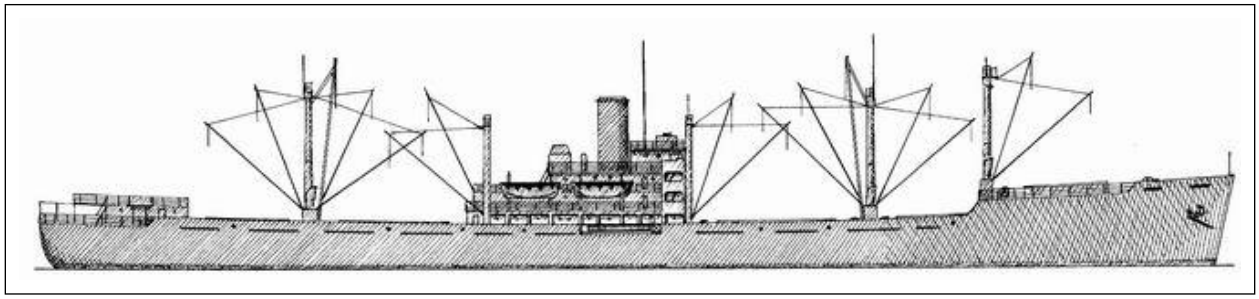
Office of National Marine Sanctuaries
Office of Response and Restoration

Screening Level Risk Assessment Package

Drexel Victory



March 2013

National Oceanic and
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Photo: Diagram of VC2-S-AP2 Type Victory Ship
Source: http://drawings.usmaritimecommission.de/drawings_v_types.htm

Table of Contents

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.

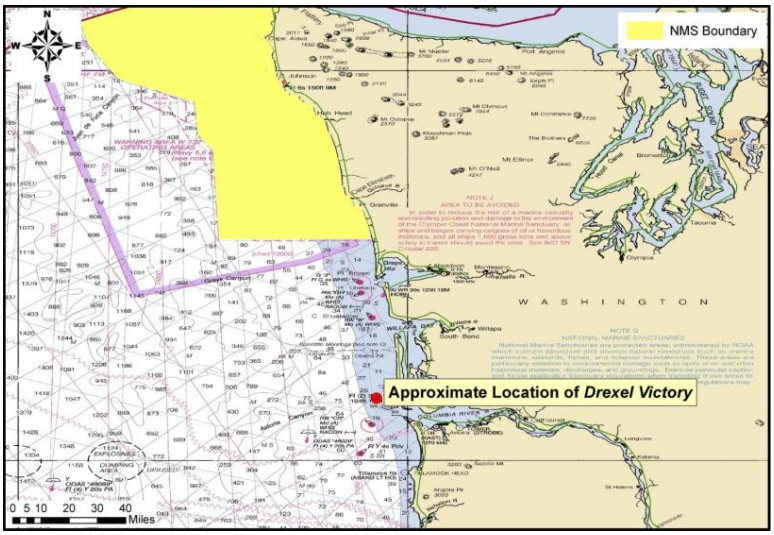
The potential polluting shipwrecks were identified through searching a broad variety of historical sources. NOAA then worked with Research Planning, Inc., RPS ASA, and Environmental Research Consulting to conduct the modeling forecasts, and the ecological and environmental resources at risk assessments.

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: *Drexel Victory*

The freighter *Drexel Victory*, which broke up and sank while crossing over the Columbia River Bar in 1947, 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 *Drexel Victory*, 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.



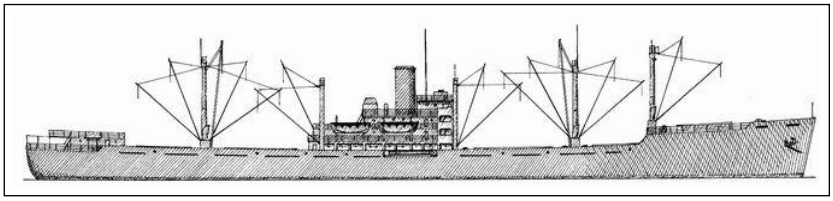
Based on this screening-level assessment, each vessel was assigned a summary score calculated using the seven risk criteria described in this report. For the Worst Case Discharge, *Drexel Victory* scores High with 16 points; for the Most Probable Discharge (10% of the Worse Case volume), *Drexel Victory* scores Medium with 12 points. Given these scores, NOAA would typically recommend that this site be considered for further assessment to determine the vessel condition, amount of oil onboard, and feasibility of oil removal action. However, given the moderate/low level of data certainty and that the location of this vessel is unknown, NOAA recommends that surveys of opportunity with state, federal, or academic entities be used to attempt to locate this vessel and that general notations are made 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. Outreach efforts with the technical and recreational dive community as well as commercial and recreational fishermen who frequent the area would be helpful to gain awareness of localized spills in the general area where the vessel is believed lost.

Vessel Risk Factors		Risk Score	
Pollution Potential Factors	A1: Oil Volume (total bbl)	Med	
	A2: Oil Type		
	B: Wreck Clearance		
	C1: Burning of the Ship		
	C2: Oil on Water		
	D1: Nature of Casualty		
	D2: Structural Breakup		
Archaeological Assessment	Archaeological Assessment	Not Scored	
Operational Factors	Wreck Orientation	Not Scored	
	Depth		
	Confirmation of Site Condition		
	Other Hazardous Materials		
	Munitions Onboard		
	Gravesite (Civilian/Military)		
	Historical Protection Eligibility		
		WCD	MP (10%)
Ecological Resources	3A: Water Column Resources	Low	Low
	3B: Water Surface Resources	Med	Med
	3C: Shore Resources	Med	Low
Socio-Economic Resources	4A: Water Column Resources	Low	Low
	4B: Water Surface Resources	High	Med
	4C: Shore Resources	High	High
Summary Risk Scores		16	12

The determination of each risk factor is explained in the document. This summary table is found on page 41.

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

Vessel Particulars



Official Name: *Drexel Victory*

Official Number: 247707

Vessel Type: Freighter

Vessel Class: VC2-S-AP2 Type Victory Ship

Former Names: N/A

Year Built: 1945

Builder: Kaiser Permanente No.2, Richmond, CA

Builder's Hull Number: 744

Flag: American

Owner at Loss: Olson & Co.

Controlled by: Unknown **Chartered to:** Unknown

Operated by: Unknown

Homeport: Unknown

Length: 439 feet **Beam:** 62 feet **Depth:** 34 feet

Gross Tonnage: 7,607 **Net Tonnage:** 4,563

Hull Material: Steel **Hull Fastenings:** Welded **Powered by:** Oil-fired steam

Bunker Type: Heavy fuel oil (Bunker C) **Bunker Capacity (bbl):** Unknown

Average Bunker Consumption (bbl) per 24 hours: Unknown

Liquid Cargo Capacity (bbl): 0 **Dry Cargo Capacity:** 500,000 cubic feet

Tank or Hold Description: Unknown

Casualty Information

Port Departed: Unknown

Destination Port: Unknown

Date Departed: Unknown

Date Lost: February 7, 1947

Number of Days Sailing: Unknown

Cause of Sinking: Grounding

Latitude (DD): 46.31232

Longitude (DD): -124.1596

Nautical Miles to Shore: 4.8

Nautical Miles to NMS: 49

Nautical Miles to MPA: 0.75

Nautical Miles to Fisheries: Unknown

Approximate Water Depth (Ft): 210

Bottom Type: Unknown

Is There a Wreck at This Location? Unknown, the wreck has not been located

Wreck Orientation: Unknown

Vessel Armament: None

Cargo Carried when Lost: 4,560 tons of wheat

Cargo Oil Carried (bbl): 0

Cargo Oil Type: N/A

Probable Fuel Oil Remaining (bbl): Unknown, ≤12,000

Fuel Type: Heavy fuel oil (Bunker C)

Total Oil Carried (bbl): ≤12,000

Dangerous Cargo or Munitions: None

Munitions Carried: None

Demolished after Sinking: No

Salvaged: No

Cargo Lost: Yes

Reportedly Leaking: No

Historically Significant: Unknown

Gravesite: No

Salvage Owner: Not known if any

Wreck Location

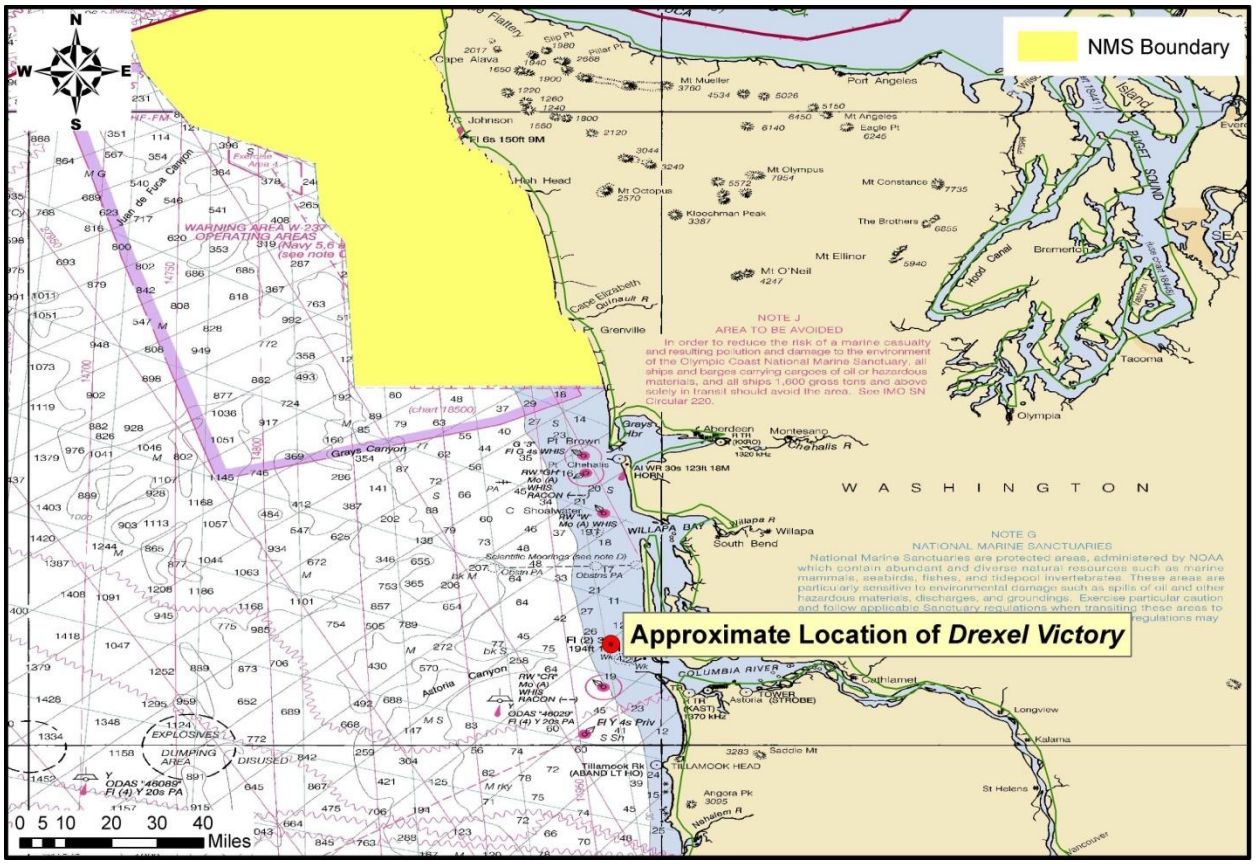


Chart Number: 18007

Casualty Narrative

The back of the freighter *Drexel Victory* was broken as the ship crossed over the Columbia River Bar while leaving Portland, OR destined for Yokohama, Japan. The cause of the wreck was a mystery as the charts for the area showed that the channel was 57 feet deep and the vessel was only drawing a depth of 30 feet. Some speculated that the vessel may have landed on a shifting sand bar after being lifted by a swell, and others thought the vessel may have struck another submerged wreck.

