

**REVIEW ON PRESIDENTE RIVERA
OIL SPILL IN DELAWARE RIVER**

by

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ABSTRACT

On June 24, 1989, the motor tanker Presidente Rivera ran aground in the Delaware River, releasing approximately 300,000 gallons of oil. The spill occurred in a 48-hour period in which there were two other major oil spills in the United States occurring in Galveston, Texas and Newport, Rhode Island, and less than half a year after the nation's worst-ever oil spill, that of the Exxon Valdez. Cleanup efforts in the Presidente Rivera spill were hampered by the unique properties of the spilled oil, and a lack of cleanup technology to deal with it. Cleanup efforts were criticized by government officials and the public with respect to organization and size.

This report presents concisely the event of the Presidente Rivera oil spill, the environmental factors associated with the Delaware River, and the cleanup operations. This study has been intended to examine the state-of-the-art of our capabilities and limitations dealing with oil spills using the Presidente Rivera oil spill as an example, although individual oil spills are different and environments affected by oil spills are site-specific.

ACKNOWLEDGEMENTS

The analysis of the Presidente Rivera oil spill on the Delaware River reported herein could not have been possible without the valuable help of certain individuals. The authors would like to thank Ms. Diane E. Wehner of the Delaware Department of Natural Resources and Environmental Control for access to her Preassessment Screen Report and the valuable information that she provided over the phone. In addition, the authors would like to thank the offices of Representative Thomas Carper, Delaware Governor Castle, and Delaware State Representative George Carey for their help in providing government reports on the incident. The authors would like to thank the Coast Guard and NOAA for providing their observations and maps.

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1 INTRODUCTION

1.1 Background

The oil spill in Prince William sound, Alaska in March, 1989 as well as three oil spills in the Delaware River, Rhode Island's Narragansett Bay and the Houston Ship Channel in June, 1989 reminded us that major oil spills do occur and that available technology for cleaning oil spills is not adequate.

Studies on oil spills in the Delaware River were performed more than ten years ago by the researchers at the University of Delaware (e.g., Wang, Campbell and Ditmars, 1976; Biggs, 1977). As a result, there is a need to review the state-of-the-art on existing knowledge of oil drift, spreading, evaporation and deposition as well as to synthesize available data on the Presidente Rivera oil spill in the Delaware River in June, 1989.

1.2 Objectives and Scope

This report provides a concise account of the Presidente Rivera oil spill, its effects on the environment of the Delaware River, and the cleanup operations and difficulties. The state-of-the-art of mathematical and numerical modeling of oil drift, spreading, evaporation and deposition is reviewed in a separate report by Lee, Kobayashi and Ryu (1990).

This report is based on available data from various sources indicated in References including the State of Delaware's Presidente Rivera Preassessment Screen Report by Wehner (1989). The scope of this report is limited since it is a result of an independent study performed by the first author under the supervision of the second author of this report in relation to the Sea Grant mini-project entitled, "Review of Oil Spills and Their Effects."

2 PRESIDENTE RIVERA SPILL

2.1 Oil Spill Event

On Saturday, June 24, 1989 at 4:45 a.m., the motor tanker Presidente Rivera ran aground in the Delaware River. The tanker was carrying 18 million gallons of No. 6 fuel oil and was preparing to dock at the Sun Oil refinery in Marcus Hook, Pennsylvania. The 749-ft tanker grounded on Claymont Shoal, near Naaman's Creek, ripping open four of its 17 cargo tanks. The ship strayed outside the 40-ft deep shipping channel, and hit bottom during low tide. Approximately 300,000 gallons of oil were released into the Delaware River as a result. The tanker was not of the double-bottom hull variety. Barges were brought to the site of the spill to unload some of the remaining cargo to stop leakage so the ship could be refloated. The tanker was refloated at 2:12 a.m. on June 25, and moved, leaking slightly, to the Sun Oil refinery.

The spilled oil was very dense, and formed clumps with diameters of up to 10 ft. Due to the oil's relative density to water (specific gravity = 0.99), the oil behaved unpredictably, some of it floating, and some of it sinking to the bottom, as evidenced by the presence of bottom debris in tar balls recovered at the water surface. The oil was transported predominantly by tidal currents, with wind being light and generally negligible during the spill event.

By the afternoon of June 25, the spill had affected 17 miles of riverline and estuarine shoreline. The most heavily affected area was immediately south of the port of Wilmington for approximately 3 miles. Included in this region is the Christina River, which is used as a drinking water supply for the City of Wilmington. Over the next few days, the oil affected portions of the Pennsylvania (PA), New Jersey (NJ), and Delaware (DE) shorelines, with Delaware being the hardest hit. The oil impacted shorelines north of Little Tinicum Island in NJ, and south of Pea Patch Island in DE. The oil was estimated to be moving at a rate of 2 mph due to tidal currents.

Vegetation along the Delaware shoreline was heavily stained in some areas, in width of

5-20 ft. Much of the area affected by the spill is predominantly industrial, thereby reducing the spill's environmental impact. However, the oil also affected undeveloped wetlands south of Wilmington, DE and in NJ. The spill fouled numerous crab pots. NOAA conducted a study of the oiling, the results of which are found in Figure 1 quoted from the report of Wehner (1989). A 3-week commercial crabbing ban for the area was enacted as a result.

Hundreds of birds were oiled during the event. Tri-State Bird Rescue and Research reported treating in excess of 120 birds, including great blue herons, cattle egrets, black-crowned night herons, Canadian geese, glossy ibises, mallard ducks, and ring-billed gulls. Other colonial wading birds and several cormorants and other gulls were observed somewhat oiled, but could not be captured. Several dead mammals were found in the spill area.

The oil threatened the cooling water supplies for the nuclear power plant at Artificial Island, and they remained ready to shut down throughout the spill event.

Figures 2-7 quoted from the report of Wehner (1989) show graphical representations of the NOAA observations during June 26 to June 30. A summary of the observations made by the Coast Guard and the Division of Natural Resources and Environmental Control (DNREC), State of Delaware, is given in Appendices A and B, respectively.

2.2 Characteristics of Spilled Oil

The chemical spilled in the Presidente Rivera spill was No. 6 fuel oil. It is a very viscous oil that is largely insoluble in water and tends to stick together in clumps rather than forming extensive slicks. This tendency to form clumps presents problems in that it can be difficult to clean up due to the sheer size and weight of the clumps, and because they limit the area of oil exposed to the environment. The low soluble oil is advantageous to environmental impact because it is less toxic than most lighter oils. The major threat to the environment posed by this oil occurs if it smothers organisms.

Under the force of gravity, spilled oil will generally disperse into a thin layer, making evaporation feasible. No. 6 fuel oil, however, does not disperse easily. Its high viscosity allows for only an approximately 10% reduction in spill volume due to evaporation, in



Presidente Rivera Spill
Crab Pot Survey
Delaware Dept. of Fish & Wildlife
Observer: Cole
Date: 1 July, 1989

