Screening Level Risk Assessment Package

Coimbra
National Oceanic and Atmospheric Administration

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Photo: U.S. Coast Guard Identification Photograph of Coimbra
Courtesy of National Archives, Washington, D.C.
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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: Coimbra

The tanker Coimbra, torpedoed and sunk during World War II off the coast of Long Island 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 Coimbra, 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.

The Coimbra is a particularly well-studied and visited wreck. In 1967, the U.S. Coast Guard’s Sunken Tanker Project Report determined that residual traces of the lubricating oil cargo remained in the tanks that were accessible to the divers. They were not able to assess the condition or contents of any of the tanks that were sunken into the mud. In 1975, the Polytechnic Institute of New York estimated the remaining contents of the un-assessed tanks at 28,500 bbl; this volume does not account for remaining bunkers. In 2009, recreational divers reported more oil than usual on the site. In 2009, at the request of the U.S. Coast Guard, NOAA obtained an accurate location and high-resolution sonar data of the wreck. During the survey, no oil was reported on the site.

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, Coimbra scores High with 16 points; for the Most Probable Discharge (10% of the Worse Case volume), Coimbra scores Medium with 12 points. Given these scores, NOAA recommends that this site be noted in Area Contingency Plans and be considered for further assessment to determine the vessel condition, amount of oil onboard, and feasibility of oil removal action. At a minimum an active monitoring program should be implemented. Outreach efforts with the technical and recreational dive community as well as commercial and recreational fishermen who frequent the area would help gain awareness of changes in the site.

The determination of each risk factor is explained in the document. This summary table is found on page 45.
Vessel Particulars

Official Name: Coimbra
Official Number: 165498
Vessel Type: Tanker
Vessel Class: N/A
Former Names: N/A
Year Built: 1937
Builder: Howaldts-Werke A.G., Kiel
Builder’s Hull Number: 756
Flag: British
Owner at Loss: Socony-Vacuum Transportation Co. Ltd.
Controlled by: Unknown
Chartered to: Unknown
Operated by: Unknown
Homeport: London
Length: 422 feet
Beam: 60 feet
Depth: 32 feet
Gross Tonnage: 6,768
Net Tonnage: 3976
Hull Material: Steel
Hull Fastenings: Riveted
Powered by: Oil-fired steam
Bunker Type: Heavy Fuel Oil (Bunker C)
Bunker Capacity (bbl): Unknown
Average Bunker Consumption (bbl) per 24 hours: Unknown
Liquid Cargo Capacity (bbl): Unknown
Dry Cargo Capacity: Unknown
Tank or Hold Description: Unknown, but Coimbra’s sister ship had eight main cargo tanks and four summer tanks
Casualty Information

**Port Departed:** New York

**Date Departed:** January 14, 1942

**Number of Days Sailing:** 1

**Latitude (DD):** 40.4014

**Nautical Miles to Shore:** 28.02

**Approximate Water Depth (Ft):** 170

**Is There a Wreck at This Location?** Yes, wreck has been positively located and identified

**Wreck Orientation:** Broken into three parts and resting on its starboard side, the bow is inverted

**Vessel Armament:** One B.L. 4” gun; one Holman Projector; two Hotchkiss .303 guns; four Lewis .303 machine guns; one Ross rifle .303; two Walther 7.65 mm pistols

**Cargo Carried when Lost:** Lubricating oil

**Cargo Oil Carried (bbl):** Approximately 64,800

**Probable Fuel Oil Remaining (bbl):** Unknown, <10,000

**Total Oil Carried (bbl):** <75,000

**Munitions Carried:** 53 rounds 4” cordite charges; 40 rounds 4” high-explosive shells; 5 rounds 4” practice shells; 48 rounds 4” percussion tubes; 32 bombs for Holman Projector; 4,600 rounds for machine guns; 40 rounds for pistols

**Demolished after Sinking:** No

**Salvaged:** No

**Historically Significant:** Yes

**Gravesite:** Yes

**Cargo Lost:** Yes, partially

**Reportedly Leaking:** Yes

**Salvage Owner:** Not known if any
Wreck Location

Casualty Narrative

“At 09.41 hours on 15 Jan, 1942, the unescorted Coimbra (Master John Patrick Barnard) was hit by one G7e torpedo from U-123, which had spotted the lights of the tanker astern while the U-boat was proceeding eastbound following the southern shore of Long Island. The torpedo struck on the starboard side just aft of the superstructure. A huge towering explosion lit up the night sky and the cargo of oil quickly caught fire and spread across the water. Residents from the Hamptons on Long Island could see the fire at sea 27 miles away and alerted the authorities. At 09.59 hours, a coup de grâce hit the tanker underneath the funnel and her stern settled fast, striking the sea floor after five minutes. Like his previous victim, the Norness, the bow of the Coimbra was sticking out of the water. Hardegen commented: These are some pretty buoys we are leaving for the Yankees in the harbor approaches as replacement for the lightships. The tanker later sank completely. The master, 29 crew members, and six gunners were lost. Ten survivors, six of them wounded were rescued from the rough seas. Two crew members were picked up by USS Rowan (DD 405) and landed at Argentia, Newfoundland. The remaining survivors were rescued by another American destroyer and landed at St. Johns.”

http://www.uboat.net:8080/allies/merchants/ships/1251.htm
Figure 1-1 shows a photograph of the sinking of the Coimbra taken by the First Air Force at Mitchell Field, NY.

**Figure 1-1:** LIFE Magazine article depicting the sinking of the tanker Coimbra (Source: National Archives, College Park, MD, Declassification Number NND968133.

**General Notes**

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

**HISTORY**
NM4/42
NM49/42

**DESCRIPTION**
NO.310; TANKER, 6768 GT, SUNK 1/15/42 BY SUBMARINE; POS. ACCURACY 1-3 MILES; POS. LAT. 40-20-00N, LONG. 72-20-00W. NO.199; TKR 3976 NT, SUNK 1/15/42 AT LAT. 40-22-00N, LONG. 72-20W.

**** POLYTECNIC INSTITUTE OF NY--PROPOSAL FOR RECOVERY OF OIL, 1975; REPORTS WK. IN 3 SECTIONS, STERN HEELED AT 80 DEG, MIDSHEIPS SECTION INCLINED AT 75 DEG TO PORT AND PARTIALLY BURIED, ...VESSEL 6798 GT, 433 FT L, 33 FT D, BUILT 1937, OWNED BY SOCONY-VACUM COMPANY LTD.

**** USCG, SUNKEN TANKER PROJECT REPORT, 1967--LOCATED AT POS.40-23-12N 72-21-30W, DIVERS OBSERVE VESSEL IN 3 SECTIONS AT 182 FT DEPTH, METAL IN EXCELLENT CONDITION W/LITTLE DETERIORATION (CG POS. NOT CONSIDERED
RELIABLE DUE TO LARGE DIFFERENCES BETWEEN CG AND OTHER SOURCES OF PO.
FOR OTHER WKS. IN REPORT. 1967 POS MAY BE BASED ON EARLIER AND LESS
ACCURATE LORAN-C CHAR. LORAN C RATES PROVIDED BY MR. RICHARD TARACKA,
GREENWICH, CT. POLICE DEPARTMENT, TEL NO 203-622-8020; 9960-X 262040, 9960-Y
43576.3. (ENTERED MSM 4/90).

TANKER, 6770 TONS; 433 FT. L, 60 FT. W, TORPEDOED 1/15/42 IN 180 FT.
TANKER, 6786 TONS; TORPEDOED 1/15/42, IN 180 FT; PORT AND CENTER TANKS
BELOW OCEAN FLOOR; DIVER INVEST. IN 1967 POS 40-22N, 72-20W. BUILT BY
HOWALDJ SWERKE CO. OF GERMANY IN 1937; TANKER OWNED BY THE SOCONY
VACUME OIL CO. LTD.; 423 FT. LONG, 60 FT. BEAM, DISPLACED 6768 GROSS TONS; HIT
AMIDSHIPS BY A TORPEDO FROM THE U-123 ON JANUARY 15, 1942; FUEL CARGO
EXPLODED INTO FLAMES AND SHIP WAS RIPPED INTO THREE SECTIONS BEFORE
SINKING; LOCATED 56 MILES SOUTHEAST OF JONES INLET IN 180 FT.; LORAN C
RATES: 9960-26203.6, 9960-Y 43576.6. (ENTERED MSM 6/9).

The Coimbra was resurveyed in November 2009 by the NOAA Office of Coast Survey

Figure 1-2: High-resolution multibeam bathymetry of the Coimbra wreck taken by the NOAA Ship Thomas Jefferson,
Wreck Condition/Salvage History

From Brad Sheard's book Beyond Sportdiving—

“The Coimbra lies on her starboard side under 180 feet of water. Her hull is broken at each of the torpedo impact points, forming three fairly intact sections. The shortest of the three pieces is the extreme stern, whose deck lies heeled over approximately 80 degrees to starboard. Part of the superstructure is still in place, including the stern gun that Lieutenant Hardegen made a note of in his war diary. Just forward of the stern section lies the midships piece of the wreck, intact to a point approximately 40 to 50 feet aft of the center island bridge. It lies inclined somewhat farther to starboard at an angle of about 100 degrees. Forward of this second break in the hull, the remainder of the ship runs intact all the way to her bow, which is now somewhat crumpled and twisted, and heeled over so far that it lies nearly upside down on the sandy bottom.
It is difficult to ascertain the condition of her internal tanks. In the extreme stern, her hull is but an empty shell. All the internal appointments of the crew's quarters have slid to the lower, starboard side of the wreck. Here, amidst a pile of rubble, divers have found her galley implements, including a few unbroken pieces of china bearing a small, blue flag emblazoned with a single letter "S". This apparently represents the initials of her owners, the Socony-Vacuum Company, Ltd. There were no oil tanks in this part of the ship.