General Notes

NOAA Automated Wreck and Obstruction Information System (AWOIS) Data:

DESCRIPTION
24 NO.1072 POSITION ACCURACY WITHIN 1 MILE

Wreck Condition/Salvage History

Unknown; the wreck has not been discovered.

Archaeological Assessment

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

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

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

Assessment

NOAA archaeologists have located little historic documentation on the sinking of *Drexel Victory*, and no site reports exist that would allow NOAA archaeologists to provide much additional archaeological assessment about the shipwreck on top of the casualty narrative included in this packet and readily available through the Google Newspaper Archives. Based on the large degree of inaccuracy in the reported sinking location and the shifting shoals present in this area, it is unlikely that the shipwreck will be intentionally located.

Should the vessel be located in a survey of opportunity or due to a mystery spill attributed to this vessel, it should be noted that this vessel may be 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.

Background Information References

Vessel Image Sources: http://drawings.usmaritimecommission.de/drawings_v_types.htm

Construction Diagrams or Plans in RULET Database? No, paper plans may be available from the Smithsonian Institute

Text References:

-AWOIS database #50091

-Google newspapers

Vessel Risk Factors

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

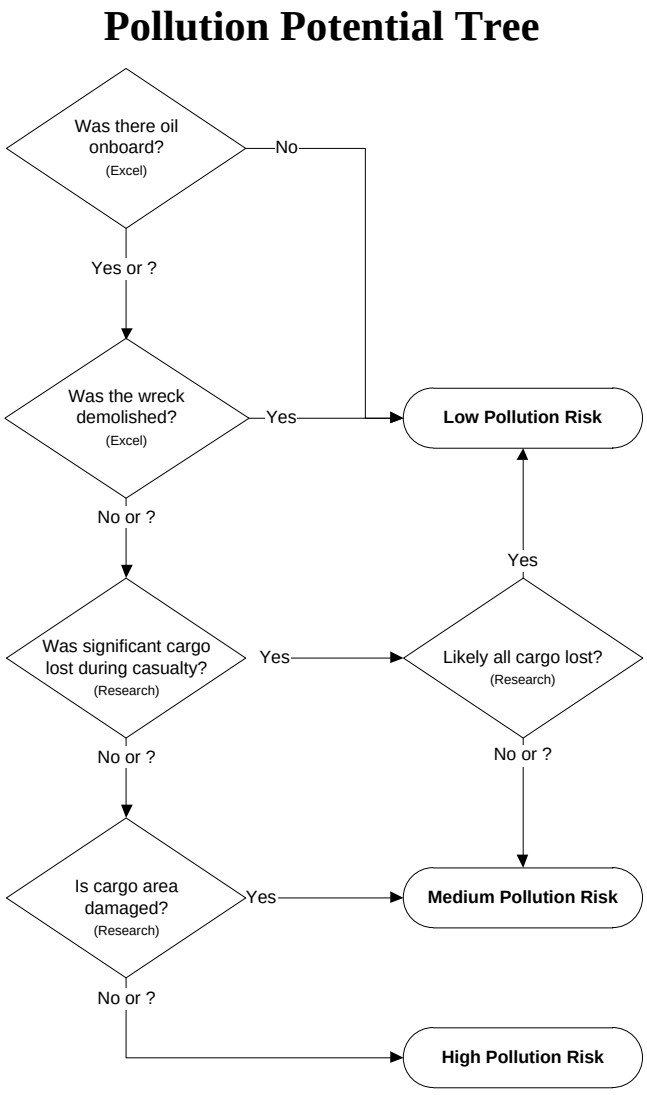


Figure 1-1: U.S. Coast Guard Salvage Engineering Response Team (SERT) developed the above Pollution Potential Decision Tree.

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

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

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 *Drexel Victory* 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 *Drexel Victory i*s ranked as High Volume because it is thought to have a potential for up to 12,000 bbl based on the bunker capacity of similar sized vessels, although some of that may have been lost at the time of the casualty due to breakup of the vessel. Data quality is medium.

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

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 *Drexel Victory* is classified as High Risk because the bunker oil is heavy fuel oil, a Group IV oil type. Data quality is high.

Was the wreck demolished?

Risk Factor B: Wreck Clearance

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

- **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 *Drexel Victory* 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

[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]

The *Drexel Victory* 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 *Drexel Victory* 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 low because full sinking reports were not located.

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 *Drexel Victory* is classified as High Risk because it is believed to have sunk after breaking its back on a sandbar. Data quality is medium because it is not known for sure if the vessel landed on a sandbar or on top of another shipwreck.

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 *Drexel Victory* is classified as Unknown Risk because it is not known whether additional structural breakup occurred since the location is unknown. Data quality is Low.

Factors That May Impact Potential Operations

Orientation (degrees)

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

The location of the *Drexel Victory* is unknown. Data quality is low.

Depth

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

The depth for *Drexel Victory* is believed to be approximately 210 feet due to the last known location. Data quality is low.

Visual or Remote Sensing Confirmation of Site Condition

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

The location of the *Drexel Victory* is unknown. Data quality is low.

Other Hazardous (Non-Oil) Cargo on Board

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

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

Munitions on Board

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

The *Drexel Victory* had did not carry any munitions. Data quality is high.

Vessel Pollution Potential Summary

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

Table 1-1: Summary matrix for the vessel risk factors for the *Drexel Victory* 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 12,000 bbl, not reported to be leaking	**Med**
	A2: Oil Type	High	Bunker oil is heavy fuel oil, a Group IV oil type	
	B: Wreck Clearance	High	Vessel not reported as cleared	
	C1: Burning of the Ship	High	No fire was reported	
	C2: Oil on Water	Low	No oil known to have been reported	
	D1: Nature of Casualty	Medium	Broke its back on a sandbar or another wreck	
	D2: Structural Breakup	Low	Unknown structural breakup	
Archaeological Assessment	Archaeological Assessment	Low	No detailed sinking reports were located and no site reports exist so a detailed assessment could not be prepared	**Not Scored**
Operational Factors	Wreck Orientation	Low	Unknown	**Not Ranked**
	Depth	Low	Unknown, likely around 210 feet	
	Visual or Remote Sensing Confirmation of Site Condition	Low	Site has never been located	
	Other Hazardous Materials Onboard	High	No	
	Munitions Onboard	High	No	
	Gravesite (Civilian/Military)	High	No	
	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 *Drexel Victory* this would be 12,000 bbl based on current estimates of the amount of oil remaining onboard the wreck.

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

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

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

When a spill occurs, the trajectory, fate, and effects of the oil will depend on environmental variables, such as the wind and current directions over the course of the oil release, as well as seasonal effects. The magnitude and nature of potential impacts to resources will also generally have a strong seasonal component (e.g., timing of bird migrations, turtle nesting periods, fishing seasons, and tourism seasons).

Table 2-1: Potential oil release scenario types for the *Drexel Victory*.

Scenario Type	Release per Episode	Time Period	Release Rate	Relative Likelihood	Response Tier
Chronic (0.1% of WCD)	12 bbl	Fairly regular intervals or constant	100 bbl over several days	More likely	Tier 1
Episodic (1% of WCD)	120 bbl	Irregular intervals	Over several hours or days	Most Probable	Tier 1-2
Most Probable (10% of WCD)	1,200 bbl	One-time release	Over several hours or days	Most Probable	Tier 2
Large (50% of WCD)	6,000 bbl	One-time release	Over several hours or days	Less likely	Tier 2-3
Worst Case	12,000 bbl	One-time release	Over several hours or days	Least likely	Tier 3

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

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

Oil Type for Release

The *Drexel Victory* contained a maximum of 12,000 bbl of bunker fuel oil (a Group IV oil). Thus, the oil spill model was run using heavy fuel oil.

Oil Thickness Thresholds

The model results are reported for different oil thickness thresholds, based on the amount of oil on the water surface or shoreline and the resources potentially at risk. Table 2-2 shows the terminology and thicknesses used in this report, for both oil thickness on water and the shoreline. For oil on the water surface, a thickness of 0.01 g/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 2-2b shows the number of tarballs per m^2 on the shoreline for these oil thickness thresholds, assuming that each tarball was a sphere that was 1 inch in diameter.

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

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

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

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

Potential Impacts to the Water Column

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

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

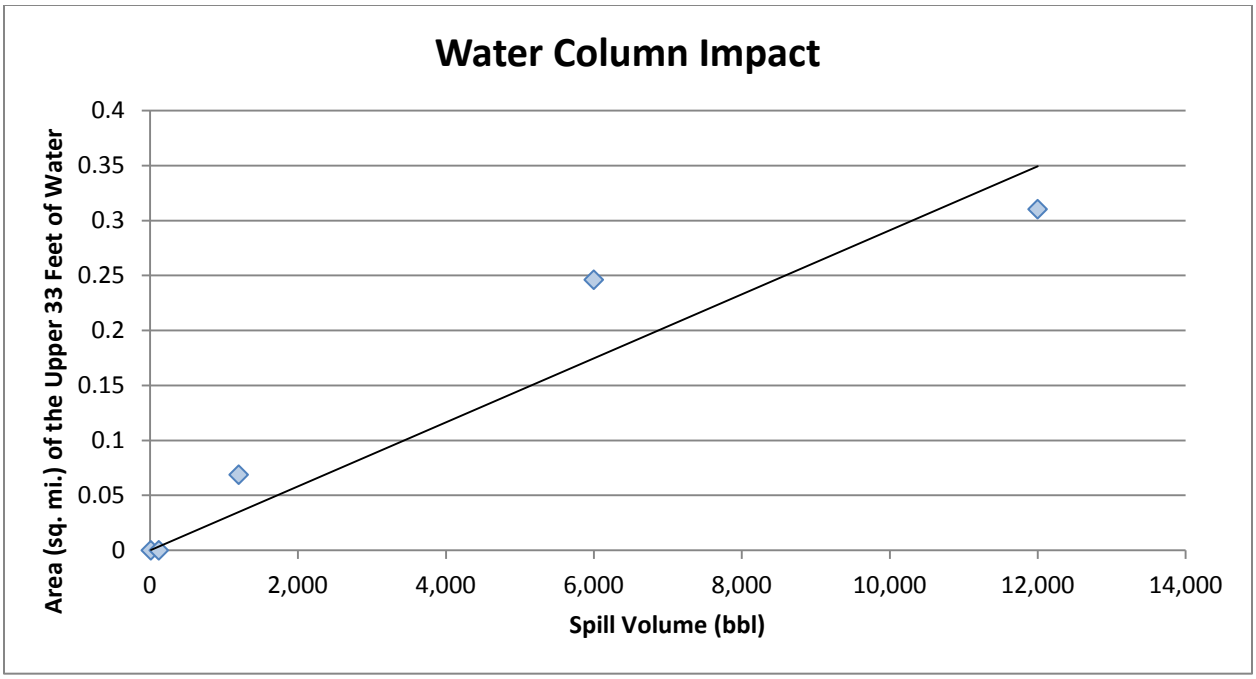


Figure 2-1: Regression curve for estimating the volume of water column at or above 1 ppb aromatics as a function of spill volume for the *Drexel Victory*.

