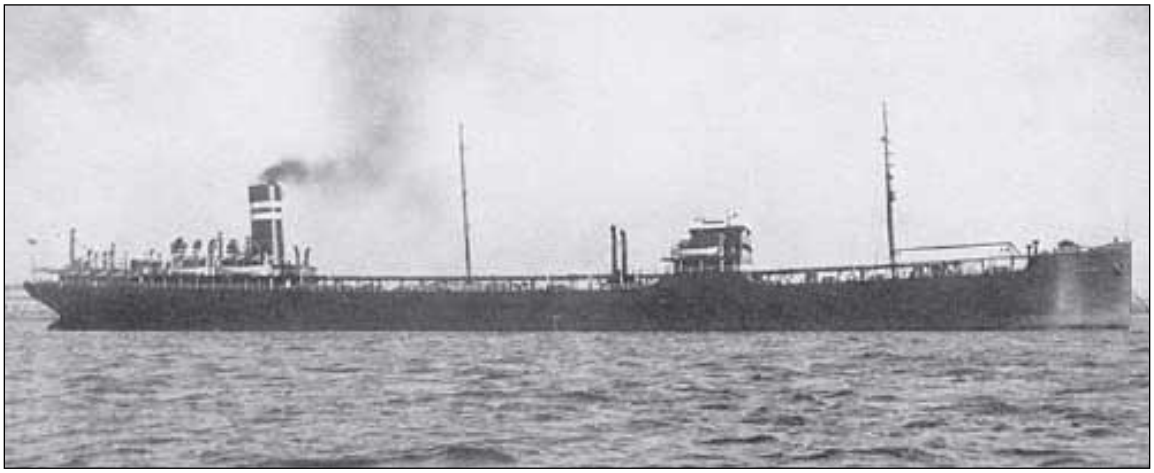
Office of National Marine Sanctuaries
Office of Response and Restoration

Screening Level Risk Assessment Package

C.O. Stillman



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National Oceanic and
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Photo: Photograph of *C.O. Stillman*
Source: http://www.uboat.net/allies/merchants/ships/1749.html

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Project Background

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

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

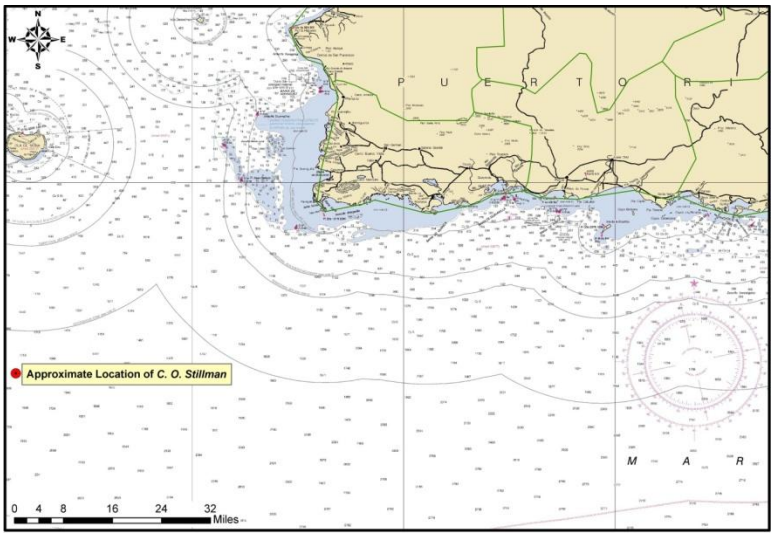
The potential polluting shipwrecks were identified through searching a broad variety of historical sources. NOAA then worked with Research Planning, Inc., RPS ASA, and Environmental Research Consulting to conduct the modeling forecasts, and the ecological and environmental resources at risk assessments.

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

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

Executive Summary: *C.O. Stillman*

The tanker *C.O. Stillman*, torpedoed and sunk during World War II off the southeast coast of Puerto Rico in 1942, was identified as a potential pollution threat, thus a screening-level risk assessment was conducted. The different sections of this document summarize what is known about the *C.O. Stillman*, 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.



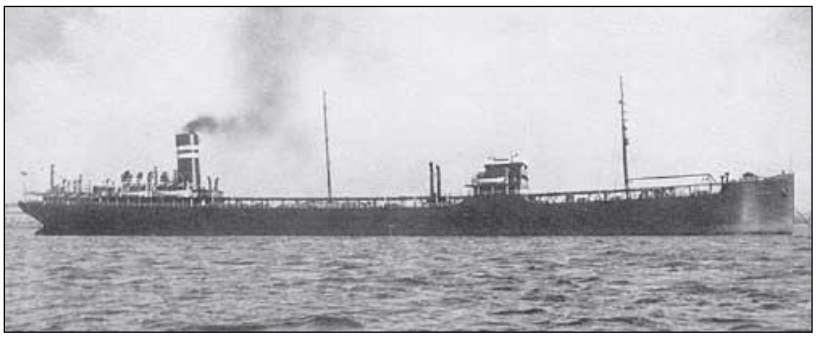
Based on this screening-level assessment, each vessel was assigned a summary score calculated using the seven risk criteria described in this report. For the Worst Case Discharge, *C.O. Stillman* scores Medium with 14 points; for the Most Probable Discharge (10% of the Worse Case volume), *C.O. Stillman* scores Low with 8 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 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 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 to be lost.

Vessel Risk Factors		Risk Score	
Pollution Potential Factors	A1: Oil Volume (total bbl)	Med	
	A2: Oil Type		
	B: Wreck Clearance		
	C1: Burning of the Ship		
	C2: Oil on Water		
	D1: Nature of Casualty		
	D2: Structural Breakup		
Archaeological Assessment	Archaeological Assessment	Not Scored	
Operational Factors	Wreck Orientation	Not Scored	
	Depth		
	Confirmation of Site Condition		
	Other Hazardous Materials		
	Munitions Onboard		
	Gravesite (Civilian/Military)		
	Historical Protection Eligibility		
		WCD	MP (10%)
Ecological Resources	3A: Water Column Resources	Med	Low
	3B: Water Surface Resources	Med	Low
	3C: Shore Resources	Med	Low
Socio-Economic Resources	4A: Water Column Resources	Med	Low
	4B: Water Surface Resources	Med	Low
	4C: Shore Resources	Med	Low
Summary Risk Scores		14	8

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

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

Vessel Particulars



Official Name: *C.O. Stillman*

Official Number: 160498

Vessel Type: Tanker

Vessel Class: Unknown

Former Names: N/A

Year Built: 1928

Builder: Bremer Vulkan, Vegesack

Builder's Hull Number: Unknown

Flag: Panamanian

Owner at Loss: Panama Transport Co., a subsidiary of Standard Oil Company of New Jersey

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

Operated by: Unknown

Homeport: Panama

Length: 564 feet **Beam:** 75 feet **Depth:** 44 feet

Gross Tonnage: 13,006 **Net Tonnage:** 7,765

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

Bunker Type: Medium fuel oil (Marine Diesel) **Bunker Capacity (bbl):** Unknown

Average Bunker Consumption (bbl) per 24 hours: Unknown

Liquid Cargo Capacity (bbl): Unknown

Dry Cargo Capacity: Unknown

Tank or Hold Description: Unknown

Casualty Information

Port Departed: Aruba

Destination Port: New York

Date Departed: June 3, 1942

Date Lost: June 6, 1942

Number of Days Sailing: 3

Cause of Sinking: Act of War (Torpedoes)

Latitude (DD): 17.55

Longitude (DD): -67.9167

Nautical Miles to Shore: ≈ 30

Nautical Miles to NMS: 866

Nautical Miles to MPA: 21

Nautical Miles to Fisheries: Unknown

Approximate Water Depth (Ft): 12,000 (2,000 fathoms)

Bottom Type: Unknown

Is There a Wreck at This Location? No, the wreck has never been located and there is discrepancy between the historic sinking coordinates

