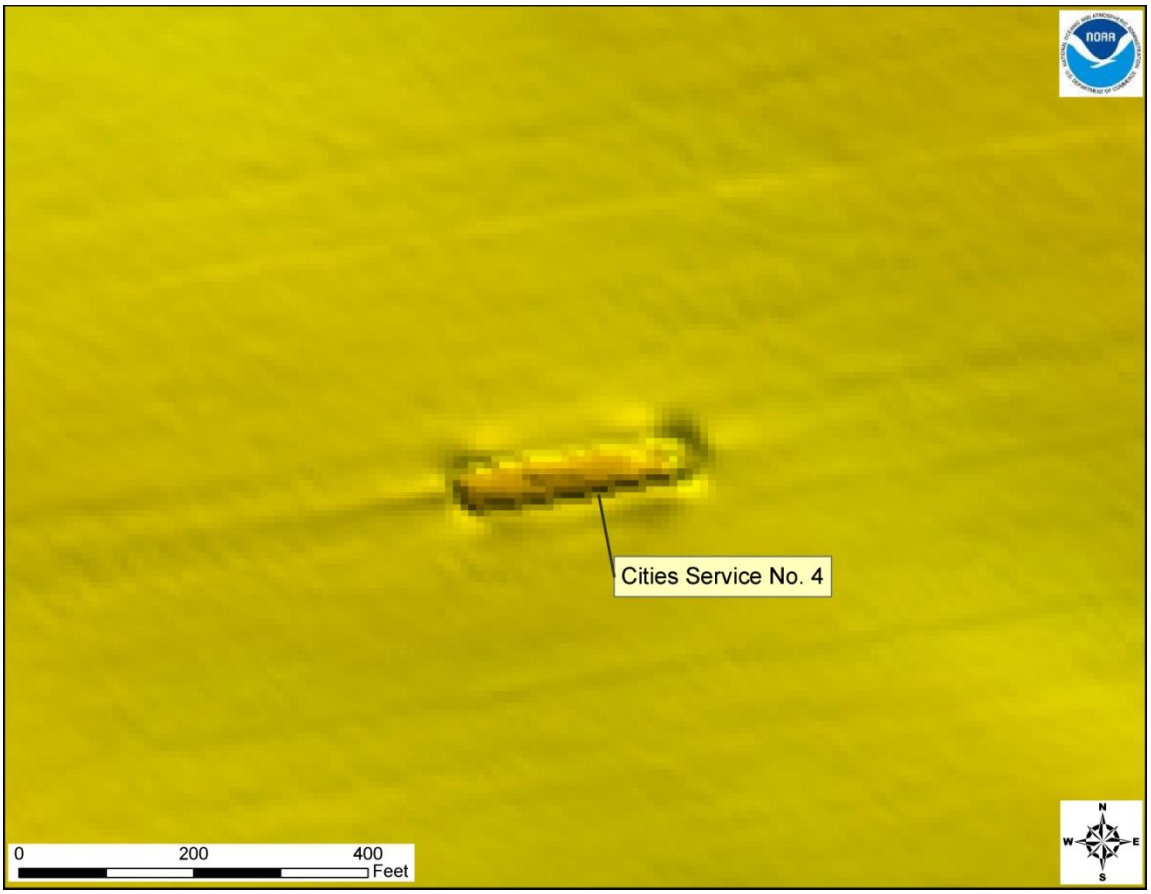
Office of National Marine Sanctuaries
Office of Response and Restoration

Screening Level Risk Assessment Package

Cities Service No. 4



March 2013

National Oceanic and
Atmospheric Administration

Office of National Marine Sanctuaries
Daniel J. Basta, Director
Lisa Symons
John Wagner

Office of Response and Restoration
Dave Westerholm, Director
Debbie Payton
Doug Helton

Photo: Processed Multibeam Sonar Image of *Cities Service No. 4*
Source: NOAA Bathymetric Survey H11997

Table of Contents

Project Background

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

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

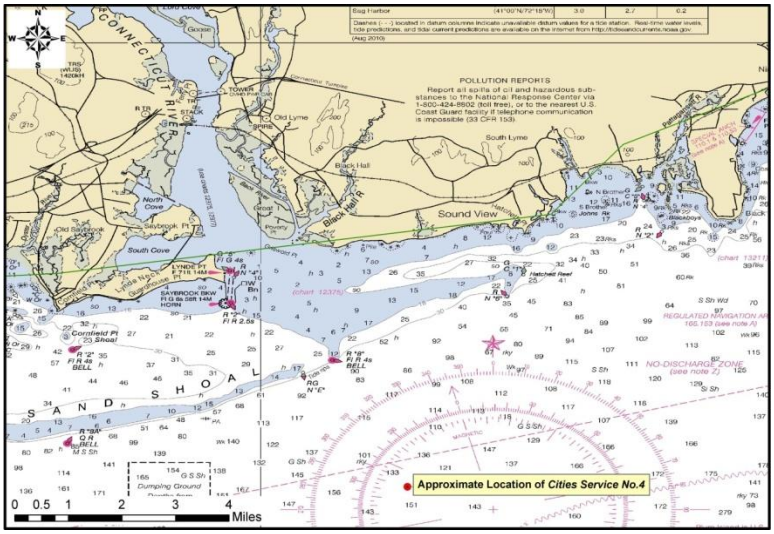
The potential polluting shipwrecks were identified through searching a broad variety of historical sources. NOAA then worked with Research Planning, Inc., RPS ASA, and Environmental Research Consulting to conduct the modeling forecasts, and the ecological and environmental resources at risk assessments.

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

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

Executive Summary: *Cities Service No. 4*

The tank barge *Cities Service No. 4*, sunk in rough seas off the coast of Connecticut in 1936, 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 *Cities Service No 4*, the results of environmental impact modeling composed of different release scenarios, the ecological and socio-economic resources that would be at risk in the event of releases, the screening-level risk scoring results and overall risk assessment, and recommendations for assessment, monitoring, or remediation.



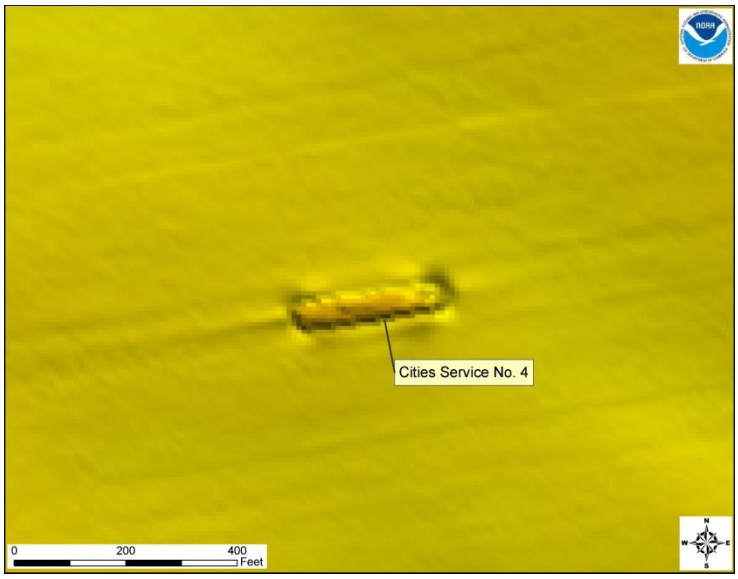
Based on this screening-level assessment, each vessel was assigned a summary score calculated using the seven risk criteria described in this report. For the Worst Case Discharge, *Cities Service No. 4* scores High with 15 points; for the Most Probable Discharge (10% of the Worse Case volume), *Cities Service No. 4* scores Low with 10 points. Given these scores and the higher level of data certainty, NOAA recommends that this site be considered for further assessment to determine the vessel condition, amount of oil onboard, and feasibility of oil removal action. Also, it is recommended that general notations are made in the Area Contingency Plans so that if a mystery spill is reported in the general area, this vessel could be investigated as a source. 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 be helpful to gain awareness of changes in the site.

Vessel Risk Factors		Risk Score	
Pollution Potential Factors	A1: Oil Volume (total bbl)	High	
	A2: Oil Type		
	B: Wreck Clearance		
	C1: Burning of the Ship		
	C2: Oil on Water		
	D1: Nature of Casualty		
	D2: Structural Breakup		
Archaeological Assessment	Archaeological Assessment	Not Scored	
Operational Factors	Wreck Orientation	Not Scored	
	Depth		
	Confirmation of Site Condition		
	Other Hazardous Materials		
	Munitions Onboard		
	Gravesite (Civilian/Military)		
	Historical Protection Eligibility		
		WCD	MP (10%)
Ecological Resources	3A: Water Column Resources	Med	Low
	3B: Water Surface Resources	Med	Low
	3C: Shore Resources	Med	Low
Socio-Economic Resources	4A: Water Column Resources	Med	Low
	4B: Water Surface Resources	Med	Med
	4C: Shore Resources	Med	Low
Summary Risk Scores		15	10

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

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

Vessel Particulars



Official Name: *Cities Service No. 4*

Official Number: Unknown

Vessel Type: Tank Barge

Vessel Class: Unknown

Former Names: Unknown

Year Built: 1929

Builder: Bethlehem Steel Company, Fore River Shipyard, Quincy, MA

Builder's Hull Number: 1431

Flag: American

Owner at Loss: Cities Service Oil Company

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

Operated by: Unknown

Homeport: Unknown

Length: Unknown **Beam:** Unknown **Depth:** Unknown

Gross Tonnage: Unknown **Net Tonnage:** Unknown

Hull Material: Steel **Hull Fastenings:** Riveted **Powered by:** N/A

Bunker Type: N/A **Bunker Capacity (bbl):** 0

Average Bunker Consumption (bbl) per 24 hours: Unknown

Liquid Cargo Capacity (bbl): 12,000 **Dry Cargo Capacity:** Unknown

Tank or Hold Description: Vessel had 5 cargo tanks divided port and starboard by an oil-tight longitudinal bulkhead, the longest hold was 29' 6"

