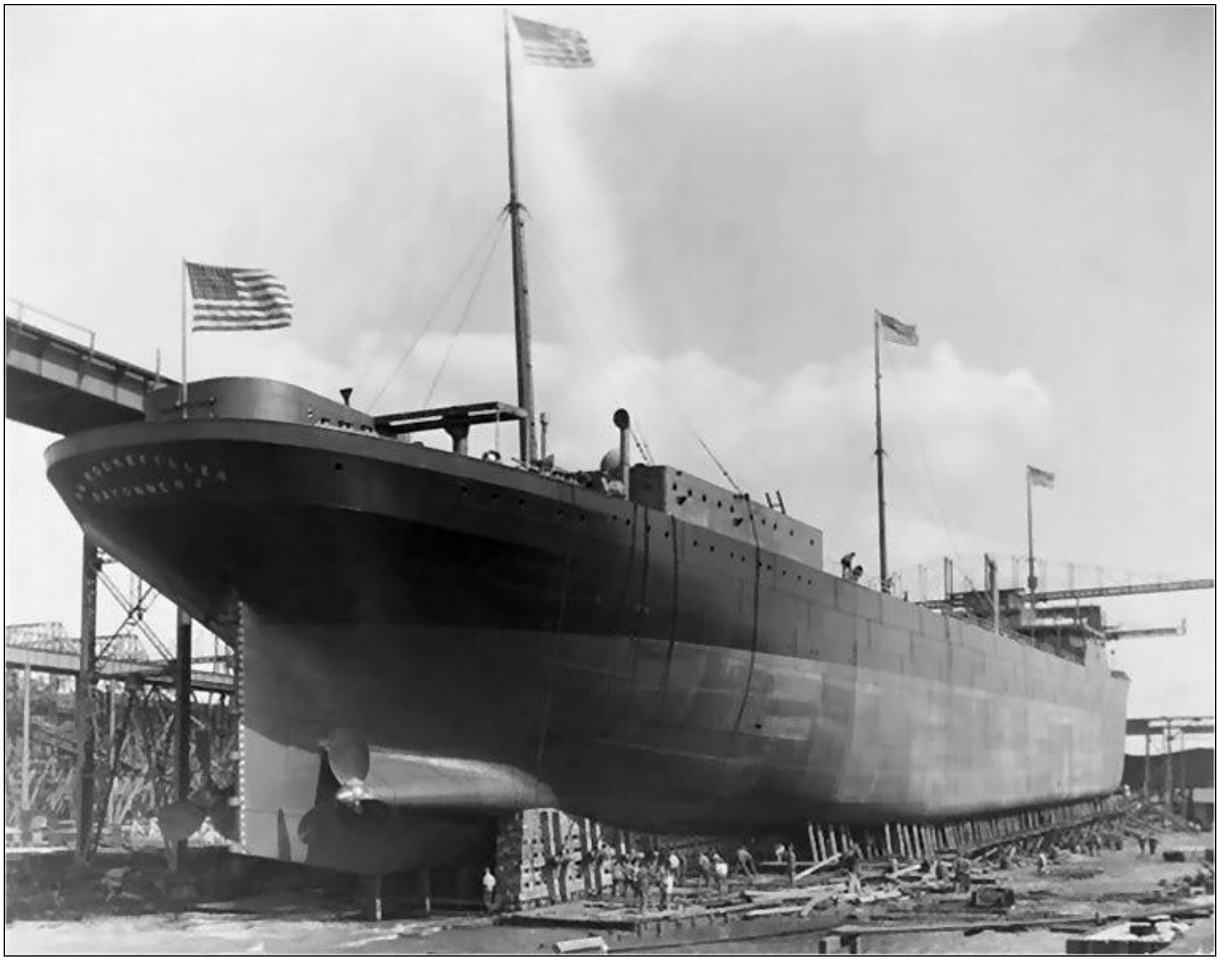
Office of National Marine Sanctuaries
Office of Response and Restoration

Screening Level Risk Assessment Package

William Rockefeller



March 2013

National Oceanic and
Atmospheric Administration

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Photo: Photograph of *William Rockefeller* Under Construction
Courtesy of The Mariners' Museum Library, Newport News, VA

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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.

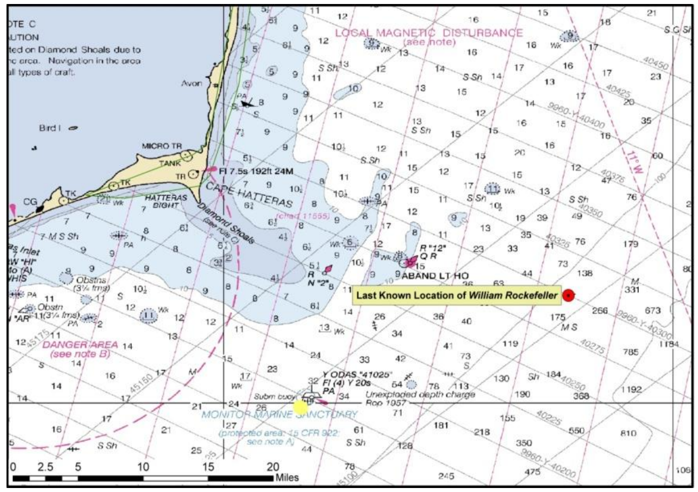
The potential polluting shipwrecks were identified through searching a broad variety of historical sources. NOAA then worked with Research Planning, Inc., RPS ASA, and Environmental Research Consulting to conduct the modeling forecasts, and the ecological and environmental resources at risk assessments.

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: *William Rockefeller*

The tanker *William Rockefeller*, torpedoed and sunk during World War II off Cape Hatteras, North Carolina 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 *William Rockefeller*, 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.



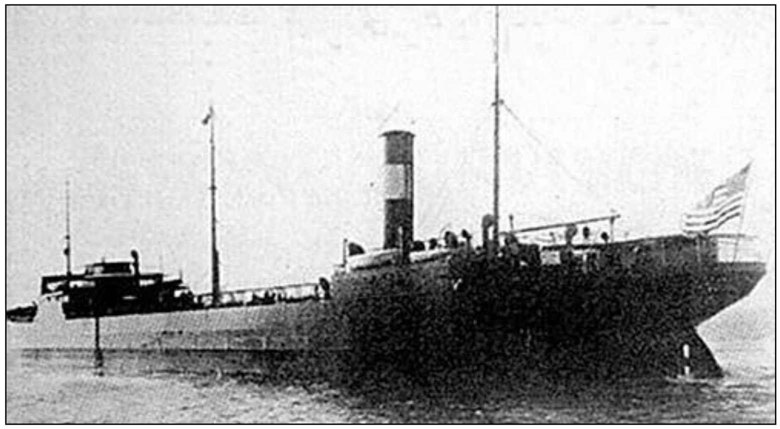
Based on this screening-level assessment, each vessel was assigned a summary score calculated using the seven risk criteria described in this report. For the Worst Case Discharge, *William Rockefeller* scores High with 16 points; for the Most Probable Discharge (10% of the Worst Case volume), *William Rockefeller* scores Medium with 14 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 the *William Rockefeller* is unknown, NOAA recommends that surveys of opportunity be used to attempt to locate this vessel, and that a notation is made in the Area Contingency Plans so that if a mystery spill is reported in the general area, this vessel could be investigated as a source. Outreach efforts with the technical and recreational dive community as well as commercial and recreational fishermen who frequent the area would be helpful to gain awareness of localized spills in the general area where the vessel is believed lost.

Vessel Risk Factors		Risk Score	
Pollution Potential Factors	A1: Oil Volume (total bbl)	Med	
	A2: Oil Type		
	B: Wreck Clearance		
	C1: Burning of the Ship		
	C2: Oil on Water		
	D1: Nature of Casualty		
	D2: Structural Breakup		
Archaeological Assessment	Archaeological Assessment	Not Scored	
Operational Factors	Wreck Orientation	Not Scored	
	Depth		
	Confirmation of Site Condition		
	Other Hazardous Materials		
	Munitions Onboard		
	Gravesite (Civilian/Military)		
	Historical Protection Eligibility		
		WCD	MP (10%)
Ecological Resources	3A: Water Column Resources	Med	Low
	3B: Water Surface Resources	High	High
	3C: Shore Resources	Med	Med
Socio-Economic Resources	4A: Water Column Resources	Med	Low
	4B: Water Surface Resources	High	High
	4C: Shore Resources	Med	Med
Summary Risk Scores		16	14

The determination of each risk factor is explained in the document. This summary table is found on page 39.

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

Vessel Particulars



Official Name: *William Rockefeller*

Official Number: 221675

Vessel Type: Tanker

Vessel Class: 8,374 gross ton Tanker

Former Names: N/A

Year Built: 1921

Builder: Newport News Shipbuilding, Newport News, VA

Builder's Hull Number: 261

Flag: American

Owner at Loss: Standard Oil Co. of New Jersey

Controlled by: Unknown

Chartered to: Unknown

Operated by: Standard Oil Co. of New Jersey

Homeport: Wilmington, DE

Length: 554 feet

Beam: 75 feet

Depth: 43 feet

Gross Tonnage: 14,054

Net Tonnage: 8,790

Hull Material: Steel

Hull Fastenings: Riveted

Powered by: Oil-fired steam

Bunker Type: Heavy Fuel Oil (Bunker C)

Bunker Capacity (bbl): 16,191

Average Bunker Consumption (bbl) per 24 hours: Unknown

Liquid Cargo Capacity (bbl): 138,000

Dry Cargo Capacity: Unknown

Tank or Hold Description: Vessel had eight cargo tanks divided port and starboard by an oil-tight centerline bulkhead

Casualty Information

Port Departed: Aruba

Destination Port: New York

Date Departed: June 19, 1942

Date Lost: June 28, 1942

Number of Days Sailing: ≈ 10

Cause of Sinking: Act of War (Torpedoes)

Latitude (DD): 35.11685

Longitude (DD): -75.11624

Nautical Miles to Shore: 26

Nautical Miles to NMS: 19

Nautical Miles to MPA: 0

Nautical Miles to Fisheries: Unknown

Approximate Water Depth (Ft): 850

Bottom Type: Clay-silt/sand

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

Wreck Orientation: Unknown

Vessel Armament: One 3-inch gun

Cargo Carried when Lost: 135,000 bbl of Bunker C fuel oil (11.2 API gravity)