At both of the torpedo impact points, the oil tanks are open to the sea and empty. Between the hull breaks, little can be concluded about the presence or absence of oil inside. The exterior of the hull is in excellent condition, with no apparent breaches. Along the sand, several of her tank inspection hatches can be seen, bent and distorted by the weight of the ship's hull. While open to the sea, the hatches now lie at the bottom of the tank since the ship lies on her starboard side. This effectively blocks the escape route for the lighter-than-water oil.

For now, the old tanker lies quietly on the ocean bottom, visited frequently by fishermen and occasionally by curious divers. Her location is clearly marked, however, by the thin slick of lubricating oil continuously oozing from her hull. No one knows exactly how much oil remains in her holds, or how long her heavy, steel hull will resist the relentless deterioration of the sea water in which she lies. Tragically, the Coimbra may someday make the headlines once again.”

**Archeological Assessment**

The archeological 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 archeological 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, archeological assessments cannot be made with any degree of certainty and were not prepared. For vessels with full archeological assessments, NOAA archeologists 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**

*Coimbra* is a shipwreck that has received much attention by environmentalists, U.S. Coast Guard, and various academic institutes since it was torpedoded by the German submarine *U-123* on January 15, 1942. The wreck has been described as an environmental disaster waiting to happen and estimates of remaining cargo oil left onboard the wreck have been as high as 35,000 bbl (1,470,000 gallons) of lubricating oil,
not including bunkers. The more commonly accepted and used estimate still remains as high as 28,500 bbl (1,197,000 gallons) of lubricating oil in eight cargo tanks, not including bunkers. The problem with these estimates, however, is that the studies they are based on are not easily accessible and were written as early as 1975. After more than three additional decades of leaking, it is unlikely that this amount of oil remains in the wreck. The estimate of 28,500 bbl of oil in eight intact cargo tanks appears to originate from a 1975 study written by the Polytechnic Institute of New York and referenced in a New York Times article written on November 30, 1975. Unfortunately, this study has not been located, so one is left to speculate as to which eight tanks the article refers.

Since the 1967 U.S. Coast Guard “Sunken Tanker Project Report” reported that the starboard tanks in the middle section were empty except for slight traces of oil and divers report the stern section where the bunker tanks were located is empty, the only tanks the study could reference would be the port side tanks the U.S. Coast Guard could not access in 1967, or the inverted tanks in the bow section. Since 1967, there is evidence to suggest the middle and aft sections of the wreck have rolled over. In fact, diver reports suggest that this transition likely occurred between 1987 when diver and author Dan Berg reported the wreck was listing to port (in an article written in his book Wreck Valley Vol. II, 1990) and 1991 when diver and author Brad Sheard reported the wreck was lying on its starboard side in his book Beyond Sportdiving. Today, divers report the decking on the wreck corroded away and the tank hatches from the middle section open to the sea, meaning the portside tanks are also likely empty or only contain residual oil since much of the oil would have escaped as the vessel rolled from its port side to its starboard side. Given these factors, it is likely that the article written by the Polytechnic Institute of New York refers to the tanks in the inverted bow section of the wreck.

It is not known, however, if the eight tanks referenced meant the four main bow cargo tanks divided into port and starboard tanks by the oil tight centerline bulkhead, or if it meant the four main bow cargo tanks and the four bow summer tanks or a combination of the two. Given that each main tank could hold around 3,571 bbl (150,000 gallons) of oil, any of the above scenarios would give about the same approximation of remaining oil as the Polytechnic Institute of New York came up with in 1975. It seems improbable, however, that this could be an accurate estimate given the violent nature in which the vessel sank. The captain of U-123, Reinhard Hardegen reported in his war diary that the tanker Coimbra’s bridge was on fire (a structure located over main cargo tanks three and four, and over port and starboard summer tanks number two). As Coimbra sank, the vessel’s stern struck the bottom, leaving the burning bow remaining above water from the foremost to the stem (the foremost was located above main cargo tanks one and two and above port and starboard summer tanks number one). The vessel’s bow remained like this well after daylight before it finally lost buoyancy and sank.

Given the circumstances of the sinking and the violent nature of the torpedo attack, it is unlikely that any of the tanks on Coimbra escaped without some form of damage and some release of oil, so the exact amount of remaining oil cannot be determined with any degree of certainty.

Should the vessel be assessed, it should be noted that this vessel is of historic significance and will require appropriate actions be taken under the National Historic Preservation Act (NHPA) and the Sunken Military Craft Act (SMCA) prior to any actions that could impact the integrity of the vessel. This vessel
may be eligible for listing on the National Register of Historic Places. The site is also considered a war grave and appropriate actions should be undertaken to minimize disturbance to the site.

**Background Information References**

**Vessel Image Sources:** National Archives, Washington, DC; National Archives, College Park, MD

**Construction Diagrams or Plans in RULET Database?** No

**Text References:**

- Office of the Chief of Naval Operations
  1942 Tenth Fleet ASW Analysis & Stat. Section Series XIII. Report and Analyses of U. S. and Allied Merchant Shipping Losses 1941-1945 MS-19 - Nymph, Records of the Office of the Chief of Naval Operations, Box 239, Record Group 38, National Archives at College Park, MD.

- United States Coast Guard
  WWII Reports Concerning Merchant Vessels Sinking, 1938-2002 FOREIGN Ciltvairia to Denewood, Records of the United States Coast Guard, Entry P-2, Box 60, Record Group 26, National Archives Building, Washington, DC.

  Office of Operations Intelligence and Security Division Merchant Vessels Information Files, 1939-52 Cockerel to Comatugia, Records of the United States Coast Guard, MLR A1 180, Box 36, Record Group 26, National Archives Building, Washington, DC.

- United States Coast Guard

- New York Times

  [http://www.uboot.net/allies/merchants/1251.htm](http://www.uboot.net/allies/merchants/1251.htm)

- AWOIS database
- Coast Survey 2009 field report

- NIMA database
- Global Wrecks
  [http://njscuba.net/sites/site_coimbra.html](http://njscuba.net/sites/site_coimbra.html)

**Vessel Risk Factors**

In this section, the risk factors that are associated with the vessel are defined and then applied to the *Coimbra* 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 1-2 is simple and straightforward and, in combination with the accompanying archeological 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 archeological assessment may provide additional input that will amend the score for Section 1. Where available, additional information that may have bearing on operational considerations for any assessment or remediation activities is provided.

Each risk factor is characterized as High, Medium, or Low Risk or a category-appropriate equivalent such as No, Unknown, Yes, or Yes Partially. The risk categories correlate to the decision points reflected in Figure 1-2.

**Pollution Potential Tree**

![Pollution Potential Tree Diagram]

*Figure 1-2: U.S. Coast Guard Salvage Engineering Response Team (SERT) developed the above Pollution Potential Decision Tree.*
Each of the risk factors also has a “data quality modifier” that reflects the completeness and reliability of the information on which the risk ranks were assigned. The quality of the information is evaluated with respect to the factors required for a reasonable preliminary risk assessment. The data quality modifier scale is:

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

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

### Pollution Potential Factors

#### Risk Factor A1: Total Oil Volume

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

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

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

The *Coimbra* is ranked as High Volume because, the best estimates of remaining oil suggests there are potentially 28,500 bbl of oil remaining onboard. Data quality is low because this estimate has not been confirmed through detailed analysis of the vessel or of oil remaining in the intact tanks and cannot accurately determine how much oil has been released through frequently reported leaks.

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 multiple reports of leakage from the *Coimbra*.

#### 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:

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\(^1\) 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).”
- **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 *Coimbra* is classified as Medium Risk because the cargo is lubricating oil, a Group II oil type. Data quality is high.

**Was the wreck demolished?**

**Risk Factor B: Wreck Clearance**

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

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

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

**Was significant cargo or bunker lost during casualty?**

**Risk Factor C1: Burning of the Ship**

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

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

The *Coimbra* is classified as Medium Risk because the oil caught fire and burned for a short period of time. Data quality is high.

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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]
Risk Factor C2: Reported Oil on the Water
This risk factor addresses reports of oil on the water at the time of the vessel casualty. The amount is relative and based on the number of available reports of the casualty. Seldom are the reports from trained observers so this is very subjective information. The risk categories are defined as:

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

The *Coimbra* is classified as Medium Risk because the oil was reported to have spread across the water as it burned. Data quality is medium.

*Is the cargo area damaged?*

Risk Factor D1: Nature of the Casualty
This risk factor addresses the means by which the vessel sank. The risk associated with each type of casualty is determined by the how violent the sinking event was and the factors that would contribute to increased initial damage or destruction of the vessel (which would lower the risk of oil, other cargo, or munitions remaining on board). The risk categories are:

- **Low Risk:** Multiple Torpedo Detonations, Multiple Mines, Severe Explosion
- **Medium Risk:** Single Torpedo, Shellfire, Single Mine, Rupture of Hull, Breaking in Half, Grounding on Rocky Shoreline
- **High Risk:** Foul Weather, Grounding on Soft Bottom, Collision
- **Unknown:** The cause of the loss of the vessel is not known

The *Coimbra* is classified as Low Risk because there were two torpedo detonations and the vessel is broken into three sections. Data quality is high.

Risk Factor D2: Structural Breakup
This risk factor takes into account how many pieces the vessel broke into during the sinking event or since sinking. This factor addresses how likely it is that multiple components of a ship were broken apart including tanks, valves, and pipes. Experience has shown that even vessels broken in three large sections can still have significant pollutants on board if the sections still have some structural integrity. The risk categories are:

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

The *Coimbra* is classified as Medium Risk because it is broken into three pieces and the tanks around the breaks are open to the sea. Data quality is high.
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 Coimbra is broken into three parts and resting on its starboard side, the bow is inverted. Data quality is high.