Casualty Information

Port Departed: Unknown

Destination Port: Unknown

Date Departed: Unknown

Date Lost: January 24, 1936

Number of Days Sailing: Unknown

Cause of Sinking: Rough Seas

Latitude (DD): 41.2134

Longitude (DD): -72.2937

Nautical Miles to Shore: 3.3

Nautical Miles to NMS: 122

Nautical Miles to MPA: 0

Nautical Miles to Fisheries: Unknown

Approximate Water Depth (Ft): 140

Bottom Type: Mud

Is There a Wreck at This Location? Yes, wreck has been located

Wreck Orientation: Unknown

Vessel Armament: None

Cargo Carried when Lost: 12,000 bbl of domestic oil

Cargo Oil Carried (bbl): 12,000

Cargo Oil Type: Unknown

Probable Fuel Oil Remaining (bbl): N/A

Fuel Type: N/A

Total Oil Carried (bbl): 12,000

Dangerous Cargo or Munitions: N/A

Munitions Carried: None

Demolished after Sinking: Unknown

Salvaged: Unknown

Cargo Lost: Yes, partially

Reportedly Leaking: No

Historically Significant: Unknown

Gravesite: No

Salvage Owner: Not known if any

Wreck Location

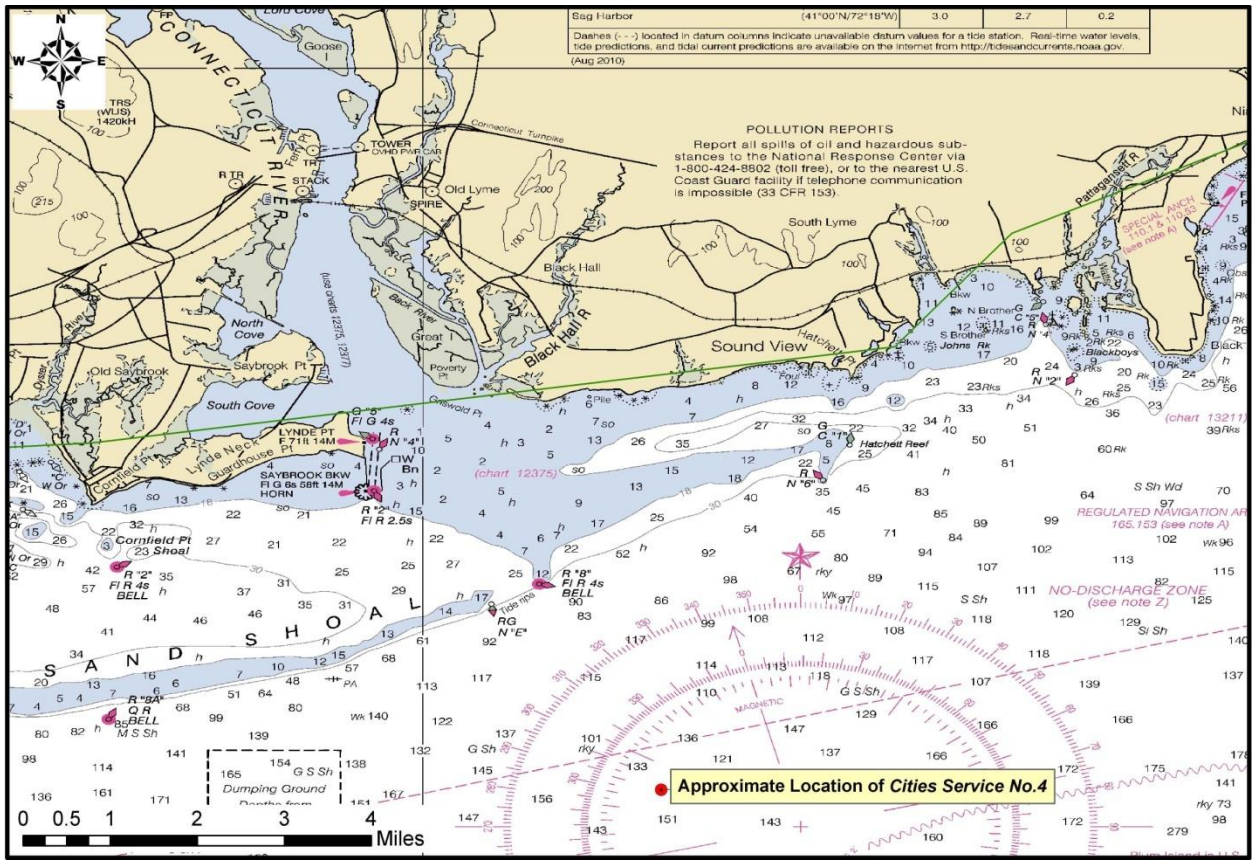


Chart Number: 12354

Casualty Narrative

"New London, Conn., Jan. 24—(AP)—Two men, comprising the crew of the tank barge *Cities Service No. 4* were rescued with great difficulty late today when the freight boat, loaded with 12,000 bbl of domestic oil sank four miles east of Cornfield Point lightship. Capt. Hans Olsen of Cambridge Mass., and William Bound of East Braintree, Mass., succeeded in remaining afloat in the icy water of Long Island sound for five minutes before the tug Dauntless, which was towing the barge, was able to come to their aid. Bound was taken to a New London hospital where he was treated for frostbite and exposure while Olsen responded to medical aid on board the tug. The freight boat was enroute to Braintree from Bayward, N.J. Capt. Olson said the barge started to leak suddenly and sank in a few minutes."

http://news.google.com/newspapers?nid=1928&dat=19360125&id=YM4gAAAAIBAJ&sjid=6moFAAAAIBAJ&pg=5409,1920102

General Notes

AWOIS Data:

H9181/70-71--OPR-474; LIMITED DEVELOPEMENT OF 25 METER LS FOUND APPARENT WRECK RISING 15 FT IN 140 FT, 127 FT LD (ACTUAL); FATHO TRACE BROKEN, NO DIVER VERIFICATION; AT POS.41-12-48N, 72-17-39W.
CL1291/81--CG; WK FOUND W/SS IN 143 FT OF WATER, DIVER IDENTIFIED AS BARGE RIVETED CONSTRUCTION, STEEL, MUCH MARINE GROWTH. INFO VERIFIED BY TELECON CGC MAHONING.

DESCRIPTION
01 1936 24 NO. 8373. BARGE, 810 GT, SUNK 1/24/36 BY MARINE CASUALTY; POSITION ACCURACY WITHIN 1 MILE 206 LORAN C RATES: 9960-W 14806.9; 9960-Y 43970.7. (ENTERED MSM 3/89) **** IT WAS DETERMINED THAT ITEM 1830 WAS THE SAME AS THIS ITEM. THE DATA FROM ITEM 1830 WAS COMBINED WITH THIS ITEM.

Wreck Condition/Salvage History

Wreck condition and salvage history are unknown. The wreck reportedly rises 10 to 15 feet off the bottom in about 140 feet of water.

Archaeological Assessment

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

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

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

Assessment

Cities Service No. 4 is a tank barge that NOAA has had little luck obtaining much information about. The barge sank in 1936 inside of Long Island Sound while carrying a cargo of 12,000 bbl (504,000 gallons) of domestic oil. Newspaper reports of the incident reveal that the vessel sprung a leak in rough seas before rapidly sinking. Since sinking in 1936, the barge has been charted by NOAA's Office of Coast Survey for

the Automated Wrecks and Obstructions Information System (AWOIS) database and was explored by a diver in 1981 who reported the wreck was a riveted steel barge covered in marine growth.

During each of these surveys, no oil was reported on the site. Given the nature of the loss, the breach of structural integrity, and the amount of time the barge has been on the bottom, the wreck was originally listed as a low priority shipwreck for potential simple site investigation. After mystery tar balls were discovered on a beach bordering Long Island Sound in 2011, however, a search was conducted of several wreck databases in order to determine a possible source of the oil, and the barge was elevated to a potential high priority target.

In 2008, NOAA bathymetric survey H11997 acquired multibeam sonar imagery of Long Island Sound in the vicinity of Cities Service No. 4. In 2011, the U.S. Geological Survey, Coastal and Marine Geology Program published these data through Woods Hole Coastal and Marine Science Center, Woods Hole, MA as H11997_2M_GEO: 2-m Bathymetric Grid of National Oceanic and Atmospheric Administration (NOAA) Survey H11997 Offshore in Eastern Long Island Sound (Geographic, WGS84).

This data provided NOAA archaeologists with the ability to review the sonar "image" of the wreck of *Cities Service No. 4* in order to make some interpretations about the site. The sonar image of the site (shown in this package) appears to depict a barge that is resting upright on the bottom with its deck collapsed into the hull of the vessel. Shadows in the sonar data suggest that the hull is standing proud of the bottom and is casting a sonar shadow into the inside of the barge, which appears to be lacking an intact deck. If this interpretation of the data is correct, it is unlikely that the barge retains oil. Unfortunately, the sonar data is relatively low resolution and open to additional interpretation.

This vessel may be of historic significance and will require appropriate actions be taken under the National Historic Preservation Act (NHPA) prior to any actions that could impact the integrity of the vessel. The site may be eligible for listing in the National Register of Historic Places and a full National Register assessment should be undertaken prior to any actions that could impact the integrity of the vessel.

Background Information References

Vessel Image Sources: No image available

Construction Diagrams or Plans in RULET Database? No

Text References:
http://news.google.com/newspapers?nid=1928&dat=19360125&id=YM4gAAAAIBAJ&sjid=6moFAAAAIBAJ&pg=5409,1920102
http://news.google.com/newspapers?nid=1915&dat=19360127&id=wfhGAAAAIBAJ&sjid=N_gMAAAAIBAJ&pg=4228,2120783

Vessel Risk Factors

In this section, the risk factors that are associated with the vessel are defined and then applied to the *Cities Service No. 4* 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 archaeological assessment, provides a picture of the wreck that is as complete as possible based on current knowledge and best professional judgment. This assessment *does not* take into consideration operational constraints such as depth or unknown location, but rather attempts to provide a replicable and objective screening of the historical date for each vessel. SERT reviewed the general historical information available for the database as a whole and provided a stepwise analysis for an initial indication of Low/Medium/High values for each vessel.

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

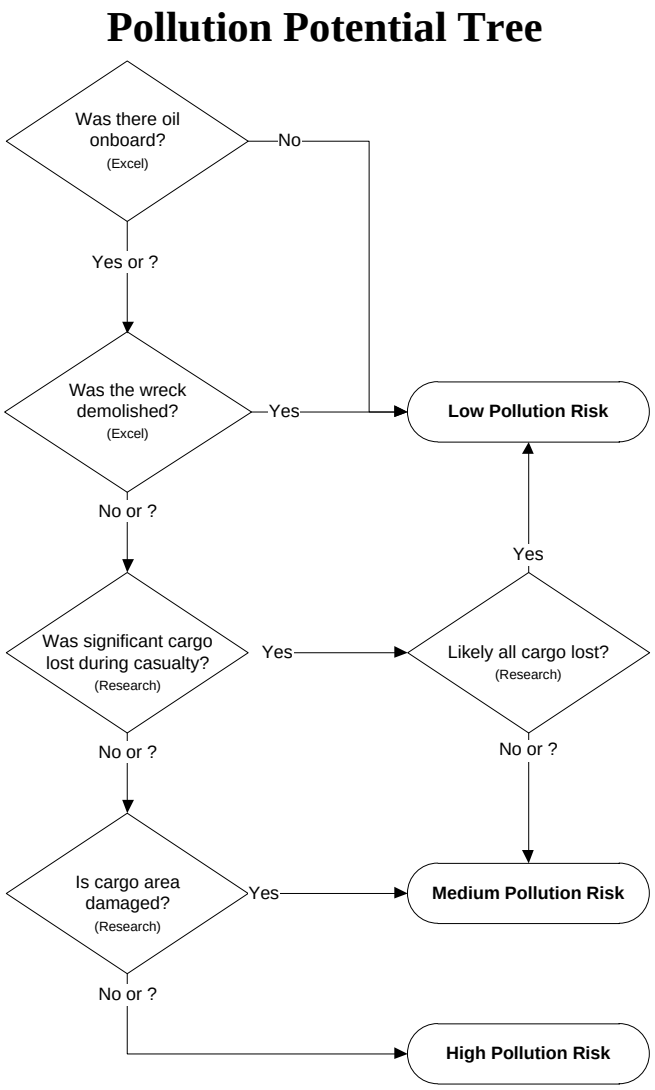


Figure 1-2: U.S. Coast Guard Salvage Engineering Response Team (SERT) developed the above Pollution Potential Decision Tree.

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

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 *Cities Service No. 4* 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 *Cities Service No. 4 i*s ranked as High Volume because it is thought to have a potential for up to 12,000 bbl, although some of this may have been lost through the breach in the hull. Data quality is medium.