Cargo Oil Carried (bbl): 135,000

Cargo Oil Type: Heavy Fuel Oil

Probable Fuel Oil Remaining (bbl): ≤ 15,000

Fuel Type: Heavy Fuel Oil (Bunker C)

Total Oil Carried (bbl): ≤ 150,000

Dangerous Cargo or Munitions: Yes

Munitions Carried: Munitions for onboard weapon (3-inch shells)

Demolished after Sinking: No

Salvaged: No

Cargo Lost: Yes, partially

Reportedly Leaking: No

Historically Significant: Yes

Gravesite: No

Salvage Owner: Not known if any

Wreck Location

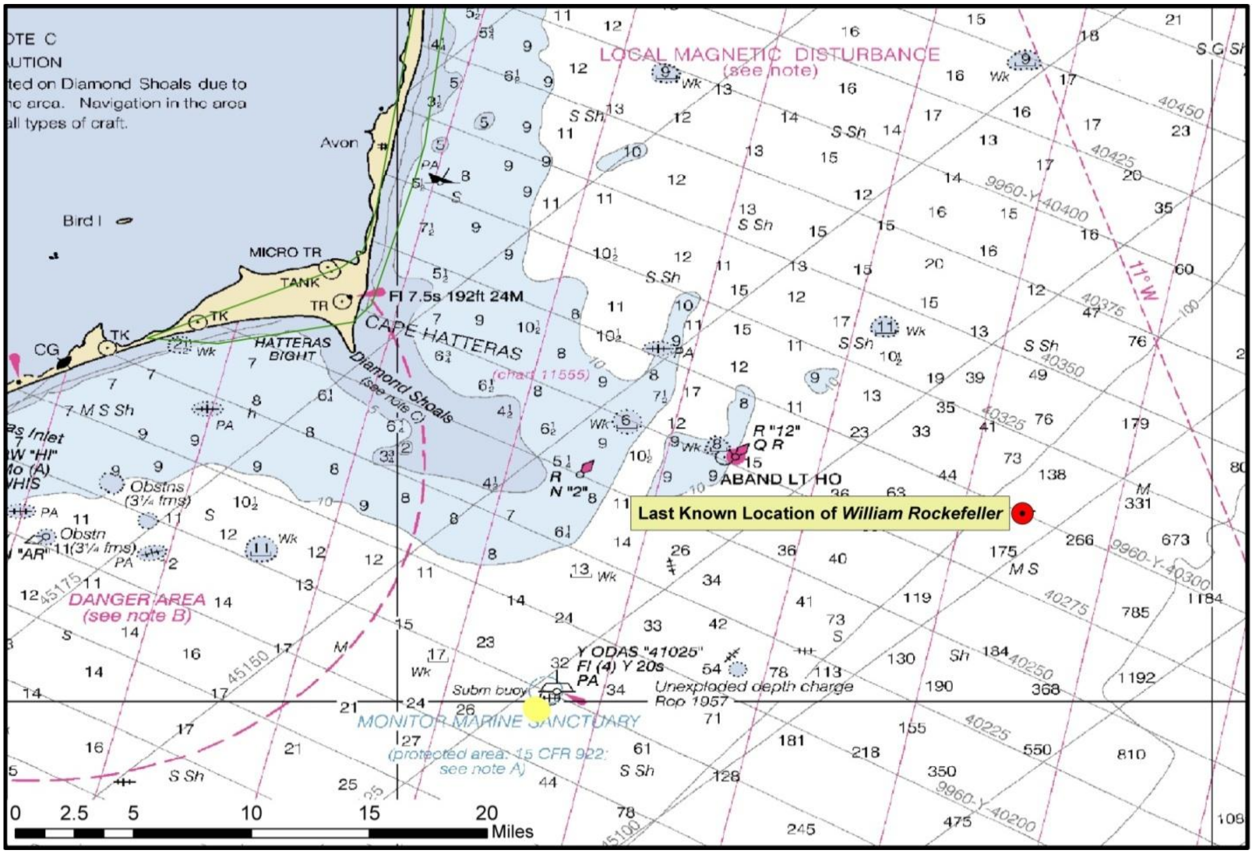


Chart Number: 12200

Casualty Narrative

"At 18.16 hours on 28 Jun, 1942, the *William Rockefeller* (Master William R. Stewart), escorted by the U.S. Coast Guard vessel *USS CG-460*, was hit on the port side amidships by one torpedo from *U-701* while steaming on a nonevasive course at 9.2 knots about 16 miles east-northeast of Diamond Shoals Light Buoy. The torpedo struck at the pump room, opened a hole about 20 feet in diameter, sprayed oil over the ship and caused the flooding of the pump room and the #5 tank. As the cargo caught fire and flames engulfed the stern, the nine officers, 35 crewmen and six armed guards (the ship was armed with one 3in gun) abandoned ship in four lifeboats and were picked up after 20 minutes by the escort, which landed them at the Ocracoke Coast Guard Station the same afternoon. The U-boat was unsuccessfully attacked by the escort and a U.S. Coast Guard aircraft and sank the drifting and burning wreck with a coup de grâce in 35°11N/75°07W at 05.25 hours on 29 June."
-http://www.uboat.net/allies/merchants/ships/1867.html

General Notes

AWOIS Data:
DESCRIPTION
TANKER; 14054 GT; SUNK 6/28/42 BY SUBMARINE; POSITION ACCURACY 1-3 MILES DATED 6/28/42.

SURVEY REQUIREMENTS NOT DETERMINED
TKR; 14,054 TONS; TORPEDOED 6/28/42 W/125,000 BBL OF FUEL OIL ON BOARD, IN 650 FT.

Wreck Condition/Salvage History

Unknown, the wreck has not been located.

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

William Rockefeller is a shipwreck that has been considered a potential high priority site because of the overall size of the ship and the large cargo of heavy fuel oil carried onboard the vessel. *William Rockefeller*, at the time of its sinking, was one of the largest tankers in the world with a gross tonnage of 14,054 tons. At the time of its loss, it was also carrying a cargo of 135,000 bbl of Bunker C fuel oil, and had a bunker capacity of 16,191 bbl of Bunker C fuel oil. Based on the vessel's size and the amount of heavy fuel oil carried, the ship certainly appears to be a higher priority wreck. In light of the nature in which the vessel sank, the lack of any additional information about where the vessel came to rest, and the potential depth of the site, however, a more reactive approach might be appropriate.

When *William Rockefeller* was torpedoed on June 28, 1942, the torpedo blast opened a 20-ft-by-20-ft hole in the side of the ship (Fig. 1-1), flooded the pump room and the number 5 tank as well as ruptured the tanker's deck. Soon after, fire spread across the ship extending from the bridge structure aft forced the crew of the tanker to abandon the ship. For an additional 11 hours, the tanker continued to drift along the main axis of the Gulf Stream and burn, until the U-boat (*U-701*) returned under the cover of darkness and sank the tanker with another torpedo. The exact location of this final attack is not known, and the navy could only approximate that the ship had probably drifted 15 miles northeast from the location where the initial attack occurred.

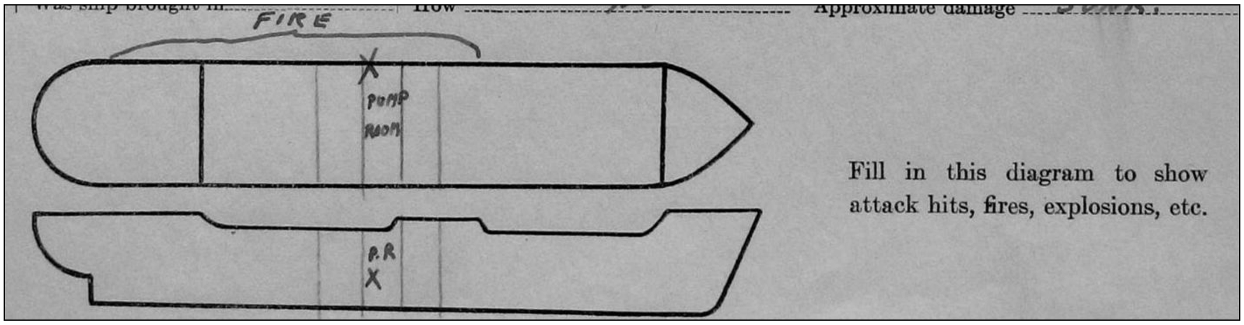


Figure 1-1: U.S. Coast Guard diagram of the location of torpedo impact and fire aboard *William Rockefeller* (Image courtesy of National Archives, Washington, DC).

Since the location of the initial attack on *William Rockefeller* is not known (attack reports disagree by as many as 15 miles), the search area required to locate this wreck would be huge. Initial search maps drafted by NOAA to discuss the feasibility of locating this wreck during the NOAA Battle of the Atlantic Expeditions have revealed that a search area of approximately 750 nautical miles along the axis of the Gulf Stream might be required to locate the wreck (Fig. 1-2).