Potential Water Surface Slick

The slick size from an oil release from the *Drexel Victory* is a function of the quantity released. The estimated water surface coverage by a fresh slick (the total water surface area "swept" by oil over time) for the various scenarios is shown in Table 2-3, as the mean result of the 200 model runs. Note that this is an estimate of total water surface affected over a 30-day period. The slick will not be continuous but rather be broken and patchy due to the subsurface release of the oil. Surface expression is likely to be in the form of sheens, tarballs, and streamers.

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

Scenario Type	Oil Volume (bbl)	Estimated Slick Area Swept Mean of All Models	
		0.01 g/m²	10 g/m²
Chronic	12	52 mi²	52 mi²
Episodic	120	170 mi²	170 mi²
Most Probable	1,200	550 mi²	550 mi²
Large	6,000	1,300 mi²	1,300 mi²
Worst Case Discharge	12,000	1,900 mi²	1,900 mi²

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

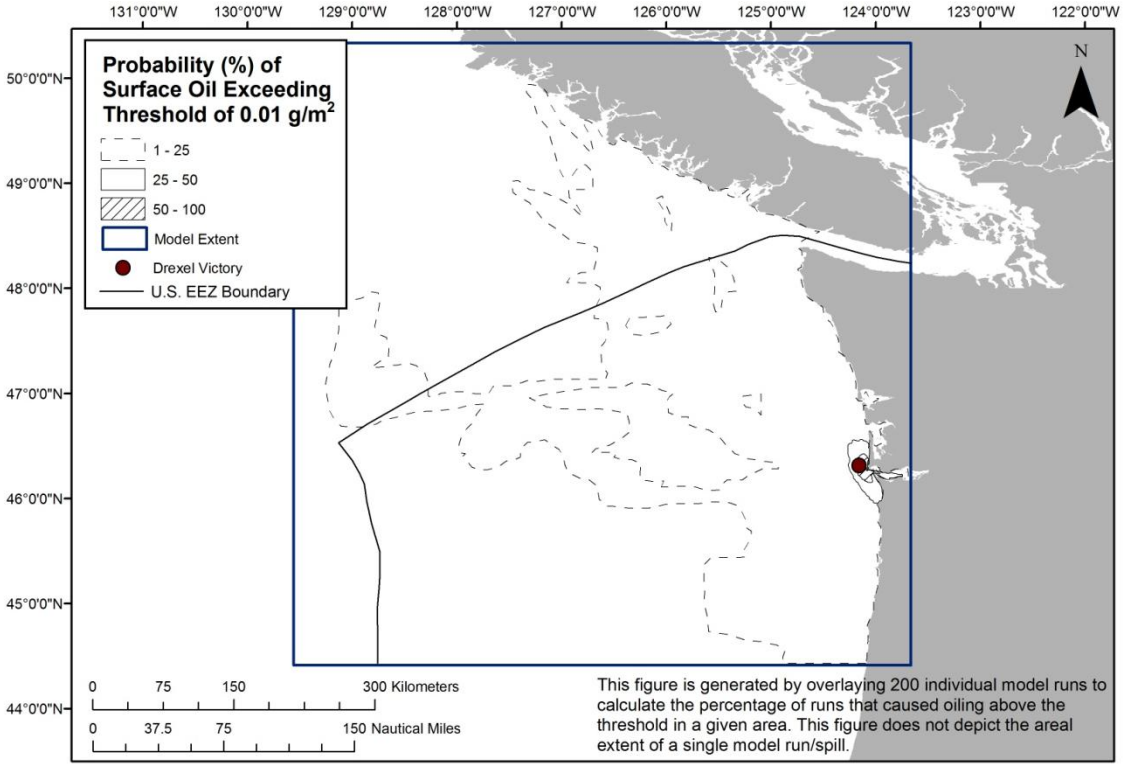


Figure 2-2: Probability of surface oil (exceeding 0.01 g/m^2) from the Most Probable spill of 1,200 bbl of heavy fuel oil from the *Drexel Victory* at the threshold for socio-economic resources at risk.

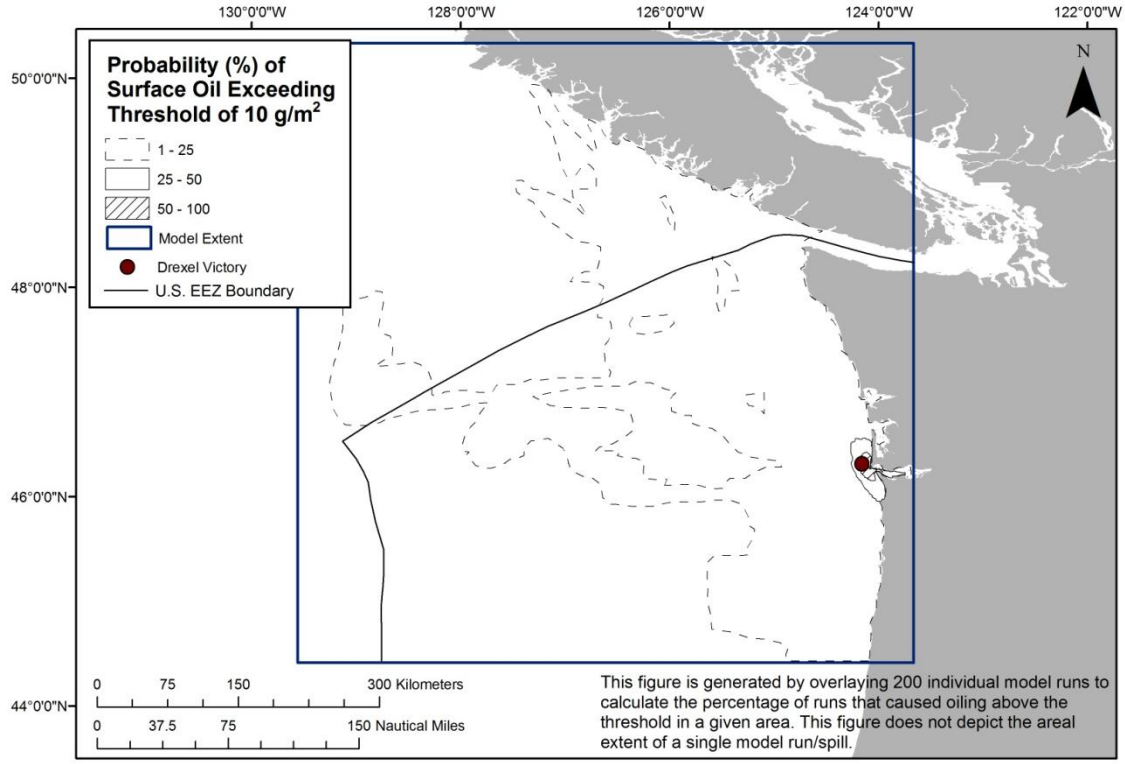


Figure 2-3: Probability of surface oil (exceeding 10 g/m^2) from the Most Probable spill of 1,200 bbl of heavy fuel oil from the *Drexel Victory* at the threshold for ecological resources at risk.

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

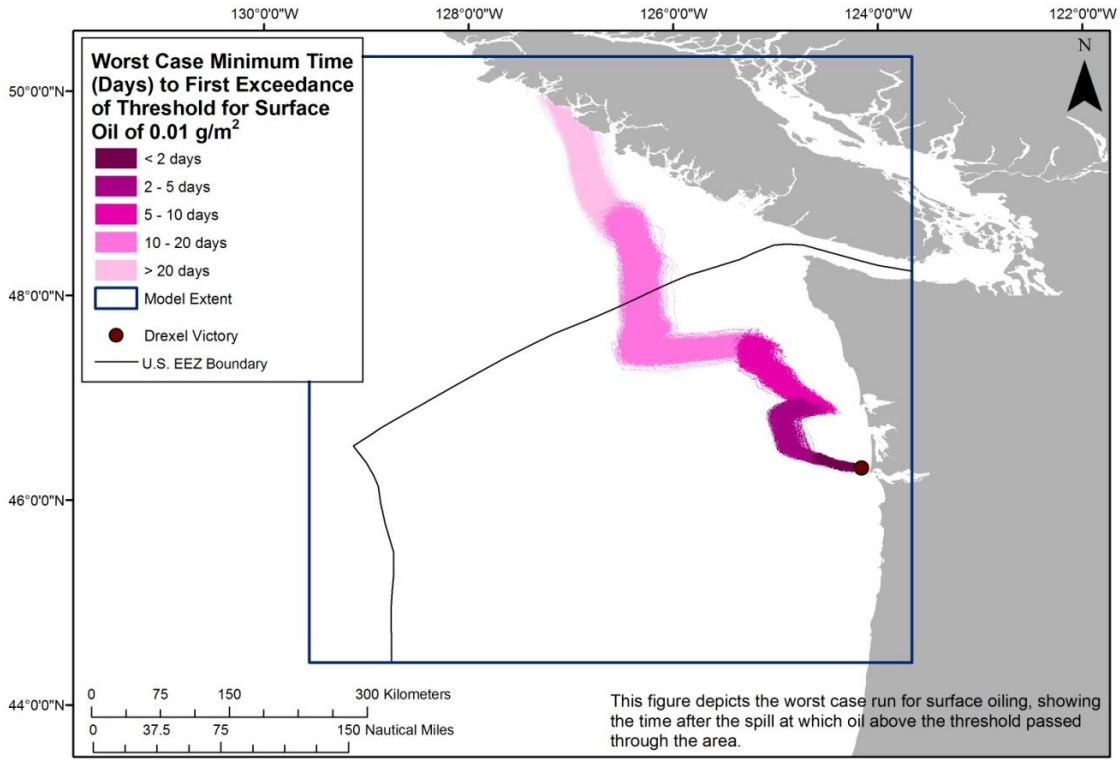


Figure 2-4: Water surface oiling from the Most Probable spill of 1,200 bbl of heavy fuel oil from the *Drexel Victory* shown as the area over which the oil spreads at different time intervals.