The risk factor for volume also incorporates any reports or anecdotal evidence of actual leakage from the vessel or reports from divers of oil in the overheads, as opposed to potential leakage. This reflects the history of the vessel's leakage. There are no reports of leakage from *Cities Service No. 4*.

Risk Factor A2: Oil Type

The oil type(s) on board the wreck are classified only with regard to persistence, using the U.S. Coast Guard oil grouping[1]. (Toxicity is dealt with in the impact risk for the Resources at Risk classifications.) The three oil classifications are:

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

The *Cities Service No. 4* is classified as Medium Risk because the cargo of domestic oil is believed to be a medium fuel oil, a Group II oil type. Data quality is medium.

Was the wreck demolished?

Risk Factor B: Wreck Clearance

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

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

The *Cities Service No. 4* 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

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

- **Unknown:** It is not known whether or not the vessel burned at the time of the casualty

The *Cities Service No. 4* is classified as High Risk because it was not reported to have burned. Data quality is high.

Risk Factor C2: Reported Oil on the Water

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

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

The *Cities Service No. 4* is classified as High Risk because no oil is known to have been reported as spreading across the water as the vessel went down. Data quality is high.

Is the cargo area damaged?

Risk Factor D1: Nature of the Casualty

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

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

The *Cities Service No. 4* is classified as High Risk because it sank in a nonviolent manner after taking on water. 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 *Cities Service No. 4* is classified as High Risk because it is contiguous. 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 orientation of the *Cities Service No. 4* is believed to be resting upright on an even keel. Data quality is medium.

Depth

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

The depth for *Cities Service No. 4* is 140 feet. Data quality is high.

Visual or Remote Sensing Confirmation of Site Condition

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

The location of the *Cities Service No. 4* is well charted and multibeam sonar surveys confirm the presence of the wreck. 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 *Cities Service No. 4* had no munitions onboard. Data quality is high.

Vessel Risk Factors Summary

Table 1-1 summarizes the risk factor scores for the pollution potential and mitigating factors that would reduce the pollution potential for the *Cities Service No. 4*.

Table 1-1: Summary matrix for the vessel risk factors for the Cities Services Barge #4 are color-coded as red (high risk), yellow (medium risk), and green (low risk).

Vessel Risk Factors		Data Quality Score	Comments	Risk Score
Pollution Potential Factors	A1: Oil Volume (total bbl)	Medium	Potential for up to 12,000 bbl, no reports of leaking	**High**
	A2: Oil Type	Medium	Cargo is domestic fuel oil, a Group II oil	
	B: Wreck Clearance	High	Vessel not cleared	
	C1: Burning of the Ship	High	No fire was reported	
	C2: Oil on Water	High	No oil was reported on the water	
	D1: Nature of Casualty	High	Lost after taking on water	
	D2: Structural Breakup	High	Vessel in one contiguous piece	
Archaeological Assessment	Archaeological Assessment	Low	No detailed sinking records of this wreck have been located and no dive reports have been uncovered, an accurate assessment cannot be made	**Not Scored**
Operational Factors	Wreck Orientation	Medium	Vessel believed to be upright	**Not Scored**
	Depth	Low	140 ft, muddy bottom	
	Visual or Remote Sensing Confirmation of Site Condition	High	NOAA survey 2008	
	Other Hazardous Materials Onboard	High	No	
	Munitions Onboard	High	No	
	Gravesite (Civilian/Military)	High	No	
	Historical Protection Eligibility (NHPA/SMCA)	High	Unknown, full National Register assessment should be conducted	

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 of the discharges would tend 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 present on the vessel. In the case of the *Cities Service No. 4* this would be 12,000 bbl based on current estimates of the maximum amount of oil remaining onboard the wreck.

The likeliest scenario of oil release from most sunken wrecks, including the *Cities Service No. 4*, 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 cause 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 *Cities Service No. 4*.

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

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

For the large and WCD scenarios, the duration of the release was assumed to be 12 hours, envisioning a storm scenario where the wreck is damaged or broken up, and the model simulations were run for a period of 30 days. The releases were assumed to be from a depth between 2-3 meters above the sea floor, using the information known about the wreck location and depth.

It is important to acknowledge that these scenarios are only for this screening-level assessment. Detailed site/vessel/and seasonally specific modeling would need to be conducted prior to any intervention on a specific wreck.

Oil Type for Release

The *Cities Service No. 4* contained a maximum of 12,000 bbl of domestic oil, which is likely home heating oil (a Group II oil), as cargo. Thus, the oil spill model was run using light fuel oil.

Oil Thickness Thresholds

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

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

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

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

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

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

Potential Impacts to the Water Column

Impacts to the water column from an oil release from the *Cities Service No. 4* will be determined by the volume of leakage. Because oil from sunken vessels will be released at low pressures, the droplet sizes will be large enough for the oil to float to the surface. Therefore, impacts to water column resources will result from the natural dispersion of the floating oil slicks on the surface, which is limited to about the top 33 feet. The metric used for ranking impacts to the water column is the area of water surface in mi^2 that has been contaminated by 1 part per billion (ppb) oil to a depth of 33 feet. At 1 ppb, there are likely to be impacts to sensitive organisms in the water column and potential tainting of seafood, so this concentration is used as a screening threshold for both the ecological and socio-economic risk factors for water column resource impacts. To assist planners in understanding the scale of potential impacts for different leakage volumes, a regression curve was generated for the water column volume oiled using the five volume scenarios, which is shown in Figure 2-1. Using this figure, the water column impacts can be estimated for any spill volume.

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

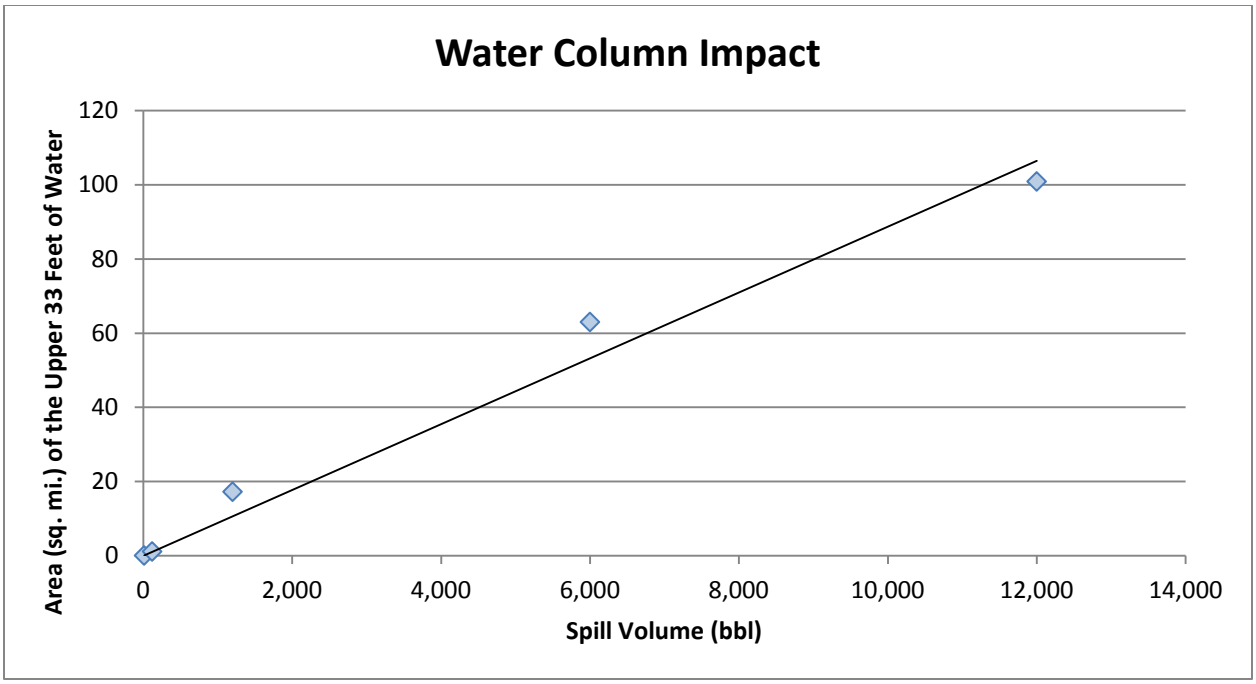


Figure 2-1: Regression curve for estimating the volume of water column at or above 1 ppb aromatics impacted as a function of spill volume for the *Cities Service No. 4*.

Potential Water Surface Slick

The slick size from an oil release from the *Cities Service No. 4* 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 and streamers.

Table 2-3: Estimated slick area swept on water for oil release scenarios from the *Cities Service No. 4*.

Scenario Type	Oil Volume (bbl)	Estimated Slick Area Swept Mean of All Models	
		0.01 g/m²	10 g/m²
Chronic	12	31 mi²	22 mi²
Episodic	120	75 mi²	56 mi²
Most Probable	1,200	200 mi²	150 mi²
Large	6,000	591 mi²	370 mi²
Worst Case Discharge	12,000	1,000 mi²	580 mi²

The location, size, shape, and spread of the oil slick(s) from an oil release 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 post-release, are shown in Figure 2-2 and Figure 2-3 using the Most Probable volume and the socio-economic and ecological thresholds.

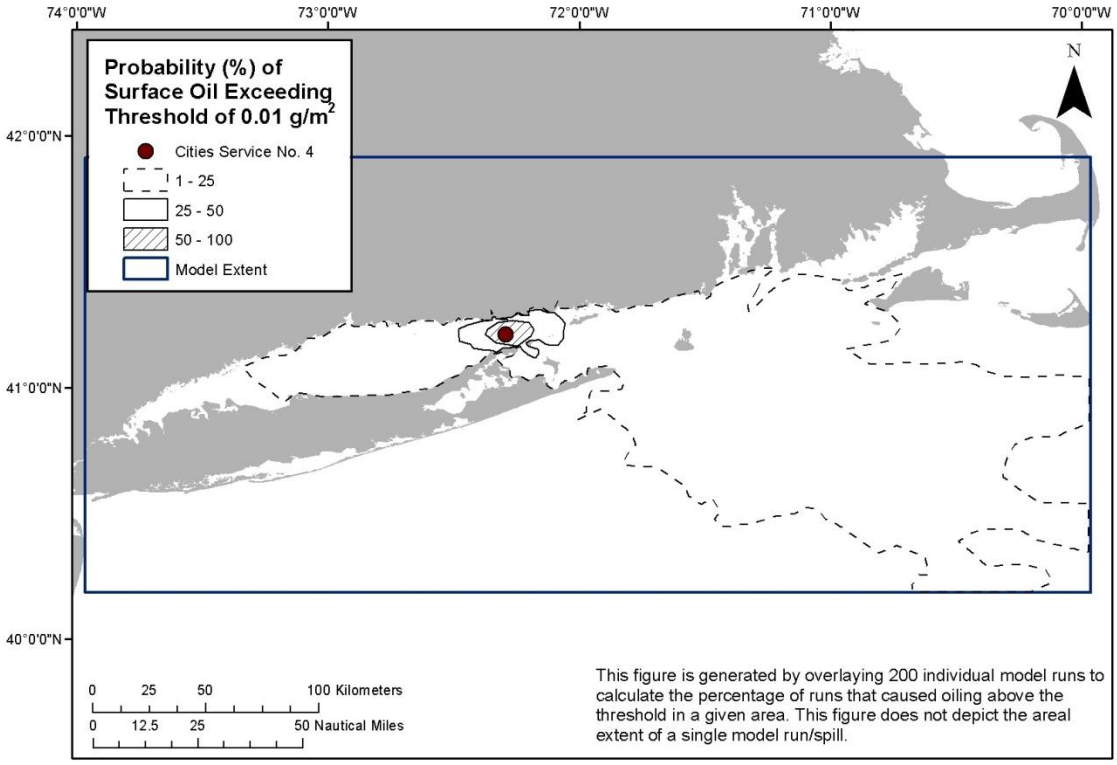


Figure 2-2: Probability of surface oil (exceeding 0.01 g/m^2) from the Most Probable spill of 1,200 bbl of light fuel oil from the *Cities Service No. 4* at the threshold for socio-economic resources at risk.