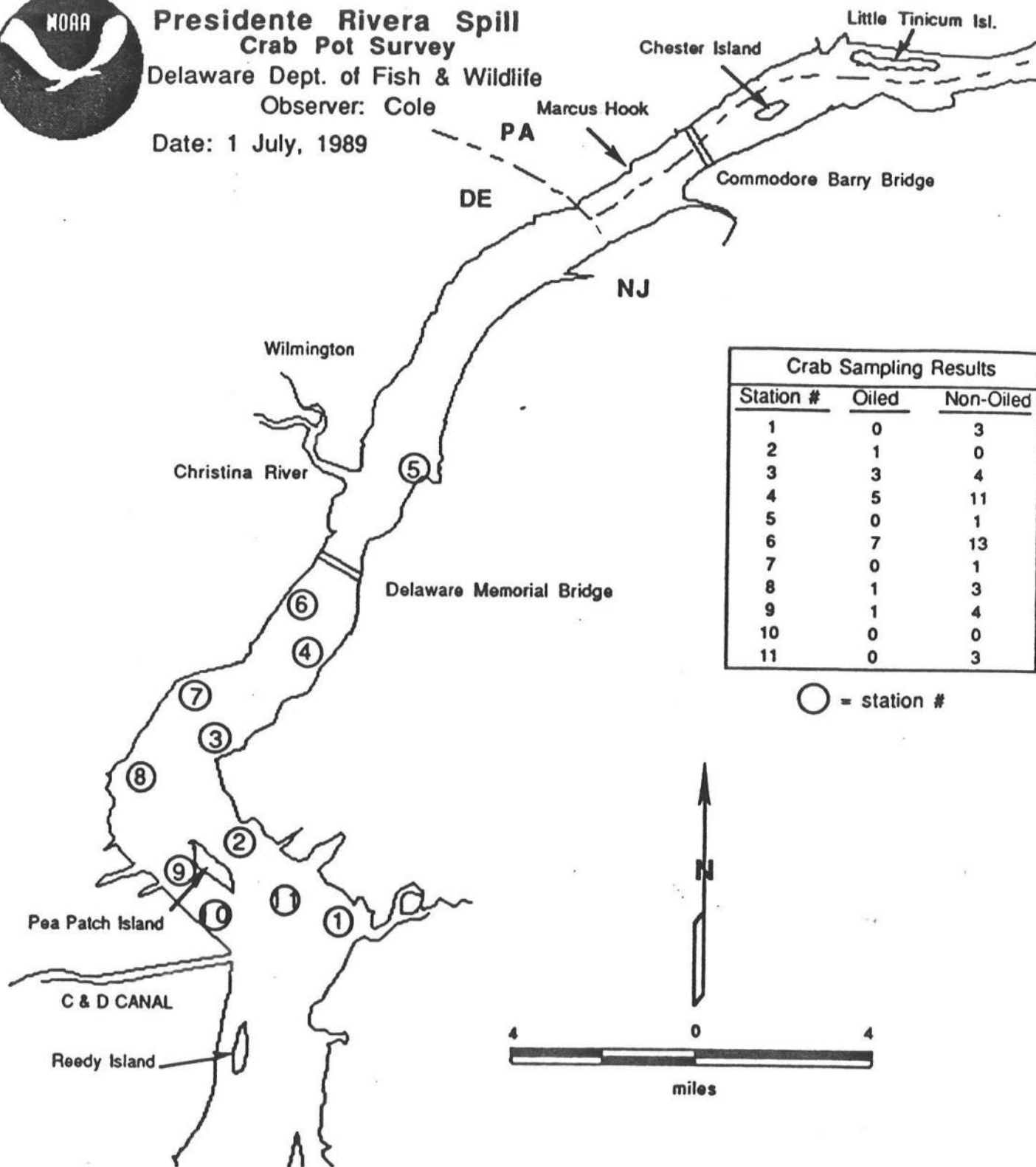


Figure 1: NOAA Crab Pot Survey



Presidente Rivera Spill

Observations for June 26, 1989
0900 - 0945 Galt

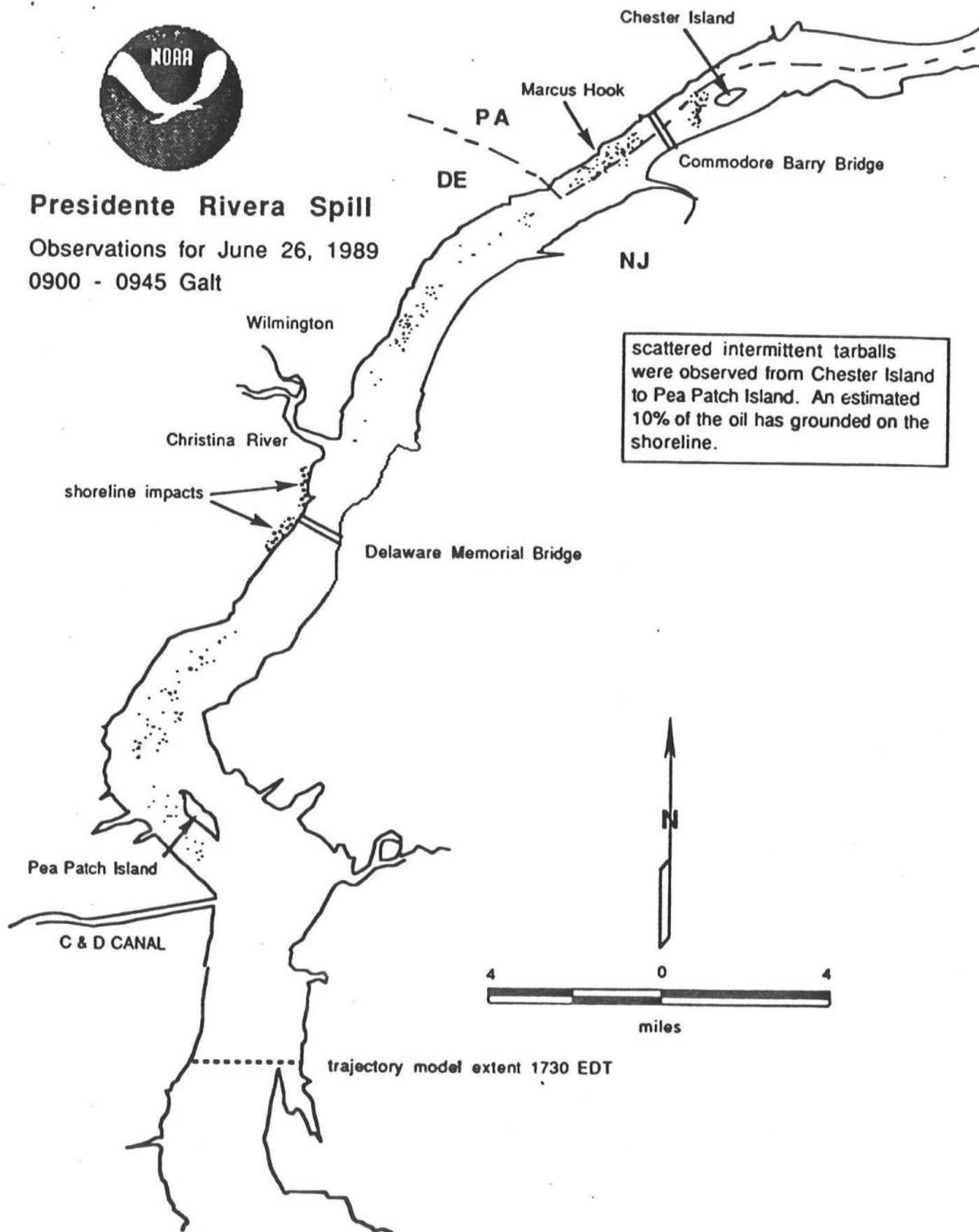


Figure 2: NOAA Observations-June 26, 1989



Presidente Rivera Spill

June 27, 1989 - 1100

Observers-Galt/Wiltshire

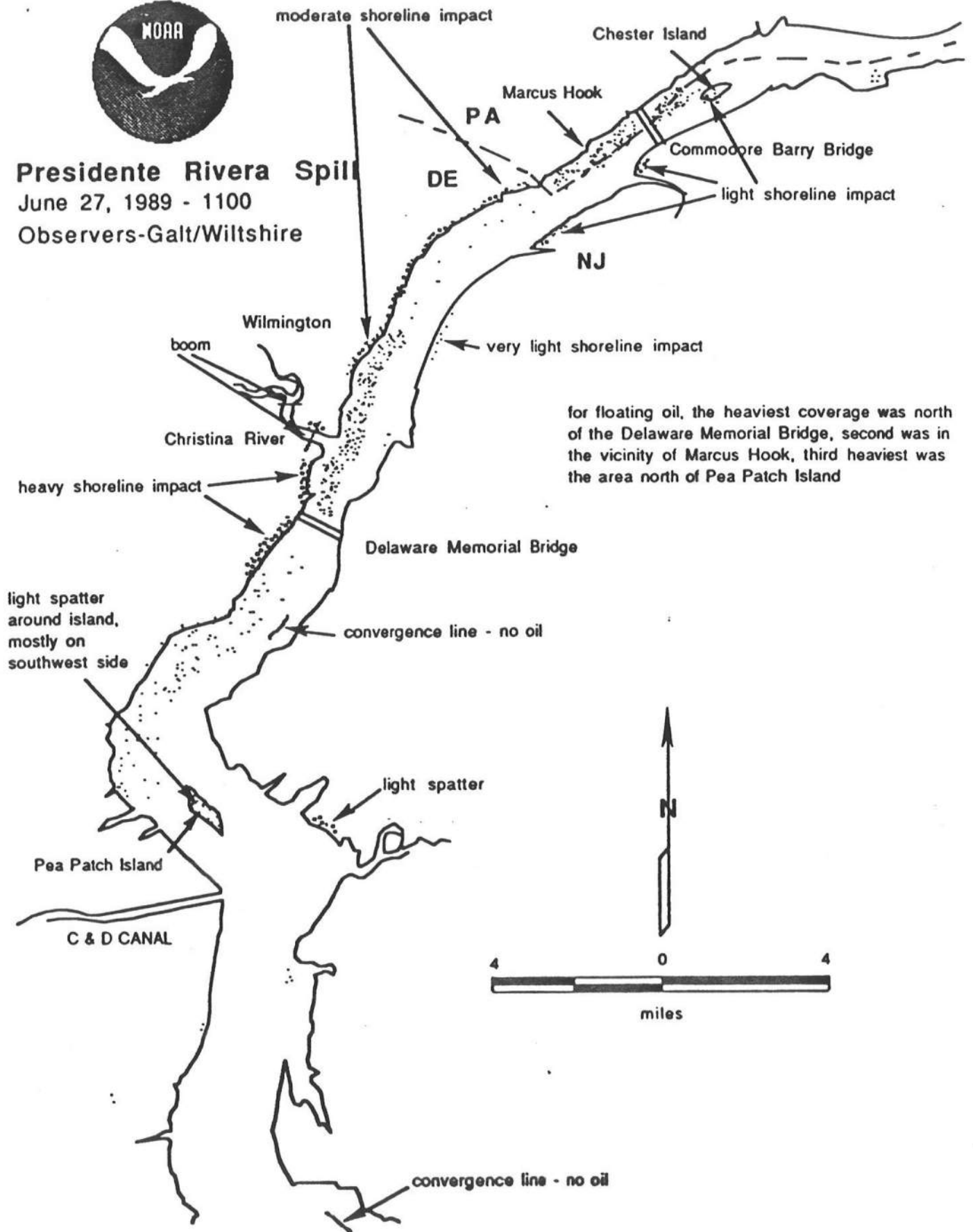


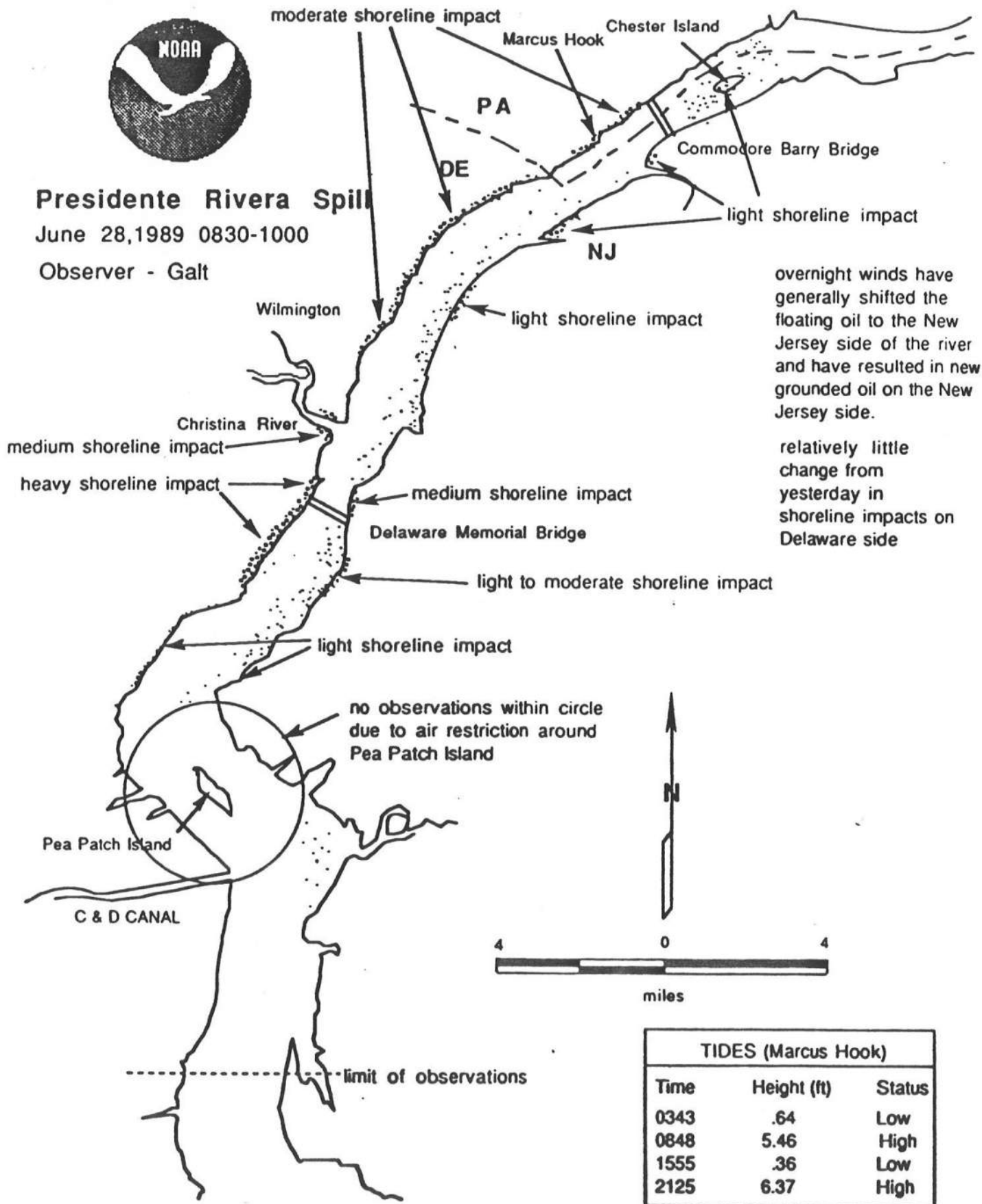
Figure 3: NOAA Observations-June 27, 1989