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

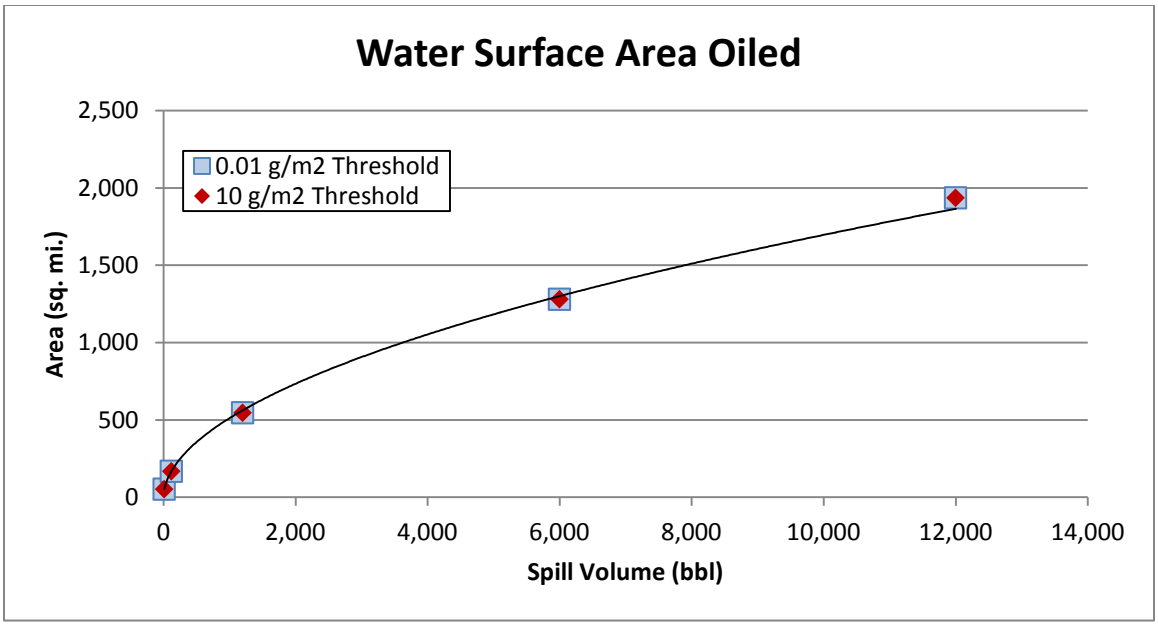


Figure 2-5: Regression curve for estimating the amount of water surface oiling as a function of spill volume for the *Drexel Victory*, showing both the ecological threshold of 10 g/m^2 and socio-economic threshold of 0.01 g/m^2.

Potential Shoreline Impacts

Based on the modeling results, shorelines from the southern half of Victoria Island in Canada, to as far south as Waldport, Oregon, are at risk. Figure 2-6 shows the probability of oil stranding at concentrations that exceed the threshold of 1 g/m^2, for the Most Probable release of 1,200 bbl. However, the specific areas that would be oiled will depend on the currents and winds at the time of the oil release(s), as well as on the amount of oil released. Figure 2-7 shows the single oil spill scenario that resulted in the maximum extent of shoreline oiling for the Most Probable volume. Estimated miles of shoreline oiling above the threshold of 1 g/m^2 by scenario type are shown in Table 2-4.

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

Scenario Type	Volume (bbl)	Estimated Miles of Shoreline Oiling Above 1 g/m^2			
		Rock/Gravel/Artificial	Sand	Wetland/Mudflat	Total
Chronic	12	2	2	0	4
Episodic	120	5	10	0	15
Most Probable	1,200	7	16	0	23
Large	6,000	9	17	0	26
Worst Case Discharge	12,000	11	19	1	30

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

Scenario Type	Volume (bbl)	Estimated Miles of Shoreline Oiling Above 1 g/m^2			
		Rock/Gravel/Artificial	Sand	Wetland/Mudflat	Total
Chronic	12	2	2	0	3
Episodic	120	4	10	0	14
Most Probable	1,200	4	16	0	20
Large	6,000	5	17	0	22
Worst Case Discharge	12,000	6	18	1	25

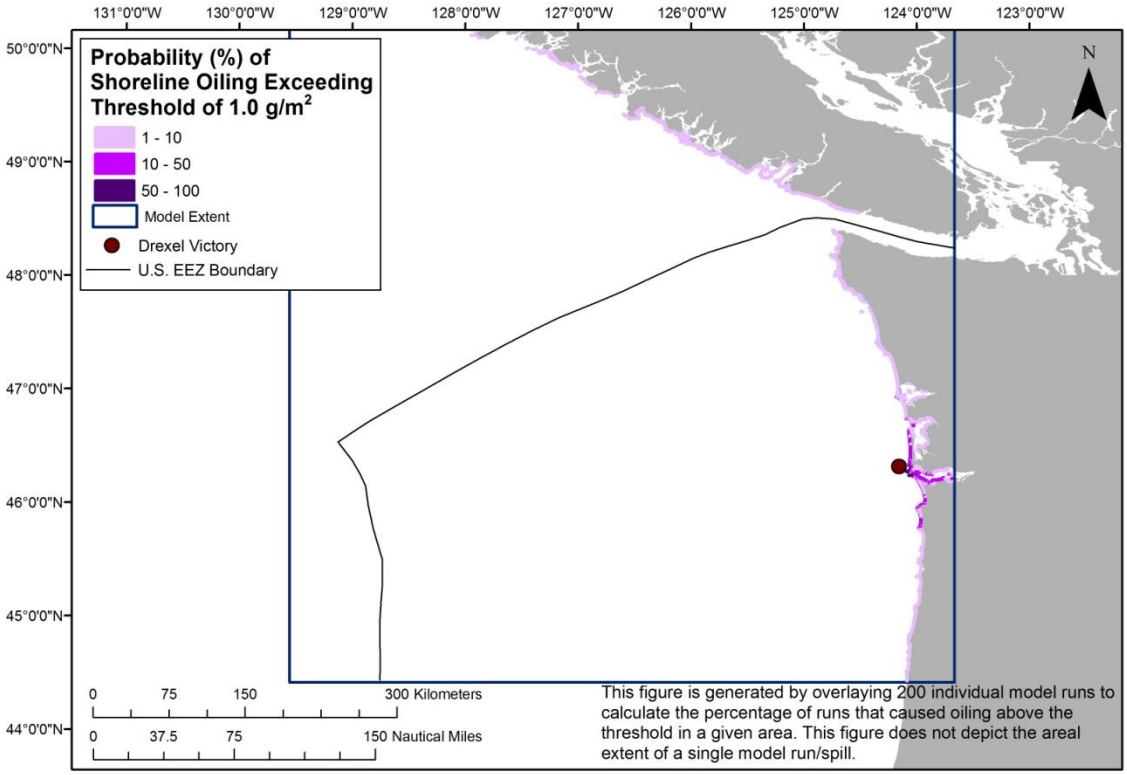


Figure 2-6: Probability of shoreline oiling (exceeding 1.0 g/m^2) from the Most Probable Discharge of 1,200 bbl of heavy fuel oil from the *Drexel Victory*.

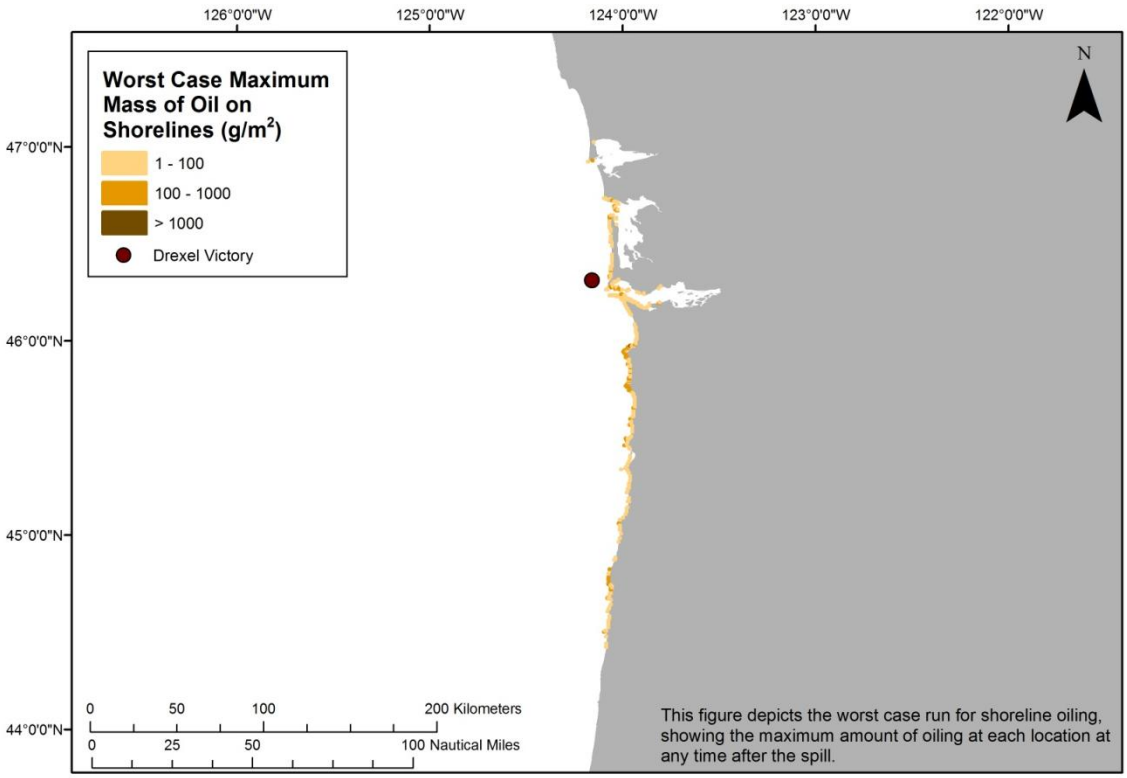


Figure 2-7: The extent and degree of shoreline oiling from the single model run of the Most Probable Discharge of 1,200 bbl of heavy fuel oil from the *Drexel Victory* that resulted in the greatest shoreline oiling.