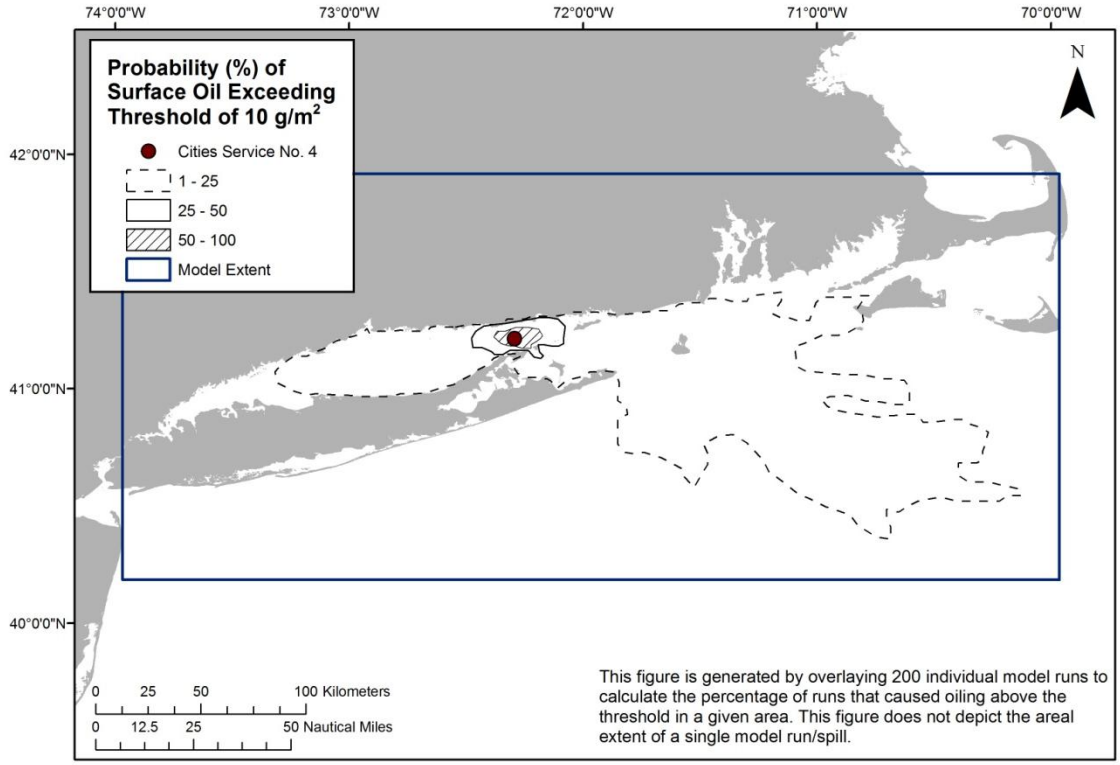


Figure 2-3: Probability of surface oil (exceeding 10 g/m^2) from the Most Probable spill of 1,200 bbl of light fuel oil from the *Cities Service No. 4* at the threshold for ecological resources at risk.

The behavior of light fuel oils to spread into thin sheens is demonstrated by the comparison of Figures 2-2 and 2-3, which show the probability of surface oil at different thicknesses. At the socio-economic threshold of a barely visible sheen (0.01 g/m^2), the overlay of all 200 models generates a map showing the probability of 1-25% oil in each model grid that covers a very large area. At the ecological threshold of a heavy sheen with dark colors (10 g/m^2), the 1-25% probability area of oil presence is much smaller and remains within Long Island Sound.

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

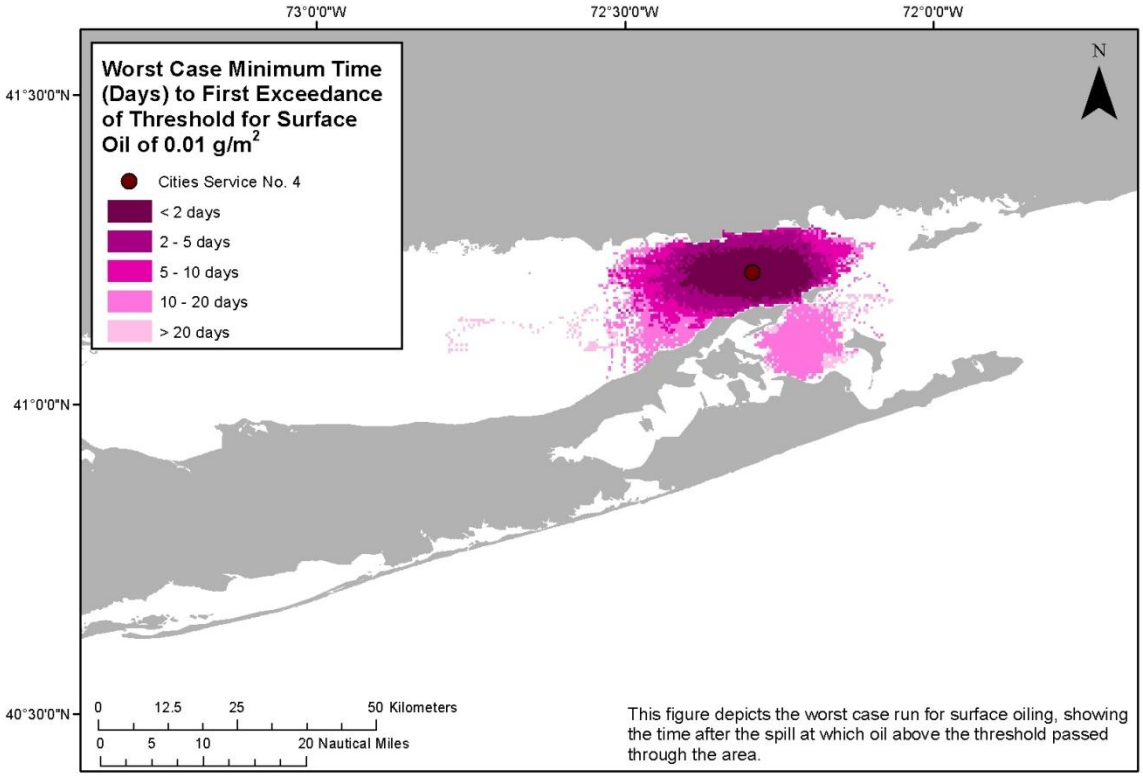


Figure 2-4: Water surface oiling from the Most Probable spill of 1,200 bbl of light fuel oil from the *Cities Service No. 4* shown as the area over which the oil spreads at different time intervals.

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.

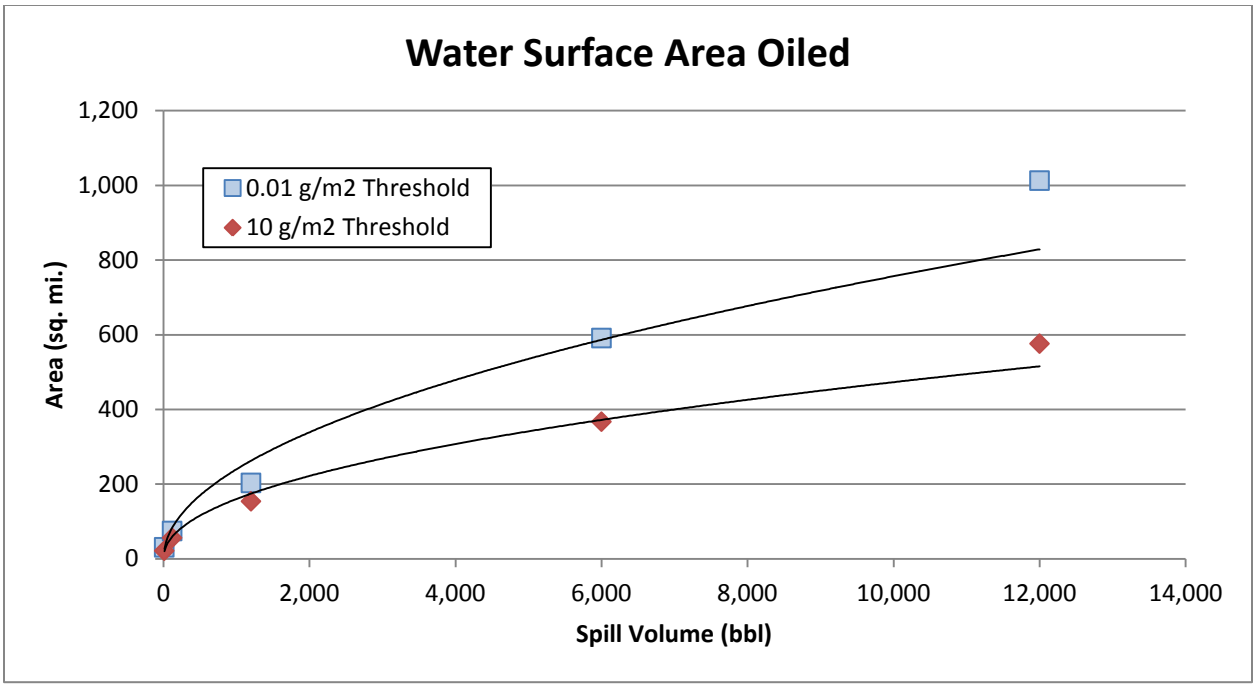


Figure 2-5: Regression curve for estimating the amount of water surface oiling as a function of spill volume for the *Cities Service No. 4*, showing both the ecological threshold of 10 g/m^2 and socio-economic threshold of 0.01 g/m^2.

Potential Shoreline Impacts

Based on these modeling results, shorelines along eastern Long Island Sound to Point Judith, Rhode Island, 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 1,200 bbl. However, the specific areas that would be oiled will depend on the currents and winds at the time of the oil release(s), as well as on the amount of oil released. Figure 2-7 shows the single oil spill scenario that resulted in the maximum extent of shoreline oiling for the Most Probable volume. Estimated miles of shoreline oiling above the threshold of 1 g/m^2 by scenario and shoreline type are shown in Table 2-4. Gravel beaches along the northeastern shoreline of Long Island and gravel beaches and rocky shores along eastern Connecticut are at greatest risk of oiling.

Table 2-4: Estimated shoreline oiling from leakage from the *Cities Service No. 4*.