Presidente Rivera Spill

June 28, 1989 0830-1000

Observer - Galt



TIDES (Marcus Hook)		
Time	Height (ft)	Status
0343	.64	Low
0848	5.46	High
1555	.36	Low
2125	6.37	High

Figure 4: NOAA Observations-June 28, 1989



Presidente Rivera Spill

June 29, 1989 0950-1045

Observer - Levine, Dahlin

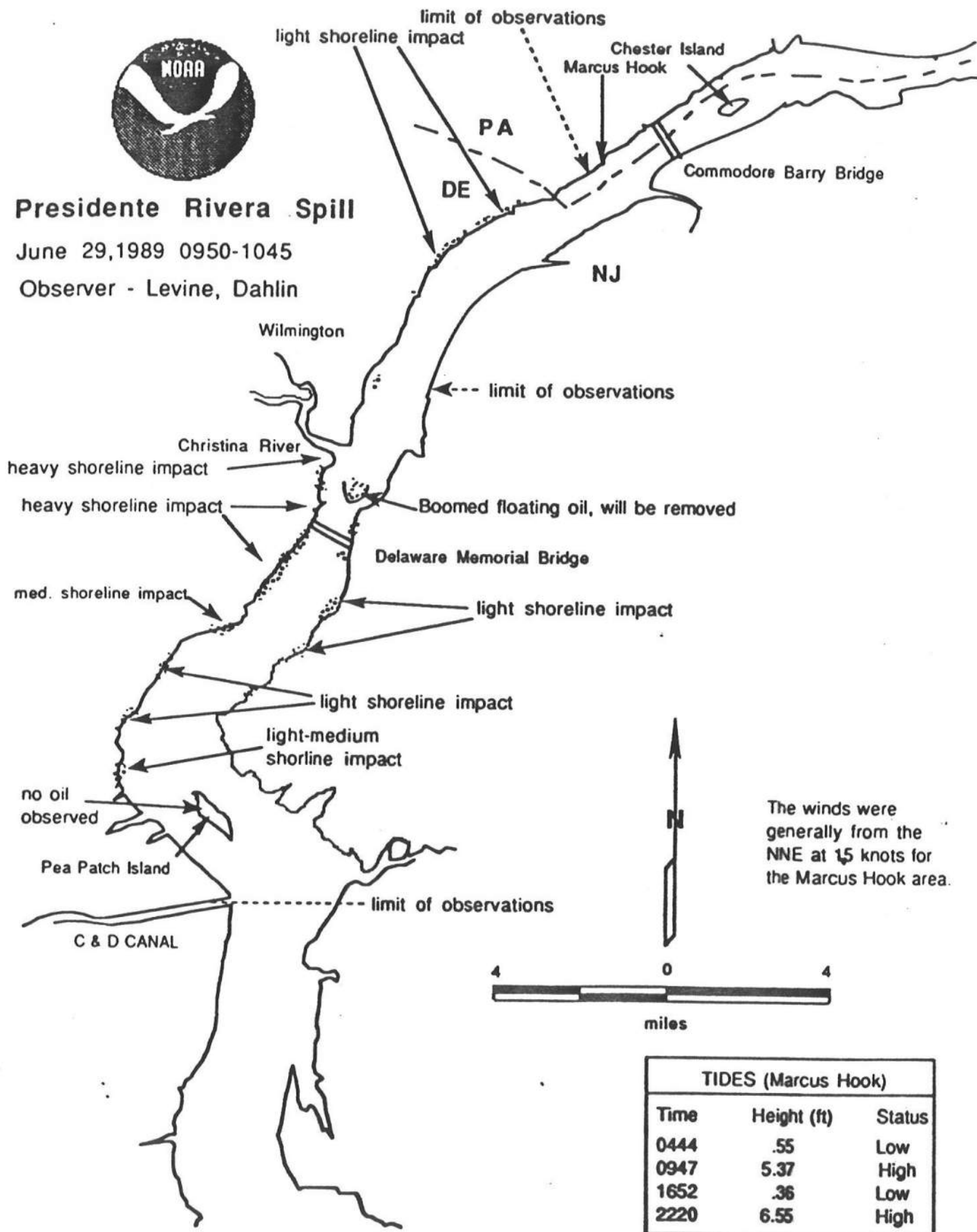


Figure 5: NOAA Observations-June 29, 1989 (Morning)

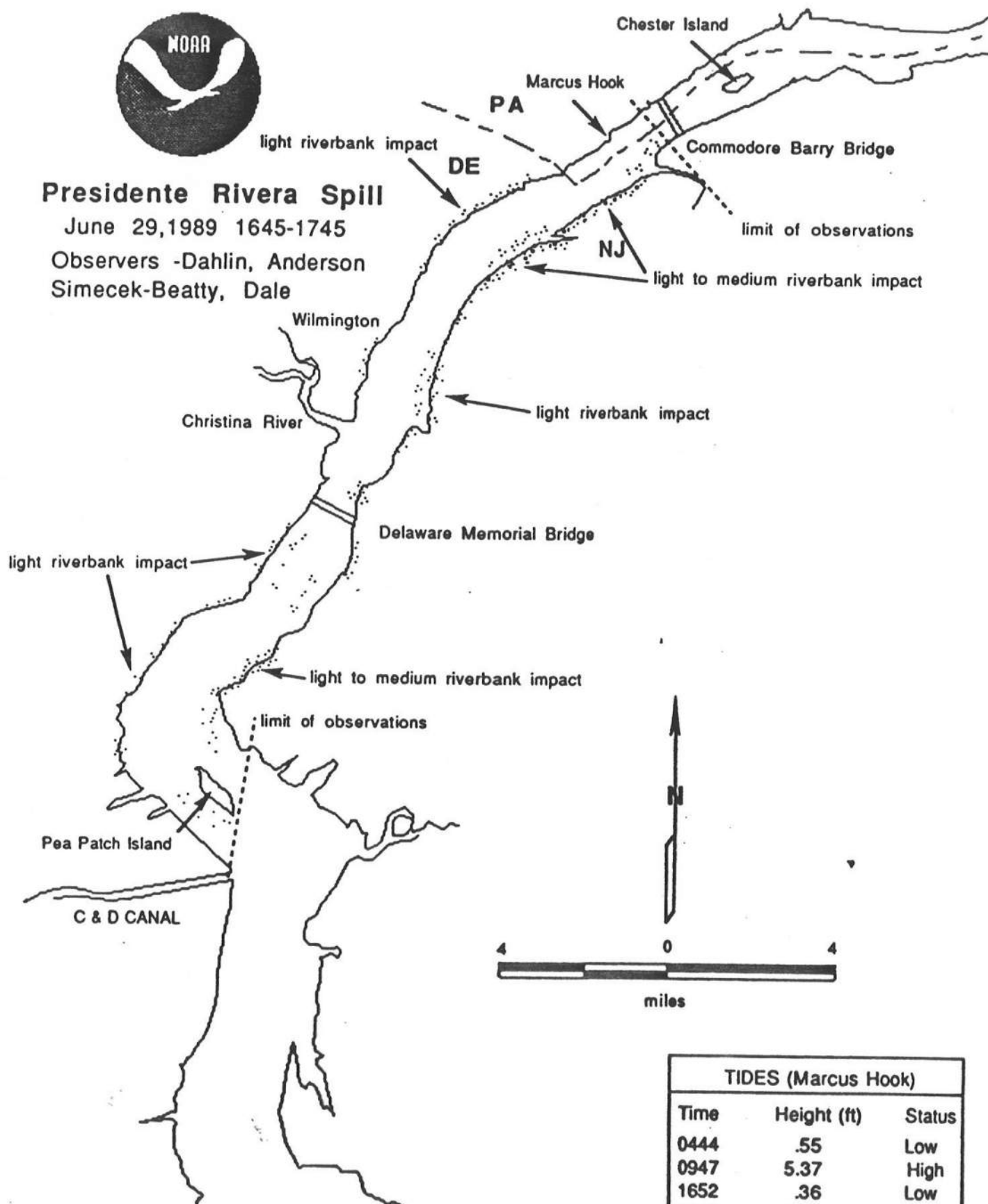


Presidente Rivera Spill

June 29, 1989 1645-1745

Observers -Dahlin, Anderson

Simecek-Beatty, Dale



TIDES (Marcus Hook)		
Time	Height (ft)	Status
0444	.55	Low
0947	5.37	High
1652	.36	Low
2220	6.55	High

Figure 6: NOAA Observations-June 29, 1989 (Evening)



