several states); most significant breeding population of waders in state; marsh nesters have center of abundance here; internationally significant stopover point for whimbrel, short-billed dowitcher, and red knot • Assateague Island, MD: globally important bird area due to 60+ pairs of nesting piping plovers; largest colony of nesting least tern in MD; important for migratory shorebirds • Edwin B. Forsythe National Wildlife Refuge (NWR) and Sandy Hook, NJ: essential nesting and foraging habitat for imperiled beach nesters (piping plover, American oystercatcher, black skimmer, least tern) • Barrier islands on south shore of Long Island and islands/marshes on bay side: beach nesters (e.g., piping plover), nesting wading birds, raptors, migrating shorebirds, wintering waterfowl • RI and MA: Numerous important sites for beach and salt marsh habitats, including many NWRs that support breeding (least tern and piping plover) and migratory stopover points • Cape Cod is a nationally significant migratory stopover site for numerous species; Monomoy NWR and South Beach are the most important habitats in New England for nesting piping plover, American oystercatchers, and major late-summer concentrations of shorebirds and roseate tern	Colonial and beach nesters peak Apr-Aug Migration typically spring/fall, but varies by species and location and ranges from Feb-June/Aug-Dec
Raptors and Passerines	Lower Delmarva (Cape Charles area of VA): 20-80K raptors and over 10 million migrating passerines	Fall
Sea Turtles	Leatherback (FE), loggerhead, Kemp's ridley (FE) present offshore from spring-summer in the area of most probable impact. Greens occur in VA, NJ, and DE but are rare further north	Adults and juveniles present spring/summer

Species Group	Species Subgroup and Geography	Seasonal Presence
	Nesting (annual counts along shorelines with most probable impacts); Mostly occurs in North Carolina but loggerheads can nest as far north as Delaware • 650+ Loggerhead (FT) • < 20 Green (FT) • < 10 Leatherback (FE) Distribution: • Offshore hot spots not well known Bays and sounds are foraging grounds for juvenile green, loggerhead, and Kemp's ridley (FE)	Loggerhead: Nest: Mar-Nov Hatch: May-Dec
Marine Mammals	*Baleen whales*: North Atlantic right whale (FE), humpback whale (FE), fin whale (FE), sei whale (FE) and minke whale are more common offshore but can move inshore to feed on forage fish and zooplankton • Right whales are critically endangered (300-400 individuals remaining) and use this area as a migratory pathway. The western boundary of Great South Channel Critical habitat area is ~15 nm east of Cape Cod *Inshore cetaceans:* Atlantic white-sided, bottlenose dolphin, harbor porpoise, common dolphin, and killer whale use coastal waters out to the shelf break *Offshore cetaceans*: Northern bottlenose whale, pilot whale, Risso's dolphin, striped dolphin, common dolphin, Atlantic spotted dolphin, spinner dolphin • Often associated with shelf edge features and convergence zones *Pinnipeds*: 100s of gray seal and harbor seal are common during the winter, with Block Island, Plum Island, Fishers Island, and Great Gull Island serving as important haul out locations. They can also occur as far south as NC. Harp, hooded, and gray seals have also been observed but are rare	Baleen whales migrate through the area spring and fall; males and juveniles may stay year round Dolphins more common in southern part of study area, during the summer Harbor porpoises calve May-Aug Harbor seals present during winter
Fish & Invertebrates	Coastal ocean waters support many valuable fisheries and/or species of concern in the region: • *Benthic or bottom associated*: American lobster, sea scallop, scup, black sea bass, butterfish, winter flounder, goosefish, scamp, horseshoe crab, tilefish, other reef species • *Midwater*: Atlantic mackerel, spanish mackerel, shortfin squid, bluefish, menhaden, spiny dogfish, smooth dogfish • *Pelagic*: Bluefin tuna, yellowfin tuna, wahoo, dolphinfish, bigeye tuna, swordfish • *Diadromous*: Alewife, blueback herring, American shad, hickory shad, Atlantic tomcod, American eel, Atlantic sturgeon (Fed. species of concern), shortnose sturgeon (FE), striped bass • *Estuarine dependent*: Southern flounder, spotted seatrout, blue crab, Atlantic croaker, spot, weakfish, shrimp • *Estuarine resident*: Eastern oyster, northern quahog Important concentration/conservation areas are: • Pelagic species can be more concentrated around the shelf break and at oceanographic fronts in the region • Nantucket Lightship closed area (S. of Nantucket) • Essential Fish Habitat (EFH) for highly migratory species occurs in the area, including swordfish, bluefin tuna, yellowfin tuna, many shark species • Juvenile and adult bluefin tuna aggregate in the area in the winter	Benthic and midwater species are present throughout the year; Generally spawning during the warmer months (except winter flounder) Anadromous fish migrate inshore to spawn in fresh water in spring; American eel migrates offshore to spawn in winter Bluefin tunas present fall-spring Estuarine dependent fish migrate offshore in fall/winter to spawn; Juveniles and adults use estuaries during spring/summer
Benthic Habitats	Submerged aquatic vegetation (mostly eelgrass) is critical to numerous species and occurs inside of bays and sounds throughout the region	Year round