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

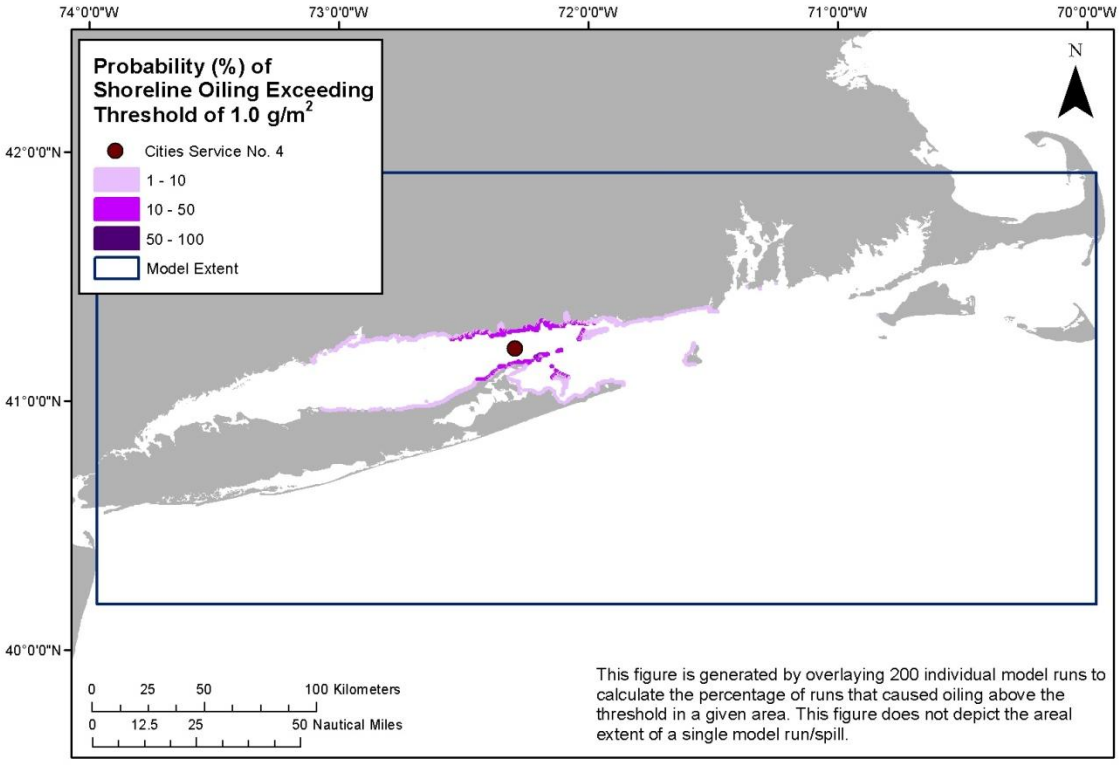


Figure 2-6: Probability of shoreline oiling (exceeding 1.0 g/m^2) from the Most Probable Discharge of 1,200 bbl of light fuel oil from the *Cities Service No. 4*.

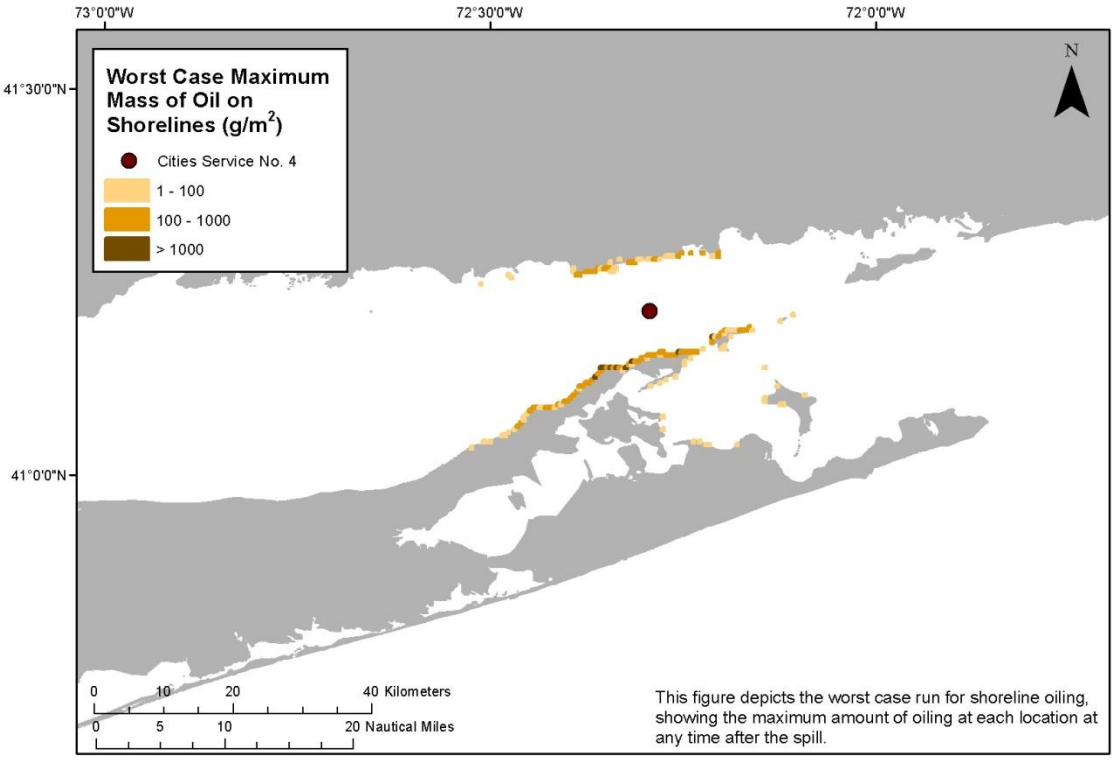


Figure 2-7: The extent and degree of shoreline oiling from the single model run of the Most Probable Discharge of 1,200 bbl of light fuel oil from the *Cities Service No. 4* that resulted in the greatest shoreline oiling.

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.

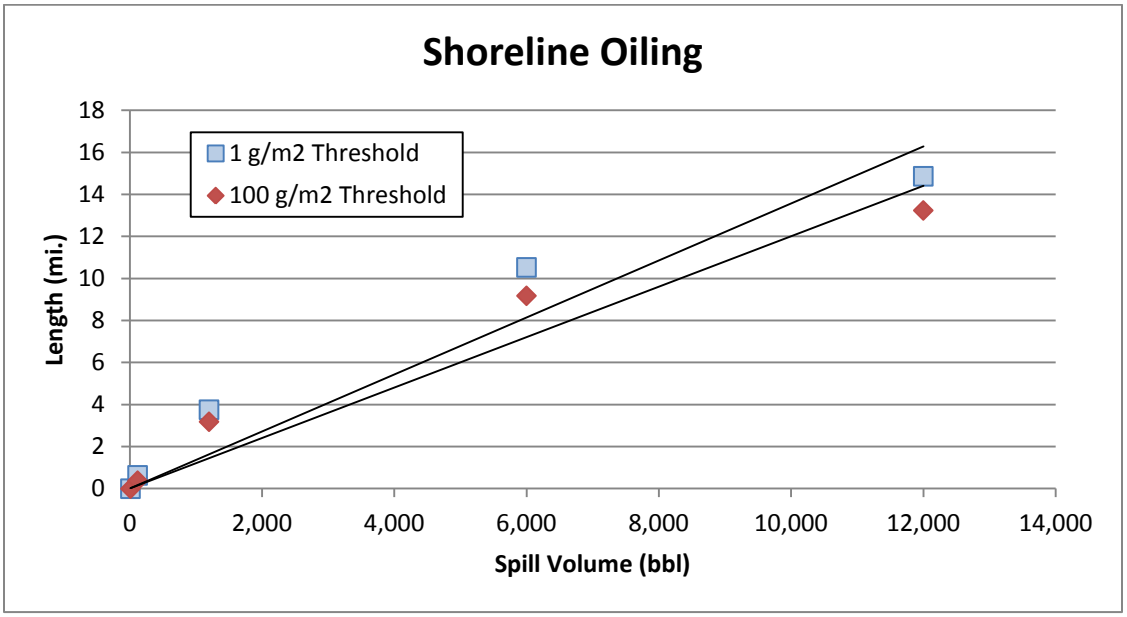


Figure 2-8: Regression curve for estimating the amount of shoreline oiling at different thresholds as a function of spill volume for the *Cities Service No. 4*.

The worst case scenario for shoreline exposure along the potentially impacted area for the WCD volume (Table 2-5) impacts rocky shores and gravel beaches. Salt marshes and tidal flats are also at risk. The worst case scenario for the Most Probable volume (Table 2-6) impacts rocky shores and gravel beaches.

Table 2-5: Worst case scenario shoreline impact by habitat type and oil thickness for a leakage of 12,000 bbl from the *Cities Service No. 4*.

Shoreline/Habitat Type	Lighter Oiling Oil Thickness <1 mm Oil Thickness >1 g/m²	Heavier Oiling Oil Thickness >1 mm Oil Thickness >100 g/m²
Rocky and artificial shores/Gravel beaches	48 miles	38 miles
Sand beaches	11 miles	7 miles
Salt marshes and tidal flats	7 miles	2 miles

Table 2-6: Worst case scenario shoreline impact by habitat type and oil thickness for a leakage of 1,200 bbl from the *Cities Service No. 4*.

Shoreline/Habitat Type	Lighter Oiling Oil Thickness <1 mm Oil Thickness >1 g/m²	Heavier Oiling Oil Thickness >1 mm Oil Thickness >100 g/m²
Rocky and artificial shores/Gravel beaches	20 miles	12 miles
Sand beaches	1 mile	0 miles
Salt marshes and tidal flats	0 miles	0 miles

SECTION 3: ECOLOGICAL RESOURCES AT RISK

Biological resources at risk from a catastrophic release of oil from the *Cities Service No.4* (Table 3-1) include numerous guilds of birds present in nearshore/offshore waters of Long Island Sound, particularly those sensitive to surface oiling while rafting or plunge diving to feed. In addition, this region is important for migrating marine mammals and commercially important fish and invertebrates.

Table 3-1: Ecological Resources at Risk from a Catastrophic Release of Oil from the *Cities Service No. 4*.
(FT = Federal threatened; FE = Federal endangered; ST = State threatened; SE = State endangered).