Presidente Rivera Spill

30 June 1989

0830-1000, Simecek-Beatty

1030-1130, Levine

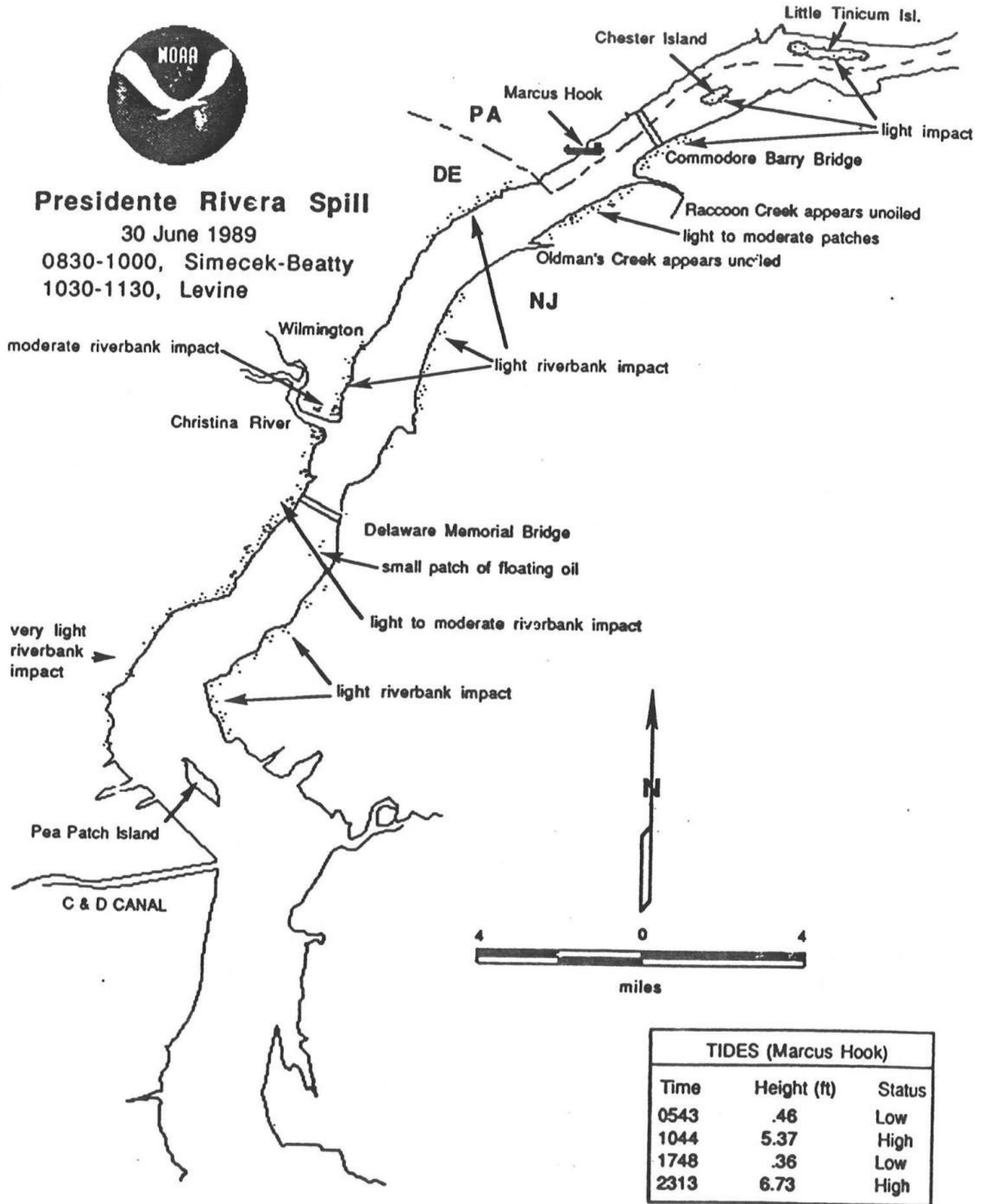


Figure 7: NOAA Observations-June 30, 1989

contrast to No. 2 fuel oil's ability to experience up to a 75% reduction due to evaporation (Bishop, 1983).

The pour point of the spilled oil is approximately 95°F. Average water temperature of the Delaware River at the time of the spill was 65°F, causing the oil to stay in a solid form when in the water. When on land, the oil melted when exposed to sunlight and air temperatures that exceeded 90°F. The specific gravity of the oil was 0.99 and the oil clumps behaved unpredictable, bobbing in the water column and creating problems for cleanup methods for spilled oil at water surface.

An analysis of the No. 6 fuel oil was done by Louisiana State University (LSU), the Environmental Protection Agency (EPA), and the State of Delaware's DNREC. LSU used Gas Chromatography/Mass Spectrometry in their analysis. They concluded that the oil was characterized by high concentrations of Naphthalene and alkyl-substituted Naphthalenes. Trace levels of Dibenzothiobene indicated that the oil may have been desulfurized during refinement. The high levels of Naphthalene can have toxic effects, but will diffuse into the water column at a very slow rate, thereby lessening the potential for toxic effects. Organisms covered by the oil, however, will be at risk. The oil should be readily metabolized by indigenous microbes, but the large size of tar balls will limit the rates of natural degradation. The DNREC's analysis, using a base/neutral organics scan, confirmed the high concentrations of Naphthalenes in the Presidente Rivera oil. The EPA conducted toxicity tests on the oil and concluded that it contained water-soluble toxic components that, given the proper set of circumstances, could be lethal to aquatic animals.

3 ENVIRONMENTAL FACTORS

The environment in which an oil spill occurs is an important factor in determining the magnitude and method of a response effort. Important parameters in the Presidente Rivera spill were meteorological and tidal conditions, shoreline types, finfish and shellfish, wildlife, and economic and social factors. Each of these is discussed below.

3.1 Meteorological and Tidal Conditions

The movement and behavior of an oil spill is very much a function of the meteorological and oceanographic conditions. The movement of spilled oil is predominantly determined by the speed and direction of wind and currents. In the absence of currents, the spilled oil will move in the direction of wind at a speed of roughly 3% of the wind speed (Bishop, 1983). In the absence of wind, the spilled oil will move in the same direction and speed of the water. The movement of the spilled oil is ultimately a combination of these two factors.

At the time of the Presidente Rivera spill, thunderstorms with easterly winds were in the area and blew the oil toward the shores of Delaware and Pennsylvania. Through the next week, winds were generally light, averaging 5- 10 knots. This aided cleanup efforts considerably.

Temperature also affects the behavior of an oil. As temperatures rise, the volatility of toxic components is increased and the viscosity of an oil is decreased, thereby increasing the surface area of the spilled oil. This increased surface area also promotes microbial activity, solubility, and evaporation of the more volatile components of an oil. However, the oil's more toxic components will be exposed to the environment.

The No. 6 oil spilled in the Presidente Rivera spill had a high pour point (95°F) and viscosity, causing it to stay, for the most part, in the form of solid tar-balls in the 65°F water. Air temperatures, however, rose to 98°F during the day, and caused some slicks to be formed, and melted the oil once it was on land.

3.2 Shoreline

The most visible area to suffer from oil pollution is the shoreline. The Presidente Rivera spill had the potential to impact miles of the Delaware, Pennsylvania, and New Jersey shorelines. Most of these shorelines are made up of tidal marshes and wetlands. Although much of the shoreline adjacent to the spill area was industrial, the spill had potential to affect miles of undeveloped shorelines including 3 national wildlife refuges and many parks.

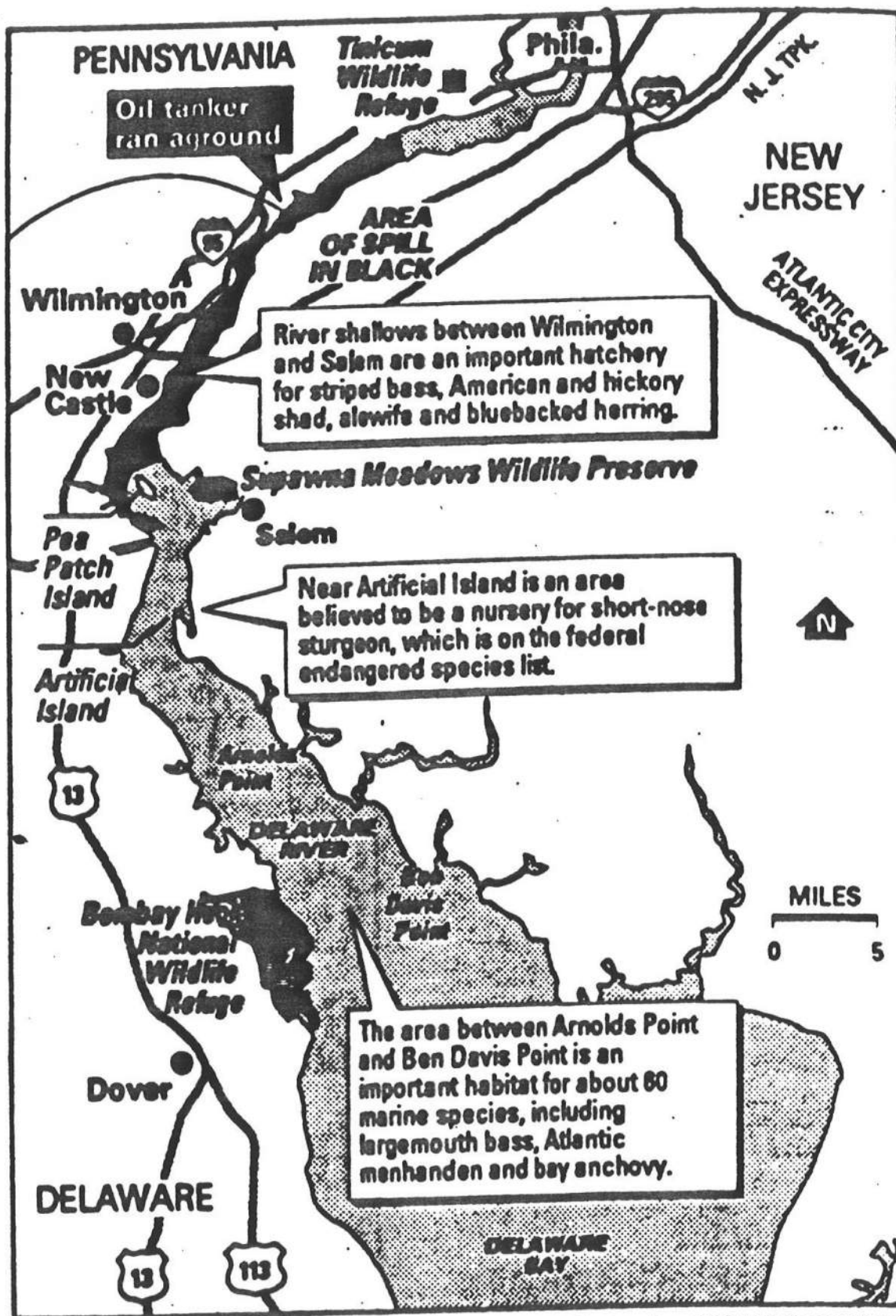
Wetlands and marshes tend to trap oil due to the high absorptive capacity of resident vegetation and the sheltered conditions. When contacted with oil, the vegetation becomes smothered and will often die within 2 to 3 days. The tidal action of the Delaware River will spread oil at considerable widths into the marshes. High tides will tend to float deposited oil and deposit it further inland. Although vegetation tends to recover by the following season, animals may take longer to recover. The intertidal zone is rich in microorganisms, and oil will often seep into the soil and affect these populations for extended periods of time. Muskrats, nesting shorebirds, and wading birds populate the intertidal area, and the tidal creeks serve as important spawning grounds for finfish and shellfish. Care must be taken in deciding whether to clean the area since cleaning is often more harmful than letting the area be cleaned by natural mechanisms. Tidal marshes are widely recognized as the worst-case scenario for oil contact, and therefore, should be given priority in detainment efforts.