The Environmental Sensitivity Index (ESI) atlases for the potentially impacted coastal areas from a leak from the *Oregon* 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 based on a 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 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 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/m^2 for water surface impacts; and 100 g/m^2 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 *Oregon* is provided, both as text and as shading of the applicable degree of risk bullet, for the WCD release of 9,000 bbl and a border around the Most Probable Discharge of 900 bbl. Please note: The probability of oiling cannot be determined using the regression curves; probability can only be determined from the 200 model runs. Thus, the modeling results and regression curves for the *Norness* are used to estimate the values used in the risk scoring for the **degree of oiling only**.

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 (not scored)

This risk factor reflects the probability that at least 0.2 mi^2 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 mi^2 of the upper 33 feet of the water column at the threshold level
- **Medium Impact**: impact on 0.2 to 200 mi^2 of the upper 33 feet of the water column at the threshold level
- **High Impact:** impact on more than 200 mi^2 of the upper 33 feet of the water column at the threshold level

The *Oregon* is classified as Medium Risk for degree of oiling for water column ecological resources for the WCD of 9,000 bbl because the mean volume of water contaminated in the model runs was 82 mi^2 of the upper 33 feet of the water column. For the Most Probable Discharge of 900 bbl, the *Oregon* is classified as Medium Risk for degree of oiling because the mean volume of water contaminated was 8 mi^2 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/m^2 (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 (not scored)

This risk factor reflects the probability that at least 1,000 mi^2 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 mi^2 of water surface impact at the threshold level
- **Medium Impact:** 1,000 to 10,000 mi^2 of water surface impact at the threshold level
- **High Impact:** more than 10,000 mi^2 of water surface impact at the threshold level

The *Oregon* is classified as Medium Risk for degree of oiling for water surface ecological resources for the WCD because the mean area of water contaminated in the model runs was 1,400 mi^2. It is classified as Low Risk for degree of oiling for the Most Probable Discharge because the mean area of water contaminated was 280 mi^2.

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. For the modeled wrecks, shorelines were 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. <u>In this risk analysis for the *Oregon*, shorelines have NOT been weighted by their degree of sensitivity to oiling because these data are available only for modeled vessels. Therefore, the impacts are evaluated only on the total number of shoreline miles oiled as determined from the regression curve</u>.

Risk Factor 3C-1: Shoreline Probability of Oiling of EcoRAR (not scored)

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/m^2 (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/m^2 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 *Oregon* is classified as Low Risk for degree of oiling for shoreline ecological resources for the WCD because the mean length of shoreline contaminated in the model runs was 3 miles. It is classified as Low Risk for degree of oiling for the Most Probable Discharge because the mean length of shoreline contaminated in the model runs was 0 miles.

Considering the modeled risk scores and the ecological resources at risk, the ecological risk from potential releases of the WCD of 9,000 bbl of light fuel oil from the *Oregon* is summarized as listed below and indicated in the far-right column in Table 3-2:

- Water column resources – Medium, 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 the area affected includes with seasonally very large number of wintering, nesting, and migratory birds that use ocean, coastal, and estuarine habitats at risk and winter concentrations of seals. 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 and streamers
- Shoreline resources – Low, because of the lower likelihood of significant amounts of light fuel oil to strand onshore and most of the potentially impacted shorelines are sand/gravel beaches where a light fuel oil would not be as persistent as heavier oils