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

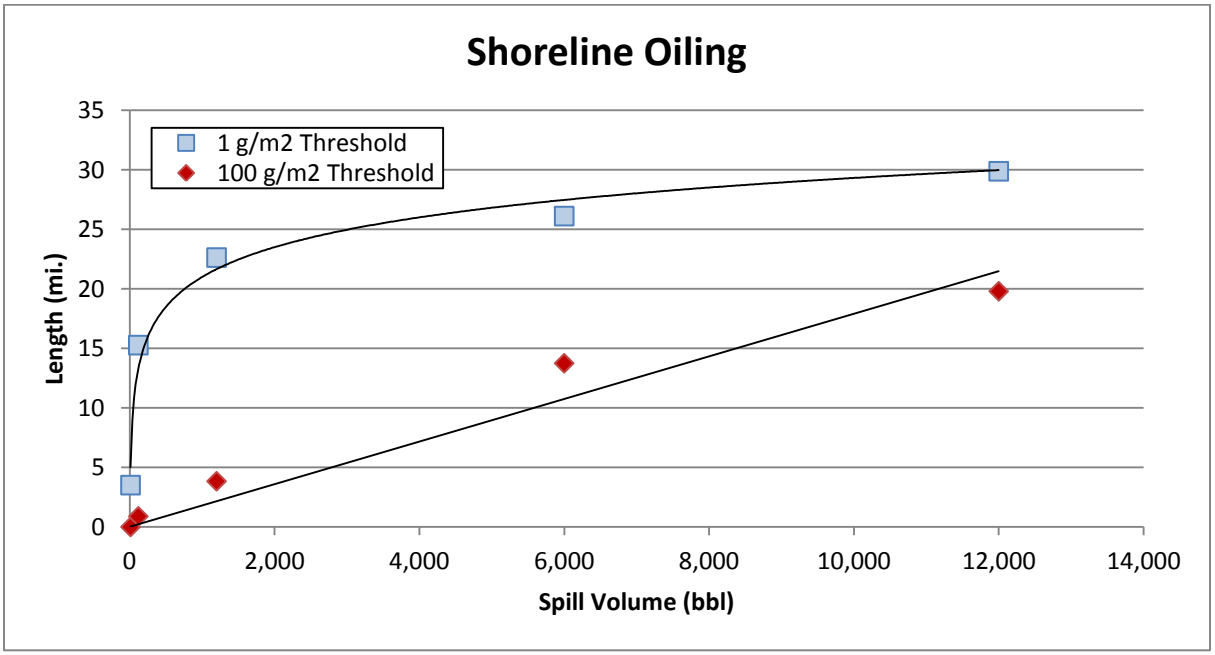


Figure 2-8: Regression curve for estimating the amount of shoreline oiling at different thresholds as a function of spill volume for the *Drexel Victory*.

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

Table 2-5: Worst case scenario shoreline impact by habitat type and oil thickness for a leakage of 12,000 bbl from the *Drexel Victory*.

Shoreline/Habitat Type	Lighter Oiling Oil Thickness <1 mm Oil Thickness >1 g/m²	Heavier Oiling Oil Thickness >1 mm Oil Thickness >100 g/m²
Rocky and artificial shores/Gravel beaches	93 miles	71 miles
Sand beaches	18 miles	14 miles
Salt marshes and tidal flats	0 miles	0 miles

Table 2-6: Worst case scenario shoreline impact by habitat type and oil thickness for a leakage of 1,200 bbl from the *Drexel Victory*.

Shoreline/Habitat Type	Lighter Oiling Oil Thickness <1 mm Oil Thickness >1 g/m²	Heavier Oiling Oil Thickness >1 mm Oil Thickness >100 g/m²
Rocky and artificial shores/Gravel beaches	22 miles	5 miles
Sand beaches	60 miles	0 miles
Salt marshes and tidal flats	1 mile	0 miles

SECTION 3: ECOLOGICAL RESOURCES AT RISK

Ecological resources at risk from a catastrophic release of oil from the *Drexel Victory* (Table 3-1) include numerous guilds of birds, particularly those sensitive to surface oiling while rafting or plunge diving to feed and are present in nearshore/offshore waters. Many seabirds and shorebirds use the estuaries and offshore islands as foraging and nesting habitat. Sand Island in the Columbia River estuary hosts the largest nesting populations of Caspian tern and double-crested cormorants in the world. Many sea stacks and coastal islands in the area are protected habitat for seabird nesting and heavily used pinniped haul-outs. Gray whales and killer whales can be found quite close to shore. In addition, this region supports commercially important fish and invertebrate populations, including foraging and spawning habitat for several species of endangered salmon.

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

Species Group	Species Subgroup and Geography	Seasonal Presence
Birds	Pelagic waters are productive foraging hotspots for pelagic birds • Common inshore (<6 km from shore): sooty shearwater, California gull, Glaucous-winged gull, common murres, rhinoceros auklets • Common offshore (>6 km from shore): sooty shearwater, northern fulmar, fork-tailed storm-petrel, California gull, glaucous-winged gull, common murre, Cassin's auklet, rhinoceros auklet • Northern fulmars common (flocks of 5-10,000) around factory ships late fall • Majority of the birds using these areas are migratory or wintering • Short-tailed (FE), black-footed (SSC) and Laysan albatross present • Other species include tufted puffin, herring gull, Thayer's gull, black-legged kittiwake, jaegers, phalaropes, shearwaters *Pelagic hotspots* • Cape Disappointment waters are foraging habitat for thousands of shearwaters, gulls, terns, and common murres • Olympic Coast National Marine Sanctuary: 100 species of bird present; productive waters attract large feeding aggregations • Heceta Bank, Perpetua Bank, Stonewall Bank, and surrounding waters are sites of upwelling and fishing activity that result in high concentrations of prey and large numbers of seabirds including short-tailed albatross (FE, rare), black-footed albatross (FE, up to hundreds), pink-footed shearwater (1,000s), northern fulmar (1,000s), Cassin's auklet (10,000s) • High densities of sooty and short-tailed shearwater (flocks of thousands), California gull (thousands), Sabine's gull (hundreds) in offshore Canada *Shorebird/waterfowl hotspots* Bays and estuaries are important foraging grounds for migratory and resident shorebirds • Tahkenitch Creek Estuary: Large concentrations of migrating shorebirds, Caspian tern, great blue heron, and wintering western grebe • Siltcoos Estuary: important habitat for bufflehead, California gull, Caspian tern, Clark's grebe, common loon, great blue heron, green heron, long-billed curlew, red-necked grebe, and Virginia rail • Alsea Bay: brown pelicans, Caspian terns, shorebirds (thousands) • Tillamook Bay: waterfowl (7,500, 34 species), great blue heron rookery,	Shearwaters present May-Sep Fulmars present summer-fall Black-footed albatross common May-Oct Common murres present May-Jun Gulls present May-Nov Sandpipers present spring and fall Waterfowl Oct-Apr Shorebirds present Spring-Fall

Species Group	Species Subgroup and Geography	Seasonal Presence
	shorebirds plentiful • Aleutian Canada goose wintering at Nestucca Bay NWR, dusky Canada goose wintering at Nestucca and Oregon Islands NWR • Cape Disappointment: diverse habitat supports foraging seabirds (shearwaters, gulls, terns, common murre) • Willapa Bay: >180 species birds recorded; high concentrations of waterfowl in the bay and shorebirds (>10,000 in spring) and pelicans roosting at Leadbetter Point, Sand Island, and Gunpowder Island • Cleland Island/Southeast Clayoquot Sound: Potentially >10,000 wintering waterfowl; black brant use eelgrass beds in large numbers, large concentrations of white-winged and surf scoters molting/migrating in spring • Tofino mudflats: Stopover for migratory western sandpipers (10,000s; highest concentrations on west coast of Canada) and other shorebirds (dowitchers, dunlin, least sandpipers, black-bellied plovers, greater yellowlegs, sanderling, whimbrel, black oystercatchers); wintering trumpeter swan, mallard, northern pintail, American wigeon, surf scoter bufflehead, loons, and grebes; late summer foraging area for great blue heron • Barkley Sound: Migratory habitat for surf scoters, western grebes, surfbirds *Nesting concentrations/locations (bp=breeding pairs)* • Marbled murrelet (FT) nest in coastal forests and use nearshore waters for foraging, mating, loafing, molting and preening • Western snowy plover (FT) breeds on coastal beaches (331 nesting birds in OR/WA) nesting at beaches near Tahkenitch Creek estuary, Siltcoos estuary, Sutton Beach/Baker Beach, Leadbetter Point, and Midway/Grayland Beach • Two Arches Rock National Wildlife Refuge (NWR): 42,400+ nesting seabirds • Three Arch Rocks NWR: 12 species of seabirds, 226,000 nesting birds, including 60% of OR's tufted puffin population; brown pelicans, bald eagles • Bird Rocks NWR: 49,500 nesting birds, 6 species Yaquina Head: 52,000+ birds nesting; one of largest common murre breeding locations in OR (50,000+), Brandt's cormorant (800-1,500 nests), pelagic cormorants (~610 nests), black oystercatcher (6-7 bp) • East Sand Island (Columbia River entrance): largest Caspian tern colony in the world (9,900 bp), largest double-crested cormorant (12,000 bp) colony in the world, Brandt's cormorants (100 bp), pelican roost (<18,000), large colonies of gulls, pigeon guillemots nesting • Cape Disappointment: cliffs support nesting Brandt's cormorants (64), pelagic cormorants (240), pigeon guillemots (12), and gulls (12) • Washington Islands NWR: 200,000 nesting birds total, including Leach's storm-petrel (50,000), fork-tailed storm petrel, rhinoceros auklet (25,000), tufted puffin (20,000), common murre (10,000), glaucous-winged gull, western gull, Brandt's cormorant, pelagic cormorant, Cassin's auklet, black oystercatcher, pigeon guillemot, and double crested cormorant o 70% of WA's nesting seabird population and >50% of the west coast breeding population of fork-tailed storm-petrels • Hesquiat Lake Area: High concentration of marbled murrelets (FT) nesting • Cleland Island/Southeast Clayoquot Sound: Black oystercatchers (50s), pigeon guillemots (hundreds), Leach's storm-petrels (5-6,000), Cassin's auklet, rhinoceros auklet, tufted puffin, fork-tailed storm-petrel, marbled murrelet • Barkley Sound: marbled murrelets, black oystercatchers (nesting on 13 islets), glaucous-winged gull (728 pairs); the majority of the Canadian populations of Brandt's cormorants nest here	*Nesting months* Murrelets: Apr-Sep Oystercatchers: Apr-Oct Alcids: Apr-Aug Common murres: Apr-Jul Storm-petrels: May-Oct Great blue herons: Mar-Aug Gulls: Apr-Sep Cormorants: Apr-Sep Caspian tern: Apr-Sep Western snowy plover: Mar-Sep Gulls: Apr-Sep