3.3 Finfish and Shellfish

The Delaware River and its tributaries and marshes are used extensively by fish for spawning and as a nursery habitat as indicated in Figure 8 (Philadelphia Inquirer, 1989). Among species that use the river are white perch, striped bass, spot, channel catfish, brown bullheads, american eel, weakfish, bluefish, hoghooker, anchovies, menhaden and alewives. All of these species were recovered in trawl samples of the area of the river in which there was heavy impact by the oil. Of particular interest to the area surrounding the spill is the shad population. There have been longstanding, effective efforts to rehabilitate the Delaware River's use as a shad nursery area.

It is generally accepted that oil spills have less of an impact on finfish than most other forms of life because of their highly mobile character and the tendency of oil to float on the surface. However, oil has the potential to enter the food chain through ingestion, and immobile fish larvae are susceptible to toxic effects.

More susceptible to damaging effects of oil are shellfish and crustaceans. The area affected



SOURCE: Watershed Association of the Delaware River

The Philadelphia Inquirer / KIRK MONTGOMERY

Figure 8: Wildlife Refuges and Fish Habitats in Relation to Spill Area

by the spill is home to a commercial blue crab industry. Both long and short-term physiological problems can result in blue crabs that assimilate aromatic hydrocarbon compounds. Studies done by Hale (1988) indicate that reproduction and ecdysis in blue crabs may be impacted by specific compounds associated with aromatic hydrocarbons.

3.4 Wildlife

As mentioned in section 3.2, oil can impact the wildlife community through the oiling of intertidal marshes and wetlands. The Presidente Rivera spill had potential to impact three national wildlife refuges. Among the wildlife affected by an oil spill are birds. Birds encounter oil by landing and diving in slicks, and ingesting it when preening the oil from their feathers. When birds come into contact with oil, it soaks their feathers and destroys their weather-proofing and insulating properties, so that the birds are liable to die of exposure and exhaustion. Ingestion of the toxic components of oil by birds may result in internal damage to their respiratory, alimentary, or excretory systems. Oiled birds may also contact their eggs and smear them, resulting in possible asphyxiation of the embryo. Due to the highly mobile nature of birds, they are likely to spread the toxic effects of oil widely throughout their species and food chain.

The area in which the spill occurred is used by a large variety and quantity of birds. Of particular importance is the Pea Patch Island nature preserve, located approximately 15 miles south of the spill site. The Island is a year-round haven for birds, and at the time of the spill was home to over 13,000 colonial wading birds (9 species). The island is also the site of one of the largest heron rookeries on the East Coast.

Limited quantities of ospreys also nest on the Delaware side of the river near Delaware City.

3.5 Economic and Social Considerations

The Presidente Rivera spill had potential to damage the social and economic use of the affected area. The area is home to commercial and recreational crabbing and fishing activities. In addition, the shoreline is home to numerous parks and beaches which could experience a loss of tourism revenues. Inconvenience and losses due to delays caused by tanker traffic restrictions could occur. The nuclear power plant at Artificial Island, as well as other industrial plants, use the Delaware River as a source of cooling water. The presence of oil in cooling pipes may cause foaming, priming and overheating, resulting in possible blistering or failure. The spill also had potential to taint human drinking water supplies. The Christina River is used as a drinking water supply for the city of Wilmington, and it is in the area that was the most heavily affected by the spill.

4 CLEANUP OPERATIONS

4.1 Organization

Federal activities for responding to oil spills are governed by the National Oil and Hazardous Substance Pollution Contingency Plan (NCP). The NCP established, as part of its mechanism, the National Response Team, National Response Center, Regional Response Teams, Regional Response Centers, and On- Site Coordinators, as shown in Figure 9 (Meyers, 1989). Their functions are as follows:

- National Response Team (NRT) plans and coordinates federal response to oil spills. The NRT can be activated as an emergency response team if an oil spill exceeds the capacity of the Regional Response Team, transects international boundaries, or presents a significant threat to a population, national policy, property, or natural resource. The NRT can also be activated at the request of any of its members. The NRT's federal representation and their respective duties are given in Figure 10 (Meyers, 1989).
- National Response Center (NRC) receives and distributes reports regarding oil and hazardous substance spills. All oil spills must be reported to the NRC, which immediately notifies the On-Scene-Coordinator.
- Regional Response Team (RRT) develops oil spill response contingency plans for specific regions of the United States, and assists in spill cleanup operations if necessary.