Wreck Orientation: Unknown

Vessel Armament: One 5-inch 51 gun and two 30cal Browning Machine Guns

Cargo Carried when Lost: 132,000 bbl of bunker fuel oil and 39 tons of dry cargo

Cargo Oil Carried (bbl): 132,000

Cargo Oil Type: Heavy fuel oil

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

Fuel Type: Marine Diesel

Total Oil Carried (bbl): ≤ 144,000

Dangerous Cargo or Munitions: Yes

Munitions Carried: Munitions for onboard weapons

Demolished after Sinking: No

Salvaged: No

Cargo Lost: Yes

Reportedly Leaking: No

Historically Significant: Yes

Gravesite: Yes

Salvage Owner: Not known if any

Wreck Location

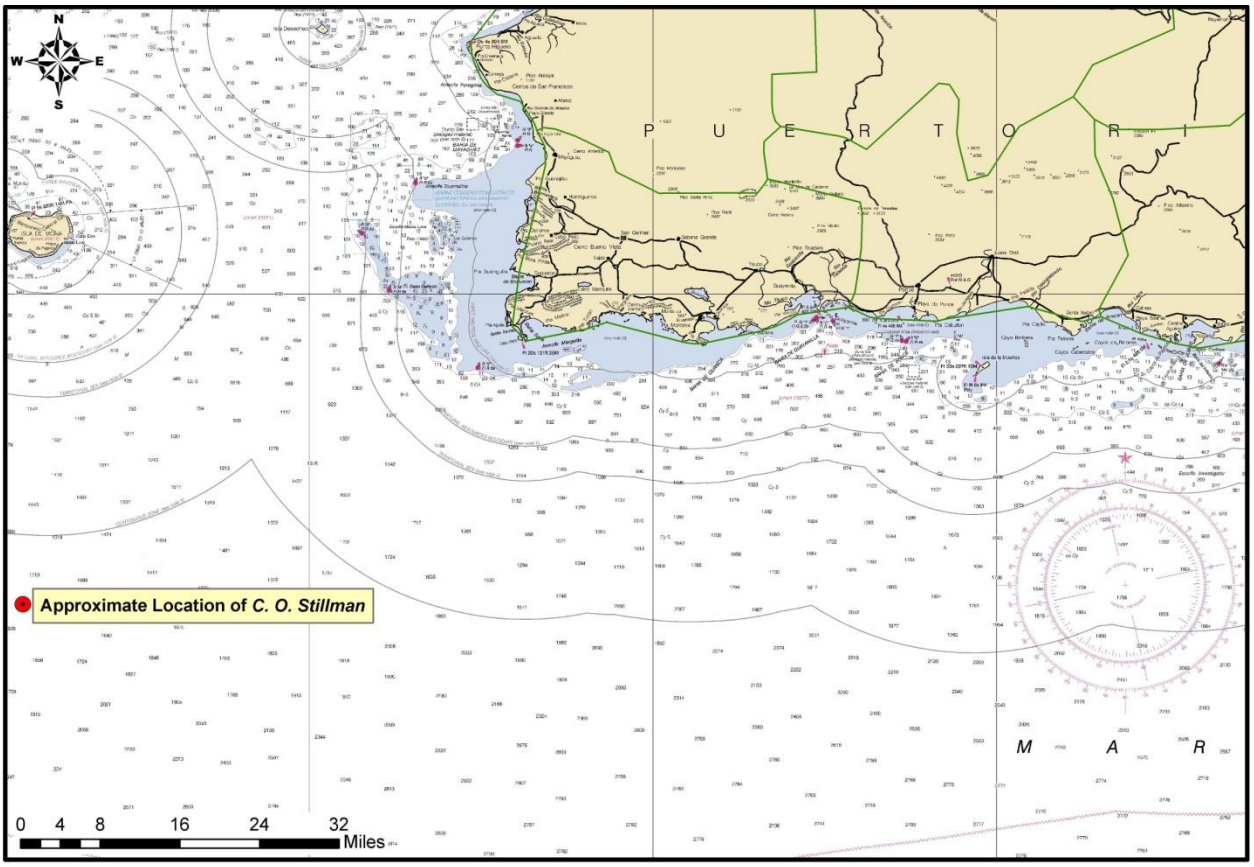


Chart Number: 25640

Casualty Narrative

"At 03.07 hours on 6 Jun, 1942, the unescorted *C.O. Stillman* (Master Daniel H. Larsen) was struck by one torpedo from *U-68* on the starboard side abaft the midship house setting the after end of the house on fire. The engines were secured and the most of the 47 crewmen, eight armed guards and three workaways from other tankers aboard abandoned ship in two lifeboats and four rafts. 20 minutes later another torpedo hit the ship on the starboard side forward of the engine room, showering the deck with fuel oil and debris. The remaining men aboard jumped overboard and swam to the rafts, while the tanker sank within two minutes 60 miles southwest of Puerto Rico. Three crew members were lost.

Just before dark on 7 June, the 22 crewmen and three armed guards on the four rafts were picked up by the U.S. Coast Guard patrol boat #83310 after she was notified by an Army aircraft, which had spotted the rafts. On 8 June, they were landed at Ponce, Puerto Rico and were repatriated on the American steam passenger ship Seminole. The two lifeboats drifted until the dawn on 6 June and then set sail for the Dominican Republic. One boat with 17 survivors landed at the Bay of Yuma and the other with 13 survivors at La Romana."
-http://www.uboat.net:8080/allies/merchants/ships/1749.html

General Notes

The sinking report reveals that the "Ship was hit by two torpedoes before abandoned. First torpedo set fire to ship immediately. Flames enveloped middle of ship. It tore huge hole in starboard side. Captain and at least 24 other survivors who landed together were on ship for approximately 15 minutes. The second torpedo hit. Ship sank within 5 minutes after second hit."

Wreck Condition/Salvage History

Unknown; the wreck has never been located and lies in very deep water somewhere west of Puerto Rico.

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

Unfortunately, the wreck of *C.O. Stillman* has never been located, and the extreme ocean depths the vessel was lost in and discrepancies in the reported sinking location prevent an accurate archaeological assessment of the shipwreck from being made. Depending on the historic sinking report, this wreck is believed to have been lost anywhere from 30 to 45 miles from shore in depths ranging from 10,000 to over 12,000 feet. Based on the large degree of inaccuracy between reported sinking locations, it is unlikely that the shipwreck will be intentionally located.

Ongoing research also strongly suggests that vessels in great depths of water are generally found in an upright orientation. This orientation has often lead to loss of oil from vents and piping long before loss of structural integrity of hull plates from corrosion or other physical impacts. As it is believed that this vessel is in water greater than 10,000 feet, it is likely to have settled upright and may no longer contain oil.

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

Background Information References

Vessel Image Sources: http://www.uboat.net/allies/merchants/ships/1749.html

Construction Diagrams or Plans in RULET Database? No

Text References:

-http://www.uboat.net/allies/merchants/ships/1749.html

Vessel Risk Factors

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

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

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.

Pollution Potential Tree

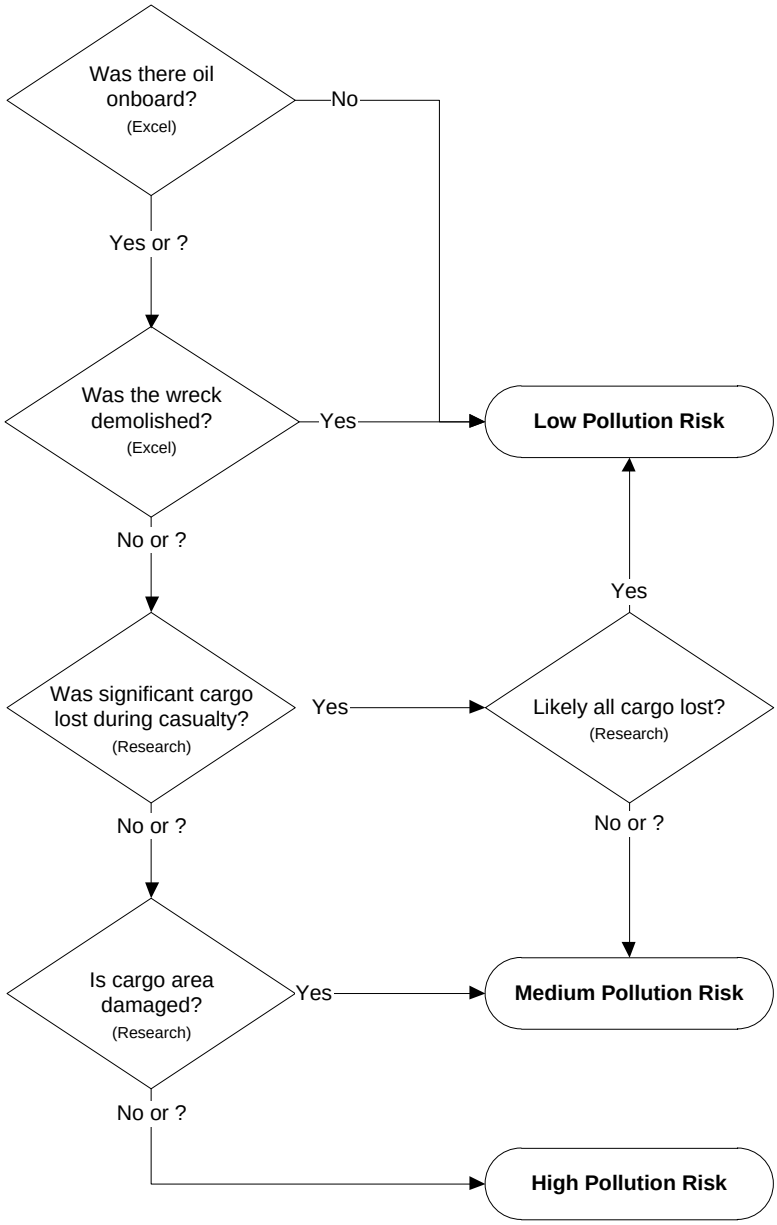


Figure 1-1: U.S. Coast Guard Salvage Engineering Response Team (SERT) developed the above Pollution Potential Decision Tree.

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

- **High Data Quality:** All or most pertinent information on wreck available to allow for thorough risk assessment and evaluation. The data quality is high and confirmed.

- **Medium Data Quality:** Much information on wreck available, but some key factor data are missing or the data quality is questionable or not verified. Some additional research needed.
- **Low Data Quality:** Significant issues exist with missing data on wreck that precludes making preliminary risk assessment, and/or the data quality is suspect. Significant additional research needed.

In the following sections, the definition of low, medium, and high for each risk factor is provided. Also, the classification for the *C.O. Stillman* 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 *C.O. Stillman* is ranked as High Volume because it is thought to have a potential for up to 144,000 bbl, although some of that was lost at the time of the casualty due to the explosion and breakup of the vessel. Data quality is medium.

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

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., jet fuels, kerosene, and 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)

[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]; not included because not likely present on wrecks

The *C.O. Stillman* is classified as Medium Risk because the cargo is believed to be light fuel oil, a Group II oil type. Data quality is low because the sinking reports simply state that the ship was carrying bunker oil. This was interpreted to mean diesel oil since the bunker oil used in the *C.O. Stillman* was diesel oil.

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 site 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 *C.O. Stillman* is classified as High Risk because there are no known historic accounts of the wreck being demolished as a hazard to navigation. Data quality is high.

Was significant cargo or bunker lost during casualty?

Risk Factor C1: Burning of the Ship

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

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

The *C.O. Stillman* is classified as Medium Risk because a significant fire was reported at the time of the 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 know whether or not there was oil on the water at the time of the casualty

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

Is the cargo area damaged?

Risk Factor D1: Nature of the Casualty

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

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

The *C.O. Stillman* is classified as Low Risk because there were two torpedo detonations. Data quality is high.