Species Group	Species Subgroup and Geography	Seasonal Presence
Pelagic Birds and Sea Birds	• Long Island Sound (LIS)/offshore waters: Support 1,000s of loons, grebes, petrels, shearwaters, pelicans, cormorants, phalaropes, and terns • Northern gannet are abundant fall-spring throughout the coastal zone (often > 3 km from shore) • Pelagic/waterbird bird use of RI waters most diverse and abundant fall through spring, but 10,000s of birds have been observed feeding some summers (RI is critical wintering habitat for a significant number of loons)	Terns, gulls, cormorants present spring/summer; Loons and pelicans present in spring/fall; Shearwaters in summer; Grebes, phalaropes in fall/winter
Sea Ducks	Sea ducks (includes mean and max distance of flocks to shore in Long Island Sound (2009-2010 data); • Scoters (black, surf, and white-winged; 2 nm/8-13 nm): 6-22K • Long-tailed duck (2 nm/25 nm): 3-7K • Common eider (<1 nm/19 nm): 21-41K • Bufflehead, mergansers, and goldeneyes (<1 nm/7-14 nm): 7K • Benthic community composition and water depth important for determining preferred foraging sites (not well known, some studies have been conducted)	Sea ducks surveyed in winter (peak abundances); Migration from fall to spring (Oct-Apr)
Shorebirds, Waterfowl, and Colonial Nesting Birds	Shorebirds, colonial nesting birds (colonial waterbirds, shorebirds, and waterfowl are abundant on small islands, beaches, and marshes throughout the region) • Great Gull Island (LIS): one of the most important tern nesting sites in the world (1,600 pairs of roseate tern (FE), 10K common tern); Faulkner Island, CT, important nesting site for roseate tern (FE) • CT: Hammonasset Beach State Park: nesting saltmarsh sharp-tailed sparrow and migratory stopover point • CT and RI: 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 • RI: Most critical wintering areas for harlequin duck occur north of spill area, but rocky coasts in MA and RI also important • LIS provide important habitat for 1,000s of migratory waterfowl including declining populations of American black duck and northern pintail • Salt marshes of this region provide important American black duck nesting site	Colonial and beach nesters peak Apr-Aug Migration typically spring/fall, but varies by species and location and ranges from Feb-Jun/Aug-Dec. Fall-spring Nesting Apr-Jun
Raptors and Passerines	Long Island Sounds: 1000's of osprey; northern harriers (FT)	Spring-fall
Sea Turtles	Long Island Sound: Summer foraging grounds for adult and juvenile green (FE), loggerhead (FT), Kemp's ridley (FE) and Leatherback (FE) sea turtles	Adults and juveniles present spring/ summer
Marine Mammals	*Baleen whales*: North Atlantic Right whale (FE), Humpback whale (FE), Fin whale (FE), and Minke whale are more common offshore but can move inshore to feed on forage fish and zooplankton. • Right whales are critically endangered (300-400 individuals remaining) and use this area as a migratory pathway *Inshore cetaceans:* Atlantic white-sided dolphin, bottlenose dolphin, harbor	Baleen whales migrate through the area spring and fall; males and juveniles may stay year round Dolphins more common

Species Group	Species Subgroup and Geography	Seasonal Presence
	porpoise, common dolphin, and killer whale use coastal waters to the shelf break *Pinnipeds*: 100s of gray seals and harbor seals are common during the winter, with Block Island, Plum Island, Fishers Island, and Great Gull Island serving as important haul out locations. Hooded and harp seals can occur but are less common	in southern area, during summer; Harbor porpoises calve May-Aug Seals common Nov-Jun
Fish and Invertebrates	Coastal ocean waters support many valuable fisheries and/or species of concern in the region: • Benthic: Sea scallop, scup, summer flounder, winter flounder, black sea bass, Atlantic rock crab, Atlantic surf clam • Midwater: Atlantic mackerel, Atlantic herring, longfin squid, shortfin squid, striped bass, bluefish, menhaden, spiny dogfish shark, spot, weakfish • Pelagic: bluefin tuna, yellowfin tuna, dolphinfish, and longbill spearfish • Diadromous: alewife, blueback and atlantic herring, American shad, hickory shad, American eel, Atlantic sturgeon (Fed. species of concern), shortnose sturgeon (FE) Estuaries are important nursery grounds for many of these species, and also support fisheries for blue crab, shrimp, horseshoe crab, American oyster and many other species Important concentration/conservation areas: • Essential Fish Habitat (EFH) for highly migratory species occurs in the area, including swordfish, bluefin tuna, yellowfin tuna, and many shark species • Juvenile and adult bluefin tuna aggregate in the area in the winter	Generally spawn during the warmer months (except winter flounder) Many coastal fish migrate seasonally either across the shelf or east-west (winter flounder) Juveniles of many species use estuaries, seagrass, hard bottom habitats as nursery areas
Benthic Habitats	Submerged aquatic vegetation (mostly eelgrass) is extremely critical to numerous species and occurs inside of bays and sounds throughout the region. Shallow depths provide important foraging habitat for sea birds and ducks	Year round Fall-spring

The Environmental Sensitivity Index (ESI) atlases for the potentially impacted coastal areas from a leak from the *Cities Service No. 4* 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.

As a reminder, the ecological impact thresholds are: 1 ppb aromatics for water column impacts; 10 g/m^2 for water surface impacts; and 100 g/m^2 for shoreline impacts.

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).

In the following sections, the definition of low, medium, and high for each ecological risk factor is provided. Also, the classification for the *Cities Service No. 4* is provided, both as text and as shading of the applicable degree of risk bullet, for the WCD release of 12,000 bbl and a border around the Most Probable Discharge of 1,200 bbl.

Risk Factor 3A: Water Column Impacts to EcoRAR

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

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

This risk factor reflects the probability that at least 0.2 mi^2 of the upper 33 feet of the water column would be contaminated with a high enough concentration of oil to cause ecological impacts. The three risk scores for water column oiling probability are:

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

Risk Factor 3A-2: Water Column Degree of Oiling of EcoRAR

The degree of oiling of the water column reflects the total volume of water that would be contaminated by oil at a concentration high enough to cause impacts. The three categories of impact are:

- **Low Impact:** impact on less than 0.2 mi^2 of the upper 33 feet of the water column at the threshold level
- **Medium Impact**: impact on 0.2 to 200 mi^2 of the upper 33 feet of the water column at the threshold level
- **High Impact:** impact on more than 200 mi^2 of the upper 33 feet of the water column at the threshold level

The *Cities Service No. 4* is classified as High Risk for oiling probability for water column ecological resources for the WCD of 12,000 bbl because 95% 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 100 mi^2 of the upper 33 feet of the water column. For the Most Probable Discharge of 1,200 bbl, the *Cities Service No. 4* is classified as High Risk for oiling probability for water column ecological resources because 91% 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 17 mi^2 of the upper 33 feet of the water column.

Risk Factor 3B: Water Surface Impacts to EcoRAR

Ecological resources at risk at the water surface include surface feeding and diving sea birds, sea turtles, and marine mammals. These organisms can be affected by the toxicity of the oil as well as from coating with oil. The threshold for water surface oiling impact to ecological resources at risk is 10 g/m^2 (10 grams of floating oil per square meter of water surface). At this concentration and above, one would expect impacts to birds and other animals that spend time on the water surface.

Risk Factor 3B-1: Water Surface Probability of Oiling of EcoRAR

This risk factor reflects the probability that at least 1,000 mi^2 of the water surface would be affected by enough oil to cause impacts to ecological resources. The three risk scores for oiling are:

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

Risk Factor 3B-2: Water Surface Degree of Oiling of EcoRAR

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

- **Low Impact:** less than 1,000 mi^2 of water surface impact at the threshold level
- **Medium Impact:** 1,000 to 10,000 mi^2 of water surface impact at the threshold level
- **High Impact:** more than 10,000 mi^2 of water surface impact at the threshold level

The *Cities Service No. 4* is classified as Medium Risk for oiling probability for water surface ecological resources for the WCD because 14% of the model runs resulted in at least 1,000 mi^2 of the water surface

affected above the threshold of 10 g/m^2. It is classified as Low Risk for degree of oiling because the mean area of water contaminated was 580 mi^2. The *Cities Service No. 4* is classified as Low Risk for oiling probability for water surface ecological resources for the Most Probable Discharge because 1% of the model runs resulted in at least 1,000 mi^2 of the water surface affected above the threshold of 10 g/m^2. It is also classified as Low Risk for degree of oiling because the mean area of water contaminated was 150 mi^2.

Risk Factor 3C: Shoreline Impacts to EcoRAR

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

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

This risk factor reflects the probability that the shoreline would be coated by enough oil to cause impacts to shoreline organisms. The threshold for shoreline oiling impacts to ecological resources at risk is 100 g/m^2 (i.e., 100 grams of oil per square meter of shoreline). The three risk scores for oiling are:

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

Risk Factor 3C-2: Shoreline Degree of Oiling of EcoRAR

The degree of oiling of the shoreline reflects the length of shorelines oiled by at least 100 g/m^2 in the event of a discharge from the vessel. The three categories of impact are:

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

The *Cities Service No. 4* is classified as High Risk for oiling probability for shoreline ecological resources for the WCD because 100% of the model runs resulted in shorelines affected above the threshold of 100 g/m^2. It is classified as Medium Risk for degree of oiling because the mean weighted length of shoreline contaminated was 26 miles. The *Cities Service No. 4* is classified as High Risk for oiling probability to shoreline ecological resources for the Most Probable Discharge because 97% of the model runs resulted in shorelines affected above the threshold of 100 g/m^2. It is classified as Low Risk for degree of oiling because the mean weighted length of shoreline contaminated was 6 miles.

Considering the modeled risk scores and the ecological resources at risk, the ecological risk from potential releases of the WCD of 12,000 bbl of light fuel oil from the *Cities Service No. 4* is summarized as listed below and indicated in the far-right column in Table 3-2:

- Water column resources – Medium, because of the importance of coastal and estuarine waters as spawning and rearing habitat for commercially important fish and shellfish
- Water surface resources – Medium, because of the high concentrations of birds in Long Island Sound and adjacent shorelines as wintering, migratory, and nesting habitat
- Shoreline resources – Medium, because light fuel oils are not generally persistent on the dominantly gravel beaches and rocky shores at risk, although these shorelines are used by many shorebirds for nesting and migratory stopovers

Table 3-2: Ecological risk scores for the **Worst Case Discharge of 12,000 bbl** of light fuel oil from the *Cities Service No. 4*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
3A-1: Water Column Probability EcoRAR Oiling	Low	Medium	High	95% of the model runs resulted in at least 0.2 mi^2 of the upper 33 feet of the water column contaminated above 1 ppb aromatics	Med
3A-2: Water Column Degree EcoRAR Oiling	Low	**Medium**	High	The mean volume of water contaminated above 1 ppb was 100 mi^2 of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	Low	**Medium**	High	14% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 10 g/m^2	Med
3B-2: Water Surface Degree EcoRAR Oiling	**Low**	Medium	High	The mean area of water contaminated above 10 g/m^2 was 580 mi^2	
3C-1: Shoreline Probability EcoRAR Oiling	Low	Medium	High	100% of the model runs resulted in shoreline oiling of 100 g/m^2	Med
3C-2: Shoreline Degree EcoRAR Oiling	Low	**Medium**	High	The length of shoreline contaminated by at least 100 g/m^2 was 26 mi	

For the Most Probable Discharge of 1,200 bbl, the ecological risk from potential releases from the *Cities Service No. 4* is summarized as listed below and indicated in the far-right column in Table 3-3:

- Water column resources – Low, because of the very small area of potential water column impacts
- Water surface resources – Low, because of the small area of potential impact
- Shoreline resources – Low, because of the very small amount of shoreline oiling and light fuel oils are not generally persistent on the dominantly gravel beaches

Table 3-3: Ecological risk scores for the **Most Probable Discharge of 1,200 bbl** of light fuel oil from the *Cities Service No. 4*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
3A-1: Water Column Probability EcoRAR Oiling	**Low**	**Medium**	**High**	91% of the model runs resulted in at least 0.2 mi^2 of the upper 33 feet of the water column contaminated above 1 ppb aromatics	**Low**
3A-2: Water Column Degree EcoRAR Oiling	**Low**	**Medium**	**High**	The mean volume of water contaminated above 1 ppb was 17 mi^2 of the upper 33 feet of the water column	
3B-1: Water Surface Probability EcoRAR Oiling	**Low**	**Medium**	**High**	1% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 10 g/m^2	**Low**
3B-2: Water Surface Degree EcoRAR Oiling	**Low**	**Medium**	**High**	The mean area of water contaminated above 10 g/m^2 was 150 mi^2	
3C-1: Shoreline Probability EcoRAR Oiling	**Low**	**Medium**	**High**	97% of the model runs resulted in shoreline oiling of 100 g/m^2	**Low**
3C-2: Shoreline Degree EcoRAR Oiling	**Low**	**Medium**	**High**	The length of shoreline contaminated by at least 100 g/m^2 was 6 mi	

SECTION 4: SOCIO-ECONOMIC RESOURCES AT RISK

In addition to natural resource impacts, spills from sunken wrecks have the potential to cause significant social and economic impacts. Socio-economic resources potentially at risk from oiling are listed in Table 4-1 and shown in Figures 4-1 and 4-2. The potential economic impacts include disruption of coastal economic activities such as commercial and recreational fishing, boating, vacationing, commercial shipping, and other activities that may become claims following a spill.