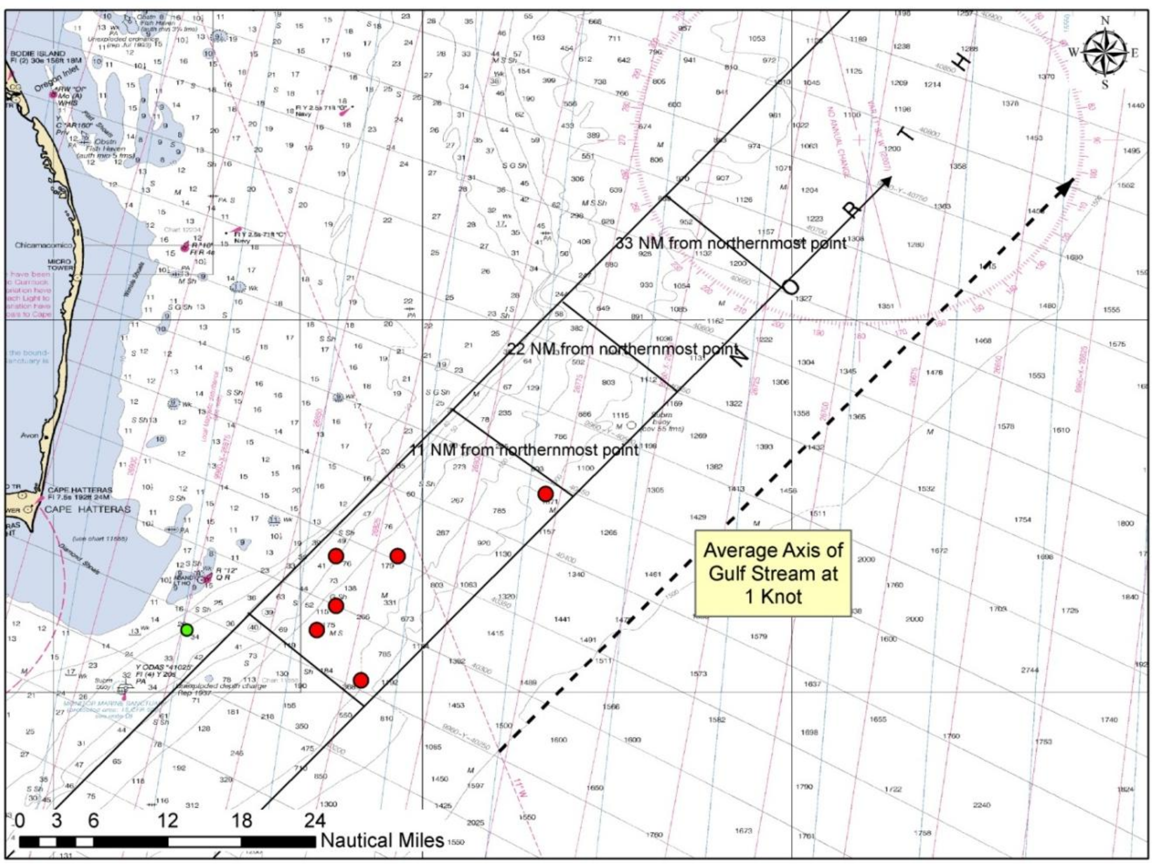


Figure 1-2: Theoretical survey areas for *William Rockefeller* based on the northernmost reported attack location and current speeds of 1-3 knots. With of the extreme outlying points, the survey areas could range from small 25 nautical mile areas localized around particular historic coordinates to an approximately 750 nautical mile survey area if the entire area is searched out to 33 nautical miles from the northernmost attack location.

Since the environmental models of oil drift for this area predict a drift heading almost entirely due east, the search are may actually be much larger. Given that water depths in this area range from 850 feet to over 6,000 feet, the technology required and costs associated with the discovery of this wreck would seem to decrease the priority of the wreck. This is especially the case in light of the conclusions made by the U.S. Coast Guard in 1967 that oil will likely escape from a wreck's vents and piping long before its hull plates corrode.

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

Background Information References

Vessel Image Sources:
http://www.nc-wreckdiving.com/WRECKS/ROCKEFELLER/ROCKEFELLER.HTML

Construction Diagrams or Plans in RULET Database? No

Text References:

-Office of the Chief of Naval Operations
1942 Summary of Statements by Survivors S/S "WM. Rockefeller, American Tanker 14,054 G. T., Standard Oil Company of New Jersey. Tenth Fleet ASW Analysis & Stat. Section Series XIII. Report and Analyses of U. S. and Allied Merchant Shipping Losses Williams D. Burnham - YP-453, Records of the Office of the Chief of Naval Operations, Box 253, Record Group 38, National Archives at College Park, College Park, MD.

-United States Coast Guard
1944 Report on U.S. Merchant Tanker War Action Casualty, S/S *William Rockefeller*. War Casualty Section, Casualty Reports 1941 to 1946, Records of the United States Coast Guard, Entry 191, Box 5, Record Group 26, National Archives Building, Washington, DC.

-http://www.uboat.net/allies/merchants/ships/1867.html

-AWOIS database

-NIMA database

-Global Wrecks database

Vessel Risk Factors

In this section, the risk factors that are associated with the vessel are defined and then applied to the *William Rockefeller* 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 1-3 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.

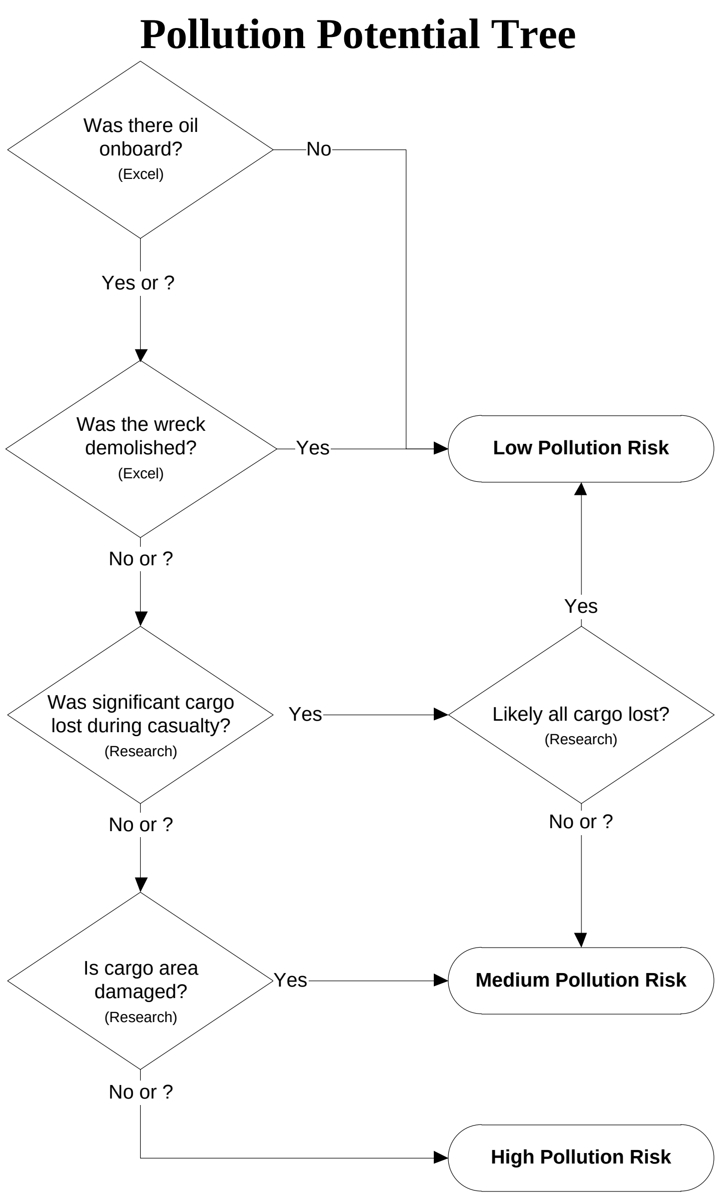


Figure 1-3: U.S. Coast Guard Salvage Engineering Response Team (SERT) developed the above Pollution Potential Decision Tree.

Each risk factor is characterized as either 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 1-3.

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 *William Rockefeller* is provided, both as text and as shading of the applicable degree of risk bullet.

Pollution Potential Factors

Was there oil onboard? *(First diamond down in Figure 1-1)*

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 *William Rockefeller i*s ranked as High Volume because it is thought to have a potential for up to 150,000 bbl, although some of that was lost at the time of the casualty due to the fire and spill around 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 *William Rockefeller*.

Risk Factor A2: Oil Type

The oil type(s) on board the wreck are classified only with regard to persistence, using the U.S. Coast

Guard oil grouping[1]. (Toxicity is dealt with in the impact risk for the Resources at Risk classifications.) The three oil classifications are:

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

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

Was the wreck demolished? *(Second diamond down in Figure 1-1)*

Risk Factor B: Wreck Clearance

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

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

The *William Rockefeller* 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? *(Third diamond down in Figure 1-1)*

Risk Factor C1: Burning of the Ship

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

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

[1] Group I Oil or Nonpersistent oil is defined as "a petroleum-based oil that, at the time of shipment, consists of hydrocarbon fractions: At least 50% of which, by volume, distill at a temperature of 340°C (645°F); and at least 95% of which, by volume, distill at a temperature of 370°C (700°F)."
Group II - Specific gravity less than 0.85 crude [API° >35.0]
Group III - Specific gravity between 0.85 and less than .95 [API° ≤35.0 and >17.5]
Group IV - Specific gravity between 0.95 to and including 1.0 [API° ≤17.5 and >10.0]

The *William Rockefeller* is classified as Medium Risk because the ship burned for 11 hours. Data quality is high.

Risk Factor C2: Reported Oil on the Water

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

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

The *William Rockefeller* is classified as Medium Risk because the oil was reported to have sprayed across that ship at the time of the casualty. Data quality is high.

Is the cargo area damaged*? (Fourth diamond down in Figure 1-1)*

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 *William Rockefeller* is classified as Low Risk because there were two torpedo detonations and the ship caught fire. 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 *William Rockefeller* is classified as Unknown Risk because it is was not known to have broken at the time of casualty; whether additional structural breakup occurred is unknown as location is unknown. Data quality is low.

Factors That May Impact Potential Operations

Orientation (degrees)

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

The location of the *William Rockefeller* is unknown. Data quality is low.

Depth

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

The depth for *William Rockefeller* is believed to be greater than 850 and as deep as 6,000 feet due to the last known location. Data quality is low.

Visual or Remote Sensing Confirmation of Site Condition

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

The location of the *William Rockefeller* 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 *William Rockefeller* had munitions for onboard weapons, one 3-inch gun. 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 *William Rockefeller*. Operational factors are listed but do not have a risk score.

Table 1-1: Summary matrix for the vessel risk factors for the *William Rockefeller* 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 150,000 bbl, no reports of leakage	**Med**
	A2: Oil Type	High	Group IV, heavy fuel oil and Bunker C	
	B: Wreck Clearance	High	Not known to be cleared	
	C1: Burning of the Ship	High	Ship burned for 11 hours	
	C2: Oil on Water	High	Oil was reported spraying over/on the deck at the time of casualty	
	D1: Nature of Casualty	High	Two torpedo strikes	
	D2: Structural Breakup	Low	Unknown	
Archaeological Assessment	Archaeological Assessment	High	Detailed sinking records of this ship exist, assessment is believed to be very accurate	**Not Scored**
Operational Factors	Wreck Orientation	Low	Unknown, potential to be upright	**Not Scored**
	Depth	Low	850 to 6,000 feet	
	Visual or Remote Sensing Confirmation of Site Condition	Low	None; location is unknown	
	Other Hazardous Materials Onboard	High	None reported.	
	Munitions Onboard	High	Munitions for one 3-inch gun	
	Gravesite (Civilian/Military)	High	No	
	Historical Protection Eligibility (NHPA/SMCA)	High	Yes, 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 *William Rockefeller* this would be about 150,000 bbl based on the maximum amount of oil onboard the wreck.

