TEXAS MARSH BURN: REMOVING OIL FROM A SALT MARSH USING IN SITU BURNING

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ABSTRACT: *Frequently coastal marsh is burned to enhance regrowth; but rarely is it burned to remove spilled oil. On January 7, 1992, a 40.64 cm crude oil pipeline ruptured causing a spill in a salt marsh. Four days later, in an unprecedented cleanup coordinated by Exxon Pipeline Company and the Texas General Land Office, 1,150 barrels of South Texas crude was ignited and removed, minimizing environmental damage to Copano Bay, Chiltipin Creek, and the surrounding wetlands.*

This cleanup had been made difficult by inclement weather and heavy rainfall that saturated the marsh. Ingress and egress had damaged the marsh and was discontinued. Conventional mechanical cleanup techniques had been used with minimal success. Alternative methods like bioremediation, low pressure flooding, and peat moss applications were considered, but proved unfeasible. The unified command system then made an application for a permit to burn and gained approval. Seventy-six hours into the event, a successful test burn was conducted; one day later, the majority of the oil was ignited. It maintained a full burn for 21 hours, self-extinguished, and later was re-ignited for further removal.

Emerging technologies such as in-situ burning are additional implements in the oil spill responder's toolbox. In Texas, burning helped save a marsh.

An oil spill occurred from a pipeline owned by Exxon Pipeline Co. (EPC) on the morning of January 7, 1992, during a routine transfer of South Texas light crude (API gravity 36.0) from their Harbor Island facility to their facility in Vanderbilt, Texas. The Harbor Island facility, located near Ingleside, Texas, consists of several large, aboveground storage tanks and a marine terminal. The interstate, belowground pipeline, suffered a rupture due to corrosion, which extended about 1.5 m along the seam on its underside. The line was installed in 1966 and is 40.64 cm in diameter, with a wall thickness of 0.556 cm, and rated for a maximum operating pressure of 1,104 psig. On the evening before the incident at approximately 10:45 p.m., EPC's Oil Traffic Control Center confirmed a probable leak on the pipeline in question. Earlier, the Ingleside transfer pumps had shut down on an operational trip after switching from a very light plant distillate to a heavy crude. At the time, the recording pressure chart at Ingleside showed a momentary pressure increase to 1,145 psig at the station, 3.7 percent above the maximum operating pressure, but well within the 10 percent surge allowable. Apparently, at the same time, a leak occurred 22.7 km away at 1,072 psig, below the 1,104 psig maximum operating pressure. Even though pressures were in an acceptable operating range, the date of the latest test (1966) was 26 years prior to the incident and the pipeline then had achieved a maximum test pressure of 1,380 psig. The rupture occurred in a privately owned tidal mud flat at the mouths of Chiltipin Creek and the Aransas River near Copano Bay (Figure 1) 50 km from the Aransas Wildlife Refuge.

Copano Bay (Figure 2) is a body of water about 13 km wide and 38 km long that flows into the Aransas Bay system and is primarily used by recreational and commercial fisherman. Oil and gas facilities and liquid petroleum gas processing plants in and around the bay pose other environmental threats.

Response

At the time of the release, it was raining, cold, and windy. The temperature was about 7° C with winds at 15 to 20 knots. Rainfall in recent days had been heavy leaving the ground saturated and a forecast predicted continued rain for the next several days.

After the problem was encountered, EPC ordered their air patrol to investigate. Hampered by fog, the patrol finally discovered the leak at 10:45 a.m. the next day. Maintenance and cleanup crews were dispatched and agency notifications were made. The National Response Center[2] was notified along with a host of state agencies. Texas General Land Office (TGLO)[5] received its first call at 1:22 p.m. on January 7, 1992. The caller stated that 750 barrels of crude oil had spilled from a ruptured pipeline in a plowed field. When agency representatives converged at the site, EPC's incident commander provided additional information. Two valves, 18 km apart, had been shut in; but 16,000 barrels remained in the line and continued to pose a threat. EPC's initial response was to contain and control the movement of the oil and to begin pipeline repairs. Containment boom had been placed in the river and sorbent boom was placed at the leading edge of the spill, which at the time was approximately 540 km from the river. EPC had established a 24-hour operation. In the days following, over 130 people would be utilized to mitigate the situation.

