SECTION 3. OPERATIONAL RESPONSE EFFORTS

Salvage Efforts

Sea conditions drove the spill response, limiting options, causing many logistical problems, and threatening to break the ship up. For example, arrival of the *Salvage Chief* from Astoria was delayed for three days because it could not safely cross the Columbia River bar and head out to the spill site. The tow line broke on 2 March during one of the fiercest storms of the winter.

When the *M/V New Carissa* grounded in the surf off North Spit on 4 February, the first response action taken was to ballast her to make the vessel more stable. Waves up to 6 m were breaking over the vessel. A Unified Command, comprised of the USCG, the State of Oregon, and the RP representative, was formed to manage the spill, using the Incident Command System organization. The Salvage Master and Smit International technical teams arrived on 5 February, and they formed a Salvage Branch/Vessel Offload Group with the USCG and other responders. The primary plan was to refloat the vessel with the oil intact, but backup plans were made for off-loading the oil if necessary.

These plans changed when, on 8 February, fractures in the hull were observed and oil started leaking from the ship. The weather forecast was for large waves, and there was concern that the vessel would break up and release the oil. Thus, at 0940 on 10 February, the Unified Command decided to try to ignite the oil in the vessel. The Decision Memo for burning the oil is included in Appendix B. A U.S. Navy Explosive Ordnance Disposal Mobil Unit 11 set and exploded ordnance at 1806 that day to blow holes in the six fuel tanks. Incendiary devices and gasoline was used to ignite the oil. However, only the diesel tank in hold No. 6 near the engine room burned during this first attempt.

On 11 February, a second attempt to ignite the fuel in the vessel's tanks/holds was successful. Navy teams placed 39 explosive charges, 2,280 liters of jelled petroleum, and almost 180 kilograms of plastic explosives throughout the vessel to ensure the compartments were breached to ignite the bunker fuel oil onboard. At 1742, the charges were detonated and the fuel ignited. Within approximately an hour, the entire ship was engulfed in flames. As of midnight Thursday, observers reported the stern separated from the vessel (apparently just forward of the No. 5 and No. 6 fuel tanks).

The fire burned for about 33 hours; by morning on 13 February the fire was out. Efforts were made for the next two days to re-ignite the oil by helitorch, but each time the fire would burn out after about one hour. In general, plumes generated lofted up approximately 150-300 m, drifted north by northwest, before dissipating within 2-5 km. The last effort to burn the oil was on the afternoon of 15 February. An estimated 165,000-255,000 gal of oil were burned on the vessel (see Oil Recovery and Fate section). A survey team boarded the vessel and reported the status of each hold and fuel tank (Table 1).

On 16 February, a large winter storm struck at high tide. The waves drove the bow section almost onto the beach. A plan to refloat the bow section and tow it 415 km offshore to a scuttling site was approved. The Unified Command Decision Memo for sinking the bow is included in Appendix B. The hatch covers would be put back in place and the vessel sunk in a

TABLE 1. Status of the cargo holds and fuel tanks on the *M/V New Carissa* as of 15 February.

Cargo Hold	Status	Fuel Tanks	Original Fuel Volume (gal)
1	Empty, no fire or smoke	None	None
2	Re-ignited fire, burning	No. 1 (heavy oil)	114,466
3	Burning or smoldering	No. 2 (heavy oil)	101,507
4	Empty, no fire or smoke	No. 3 (heavy oil)	3,179
5	Open to the sea, no fire or smoke	No. 4 (heavy oil)	98,104
6	Open to the sea, no fire or smoke	No. 5 (heavy oil)	41,772
		No. 6 (diesel fuel)	37,364

manner to minimize loss of bunker fuel on board. The MSRC response vessel, *Oregon Responder* arrived on-scene to follow the tow to recover any oil leaking from the vessel while in transit or when sunk. Contingency plans were evaluated to address two other scenarios: if the vessel could not be refloated; or the vessel is refloated but does not make it out 415 km. Delivery of a specialized towing hawser and bad weather delayed attempts to start pulling on the bow for 10 days, until 26 February.

It was now feasible to consider offloading the vessel because it was very stable and close to shore. The USCG Pacific Strike Team mobilized on 17 February to offload the oil while waiting for a weather and tide window to refloat the bow. Pumping began on 21 February; after two days of effort, 130,000 gal of liquid were removed, containing only 250 gal of oil. The residual oil was too viscous to pump.