Risk Factor D2: Structural Breakup

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

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

The *C.O. Stillman* is classified as Unknown Risk because it is not known whether additional structural breakup occurred after the vessel sank 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 orientation for the *C.O. Stillman* is not known since the location 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 *C.O. Stillman* is believed to be over 12,000 feet deep based on the speculated sinking 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 *C.O. Stillman* 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 *C.O. Stillman* had munitions for onboard weapons, one 5-inch .51 caliber gun and two .30 caliber Browning Machine Guns. 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 *C.O. Stillman.* Operational factors are listed but do not have a risk score.

Table 1-1: Summary matrix for the vessel risk factors for the *C.O. Stillman* 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 144,000 bbl, not reported to be leaking	**Med**
	A2: Oil Type	Low	Cargo is thought to be light fuel oil, a Group II oil type	
	B: Wreck Clearance	High	Vessel not reported as cleared	
	C1: Burning of the Ship	High	A severe fire was reported	
	C2: Oil on Water	High	Oil was reported on the water; amount is not known	
	D1: Nature of Casualty	High	Two torpedo detonations	
	D2: Structural Breakup	Low	Unknown structural breakup	
Archaeological Assessment	Archaeological Assessment	Low	Limited sinking records of this ship were located and no site reports exist, assessment is believed to have limited accuracy	**Not Ranked**
Operational Factors	Wreck Orientation	Low	Unknown, potential to be upright	**Not Ranked**
	Depth	Low	>12,000 ft	
	Visual or Remote Sensing Confirmation of Site Condition	Low	Location unknown	
	Other Hazardous Materials Onboard	High	No	
	Munitions Onboard	High	Munitions for onboard weapons	
	Gravesite (Civilian/Military)	High	Yes	
	Historical Protection Eligibility (NHPA/SMCA)	High	NHPA and possibly SMCA	

SECTION 2: ENVIRONMENTAL IMPACT MODELING

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

Release Scenarios Used in the Modeling

The potential volume of leakage at any point in time will tend to follow a probability distribution. Most discharges are likely to be relatively small, though there could be multiple such discharges. There is a lower probability of larger discharges, though these scenarios would cause the greatest damage. A **Worst Case Discharge** (WCD) would involve the release of all of the cargo oil and bunkers present on the vessel. In the case of the *C.O. Stillman* this would be about 144,000 bbl based on current estimates of the maximum amount of oil remaining onboard the wreck.

The likeliest scenario of oil release from most sunken wrecks, including the *C.O. Stillman*, 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 *C.O. Stillman*.

Scenario Type	Release per Episode	Time Period	Release Rate	Relative Likelihood	Response Tier
Chronic (0.1% of WCD)	144 bbl	Fairly regular intervals or constant	100 bbl over several days	More likely	Tier 1
Episodic (1% of WCD)	1,440 bbl	Irregular intervals	Over several hours or days	Most Probable	Tier 1-2
Most Probable (10% of WCD)	14,400 bbl	One-time release	Over several hours or days	Most Probable	Tier 2
Large (50% of WCD)	72,000 bbl	One-time release	Over several hours or days	Less likely	Tier 2-3
Worst Case	144,000 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 *C.O. Stillman* contained a maximum of 132,000 bbl of "fuel oil" as cargo and up to 12,000 bbl of marine diesel as the bunker fuel (a Group II oil). The actual oil type for the cargo is not known; there are conflicting reports with about a third of the documents reporting "bunker oil" and two thirds of the documents reporting "fuel oil." Assuming that the cargo was the same as the ship's bunkers, the oil spill model was run using light 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 *C.O. Stillman* will be determined by the volume of leakage. Because oil from sunken vessels will be released at low pressures, the droplet sizes will be large enough for the oil to float to the surface. Therefore, impacts to water column resources will result from the natural dispersion of the floating oil slicks on the surface, which is limited to about the top 33 feet. The metric used for ranking impacts to the water column is the area of water surface in mi^2 that has been contaminated by 1 part per billion (ppb) oil to a depth of 33 feet. At 1 ppb, there are likely to be impacts to sensitive organisms in the water column and potential tainting of seafood, so this concentration is used as a screening threshold for both the ecological and socio-economic risk factors for water column resource impacts. To assist planners in understanding the scale of potential impacts for different leakage volumes, a regression curve was generated for the water column volume oiled using the five volume scenarios, which is shown in Figure 2-1. Using this figure, the water column impacts can be estimated for any spill volume.

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

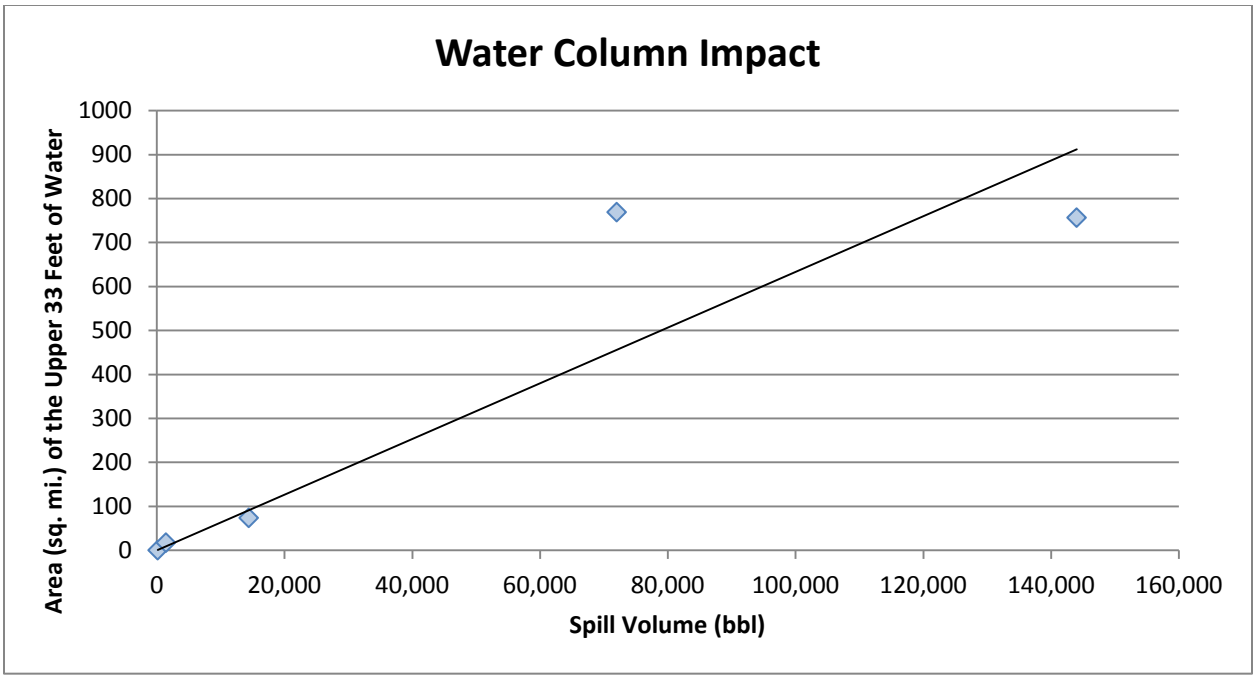


Figure 2-1: Regression curve for estimating the volume of water column at or above 1 ppb aromatics impacted as a function of spill volume for the *C.O. Stillman*.

Potential Water Surface Slick

The slick size from an oil release from the *C.O. Stillman* 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 median 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 *C.O. Stillman*.

Scenario Type	Oil Volume (bbl)	Estimated Slick Area Swept Mean of All Models	
		0.01 g/m²	10 g/m²
Chronic	144	680 mi²	36 mi²
Episodic	1,440	2,500 mi²	99 mi²
Most Probable	14,400	11,000 mi²	260 mi²
Large	72,000	39,000 mi²	500 mi²
Worst Case Discharge	144,000	71,000 mi²	1,100 mi²

The location, size, shape, and spread of the oil slick(s) from an oil release from the *C.O. Stillman* 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.

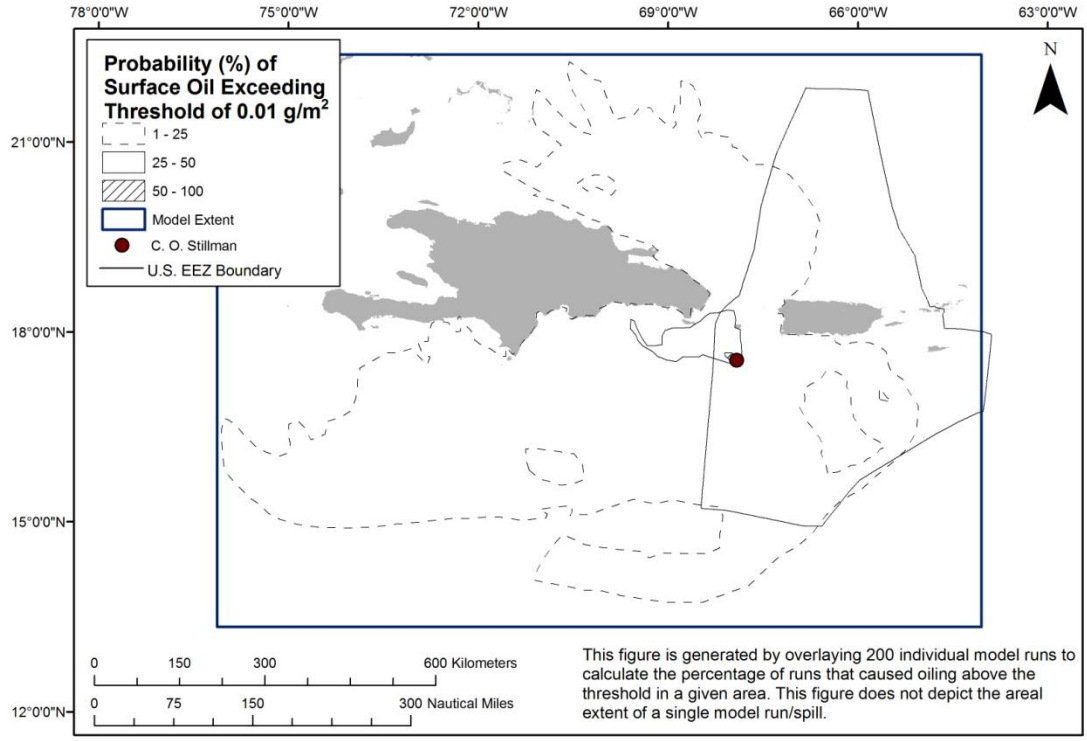


Figure 2-2: Probability of surface oil (exceeding 0.01 g/m^2) from the Most Probable spill of 14,400 bbl of light fuel oil from the *C.O. Stillman* at the threshold for socio-economic resources at risk.