Socio-economic resources in the areas potentially affected by a release from the *Cities Service No. 4* include over 200 miles of very highly utilized recreational beaches and beachfront communities on northern and eastern Long Island and along the southern Connecticut coast east towards Rhode Island, as well as Fishers Island and Block Island. Over six million people visit area beaches annually. At the eastern end of Long Island Sound is the Narragansett Indian Reservation.

The Long Island Sound area is also a moderately important port area with 142 large vessel calls and 7.8 million tonnage annually combined for the ports of Bridgeport, CT, Groton, CT, New Haven, CT, New London, CT, Port Jefferson, NY and Riverhead, NY. There are 61 tanker calls to New Haven and 40 tanker calls to Riverhead annually. There is a major power station, the Northport Power Station, that has industrial water intakes in the Long Island Sound.

Long Island Sound is also an important commercial and recreational fishing area with commercial fisheries worth over $80 million annually, and sport fishing reaching $140 million annually. There are important fishing fleets coming out of Montauk, NY, and Point Judith, RI, as well as smaller ones from New London, CT, and Stonington, CT.

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 *Cities Service No. 4* 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 *Cities Service No. 4*.

Resource Type	Resource Name	Economic Activities
National Wildlife Refuges	Stewart B. McKinney NWR (CT) Ninigret NWR (RI) Amagansett NWR (NY) Block Island NWR (RI)	National wildlife refuges in three states may be impacted. These federally managed and protected lands provide refuges and conservation areas for sensitive species and habitats.
Tourist Beaches	Montauk, NY Block Island, RI East Matunuck State Beach, RI Roger W. Wheeler State Beach, RI Scarborough State Beach, RI Fishers Island Old Lyme, CT Old Saybrook, CT Mystic, CT Ivoryton, CT Westbrook, CT Greenport, NY	Potentially affected beach resorts and beach-front communities in southern Connecticut, northern and western Long Island and western Rhode Island provide recreational activities (e.g., swimming, boating, recreational fishing, wildlife viewing, nature study, sports, dining, camping, and amusement parks) with substantial income for local communities and state tax income. Many of these recreational activities are limited to or concentrated into the late spring into early fall months.
State Parks	Montauk SP (NY) Montauk Downs SP (NY) Caumsett SP (NY) Sunken Meadow SP (NY) Wildwood SP (NY) Orient Beach SP (NY) Hither Hills SP (NY) Haley Farm SP (CT) Bluff Point SP (CT) Harkness Memorial SP (CT) Hammonasset SP (CT) Silver Sands SP (CT) Sherwood Island SP (CT) Misquamicut SP (RI)	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 Connecticut, Rhode Island, and New York are potentially impacted. Many of these recreational activities are limited to or concentrated into the late spring into early fall months.
Tribal Lands	Narragansett Indian Reservation, RI	Narragansett Indian Reservation, Rhode Island, is home to 2,400 tribal members.
Commercial Fishing	A number of fishing fleets use the Long Island Sound and surrounding waters for commercial fishing.	
	Montauk, NY	Total Landings (2010): $17.7M
	New London, CT	Total Landings (2010): $10.6M
	Stonington, CT	Total Landings (2010): $18.5M
	Point Judith, RI	Total Landings (2010): $32.2M
Ports	There are a number of significant commercial ports in the Long Island Sound area 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, and other smaller ports and marinas.	
	New London, CT	12 port calls annually
	Bridgeport, CT	14 port calls annually
	Groton, CT	1 port calls annually
	New Haven, CT	73 port calls annually
	Port Jefferson, NY	2 port calls annually
	Riverhead, NY	40 port calls annually

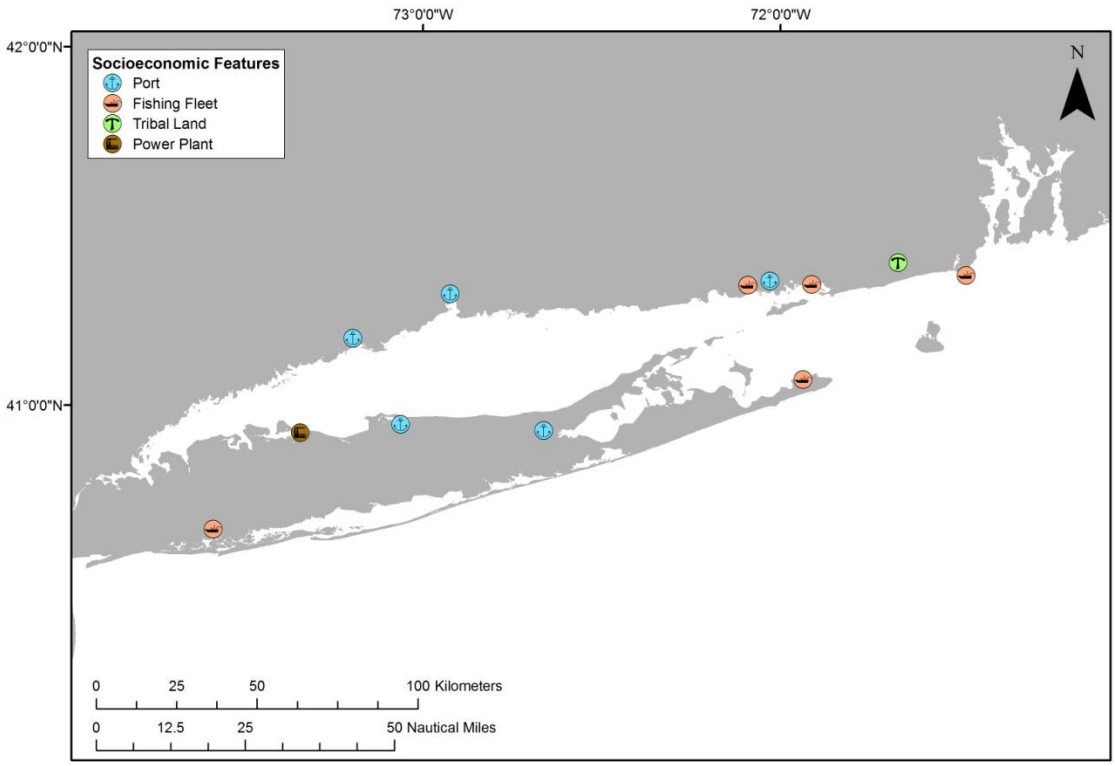


Figure 4-1: Tribal lands, ports, power plants, and commercial fishing fleets at risk from a release from the *Cities Service No. 4*.

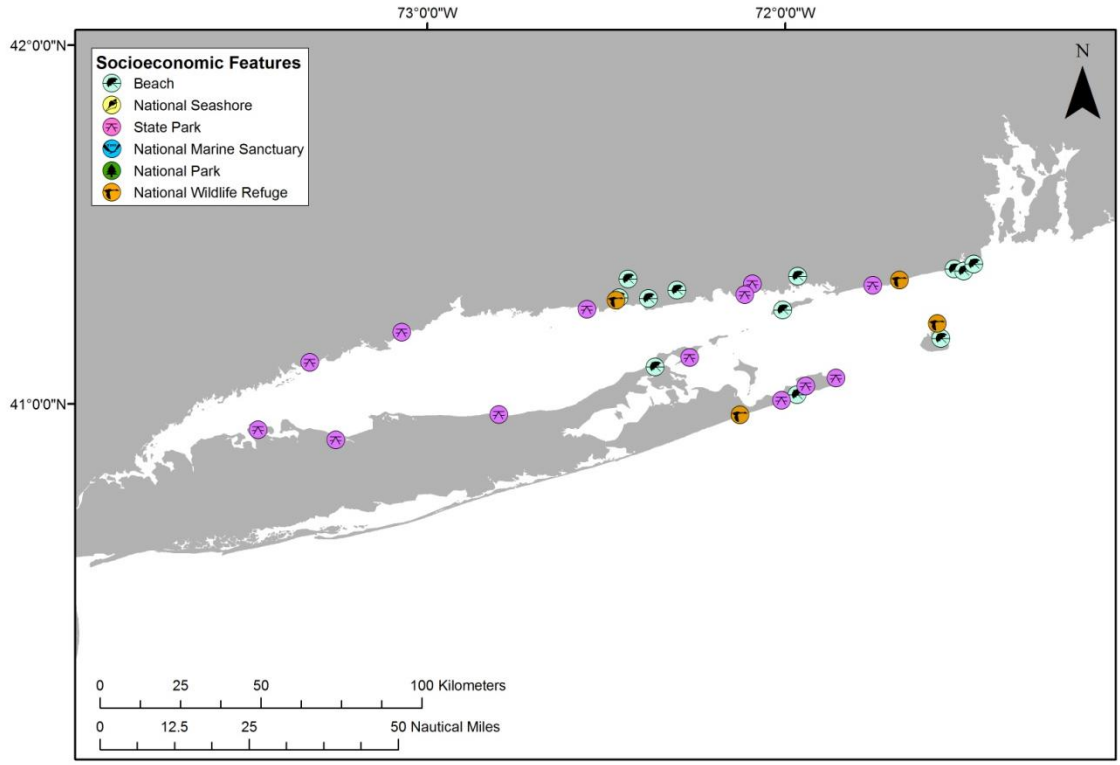


Figure 4-2: Beaches and coastal state parks, and Federal protected areas at risk from a release from the *Cities Service No. 4*.

Socio-Economic Risk Factors

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

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

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

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

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

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

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

In the following sections, the definition of low, medium, and high for each socio-economic risk factor is provided. Also, in the text classification for the *Cities Service No. 4* shading indicates the degree of risk, for the WCD release of 12,000 bbl and a border indicates degree of risk for the Most Probable Discharge of 1,200 bbl.

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

This risk factor reflects the probability that at least 0.2 mi^2 of the upper 33 feet of the water column would be contaminated with a high enough concentration of oil to cause socio-economic impacts. The threshold for water column impact to socio-economic resources at risk is an oil concentration of 1 ppb (i.e., 1 part oil per one billion parts water). At this concentration and above, one would expect impacts and potential tainting to socio-economic resources (e.g., fish and shellfish) in the water column; this concentration is used as a screening threshold for both the ecological and socio-economic risk factors.

The three risk scores for oiling are:

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

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

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

- **Low Impact:** impact on less than 0.2 mi^2 of the upper 33 feet of the water column at the threshold level
- **Medium Impact:** impact on 0.2 to 200 mi^2 of the upper 33 feet of the water column at the threshold level
- **High Impact:** impact on more than 200 mi^2 of the upper 33 feet of the water column at the threshold level

The *Cities Service No. 4* is classified as High Risk for oiling probability and Medium Risk for degree of oiling for water column socio-economic resources for the WCD of 12,000 bbl because 95% of the model runs resulted in contamination of 100 mi^2 of the upper 33 feet of the water column above the threshold of 1 ppb aromatics, and the mean volume of water contaminated was 100 mi^2 of the upper 33 feet of the water column. For the Most Probable Discharge of 1,200 bbl, the *Cities Service No. 4* is classified as High Risk for oiling probability for water column socio-economic resources because 91% of the model runs resulted in contamination of 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 17 mi^2 of the upper 33 feet of the water column.