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 Coimbra is 170 feet deep. Data quality is high.

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

Parts of the Coimbra are known to be intact and structurally sound. Recent remote sensing work by the NOAA Ship Thomas Jefferson confirms this information. Data quality is high.

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 Coimbra had munitions for onboard weapons, one B.L. 4” gun; one Holman Projector; two Hotchkiss .303 guns; four Lewis .303 machineguns; one Ross rifle .303; two Walther 7.65 mm pistols. 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 Coimbra. Operational factors are listed but do not have a risk score.
Table 1-1: Summary matrix for the vessel risk factors for the Coimbra color-coded as red (high risk), yellow (medium risk), and green (low risk).

<table>
<thead>
<tr>
<th>Vessel Risk Factors</th>
<th>Data Quality Score</th>
<th>Comments</th>
<th>Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pollution Potential Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1: Oil Volume (total bbl)</td>
<td>Low</td>
<td>28,500 bbl, reported to be leaking</td>
<td></td>
</tr>
<tr>
<td>A2: Oil Type</td>
<td>High</td>
<td>Cargo is lubricating oil, a Group III oil type</td>
<td></td>
</tr>
<tr>
<td>B: Wreck Clearance</td>
<td>High</td>
<td>Vessel not reported as cleared</td>
<td></td>
</tr>
<tr>
<td>C1: Burning of the Ship</td>
<td>High</td>
<td>Fire was reported</td>
<td></td>
</tr>
<tr>
<td>C2: Oil on Water</td>
<td>High</td>
<td>Oil was reported on the water; amount is not known</td>
<td></td>
</tr>
<tr>
<td>D1: Nature of Casualty</td>
<td>High</td>
<td>Two torpedo detonations</td>
<td></td>
</tr>
<tr>
<td>D2: Structural Breakup</td>
<td>High</td>
<td>The vessel is broken into three sections</td>
<td></td>
</tr>
<tr>
<td><strong>Archaeological Assessment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Archaeological Assessment</td>
<td>High</td>
<td>Detailed sinking records and site assessments of this ship exist, assessment is believed to be very accurate</td>
<td></td>
</tr>
<tr>
<td><strong>Operational Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wreck Orientation</td>
<td>High</td>
<td>Stern and amidships sections resting on starboard side, bow is inverted</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>High</td>
<td>170 ft</td>
<td></td>
</tr>
<tr>
<td>Visual or Remote Sensing Confirmation of Site Condition</td>
<td>High</td>
<td>Location is a popular technical diving and sport fishing site; NOAA conducted a survey in 2009 to locate the wreck and update the NOAA charts</td>
<td></td>
</tr>
<tr>
<td>Other Hazardous Materials Onboard</td>
<td>High</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Munitions Onboard</td>
<td>High</td>
<td>Munitions for onboard weapons</td>
<td></td>
</tr>
<tr>
<td>Gravesite (Civilian/Military)</td>
<td>High</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Historical Protection Eligibility (NHPA/SMCA)</td>
<td>High</td>
<td>NHPA and SMCA</td>
<td></td>
</tr>
</tbody>
</table>
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 Coimbra this would be about 29,000 bbl based on current estimates of the amount of oil remaining onboard the wreck.

The likeliest scenario of oil release from most sunken wrecks, including the Coimbra, 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 Coimbra.

<table>
<thead>
<tr>
<th>Scenario Type</th>
<th>Release per Episode</th>
<th>Time Period</th>
<th>Release Rate</th>
<th>Relative Likelihood</th>
<th>Response Tier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic (0.1% of WCD)</td>
<td>29 bbl</td>
<td>Fairly regular intervals or constant</td>
<td>100 bbl over several days</td>
<td>More likely</td>
<td>Tier 1</td>
</tr>
<tr>
<td>Episodic (1% of WCD)</td>
<td>290 bbl</td>
<td>Irregular intervals</td>
<td>Over several hours or days</td>
<td>Most Probable</td>
<td>Tier 1-2</td>
</tr>
<tr>
<td>Most Probable (10% of WCD)</td>
<td>2,900 bbl</td>
<td>One-time release</td>
<td>Over several hours or days</td>
<td>Most Probable</td>
<td>Tier 2</td>
</tr>
<tr>
<td>Large (50% of WCD)</td>
<td>14,500 bbl</td>
<td>One-time release</td>
<td>Over several hours or days</td>
<td>Less likely</td>
<td>Tier 2-3</td>
</tr>
<tr>
<td>Worst Case</td>
<td>29,000 bbl</td>
<td>One-time release</td>
<td>Over several hours or days</td>
<td>Least likely</td>
<td>Tier 3</td>
</tr>
</tbody>
</table>

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 Coimbra contained a maximum of 28,500 bbl of lubricating oil (a Group II oil) as cargo and bunker fuel oil (a Group IV oil). Because the bulk of the oil likely remaining on board is lubricating oil, the oil spill model was run using light fuel oil.

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

<table>
<thead>
<tr>
<th>Oil Description</th>
<th>Sheen Appearance</th>
<th>Approximate Sheen Thickness</th>
<th>No. of 1 inch Tarballs</th>
<th>Threshold/Risk Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Sheen</td>
<td>Barely Visible</td>
<td>0.00001 mm</td>
<td>0.01 g/m²</td>
<td>~5-6 tarballs per acre</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Socio-economic Impacts to Water Surface/Risk Factor 4B-1 and 2</td>
</tr>
<tr>
<td>Heavy Oil Sheen</td>
<td>Dark Colors</td>
<td>0.01 mm</td>
<td>10 g/m²</td>
<td>~5,000-6,000 tarballs per acre</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ecological Impacts to Water Surface/ Risk Factor 3B-1 and 2</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Oil Description</th>
<th>Oil Appearance</th>
<th>Approximate Sheen Thickness</th>
<th>No. of 1 inch Tarballs</th>
<th>Threshold/Risk Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Sheen/Tarballs</td>
<td>Dull Colors</td>
<td>0.001 mm</td>
<td>1 g/m²</td>
<td>~0.12-0.14 tarballs/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Socio-economic Impacts to Shoreline Users/Risk Factor 4C-1 and 2</td>
</tr>
<tr>
<td>Oil Slick/Tarballs</td>
<td>Brown to Black</td>
<td>0.1 mm</td>
<td>100 g/m²</td>
<td>~12-14 tarballs/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ecological Impacts to Shoreline Habitats/Risk Factor 3C-1 and 2</td>
</tr>
</tbody>
</table>

Potential Impacts to the Water Column
Impacts to the water column from an oil release from the Coimbra 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 mi² that has been contaminated by 1 part per billion (ppb) oil to a depth of 33 feet. At 1 ppb, there are likely to be impacts to sensitive organisms in the water column and potential tainting of seafood, so this concentration is used as a screening threshold for both the ecological and socio-economic risk factors for water column resource impacts. To assist planners in understanding the scale of potential impacts for different leakage volumes, a regression curve was generated for the water column volume oiled using the five volume scenarios, which is shown in Figure 2-1. Using this figure, the water column impacts can be estimated for any spill volume.

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 Coimbra.

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

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

<table>
<thead>
<tr>
<th>Scenario Type</th>
<th>Oil Volume (bbl)</th>
<th>Estimated Slick Area Swept Mean of All Models</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.01 g/m²</td>
</tr>
<tr>
<td>Chronic</td>
<td>29</td>
<td>629 mi²</td>
</tr>
<tr>
<td>Episodic</td>
<td>290</td>
<td>2,340 mi²</td>
</tr>
<tr>
<td>Most Probable</td>
<td>2,900</td>
<td>7,490 mi²</td>
</tr>
<tr>
<td>Large</td>
<td>14,500</td>
<td>17,100 mi²</td>
</tr>
<tr>
<td>Worst Case Discharge</td>
<td>29,000</td>
<td>24,000 mi²</td>
</tr>
</tbody>
</table>

The location, size, shape, and spread of the oil slick(s) from an oil release from the Coimbra 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.
Section 2: Environmental Impact Modeling

Figure 2-2: Probability of surface oil (exceeding 0.01 g/m²) from the Most Probable spill of 2,900 bbl of light fuel oil from the Coimbra at the threshold for socio-economic resources at risk.

Figure 2-3: Probability of surface oil (exceeding 10 g/m²) from the Most Probable spill of 2,900 bbl of light fuel oil from the Coimbra at the threshold for ecological resources at risk.
The maximum potential cumulative area swept by oil slicks at some time after a Most Probable Discharge is shown in Figure 2-4 as the timing of oil movements.

**Figure 2-4**: Water surface oiling from the Most Probable spill of 2,900 bbl of light fuel oil from the Coimbra 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 Coimbra, showing both the ecological threshold of 10 g/m$^2$ and socio-economic threshold of 0.01 g/m$^2$.

**Potential Shoreline Impacts**

Based on these modeling results, shorelines from as far north as Cape Cod, 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 2,900 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 Coimbra.**

<table>
<thead>
<tr>
<th>Scenario Type</th>
<th>Volume (bbl)</th>
<th>Estimated Miles of Shoreline Oiling Above 1 g/m$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rock/Gravel/Artificial</td>
</tr>
<tr>
<td>Chronic</td>
<td>29</td>
<td>0</td>
</tr>
<tr>
<td>Episodic</td>
<td>290</td>
<td>1</td>
</tr>
<tr>
<td>Most Probable</td>
<td>2,900</td>
<td>3</td>
</tr>
<tr>
<td>Large</td>
<td>14,500</td>
<td>7</td>
</tr>
<tr>
<td>Worst Case Discharge</td>
<td>29,000</td>
<td>9</td>
</tr>
</tbody>
</table>
Figure 2-6: Probability of shoreline oiling (exceeding 1.0 g/m²) from the Most Probable Discharge of 2,900 bbl of light fuel oil from the Coimbra.