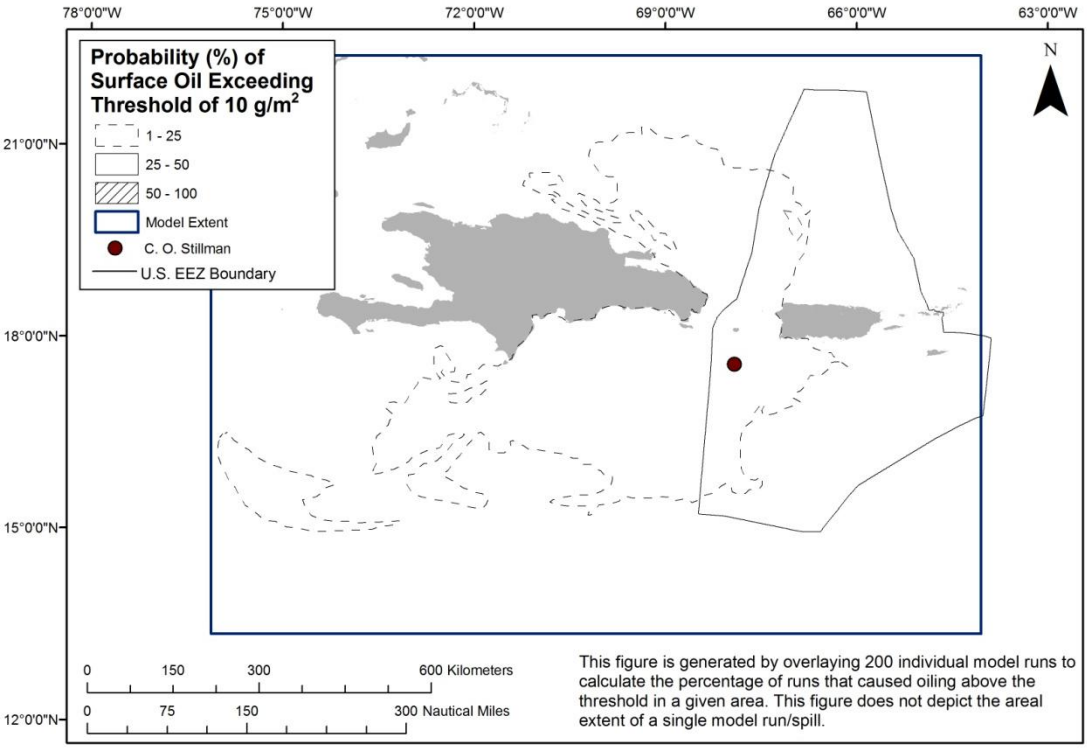


Figure 2-3: Probability of surface oil (exceeding 10 g/m^2) from the Most Probable spill of 14,400 bbl of light fuel oil from the *C.O. Stillman* at the threshold for ecological resources at risk.

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.

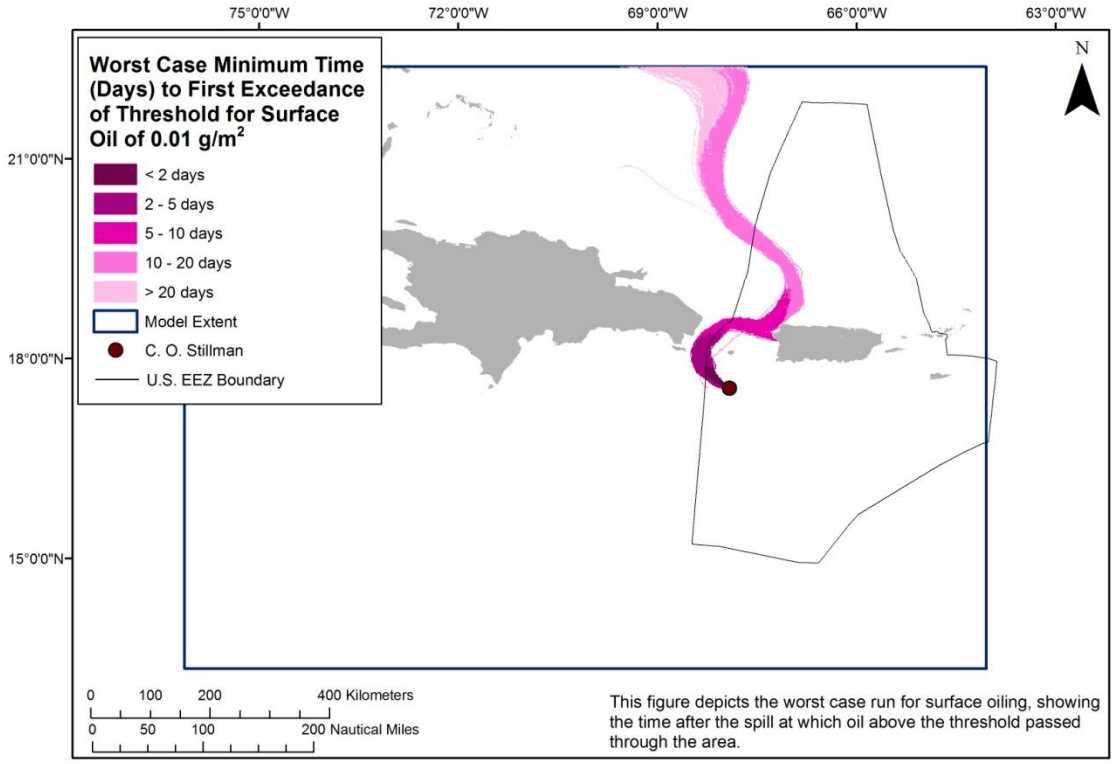


Figure 2-4: Water surface oiling from the Most Probable spill of 14,400 bbl of light fuel oil from the *C.O. Stillman* shown as the area over which the oil spreads at different time intervals.

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. Note that there are different scales for each threshold (on the right for the 10 g/m^2 curve and on the left for the 0.01 g/m^2 curve).

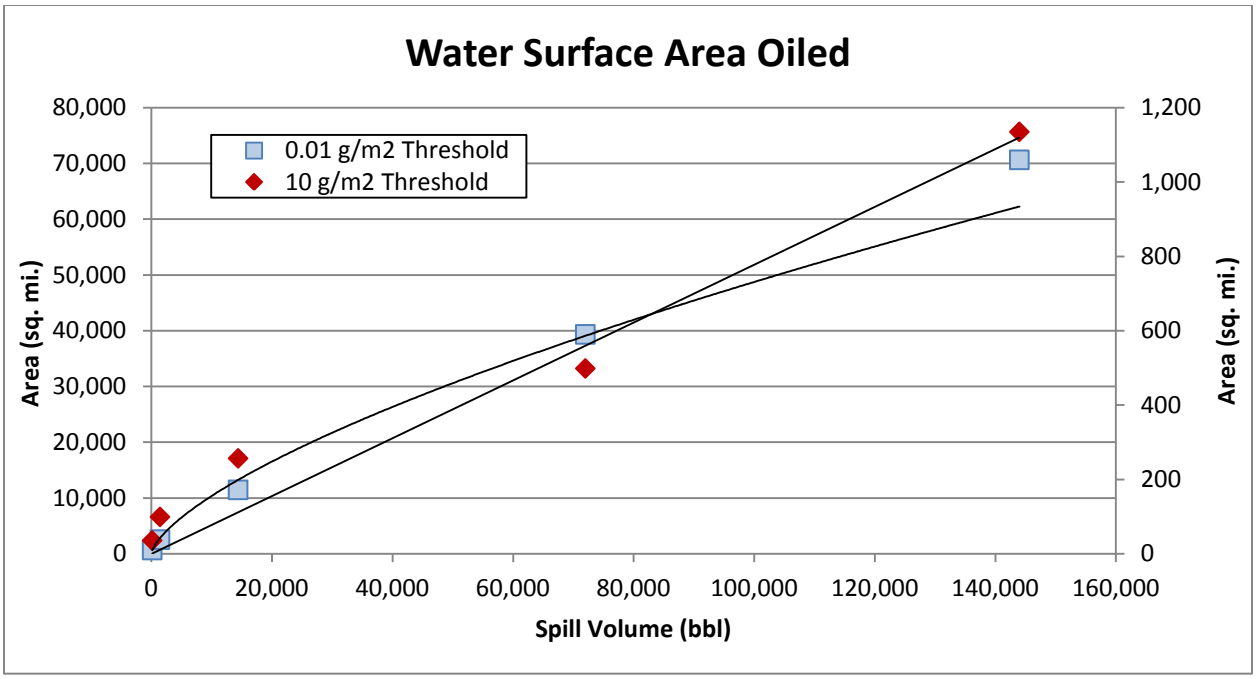


Figure 2-5: Regression curve for estimating the amount of water surface oiling as a function of spill volume for the *C.O. Stillman*, showing both the ecological threshold of 10 g/m^2 (use the scale on the right side of the plot) and socio-economic threshold of 0.01 g/m^2 (use the scale on the left side of the plot).

Potential Shoreline Impacts

Based on these modeling results, shorelines along the western and southern shoreline of Puerto Rico, most of the Dominican Republic, and the southern shoreline of Haiti are at risk. Figure 2-6 shows the probability of oil stranding on the shoreline at concentrations that exceed the threshold of 1 g/m^2, for the Most Probable release of 14,400 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 2-4: Estimated shoreline oiling from leakage from the *C.O. Stillman*.