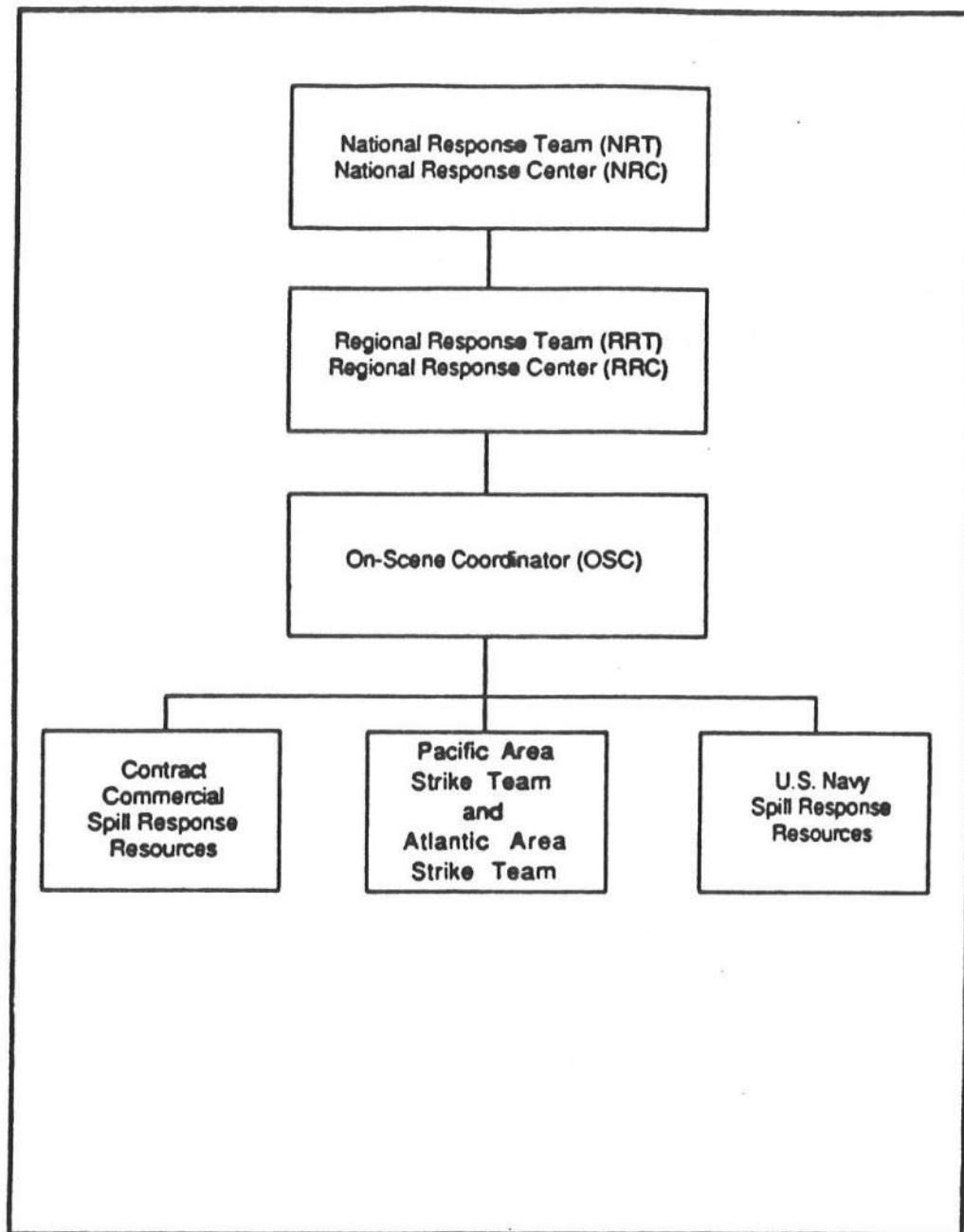


Figure 9: Federal Response Organization

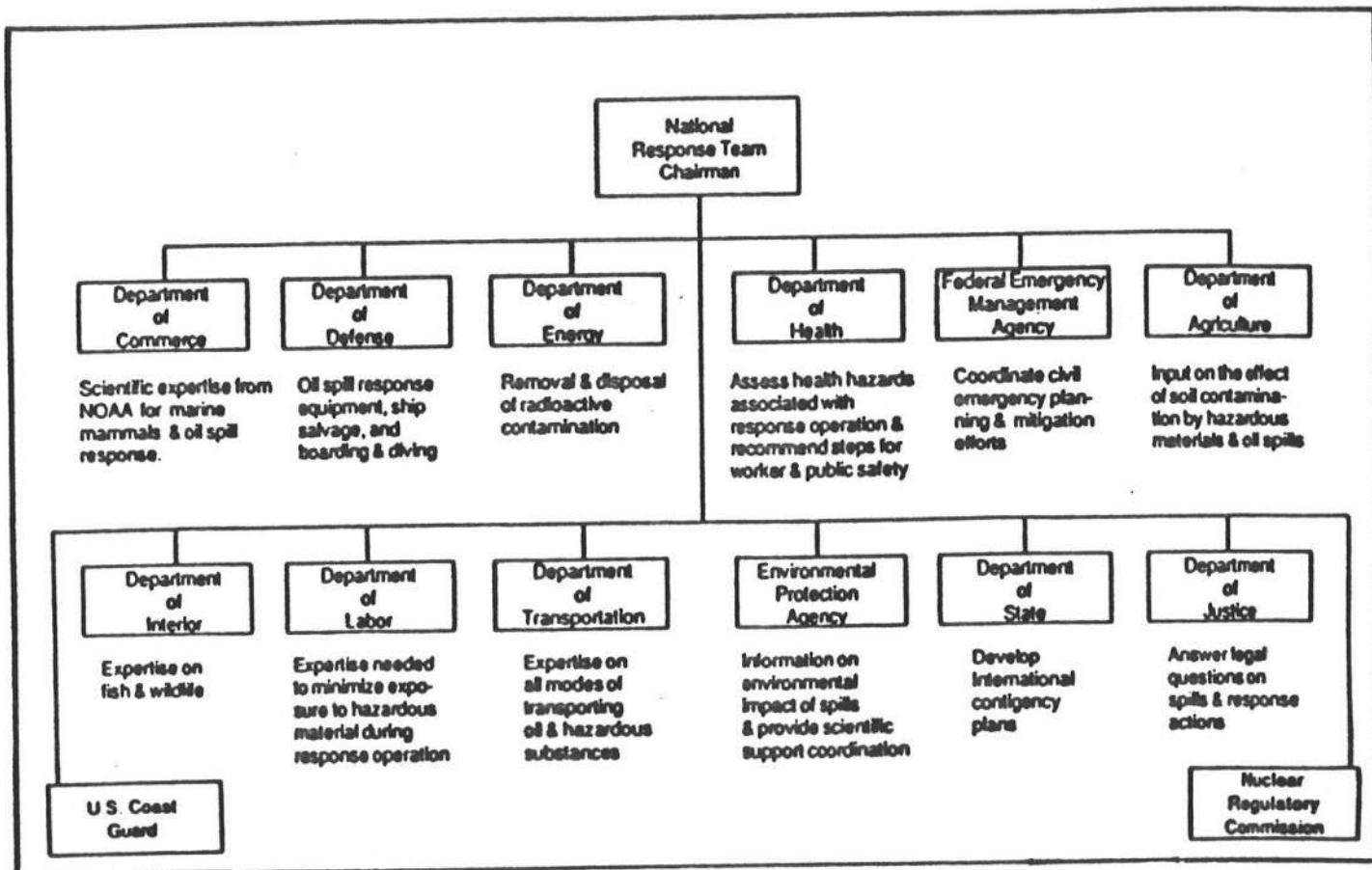


Figure 10: Federal Representation on National Response Team

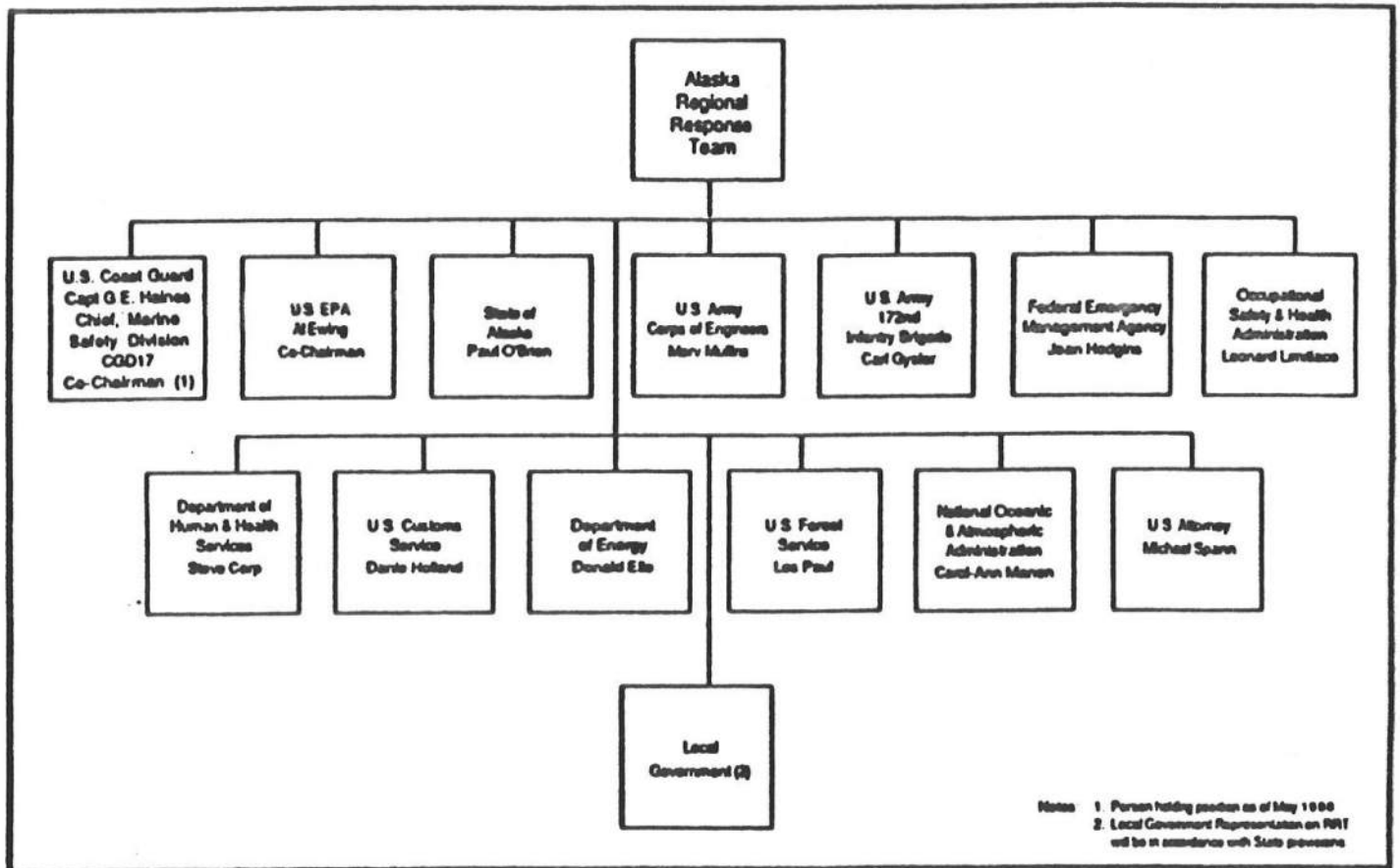
The RRT may be activated as an emergency response team at the request of the On-Site-Coordinator or by any RRT member. An example of representation of the team is shown in Figure 11 (Meyers, 1989).

- Regional Response Center (RRC) serves as an operation and communications center for the RRT.
- On-Scene-Coordinator (OSC) collects pertinent facts about a spill, its source and cause, and the parties responsible for the spill. The OSC determines potential health and environmental impact as well as establishes priorities for minimizing the impact of a spill and documents cleanup costs. If the spiller assumes responsibility for the spill, the OSC monitors the spiller's cleanup efforts. If they are inadequate, the OSC deploys resources to assist in cleanup. If the spiller does not claim responsibility, the OSC initiates the response operation and hires commercial contractors as required. If commercial resources are not sufficient, the OSC will deploy federal resources. Each OSC is responsible for developing and updating local contingency plans. These plans should involve all agencies that would have a role in the local response effort.

In addition to these establishments, the National Strike Force (NSF) has been created by the U.S. Coast Guard to provide experienced personnel and equipment to assist the OSC. The NSF consists of the Atlantic and Pacific Strike teams, which are always on call and are capable of deployment anywhere in the nation. The Coast Guard is the primary authority in all the establishments explained above.

Many state governments have their own contingency plans, similar in format to the National Contingency Plan. In the Delaware River and Bay region, state agencies concerned with the cleanup of oil spills are the Delaware Division of Natural Resources and Environmental Control (DNREC), New Jersey Division of Environmental Protection, and Pennsylvania Division of Environmental Resources. Delaware, for example, requires that all spills occurring or threatening their waters be reported to the DNREC. The DNREC will handle most small cleanup operations, but larger spills become a joint effort between Federal, State, and private cooperatives.

The oil industry has set up private, non-profit cooperatives throughout the nation to conduct responses to oil spills. The Delaware River and Bay Cooperative serves the



Notes: 1. Person holding position as of May 1990
2. Local Government Representation on RRT will be in accordance with State provisions

Figure 11: Representation on Regional Response Team Example: Alaska

Delaware River area with equipment and manpower to combat oil spills. The cooperative is funded by refineries along the Delaware River.

Private contractors are a main resource for oil spill cleanup operations. Hiring of these contractors is done by the spiller of the oil, and both federal and state governments. The Coast Guard supervises the private contractors as to proper cleanup procedures and methods. There are a sizeable number of these private contractors in the Delaware River and Bay region.

4.2 Techniques and Difficulties

The cleanup of the Presidente Rivera oil spill was unique because of the No. 6 fuel oil. The fact that much of the oil was initially submerged led to initial estimates of spill volume as high as 800,000 gallons. Sonar scans of the river did not reveal large quantities of oil beneath the surface, and estimates of the spill volume were downgraded to approximately 300,000 gallons.

The formation of the spilled oil into large clumps presented problems because most cleanup techniques are designed to deal with slicks. Oil clumps pushed beneath and broke containment booms and clogged skimmers. Heavier booms, designed for offshore use, were brought in on the second day of cleanup and proved more effective. The Coast Guard used a boom that was pulled by two ships sailing parallel. The oil clumps were scooped out by clamshell barges. Much of the cleanup was conducted manually, using pitchforks and shovels to pick up the oil balls and put them into plastic bags. The oil presented additional problems when it impacted the shoreline. Temperatures exceeding 90°F caused the oil to melt when out of the water as shown in Figure 12 (News Journal, 1989). Once melted, the most efficient method of cleanup was to use vacuum hoses, connected to trucks, to suck up the oil. Marshes



Sun-melted oil mars the shoreline at Echo Beach, Del.