After four days of pulling, the *Sea Victory* finally re-floated the bow section on 2 March and headed to the scuttling site. However, the tow line to the bow section parted at about 1700 PST that afternoon at 90 km offshore, and the bow drifted to the NE at about 5 kt. There was a severe winter storm moving through the area and wind gusts of up to 100 kts were predicted with seas over 9 m. The tug tracked the movement of the bow section, updating its position frequently. It grounded again at about 0700 PST on 3 March just outside the mouth of Alsea Bay (Fig. 1). On 8 March, the bow was once again re-floated and towed to sea. Three days later, it reached the scuttling site and was sunk at 1500 on 11 March. The *Oregon Responder* followed the tow to sea, but no recoverable oil was released.

Shoreline Protection and Cleanup

The planning and operations sections spent time refining protection priorities and strategies in the event of a spill. On 5 February, boom was pre-staged at Ten Mile Creek. Booms were eventually deployed inside Coos Bay near Charleston Harbor and the entrance to South Slough, the mouth of Ten Mile Creek, inside the Umpqua and Siuslaw Rivers, at Tahkinitch Creek, and Siltcoos River (Table 2).

TABLE 2. Summary of response and cleanup activities during the *M/V New Carissa* spill.

Date	Number of Workers By Area	Amount of Waste Collected By Area	Booming Strategies/ Operations
8 February 1999	Cleanup crews on scene		
9 February 1999	91 cleanup workers Div. A, and 35 in Div. B*		
10 February 1999	Cleanup crews off beach for burn		16,000 ft total at Charleston Harbor, Joeney Slough, Ten Mile Creek, and Umpqua jetty
11 February 1999	Cleanup crews off beach in PM for burn		Another 16,000 ft of boom is on standby
14 February 1999			Charleston 5740 ft, Coos Bay 2,000 ft, Ten Mile Ck 900 ft, Tahkenitch Ck 800 ft, Winchester 700 ft, Umpqua River 1,800 ft
15 February 1999	Clean up crews discontinued at noon due to high surf conditions	629 yd^3 oily debris from Coos Bay area; ODEQ determined debris as non-hazardous	No change in boom deployment
16 February 1999	No cleanup conducted because of storm		
17 February 1999	Clean up crews stop work at 1220 due to heavy surf	Collected 0 yd^3 Total = 629 yd^3	Boom at Siltcoos River, Tahkenitch Creek, and Umpqua River severely damaged due to heavy weather and debris
18 February 1999	Clean up crews stop work at 1100 due to heavy surf	Collected 10 yd^3 Total = 639 yd^3	
20 February 1999	Total beach clean up personnel 180	In 2 days, collected 261 yd^3; Total = 900 yd^3	
21 February 1999	Total beach clean-up personnel 160	Collected 30 yd^3 Total = 930 yd^3	Repaired boom as needed. Removed Umpqua River boom
22 February 1999		Collected 55 yd^3 Total = 985 yd^3	
23 February 1999		Collected 15 yd^3 Total = 1,000 yd^3	
24 February 1999		Collected 8 yd^3 Total = 1,008 yd^3	
25 February 1999	Intermittent beach cleanup continues as weather permits	Collected 27 yd^3 Total = 1,035 yd^3	
26 February 1999		Collected 10 yd^3 Total = 1,045 yd^3	

***** Div. A = Vessel to 2 nm north; Div. B = 2 nm north of vessel to Horsfall staging area

TABLE 2. Continued.

Date	Number of Workers By Area	Amount of Waste Collected By Area	Feet of Boom By Location
27 February 1999		Total = 1,070 yd^3	
28 February 1999		Collected 20 yd^3 Total = 1,090 yd^3	
3 March 1999		Collected 0 yd^3 Total = 1,090 yd^3	
3 March 1999		Total = 1,165 yd^3	Boom deployed in inner harbor Alsea Bay
5 March 1999	Cleanup crews at Ten Mile and Tahkenitch Creek and snowy plover habitat in Coos Bay		Boom marine science center in Yaquina Bay to protect water intakes
7 March 1999	30 cleanup workers in Coos Bay cleaning snowy plover habitat; 75 cleanup workers at Waldport area		
8 March 1999	30 cleanup workers in Coos Bay cleaning snowy plover habitat	2 bags of soiled material collected N of Waldport	
9 March 1999	10 cleanup workers in Coos Bay		
10 March 1999	10 cleanup workers in Coos Bay; 30 workers continued clean-up in Waldport	<1 quart of tar balls collected in Waldport; 167 yd^3 of solid waste Total debris collected to date = 1,194 yd^3	All boom in Alsea and Yaquina Bays removed from water
11 March 1999	19 cleanup workers in Coos Bay	Newport: 1 quart of tar balls collected; Alsea Bay = 7 bags of thatch; South of Alsea Bay = 2 bags of debris	
12 March 1999	5 workers remain in Waldport; 10 workers in Coos Bay	Total = 169 yd^3 solid waste collected in Waldport area	
16 March 1999	5 workers in Waldport; 15 workers in Coos Bay		