Scenario Type	Volume (bbl)	Estimated Miles of Shoreline Oiling Above 1 g/m^2			
		Rock/Gravel/Artificial	Sand	Wetland/Mudflat	Total
Chronic	144	0	0	0	0
Episodic	1,440	1	0	0	1
Most Probable	14,400	0	1	0	2
Large	72,000	0	7	0	8
Worst Case Discharge	144,000	1	13	0	14

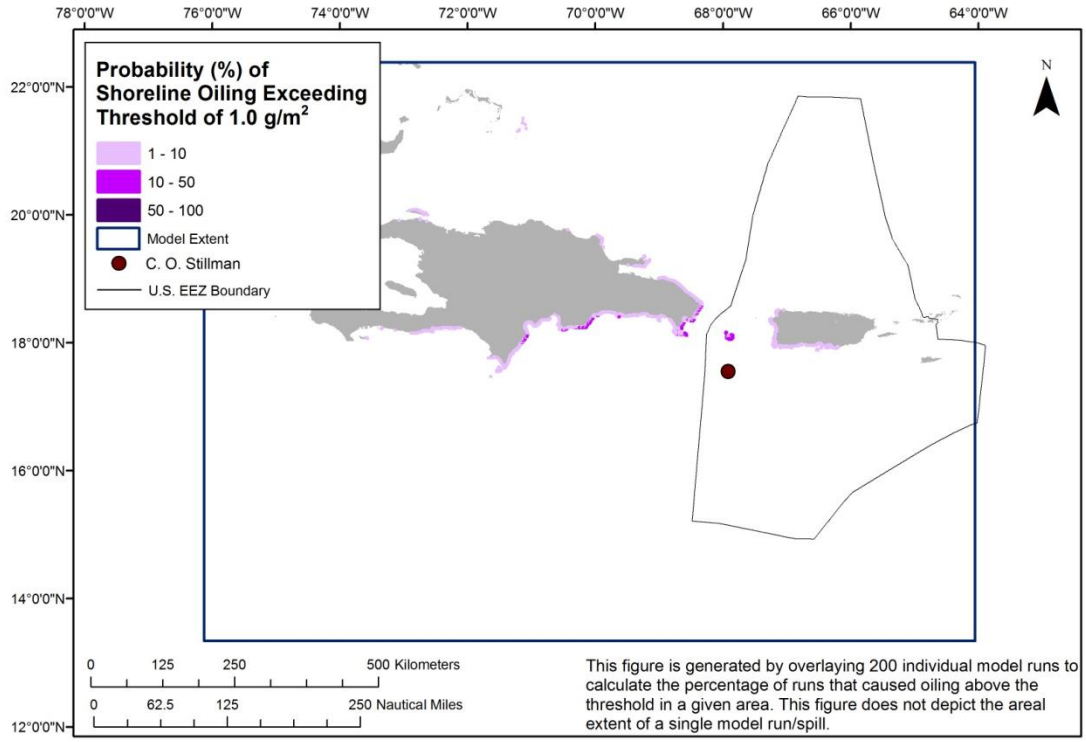


Figure 2-6: Probability of shoreline oiling (exceeding 1.0 g/m^2) from the Most Probable Discharge of 14,400 bbl of light fuel oil from the *C.O. Stillman*.

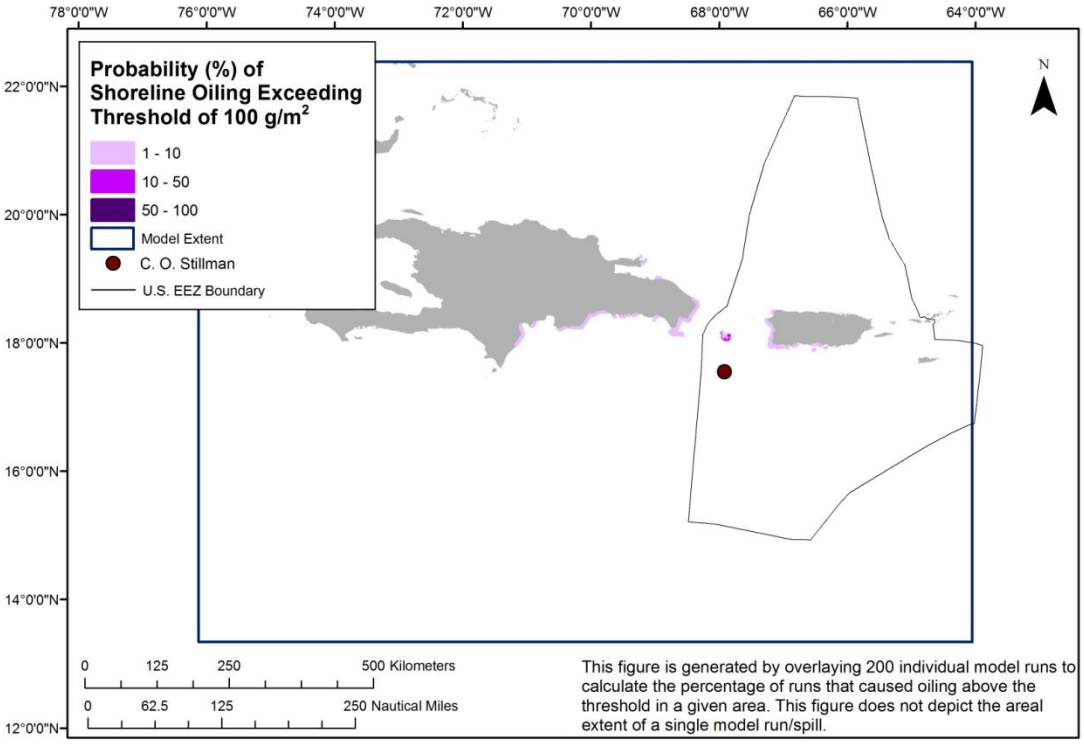


Figure 2-7: The extent and degree of shoreline oiling from the single model run of the Most Probable Discharge of 14,400 bbl of light fuel oil from the *C.O. Stillman* that resulted in the greatest shoreline oiling.

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.

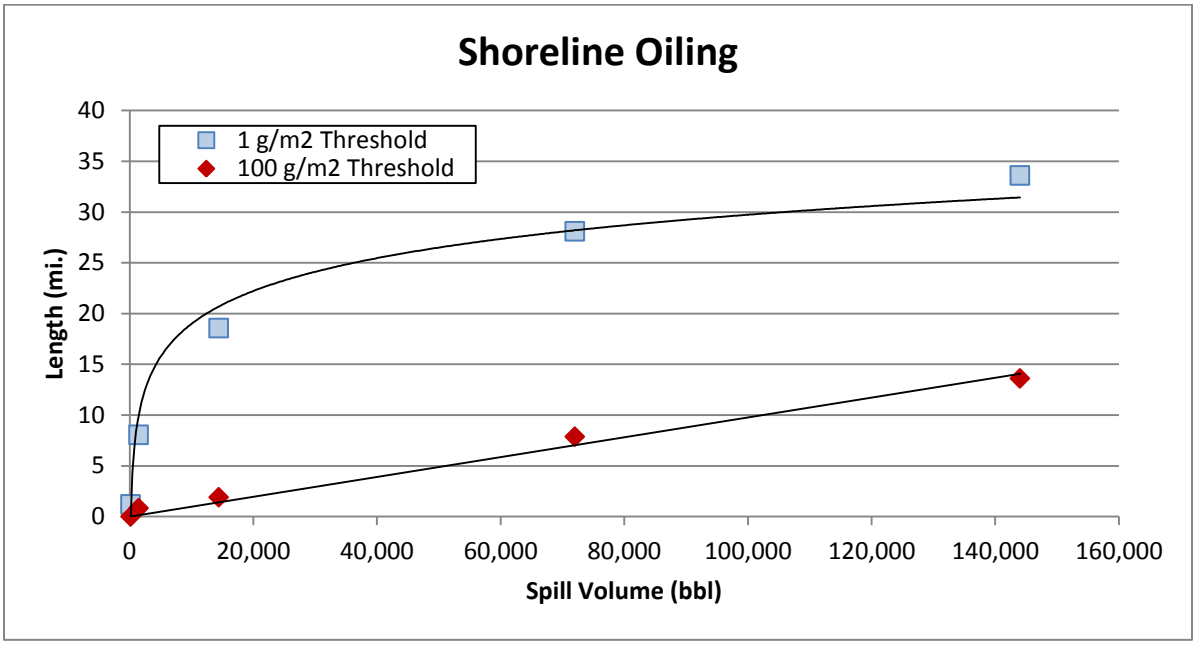


Figure 2-8: Regression curve for estimating the amount of shoreline oiling at different thresholds as a function of spill volume for the *C.O. Stillman*.

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 sand beaches. Salt marshes and tidal flats near tidal inlets are also at risk.

Table 2-5: Worst case scenario shoreline impact by habitat type and oil thickness for a leakage of 144,000 bbl from the *C.O. Stillman*.

Shoreline/Habitat Type	Lighter Oiling Oil Thickness <1 mm Oil Thickness >1 g/m^2	Heavier Oiling Oil Thickness >1 mm Oil Thickness >100 g/m^2
Rocky and artificial shores/Gravel beaches	17 miles	4 miles
Sand beaches	43 miles	16 miles
Salt marshes and tidal flats	17 miles	7 miles

Table 2-6: Worst case scenario shoreline impact by habitat type and oil thickness for a leakage of 14,400 bbl from the *C.O. Stillman*.