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

This risk factor reflects the probability that at least 1,000 mi^2 of the water surface would be affected by enough oil to cause impacts to socio-economic resources. The three risk scores for oiling are:

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

The threshold level for water surface impacts to socio-economic resources at risk is 0.01 g/m^2 (i.e., 0.01 grams of floating oil per square meter of water surface). At this concentration and above, one would expect impacts to socio-economic resources on the water surface.

Risk Factor 4B-2: Water Surface Degree of Oiling of SRAR

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

- **Low Impact:** less than 1,000 mi^2 of water surface impact at the threshold level
- **Medium Impact:** 1,000 to 10,000 mi^2 of water surface impact at the threshold level
- **High Impact:** more than 10,000 mi^2 of water surface impact at the threshold level

The *Cities Service No. 4* is classified as Medium Risk for both oiling probability and degree of oiling for water surface socio-economic resources for the WCD because 37% of the model runs resulted in at least 1,000 mi^2 of the water surface affected above the threshold of 0.01 g/m^2, and the mean area of water contaminated was 1,000 mi^2. The *Cities Service No. 4* is classified as Low Risk for oiling probability for water surface socio-economic resources for the Most Probable Discharge because 0.5% of the model runs resulted in at least 1,000 mi^2 of the water surface affected above the threshold of 0.01 g/m^2. It is classified as Medium Risk for degree of oiling because the mean area of water contaminated was 200 mi^2.

Risk Factor 4C: Shoreline Impacts to SRAR

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

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

This risk factor reflects the probability that the shoreline would be coated by enough oil to cause impacts to shoreline users. The threshold for impacts to shoreline SRAR is 1 g/m^2 (i.e., 1 gram of oil per square meter of shoreline). The three risk scores for oiling are:

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

Risk Factor 4C-2: Shoreline Degree of Oiling of SRAR

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

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

The *Cities Service No. 4* is classified as High Risk for oiling probability for shoreline socio-economic resources for the WCD because 100% of the model runs resulted in shorelines affected above the threshold of 1 g/m^2. It is classified as Medium Risk for degree of oiling because the mean length of weighted shoreline contaminated was 31 miles. The *Cities Service No. 4* is classified as High Risk for oiling probability for shoreline socio-economic resources for the Most Probable Discharge as 99% of the model runs resulted in shorelines affected above the threshold of 1 g/m^2, and Low Risk for degree of oiling because the mean length of weighted shoreline contaminated was 8 miles.

Considering the modeled risk scores and the socio-economic resources at risk, the socio-economic risk from potential releases of the WCD of 12,000 bbl of light fuel oil from the *Cities Service No. 4* is summarized as listed below and indicated in the far-right column in Table 4-2:

- Water column resources – Medium, because a moderate area of water column would be impacted in important fishing grounds
- Water surface resources – Medium, because a moderate area of offshore surface waters would be impacted in shipping lanes, fishing areas, and boating areas. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of sheens and streamers
- Shoreline resources – Medium, because a moderate length of shoreline would be impacted in areas with high-value shoreline resources

Table 4-2: Socio-economic risk factor ranks for the **Worst Case Discharge of 12,000 bbl** of light fuel oil from the *Cities Service No. 4*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
4A-1: Water Column Probability SRAR Oiling	Low	Medium	High	95% of the model runs resulted in at least 0.2 mi^2 of the upper 33 feet of the water column contaminated above 1 ppb aromatics	Med
4A-2: Water Column Degree SRAR Oiling	Low	Medium	High	The mean volume of water contaminated above 1 ppb was 100 mi^2 of the upper 33 feet of the water column	
4B-1: Water Surface Probability SRAR Oiling	Low	Medium	High	37% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 0.01 g/m^2	Med
4B-2: Water Surface Degree SRAR Oiling	Low	Medium	High	The mean area of water contaminated above 0.01 g/m^2 was 1,000 mi^2	
4C-1: Shoreline Probability SRAR Oiling	Low	Medium	High	100% of the model runs resulted in shoreline oiling of 1 g/m^2	Med
4C-2: Shoreline Degree SRAR Oiling	Low	Medium	High	The length of shoreline contaminated by at least 1 g/m^2 was 31 mi	

For the Most Probable Discharge of 1,200 bbl, the socio-economic risk from potential releases of light fuel oil from the *Cities Service No. 4* is summarized as listed below and indicated in the far-right column in Table 4-3:

- Water column resources – Low, because a relatively small area of water column would be impacted in important fishing grounds
- Water surface resources – Medium, because a moderate area of offshore surface waters would be impacted in shipping lanes, fishing areas, and boating areas. It should be noted that oil on the surface will not be continuous but rather be broken and patchy and in the form of sheens and streamers
- Shoreline resources – Low, because a moderate relatively small length of shoreline would be impacted in areas with high-value shoreline resources

Table 4-3: Socio-economic risk factor ranks for the **Most Probable Discharge of 1,200 bbl** of light fuel oil from the *Cities Service No. 4*.

Risk Factor	Risk Score			Explanation of Risk Score	Final Score
4A-1: Water Column Probability SRAR Oiling	Low	Medium	High	91% of the model runs resulted in at least 0.2 mi^2 of the upper 33 feet of the water column contaminated above 1 ppb aromatics	Low
4A-2: Water Column Degree SRAR Oiling	Low	Medium	High	The mean volume of water contaminated above 1 ppb was 17 mi^2 of the upper 33 feet of the water column	
4B-1: Water Surface Probability SRAR Oiling	Low	Medium	High	0.5% of the model runs resulted in at least 1,000 mi^2 of water surface covered by at least 0.01 g/m^2	Med
4B-2: Water Surface Degree SRAR Oiling	Low	Medium	High	The mean area of water contaminated above 0.01g/m^2 was 200 mi^2	
4C-1: Shoreline Probability SRAR Oiling	Low	Medium	High	99% of the model runs resulted in shoreline oiling of 1 g/m^2	Low
4C-2: Shoreline Degree SRAR Oiling	Low	Medium	High	The length of shoreline contaminated by at least 1 g/m^2 was 8 mi	

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

The overall risk assessment for the *Cities Service No. 4* is comprised of a compilation of several components that reflect the best available knowledge about this particular site. Those components are reflected in the previous sections of this document and are:

- Vessel casualty information and how the site formation processes have worked on this vessel
- Ecological resources at risk
- Socio-economic resources at risk
- Other complicating factors (war graves, other hazardous cargo, etc.)

Table 5-1 summarizes the screening-level risk assessment scores for the different risk factors, as discussed in the previous sections. The ecological and socio-economic risk factors are presented as a single score for water column, water surface, and shoreline resources as the scores were consolidated for each element. For the ecological and socio-economic risk factors each has two components, probability and degree. Of those two, degree is given more weight in deciding the combined score for an individual factor, e.g. a high probability and medium degree score would result in a medium overall for that factor.

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

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

For the Worst Case Discharge, *Cities Service No. 4* scores High with 15 points; for the Most Probable Discharge, *Cities Service No. 4* scores Low with 10 points. The spread in the scores for the two release scenarios is due to the behavior of spills of light fuel, with smaller releases likely to be less persistent. Under the National Contingency Plan, the U.S. Coast Guard and the Regional Response Team have the primary authority and responsibility to plan, prepare for, and respond to oil spills in U.S. waters. Based on the technical review of available information, NOAA proposes the following recommendations for the *Cities Service No. 4*. The final determination of what type of action, if any, rests with the U.S. Coast Guard.

Even though there is currently no evidence to suggest that the wreck still contains oil, it would be advisable to investigate this site since its location means there is a high likelihood that any remaining oil would impact surrounding shorelines, and previous surveys of the barge were not intended to assess its ability to retain oil. This investigation could probably be conducted quickly and cost effectively using high-resolution, side-scan sonar, which would likely provide enough information to determine if the wreck is a potential pollution threat. Alternatively, if video graphic data are preferred, several institutes in the surrounding area including Woods Hole Oceanographic Institute own remotely operated vehicles with

3D video capabilities. The simplest approach may also be to interview the local diving community to find out if anyone has explored the wreck. Although NOAA has not been able to locate any diver who has been on the site, it is likely that a wreck as well marked and charted as *Cities Service No. 4* has been visited by curious local divers over the years.

Cities Service No. 4	**Possible NOAA Recommendations**
✓	Wreck should be considered for further assessment to determine the vessel condition, amount of oil onboard, and feasibility of oil removal action
	Location is unknown; Use surveys of opportunity to attempt to locate this vessel and gather more information on the vessel condition
✓	Conduct active monitoring to look for releases or changes in rates of releases
✓	Be noted in the Area Contingency Plans so that if a mystery spill is reported in the general area, this vessel could be investigated as a source
✓	Conduct outreach efforts with the technical and recreational dive community as well as commercial and recreational fishermen who frequent the area, to gain awareness of changes in the site

Table 5-1: Summary of risk factors for the *Cities Service No. 4*.

Vessel Risk Factors		Data Quality Score	Comments		Risk Score
Pollution Potential Factors	A1: Oil Volume (total bbl)	Medium	Potential for up to 12,000 bbl, no reports of leaking		**High**
	A2: Oil Type	Medium	Cargo is domestic fuel oil, a Group II oil		
	B: Wreck Clearance	High	Vessel not cleared		
	C1: Burning of the Ship	High	No fire was reported		
	C2: Oil on Water	High	No oil was reported on the water		
	D1: Nature of Casualty	High	Lost after taking on water		
	D2: Structural Breakup	High	Vessel in one contiguous piece		
Archaeological Assessment	Archaeological Assessment	Low	No detailed sinking records of this wreck have been located and no dive reports have been uncovered, an accurate assessment cannot be made		**Not Scored**
Operational Factors	Wreck Orientation	Medium	Vessel believed to be upright		**Not Scored**
	Depth	Low	140 ft, muddy bottom		
	Visual or Remote Sensing Confirmation of Site Condition	High	NOAA survey 2008		
	Other Hazardous Materials Onboard	High	No		
	Munitions Onboard	High	No		
	Gravesite (Civilian/Military)	High	No		
	Historical Protection Eligibility (NHPA/SMCA)	Low	Unknown, full National Register assessment should be conducted		
				WCD	**Most Probable**
Ecological Resources	3A: Water Column Resources	High	A larger release can affect important spawning/rearing habitats	**Med**	**Low**
	3B: Water Surface Resources	High	Can be seasonally large numbers of birds in the potential impact area	**Med**	**Low**
	3C: Shore Resources	High	Light fuel oils are generally not persistent but can have acute effects on biota	**Med**	**Low**
Socio-Economic Resources	4A: Water Column Resources	High	Moderate to small area would be impacted in important fishing grounds	**Med**	**Low**
	4B: Water Surface Resources	High	Moderate area of offshore surface waters would be impacted in shipping lanes, fishing areas, and boating areas	**Med**	**Med**
	4C: Shore Resources	High	Moderate to small length of shoreline would be impacted in areas with high-value shoreline resources	**Med**	**Low**
Summary Risk Scores				**15**	**10**