When oil started leaking from the ship on 8 February, cleanup workers were on-scene by the afternoon removing oil from the shoreline. All cleanup was conducted using manual methods: workers used squeegees, rakes, brooms, shovels, trowels, etc. to recover oil, oiled sediment, and oily debris which were placed in bags. Most of the stranded oil was in the form of widely scattered tar balls. Workers were given trowels instead of shovels when it was determined that they were removing too much clean sediment while trying to pick up tar balls using shovels. Sorbents (snare on a rope) were staked out at the high-tide line to recover floating tar balls in the surf at key locations, including public access points. By 14 February, nearly 4,000 m of boom had been deployed and 629 yd^3 of material had been recovered from the Coos Bay area. By 12 March, nearly 1,200 yd^3 of material had been collected from Coos Bay area and 170 yd^3 of solid waste from the Waldport area (Table 2).

Based on the information posted in the USCG POLREPs (summarized in Table 2), the number of shoreline cleanup crew reached a maximum of 180 workers on 20 February in the Coos Bay area. Shoreline cleanup activity was highly variable, depending on the timing of high tides and the passage of storms (when it was not safe for crews to be on the beach), and the amount of oil on the shoreline. Most of the oil came ashore as small tar balls. Oily debris recovery rates were very low, reflecting the small size and sparse distribution of the tar balls. Small cleanup crews were kept on standby to respond to reports of oil during on-going shoreline assessments through August. Daily solid oil recovery numbers varied, ranging from 1-34 pounds of tar balls.

Cleanup of the Stern Section

Operations resumed on the stern section on 21 March. A contractor was hired by the RP to remove debris, hazardous materials, and oil floating on the water in the engine room. There could be as much as 8,000 gal of oil and sludge in the engine room. How much oil remained in the No. 5 fuel oil tank and the No. 1 diesel tank was not known.

On 18 April, USCG-hired contractors started pumping oil from the No. 5 fuel oil tank, but only got about one gallon of oil before pumping water and sand. Pumping continued on 19 and 21 April, with the same results. On 19 April, divers were hired to locate, open, and clean all tanks that potentially contain oil. By 20 May, divers had found and opened/cleaned a total of 20 tanks. Table 3 includes the 18 tanks that were identified in the POLREPs by type, and any information that was included about the diver observations on the presence of oil. All of the tanks were opened, any oil was removed or allowed to escape, and the tanks were cleaned underwater using air lances. The No. 5 starboard ballast water tank (BWT) contained a large volume of oil that was pumped off, rather than released underwater for recovery by skimmers from the water surface in the engine room. Skimming operations were completed on 29 April. The surfaces in the engine room were cleaned using sorbents until 7 May, after which a surface cleaning agent, Cytosol, was used. On 21 May, the FOSC determined the substantial threat of discharge to be mitigated, and oil removal operations aboard the stern section of the *M/V New Carissa* to be complete.

During the period 18 April-20 May, 4,120 gallons of liquid, containing 2,150 gallons of oil, and 78 yd^3 of debris were removed from the stern section. The debris volume included 19 yd^3 of material removed from the refrigerator/dry stores area.

TABLE 3. Tanks identified as potentially containing oil in the stern section. All tanks were cleaned.

Tank Type	Size (gallons)	Observations
1. Bilge sludge		No oil; open to the sea
2. Stuffing box drain	367	Steady flow of oil when tube opened
3. Lube oil sump	4,691	Lots of oil released when opened
4. Stern tube lube oil	367	Mass of oil poured out from man-way when opened
5. Bilge oil	8,488	Mass of oil released
6. Lube oil waste	105	Oil poured out from vent pipe when opened
7. Cylinder bottom drain	132	Mass oil discharge
8. Fuel oil waste	211	Oil released when opened
9. Bilge primary		Oil discharge when vent opened
No. 5 STARBOARD BWT		Steady stream of oil from drilled hole; eventually pumped off >1,500 gal
11. Fuel oil sludge	264	
12. Lube oil sludge	132	
13. G/E lube oil settling	4,224	
14. No. 5 PORT BWT		Tank missing/empty
15. Aft peak		No oil present
16. Stern tube void		No oil present
17. Steering gear hydraulic	50	Tank was removed with oil inside
18. Steering gear hydraulic	50	Tank was removed with oil inside
19. Not specified		
20. Not specified		

The RP began removal of the stern section on 1 June. The wreck removal plans at that time called for removal of scrap metal, patching and refloating of the stern, then sinking it at sea. If the stern could be refloated, then crews would dismantle it completely for scrapping and recycling. An oil discharge was discovered inside the engine room of the stern early on 28 July. The oil was a mixture of diesel and lube oil or bunkers estimated to be between 250 and 400 gal. Over 100 bags of oily sorbents were collected on 28 July as a result of cleanup efforts within the engine room.