Table 3-2: Ecological risk factor scores for the **Worst Case Discharge of 9,000 bbl** of light fuel oil from the *Oregon*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
3A-1: Water Column Probability EcoRAR Oiling	Low	Medium	High	N/A: Only available for modeled vessels	Med
3A-2: Water Column Degree EcoRAR Oiling	Low	**Medium**	High	The mean volume of water contaminated above 1 ppb was 82 mi^2 of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	Low	Medium	High	N/A: Only available for modeled vessels	Med
3B-2: Water Surface Degree EcoRAR Oiling	Low	**Medium**	High	The mean area of water contaminated above 10 g/m^2 was 1,400 mi^2	
3C-1: Shoreline Probability EcoRAR Oiling	Low	Medium	High	N/A: Only available for modeled vessels	Low
3C-2: Shoreline Degree EcoRAR Oiling	**Low**	Medium	High	The length of shoreline contaminated by at least 100 g/m^2 was 3 mi	

For the Most Probable Discharge of 900 bbl of light fuel oil, the ecological risk from potential releases from the *Oregon* is summarized as listed below and indicated in the far-right column in Table 3-3:

- Water column resources – Low, because of the very small area of water column impacts that occurred mostly far offshore where water column resources are less concentrated
- Water surface resources – Low, because of the small area of impact. 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 little to no oil is likely to strand on the shoreline

Table 3-3: Ecological risk factor scores for the **Most Probable Discharge of 900 bbl** of light fuel oil from the *Oregon*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
3A-1: Water Column Probability EcoRAR Oiling	Low	Medium	High	N/A: Only available for modeled vessels	Low
3A-2: Water Column Degree EcoRAR Oiling	Low	**Medium**	High	The mean volume of water contaminated above 1 ppb was 4 mi^2 of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	Low	Medium	High	N/A: Only available for modeled vessels	Low
3B-2: Water Surface Degree EcoRAR Oiling	**Low**	Medium	High	The mean area of water contaminated above 10 g/m^2 was 280 mi^2	
3C-1: Shoreline Probability EcoRAR Oiling	Low	Medium	High	N/A: Only available for modeled vessels	Low
3C-2: Shoreline Degree EcoRAR Oiling	**Low**	Medium	High	The length of shoreline contaminated by at least 100 g/m^2 was 0 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. Socio-economic resources potentially at risk from oiling are listed in Table 4-1 and shown in Figures 4-1 and 4-2. 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 *Oregon* include recreational beaches from North Carolina to Massachusetts that are very highly utilized during summer, and are still in use during spring and fall for shore fishing. Hotspots for chartered fishing vessels and recreational fishing party vessels include along the New Jersey shore, off the mouth of Delaware Bay, and off the outer banks of North Carolina. Many areas along the entire potential spill zone are widely popular seaside resorts and support recreational activities such as boating, diving, sightseeing, sailing, fishing, and wildlife viewing.

A release could impact shipping lanes, which accommodate port calls from New York east of Cape Cod, and into Narragansett Bay. Coastal waters off Rhode Island and southern Massachusetts are popular sailing locations. A proposed offshore wind farm site is located in Nantucket Sound. Commercial fishing is economically important to the region. A release could impact fishing fleets where regional commercial landings for 2010 exceeded $600 million. Cape May-Wildwood, NJ and Hampton Roads, VA were the 6th and 7th nationally ranked commercial fishing ports by value in 2010. The most important species by dollar value present in and around the Mid-Atlantic are sea scallops, surf clams, ocean quahogs, menhaden, striped bass, and blue crab.

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.

Spill response costs for a release of oil from the *Oregon* 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.

Table 4-1: Socio-economic resources at risk from a release of oil from the *Oregon*.

Resource Type	Resource Name	Economic Activities
Tourist Beaches	Ocean City, Maryland Rehoboth Beach, Delaware Dewey Beach, Delaware Indian Beach, Delaware Bethany Beach, Delaware Middlesex Beach, Delaware Fenwick Island, Delaware Cape May, New Jersey Wildwood, New Jersey Avalon, New Jersey	Potentially affected beach resorts and beach-front communities in Massachusetts, Rhode Island, New York, New Jersey, Delaware, and North Carolina provide recreational activities (e.g., swimming, boating, recreational fishing, wildlife viewing, nature study, sports, dining, camping, and amusement parks) with substantial income for local communities and state tax income. Much of the east coast of New Jersey, northeastern Delaware, the southern coast of Long Island, New York, the southern coast of Rhode Island, and the southwestern shore of Massachusetts and Martha's