The likeliest scenario of oil release from most sunken wrecks, including the *William Rockefeller*, 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 *William Rockefeller*.

Scenario Type	Release per Episode	Time Period	Release Rate	Relative Likelihood	Response Tier
Chronic (0.1% of WCD)	150 bbl	Fairly regular intervals or constant	100 bbl over several days	More likely	Tier 1
Episodic (1% of WCD)	1,500 bbl	Irregular intervals	Over several hours or days	Most Probable	Tier 1-2
Most Probable (10% of WCD)	15,000 bbl	One-time release	Over several hours or days	Most Probable	Tier 2
Large (50% of WCD)	75,000 bbl	One-time release	Over several hours or days	Less likely	Tier 2-3
Worst Case	150,000 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 *William Rockefeller* contained a maximum of 150,000 bbl of heavy fuel oil as cargo and bunker fuel oil (both Group IV oils). Thus, the oil spill model was run using heavy fuel oil.

Oil Thickness Thresholds

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

For oil stranded onshore, a thickness of 1 g/m^2 was used as the threshold for socio-economic impacts because that amount of oil would conservatively trigger the need for shoreline cleanup on amenity beaches. A thickness of 100 g/m^2 was used as the threshold for ecological impacts based on a synthesis of the literature showing that shoreline life has been affected by this degree of oiling.[2] Because oil often strands onshore as tarballs, Table 2-2B shows the number of tarballs per m2 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 *William Rockefeller* 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 the 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.

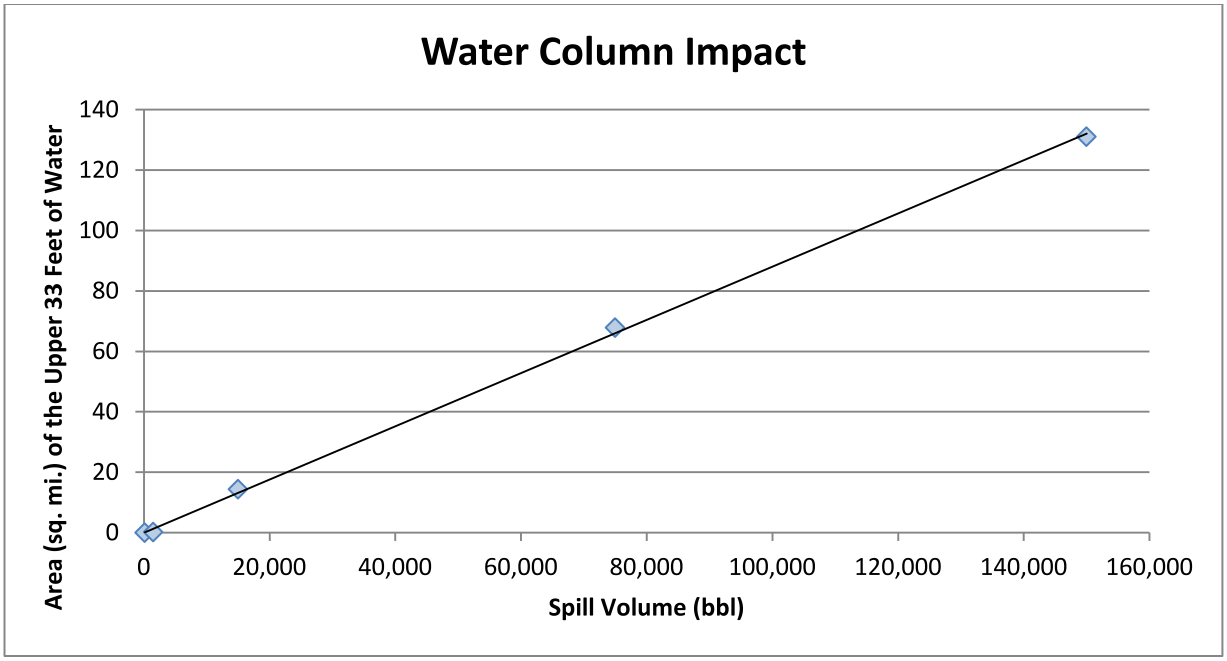


Figure 2-1: Regression curve for estimating the volume of water column at or above 1 ppb aromatics impacted as a function of spill volume for the *William Rockefeller*.

Potential Water Surface Slick

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

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

Scenario Type	Oil Volume (bbl)	Estimated Slick Area Swept Mean of All Models	
		0.01 g/m^2	10 g/m^2
Chronic	150	1,800 mi^2	1,800 mi^2
Episodic	1,500	5,800 mi^2	5,800 mi^2
Most Probable	15,000	19,000 mi^2	19,000 mi^2
Large	75,000	44,000 mi^2	44,000 mi^2
Worst Case Discharge	150,000	64,000 mi^2	64,000 mi^2

The location, size, shape, and spread of the oil slick(s) from an oil release from the *William Rockefeller* 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.

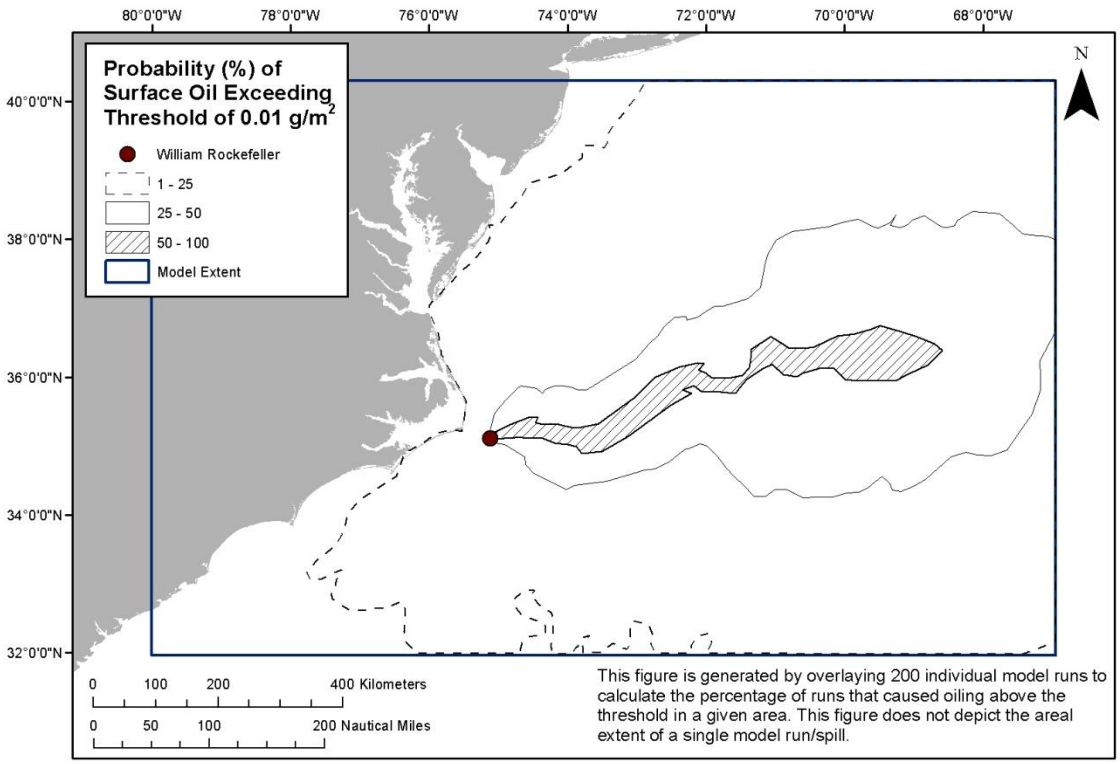


Figure 2-2: Probability of surface oil (exceeding 0.01 g/m^2) from the Most Probable spill of 15,000 bbl of heavy fuel oil from the *William Rockefeller* at the threshold for socio-economic resources at risk.

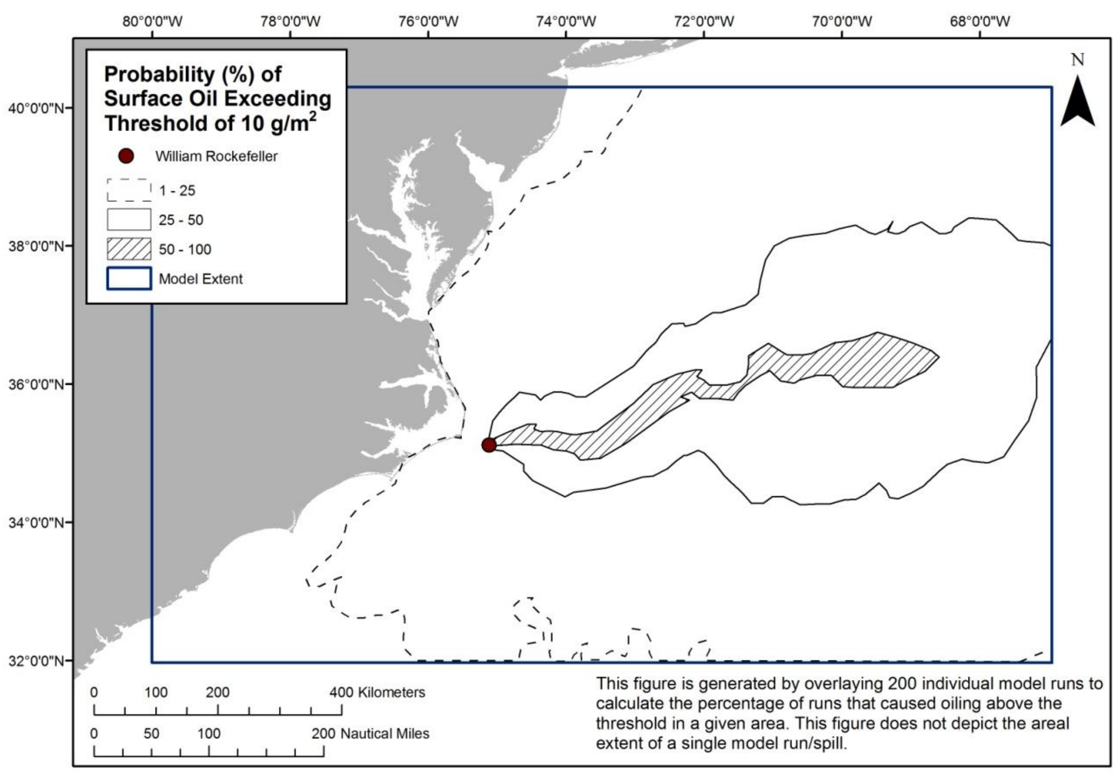


Figure 2-3: Probability of surface oil (exceeding 10 g/m^2) from the Most Probable spill of 15,000 bbl of heavy fuel oil from the *William Rockefeller* at the threshold for ecological resources at risk.