Figure 2-7: The extent and degree of shoreline oiling from the single model run of the Most Probable Discharge of 2,900 bbl of light fuel oil from the Coimbra 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 Coimbra.

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 29,000 bbl from the Coimbra.

<table>
<thead>
<tr>
<th>Shoreline/Habitat Type</th>
<th>Lighter Oiling Oil Thickness &lt;1 mm</th>
<th>Oil Thickness &gt;1 g/m²</th>
<th>Heavier Oiling Oil Thickness &gt;1 mm</th>
<th>Oil Thickness &gt;100 g/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rocky and artificial shores/Gravel beaches</td>
<td>21 miles</td>
<td></td>
<td>9 miles</td>
<td></td>
</tr>
<tr>
<td>Sand beaches</td>
<td>80 miles</td>
<td></td>
<td>52 miles</td>
<td></td>
</tr>
<tr>
<td>Salt marshes and tidal flats</td>
<td>12 miles</td>
<td></td>
<td>2 miles</td>
<td></td>
</tr>
</tbody>
</table>

Table 2-6: Worst case scenario shoreline impact by habitat type and oil thickness for a leakage of 2,900 bbl from the Coimbra.

<table>
<thead>
<tr>
<th>Shoreline/Habitat Type</th>
<th>Lighter Oiling Oil Thickness &lt;1 mm</th>
<th>Oil Thickness &gt;1 g/m²</th>
<th>Heavier Oiling Oil Thickness &gt;1 mm</th>
<th>Oil Thickness &gt;100 g/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rocky and artificial shores/Gravel beaches</td>
<td>0 miles</td>
<td></td>
<td>0 miles</td>
<td></td>
</tr>
<tr>
<td>Sand beaches</td>
<td>20 miles</td>
<td></td>
<td>0 miles</td>
<td></td>
</tr>
<tr>
<td>Salt marshes and tidal flats</td>
<td>0 miles</td>
<td></td>
<td>0 miles</td>
<td></td>
</tr>
</tbody>
</table>
SECTION 3: ECOLOGICAL RESOURCES AT RISK

Ecological resources at risk from a catastrophic release of oil from the *Coimbra* (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 *Coimbra*.**

(FT = Federal threatened; FE = Federal endangered; ST = State threatened; SE = State endangered).

<table>
<thead>
<tr>
<th>Species Group</th>
<th>Species Subgroup and Geography</th>
<th>Seasonal Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelagic Birds and Sea Ducks</td>
<td>North and Mid-Atlantic inshore/offshore waters: 150K loons (RI is critical wintering habitat for a significant number of loons); 2K grebes; 1,000s of petrels; millions of shearwaters, storm-petrels, gulls; 300K boobies; 6K pelicans; 100,000s of cormorants, phalaropes, and terns; 10,000s of alcids; 1,000s of raptors, jaegers, and skimmers; 1.3 million sea ducks</td>
<td>Terns, gulls present in spring/summer; Loons, sea ducks present in spring/fall</td>
</tr>
<tr>
<td></td>
<td>Mouths of DE Bay and Chesapeake Bay, and Nantucket Island have high concentrations of species that are abundant over shoals (e.g., loons, pelicans, cormorants, sea ducks, gulls, terns, alcids); shoals off of Nantucket Island are largest on East Coast and concentrate millions of birds (very important for scoters and other sea ducks); shoals also occur off of Long Island</td>
<td>Most surveys in winter but use of shoals and offshore waters varies by species group and occurs throughout the year; summer shoal use more common on northern shoals</td>
</tr>
<tr>
<td></td>
<td>Audubon’s shearwaters (50-75% of population) concentrate along the edge of the Continental Shelf off the coast of NC extending northward to the VA border (~3,800 pairs)</td>
<td>Shearwaters off of NC/VA: late summer</td>
</tr>
<tr>
<td></td>
<td>Northern gannet are abundant Fall-Spring throughout the coastal zone (often &gt;3 km from shore)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pelagic/waterbird bird use of RI waters is most diverse and abundant Fall through Spring, but 10,000s of birds have been observed feeding some summers</td>
<td></td>
</tr>
<tr>
<td>Sea Ducks</td>
<td>Sea ducks (mean and max distance of flocks to shore, 2009-2010 data)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scoters (black, surf, and white-winged; 2 nm/8-13 nm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cape Cod/Nantucket: 51-55K</td>
<td>Sea ducks surveyed in Winter (peak abundances). Migration from Oct-Apr</td>
</tr>
<tr>
<td></td>
<td>Nantucket Shoals: 9-36K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LI Sound: 6-22K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off LI south coast: 8-19K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off NJ coast: 1K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DE Bay: 12-14K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off MD/DE: 18-111K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chesapeake Bay: 34-73K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off Pamlico Sound: 4-43K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Long-tailed duck (2 nm/25 nm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cape Cod/Nantucket: 31K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nantucket Shoals: 71-128K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LI Sound: 3-7K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off LI south coast: 1-38K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off NJ coast: 1-6K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off MD/DE: 2K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chesapeake Bay: 17-31K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Common eider (&lt;1 nm/19 nm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cape Cod/Nantucket: 92-201K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nantucket Shoals: 2-6K</td>
<td></td>
</tr>
</tbody>
</table>
### Section 3: Ecological Resources at Risk

<table>
<thead>
<tr>
<th>Species Group</th>
<th>Species Subgroup and Geography</th>
<th>Seasonal Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shorebirds and Colonial Nesting Birds</strong></td>
<td>Shorebirds and colonial nesting birds are abundant on small islands, beaches, and marshes throughout the region</td>
<td>Colonial and beach nesters peak Apr-Aug</td>
</tr>
<tr>
<td></td>
<td>VA Barrier Island/Lagoon System: most important bird area in VA and one of most along Atlantic Coast (of global/hemispheric importance): piping plover (FT), Wilson’s plover, American oystercatcher, gull-billed tern, least tern, black skimmer (many of these species are state listed or of special concern in several states); most significant breeding population in state of waders; marsh nesters have center of abundance here; internationally significant stopover point for whimbrel, short-billed dowitcher, and red knot</td>
<td>Migration typically Spring/fall, but varies by species and location and ranges from Feb-Jun/Aug-Dec</td>
</tr>
<tr>
<td></td>
<td>Assateague Island, MD: globally important bird area due to 60+ pairs of nesting piping plovers; largest colony of nesting least terns in MD; important for migratory shorebirds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DE/NJ sides of DE Bay: extremely important migratory stopover point for several species of shorebirds (tied to horseshoe crab spawning): ruddy turnstone, short-billed dowitcher, red knot, etc. Delaware Bay is globally/hemispherically important as a migratory stopover site; red knots have decreased over 90% since 1990 and this is the most important stopover location for them.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NJ: Edwin B. Forsythe NWR and Sandy Hook: essential nesting and foraging habitat for imperiled beach nesters (piping plover, American oystercatcher, black skimmer, least tern).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Barrier islands on south shore of Long Island and islands/marshes on bay side: beach nesters (e.g., piping plovers), nesting wading birds, raptors, migrating shorebirds, wintering waterfowl etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Great Gull Island (LIS): one of the most important tern nesting sites in the world (1,600 pairs of roseate terns (FE), 10K common terns); Bird Island (and possibly Ram Island), MA is the other important site for roseate tern; together they make up 80% of the nesting population.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CT: Hammonasset Beach State Park: nesting saltmarsh sharp-tailed sparrow and migratory stopover point</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RI and MA: Numerous important sites for beach and salt marsh habitats, including many NWRs that support breeding (e.g., least tern and piping plover) and migratory stopover points.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cape Cod is a nationally significant migratory stopover site for numerous species; e.g., Monomoy NWR and South Beach are the most important habitats in New England for nesting piping plover, American oystercatchers, and major late-summer concentrations of shorebirds and roseate terns</td>
<td></td>
</tr>
<tr>
<td><strong>Raptors and Passerines</strong></td>
<td>Lower Delmarva (Cape Charles area of VA): 20-80K raptors and over 10 million migrating passerines</td>
<td>Fall</td>
</tr>
</tbody>
</table>
Section 3: Ecological Resources at Risk