Shoreline/Habitat Type	Lighter Oiling Oil Thickness <1 mm Oil Thickness >1 g/m^2	Heavier Oiling Oil Thickness >1 mm Oil Thickness >100 g/m^2
Rocky and artificial shores/Gravel beaches	0 miles	0 miles
Sand beaches	90 miles	0 miles
Salt marshes and tidal flats	0 miles	0 miles

SECTION 3: ECOLOGICAL RESOURCES AT RISK

Ecological resources at risk from a catastrophic release of oil from the *C.O. Stillman* (Table 3-1) include numerous marine and coastal species. Hispaniola and Puerto Rico have high levels of biodiversity and endemism. Many species of bird nest and/or winter in the potential area of impact, and are sensitive to surface oiling while rafting, wading or feeding. Regionally important sea turtle nesting sites occur in the region. Coastal and offshore waters support populations of manatees, dolphins and whales, including the densest breeding concentration of humpback whales in the North Atlantic. In addition, the presence of significant hardbottom, mangrove and seagrass habitats support commercially important fish and invertebrates. Spawning sites for mutton snapper and red hind occur in the area of impact.

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

Species Group	Species Subgroup and Geography	Seasonal Presence
Seabirds and wading birds	*South shore of Puerto Rico* • Bahia de Jobos/Cayos de Barca: high concentrations of American coot, blue-winged teal, brown pelican, Caribbean coot, common snipe, shorebirds, wading birds ○ Black-necked stilt, least tern (ST), peregrine falcon, common moorhen, clapper rail, sora, white-cheeked pintail • Punta Aguila: high concentrations of blue-winged teal and wading birds; brown pelican, common moorhen, white-cheeked pintail • Cayos de Caracoles: American oystercatcher and wading birds nesting; brown pelican, magnificent frigatebird • Cayo Barberia: brown pelican and wading birds present • Isla Caja de Muertos: brown booby, brown pelican, wading birds present; white-tailed tropicbird nesting • Bahia Montalvo: Roseate tern (FT, ST) and brown pelican forage in offshore waters; rubble islands are used by nesting sandwich tern and roseate terns and roosting brown pelican and magnificent frigatebird • Blue-winged teal and clapper rail common in mangrove habitats • Punta Jaguey and Peninsula: High-very high concentrations of shorebirds, wading birds, waterfowl and seabirds; greater flamingo habitat; piping plover (FT, ST) can be present; clapper rail (low), least tern, snowy plover (ST) and black-necked stilt (high) nesting *Western coast of Puerto Rico* • Common estuarine species include green heron, brown pelican, ruddy duck, purple gallinule • Wading birds include greater flamingo and clapper rail • Black-necked stilts are present along the shoreline in high concentrations • Refugio de Aves de Bueron: waterfowl hotspot (white-cheeked pintail, pied-billed grebe, American coot, blue- winged teal, Caribbean coot (ST), common moorhen, ruddy duck (ST), least grebe); high concentration of brown pelican, shorebirds, wading birds, magnificent frigatebird, peregrine falcon, yellow-breasted crake (ST) • Laguna Guaniquilla: similar avifauna to Refugio de Aves de Bueron, West Indian whistling duck (ST) present *Offshore Puerto Rico Islands*	*Nesting* Audubon's shearwater Feb-Jul White-tailed tropicbird Mar-Jul Sooty tern Apr-Aug Brown noddy Apr-Aug Bridled tern Apr-Jul Red-footed booby Apr-Jun Laughing gull May-Jul Brown booby Mar-Jun, Sep-Oct Magnificent frigatebird Aug-Apr Masked booby Mar-May, Sep Least tern Apr-Jul Clapper rail Apr-May Black-necked stilt Apr-Oct Snowy plover Jan-Aug American oystercatcher May-Jul White-cheeked pintail nests Feb-Jun *Presence* Blue-winged teal present Oct-Apr Piping plover Aug-Mar

Species Group	Species Subgroup and Geography	Seasonal Presence

	• Mona Island: Laughing gull, sooty tern, Audubon's shearwater, bridled tern, brown booby, brown noddy, red-footed booby, white-tailed tropicbird nesting
	• Monita Island: Laughing gull, sooty tern, Audubon's shearwater, bridled tern, brown booby, brown noddy, red-footed booby, white-tailed tropicbird, masked booby and magnificent frigatebird nesting
	• Desecheo Island: American oystercatcher, gulls, magnificent frigatebird, terns present in high concentrations; red-footed booby, brown booby nesting
	
	Dominican Republic
	• Seabird nesting colonies can be found on satellite islands
	• Punta Cana: hotspot for terrestrial and aquatic species
	• Bahia de las Calderas: 124 species birds documented
	  ○ Largest nesting population (regionally important) of magnificent frigatebird on Hispaniola
	  ○ Important for migratory and coastal birds, including Wilson's plover and willet, least tern
	  ○ Bay is refuge for brown booby and seabirds
	  ○ Rare species sometimes recorded: black-legged kittiwake, great black-backed gull, lesser black-backed gull, Wilson's phalarope, red-necked phalarope
	• Sierra Martin Garcia: diversity of habitats in small area supports high bird diversity
	• Jaragua National Park is important site for West Indian whistling-duck and white-crowned pigeon
	• Alto Velo is the largest seabird colony in the West Indies with 8 species nesting and 80,500 pairs; 80,000 pairs are sooty tern
	• Beata: 10 species nesting, 30-50,000 nesting pairs
	• Laguna Limon – largest reported population of Caribbean coot (<6,000) birds)
	• Black rail and piping plover can be present but not in high concentrations	

Raptors and Passerines	Many passerine birds can be found in mangrove forests in high concentrations • Belted kingfishers are common in lagoons and estuaries • Peregrine falcons overwinter in nearshore areas • Yellow-shouldered blackbird (FE) and Puerto Rican nightjar (FE) present on Puerto Rico in nearshore areas • White-crowned pigeon present on Mona Island and mainland Puerto Rico and nesting at Cayos de Caracoles and around Bahia de Jobos • White-winged dove present in high concentrations in nearshore areas	Neotropical migrants present Oct-Apr Belted kingfisher present Sep-Apr Peregrine falcons present Oct-Apr Pigeon nests Mar-Sep
Sea turtles	Hawksbill (FE) and leatherback (FE) sea turtles are common nesting species in Puerto Rico and the Dominican Republic. Green (FT), and loggerhead (FT) sea turtles nest occasionally in the area (numbers below are in crawls/year). Hawksbills, leatherbacks and greens nest in Puerto Rico • Mona island is a regionally important nesting site (and is critical habitat) for hawksbills, with >1000 hawksbills and <25 green turtles • Aguadilla: <25 leatherback • Aguada, Rincon, Mayaguez each have <25 hawksbill and leatherback • Anasco: <25 hawksbill and 25-100 leatherback • Cabo Rojo: <25 hawksbill • Caja de Muerto: 25-100 hawksbill Hawksbills, leatherbacks, greens and loggerheads nest in the Dominican Republic	Sea turtles present year round in nearshore waters Green nests Mar-Jul Hawksbill nests Aug-Dec Loggerhead nests Mar-Jun Leatherback nests Feb-Jun, peaks Apr-Jul, not present during the

Species Group	Species Subgroup and Geography	Seasonal Presence
	• Major leatherback nesting beaches (100-500) along the eastern side of DR from Boca del Maimon to Playa Nisibon • Playas de Oveido: 25-100 leatherback • Los Arroyos: <25 loggerhead • Isla Saona: 25-100 hawksbill, <25 green • Boca del Maimon: <25 loggerhead Marine distribution • Waters along the east coast of Hispaniola are considered a green sea turtle foraging site • Hawksbills forage in reef habitats	winter
Marine mammals	Manatees (FE) present in sheltered lagoons along the shoreline Atlantic spotted dolphin, pantropical spotted dolphin, spinner dolphin, bottlenose dolphin, humpback whale (FE), sperm whale (FE), and shortfin pilot whale are all common in coastal areas • Very high (densest concentration in the north Atlantic) concentrations of humpback whales mate and calve during the winter in the Caribbean sea west from the coast of Puerto Rico to Silver Bank • High sperm whale concentrations off the western coast of Puerto Rico Other mammals that are present, but not common include the rough-toothed dolphin, striped dolphin, short-beaked and long-beaked common dolphin, Fraser's dolphin, Risso's dolphin, melon-headed whale, pygmy killer whale, false killer whale, killer whale, pygmy sperm whale, dwarf sperm whale, beaked whale spp., minke whale, Bryde's whale, sei whale(FE), fin whale (FE)	Manatees present year round Humpback whale Nov-May Sperm whale Sep-Jul Cetaceans present year round Baleen whales present during the winter
Fish & Invertebrates	*Littoral* • Blue land crabs are common in Puerto Rico; they burrow in low-lying nearshore areas and carry eggs to the ocean to spawn *Diadromous/freshwater* • Streams contain unique fish assemblages • Endemic species can be found in some nearshore areas (i.e., *Cyprinodon nichollsi* in Laguna de Oveido, Dominican Republic) • Anadromous species include gobies, hog-nosed mullet, native stream fish that spawn in downstream reaches from Aug-May • American eels can also be present in coastal streams *Nearshore* • Blue crab, penaeid shrimp • Snook and tarpon common in bays • Nursery habitat for many reef fish and snook, tarpon, ladyfish and bonefish *Shelf* • Reef-associated fish include morays, snake eels, lizardfish, frogfish, batfish, squirrelfish, trumpetfish, pipefish and seahorses, flying gurnards, scorpionfish, seabasses and groupers, basslets, bigeyes, cardinalfish, tilefish, jacks, snappers, grunts, porgies, drums, goatfish, spadefish, butterflyfish, angelfish, damselfish, hawkfish, wrasses, parrotfish, jawfish, gobies, surgeonfish, flounders, soles, leatherjackets, boxfish, puffers • Reef associated invertebrates include octopus, Caribbean spiny lobster, queen conch • High concentrations of Mona Island shrimp, West Indian topsnail near Mona	Blue land crab spawns Jun-Dec American eels outmigration occurs in the fall Red hind spawns Mar-Jun Snook spawn Apr-Feb Mutton snapper spawn Feb, Apr-Jun Blue marlin present May-Nov