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.

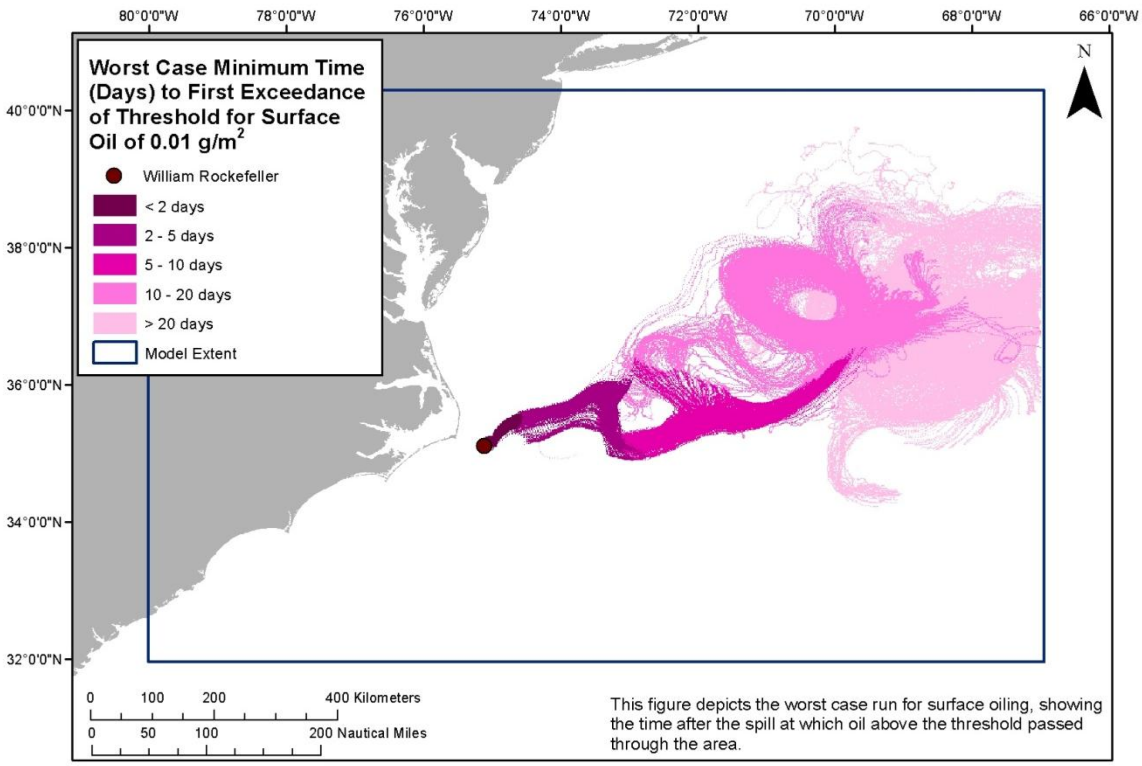


Figure 2-4: Water surface oiling from the Most Probable of 15,000 bbl of heavy fuel oil from the *William Rockefeller* shown as the area over which the oil spreads at different time intervals.

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

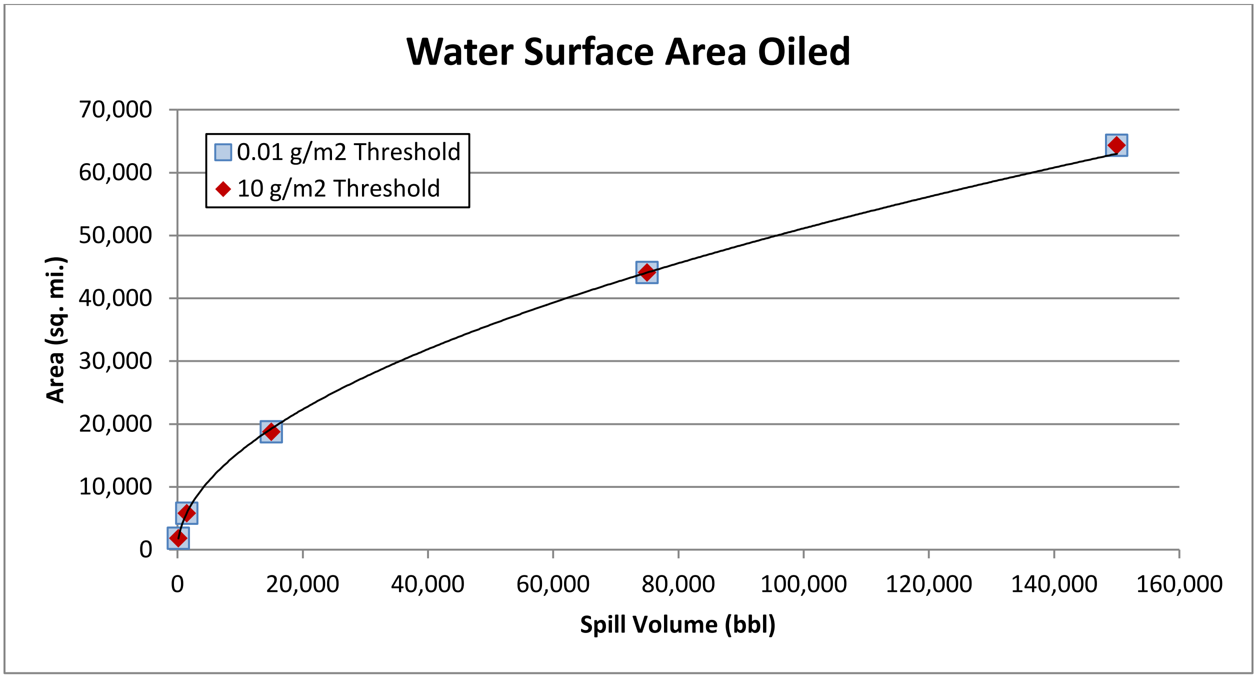


Figure 2-5: Regression curve for estimating the amount of water surface oiling as a function of spill volume for the *William Rockefeller*, showing both the ecological threshold of 10 g/m^2 and socio-economic threshold of 0.01 g/m^2. The curves are similar and so they plot on top of each other.

Potential Shoreline Impacts

Based on these modeling results, shorelines from as far north as Virginia Beach, Virginia, to as far south as Cape Lookout, North Carolina, 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 15,000 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 *William Rockefeller*.

Scenario Type	Volume (bbl)	Estimated Miles of Shoreline Oiling Above 1 g/m^2			
		Rock/Gravel/Artificial	Sand	Wetland/Mudflat	Total
Chronic	150	0	15	0	16
Episodic	1,500	0	23	0	23
Most Probable	15,000	0	24	0	25
Large	75,000	0	25	0	25
Worst Case Discharge	150,000	0	29	1	29

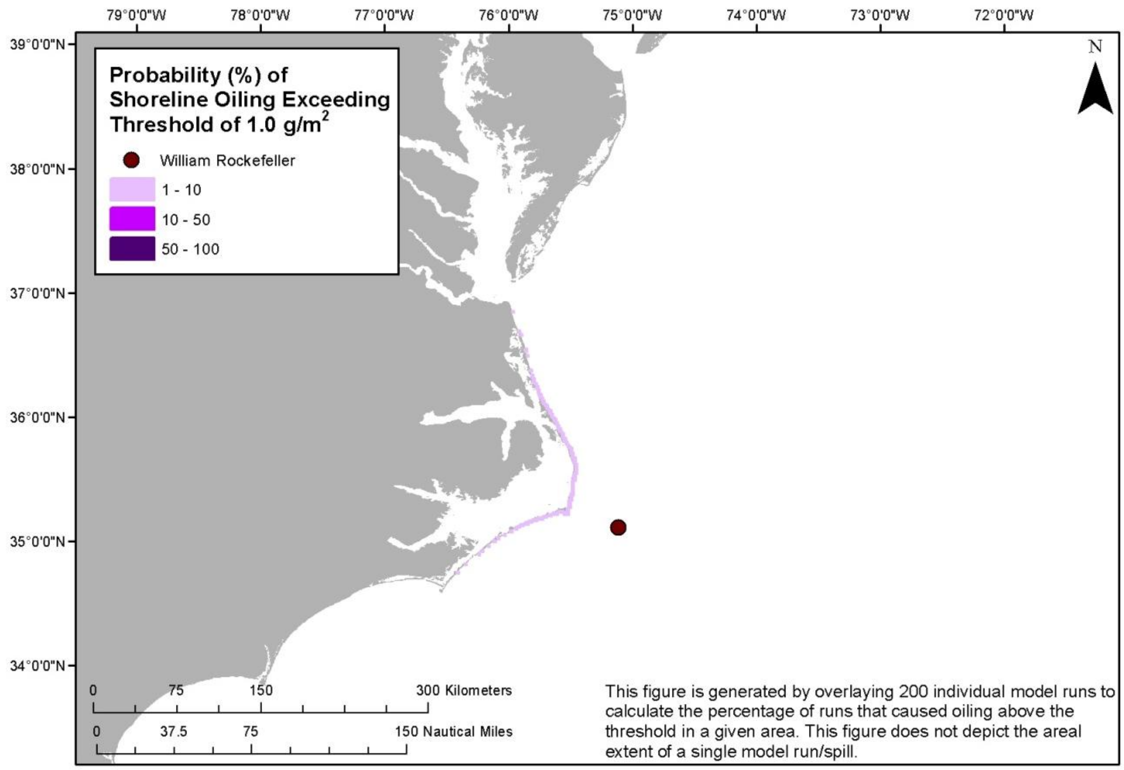


Figure 2-6: Probability of shoreline oiling (exceeding 1.0 g/m^2) from the Most Probable Discharge of 15,000 bbl of heavy fuel oil from the *William Rockefeller*.