<table>
<thead>
<tr>
<th>Species Group</th>
<th>Species Subgroup and Geography</th>
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</tr>
</thead>
</table>
| Sea Turtles   | Estuaries are summer foraging grounds for adult and juvenile green (FE) and loggerhead (FT) sea turtles, especially Chesapeake Bay and Long Island Sound. Leatherback (FE), loggerhead, Kemp’s ridley (FE) present offshore. Greens occur in VA, NJ, and DE but are rare further north.  
Nesting: Loggerheads nest on sand beaches south of Delaware. Kemp’s ridley, green, and leatherback turtles may nest occasionally on the NC Outer Banks. | Adults and juveniles present spring/summer.  
Loggerheads  
Nest: Mar-Nov  
Hatch: May-Dec |
| Marine Mammals| *Baleen whales*: North Atlantic right whale (FE), humpback whale (FE), fin whale (FE) and minke whales are more common offshore but can move inshore to feed on forage fish and zooplankton.  
- Right whales are critically endangered (300-400 individuals remaining) and use this area as a migratory pathway  
- Inshore cetaceans: Atlantic white-sided, bottlenose dolphin, harbor porpoise and killer whales use coastal waters out to the shelf break.  
*Offshore cetaceans*: Northern bottlenose whale, pilot whales, Risso’s dolphin, striped dolphin, common dolphin, Atlantic spotted dolphin, spinner dolphin  
- Often associated with shelf edge features and convergence zones  
*Deep diving whales*: Sperm whale (FE), beaked whales (5 spp present) forage in deep waters and canyons in the region.  
Pinnipeds: Gray seals and harbor seals are common during the winter, using Block Island as a haulout. Stray hooded seals and other sea lions can occur | Baleen whales migrate through the area spring and fall; males and juveniles may stay year round.  
Dolphins more common in southern part of study area, during summer  
Harbor porpoises calve May-Aug  
Sperm whales present spring–summer |
| Fish & Invertebrates | Coastal ocean waters support many valuable fisheries and/or species of concern in the region:  
- Benthic: American lobster, sea scallop, scup, summer flounder, winter flounder, black sea bass, Atlantic rock crab, goosefish, Atlantic surf clam, butterfish,  
- Midwater: Atlantic mackerel, Atlantic herring, longfin squid, shortfin squid, striped bass, bluefish, menhaden, spiny dogfish sharks, spot, weakfish  
- Pelagic: bluefin tuna, yellowfin tuna, wahoo, dolphinfish, bigeye tuna, swordfish  
- Diadromous: alewife, blueback herring, American shad, Hickory shad, American eel, Atlantic sturgeon (Fed. species of concern)  
Pelagic species can be more concentrated around the shelf break and at oceanographic fronts in the region  
Estuaries are important nursery grounds for many of these species, and support many fisheries-blue crab, shrimp, horseshoe crab, Eastern oyster  
Important concentration/conservation areas are:  
- Nantucket Lightship closed area (S of Nantucket)  
- Great South Channel – boulder and cobble substrate thought to be nursery area for cod  
- EFH for highly migratory species occurs in the area, including swordfish, bluefin tuna, yellowfin tuna, bigeye tuna, shark species  
- Juvenile and adult bluefin tuna aggregate in the area in the winter  
Norfolk Canyon, Veatch Canyon, Oceanographer Canyon, and Lydonia Canyon are gear-restricted because they are important habitat for golden tilefish and monkfish | Generally spawn during the warmer months (except winter flounder).  
Juveniles of many species use estuaries, seagrass, and hard-bottom habitats as nursery areas  
Many coastal fish migrate seasonally either across the shelf or east-west (winter flounder) |
| Benthic Habitats | Submerged aquatic vegetation (mostly eelgrass) is critical to numerous species and occurs inside of bays and sounds throughout the region | Year round |
The Environmental Sensitivity Index (ESI) atlases for the potentially impacted coastal areas from a leak from the Coimbra are generally available at each U.S. Coast Guard Sector. They can also be downloaded at: http://response.restoration.noaa.gov/esi. These maps show detailed spatial information on the distribution of sensitive shoreline habitats, biological resources, and human-use resources. The tables on the back of the maps provide more detailed life-history information for each species and location. The ESI atlases should be consulted to assess the potential environmental resources at risk for specific spill scenarios. In addition, the Geographic Response Plans within the Area Contingency Plans prepared by the Area Committee for each U.S. Coast Guard Sector have detailed information on the nearshore and shoreline ecological resources at risk and should be consulted.

**Ecological Risk Factors**

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

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

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

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

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

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

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

In the following sections, the definition of low, medium, and high for each ecological risk factor is provided. Also, the classification for the Coimbra is provided, both as text and as shading of the applicable degree of risk bullet, for the WCD release of 29,000 bbl and a border around the Most Probable Discharge of 2,900 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 *Coimbra* is classified as High Risk for oiling probability for water column ecological resources for the WCD of 29,000 bbl because 58% 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 151 mi$^2$ of the upper 33 feet of the water column. For the Most Probable Discharge of 2,900 bbl, the *Coimbra* 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 95 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 mi² of the water surface would be affected by enough oil to cause impacts to ecological resources. The three risk scores for oiling are:

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

Risk Factor 3B-2: Water Surface Degree of Oiling of EcoRAR
The degree of oiling of the water surface reflects the total amount of oil that would affect the water surface in the event of a discharge from the vessel. The three categories of impact are:

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

The Coimbra is classified as High Risk for oiling probability for water surface ecological resources for the WCD because 91% of the model runs resulted in at least 1,000 mi² of the water surface affected above the threshold of 10 g/m². It is classified as Medium Risk for degree of oiling because the mean area of water contaminated was 4,440 mi². The Coimbra is classified as Medium Risk for water surface ecological resources for the Most Probable Discharge because 37% of the model runs resulted in at least 1,000 mi² of the water surface affected above the threshold of 10 g/m². It is classified as Low Risk for degree of oiling because the mean area of water contaminated was 970 mi².

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

Risk Factor 3C-1: Shoreline Probability of Oiling of EcoRAR
This risk factor reflects the probability that the shoreline would be coated by enough oil to cause impacts to shoreline organisms. The threshold for shoreline oiling impacts to ecological resources at risk is 100 g/m² (i.e., 100 grams of oil per square meter of shoreline). The three risk scores for oiling are:

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

Risk Factor 3C-2: Shoreline Degree of Oiling of EcoRAR
The degree of oiling of the shoreline reflects the length of shorelines oiled by at least 100 g/m² in the event of a discharge from the vessel. The three categories of impact are:

- **Low Impact**: less than 10 miles of shoreline impacted at the threshold level
- **Medium Impact**: 10 - 100 miles of shoreline impacted at the threshold level
- **High Impact**: more than 100 miles of shoreline impacted at the threshold level
The *Coimbra* is classified as Medium Risk for oiling probability for shoreline ecological resources for the WCD because 46% of the model runs resulted in shorelines affected above the threshold of 100 g/m². It is classified as Medium Risk for degree of oiling because the mean weighted length of shoreline contaminated was 28 miles. The *Coimbra* is classified as Medium Risk for oiling probability for shoreline ecological resources for the Most Probable Discharge because 18% of the model runs resulted in shorelines affected above the threshold of 100 g/m². It is classified as Low Risk for degree of oiling because the mean weighted length of shoreline contaminated was 6 miles.

Considering the modeled risk scores and the ecological resources at risk, the ecological risk from potential releases of the WCD of 29,000 bbl of lubricating oil from the *Coimbra* is summarized as listed below and indicated in the far-right column in Table 3-2:

- Water column resources – Medium, because the area of highest exposure occurs in open shelf waters without any known concentrations of sensitive upper water column resources
- Water surface resources – Medium, because although there can be very large number of wintering, nesting, and migratory birds that use ocean, coastal, and estuarine habitats at risk, light fuel oils on the surface will not be continuous but rather be in the form of sheens that pose lesser risks to birds, sea turtles, and marine mammals
- Shoreline resources – Medium, because most of the shoreline at risk is composed of sand and gravel beaches where light fuel oils are not expected to persist, 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 factor scores for the Worst Case Discharge of 29,000 bbl of lubricating oil from the *Coimbra*.

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Risk Score</th>
<th>Explanation of Risk Score</th>
<th>Final Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A-1: Water Column Probability EcoRAR Oiling</td>
<td>Low</td>
<td>58% of the model runs resulted in at least 0.2 mi² of the upper 33 feet of the water column contaminated above 1 ppb aromatics</td>
<td>Med</td>
</tr>
<tr>
<td>3A-2: Water Column Degree EcoRAR Oiling</td>
<td>Low</td>
<td>The mean volume of water contaminated above 1 ppb was 151 mi² of the upper 33 feet of the water column</td>
<td>Med</td>
</tr>
<tr>
<td>3B-1: Water Surface Probability EcoRAR Oiling</td>
<td>Low</td>
<td>91% of the model runs resulted in at least 1,000 mi² of water surface covered by at least 10 g/m²</td>
<td>Med</td>
</tr>
<tr>
<td>3B-2: Water Surface Degree EcoRAR Oiling</td>
<td>Low</td>
<td>The mean area of water contaminated above 10 g/m² was 4,440 mi²</td>
<td>Med</td>
</tr>
<tr>
<td>3C-1: Shoreline Probability EcoRAR Oiling</td>
<td>Low</td>
<td>46% of the model runs resulted in shoreline oiling of 100 g/m²</td>
<td>Med</td>
</tr>
<tr>
<td>3C-2: Shoreline Degree EcoRAR Oiling</td>
<td>Low</td>
<td>The length of shoreline contaminated by at least 100 g/m² was 28 mi</td>
<td>Med</td>
</tr>
</tbody>
</table>
For the Most Probable Discharge of 2,900 bbl, the ecological risk from potential releases from the *Coimbra* is summarized as listed below and indicated in the far-right column in Table 3-3:

- Water column resources – Low, because the area of highest exposure occurs in open shelf waters without any known concentrations of sensitive upper water column resources
- Water surface resources – Low, because although there can be very large number of wintering, nesting, and migratory birds that use ocean, coastal, and estuarine habitats at risk, light fuel oils on the surface will not be continuous but rather be in the form of sheens that pose lesser risks to birds, sea turtles, and marine mammals
- Shoreline resources – Low, because of the small amount of potential shoreline oiling

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Risk Score</th>
<th>Explanation of Risk Score</th>
<th>Final Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A-1: Water Column Probability EcoRAR Oiling</td>
<td>Low Medium High</td>
<td>100% of the model runs resulted in at least 0.2 m² of the upper 33 feet of the water column contaminated above 1 ppb aromatics</td>
<td>Low</td>
</tr>
<tr>
<td>3A-2: Water Column Degree EcoRAR Oiling</td>
<td>Low Medium High</td>
<td>The mean volume of water contaminated above 1 ppb was 95 m² of the upper 33 feet of the water column</td>
<td>Low</td>
</tr>
<tr>
<td>3B-1: Water Surface Probability EcoRAR Oiling</td>
<td>Low Medium High</td>
<td>37% of the model runs resulted in at least 1,000 m² of water surface covered by at least 10 g/m²</td>
<td>Low</td>
</tr>
<tr>
<td>3B-2: Water Surface Degree EcoRAR Oiling</td>
<td>Low Medium High</td>
<td>The mean area of water contaminated above 10 g/m² was 970 m²</td>
<td>Low</td>
</tr>
<tr>
<td>3C-1: Shoreline Probability EcoRAR Oiling</td>
<td>Low Medium High</td>
<td>18% of the model runs resulted in shoreline oiling of 100 g/m²</td>
<td>Low</td>
</tr>
<tr>
<td>3C-2: Shoreline Degree EcoRAR Oiling</td>
<td>Low Medium High</td>
<td>The length of shoreline contaminated by at least 100 g/m² was 6 mi</td>
<td>Low</td>
</tr>
</tbody>
</table>
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 Coimbra include very highly utilized recreational beaches from North Carolina to Massachusetts during summer, but also during spring and fall for shore fishing. Hotspots for chartered fishing vessels and recreational fishing party vessels include along the New Jersey shore, off the mouth of Delaware Bay, and off the outer banks of North Carolina. Many areas along the entire potential spill zone are widely popular seaside resorts and support recreational activities such as boating, diving, sightseeing, sailing, fishing, and wildlife viewing.