Species Group	Species Subgroup and Geography	Seasonal Presence
Pinnipeds, Otters & Small Mammals	*Oregon* • Harbor seals present year round; haul-outs at Salishan Spit in Lincoln City, Strawberry Point State Park, and Nehalem Bay • Three Arch Rocks, OR is Steller sea lion (FT) rookery • River otters, nutria, and muskrats can be found in the lower portions of the Columbia River • California sea lion males are common and haul out on beaches near Newport, in the mouth of the Columbia River, and in jetties, offshore rocks and islands, logbooms, marina docks, and navigation buoys along the outer coast of Washington • Stellar sea lion haul-out sites numerous along the OR coast *Willapa Bay and Grays Harbor* • Numerous harbor seal haul-out sites are located on intertidal mudflats and sand bars; peak abundance is during pupping and molting seasons Nursery areas are at Pine Island Channel, Ellen Sands, Shoalwater Bay, and northeast of Long Island in Willapa Bay and Whitcomb Flats, Mid-Harbor Flats, Sand Island shoals, Sand Island, Goose Island, Chenoise Creek channels, and North Bay in Grays Harbor • Peak harbor seal abundances occur during the pupping and molting season • Small numbers of California sea lions may be found seasonally in Willapa Bay, Grays Harbor (often hauled out on docks at Westport Marina) *Grays Harbor to Olympic Coast* • Numerous harbor seal haul-out sites are located on intertidal rocks and beaches in this region • Peak harbor seal abundances occur during the pupping and molting season • Large numbers of Steller sea lions use a number of offshore rocks in the vicinity of Split Rock seasonally • Small numbers of California sea lions can also be found in the area *Olympic Coast to Flattery Point* • Numerous harbor seal haul-out sites are located in intertidal areas around islands, rocks and reefs • Peak harbor seal abundances occur during the pupping and molting season • Main Steller and California sea lion haul-out sites are at Carroll Island, Bodelteh Islands, Cape Alava, and Tatoosh Island • Sea otter concentrations found at Destruction Island, Perkins Reef, Cape Johnson, Sand Point, Cape Alava, and Duk Point *Vancouver Island* • Harbor seals (100s at a site) present along Pacific coast of Vancouver Island • Steller sea lions pup on offshore islands (Cleland Island, Barrier Rocks, Ferrer Point, Escalante Point, Raphael Point, Plover Reefs, Long Beach Rocks, Wouwer Island, Folger Island, and Pachena Point) • Sea otter populations present (> 2000 on Vancouver Island) from Hesquiat Harbor north/west along the shoreline • Northern fur seals (~125,000) winter in Canadian waters; main wintering area is La Perouse Bank off SW Vancouver Island • California sea lions haul-out at Wouwer Island, Folger Island; British Columbia is the northern limit of their distribution	Steller sea lion present year round, pups May-July Otters are year round residents Harbor seals present year round, pup Apr-Jul, molt Jul-Aug California sea lions present Sep-May Fur seals present Dec-Jun, peak abundance during fall and spring migration
Cetaceans	*Cetaceans* *Coastal*: Gray whale (SE), harbor porpoise, bottlenose dolphin are all commonly	Gray whales present Feb-Dec (peak Mar-

Species Group	Species Subgroup and Geography	Seasonal Presence
	seen in nearshore environments • Gray whale (SE) resident population (35-50 animals) in nearshore waters from Oregon to Vancouver • Gray whales migrate through areas relatively close to shore • Harbor porpoise – OR/WA coast stock (4,583 animals) present in area of impact; higher densities around the Columbia River mouth (4,583 animals in coastal WA-OR waters) *Offshore*: Sei whale (FE), sperm whale (FE), *Kogia* spp., Baird's beaked whale, Cuvier's beaked whale and *Mesoplodon* spp.can all occur in offshore waters • All but sei whale are deep-diving and feed on squid *Found in coastal and offshore waters*: Fin whale (FE), humpback whale (FE), minke whale, northern right whale (FE), Dall's porpoise, killer whale, long-beaked common dolphin, northern right-whale dolphin, Pacific white-sided dolphin, Risso's dolphin, short-beaked common dolphin, short-finned pilot whale • Resident population of killer whales (87 animals) common in coastal waters, disperse to coastal ocean during the winter, when both northern and southern residents can be found in the area of impact • Transient and offshore killer whales can be present	May), calves present in spring Harbor porpoises present year round, calve Jun-Aug Blue whales, humpback whales present spring-fall Killer whales mate Jul-Aug and calve fall-winter Dall's porpoises calve year round
Sea Turtles	Leatherback sea turtles (FE) are present in coastal waters in low numbers. Waters north of Cape Blanco are critical foraging habitat Green (FE), loggerhead (FT), and olive ridley (FT) sea turtles can be found offshore in low numbers	Leatherbacks present May-Nov
Fish & Inverts	*Anadromous* • Chinook salmon (FT), coho salmon (FE), steelhead (FT), bull trout (FT), chum salmon, pink salmon, sockeye salmon, coastal cutthroat trout, green sturgeon (FT), and white sturgeon populations spawn in coastal rivers • Use coastal and estuarine environments as juveniles and adults • Adults forage in ocean waters prior to upstream migration *Estuarine* • Eelgrass beds are important nursery grounds for many species, including California halibut • Oysters can be present in shallow and intertidal waters; Grays Harbor and Willapa Bay account for half of the oysters harvested along the west coast of the U.S. • Pacific herring spawn adhesive eggs on nearshore seagrass and algae (Columbia River, Willapa Bay, Grays Harbor are major spawning grounds *Intertidal/nearshore subtidal* • Sandy intertidal species: starry flounder, staghorn sculpin, sand lance, sand sole, redtail surfperch, and sanddab ○ Surf smelt spawn in the upper intertidal zone of coarse sand/gravel beaches; eggs adhere to the substrate • Rocky intertidal areas are habitat for tidepool sculpin, wolf eel, juvenile lingcod and greenling, gunnels, eelpouts, pricklebacks, cockcombs, and warbonnets • Intertidal rocky habitats have high invertebrate diversity, including some species of edible clam • Dungeness crab move nearshore to spawn on sand beaches • Several species of shrimp and clams can be found in nearshore waters • Northern abalone (SSC) can be found in nearshore subtidal areas along	*Spawning* Coho: Nov-Jan Chinook: late summer-fall Cutthroat trout: Dec-May Steelhead: winter and summer White sturgeon: May-Jun Smelt: year round Herring: Jan-Apr Dungeness crabs mate in the spring and spawn Jun-Sep

Species Group	Species Subgroup and Geography	Seasonal Presence
	exposed shorelines of Vancouver Island *Demersal* • Many species of rockfish (>20), lingcod, kelp greenling, cabezon, kelp perch, wolf eel, and red Irish lord are found in the area and can be associated with rocky reef habitats and kelp beds • Heceta Bank is extremely productive groundfish habitat and has been designated Essential Fish Habitat *Pelagic* • Important habitat for forage fish (sardine, anchovy) and large predators (white shark) and other ecologically important species • Basking sharks filter feed near the surface • Ocean sunfish bask in surface waters of the open ocean	Rockfish and halibut spawn in deeper offshore waters in winter/spring
Benthic Habitats	Turf grass, rockweed and sea palm common in rocky intertidal areas Kelp beds (bull kelp and giant kelp) can be found in nearshore waters along the shoreline and is important habitat for fish and invertebrates, and foraging grounds for marine mammals. Most kelp present from Olympic National Park north and around Destruction Island and north of Tofino, BC especially at Nootka Island and Hesquiat Peninsula Eelgrass is present in more sheltered, shallow habitats; large beds are present in Netarts Bay, Gray's Harbor and Willapa Bay. Eelgrass is present sheltered, shallow habitats around Ucluelet and Bligh Island. Large beds present around Clayoquot and Stubbs Island and Tofino mudflats	Kelp canopy is fullest Mar-Nov

The Environmental Sensitivity Index (ESI) atlases for the potentially impacted coastal areas from a leak from the *Drexel Victory* 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 both the Worst Case and the Most Probable Discharge oil release from the wreck. Risk factors for ecological resources at risk (EcoRAR) are divided into three categories:

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

The impacts from an oil release 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 *Drexel Victory* is provided, both as text and as shading of the applicable degree of risk bullet, for the WCD release of 12,000 bbl and a border around the Most Probable Discharge of 1,200 bbl.

Risk Factor 3A: Water Column Impacts to EcoRAR

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

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

This risk factor reflects the probability that at least 0.2 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 *Drexel Victory* is classified as Medium Risk for oiling probability for water column ecological resources for the WCD of 12,000 bbl because 48% of the model runs resulted in contamination of more than 0.2 mi^2 of the upper 33 feet of the water column above the threshold of 1 ppb aromatics. It is classified as Medium Risk for degree of oiling because the mean volume of water contaminated was 0.3 mi^2 of the upper 33 feet of the water column. For the Most Probable Discharge of 1,200 bbl, the *Drexel Victory* is classified as Low Risk for oiling probability for water column ecological resources because 0.5% of the model runs resulted in contamination of more than 0.2 mi^2 of the upper 33 feet of the water column above the threshold of 1 ppb aromatics. It is classified as Low Risk for degree of oiling because the mean volume of water contaminated was 0.1 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

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 *Drexel Victory* is classified as Medium Risk for oiling probability for water surface ecological resources for the WCD because 49% of the model runs resulted in at least 1,000 mi^2 of the water surface affected above the threshold of 10 g/m^2. It is classified as Medium Risk for degree of oiling because the mean area of water contaminated was 1,940 mi^2. The *Drexel Victory* is classified as Medium Risk for oiling probability for water surface ecological resources for the Most Probable Discharge because 19% of

the model runs resulted in at least 1,000 mi^2 of the water surface affected above the threshold of 10 g/m^2. It is classified as Low Risk for degree of oiling because the mean area of water contaminated was 550 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. In this risk analysis, shorelines have been weighted by their degree of sensitivity to oiling. Wetlands are the most sensitive (weighted as "3" in the impact modeling), rocky and gravel shores are moderately sensitive (weighted as "2"), and sand beaches (weighted as "1") are the least sensitive to ecological impacts of oil.

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

This risk factor reflects the probability that the shoreline would be coated by enough oil to cause impacts to shoreline organisms. The threshold for shoreline oiling impacts to ecological resources at risk is 100 g/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 *Drexel Victory* is classified as High Risk for oiling probability for shoreline ecological resources for the WCD because 95% of the model runs resulted in shorelines affected above the threshold of 100 g/m^2. It is classified as Medium Risk for degree of oiling because the mean weighted length of shoreline contaminated was 28 miles. The *Drexel Victory* is classified as High Risk for oiling probability to shoreline ecological resources for the Most Probable Discharge because 94% of the model runs resulted in shorelines affected above the threshold of 100 g/m^2. It is classified as Low Risk for degree of oiling because the mean weighted length of shoreline contaminated was 6 miles.