Resource Type	Resource Name	Economic Activities
	Atlantic City, New Jersey Ocean City, New Jersey Absecon Beach, New Jersey Ludlam Beach, New Jersey Seven Mile Beach, New Jersey Margate City, New Jersey Peck Beach, New Jersey Ventnor City, New Jersey Brigantine Beach, New Jersey Beach Haven, New Jersey Spray Beach, New Jersey Brant Beach, New Jersey Long Beach, New Jersey Point Pleasant Beach, New Jersey Seaside Park, New Jersey Ortley Beach, New Jersey Ocean Beach, New Jersey Normandy Beach, New Jersey Ocean Beach, New York Fire Island Pines, New York Southampton, New York East Hampton, New York Westhampton Beach, New York Montauk, New York Block Island, Rhode Island East Matunuck State Beach, Rhode Island Roger W. Wheeler State Beach, Rhode Island Scarborough State Beach, Rhode Island Newport, Rhode Island Martha's Vineyard, Massachusetts Nantucket, Massachusetts Hyannis, Massachusetts Yarmouth, Massachusetts Dennisport, Massachusetts Harwich, Massachusetts Chatham, Massachusetts	Vineyard, Massachusetts, are lined with economically valuable beach resorts and residential communities. Many of these recreational activities are limited to or concentrated into the late spring through the early fall months.
National Seashores	Cape Hatteras National Seashore, NC Assateague Island National Seashore, MD and VA Fire Island National Seashore, NY	National seashores provide recreation for local and tourist populations while preserving and protecting the nation's natural shoreline treasures. National seashores are coastal areas federally designated as being of natural and recreational significance as a preserved area. Assateague Island is known for its feral horses. Cape Hatteras is known for its Bodie Island and Cape Hatteras Lighthouses. Popular recreation activities include windsurfing, birdwatching, fishing, shell collecting, and kayaking. The barrier island provides refuge for the endangered piping plover, seabeach amaranth, and sea turtles. Fire Island has the historic William Floyd House and Fire Island Lighthouse.
National Wildlife Refuges	Prime Hook NWR (DE) Cape May NWR (NJ) Edwin B. Forsythe NWR (NJ)	National wildlife refuges in seven states may be impacted. These federally-managed and protected lands provide refuges and conservation areas for sensitive species and

Resource Type	Resource Name	Economic Activities
	Seatuck NWR (NY) Wertheim NWR (NY) Amagansett NWR (NY) Block Island NWR (RI) Ninigret NWR (RI) Trustom Pond NWR (RI) Sachuest Point NWR (RI) Nomans Land Island NWR (MA) Mashpee NWR (MA) Nantucket Island NWR (MA) Monomoy NWR (MA) Fisherman Island NWR (VA) Eastern Shore of Virginia NWR (VA) Wallops Island NWR (VA) Chincoteague NWR (VA) Back Bay NWR (VA) Mackay Island NWR (NC) Currituck NWR (NC) Pea Island NWR (NC) Cedar Island NWR (NC)	habitats.
State Parks	Assateague State Park, Maryland Delaware Seashore State Park, DE Cape Henlopen State Park, DE Cape May Point State Park, NJ Corson's Inlet State Park, NJ Barnegat Lighthouse State Park, NJ Island Beach State Park, NJ Robert Moses State Park, NY Shadmoor State Park, NY Camp Hero State Park, NY Montauk State Park, NY Salty Brine State Park, RI Fishermen's Memorial State Park, RI Beavertail State Park, RI Wetherill State Park, RI Brenton Point State Park, RI Fort Adams State Park, RI Horseneck Beach State Park, MA Demarest Lloyd State Park, MA Fort Phoenix State Park, MA Nasketucket Bay State Park, MA South Cape Beach State Park, MA	Coastal state parks are significant recreational resources for the public (e.g., swimming, boating, recreational fishing, wildlife viewing, nature study, sports, dining, camping, and amusement parks). They provide income to the states. State parks in the states of Massachusetts, Rhode Island, New York, New Jersey, Delaware, and Maryland are potentially impacted. Many of these recreational activities are limited to or concentrated into the late spring into early fall months.
Tribal Lands	Shinnecock Indian Reservation, NY	Shinnecock Indian Reservation, New York, is home to over 500 tribal members. (Note this reservation has been recognized by New York State but not by the U.S. Bureau of Indian Affairs)
	Narragansett Indian Reservation, RI	Narragansett Indian Reservation, Rhode Island, is home to 2,400 tribal members.
	Wampanoag Indian Reservation, MA	Wampanoag Indian Reservation, Massachusetts, is home to over 2,000 tribal members.
Commercial Fishing	A number of fishing fleets use the New York Bight and surrounding waters for commercial fishing.	
	Atlantic City, NJ	Total Landings (2010): $17.3M
	Belford, NJ	Total Landings (2010): $2.2M
	Cape May-Wildwood, NJ	Total Landings (2010): $81M