A release could impact shipping lanes that run through the area of impact from New York east of Cape Cod, and into Narragansett Bay. Coastal waters off Rhode Island and southern Massachusetts are popular sailing locations. A proposed offshore wind farm site is located in Nantucket Sound.

Commercial fishing is economically important to the region. Regional commercial landings for 2010 exceeded $600 million. Cape May–Wildwood, NJ and Hampton Roads, VA were the 6th and 7th nationally ranked commercial fishing ports by value in 2010. The most important species by dollar value present in and around the Mid-Atlantic are sea scallops, surf clams, ocean quahogs, menhaden, striped bass, and blue crab.

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

Spill response costs for a release of oil from the Coimbra 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 Coimbra.

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Resource Name</th>
<th>Economic Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tourist Beaches</td>
<td>Ocean City, MD</td>
<td>Potentially affected beach resorts and beach-front communities in Massachusetts, Rhode Island, New York, New Jersey, Delaware, and North Carolina provide recreational activities (e.g., swimming, boating, recreational fishing, wildlife viewing, nature study, sports, dining, camping, and amusement parks) with substantial income for local communities and state tax income. Much of the east coast of New Jersey, northeastern Delaware, the southern coast of Long Island, New York, the southern coast of Rhode Island, and the southwestern shore of Massachusetts and</td>
</tr>
</tbody>
</table>
### Section 4: Socio-Economic Resources at Risk

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Resource Name</th>
<th>Economic Activities</th>
</tr>
</thead>
</table>
|                     | Atlantic City, NJ                                                             | Martha’s Vineyard, Massachusetts, are lined with economically valuable beach resorts and residential communities.  
|                     | Ocean City, NJ                                                                | Many of these recreational activities are limited to or concentrated into the late spring into early fall months.                                                                                                          |
|                     | Absecon Beach, NJ                                                             |                                                                                                                                                                                                                      |
|                     | Ludlam Beach, NJ                                                              |                                                                                                                                                                                                                      |
|                     | Seven Mile Beach, NJ                                                          |                                                                                                                                                                                                                      |
|                     | Margate City, NJ                                                              |                                                                                                                                                                                                                      |
|                     | Peck Beach, NJ                                                                |                                                                                                                                                                                                                      |
|                     | Ventnor City, NJ                                                              |                                                                                                                                                                                                                      |
|                     | Brigantine Beach, NJ                                                          |                                                                                                                                                                                                                      |
|                     | Beach Haven, NJ                                                               |                                                                                                                                                                                                                      |
|                     | Spray Beach, NJ                                                               |                                                                                                                                                                                                                      |
|                     | Brant Beach, NJ                                                               |                                                                                                                                                                                                                      |
|                     | Long Beach, NJ                                                                |                                                                                                                                                                                                                      |
|                     | Point Pleasant Beach, v                                                      |                                                                                                                                                                                                                      |
|                     | Seaside Park, NJ                                                              |                                                                                                                                                                                                                      |
|                     | Ortley Beach, NJ                                                              |                                                                                                                                                                                                                      |
|                     | Ocean Beach, NJ                                                               |                                                                                                                                                                                                                      |
|                     | Normandy Beach, v                                                             |                                                                                                                                                                                                                      |
|                     | Ocean Beach, NY                                                               |                                                                                                                                                                                                                      |
|                     | Fire Island Pines, NY                                                         |                                                                                                                                                                                                                      |
|                     | Southampton, NY                                                               |                                                                                                                                                                                                                      |
|                     | East Hampton, NY                                                              |                                                                                                                                                                                                                      |
|                     | Westhampton Beach, NY                                                        |                                                                                                                                                                                                                      |
|                     | Montauk, NY                                                                   |                                                                                                                                                                                                                      |
|                     | Block Island, RI                                                              |                                                                                                                                                                                                                      |
|                     | East Matunuck State Beach, RI                                                 |                                                                                                                                                                                                                      |
|                     | Roger W. Wheeler State Beach, RI                                              |                                                                                                                                                                                                                      |
|                     | Scarborough State Beach, RI                                                   |                                                                                                                                                                                                                      |
|                     | Newport, RI                                                                   |                                                                                                                                                                                                                      |
|                     | Martha’s Vineyard, MA                                                        |                                                                                                                                                                                                                      |
| National Seashores  | 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.  
|                     | Assateague Island National Seashore, MD and VA                               | Assateague Island is known for its feral horses. Cape Hatteras is known for its Bodie Island and Cape Hatteras Lighthouses. Popular recreation activities include windsurfing, birdwatching, fishing, shell collecting, and kayaking. The barrier island provides refuge for the endangered piping plover, seabeach amaranth, and sea turtles. Fire Island, a barrier island south of Long Island, has the historic William Floyd House and Fire Island Lighthouse. |
|                     | Fire Island National Seashore, NY                                            |                                                                                                                                                                                                                      |
| National Wildlife  | Prime Hook NWR (DE)                                                           | National wildlife refuges in seven states may be impacted. These federally managed and protected lands provide refuges and conservation areas for sensitive species and habitats.                                      |
| Refuges             | Bombay Hook NWR (DE)                                                          |                                                                                                                                                                                                                      |
|                     | Cape May NWR (NJ)                                                             |                                                                                                                                                                                                                      |
|                     | Edwin B. Forsythe NWR (NJ)                                                    |                                                                                                                                                                                                                      |
|                     | Seatuck NWR (NY)                                                              |                                                                                                                                                                                                                      |
|                     | Wertheim NWR (NY)                                                             |                                                                                                                                                                                                                      |
|                     | Amagansett NWR (NY)                                                           |                                                                                                                                                                                                                      |
|                     | Block Island NWR (RI)                                                        |                                                                                                                                                                                                                      |
|                     | Ninigret NWR (RI)                                                             |                                                                                                                                                                                                                      |
|                     | Trustom Pond NWR (RI)                                                        |                                                                                                                                                                                                                      |
|                     | Sachuest Point NWR (RI)                                                      |                                                                                                                                                                                                                      |
### Resource Type: State Parks