Incident command

After federal and state jurisdictional issues were addressed and agreed to, and incident command system was initiated and a unified

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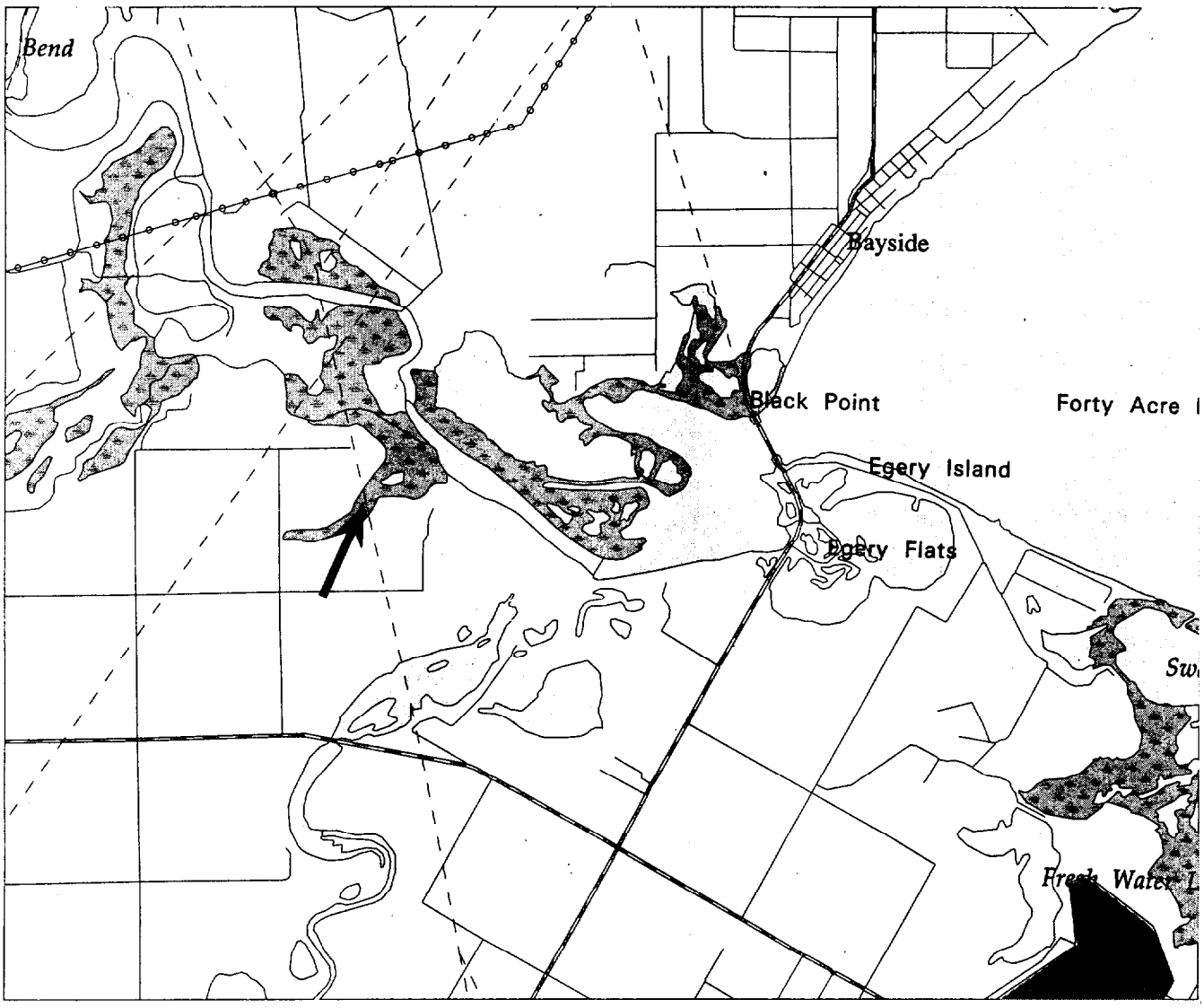