Species Group	Species Subgroup and Geography	Seasonal Presence
	• Red hind spawning aggregations occur on reefs along the western shore of Puerto Rico near Mayaguez and Cabo Rojo and Mona Island • Mutton snapper spawning aggregations have been documented in the region *Pelagic* • Species include mackerels, barracudas, dolphin, jacks, wahoo, tunas, swordfish, billfish and sharks • High concentrations of blue marlin spawn off the NW coast of Puerto Rico	
Benthic Habitats	Substantial areas of coral reefs and hard-bottom habitat are present on the continental shelf along the western and southern coast of Puerto Rico, Isla de Mona and the southern coast of the Dominican Republic Expansive seagrass beds present nearshore	Year round

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

Ecological Risk Factors

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

Ecological resources include plants and animals (e.g., fish, birds, invertebrates, and mammals), as well as the habitats in which they live. All impact factors are evaluated for both the Worst Case and the Most Probable Discharge oil release from the wreck. Risk factors for ecological resources at risk (EcoRAR) are divided into three categories:

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

The impacts from an oil release 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 *C.O. Stillman* is provided, both as text and as shading of the applicable degree of risk bullet, for the WCD release of 144,000 bbl and a border around the Most Probable Discharge of 14,400 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 *C.O. Stillman* is classified as High Risk for oiling probability for water column ecological resources for the WCD of 144,000 bbl because 100% 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 High Risk for degree of oiling because the mean volume of water contaminated was 760 mi^2 of the upper 33 feet of the water column. For the Most Probable Discharge of 14,400 bbl, the *C.O. Stillman* is

classified as High Risk for oiling probability for water column ecological resources because 100% 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 74 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 *C.O. Stillman* is classified as Medium Risk for oiling probability for water surface ecological resources for the WCD because 29% 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 1,100 mi^2. The *C.O. Stillman* is classified as Low Risk for oiling probability for water surface ecological resources for the Most Probable Discharge because 8% 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 260 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 *C.O. Stillman* is classified as High Risk for oiling probability for shoreline ecological resources for the WCD because 72% 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 15 miles. The *C.O. Stillman* is classified as Medium Risk for oiling probability to shoreline ecological resources for the Most Probable Discharge because 30% 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 2 miles.

Considering the modeled risk scores and the ecological resources at risk, the ecological risk from potential releases of the WCD of 144,000 bbl of light fuel oil from the *C.O. Stillman* is summarized as listed below and indicated in the far-right column in Table 3-2:

- Water column resources – Medium, because although a relatively large area would have water column impacts, the oil would fairly rapidly break down, and there are no known concentrations of sensitive water column resources in the area
- Water surface resources – Medium, because although there can be large number of wintering, nesting, and migratory birds that use ocean, coastal, and estuarine habitats at risk, light fuel oils on the surface will not be continuous but rather be in the form of sheens that pose lesser risks to birds, sea turtles, and marine mammals
- Shoreline resources – Medium, because most of the shoreline at risk is composed of rocky shores and sand beaches where light fuel oils are not expected to persist, although the beaches are used by many shorebirds and sea turtles for nesting and many shorebirds as wintering and migratory stopovers

Table 3-2: Ecological risk factor scores for the **Worst Case Discharge of 144,000 bbl** of light fuel oil from the *C.O. Stillman*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
3A-1: Water Column Probability EcoRAR Oiling	Low	Medium	High	100% 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	Med
3A-2: Water Column Degree EcoRAR Oiling	Low	Medium	High	The mean volume of water contaminated above 1 ppb was 757 mi^2 of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	Low	Medium	High	29% 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 1,130 mi^2	
3C-1: Shoreline Probability EcoRAR Oiling	Low	Medium	High	72% 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 15 mi	

For the Most Probable Discharge of 14,400 bbl, the ecological risk from potential releases from the *C.O. Stillman* is summarized as listed below and indicated in the far-right column in Table 3-3:

- Water column resources – Low, because a smaller area would have water column impacts, the oil would fairly rapidly break down, and there are no known concentrations of sensitive water column resources in the area
- Water surface resources – Low, because a relatively small area would be impacted, although there can be large number of wintering, nesting, and migratory birds that use ocean, coastal, and estuarine habitats at risk, light fuel oils on the surface will not be continuous but rather be in the form of sheens that pose lesser risks to birds, sea turtles, and marine mammals
- Shoreline resources – Low, because of the small amount of potential shoreline oiling

Table 3-3: Ecological risk factor scores for the **Most Probable Discharge of 14,400 bbl** of light fuel oil from the *C.O. Stillman*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
3A-1: Water Column Probability EcoRAR Oiling	Low	Medium	High	100% 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 74 mi^2 of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	Low	Medium	High	8% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 10 g/m^2	Low
3B-2: Water Surface Degree EcoRAR Oiling	Low	Medium	High	The mean area of water contaminated above 10 g/m^2 was 257 mi^2	
3C-1: Shoreline Probability EcoRAR Oiling	Low	Medium	High	30% 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 2 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 *C.O. Stillman* include several tourist beach areas and national wildlife refuges. There is a small fishing industry and several smaller, but developing ports that are also at risk.

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

Spill response costs for a release of oil from the *C.O. Stillman* 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 *C.O. Stillman*.

Resource Type	Resource Name	Economic Activities
Tourist Beaches	Aguada, PR Aguadilla, PR Guayanilla, PR Mayaguez, PR Playa La Parguera, PR Ponce, PR Rincon, PR Salinas, PR Santa Isabel, PR	Potentially affected beach resorts and beach-front communities in Puerto Rico provide recreational activities (e.g., swimming, boating, recreational fishing, wildlife viewing, nature study, sports, dining, camping, and amusement parks) with substantial income for local communities and state tax income. Much of the coast of Puerto Rico are lined with economically-valuable beach resorts and residential communities.
National Wildlife Refuges	Cabo Rojo NWR, PR Caja de Muerto Island NWR, PR Desecheo Island NWR, PR Jobos Bay National Estuarine Research Reserve, PR Mona Island, PR Monito Island, PR	National wildlife refuges in Puerto Rico may be impacted. These federally-managed and protected lands provide refuges and conservation areas for sensitive species and habitats.
Commercial Fishing Fleets	Aguada Aguadilla Anasco Arroyo Cabo Rojo Guanica Guayama Guayanilla Juana Diaz Lajas	A number of fishing fleets use the surrounding waters for commercial fishing purposes. Total annual commercial fish catches for the southern and western areas of Puerto Rico total $2.7M.

Resource Type	Resource Name	Economic Activities
Ports	Guanica, PR Guayanilla, PR Mayaguez, PR Ponce, PR	There are a number of smaller but developing commercial ports in Puerto Rico that could potentially be impacted by spillage and spill response activities

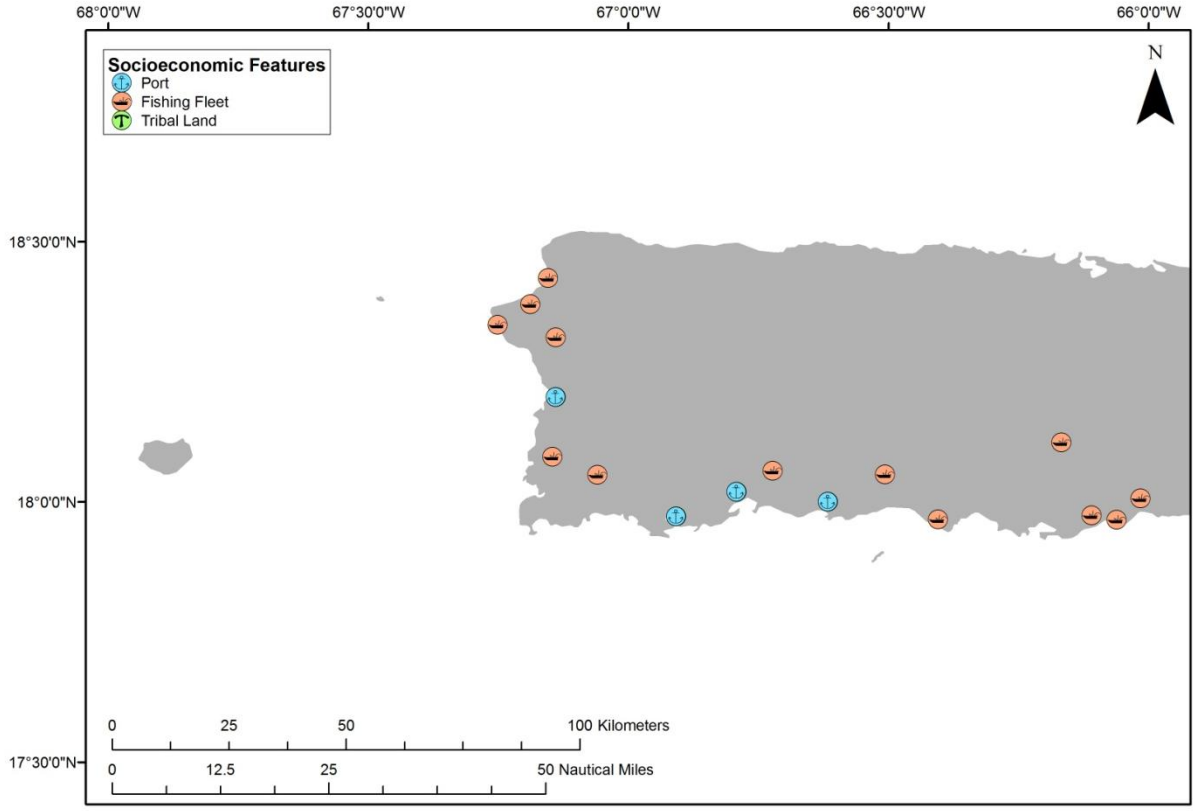


Figure 4-1: Tribal lands, ports, and commercial fishing fleets at risk from a release from the *C.O. Stillman*. (Note that there are no tribal lands at risk.)