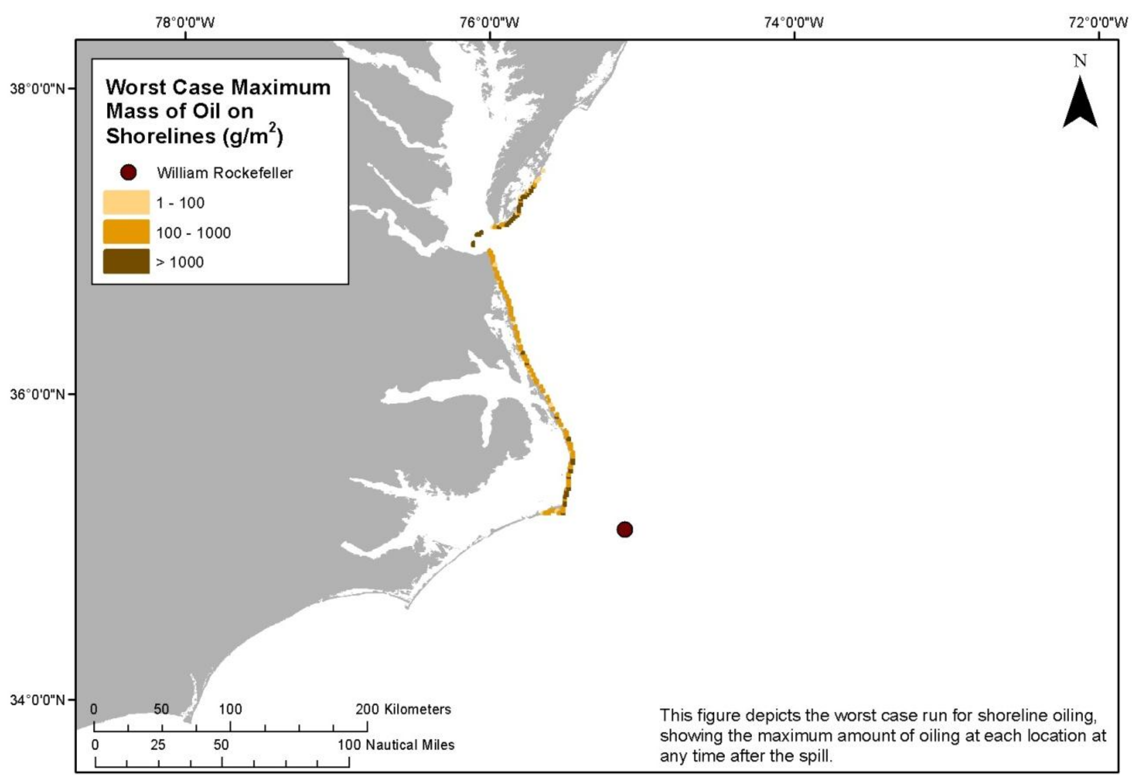


Figure 2-7: The extent and degree of shoreline oiling from the single model run of the Most Probable Discharge of 15,000 bbl of heavy fuel oil from the *William Rockefeller* that resulted in the greatest shoreline oiling.

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.

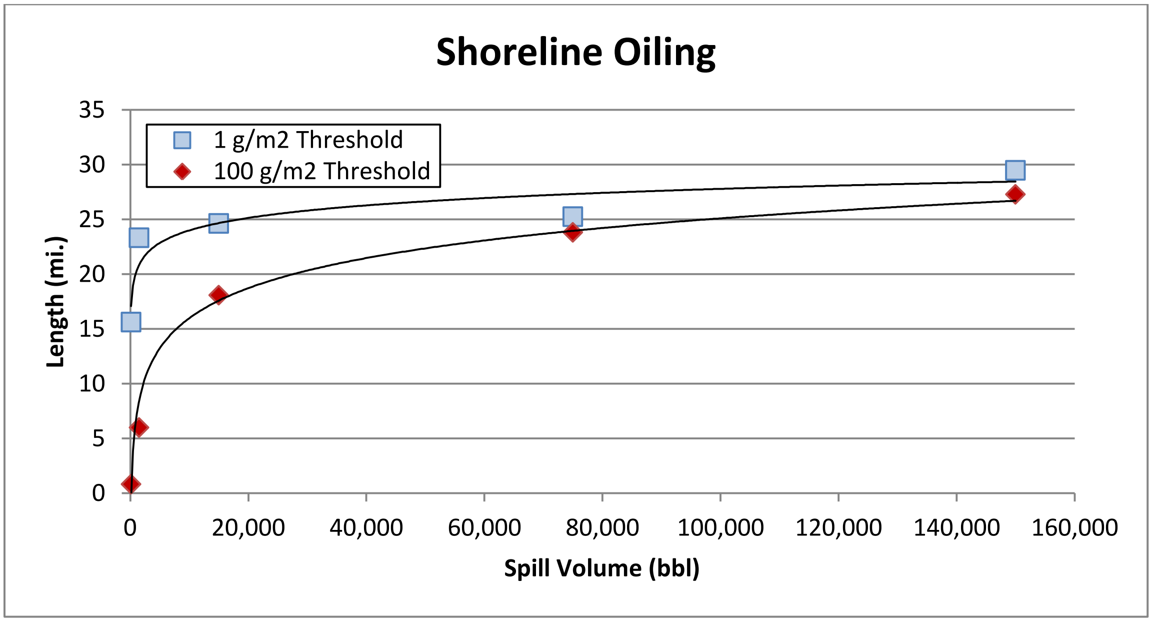


Figure 2-8: Regression curve for estimating the amount of shoreline oiling at different thresholds as a function of spill volume for the *William Rockefeller*.

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 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 150,000 bbl from the *William Rockefeller*.

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	5 mi	5 mi
Sand beaches	125 mi	117 mi
Salt marshes and tidal flats	6 mi	5 mi

Table 2-6: Worst case scenario shoreline impact by habitat type and oil thickness for a leakage of 15,000 bbl from the *William Rockefeller*.

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	4 mi	4 mi
Sand beaches	124 mi	57 mi
Salt marshes and tidal flats	3 mi	1 mi

SECTION 3: ECOLOGICAL RESOURCES AT RISK

Ecological resources at risk from a catastrophic release of oil from the *William Rockefeller* (Table 3-1) include numerous guilds of birds, particularly those sensitive to surface oiling while rafting or plunge diving to feed and are present in nearshore/offshore waters. As can be noted in the table, large numbers of birds winter in both coastal and offshore waters, and many of the beaches are very important shorebird habitat. In addition, this region is important for commercially important fish and invertebrates.

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

Species Group	Species Subgroup and Geography	Seasonal Presence
Seabirds	• Outer Continental Shelf (OCS) offshore of Cape Hatteras, NC: greatest diversity of seabirds in SE U.S.; greatest density of tropical seabirds in SE U.S. Species include: shearwaters, storm petrels, Bermuda petrels • Significant percentage of the global population of black-capped petrels (FE) may be present in *Sargassum* mats off Cape Hatteras • Audubon's shearwaters (50-75% of population) concentrate along the Continental Shelf edge off NC, extending northward to VA border (~3,800 pairs) • Seabird species groups using Mid-Atlantic U.S. waters include boobies (~300K) and alcids (tens of thousands)	OCS: Ranges by species but Mar-Nov peak Petrels off NC/VA coast during summer through early fall; Shearwaters off of NC/VA in late summer
Pelagic Birds, Waterfowl, and Diving Birds	Coastal pelagic birds, waterfowl, diving birds • Outer Banks, Inshore waters NC to VA: key foraging area for gulls and terns; key migration corridor for loons and sea ducks; NC's largest population of northern gannet and red-breasted merganser • Mid-Atlantic inshore/offshore waters: 150K loons, 6K pelicans, 100s of thousands of cormorants and terns, millions of gulls • Mouth of Chesapeake: high concentrations of gannets and very high concentrations of RBME	Terns, gulls present in spring/summer; Loons, sea ducks present in spring/fall; Gannets and red-breasted mergansers present in winter
Sea Ducks	Sea ducks (includes mean and max distance of flocks to shore, 2009-2010 data) • Surf scoter (2nm/8 nm): Chesapeake. Bay = 19-58K; NC: 0-41K • Black scoter (2 nm/13 nm): Chesapeake. Bay =3-27K; NC = 3.5-13K • Bufflehead, mergansers, goldeneyes (<1 nm/7-14 nm) • Off NC: 12K • Off MD/DE: 3K • Mouth of Chesapeake Bay have high concentrations of species that are abundant over shoals (loons, pelicans, cormorants, sea ducks, gulls, terns, alcids); scoters are 10X more abundant than other species on shoals and large numbers concentrate off VA/Chesapeake Bay	Sea ducks surveyed in winter (peak abundances); Migration from Fall to Spring (Oct-Apr) Winter use of shoals (Dec-Mar); summer use of shoals likely farther north
Shorebirds and Colonial Nesting Birds	• Outer Banks: globally important for coastal birds with 365+ species • Key species: Piping plover, willet, American oystercatcher, black skimmers • VA Barrier Island/Lagoon System: most important bird area in VA and one of most along North Atlantic: piping plover (FT), Wilson's plover, American oystercatcher, gull-billed tern, least tern, black skimmer (many of these species are state listed or special concern in VA); most significant breeding population in state of waders; marsh nesters have center of abundance here; internationally significant stopover point for whimbrel, short-billed dowitcher, and red knot	Colonial and beach nesters peak Apr-Aug Winter migration stop for plovers
Sea Turtles	Nesting (annual counts along shorelines with most probable impacts). Mostly occurs in NC but loggerheads can nest as far north as DE • 650+ Loggerhead (FT) • <20 Green (FT) • <10 Leatherback (FE)	Nesting season: Adults: May-Sept Hatching: May-Dec In water: Year round with Apr-