Considering the modeled risk scores and the ecological resources at risk, the ecological risk from potential releases of the WCD of 12,000 bbl of heavy fuel oil from the *Drexel Victory* is summarized as listed below and indicated in the far-right column in Table 3-2:

- Water column resources – Low, because of the relatively small volume of water column impacts expected in mostly offshore areas
- Water surface resources – Medium, because of the areas of potential impacts includes seasonally very large number of wintering, nesting, and migratory birds that use ocean, coastal, and estuarine habitats at risk and resident and migratory concentrations of marine mammals. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of tarballs and streamers
- Shoreline resources – Medium, because of the moderate amount of shoreline oiling likely included exposed rocky shore and sand/gravel beaches with very high seasonal shoreline resources

Table 3-2: Ecological risk factor scores for the **Worst Case Discharge of 12,000 bbl** of heavy fuel oil from the *Drexel Victory*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
3A-1: Water Column Probability EcoRAR Oiling	Low	**Medium**	High	48% of the model runs resulted in at least 0.2 mi^2 of the upper 33 feet of the water column contaminated above 1 ppb aromatics	**Low**
3A-2: Water Column Degree EcoRAR Oiling	Low	**Medium**	High	The mean volume of water contaminated above 1 ppb was 0.3 mi^2 of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	Low	**Medium**	High	49% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 10 g/m^2	**Med**
3B-2: Water Surface Degree EcoRAR Oiling	Low	**Medium**	High	The mean area of water contaminated above 10 g/m^2 was 1,940 mi^2	
3C-1: Shoreline Probability EcoRAR Oiling	Low	**Medium**	**High**	95% of the model runs resulted in shoreline oiling of 100 g/m^2	**Med**
3C-2: Shoreline Degree EcoRAR Oiling	Low	**Medium**	High	The length of shoreline contaminated by at least 100 g/m^2 was 28 mi	

For the Most Probable Discharge of 1,200 bbl, the ecological risk from potential releases of heavy fuel oil from the *Drexel Victory* is summarized as listed below and indicated in the far-right column in Table 3-3:

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

Table 3-3: Ecological risk factor scores for the **Most Probable Discharge of 1,200 bbl** of heavy fuel oil from the *Drexel Victory*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
3A-1: Water Column Probability EcoRAR Oiling	**Low**	**Medium**	**High**	0.5% of the model runs resulted in at least 0.2 mi^2 of the upper 33 feet of the water column contaminated above 1 ppb aromatics	**Low**
3A-2: Water Column Degree EcoRAR Oiling	**Low**	**Medium**	**High**	The mean volume of water contaminated above 1 ppb was 0.1 mi^2 of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	**Low**	**Medium**	**High**	19% of the model runs resulted in at least 1,000 $mi^2$of water surface covered by at least 10 g/m^2	**Med**
3B-2: Water Surface Degree EcoRAR Oiling	**Low**	**Medium**	**High**	The mean area of water contaminated above 10 g/m^2 was 550 mi^2	
3C-1: Shoreline Probability EcoRAR Oiling	**Low**	**Medium**	**High**	94% of the model runs resulted in shoreline oiling of 100 g/m^2	**Low**
3C-2: Shoreline Degree EcoRAR Oiling	**Low**	**Medium**	**High**	The length of shoreline contaminated by at least 100 g/m^2 was 6 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 *Drexel Victory* include very highly utilized recreational beaches in Washington and Oregon. Both states have significant coastlines devoted to state beaches and parks to preserve the natural beauty of the coast. 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 that run through the area of impact into important ports in the Puget Sound and Columbia River, as well as along the Pacific coasts of Washington and Oregon. There are over 5,800 vessel port calls annually with over 324 million tonnage.

Commercial fishing is economically important to the region. Regional commercial landings for 2010 exceeded $143M. Tribal nations in the area also conduct a significant amount of subsistence fishing in these waters. There are nine Tribal Nations represented in reservations along the Washington and Oregon coasts in the area of potential impact.

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

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

Resource Type	Resource Name	Economic Activities
Beach Communities	Arch Cape, OR Barview, OR Brighton, OR Cannon Beach, OR Cape Alava, WA Grayland, WA Ilwaco, WA La Push, WA Lincoln Beach, OR Lincoln City, OR Long Beach, WA Manzanita, OR Moclips, WA	Potentially affected beach resorts and beach-front communities Oregon and Washington 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. Many of these recreational activities are limited to or concentrated into the late spring into early fall months.

Resource Type	Resource Name	Economic Activities
	Neah Bay, WA Neotsu, OR Newport, OR Ocean City, WA Ocean Park, WA Ocean Shores, WA Oceanside, OR Ozette, WA Pacific Beach, WA Pacific City, OR Queets, WA Rockaway Beach, OR Seaside, OR Seaview, WA South Beach, OR Sunset Beach, OR Taholah, WA Tierra del Mar, OR Twin Rocks, OR Waldport, OR Warrenton, OR Westport, WA Woods, OR	
National Parks	Olympic National Park	National parks provide recreation for local and tourist populations as well as preserve and protect the nation's natural shoreline treasures.
National Wildlife Refuges	Bandon Marsh NWR (OR) Siletz Bay NWR (OR) Nestucca Bay NWR (OR) Three Arch Rocks NWR (OR) Cape Meares NWR (OR) Lewis & Clark NWR (OR/WA) Willapa NWR (WA) Grays Harbor NWR (WA) Copalis NWR (WA) Quillayute Needles NWR (WA) Flattery Rocks NWR (WA)	National wildlife refuges in two states may be impacted. These federally managed and protected lands provide refuges and conservation areas for sensitive species and habitats.
State Parks	Agate Beach State Recreation Site, OR Arcadia State Recreation Site, OR Beachside State Recreation Site, OR Beverly Beach State Park, OR Cape Disappointment State Park, WA Cape Kiwanda State Natural Area, OR Cape Lookout State Park, OR D River State Recreation Site, OR Del Rey State Recreation Site, OR Devil's Punchbowl State Natural Area, OR Driftwood Beach State Recreation Site, OR Ecola State Park, OR Fogarty Creek State Recreation Area, OR Fort Columbia State Park, WA Fort Stevens State Park, OR Gleneden Beach State Recreation Site, OR Gov. Patterson Memorial State Recreation	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 Oregon and Washington are potentially impacted. Many of these recreational activities are limited to or concentrated into the late spring into early fall months.

Resource Type	Resource Name	Economic Activities
	Site, OR Grayland Beach State Park, WA Griffiths-Priday State Park, WA Hug Point State Recreation Site, OR Leadbetter State Park, WA Lost Creek State Recreation Site, OR Manhattan Beach State Recreation Site, OR Nehalem Bay State Park, OR Neptune State Scenic Viewpoint, OR Neskowin Beach State Recreation Site, OR Ocean City State Park, WA Oceanside Beach State Recreation Site, OR Ona Beach State Park, OR Oswald West State Park, OR Otter Crest State Scenic Viewpoint, OR Pacific Beach State Park, WA Pacific Pines State Park, WA Robert Straub State Park, OR Rocky Creek State Scenic Viewpoint, OR Seal Rock State Recreation Site, OR South Beach State Park, OR Tolovana State Park, OR Westport Light State Park, WA Yachats Ocean Road State Natural Site, OR Yachats State Recreation Area, OR Yaquina Bay State Recreation Site, OR	
Tribal Lands	Coos, Lower Umpqua & Siuslaw Indian Reservation Coquille Indian Reservation Hoh Indian Reservation Makah Indian Reservation Ozette Indian Reservation Quileute Indian Reservation Quinault Indian Reservation Shoalwater Indian Reservation Siletz Indian Reservation	The Washington and Oregon coasts include nine Tribal Reservations.
Commercial Fishing	A number of fishing fleets use the surrounding waters for commercial fishing purposes.	
	Bay Center-South Bend, WA	Total Landings (2010): $19.4M
	Coos Bay-Charleston	Total Landings (2010): $24.0M
	Ilwaco-Chinook, WA	Total Landings (2010): $2.5M
	La Push, WA	Total Landings (2010): $17.9M
	Neah Bay, WA	Total Landings (2010): $7.7M
	Newport, OR	Total Landings (2010): $30.6M
	Tillamook, OR	Total Landings (2010): $2.6M
	Westport, WA	Total Landings (2010): $38.5M
Ports	There are a number of significant commercial ports in the Pacific Northwest 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.	
	Anacortes, WA	11 port calls annually
	Bellingham, WA	3 port calls annually
	Bremerton, WA	3 port calls annually
	Cherry Point, WA	271 port calls annually
	Columbia River, OR	2,635 port calls annually
	Coos Bay, OR	37 port calls annually

Resource Type	Resource Name	Economic Activities
	Everett, WA	81 port calls annually
	Ferndale, WA	101 port calls annually
	Manchester, WA	14 port calls annually
	March Point, WA	188 port calls annually
	Olympia, WA	22 port calls annually
	Point Wells, WA	14 port calls annually
	Port Angeles, WA	325 port calls annually
	Port Townsend, WA	1 port call annually
	Seattle, WA	1,046 port calls annually
	Tacoma, WA	1,035 port calls annually
	Westport, WA	13 port calls annually

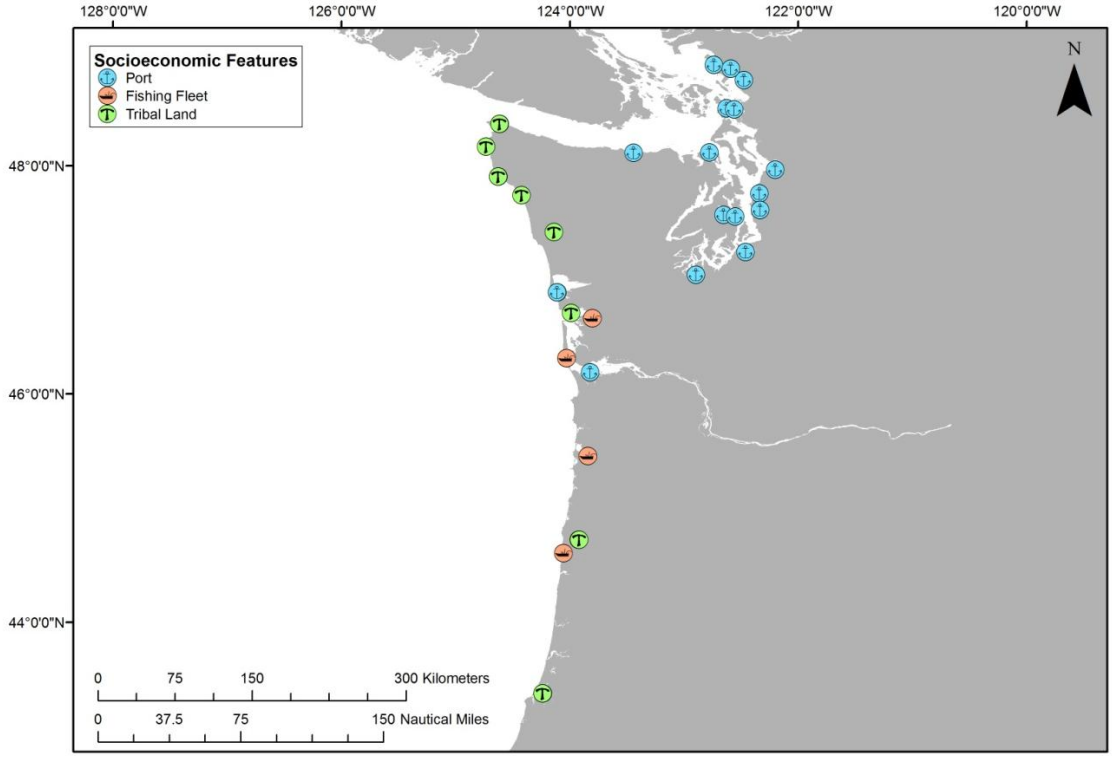


Figure 4-1: Tribal lands, ports, and commercial fishing fleets at risk from a release from the *Drexel Victory*.