Resource Type	Resource Name	Economic Activities
	Chincoteague, Virginia	Total Landings (2010): $3.5M
	Montauk, NY	Total Landings (2010): $17.7M
	New London, Connecticut	Total Landings (2010): $10.6M
	Newport, RI	Total Landings (2010): $6.9M
	Ocean City, Maryland	Total Landings (2010): $8.8M
	Point Pleasant, NJ	Total Landings (2010): $22.8M
	Stonington, Connecticut	Total Landings (2010): $18.5M
Ports	There are a number of significant commercial ports in the Northeast that could potentially be impacted by spillage and spill response activities. The port call numbers below are for large vessels only. There are many more, smaller vessels (under 400 GRT) that also use these ports.	
	Camden, NJ	249 port calls annually
	Claymont, DE	19 port calls annually
	Delaware City, DE	211 port calls annually
	Gloucester, NJ	180 port calls annually
	New York/New Jersey	5,414 port calls annually
	Newport, RI	95 port calls annually
	Philadelphia, PA	914 port calls annually
	Providence, RI	128 port calls annually
	Salem, NJ	52 port calls annually
	Wilmington, DE	443 port calls annually
Other Resources	Cape Wind Offshore Wind Farm (proposed), MA	Rated to produce up to 468 megawatts of wind power with average expected production will be 170 megawatts which is almost 75% of the 230 megawatt average electricity demand for Cape Cod and the Islands of Martha's Vineyard and Nantucket.