SECTION 4. OIL RECOVERY AND FATE

Although on-water recovery resources were mobilized during the *M/VNew Carissa* spill, no oil was recovered by them. Most of the oil was released into the surf zone where skimming was not feasible. Skimming vessels followed the towed bow during both towing efforts, but no recoverable oil was released from the ship.

The primary oil removal method was burning of the oil inside the vessel, where an estimated 165,000-255,000 gallons of oil were burned. The Unified Command Decision Memo, which documents the assumptions and calculations of the fate of the oil from the *New Carissa*, is included in Appendix B. It clearly stated "it is difficult to know how much oil was released into the water and how much burned."

The UC estimated that 25,000-70,000 gallons were released at the first grounding site. NOAA estimated that 10,000-14,000 gallons of the released oil would have been lost to the atmosphere by evaporation. Thus, an estimated 56,000-60,000 gallons would have remained in the marine environment. Section 7 discusses the shoreline impacts from the spill, and the report by Polaris (1999a) which states that on 13 February an estimated 41,353 gallons of oil were stranded on the shoreline on segments N2-N5, north of the initial grounding site. If all of these estimates are correct, then 69-74 percent of the oil released from the vessel stranded onshore on 13 February. Even considering that the releases occurred in the surf zone, the winds during the first few days after the releases were mostly from the south, with easterly or westerly components. The alongshore transport of the oil was steadily to the north, at a rate of about 10 km per day (Polaris, 1999a). It would be extremely unusual to have such a large percent of the released oil to strand on the beach. Furthermore, in Section 5, it is noted that the NOAA observers on the overflights reported the largest amount of black oil in the water on the afternoon of 14 February. Thus, it is likely that the actual amount of oil released was greater than that estimated.

The storm on 15-16 February removed much of the stranded oil from the shoreline. The SCAT-based estimates for stranded oil on 16-18 February were only 2,574 gallons (Polaris, 1999a), six percent of the amount three days earlier. Shoreline cleanup removed some fraction of this oil.

As of 3 March, about 1,200 yd^3 of oily debris had been recovered from the Coos Bay area. Oil content of the oily debris was not likely to be greater than 5 percent by volume, which would be about 10,000 gallons of oil removed by cleanup activities by 3 March. However, it should be noted that no samples were collected or tested for oil content of the oily debris, thus this is a very rough estimate based on experience at previous spills.

As discussed in Section 7, cleanup crews recorded then removed tarballs after 3 March, allowing for a relatively accurate estimate of the amount of oil stranded onshore each day. Polaris (1999a) calculated the volume of stranded tarballs from 3 march through 30 September to be 1,100 gal, with 700 gal from the Coos Bay area, and 400 gal from the Waldport area. Note that an estimated 22 percent of the released oil was stranded onshore and cleaned up in the Waldport area. Total estimated cleanup of oil stranded on the outer beaches could be as much as 11,100 gal.

Unified Command Decision Memo

16465
March 12, 1999

Fate of Oil Onboard M/V NEW CARISSA

Pregrounding Report of Oil Onboard

Tank #	gallons capacity	mT o/b	sp. gr.	API	gallons o/b
Bunker					
No. 1	134,030	422	.9749	13.6	114,466
No. 2	132,984	371	.9665	14.9	101,507
No. 3	104,483	11.7	.9290	20.8	3,179
No. 4	133,262	354	.9542	16.8	98,104
No. 5	47,422	154	.9749	13.6	41,772
Diesel					
No. 1	45,671	124	.8776	29.7	37,364
Total Oil		1436.7			396,392

Assumptions:

1. The #1 fuel tank in #2 hold was tidal prior to burn. Initial assessment after the burn indicated floating oil in the hold. Based on this, an estimated 55 K – 85 K gallons burned.
2. The #2 fuel tank in #3 hold was non-tidal prior to burn. After the burn, the level of oil in the tank appeared close to the tanktop. Based on this, an estimated 10 K – 20 K gallons oil burned.
3. Thank #3 fuel tank in #4 hold was non-tidal prior to burn. After the burn, some burn residue was seen in cargo hold. Only 3 K gallons were in this tank initially.
4. The #4 fuel tank in #5 hold was tidal prior to burn. Tank #4 was compromised when the vessel broke during the primary burn. Hold #5 continued to burn after the stern broke off for total of 33 hours. An estimated 50 K – 80 K gallons oil burned.
5. The #5 fuel tank and #1 diesel tank in the stern of vessel showed significant tidal action prior to burn. The stern continued to burn after the vessel broke. Estimate 10 K gallons oil released (based on visual overflight obs) and rest burned or remained in stern (50 K – 70 K gallons).

6. During overflights, noted a small quantity of fuel leaking from the stern during the 4 days prior to burn. Estimate 3K gallons in the water based on visual observations. For period of 3 days after the burn observed significantly more oil on the water in the vicinity of the vessel.

Fate of Oil from Grounding, Burning, and Scuttling of M/V NEW CARISSA

The following volume ranges have been estimated to describe how much of the M/V NEW CARISSA oil was discharged into the water, burned, and left on board when the bow was scuttled.

Initial quantity on board:	400 K
Oil released before burn	5 K – 10 K
Oil released after burn	20 K – 60 K
Oil burned on vessel	165 K – 255 K
Oil on board when scuttled	110K – 150 K

The lower range of oil released to the water is based on visual overflight observations. The higher range of oil released is based on a salvage model calculation of potential loss from vessel damage. There is also uncertainty associated with how much was burned or lost to the water from fuel tank #4 when the vessel broke. The relatively small quantity of oil observed on the shoreline may be due to the high degree of natural dispersion that would be expected to occur in the high surf where the vessel was grounded. This is consistent with the small tarball size and overall distribution observed on the shoreline.

The burn lasted approximately 33 hours. The rate of oil burned on the vessel results from the difficulty in calculating actual burn rates and the inaccessibility of some of the tanks. In situ burn rates are highly dependent on the surface area of the burn and the amount of oxygen available. Fuel tanks #5P and #1 MDO in the stern are not accessible. Fuel tank #4 in Hold #5 was ruptured when the stern broke off the vessel approximately 5 hours into the burn. Hold #5 and the stern section continued to burn fiercely afterwards so it is difficult to know how much oil was released into the water and how much burned.

The range of oil on board when scuttled is based on several factors. Fuel remaining in tanks #1 and #2 was difficult to determine. Life safety concerns limited the team's ability to access tank tops in more than one location. Due to the viscous properties of the oil and water mixture, it was extremely difficult to accurately determine the oil/water interface boundaries.

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FOSC	RP OSC (Acting)	SOSC (Acting)

SECTION 5. OVERFLIGHT AND TRAJECTORY INFORMATION

Maps were produced by the NOAA SSC for morning and afternoon overflights to track the spread of the oil from 8 February, after oil started leaking from the ship, until 17 February. After that, overflight maps were produced daily for the periods of 19-20 February and 26 February-6 March. Table 4 lists the maps and a summary of the floating oil observations. Copies of the overflight maps are included in Appendix C.

TABLE 4. Summary of the observations reported on NOAA overflight maps.