<table>
<thead>
<tr>
<th>Resource Name</th>
<th>Economic Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nomans Land Island NWR (MA)</td>
<td>Coastal state parks are significant recreational resources for the public (e.g., swimming, boating, recreational fishing, wildlife viewing, nature study, sports, dining, camping, and amusement parks). They provide income to the states. State parks in Massachusetts, Rhode Island, New York, New Jersey, Delaware, and Maryland are potentially impacted.</td>
</tr>
<tr>
<td>Mashpee NWR (MA)</td>
<td>Many of these recreational activities are limited to or concentrated into the late spring into early fall months.</td>
</tr>
<tr>
<td>Nantucket Island NWR (MA)</td>
<td></td>
</tr>
<tr>
<td>Monomoy NWR (MA)</td>
<td></td>
</tr>
<tr>
<td>Fisherman Island NWR (VA)</td>
<td></td>
</tr>
<tr>
<td>Eastern Shore of Virginia NWR (VA)</td>
<td></td>
</tr>
<tr>
<td>Wallops Island NWR (VA)</td>
<td></td>
</tr>
<tr>
<td>Chincoteague NWR (VA)</td>
<td></td>
</tr>
<tr>
<td>Back Bay NWR (VA)</td>
<td></td>
</tr>
<tr>
<td>Mackay Island NWR (NC)</td>
<td></td>
</tr>
<tr>
<td>Currituck NWR (NC)</td>
<td></td>
</tr>
<tr>
<td>Pea Island NWR (NC)</td>
<td></td>
</tr>
<tr>
<td>Cedar Island NWR (NC)</td>
<td></td>
</tr>
<tr>
<td>Nantucket Island NWR (MA)</td>
<td></td>
</tr>
<tr>
<td>Monomoy NWR (MA)</td>
<td></td>
</tr>
<tr>
<td>Fisherman Island NWR (VA)</td>
<td></td>
</tr>
<tr>
<td>Eastern Shore of Virginia NWR (VA)</td>
<td></td>
</tr>
<tr>
<td>Wallops Island NWR (VA)</td>
<td></td>
</tr>
<tr>
<td>Chincoteague NWR (VA)</td>
<td></td>
</tr>
<tr>
<td>Back Bay NWR (VA)</td>
<td></td>
</tr>
<tr>
<td>Mackay Island NWR (NC)</td>
<td></td>
</tr>
<tr>
<td>Currituck NWR (NC)</td>
<td></td>
</tr>
<tr>
<td>Pea Island NWR (NC)</td>
<td></td>
</tr>
<tr>
<td>Cedar Island NWR (NC)</td>
<td></td>
</tr>
<tr>
<td>State Parks</td>
<td>Coastal state parks are significant recreational resources for the public (e.g., swimming, boating, recreational fishing, wildlife viewing, nature study, sports, dining, camping, and amusement parks). They provide income to the states. State parks in Massachusetts, Rhode Island, New York, New Jersey, Delaware, and Maryland are potentially impacted.</td>
</tr>
<tr>
<td>Assateague State Park, Maryland</td>
<td>Many of these recreational activities are limited to or concentrated into the late spring into early fall months.</td>
</tr>
<tr>
<td>Delaware Seashore State Park, DE</td>
<td></td>
</tr>
<tr>
<td>Cape Henlopen State Park, DE</td>
<td></td>
</tr>
<tr>
<td>Cape May Point State Park, NJ</td>
<td></td>
</tr>
<tr>
<td>Corson’s Inlet State Park, NJ</td>
<td></td>
</tr>
<tr>
<td>Barnegat Lighthouse State Park, NJ</td>
<td></td>
</tr>
<tr>
<td>Island Beach State Park, NJ</td>
<td></td>
</tr>
<tr>
<td>Robert Moses State Park, NY</td>
<td></td>
</tr>
<tr>
<td>Shadmoor State Park, NY</td>
<td></td>
</tr>
<tr>
<td>Camp Hero State Park, NY</td>
<td></td>
</tr>
<tr>
<td>Montauk State Park, NY</td>
<td></td>
</tr>
<tr>
<td>Salty Brine State Park, RI</td>
<td></td>
</tr>
<tr>
<td>Fishermen’s Memorial State Park, RI</td>
<td></td>
</tr>
<tr>
<td>Beavertail State Park, RI</td>
<td></td>
</tr>
<tr>
<td>Wetherill State Park, RI</td>
<td></td>
</tr>
<tr>
<td>Brenton Point State Park, RI</td>
<td></td>
</tr>
<tr>
<td>Fort Adams State Park, RI</td>
<td></td>
</tr>
<tr>
<td>Horseneck Beach State Park, MA</td>
<td></td>
</tr>
<tr>
<td>Demarest Lloyd State Park, MA</td>
<td></td>
</tr>
<tr>
<td>Fort Phoenix State Park, MA</td>
<td></td>
</tr>
<tr>
<td>Nasketucket Bay State Park, MA</td>
<td></td>
</tr>
<tr>
<td>Coastal state parks are significant recreational resources for the public (e.g., swimming, boating, recreational fishing, wildlife viewing, nature study, sports, dining, camping, and amusement parks). They provide income to the states. State parks in Massachusetts, Rhode Island, New York, New Jersey, Delaware, and Maryland are potentially impacted.</td>
<td></td>
</tr>
<tr>
<td>Many of these recreational activities are limited to or concentrated into the late spring into early fall months.</td>
<td></td>
</tr>
</tbody>
</table>

### Resource Type: Tribal Lands

<table>
<thead>
<tr>
<th>Resource Name</th>
<th>Economic Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shinnecock Indian Reservation, NY</td>
<td>Shinnecock Indian Reservation, New York, is home to over 500 tribal members. (Note this reservation has been recognized by New York State but not by the U.S. Bureau of Indian Affairs)</td>
</tr>
<tr>
<td>Narragansett Indian Reservation, RI</td>
<td>Narragansett Indian Reservation, Rhode Island, is home to 2,400 tribal members.</td>
</tr>
<tr>
<td>Wampanoag Indian Reservation, MA</td>
<td>Wampanoag Indian Reservation, Massachusetts, is home to over 2,000 tribal members.</td>
</tr>
</tbody>
</table>

### Resource Type: Commercial Fishing

<table>
<thead>
<tr>
<th>City</th>
<th>Economic Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic City, NJ</td>
<td>A number of fishing fleets use the New York Bight area and surrounding waters for commercial fishing purposes.</td>
</tr>
<tr>
<td>Belford, NJ</td>
<td>Total Landings (2010): $17.3M</td>
</tr>
<tr>
<td>Cape May-Wildwood, NJ</td>
<td>Total Landings (2010): $81M</td>
</tr>
<tr>
<td>Chincoteague, Virginia</td>
<td>Total Landings (2010): $3.5M</td>
</tr>
<tr>
<td>Montauk, NY</td>
<td>Total Landings (2010): $17.7M</td>
</tr>
<tr>
<td>Newport, RI</td>
<td>Total Landings (2010): $6.9M</td>
</tr>
<tr>
<td>Ocean City, Maryland</td>
<td>Total Landings (2010): $8.8M</td>
</tr>
<tr>
<td>Point Pleasant, NJ</td>
<td>Total Landings (2010): $22.8M</td>
</tr>
</tbody>
</table>
Section 4: Socio-Economic Resources at Risk

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Resource Name</th>
<th>Economic Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ports</td>
<td>Stonington, Connecticut</td>
<td>Total Landings (2010): $18.5M</td>
</tr>
</tbody>
</table>

There are a number of significant commercial ports in the Northeast that could potentially be impacted by spillage and spill response activities. The port call numbers below are for large vessels only. There are many more, smaller vessels (under 400 GRT) that also use these ports.

- Camden, NJ 249 port calls annually
- Claymont, DE 19 port calls annually
- Delaware City, DE 211 port calls annually
- Gloucester, NJ 180 port calls annually
- New York/New Jersey 5,414 port calls annually
- Newport, RI 95 port calls annually
- Philadelphia, PA 914 port calls annually
- Providence, RI 128 port calls annually
- Salem, NJ 52 port calls annually
- Wilmington, DE 443 port calls annually

Other Resources

Cape Wind Offshore Wind Farm (proposed), MA Rated to produce up to 468 MW of wind power with average expected production of 170 MW which is almost 75% of the 230 MW average demand for Cape Cod, Martha’s Vineyard, and Nantucket.

Figure 4-1: Tribal lands, ports, and commercial fishing fleets at risk from a release from the Coimbra.
Section 4: Socio-Economic Resources at Risk

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

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

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

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

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

As a reminder, the socio-economic impact thresholds are: 1 ppb aromatics for water column impacts; 0.01 g/m² for water surface impacts; and 1 g/m² for shoreline impacts.

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

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

The three risk scores for oiling are:

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

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

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

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

The *Coimbra* is classified as High Risk for both oiling probability and for degree of oiling for water column socio-economic resources for the WCD of 29,000 bbl because 92% of the model runs resulted in contamination of more than 0.2 mi² of the upper 33 feet of the water column above the threshold of 1 ppb aromatics, and the mean volume of water contaminated 321 mi² of the upper 33 feet of the water column. For the Most Probable Discharge of 2,900 bbl, the *Coimbra* is classified as Medium Risk for oiling probability for water column socio-economic resources because 100% of the model runs resulted in contamination of more than 0.2 mi² of the upper 33 feet of the water column above the threshold of 1 ppb aromatics. It was classified as Medium Risk for degree of oiling because the mean volume of water contaminated 131 mi² of the upper 33 feet of the water column.
Section 4: Socio-Economic Resources at Risk

**Risk Factor 4B-1: Water Surface Probability of Oiling of SRAR**
This risk factor reflects the probability that at least 1,000 m² of the water surface would be affected by enough oil to cause impacts to socio-economic resources. The three risk scores for oiling are:

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

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

**Risk Factor 4B-2: Water Surface Degree of Oiling of SRAR**
The degree of oiling of the water surface reflects the total amount of oil that would affect the water surface in the event of a discharge from the vessel. The three categories of impact are:

- **Low Impact**: less than 1,000 m² of water surface impact at the threshold level
- **Medium Impact**: 1,000 to 10,000 m² of water surface impact at the threshold level
- **High Impact**: more than 10,000 m² of water surface impact at the threshold level

The *Coimbra* 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 m² of the water surface affected above the threshold of 0.01 g/m², and the mean area of water contaminated was 28,600 m². The *Coimbra* is classified as High Risk for oiling probability for water surface socio-economic resources for the Most Probable Discharge because 96% of the model runs resulted in at least 1,000 m² of the water surface affected above the threshold of 0.01 g/m². It is classified as Medium Risk for degree of oiling because the mean area of water contaminated was 9,000 m².

**Risk Factor 4C: Shoreline Impacts to SRAR**
The impacts to different types of shorelines vary based on economic value. In this risk analysis, shorelines have been weighted by their degree of sensitivity to oiling. Sand beaches are the most economically valued shorelines (weighted as “3” in the impact analysis), rocky and gravel shores are moderately valued (weighted as “2”), and wetlands are the least economically valued shorelines (weighted as “1”). Note that these values differ from the ecological values of these three shoreline types.

**Risk Factor 4C-1: Shoreline Probability of Oiling of SRAR**
This risk factor reflects the probability that the shoreline would be coated by enough oil to cause impacts to shoreline users. The threshold for impacts to shoreline SRAR is 1 g/m² (i.e., 1 gram of oil per square meter of shoreline). The three risk scores for oiling are:

- **Low Oiling Probability**: Probability = <10%
- **Medium Oiling Probability**: Probability = 10 – 50%
- **High Oiling Probability**: Probability > 50%
Risk Factor 4C-2: Shoreline Degree of Oiling of SRAR
The degree of oiling of the shoreline reflects the total amount of oil that would affect the shoreline in the event of a discharge from the vessel. The three categories of impact are:

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

The *Coimbra* is classified as High Risk for oiling probability for shoreline socio-economic resources for the WCD because 50% of the model runs resulted in shorelines affected above the threshold of 100 g/m². It is classified as Medium Risk for degree of oiling because the mean length of weighted shoreline contaminated was 65 miles. The *Coimbra* is classified as Medium Risk for both oiling probability and degree of oiling for shoreline socio-economic resources for the Most Probable Discharge because 28% of the model runs resulted in shorelines affected above the threshold of 100 g/m², and the mean length of weighted shoreline contaminated was 16 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 29,000 bbl of lubricating oil from the *Coimbra* is summarized as listed below and indicated in the far-right column in Table 4-2:

- **Water column resources** – High, because a relatively large water column area would be impacted in important fishing grounds
- **Water surface resources** – High, because a large offshore area would be affected in an area of important shipping lanes. 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 29,000 bbl of lubricating oil from the *Coimbra*.