Species Group	Species Subgroup and Geography	Seasonal Presence
	Distribution: • Offshore hot spots not well known • Young associate with Sargassum mats off of Cape Hatteras	Dec peak
Marine Mammals	Baleen whales: Primarily North Atlantic right whale (FE) and fin whale (FE) with occasional humpback whale (FE), sei whale (FE) and minke whale • Right whales are critically endangered (<400 individuals left); Coastal waters are used as a migratory pathway and border the northern extent of calving grounds Inshore cetaceans: Bottlenose dolphin and harbor porpoise use coastal waters out to the shelf break Offshore cetaceans: Pilot whale, Risso's dolphin, striped dolphin, common dolphin, Atlantic spotted dolphin, spinner dolphin, pilot whale Often associated with shelf edge features, convergence zones (fronts), and Sargassum mats (summer) Deep diving whales: Sperm whale (FE), pygmy sperm whale, beaked whales (5 species present) forage in deep waters along the shelf in the potential spill area Pinnipeds: Harbor seals can sometimes occur as far south as NC during the winter. Harp, hooded, and gray seals have also been observed but are rare Manatees occasionally occur as far north as Cape Lookout but this is not considered part of their normal range	Baleen whales present Fall-Spring. Adults migrate from feeding grounds in North Atlantic to calving grounds further south Juvenile humpbacks forage offshore during the winter Bottlenose dolphins present year round Harbor seals present during the winter
Fish and Shellfish	Coastal ocean waters support many valuable fisheries and/or species of concern in the region: • *Benthic* or bottom associated: Sea scallop, scup, black sea bass, butterfish, goosefish, scamp, horseshoe crab, tilefish, other reef species • *Midwater*: Atlantic mackerel, spanish mackerel, shortfin squid, bluefish, menhaden, spiny dogfish, smooth dogfish, • *Pelagic*: Bluefin tuna, yellowfin tuna, wahoo, dolphinfish, bigeye tuna, swordfish • *Diadromous*: Alewife, blueback herring, American shad, hickory shad, Atlantic tomcod, American eel, Atlantic sturgeon (Fed. species of concern), shortnose sturgeon (FE), striped bass • *Estuarine dependent*: Southern flounder, spotted seatrout, blue crab, atlantic croaker, spot, weakfish, shrimp • *Estuarine resident*: Eastern oyster, northern quahog Important concentration/conservation areas are: • Pelagic species can be more concentrated around the shelf break and at oceanographic fronts in the region • The Point (offshore of Cape Hatteras) – Essential Fish Habitat/Habitats Areas of Particular Concern (EFH/HAPC) for coastal migratory pelagics and dolphin/wahoo • Primary nursery areas in NC bays – for estuarine dependent species • Sargassum mats off Cape Hatteras provide foraging and shelter for juvenile fish and invertebrates	Benthic and midwater species are present throughout the year Bluefin tuna present fall-spring; other pelagic fish present year round Anadromous fish migrate inshore to spawn in fresh water in spring American eel migrates offshore to spawn in winter Estuarine dependent fish migrate offshore in fall/winter to spawn; juveniles and adults use estuaries during spring/summer
Benthic Habitats	Submerged aquatic vegetation is critical to numerous species and occurs inside of bays and sounds throughout the region Scattered hard-bottom sites are located off NC and are considered HAPC for reef-associated fishes (including the areas listed above)	Year round

The Environmental Sensitivity Index (ESI) atlases for the potentially impacted coastal areas from a leak from the *William Rockefeller* 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 *William Rockefeller* is provided, both as text and as shading of the applicable degree of risk bullet, for the WCD release of 150,000 bbl and a border around the Most Probable Discharge of 15,000 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 *William Rockefeller* is classified as High Risk for oiling probability for water column ecological resources for the WCD of 150,000 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 classified as Medium Risk for degree of oiling because the mean volume of water contaminated was 130 mi^2 of the upper 33 feet of the water column. For the Most Probable Discharge of 15,000 bbl, the *William Rockefeller* 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 14 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 *William Rockefeller* is classified as High Risk for oiling probability for water surface ecological resources for the WCD because 100% of the model runs resulted in at least 1,000 mi^2 of the water surface affected above the threshold of 10 g/m^2. It is classified as High Risk for degree of oiling because the mean area of water contaminated was 64,000 mi^2. The *William Rockefeller* is classified as High Risk for oiling probability for water surface ecological resources for the Most Probable Discharge because 99% 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 High Risk for degree of oiling because the mean area of water contaminated was 19,000 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 *William Rockefeller* is classified as Medium Risk for oiling probability for shoreline ecological resources for the WCD because 14% 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 29 miles. The *William Rockefeller* is classified as Medium Risk for degree of oiling to shoreline ecological resources for the Most Probable Discharge because 24% 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 18 miles.

Considering the modeled risk scores and the ecological resources at risk, the ecological risk from potential releases of the WCD of 150,000 bbl of heavy fuel oil from the *William Rockefeller* is summarized as listed below and indicated in the far-right column in Table 3-2:

- Water column resources – Medium, because of the importance of coastal and estuarine waters as spawning and rearing habitat for commercially important fish and shellfish
- Water surface resources – High, because of the very large number of wintering, nesting, and migratory birds that use both coastal and estuarine habitats at risk, sea turtle concentrations in Sargassum habitat, and the persistence of tarballs that can be transported long distances. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of sheens, tarballs, and streamers
- Shoreline resources – Medium, because most of the shoreline at risk is composed of sand beaches which are relatively easy to clean, although these beaches are used by many shorebirds and sea turtles for nesting and many shorebirds as wintering and migratory stopovers

Table 3-2: Ecological risk scores for the **Worst Case Discharge of 150,000 bbl** of heavy fuel oil from the *William Rockefeller*.

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 131 mi^2 of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	Low	Medium	**High**	100% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 10 g/m^2	**High**
3B-2: Water Surface Degree EcoRAR Oiling	Low	Medium	**High**	The mean area of water contaminated above 10 g/m^2 was 64,000 mi^2	
3C-1: Shoreline Probability EcoRAR Oiling	Low	**Medium**	High	14% 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 29 mi	

For the Most Probable Discharge of 15,000 bbl, the ecological risk from potential releases from the *William Rockefeller* is summarized as listed below and indicated in the far-right column in Table 3-3:

- Water column resources – Low, because although coastal and estuarine waters are spawning and rearing habitat for commercially important fish and shellfish, the impact area is relatively small
- Water surface resources – High, because of the very large number of wintering, nesting, and migratory birds that use both coastal and estuarine habitats at risk, sea turtle concentrations in *Sargassum* habitat, and the persistence of tarballs that can be transported long distances. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of sheens, tarballs, and streamers
- Shoreline resources – Medium, because most of the shoreline at risk is composed of sand beaches which are relatively easy to clean, although these beaches are used by many shorebirds and sea turtles for nesting and many shorebirds as wintering and migratory stopovers

Table 3-3: Ecological risk scores for the **Most Probable Discharge of 15,000 bbl** of heavy fuel oil from the *William Rockefeller*.

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 14 mi^2 of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	Low	Medium	**High**	99% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 10 g/m^2	High
3B-2: Water Surface Degree EcoRAR Oiling	Low	Medium	**High**	The mean area of water contaminated above 10 g/m^2 was 19,000 mi^2	
3C-1: Shoreline Probability EcoRAR Oiling	Low	**Medium**	High	11% 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 18 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 *William Rockefeller* include very highly utilized recreational beaches on the Outer Banks of North Carolina and the Cape Hatteras National Seashore during summer, but also during spring and fall for shore fishing. This area also has hotspots for chartered fishing vessels and recreational fishing parties. Many areas along the entire potential spill zone are widely popular seaside resorts and support recreational activities such as boating, diving, sightseeing, sailing, fishing, and wildlife viewing.

There are also several fishing fleets that utilize the waters around and outside the Outer Banks, yielding annual catches of about $64.7 million.

There are two significant ports in North Carolina that might be affected – Morehead City and Wilmington with a total of 635 port calls and 22.3 million tonnage annually, of which over 40% are tankers.

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 important socio-economic resources at risk and should be consulted.

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

Resource Type	Resource Name	Economic Activities
National Seashore	Cape Hatteras National Seashore, NC	National seashores provide recreation for local and tourist populations as well as preserve and protect the nation's natural shoreline treasures. National seashores are coastal areas federally designated as being of natural and recreational significance as a preserved area. Cape Hatteras is known for its Bodie Island and Cape Hatteras Lighthouses. Popular recreation activities include windsurfing, birdwatching, fishing, shell collecting, and kayaking. The barrier island provides refuge for the endangered piping plover, seabeach amaranth, and sea turtles.
National Wildlife Refuges	Back Bay NWR (VA) Mackay Island NWR (NC) Currituck NWR (NC) Pea Island NWR (NC) Cedar Island NWR (NC) Waccamaw NWR (SC)	National wildlife refuges in three states may be impacted. These federally-managed and protected lands provide refuges and conservation areas for sensitive species and habitats.

Resource Type	Resource Name	Economic Activities
Commercial Fishing	A number of fishing fleets use the New York Bight area and surrounding waters for commercial fishing purposes.	
	Beaufort-Morehead City	Total Landings (2010): $9.2M
	Belhaven-Washington	Total Landings (2010): $3.7M
	Elizabeth City	Total Landings (2010): $5.4M
	Engelhard-Swanquarter	Total Landings (2010): $10.6M
	Oriental-Vandemere	Total Landings (2010): $8.4M
	Sneads Ferry-Swansboro	Total Landings (2010): $5.4M
	Wanchese-Stumpy Point	Total Landings (2010): $22.0M
Ports	There are two significant commercial ports in North Carolina that could potentially be impacted by spillage and spill response activities. The port call numbers below are for large vessels only. There are many more, smaller vessels (under 400 GRT) that also use these ports.	
	Morehead City, NC	85 port calls annually
	Wilmington, NC	550 port calls annually

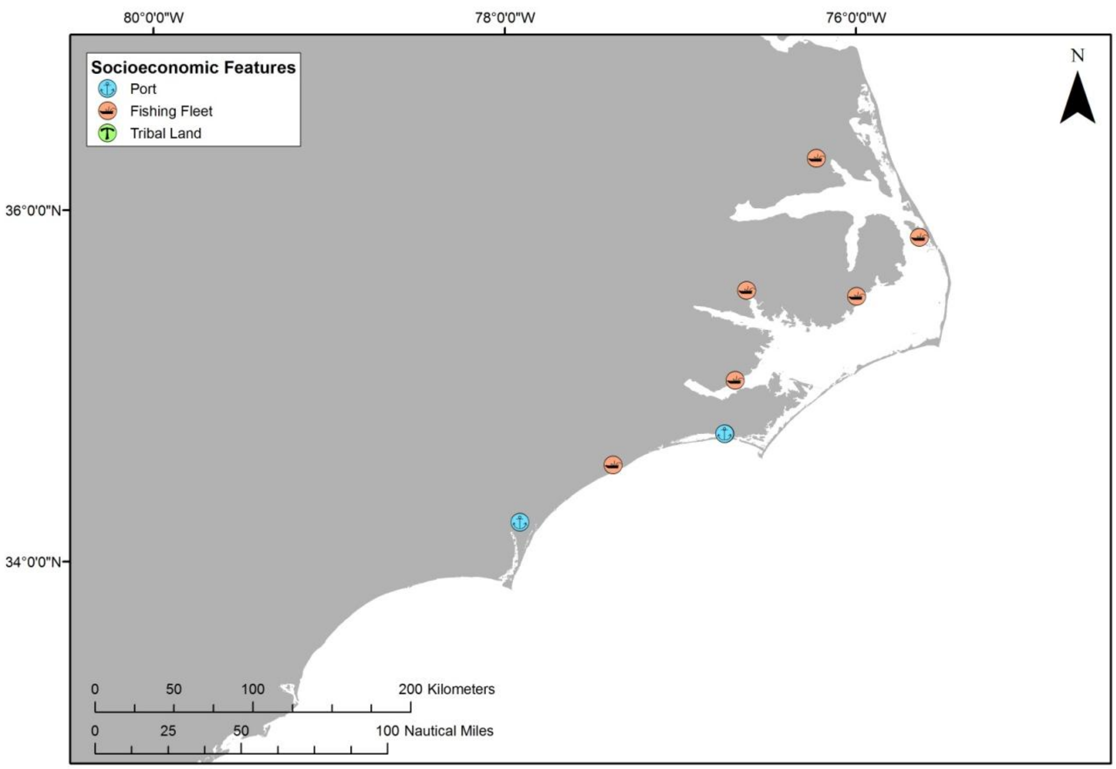


Figure 4-1: Tribal lands, ports, and commercial fishing fleets at risk from a release from the *William Rockefeller*. (Note that there are no tribal lands affected.)