Date and Time	Geographic Area Covered	Observations
8 Feb 1100-1200	Lower Coos Bay, outer coast from North Jetty to Ten Mile Creek (Ck)	Streamers of light sheen on the water, 50 m long, 100-200 m offshore from the ship's bow to 12 km N
9 Feb 0900-1000	L. Coos Bay, outer coast from North Jetty to Ten Mile Ck	6-8 dull brown streamers 2 km W and 3 km S of bow; intermittent sheen extending S from the Effluent Lagoon to the North Jetty
9 Feb 1620-1700	L. Coos Bay, S to Gregory Pt, N to Ten Mile Ck	Dull brown and silver sheen in immediate vicinity of bow; small area of tar balls and sheen N of Effluent Lagoon
10 Feb 0730-0820	L. Coos Bay and South Slough, North Jetty to Ten Mile Ck	Sheen just inside Coos Bay along the North Spit shore; large concentration of stranded oil 2.5 km S of bow
10 Feb 1210-1255	L. Coos Bay, Lighthouse Beach, N to ship, offshore about 7 km S of ship	Widely scattered tar balls and sheen at entrance of Coos Bay, extending 1.5 km out, streaks of silver sheen from jetties to bow
11 Feb 0740-0940	L. Coos Bay, South Slough, Gregory Pt., then N along shore to Umpqua River	Streaks of gray sheen and isolated sheening tar balls in L. Coos Bay and entrance to South Slough, isolated sheens and tar balls S of ship to 5 km offshore, black oil to sheen extending W of bow for ~3 km
11 Feb 1625-1800	L. Coos Bay, South Slough, Gregory Pt., N along shore to Umpqua River, then 5-10 km offshore	Small streaks of gray sheen in South Slough, few sheening tar balls outside jetties widely spaced small streaks of silver sheen 5-10 km offshore, patch of streaks with rainbow/gray sheens 5 km NW of bow
12 Feb 0730-0930	L. Coos Bay, jetties, N to Tahkenitch Ck, and along the smoke plume offshore	Small streaks of silver sheen with occasional tar balls in L. Coos Bay, no floating oil observed offshore
12 Feb 1555-1745	L. Coos Bay, jetties, along shore to N of Umpqua River	Few very small streaks of silver sheen in Coos Bay near North Slough, sheen with occasional tar balls in L. Coos Bay and South Slough, heavy sheen/black oil from ship N to Effluent Lagoon, widely scattered tar balls offshore 5-10 km N of bow

TABLE 4. Continued.

Date and Time	Geographic Area Covered	Observations
13 Feb 0745-0945	L. Coos Bay/South Slough N to halfway between Tahkenitch/Siltcoos Ck	Dull sheens with tar balls from ship in breaker zone N ~600 m; sporadic tar balls/ sheen 5-10 km N of bow beyond breakers
13 Feb 1535-1715	L. Coos Bay/South Slough N along outer shore to Siuslaw River	Scattered sheen in Coos Bay/South Slough, black oil near ship with dull sheens for 600-800 m N between breakers, widely scattered sheen/tar balls between and offshore of breakers to Tahkenitch Ck
14 Feb 0830-1030	L. Coos Bay/South Slough, to Gregory Pt, N along outer shore to Siuslaw River	Few silver sheens/tar balls in North Slough and South Slough, widely scattered sheens with tar balls offshore to Umpqua River
14 Feb 1620-1800	From the ship along the outer shore to 5 km N of Umpqua River	Streamers of black oil from bow to NNW for 200 m, becoming heavy sheen with mousse streaks, heavy gray/brown sheens/tar balls for 12 km N of bow, widely scattered sheen/tar balls to Umpqua River
15 Feb 0735-0905	L. Coos Bay/South Slough, to Gregory Pt, N along outer shore to Umpqua River	Very few tar balls in Coos Bay, brown sheens with tar balls from bow to 400 m to NW, becoming sheens to 1200 m, widely scattered sheen to 12 km N
15 Feb 1648-1700	Just around the ship	Heavy sheens tending from bow 100-200 m to NW, scattered sheens just N of ship
16 Feb 0915-1000	L. Coos Bay/South Slough, along outer shore N to Ten Mile Ck	High winds/seas made viewing conditions poor, heavy dull sheens with tar balls from bow 200 m N, scattered sheens in breakers
16 Feb 1630-1637	Just around the ship	High winds/seas made viewing conditions poor, scattering sheens just N of bow
17 Feb 0745-0905	L. Coos Bay/South Slough, N along outer shore to 7 km N of Umpqua River	Few tar balls sheening on the beach near the bow, no oil observed on water near bow, one tar ball seen in surf near Umpqua River
17 Feb 1625-1715	L. Coos Bay/South Slough, Gregory Pt, N along outer shore to Ten Mile Ck	Few tar balls sheening on the beach near the bow, no oil observed on water near bow
19 Feb 0715-0845	To the ship, then N along outer shore to Siltcoos Ck	No floating oil observed, viewing conditions were very good
20 Feb 0800-1030	To the ship, then N along outer shore and offshore to N of Siuslaw River	No floating oil observed, only logs, kelp, birds, and floats
26 Feb 1630-1700	To the ship, then N to N side of Effluent Lagoon	Silver sheens ringed both ship sections, small patch of sheen from ship 50 m to N, band of silver sheen 150 m NNE

TABLE 4. Continued.