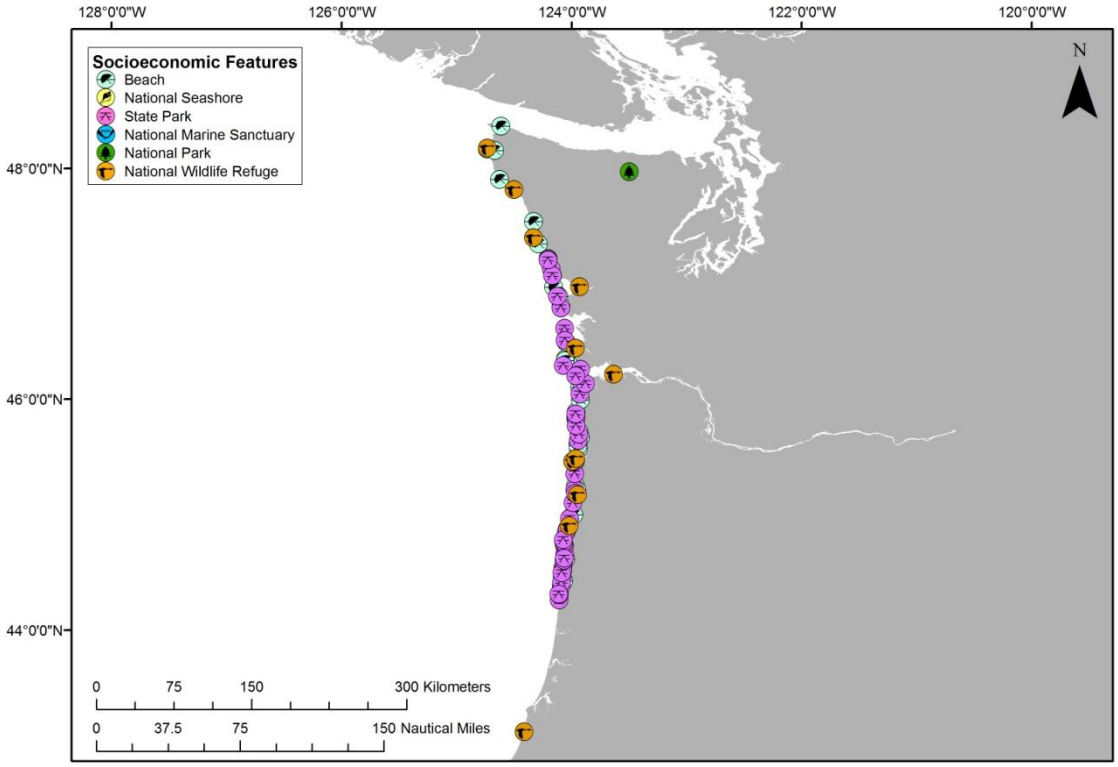


Figure 4-2: Beaches, coastal state parks, and Federal protected areas at risk from a release from the *Drexel Victory*.

Socio-Economic Risk Factors

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

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

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

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

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

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

In the following sections, the definition of low, medium, and high for each socio-economic risk factor is provided. Also, the classification for the *Drexel Victory* is provided, both as text and as shading of the applicable degree of risk bullet, for the WCD release of 12,000 bbl and a border around the Most Probable Discharge of 1,200 bbl.

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

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 *Drexel Victory* is classified as Medium Risk for both oiling probability and degree of oiling for water column socio-economic resources for the WCD of 12,000 bbl because 48% of the model runs resulted in contamination of more than 0.2 mi^2 of the upper 33 feet of the water column above the threshold of 1 ppb aromatics, and the mean volume of water contaminated was 0.3 mi^2 of the upper 33 feet of the water column. For the Most Probable Discharge of 1,200 bbl, the *Drexel Victory* is classified as Low Risk for oiling probability for water column socio-economic resources because 1% of the model runs resulted in contamination of more than 0.2 mi^2 of the upper 33 feet of the water column above the threshold of 1 ppb aromatics. It is classified as Low Risk for degree of oiling because the mean volume of water contaminated was 0.1 mi^2 of the upper 33 feet of the water column.

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

This risk factor reflects the probability that at least 1,000 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 *Drexel Victory* is classified as Medium Risk for both oiling probability and degree of oiling for water surface socio-economic resources for the WCD because 49% of the model runs resulted in at least 1,000 mi^2 of the water surface affected above the threshold of 0.01 g/m^2, and the mean area of water contaminated was 1,940 mi^2. The *Drexel Victory* is classified as Medium Risk for oiling probability for water surface socio-economic resources for the Most Probable Discharge because 19% of the model runs resulted in at least 1,000 mi^2 of the water surface affected above the threshold of 0.01 g/m^2. It is classified as Low Risk for degree of oiling because the mean area of water contaminated was 546 mi^2.

Risk Factor 4C: Shoreline Impacts to SRAR

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

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

This risk factor reflects the probability that the shoreline would be coated by enough oil to cause impacts to shoreline users. The threshold for impacts to shoreline SRAR is 1 g/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 *Drexel Victory* is classified as High Risk for oiling probability for shoreline socio-economic resources for the WCD because 95% of the model runs resulted in shorelines affected above the threshold of 1 g/m^2. It is classified as Medium Risk for degree of oiling because the mean length of weighted shoreline contaminated was 78 miles. The *Drexel Victory* is classified as High Risk for oiling probability and Medium Risk for degree of oiling for shoreline socio-economic resources for the Most Probable Discharge as 96% of the model runs resulted in shorelines affected above the threshold of 1 g/m^2, and the mean length of weighted shoreline contaminated was 61 miles.

Considering the modeled risk scores and the socio-economic resources at risk, the socio-economic risk from potential releases of the WCD of 12,000 bbl of heavy fuel oil from the *Drexel Victory* is summarized as listed below and indicated in the far-right column in Table 4-2:

- Water column resources – Low, because a relatively small area of water column would be impacted in important fishing grounds
- Water surface resources – High, because a significant area of offshore fishing areas for tribal nations would be impacted. 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 – High, because a moderate length of high-value shoreline would be impacted

Table 4-2: Socio-economic risk factor ranks for the **Worst Case Discharge of 12,000 bbl** of heavy fuel oil from the *Drexel Victory*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
4A-1: Water Column Probability SRAR Oiling	Low	**Medium**	High	48% of the model runs resulted in at least 0.2 mi^2 of the upper 33 feet of the water column contaminated above 1 ppb aromatics	Low
4A-2: Water Column Degree SRAR Oiling	Low	**Medium**	High	The mean volume of water contaminated above 1 ppb was 0.3 mi^2 of the upper 33 feet of the water column	
4B-1: Water Surface Probability SRAR Oiling	Low	**Medium**	High	49% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 0.01 g/m^2	High
4B-2: Water Surface Degree SRAR Oiling	Low	**Medium**	High	The mean area of water contaminated above 0.01 g/m^2 was 1,940 mi^2	
4C-1: Shoreline Probability SRAR Oiling	Low	**Medium**	**High**	95% of the model runs resulted in shoreline oiling of 1 g/m^2	High
4C-2: Shoreline Degree SRAR Oiling	Low	**Medium**	High	The length of shoreline contaminated by at least 1 g/m^2 was 78 mi	

For the Most Probable Discharge of 1,200 bbl, the socio-economic risk from potential releases of heavy fuel oil from the *Drexel Victory* is summarized as listed below and indicated in the far-right column in Table 4-3:

- Water column resources – Low, because a relatively small area of water column would be impacted in important fishing grounds
- Water surface resources – Medium, because a moderate area of offshore fishing areas for tribal nations would be impacted. 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 – High, because a moderate length of high-value shoreline would be impacted

Table 4-3: Socio-economic risk factor ranks for the **Most Probable Discharge of 1,200 bbl** of heavy fuel oil from the *Drexel Victory*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
4A-1: Water Column Probability SRAR Oiling	**Low**	**Medium**	**High**	1% of the model runs resulted in at least 0.2 mi^2 of the upper 33 feet of the water column contaminated above 1 ppb aromatics	**Low**
4A-2: Water Column Degree SRAR Oiling	**Low**	**Medium**	**High**	The mean volume of water contaminated above 1 ppb was 0.1 mi^2 of the upper 33 feet of the water column	
4B-1: Water Surface Probability SRAR Oiling	**Low**	**Medium**	**High**	19% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 0.01 g/m^2	**Med**
4B-2: Water Surface Degree SRAR Oiling	**Low**	**Medium**	**High**	The mean area of water contaminated above 0.01 g/m^2 was 546 mi^2	
4C-1: Shoreline Probability SRAR Oiling	**Low**	**Medium**	**High**	96% of the model runs resulted in shoreline oiling of 1 g/m^2	**High**
4C-2: Shoreline Degree SRAR Oiling	**Low**	**Medium**	**High**	The length of shoreline contaminated by at least 1 g/m^2 was 61 mi	

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

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

- Vessel casualty information and how the site formation processes have worked on this vessel
- 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. The ecological and socio-economic risk factors are presented as a single score for water column, water surface, and shoreline resources as the scores were consolidated for each element. For the ecological and socio-economic risk factors each has two components, probability and degree. Of those two, degree is given more weight in deciding the combined score for an individual factor, e.g., a high probability and medium degree score would result in a medium overall for that factor.

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

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

For the Worst Case Discharge, *Drexel Victory* scores High with 16 points; for the Most Probable Discharge, *Drexel Victory* scores Medium with 12 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 *Drexel Victory*. The final determination of what type of action, if any, rests with the U.S. Coast Guard.

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

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

Vessel Risk Factors		Data Quality Score	Comments		Risk Score
Pollution Potential Factors	A1: Oil Volume (total bbl)	Medium	Maximum of 12,000 bbl, not reported to be leaking		**Med**
	A2: Oil Type	High	Bunker oil is heavy fuel oil, a Group IV oil type		
	B: Wreck Clearance	High	Vessel not reported as cleared		
	C1: Burning of the Ship	High	No fire was reported		
	C2: Oil on Water	Low	No oil known to have been reported		
	D1: Nature of Casualty	Medium	Broke its back on a sandbar or another wreck		
	D2: Structural Breakup	Low	Unknown structural breakup		
Archaeological Assessment	Archaeological Assessment	Low	No detailed sinking reports were located and no site reports exist so a detailed assessment could not be prepared		**Not Scored**
Operational Factors	Wreck Orientation	Low	Unknown		**Not Scored**
	Depth	Low	Unknown, likely around 210 feet		
	Visual or Remote Sensing Confirmation of Site Condition	Low	Site has never been located		
	Other Hazardous Materials Onboard	High	No		
	Munitions Onboard	High	No		
	Gravesite (Civilian/Military)	High	No		
	Historical Protection Eligibility (NHPA/SMCA)	High	NHPA		
				WCD	**Most Probable**
Ecological Resources	3A: Water Column Resources	High	Very small area of potential impact	**Low**	**Low**
	3B: Water Surface Resources	High	Heavy fuel oil can generate persistent tarballs that can travel long distances including areas of seasonally high concentrations of marine birds/mammals	**Med**	**Med**
	3C: Shore Resources	High	Mostly exposed rocky shores and sand/gravel beaches at risk, with seasonally high abundance of sensitive coastal resources at risk	**Med**	**Low**
Socio-Economic Resources	4A: Water Column Resources	High	Relatively small area of water column could be impacted in important fishing grounds	**Low**	**Low**
	4B: Water Surface Resources	High	Significant area of offshore fishing areas for tribal nations could be impacted	**High**	**Med**
	4C: Shore Resources	High	Moderate length of high-value shoreline could be impacted	**High**	**High**
Summary Risk Scores				**16**	**12**