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Risk Score</th>
<th>Explanation of Risk Score</th>
<th>Final Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>4A-1: Water Column Probability SRAR Oiling</td>
<td>Low Medium High</td>
<td>92% of the model runs resulted in at least 0.2 m² of the upper 33 feet of the water column contaminated above 1 ppb aromatics</td>
<td>High</td>
</tr>
<tr>
<td>4A-2: Water Column Degree SRAR Oiling</td>
<td>Low Medium High</td>
<td>The mean volume of water contaminated above 1 ppb was 321 m² of the upper 33 feet of the water column</td>
<td>High</td>
</tr>
<tr>
<td>4B-1: Water Surface Probability SRAR Oiling</td>
<td>Low Medium High</td>
<td>100% of the model runs resulted in at least 1,000 m² of water surface covered by at least 0.01 g/m²</td>
<td>High</td>
</tr>
<tr>
<td>4B-2: Water Surface Degree SRAR Oiling</td>
<td>Low Medium High</td>
<td>The mean area of water contaminated above 0.01 g/m² was 28,600 m²</td>
<td>High</td>
</tr>
<tr>
<td>4C-1: Shoreline Probability SRAR Oiling</td>
<td>Low Medium High</td>
<td>50% of the model runs resulted in shoreline oiling of 1 g/m²</td>
<td>Medium</td>
</tr>
<tr>
<td>4C-2: Shoreline Degree SRAR Oiling</td>
<td>Low Medium High</td>
<td>The length of shoreline contaminated by at least 1 g/m² was 65 mi</td>
<td>Medium</td>
</tr>
</tbody>
</table>
For the Most Probable Discharge of 2,900 bbl, the socio-economic risk from potential releases of heavy fuel oil from the *Coimbra* is summarized as listed below and indicated in the far-right column in Table 4-3:

- Water column resources – High, because a relatively large water column area would be impacted in important fishing grounds
- Water surface resources – High, because a large offshore area would be affected in an area of important shipping lanes. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of sheens, tarballs, and streamers
- Shoreline resources – Low, because a small amount of shoreline would be impacted with the persistent oil and tarballs and would be relatively easy to clean, although there 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 2,900 bbl of lubricating oil from the *Coimbra*.

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Risk Score</th>
<th>Explanation of Risk Score</th>
<th>Final Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>4A-1: Water Column Probability SRAR Oiling</td>
<td>Low Medium High</td>
<td>100% of the model runs resulted in at least 0.2 m² of the upper 33 feet of the water column contaminated above 1 ppb aromatics</td>
<td>High</td>
</tr>
<tr>
<td>4A-2: Water Column Degree SRAR Oiling</td>
<td>Low Medium High</td>
<td>The mean volume of water contaminated above 1 ppb was 131 m² of the upper 33 feet of the water column</td>
<td>High</td>
</tr>
<tr>
<td>4B-1: Water Surface Probability SRAR Oiling</td>
<td>Low Medium High</td>
<td>100% of the model runs resulted in at least 1,000 m² of water surface covered by at least 0.01 g/m²</td>
<td>High</td>
</tr>
<tr>
<td>4B-2: Water Surface Degree SRAR Oiling</td>
<td>Low Medium High</td>
<td>The mean area of water contaminated above 0.01 g/m² was 9,000 m²</td>
<td>High</td>
</tr>
<tr>
<td>4C-1: Shoreline Probability SRAR Oiling</td>
<td>Low Medium High</td>
<td>28% of the model runs resulted in shoreline oiling of 1 g/m²</td>
<td>Low</td>
</tr>
<tr>
<td>4C-2: Shoreline Degree SRAR Oiling</td>
<td>Low Medium High</td>
<td>The length of shoreline contaminated by at least 1 g/m² was 16 mi</td>
<td>Low</td>
</tr>
</tbody>
</table>
SECTION 5: OVERALL RISK ASSESSMENT AND RECOMMENDATIONS FOR ASSESSMENT, MONITORING, OR REMEDIATION

The overall risk assessment for the Coimbra 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:

<table>
<thead>
<tr>
<th>Category</th>
<th>Score Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Priority</td>
<td>7-11</td>
</tr>
<tr>
<td>Medium Priority</td>
<td>12-14</td>
</tr>
<tr>
<td>High Priority</td>
<td>15-21</td>
</tr>
</tbody>
</table>

For the Worst Case Discharge, the Coimbra scores High with 16 points; for the Most Probable Discharge, the Coimbra scores Medium with 12 points. Under the National Contingency Plan, the U.S. Coast Guard and the Regional Response Team have the primary authority and responsibility to plan, prepare for, and respond to oil spills in U.S. waters. Based on the technical review of available information, NOAA proposes the following recommendations for the Coimbra. The final determination rests with the U.S. Coast Guard.

### Possible NOAA Recommendations

<table>
<thead>
<tr>
<th>Coimbra</th>
<th>Wreck should be considered for further assessment to determine the vessel condition, amount of oil onboard, and feasibility of oil removal action</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>Use surveys of opportunity to attempt to locate this vessel and gather more information on the vessel condition</td>
</tr>
<tr>
<td>✓</td>
<td>Conduct active monitoring to look for releases or changes in rates of releases</td>
</tr>
<tr>
<td>✓</td>
<td>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</td>
</tr>
<tr>
<td>✓</td>
<td>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</td>
</tr>
</tbody>
</table>
Table 5.1: Summary of risk factors for the *Coimbra.*

<table>
<thead>
<tr>
<th>Vessel Risk Factors</th>
<th>Data Quality Score</th>
<th>Comments</th>
<th>Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1: Oil Volume (total bbl)</td>
<td>Low</td>
<td>28,500 bbl, reported to be leaking</td>
<td>Med</td>
</tr>
<tr>
<td>A2: Oil Type</td>
<td>High</td>
<td>Cargo is lubricating oil, a Group III oil type</td>
<td></td>
</tr>
<tr>
<td>B: Wreck Clearance</td>
<td>High</td>
<td>Vessel not reported as cleared</td>
<td></td>
</tr>
<tr>
<td>C1: Burning of the Ship</td>
<td>High</td>
<td>Fire was reported</td>
<td></td>
</tr>
<tr>
<td>C2: Oil on Water</td>
<td>High</td>
<td>Oil was reported on the water; amount is not known</td>
<td></td>
</tr>
<tr>
<td>D1: Nature of Casually</td>
<td>High</td>
<td>Two torpedo detonations</td>
<td></td>
</tr>
<tr>
<td>D2: Structural Breakup</td>
<td>High</td>
<td>The vessel is broken into three sections</td>
<td></td>
</tr>
</tbody>
</table>

| Archaeological Assessment | | Detailed sinking records and site assessments of this ship exist, assessment is believed to be very accurate | Not Scored |

<table>
<thead>
<tr>
<th>Operational Factors</th>
<th></th>
<th></th>
<th>Not Scored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wreck Orientation</td>
<td>High</td>
<td>Stern and amidships sections resting on starboard side, bow is inverted</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>High</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>Visual or Remote Sensing Confirmation of Site Condition</td>
<td>High</td>
<td>Location is a popular technical diving and sport fishing site</td>
<td></td>
</tr>
<tr>
<td>Other Hazardous Materials Onboard</td>
<td>High</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Munitions Onboard</td>
<td>High</td>
<td>Munitions for onboard weapons</td>
<td></td>
</tr>
<tr>
<td>Gravesite (Civilian/Military)</td>
<td>High</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Historical Protection Eligibility (NHPA/SMCA)</td>
<td>High</td>
<td>NHPA and SMCA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ecological Resources</th>
<th></th>
<th>WCD</th>
<th>Most Probable</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A: Water Column Resources</td>
<td>High</td>
<td>Area of highest exposure occurs in open shelf waters without any known concentrations of sensitive upper water column resources</td>
<td>Med</td>
</tr>
<tr>
<td>3B: Water Surface Resources</td>
<td>High</td>
<td>Seasonally very high concentrations of marine birds in coastal and shelf waters but light sheens pose lesser risks</td>
<td>Med</td>
</tr>
<tr>
<td>3C: Shore Resources</td>
<td>High</td>
<td>Mostly sand/gravel beaches at risk, where a light fuel oil is not likely to persist</td>
<td>Med</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Socio-Economic Resources</th>
<th></th>
<th>WCD</th>
<th>Most Probable</th>
</tr>
</thead>
<tbody>
<tr>
<td>4A: Water Column Resources</td>
<td>High</td>
<td>A relatively large water column area would be impacted in important fishing grounds</td>
<td>High</td>
</tr>
<tr>
<td>4B: Water Surface Resources</td>
<td>High</td>
<td>A large offshore area would be affected in an area of important shipping lanes</td>
<td>High</td>
</tr>
<tr>
<td>4C: Shore Resources</td>
<td>High</td>
<td>A moderate length shoreline would be impacted, although there are a large number of potentially vulnerable socio-economic resources</td>
<td>Med</td>
</tr>
</tbody>
</table>

| Summary Risk Scores | | | 16 | 12 |