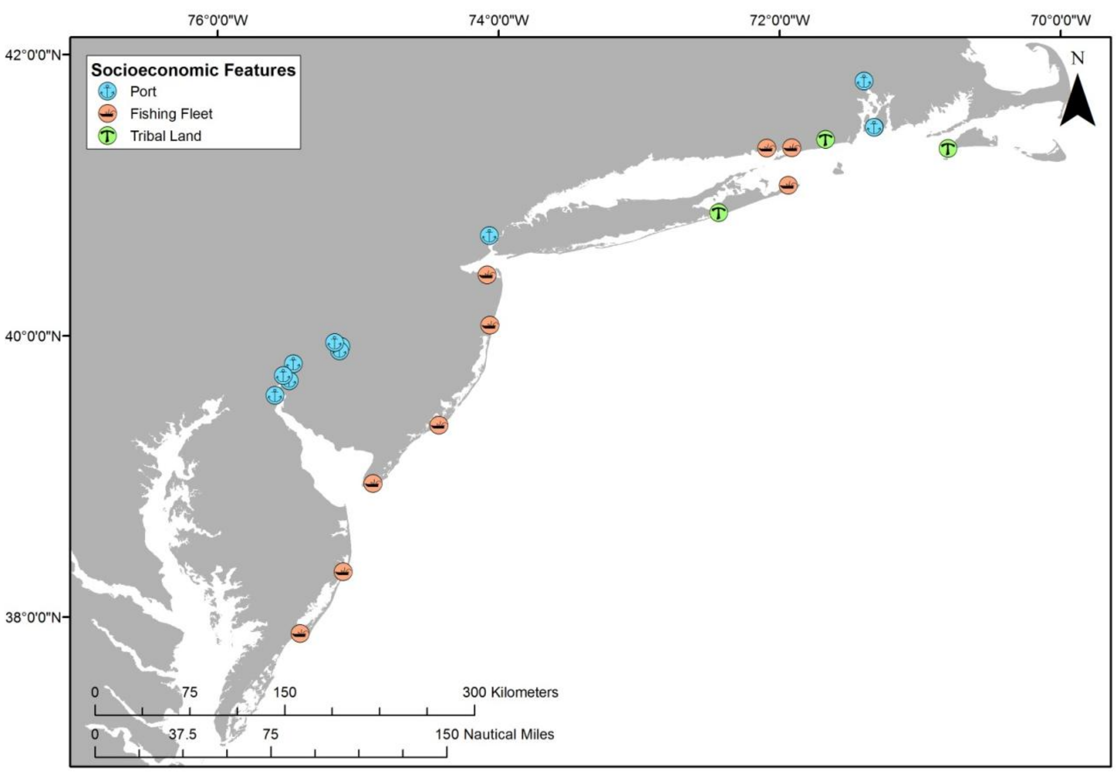


Figure 4-1: Tribal lands, ports, and commercial fishing fleets at risk from a release from the *Oregon*.

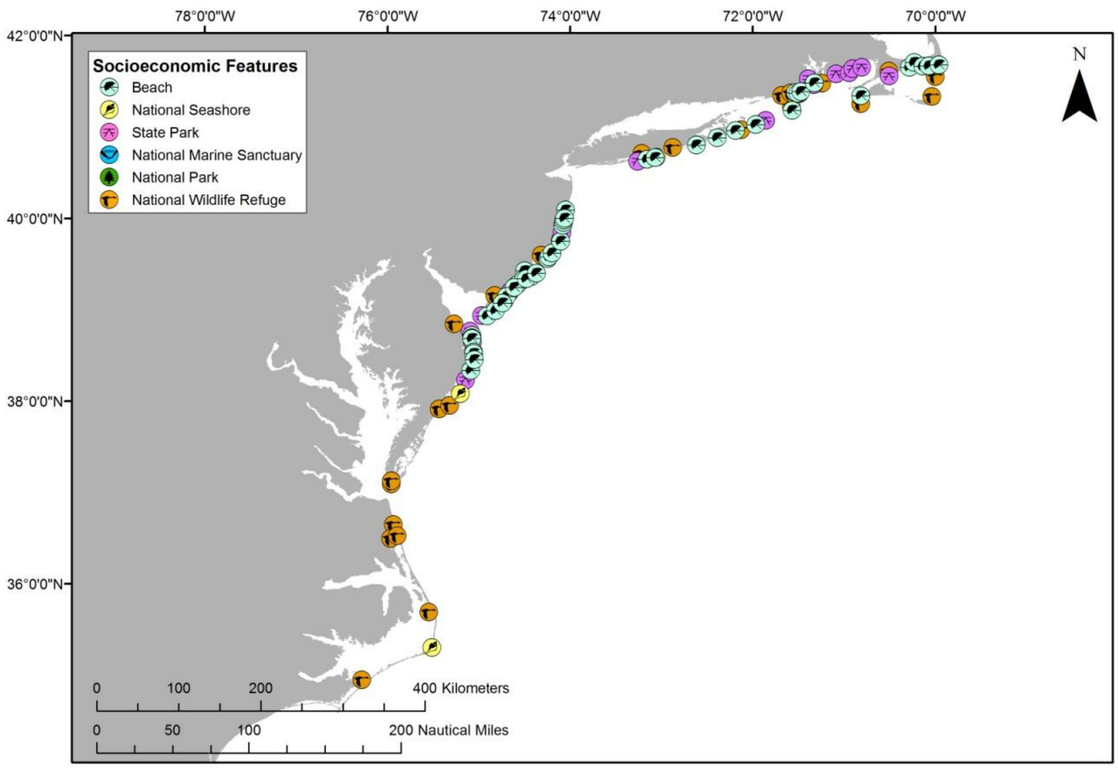


Figure 4-2: Beaches, coastal state parks, and Federal protected areas at risk from a release from the *Oregon*.

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 were one. 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 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).

As a reminder, the socio-economic impact thresholds are: 1 ppb aromatics for water column impacts; 0.01 g/m^2 for water surface impacts; and 1 g/m^2 for shoreline impacts.