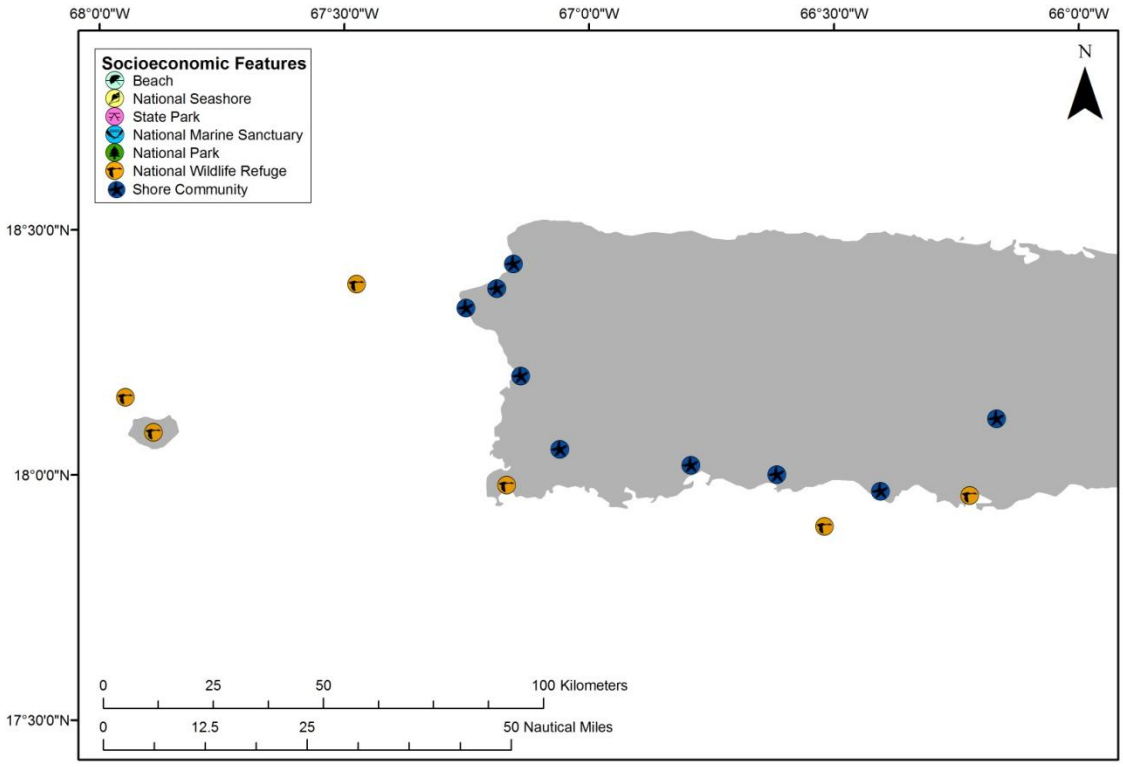


Figure 4-2: Beaches, coastal state parks, and Federal protected areas at risk from a release from the *C.O. Stillman*.

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).

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

In the following sections, the definition of low, medium, and high for each socio-economic risk factor is provided. Also, in the text classification for the *C.O. Stillman*, shading indicates the degree of risk for a WCD release of 144,000 bbl and a border indicates degree of risk for the Most Probable Discharge of 14,400 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 *C.O. Stillman* is classified as High Risk for both oiling probability and degree of oiling for water column socio-economic resources for the WCD of 144,000 bbl because 100% 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 760 mi^2 of the upper 33 feet of the water column. For the Most Probable Discharge of 14,400 bbl, the *C.O. Stillman* is classified as High Risk for oiling probability for water column socio-economic resources because 100% 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 74 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 *C.O. Stillman* is classified as High Risk for both oiling probability and degree of oiling for water surface socio-economic resources for the WCD because 100% 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 71,000 mi^2. The *C.O. Stillman* is classified as High Risk for oiling probability for water surface socio-economic resources for the Most Probable Discharge because 100% 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 High Risk for degree of oiling because the mean area of water contaminated was 11,000 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 *C.O. Stillman* is classified as High Risk for oiling probability for shoreline socio-economic resources for the WCD because 82% 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 97 miles. The *C.O. Stillman* 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 79% 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 54 miles.

Considering the modeled risk scores and the socio-economic resources at risk, the socio-economic risk from potential releases of the WCD of 144,000 bbl of light fuel from the *C.O. Stillman* is summarized as listed below and indicated in the far-right column in Table 4-2:

- Water column resources – Medium, because there is a relatively small fishing industry in the area that would be affected for a short period of time because of the short persistence of light oils
- Water surface resources – Medium, because there is a relatively small fishing industry in the area that would be affected for a short period of time because of the short persistence of light oils. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of sheens and streamers
- Shoreline resources – Medium, because light oils have low persistence on exposed shorelines

Table 4-2: Socio-economic risk factor ranks for the **Worst Case Discharge of 144,000 bbl** of light fuel oil from the *C.O. Stillman*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
4A-1: Water Column Probability SRAR Oiling	Low	Medium	High	100% 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	Med
4A-2: Water Column Degree SRAR Oiling	Low	Medium	High	The mean volume of water contaminated above 1 ppb was 757 mi^2 of the upper 33 feet of the water column	
4B-1: Water Surface Probability SRAR Oiling	Low	Medium	High	100% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 0.01 g/m^2	Med
4B-2: Water Surface Degree SRAR Oiling	Low	Medium	High	The mean area of water contaminated above 0.01 g/m^2 was 71,000 mi^2	
4C-1: Shoreline Probability SRAR Oiling	Low	Medium	High	82% of the model runs resulted in shoreline oiling of 1 g/m^2	Med
4C-2: Shoreline Degree SRAR Oiling	Low	Medium	High	The length of shoreline contaminated by at least 1 g/m^2 was 97 mi	

For the Most Probable Discharge of 14,400 bbl, the socio-economic risk from potential releases of light fuel from the *C.O. Stillman* is summarized as listed below and indicated in the far-right column in Table 4-3:

- Water column resources – Low, because there is a relatively small fishing industry in the area that would be affected for a short period of time because of the short persistence of light oils, particularly for smaller releases
- Water surface resources – Low, because there is a relatively small fishing industry in the area that would be affected for a short period of time because of the short persistence of light oils, particularly for smaller releases. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of sheens and streamers
- Shoreline resources – Low, because light oils generally have low persistence on the shoreline, particularly in highly exposed areas

Table 4-3: Socio-economic risk factor ranks for the **Most Probable Discharge of 14,400 bbl** of light fuel oil from the *C.O. Stillman*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
4A-1: Water Column Probability SRAR Oiling	**Low**	**Medium**	**High**	100% 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 74 mi^2 of the upper 33 feet of the water column	
4B-1: Water Surface Probability SRAR Oiling	**Low**	**Medium**	**High**	100% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 0.01 g/m^2	**Low**
4B-2: Water Surface Degree SRAR Oiling	**Low**	**Medium**	**High**	The mean area of water contaminated above 0.01 g/m^2 was 11,000 mi^2	
4C-1: Shoreline Probability SRAR Oiling	**Low**	**Medium**	**High**	79% of the model runs resulted in shoreline oiling of 1 g/m^2	**Low**
4C-2: Shoreline Degree SRAR Oiling	**Low**	**Medium**	**High**	The length of shoreline contaminated by at least 1 g/m^2 was 54 mi	

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

The overall risk assessment for the *C.O. Stillman* 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, the *C.O. Stillman* scores Medium with 14 points; for the Most Probable Discharge, the *C.O. Stillman* scores Low with 8 points. The spread in the scores for the two release scenarios is due to the behavior of spills of light fuel, with smaller releases likely to be less persistent. 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 *C.O. Stillman*. The final determination rests with the U.S. Coast Guard.

C.O. Stillman	**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 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 *C.O. Stillman*.

Vessel Risk Factors		Data Quality Score	Comments		Risk Score
Pollution Potential Factors	A1: Oil Volume (total bbl)	Medium	Maximum of 144,000 bbl, not reported to be leaking		**Med**
	A2: Oil Type	Low	Cargo is thought to be light fuel oil, a Group II oil type		
	B: Wreck Clearance	High	Vessel not reported as cleared		
	C1: Burning of the Ship	High	A severe fire was reported		
	C2: Oil on Water	High	Oil was reported on the water; amount is not known		
	D1: Nature of Casualty	High	Two torpedo detonations		
	D2: Structural Breakup	Low	Unknown structural breakup		
Archaeological Assessment	Archaeological Assessment	Low	Limited sinking records of this ship were located and no site reports exist, assessment is believed to have limited accuracy		**Not Ranked**
Operational Factors	Wreck Orientation	Low	Unknown, potential to be upright		**Not Ranked**
	Depth	Low	>12,000 ft		
	Visual or Remote Sensing Confirmation of Site Condition	Low	Location unknown		
	Other Hazardous Materials Onboard	High	No		
	Munitions Onboard	High	Munitions for onboard weapons		
	Gravesite (Civilian/Military)	High	Yes		
	Historical Protection Eligibility (NHPA/SMCA)	High	NHPA and possibly SMCA		
				WCD	**Most Probable**
Ecological Resources	3A: Water Column Resources	High	Area of highest exposure occurs in offshore waters without any known concentrations of sensitive resources;	**Med**	**Low**
	3B: Water Surface Resources	High	Seasonally very high concentrations of marine birds, mammals, and sea turtles in coastal and offshore waters but light sheens pose lesser risks	**Med**	**Low**
	3C: Shore Resources	High	Mostly sand beaches at risk, where a light fuel oil is not likely to persist	**Med**	**Low**
Socio-Economic Resources	4A: Water Column Resources	High	A relatively small fishing industry in the area that would be affected	**Med**	**Low**
	4B: Water Surface Resources	High	A relatively small fishing industry in the area and little port traffic in area that could be affected	**Med**	**Low**
	4C: Shore Resources	High	Mostly sand beaches at risk, where a light fuel oil is not likely to persist	**Med**	**Low**
Summary Risk Scores				**14**	**8**