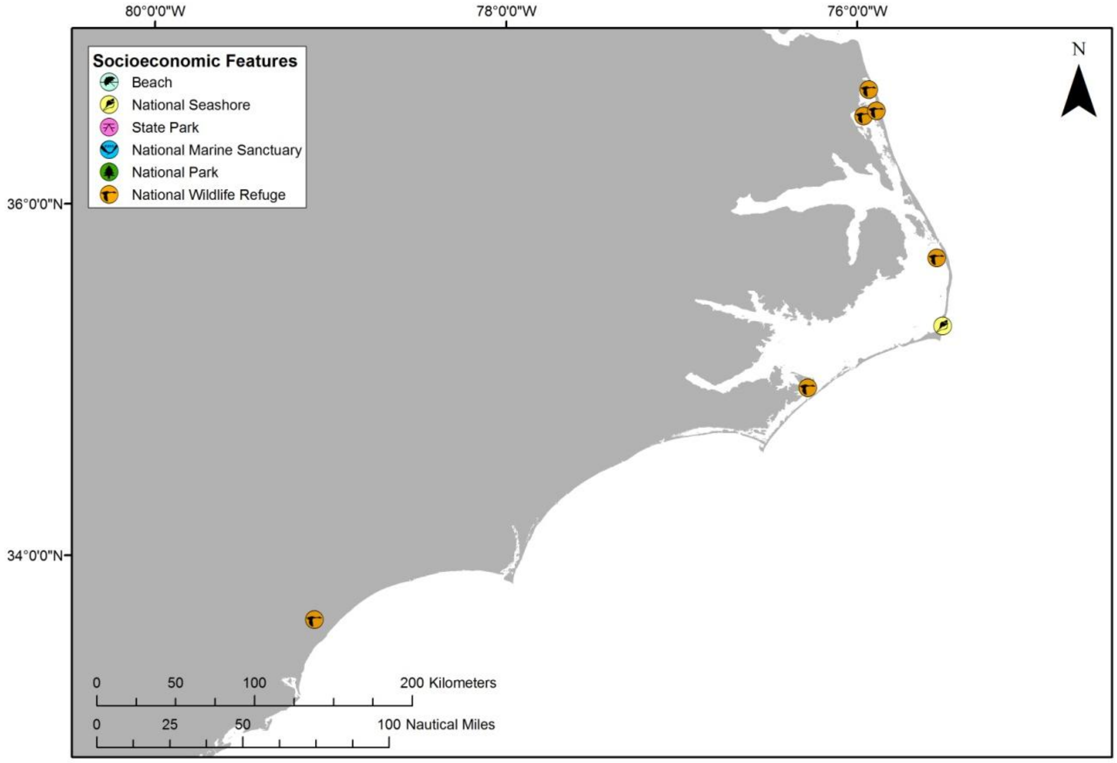


Figure 4-2: Federal protected lands at risk from a release from the *William Rockefeller*.

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 were one. The measure of the degree of impact is based on the median case for which there is at least some impact. The median case is the "middle case" – half of the cases with significant impacts have less impact than this case, and half have more.

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

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

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

In the following sections, the definition of low, medium, and high for each socio-economic risk factor is provided. Also, in the text classification for the *William Rockefeller* shading indicates the degree of risk for the WCD release of 150,000 bbl and a border indicates degree of risk for the Most Probable Discharge of 15,000 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 *William Rockefeller* is classified as High Risk for oiling probability and Medium Risk for degree of oiling for water column socio-economic resources for the WCD of 150,000 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 130 mi^2 of the upper 33 feet of the water column. For the Most Probable Discharge of 15,000 bbl, the *William Rockefeller* 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 14 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 *William Rockefeller* 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 65,000 mi^2. The *William Rockefeller* is classified as High Risk for oiling probability for water surface socio-economic resources for the Most Probable Discharge because 99% 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 19,000 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 *William Rockefeller* is classified as Medium Risk for oiling probability for shoreline socio-economic resources for the WCD because 16% 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 87 miles. The *William Rockefeller* is classified as Medium Risk for both oiling probability and degree of oiling for shoreline socio-economic resources for the Most Probable Discharge as 16% 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 73 miles.

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

Considering the modeled risk scores and the socio-economic resources at risk, the socio-economic risk from potential releases of the WCD of 150,000 bbl of heavy fuel oil from the *William Rockefeller* is summarized as listed below and indicated in the far-right column in Table 4-2:

- Water column resources – Medium, because there would be a moderate impact to important fishing grounds
- Water surface resources – High, because a large offshore area would be covered with oil, affecting port traffic and other offshore activities. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of sheens, tarballs, and streamers
- Shoreline resources – Medium, because a moderate amount of shoreline would be impacted with the persistent oil and tarballs and would be relatively easy to clean, although there are a large number of potentially vulnerable socio-economic resources located along the shoreline

Table 4-2: Socio-economic risk factor ranks for the **Worst Case Discharge of 150,000 bbl** of heavy fuel oil from the *William Rockefeller*.

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 131 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	High
4B-2: Water Surface Degree SRAR Oiling	Low	Medium	**High**	The mean area of water contaminated above 0.01 g/m^2 was 65,000 mi^2	
4C-1: Shoreline Probability SRAR Oiling	Low	**Medium**	High	16% 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 87 mi	

For the Most Probable Discharge of 15,000 bbl, the socio-economic risk from potential releases of heavy fuel oil from the *William Rockefeller* is listed below and indicated in the far-right column in Table 4-3:

- Water column resources – Low, because there would be a moderate impact to a relatively small area of important fishing grounds
- Water surface resources – High, because a large offshore area would be impacted, affecting port traffic and other offshore activities. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of sheens, tarballs, and streamers
- Shoreline resources – Medium, because a moderate amount of shoreline would be impacted with the persistent oil and tarballs and would be relatively easy to clean, although there are a large number of potentially vulnerable socio-economic resources located along the shoreline

Table 4-3: Socio-economic risk factor ranks for the **Most Probable Discharge of 15,000 bbl** heavy fuel oil from the *William Rockefeller*.

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 14 mi^2 of the upper 33 feet of the water column	
4B-1: Water Surface Probability SRAR Oiling	Low	Medium	**High**	99% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 0.01 g/m^2	High
4B-2: Water Surface Degree SRAR Oiling	Low	Medium	**High**	The mean area of water contaminated above 0.01 g/m^2 was 19,000 mi^2	
4C-1: Shoreline Probability SRAR Oiling	Low	**Medium**	High	16% 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 73 mi	

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

The overall risk assessment for the *William Rockefeller* 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 particular 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, *William Rockefeller* scores High with 16 points; for the Most Probable Discharge, *William Rockefeller* scores Medium with 14 points. Under the National Contingency Plan, the U.S. Coast Guard and the Regional Response Team have the primary authority and responsibility to plan, prepare for, and respond to oil spills in U.S. waters. Based on the technical review of available information, NOAA proposes the following recommendations for the *William Rockefeller*. The final determination rests with the U.S. Coast Guard.

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

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

Vessel Risk Factors		Data Quality Score	Comments		Risk Score
Pollution Potential Factors	A1: Oil Volume (total bbl)	Medium	Maximum of 150,000 bbl, no reports of leakage		**Med**
	A2: Oil Type	High	Group IV, heavy fuel oil and Bunker C		
	B: Wreck Clearance	High	Not known to be cleared		
	C1: Burning of the Ship	High	Ship burned for 11 hours		
	C2: Oil on Water	High	Oil was reported spraying over/on the deck at the time of casualty		
	D1: Nature of Casualty	High	Two torpedo strikes		
	D2: Structural Breakup	Low	Unknown		
Archaeological Assessment	Archaeological Assessment	High	Detailed sinking records of this ship exist, assessment is believed to be very accurate		**Not Scored**
Operational Factors	Wreck Orientation	Low	Unknown, potential to be upright		**Not Scored**
	Depth	Low	850 to 6,000 feet		
	Visual or Remote Sensing Confirmation of Site Condition	Low	None		
	Other Hazardous Materials Onboard	High	None reported.		
	Munitions Onboard	High	Munitions for one 3-inch gun		
	Gravesite (Civilian/Military)	High	No		
	Historical Protection Eligibility (NHPA/SMCA)	High	Yes, NHPA and possibly SMCA		
				WCD	**Most Probable**
Ecological Resources	3A: Water Column Resources	High	Impact area is important spawning and rearing area for commercially important fish and shellfish	**Med**	**Low**
	3B: Water Surface Resources	High	Persistent tarballs can travel long distances posing risks to large numbers of birds and sea turtles, esp. when concentrated in convergence zones and *Sargassum*	**High**	**High**
	3C: Shore Resources	High	Persistent tarballs strand on beaches and marshes, fouling habitats that are heavily used by birds and sea turtles	**Med**	**Med**
Socio-Economic Resources	4A: Water Column Resources	High	Moderate impact to a relatively small area of important fishing grounds	**Med**	**Low**
	4B: Water Surface Resources	High	A large offshore area would be impacted, affecting port traffic and other offshore activities	**High**	**High**
	4C: Shore Resources	High	There are a large number of potentially vulnerable socio-economic resources located along the shoreline	**Med**	**Med**
Summary Risk Scores				**16**	**14**