In the following sections, the definition of low, medium, and high for each socio-economic risk factor is provided. Also, in the text classification for the *Oregon*, shading indicates the degree of risk for a WCD release of 9,000 bbl and a border indicates degree of risk for the Most Probable Discharge of 900 bbl. Please note: The probability of oiling cannot be determined using the regression curves; probability can only be determined from the 200 model runs. Thus, the modeling results and regression curves for the *Norness* are used to estimate the values used in the risk scoring for the **degree of oiling only**.

Risk Factor 4A-1: Water Column: Probability of Oiling of SRAR (not scored)

This risk factor reflects the probability that at least 0.2 mi^2 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 mi^2 of the upper 33 feet of the water column at the threshold level
- **Medium Impact:** impact on 0.2 to 200 mi^2 of the upper 33 feet of the water column at the threshold level
- **High Impact:** impact on more than 200 mi^2 of the upper 33 feet of the water column at the threshold level

The *Oregon* is classified as Medium Risk for degree of oiling for water column socio-economic resources for the WCD of 9,000 bbl because the mean volume of water contaminated in the model runs was 82 mi^2 of the upper 33 feet of the water column. For the Most Probable Discharge of 900 bbl, the *Oregon* is classified as Medium Risk for degree of oiling because the mean volume of water contaminated was 8 mi^2 of the upper 33 feet of the water column.

Risk Factor 4B-1: Water Surface Probability of Oiling of SRAR (not scored)

This risk factor reflects the probability that at least 1,000 mi^2 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/m^2 (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 mi^2 of water surface impact at the threshold level
- **Medium Impact:** 1,000 to 10,000 mi^2 of water surface impact at the threshold level
- **High Impact:** more than 10,000 mi^2 of water surface impact at the threshold level

The *Oregon* is classified as High Risk for degree of oiling for water surface socio-economic resources for the WCD of 9,000 bbl because the mean area of water contaminated in the model runs was 20,000 mi^2. The *Oregon* is classified as Medium Risk for degree of oiling for water surface socio-economic resources for the Most Probable Discharge because the mean area of water contaminated was 5,300 mi^2.

Risk Factor 4C: Shoreline Impacts to SRAR

The impacts to different types of shorelines vary based on economic value. For the modeled wrecks, 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"). In this risk analysis for the *Oregon*, shorelines have NOT been weighted by their degree of sensitivity to oiling because these data are available only for modeled vessels. Therefore, the impacts are evaluated only on the total number of shoreline miles oiled as determined from the regression curve.

Risk Factor 4C-1: Shoreline Probability of Oiling of SRAR (not scored)

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/m^2 (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 *Oregon* is classified as Medium Risk for degree of oiling for the WCD because the mean length of shoreline contaminated in the model runs was 14 miles. The *Oregon* is classified as Low Risk for degree of oiling for shoreline socio-economic resources for the Most Probable Discharge because the mean length of shoreline contaminated was 6 miles.

Considering the modeled risk scores and the socio-economic resources at risk, the socio-economic risk from potential releases of the WCD of 9,000 bbl of light fuel from the *Oregon* is summarized as listed below and indicated in the far-right column in Table 4-2:

- Water column resources – Medium, because a moderate area of water column would be impacted in important fishing grounds
- Water surface resources – High, because a relatively large area of offshore surface waters would be impacted in important shipping lanes and fishing areas. 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 and streamers
- Shoreline resources – Medium, because a relatively small area of shoreline would be in high-value and sensitive areas, including beach communities

Table 4-2: Socio-economic risk factor ranks for the **Worst Case Discharge of 9,000 bbl** of light fuel oil from the *Oregon*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
4A-1: Water Column Probability SRAR Oiling	Low	Medium	High	N/A: Only available for modeled vessels	Med
4A-2: Water Column Degree SRAR Oiling	Low	Medium	High	The mean volume of water contaminated above 1 ppb was 82 mi^2 of the upper 33 feet of the water column	
4B-1: Water Surface Probability SRAR Oiling	Low	Medium	High	N/A: Only available for modeled vessels	High
4B-2: Water Surface Degree SRAR Oiling	Low	Medium	High	The mean area of water contaminated above 0.01 g/m^2 was 20,000 mi^2	
4C-1: Shoreline Probability SRAR Oiling	Low	Medium	High	N/A: Only available for modeled vessels	Med
4C-2: Shoreline Degree SRAR Oiling	Low	Medium	High	The length of shoreline contaminated by at least 1 g/m^2 was 14 mi	