Figure 1. Site of pipeline rupture (marked with arrow) at the mouths of Chiltipin Creek and the Aransas River near Copano Bay

command structure with modifications was established. EPC assumed the roles of responsible party and incident commander; the Environmental Protection Agency (EPA), as federal on-scene coordinator (FOSC); and the TGLO (Oil Spill Division) as state on-scene coordinator (SOSC). The goal of the unified command was to remove the oil from the marsh safely, with the least damage to the environment, prevent any oil from entering the river, and restore EPC's pipeline transfer capabilities. A command post was positioned on the surrounding farmland by EPC about 1.5 km from the spill site, with an established security radius of 3 km. At this command post and through this system, all decisions were made and stakeholder's concerns addressed. Agencies participating on scene included the TGLO (Coastal Division), Texas Parks and Wildlife Department, Texas Railroad Commission, Texas Water Commission, and Texas Air Control Board (now making up the Texas Natural Resource Conservation Commission), U.S. Coast Guard, and U.S. Fish and Wildlife Services (USFWS). The EPA chose to handle their duties from the Region 6 headquarters office in Dallas. They did, however, send an EPA technical assist team from Houston during the initial days of the event. Meetings were conducted twice daily to brief all representatives and interested stakeholders on all actions. Evening planning meetings with EPC and the SOSC were held to discuss operational, regulatory, and public relations matters further.

Assessments

Initial assessments were done by aerial inspection. Little was visible from the air as the oil migrated through the dense marsh grasses rather than over it. Ground assessments were the best way to determine the extent of the damage and were restricted to response personnel. With all the rain, transportation to the site was accomplished by helicopter, sleds pulled by D-8 tractors, or all-terrain vehicles. Ingress and egress to the site was around the marsh over neighboring farmland. Walking through the marsh on foot was extremely difficult and contributed to the damage by trampling. Getting equipment to the site was slow and tedious. Once at the site, it was discovered that the spilled oil encompassed between 8 and 10 ha of sensitive marshlands. The majority of the affected habitat was principally vegetated with salt-flat grass, Virginia dropseed, sea ox-eye daisy, sea-lavender, glasswort, and saltwort.[4] Wildlife was minimally affected. Two oiled gadwalls were recovered and taken to a certified rehabilitator, and several sheephead minnows were discovered dead in a nearby pond. The initial reported spill volume of 750 barrels quickly increased to over 2,900 barrels. Heavy equipment was moved in to dig up, cold cut, and replace the damaged line with a 22.7 m section of new line. A bell hole was dug around the rupture to control the trickling flow of oil.