Figure 12: Sun-Melted Presidente' Rivera Oil
Photo: Wilmington News Journal

impacted by oil were cleaned using snare to avoid additional damage caused by cleanup crews. Snare was strung between the high and low water lines, where the tidal action caused movement of the snare throughout the impacted vegetation. Work crews were instructed to avoid traversing wetlands with equipment or on foot, and cutting of vegetation was not allowed. High pressure washing was performed on boat ramps and other man-made structures affected by the oil.

Many groups participated in the cleanup process, with the Coast Guard being the coordinating agency. The Coast Guard's Gulf Strike Team was called in since part of the Atlantic Strike Team, which would normally handle a spill in the area, was busy on a larger spill in Newport, Rhode Island. The Mid-Atlantic Regional Response Team also participated in the effort. Coast Guard officials conducted frequent helicopter overflights of the spill area, and directed personnel. Daily meetings were conducted between Coast Guard officials and private contractors. Other government agencies participating in the cleanup operations included EPA, NOAA, and the state environmental agencies from New Jersey (NJ), Pennsylvania (PA) and Delaware (DE). In addition, Delaware activated 300 National Guard personnel to assist in the cleanup. Much of the manpower and equipment for cleanup operations was provided by private contractors and the Delaware River and Bay Cooperative (DRBC). The DRBC was asked to participate by the Sun Oil Refinery. The four private contractors; Guardian Environmental, Underwater Techniques, Snow Environmental, and Clean Venture, were hired by the Presidente Rivera's owner. Manpower and boats in use ranged in excess of 500 people and 90 boats.

Initial cleanup operations were conducted by cleanup crews called in one hour after the spill was reported. The tanker was surrounded by sorbent booms, and traffic on the river was halted. Booms were placed at the mouths of environmentally sensitive streams, rivers, and marshes. Protected creeks included Oldmans and Raccoon Creeks in NJ, Darby, Shellpot,

and Ridley Creeks in PA; and Naamans Creek and Christina River in DE. Oil in the leaking tanks was transferred to other tanks on the ship, and to barges. The tanker was refloated and moved, leaking slightly, to the Sun Oil Refinery the day after the spill. The remaining oil was unloaded, and divers identified damage and patched and cleaned the hull.

Coast Guard officials directed cleanup efforts on both the river and shorelines until June 29, when emphasis was placed on the shoreline. Efforts were made throughout the spill event to direct the oil toward industrial areas where it could be cleaned up. A safety zone was set up in the shipping channel, and was enforced by Coast Guard personnel in the week following the spill. Federal and state agencies took water samples during the spill event. Attempts to capture oiled birds were made, and all captured birds were taken to Tri-State Bird Research and Rescue for cleaning and treatment.

Delaware officials instituted a 3 week commercial crabbing ban on a 22-mile stretch of the river, and recreational crabbers were advised not to eat crabs caught in the area. Coast Guard officials estimated that 75% of the oil was recovered by July 2.

5 CONCLUSIONS AND RECOMMENDATIONS

Two major problems surfaced during the Presidente Rivera cleanup efforts: inadequate technology and lack of an effective oil spill contingency plan.

The No. 6 fuel oil dramatically revealed the inadequacy of cleanup technology of spilled heavy oils. Improvement of traditional technology and development of innovative technology should be pursued. In the meantime, heavy-duty offshore equipment should be at immediate disposal, rather than having to fly it in from other locations.

A detailed regional oil spill contingency plan should be developed for the Delaware River

and Bay region. This plan should include a response organization and detailed response procedures. Representation on this organization should include concerned federal agencies, the states of NJ, PA and DE, and all concerned private cleanup agencies. The organization should be chaired by the Coast Guard. Practice exercises should be conducted to facilitate a familiarity with authority hierarchy, equipment, and communication procedures.

Long-term effects of the oil spill on the Delaware River and its ecology should be monitored to provide data useful for oil spill operations in the future. Finally, efforts should be made to reduce the frequency of oil spills since prevention is better than cure.

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APPENDIX A

SUMMARY OF COAST GUARD REPORTS

A summary of the daily pollution reports issued by the Coast Guard as part of its oil spill cleanup operations is given in this appendix.

Report issued: 4:00 a.m., June 27, 1989

1. Situation: 2:00 p.m., June 26, 1989

- Cleanup continues by general contractor with approximately 154 persons and 22 boats, in addition to the skimmer DELBAY, the 125 National Guard personnel. 22,826 gallons of oil and oily debris recovered. 63,826 gallons recovered to date. Coast Guard personnel continue to monitor situation. Heaviest beached concentrations are in areas from Delaware Memorial Bridge to New Castle, DE in widths up to 5 feet. Vegetation along shoreline heavily stained. Free floating oil observed from Trainor, PA to New Castle, DE. Heaviest concentrations in vicinity of Christina River, Wilmington, DE. Free floating oil being recovered by the skimmer vessel DELBAY (800-1500 gallon/trip). Boom staging being implemented at Pea Patch Island. Vessel WHITE DOVE enroute to assist in cleanup using nets.
- Extensive interest from press and local officials.
- Diver survey being conducted to determine damage to Presidente Rivera.
- Support from oil industries includes berthing facilities at Sun Oil and communication equipment from Mobil Oil Company.
- Weather: Partly cloudy, winds S to SW at 8 knots, Temperature 88°F.

2. Action - Private Contractors - 154 Men, 22 Boats

June 25, 4:00 p.m. - Atlantic Strike team deploys skimming boom off Sun Oil dock to collect free floating tar clumps in river at Marcus Hook.

7:00 p.m. - Shipping safety zone modified to allow traffic.

8:20 p.m. - Skimming boom returned to Sun Oil dock. Approximately 12,000 gallon of oil and debris contained in boom.

June 26, 10:00 a.m. - Overflight of spill area completed.

3:00 p.m. - Received report of 30 Canadian Geese being fouled in Wilmington, DE area.

3. Plans and Recommendations

- Continue to monitor cleanup, direct personnel to observed pollution, and coordinate with other federal and state authorities.
- Remaining cargo aboard PR to be transferred to Sun Oil. Cleaning of damaged tanks and bottom to be required before departure.
- Contractors to provide 215 civilian personnel to continue cleanup. Delaware National Guardsmen to also assist in cleanup.
- Atlantic Strike Team securing a clam bucket to pick oil from skimming boom. Skimming boom to be redeployed as soon as oil is removed from within boom and boats.
- States of NJ, PA and DE to conduct helicopter overflights daily.
- Contractor to provide 3 dredges with buckets and tug support. In addition, 8 open barges may be provided by afternoon June 27.
- Request that 2 additional small cutters be provided to assist in enforcing safety zone and in towing skimming boom system.

Report Issued: 1:30 a.m., June 28, 1989

1. Situation: 2:00 p.m., June 27, 1989

- Revised estimate of amount of oil spilled is 300,000 gallons. Cleanup continues by general contractors, with approximately 160 persons and 17 boats, in addition to the skimmer DELBAY and National Guard personnel. 42,400 gallons oil and oil debris recovered. 106,240 recovered to date. Coast Guard personnel continue to monitor situation. Approximately 21 miles of PA/DE shoreline heavily contaminated. Heaviest beached concentrations are in areas from Delaware Memorial Bridge to New Castle, DE, in widths of 5-10 feet. Vegetation along shoreline heavily stained. Free floating oil observed from Trainor, PA to Pea Patch Island, DE. Heaviest concentrations in vicinity of Christina River, Wilmington, DE and New Castle, DE. Free floating oil being recovered by the skimmer DELBAY and by the vessels using the strike team skimming system. Vessel WHITE DOVE assisting in cleanup.
- Extensive interest from the press and local officials continues.
- Offloading of cargo and bottom survey of M/T Presidente Rivera continues.
- Weather: Clear, Winds S at 6 knots, Temperature 90°F.

2. Action - Private Contractors - 197 Men, 33 Boats

June 26, 5:50 p.m. - Helicopter overflight complete.

June 27, 9:00 a.m. - Atlantic Response Team meeting held.

4:00 p.m. - Skimming boom deployed off Wilmington Marine Terminal

6:00 p.m. - Atlantic Response Team meeting held.

3. Plans and Recommendations

- Continue to monitor cleanup, direct personnel to observed pollution, and coordinate with other federal and state authorities.
- Cargo operations on Presidente Rivera suspended. Hull to be cleaned and patched.
- Contractors to provide 314 civilian persons to continue cleanup. DE National Guardsmen also to assist in cleanup.
- DE National Guardsmen to stand down from cleanup in the afternoon on Wednesday, June 28. Cleanup to continue on Thursday using civilian contractors only.
- States of NJ, PA and DE to provide helicopter overflights daily.

Report Issued: 4:20 a.m., June 29, 1989

1. Situation: 8:00 p.m., June 28, 1989

- Cleanup continues by private contractors with approximately 387 persons and 70 boats, in addition to the skimmer DELBAY and 194 National Guard personnel. 40,292 gallons of oil and oily debris recovered. 146,532 gallons recovered to date. Cleanup estimated 40% complete. Coast Guard personnel continue to monitor situation. Approximately 4 miles of Delaware shoreline heavily contaminated. The heaviest beached concentrations are in areas from one half mile north to two miles south of the Delaware Memorial Bridge. Vegetation along shoreline heavily stained. Free-floating oil observed from Chester Island, NJ to Salem River, NJ, trending toward the NJ side of the river. Vegetation along shoreline heavily stained. Free floating oil being recovered by the skimmer DELBAY and by CG 55102 and CG 55105 using strike team skimming boom system. Vessel WHITE DOVE also recovering oil.
- Natural resource and environmental agencies are coordinating water quality, sediment, and biota sampling and analysis. Part of the information may be used for natural resource damage assessment, and part will be used to help in decisions about the type and extend of cleanup needed in wetland areas.
- Extensive interest from the press and local officials.
- Bottom survey of Presidente Rivera continues.
- Weather: Clear, winds WNW at 5 knots, temperature - 88°F.

2. Action - Private Contractors - 387 men, 64 boats

June 28, 7:00 a.m. - Coast Guard vessels on water for oil spill operations in vicinity of Pea Patch Island. Overflight of spill area conducted.

9:00 a.m. - Atlantic Response Team meeting held.