For the Most Probable Discharge of 900 bbl, the socio-economic risk from potential releases of light fuel from the *Oregon* is summarized as listed below and indicated in the far-right column in Table 4-3:

- Water column resources – Low, because a small area of water column would be impacted in important fishing grounds
- Water surface resources – Medium, because a moderate area of offshore surface waters would be impacted in important shipping lanes and fishing areas. 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 and streamers
- Shoreline resources – Low, because a relatively small area of shoreline would be in high-value and sensitive areas, including beach communities

Table 4-3: Socio-economic risk factor ranks for the **Most Probable Discharge of 900 bbl** of light fuel oil from the *Oregon*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
4A-1: Water Column Probability SRAR Oiling	**Low**	**Medium**	**High**	N/A: Only available for modeled vessels	**Low**
4A-2: Water Column Degree SRAR Oiling	**Low**	**Medium**	**High**	The mean volume of water contaminated above 1 ppb was 8 mi^2 of the upper 33 feet of the water column	
4B-1: Water Surface Probability SRAR Oiling	**Low**	**Medium**	**High**	N/A: Only available for modeled vessels	**Med**
4B-2: Water Surface Degree SRAR Oiling	**Low**	**Medium**	**High**	The mean area of water contaminated above 0.01 g/m^2 was 5,300 mi^2	
4C-1: Shoreline Probability SRAR Oiling	**Low**	**Medium**	**High**	N/A: Only available for modeled vessels	**Low**
4C-2: Shoreline Degree SRAR Oiling	**Low**	**Medium**	**High**	The length of shoreline contaminated by at least 1 g/m^2 was 6 mi	

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

The overall risk assessment for the *Oregon* 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 site formation processes have worked on this vessel
- Ecological 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. As noted in Sections 3 and 4, each of 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. Please note: <u>The probability of oiling cannot be determined using the regression curves; probability can only be determined from the 200 model runs. Thus, the modeling results and regression curves for the *Norness* were used to estimate the values used in the risk scoring for the **degree of oiling only**</u>.

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, *Oregon* scores Medium with 14 points; for the Most Probable Discharge, *Oregon* scores Low with 9 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 *Oregon*. The final determination rests with the U.S. Coast Guard.

Oregon	**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
✓	Use surveys of opportunity to attempt to 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

This vessel is potentially of historic significance and will require appropriate actions be taken under the National Historic Preservation Act (NHPA) 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. The site is also considered a gravesite and appropriate actions should be undertaken to minimize disturbance to the site.

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

Vessel Risk Factors		Data Quality Score	Comments		Risk Score
Pollution Potential Factors	A1: Oil Volume (total bbl)	Medium	Maximum of 8,436 bbl, not reported to be leaking		Med
	A2: Oil Type	High	Bunker fuel is diesel, a Group II 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	No oil known to have been reported on the water		
	D1: Nature of Casualty	High	Collision and storm		
	D2: Structural Breakup	High	Unknown structural breakup		
Archaeological Assessment	Archaeological Assessment	Medium	Little additional information is known about this wreck, assessment is believed to be moderately accurate		Not Scored
Operational Factors	Wreck Orientation	Low	Believed to be upright		Not Scored
	Depth	Low	130 ft		
	Visual or Remote Sensing Confirmation of Site Condition	Low	No known recent assessment		
	Other Hazardous Materials Onboard	Medium	No		
	Munitions Onboard	High	Unknown		
	Gravesite (Civilian/Military)	High	Yes		
	Historical Protection Eligibility (NHPA/SMCA)	High	NHPA		
				WCD	Most Probable
Ecological Resources	3A: Water Column Resources	High	Larger releases of light fuel oil could affect some resources	Med	Low
	3B: Water Surface Resources	High	Seasonally very high concentrations of marine birds in coastal and shelf waters could be affected by larger releases	Med	Low
	3C: Shore Resources	High	Very few shorelines at risk	Low	Low
Socio-Economic Resources	4A: Water Column Resources	High	Moderate area of water column would be impacted in important fishing grounds	Med	Low
	4B: Water Surface Resources	High	Relatively large area of offshore surface waters would be impacted in important shipping lanes and fishing areas	High	Med
	4C: Shore Resources	High	Relatively small area of shoreline would be in high-value and sensitive areas, including beach communities	Med	Low
Summary Risk Scores				14	9