Date and Time	Geographic Area Covered	Observations
27 Feb 0745-0845	L. Coos Bay/South Slough, along outer shore N to Horsfall Beach	No sheens or visible oil observed
28 Feb 0830-0930	L. Coos Bay/South Slough, N along outer shore to Ten Mile Ck	No sheens observed, some brown staining on snare staked out at the high tide line near the bow
1 Mar 0730-0815	L. Coos Bay, out jetties, N along outer shore to Horsfall Beach	No sheens or tar balls observed
1 Mar 1730-1815	To ship, then N along outer shore to Hauser	Few tar balls and sheening in swash line for ~ 5 km N of bow
2 Mar 0730-0800	To ship, S to jetties, then N along outer shore to Umpqua River	No sheens or tar balls observed
2 Mar 0830-0930	To the tug towing the bow ~35 km W, then E to Umpqua, S to Coos Bay	No oil or sheens visible offshore or along the coastline
3 Mar 0815-1040	Alsea Bay, then S along outer shore for ~ 10 km	Occasional streaks of black oil in lower Alsea Bay, silver sheen at bay entrance
3 Mar 1610-1630	Alsea Bay, then around bow and N to Seal Rocks	Patches of rainbow to dull gray sheen and tar balls S of bow for ~ 4 km, no oil N
4 Mar 0815-0900	Alsea Bay, S along outer shore ~10 km, then N to entrance to Yaquina Bay	No oil observed
5 Mar 0745-0815	Alsea Bay, S along outer shore 3 km, then N 6 km	No oil observed
6 Mar 0745-0830	Alsea Bay, S along outer shore ~6 km, then N to entrance to Yaquina Bay	No oil observed

As expected, once spilled, the heavy fuel oil quickly broke up into streaks of sheens and scattered small tar balls. When the tar balls stopped sheening, it became very difficult to see them. Knowing this, the NOAA and RP observers flew at very low altitudes in likely areas to try to find these widely scattered tar balls, but did not report seeing any. Thus, it is important to note that the overflight observations represent only the visible oil and do not represent the entire area exposed to widely scattered tar balls.

Releases from the bow section were low for the period 8-12 February, with mostly sheens observed in the vicinity. Starting on the afternoon of 12 February, it appeared that larger amounts of oil were being released from the bow section during the afternoon low tides. The largest amount of black oil in the water was observed on the afternoon of 14

February. Very little oil was observed at the first grounding site after the large storm on 16 February.

Although the dominant longshore current direction was to the north during most of the spill, there was some current reversal and transport of small amount of oil sheen and tar balls into Coos Bay on 10 and 11 February. Based on overflight data, the oil spread south into South Slough and north as far as the entrance to North Slough. It is likely that most of the oil that entered Coos Bay eventually stranded on the shoreline since the southerly winds would have kept the floating oil from exiting with the ebb tide.

Figure 5A shows stick plots and wind speed and direction graphs for the C-MAN station at Cape Arago for 4-21 February. Note that winds at Cape Arago had a strong southerly component during the spill, only rarely shifting to the north for a few brief periods. The nearest buoy that measured wave height was offshore Yaquina Bay. Figure 5B shows the significant wave heights recorded at this buoy for 4-22 February. Significant wave heights were generally around 5 m, with heights greater than 6 m during the periods of greater wind speeds.