1:45 p.m. - Diving operations commence on Presidente Rivera.

3.36 p.m. - Overflight of spill area conducted.

6:00 p.m. - Atlantic Response Team meeting held.

8:00 p.m. - Contractors meeting held.

3. Plant and Recommendations

- Continue to monitor cleanup, direct personnel to observed pollution, and coordinate with other federal and state authorities.
- Diving operations on Presidente Rivera to continue. Target date for moving from Sun Oil facility: Saturday, July 1.
- Contractors to provide approximately 487 civilian persons, 84 boats to continue cleanup.
- States of NJ, PA and DE to provide helicopter overflights daily.
- Conduct press tour of spill area.
- Natural resource trustee meeting tentatively scheduled for Friday, June 30.

Report Issued: 3:30 a.m., June 30, 1989

1. Situation: 7:00 p.m., June 29, 1989

- Cleanup continues by general contractors with approximately 441 persons and 61 boats, in addition to the skimmer DELBAY. 137,562 gallons of oil and oily debris recovered. 243,802 gallons recovered to date: while actual proportion of oil to debris is unknown, cleanup is estimated 70% complete. Coast Guard personnel continue to monitor situation. Approximately 4 miles of Delaware shoreline heavily contaminated. The heaviest beached concentrations are in areas from one-quarter mile north to three miles south of the Delaware Memorial Bridge. Vegetation along shoreline heavily stained. Light concentrations of free-floating oil observed sporadically from Edgemoor, DE to the C&D Canal. Free-floating oil being recovered by the skimmer DELBAY and by using the skimming boom system. Vessel WHITE DOVE also recovering oil.
- Extensive interest from local officials continues. Press interest continues, but is tapering off.
- Bottom cleaning operations of Presidente Rivera by divers started during slack water.
- Tri-State Bird Rescue handling oiled waterfowl. As of June 28, 94 Canada Geese, 3 Mallard Ducks, 1 Ring Bill Gull affected. Half have been washed. 30 additional oiled Canada geese recovered.

2. Action - Private Contractors - 501 men, 81 boats

June 29, 8:43 a.m. - Coast Guard vessels on water for cleanup operations.

12:30 p.m. - Press tour underway.

3:00 p.m. - Overflight of spill area conducted.

3. Plant and Recommendations

- Continue to monitor cleanup, direct personnel to observed pollution, and coordinate with other federal and state authorities. Focus of cleanup will be on shoreline areas: Coast Guard vessels will continue floating oil cleanup using skimming boom system, and will be supplemented by contractor boats with nets.
- Contractor to provide approximately 480 civilian persons, 80 boats to continue cleanup. Protective booms to be removed in Pennsylvania and Christina River, and Pea Patch Island.
- Bottom cleaning operations to continue on Presidente Rivera during slack water. Remaining oil to be transferred to undamaged tanks upon completion of bottom cleaning.
- Overflights to be conducted by New Jersey and Coast Guard.
- Atlantic Response Team meeting to be held.
- Natural Resource meeting to be held.

Report Issued: 2:03 a.m., July 2, 1989

1. Situation: 9:00 p.m., July 1, 1989

- Cleanup continues by general contractors with approximately 260 persons and 39 boats, in addition to the skimmer DELBAY. 60,600 gallons of oil and oily debris recovered. 430,544 recovered to date. Material is estimated to be 25% to 50% debris. Cleanup is estimated 75% complete throughout the spill area. Coast Guard personnel continue to monitor the situation. Other than occasional sheens, free-floating oil was negligible throughout the spill area. Protective booms pulled back to one side to allow passage of boats, yet remain available if needed. The heaviest beached concentrations are in the areas of Pennsville and Pennsgrove, NJ and from Delaware Memorial Bridge to New Castle, DE. Vegetation along shoreline heavily stained.
- Interest from local officials continues, but has abated. Press interest continued to taper off.
- Bottom cleaning operations of Presidente Rivera by divers completed at 1:45 p.m. Divers continue working on patching damage to cargo tanks. No further leakage is noticed.
- Waterfowl information: 116 collected, 5 deceased, half washed.
- Weather: Scattered clouds, Winds S at 10 knots, Temperature 85°.

2. Action - Private Contractors - 210 men, 33 boats

July 1, 11:48 a.m. - Coast Guard vessels operating on river.

12:22 p.m. - Boom retracted from Darby Creek, Essington, PA.

1:46 p.m. - Bottom cleaning of Presidente Rivera completed.

2:00 p.m. - Overflight of spill area completed.

2:30 p.m. - Contractor meeting held.

5:15 p.m. - Overflight of spill area completed.

6:00 p.m. - Atlantic Response Team meeting held.

3. Plans and Recommendations

- Continue to monitor cleanup, direct personnel to observed pollution, and coordinate with other federal and state authorities. Areas of emphasis to be NJ side north of Oldmans Creek, Tinicum Island and Chester Island, marsh grass south of New Castle to Delaware Memorial Bridge, and Stoney Creek to Naaman Creek.
- Contractor to provide approximately 250 civilian persons.
- Presidente Rivera to offload remaining cargo into barge starting at 6:00 a.m., July 2.
- Contractor meeting scheduled for 3:00 p.m., July 2.
- Atlantic Response Team meeting to schedule for 1:00, July 3.

Report Issued: 2:52 a.m., July 3, 1989

1. Situation: 8:00 a.m., July 2, 1989

- Cleanup continues by general contractors using 300 persons and 40 boats, in addition to the skimmer DELBAY. Cleanup is estimated 75% complete. Coast Guard personnel continue to monitor cleanup and lightering operations. Other than occasional sheens, free-floating oil was negligible through the spill area. Protective booms pulled back from creeks, and remain available if needed. The heaviest beached concentrations are in the areas of Pennsville and Pennsgrove, NJ and from Delaware Memorial Bridge to New Castle, DE.
- Interest from local officials continues, but has abated. Press interest continues to taper off.
- Diver reports patch on Presidente Rivera stays in place.
- Skimming boom being used to cleanup free-floating oil.
- Contractor advised to complete snare placement in marsh grasses and remove major globs of oil from river bank areas by end of work day 7/3/89.
- Oiled crabs and tar balls reported found in crab pots from Penns Beach to Salem Cove.
- Weather: Mostly Sunny, Winds W-SW at 5-10 knots, Temperature 85°F.

2. Action - Private Contractors - 304 men, 46 boats

July 2, 1:46 p.m. - Bottom cleaning completed on Presidente Rivera
2:30 p.m. - Overflight of spill area conducted.
3:30 p.m. - Contractor meeting held.

3. Plans and Recommendations

- Coordinate meeting of contractors, EPA, NOAA and state reps concerning oil impacts on crabs and develop advisory or restrictions on crabbing.
- Areas of emphasis to be on the Delaware side at area south of Christina River and Delmarva Power and Light near Claymont; NJ side between Oldmans Creek and Oldmans Point and beach area just south of Salem Canal.
- Strike team members to remain aboard Presidente Rivera to monitor transfer operations.
- Contractor meeting scheduled for 3:30 p.m., July 3.
- Atlantic Response Team meeting scheduled for 1:00 p.m., July 3.

APPENDIX B

SUMMARY OF NOTES FROM DNREC

WATER QUALITY SAMPLING

A summary of the notes from the water quality sampling conducted on June 25, 1989 by the Division of Natural Resources and Environmental Control (DNREC), State of Delaware is given in this appendix.

- 8:30 a.m. - Crab boat comes into Delaware City Dock with oiled crab pots.
- 10:00 a.m. - Left dock at Delaware City, headed north on east side of river (NJ). No sight of oil at 10:25. Tide headed out. Noted boat traffic, numerous species of birds.
- 10:30 a.m. - South of New Castle, hitting hard clumps of oil. Visual observation of approximately 25 tar balls of baseball to basketball size per acre with light sheen on the surface. Wave heights are 0 to 6 inches.
- 10:47 a.m. - Northern section of Hamburg Cove, South of Battery Park, no birds, fish stressed. No cleanup in progress. Approximately 100 tar balls per acre. Clumps impregnated with cobbles and possibly on bottom before surfacing. Cleanup could be conducted with 55 gallon drums to contain clumps. Obvious sheen on water. Samples taken for analysis.
- 10:55 a.m. - Just off Kelly's at Penns Beach (NJ side), nothing sighted. Heading NW to Delaware-Pennsylvania area, a few sparse clumps seen in mid- channel.
- 11:00 a.m. - New Castle flats, oil/tar sighted on shoreline.
- 11:04 a.m. - between Del. Mem. Bridge and Christina River, 4 boats with 2 workers per boat sighted cleaning up. Putting clumps in garbage bags. Observations: Clumps concentrated along Delaware shoreline, tide dropping and leaving clumps on shore. No Coast Guard seen anywhere. Should get much larger cleanup while tide is going out. Mouth of Christina River at port boomed, appears relatively clean. Delaware shore north of Wilmington port appears clean. Large mats of oil observed on both sides of boom across the Christina. Boom across Christina appears to be holding oil from entering Delaware River; heavy on Christina side. May consider secondary boom placement before tide comes back in. Sample taken.
- 11:30 a.m. - Left Wilmington port and headed north on Delaware side. Water and shore between Port and Edgemoor clean. Water between Delmarva Power and Light, Edgemoor; and DuPont, Edgemoor, shows dispersed oil balls, and some oil observed on shoreline (Much lower concentration than in New Castle).
- 11:35 a.m. - Just north of DuPont, Edgemoor, much heavier concentration of oil balls, some in large matts. Sample taken.
- 11:40 a.m. - Enroute to Pea Patch Island to take samples. Recommendations: Set another boom west of present boom on Christina. Continue working off Edgemoor.
- 12:00 p.m. - Arrived back at New Castle, still no cleanup crews on site. Oil observed on both sides of boom. Oil balls appear to be moving to the South-East and breaking up in response to breezes and tide. Much more dispersed.
- 12:20 p.m. - Arrived north of Pea Patch Island. Nearly slack tide. Little to no oil balls observed between New Castle and power line crossing. Oil balls started to show up south of transmission tower crossing. Appeared to be hugging east side of Pea Patch breakwater. Samples taken.
- 12:40 p.m. - Adjacent to Pea Patch Island on channel side, oil balls observed (approximately 25 balls per acre). Leading edge of oil balls approximately 1/8 mile south of Pea Patch Island. Distance between New Castle and Pea Patch - approximately 6 miles. Oil balls