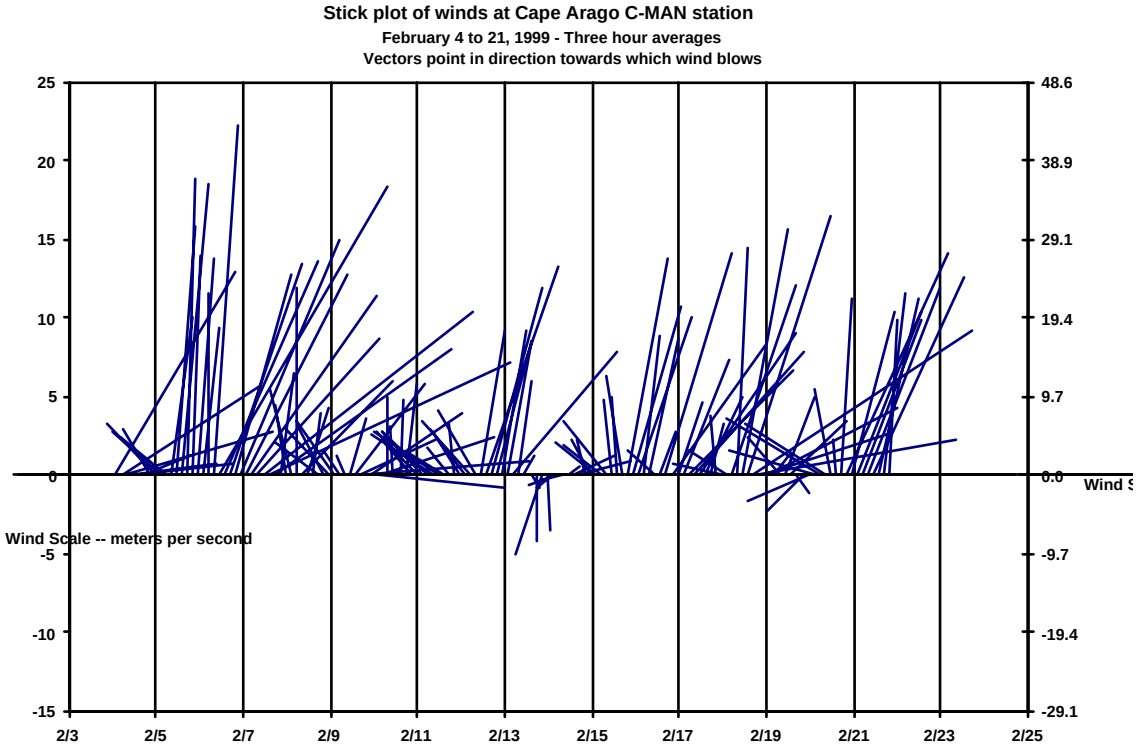

FIGURE 5A. Stick plot of winds at Cape Arago C-MAN station for 4-21 February 1999.

The Modeling and Simulation Studies group at NOAA conducted trajectory analyses throughout the spill response. Formal trajectory maps for the North Spit spill site were prepared and published on 11-14 and 16 February, and are included in Appendix C. All of the trajectory analysis results show movement of floating tar balls to the north.

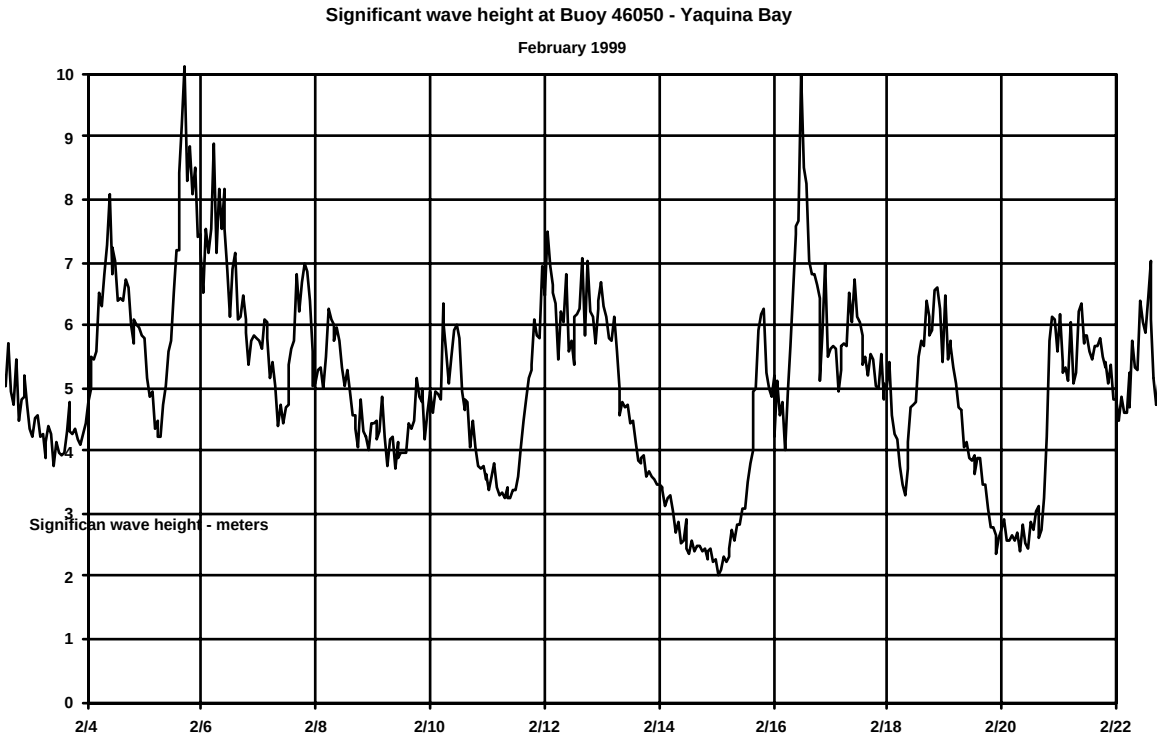

FIGURE 5B. Significant wave height (m) offshore Yaquina Bay for 4-22 February 1999.