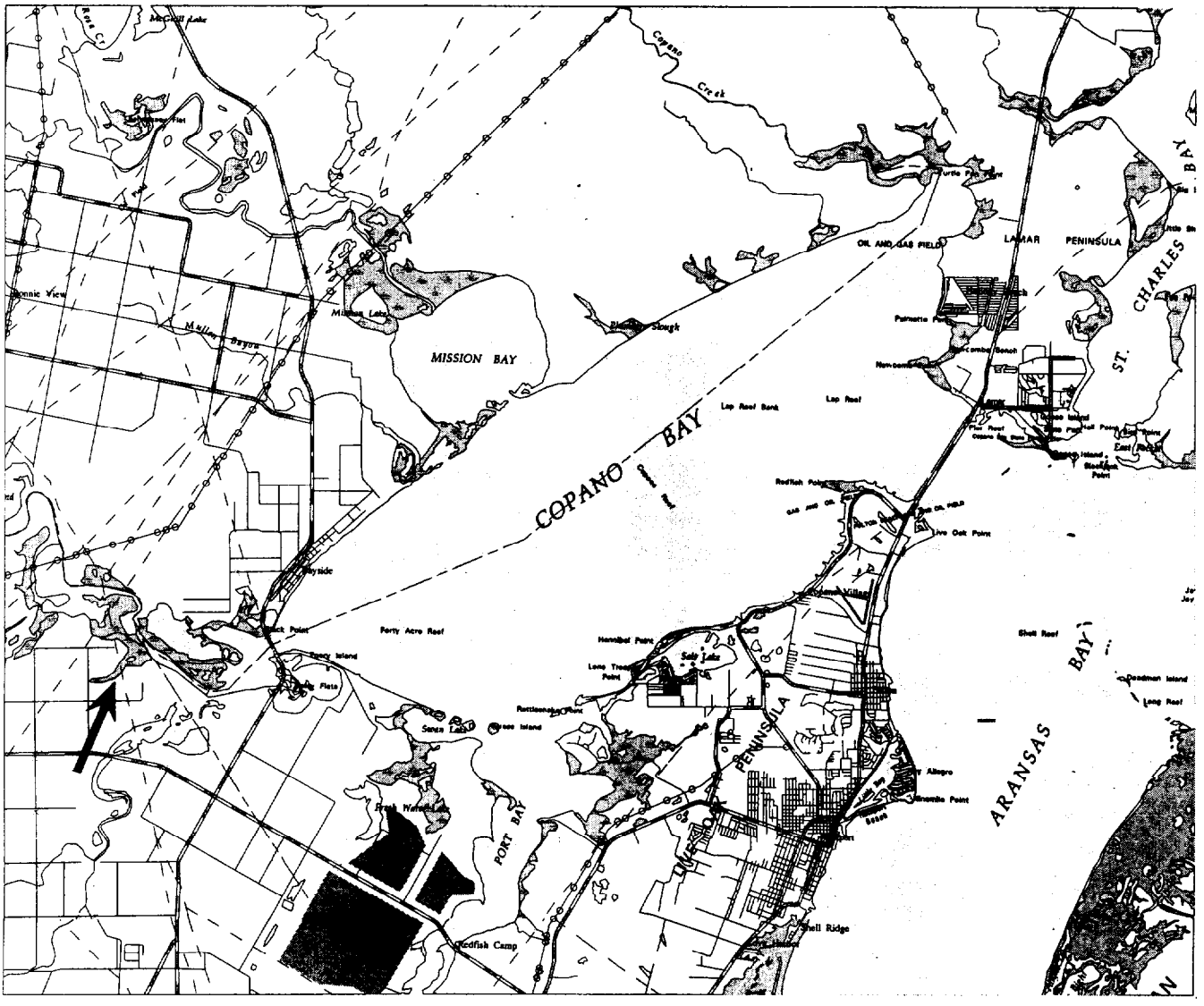

Figure 2. Map of the Copano Bay area—rupture site marked with arrow

Conventional cleanup

Eventually two tankage systems with pumps were set up with a capacity of 2,400 barrels. One tank system was by the spill site and the other near the command post; both were connected by a 7.6 cm plastic line to a point where vacuum trucks could enter and take the recovered crude back to EPC's facility. Conventional cleanup techniques, such as skimmers, pumps, and sorbents, proved to be inadequate at the site, and some were ruled out completely due to the potential damage to the marsh. Other alternative cleanup methods had to be considered as the oil continued to migrate closer to the river.

Alternative cleanup techniques

Alternative cleanup methods such as bioremediation, flooding, peat moss application, and in-situ burning were considered. Bioremediation might have been a viable action but was discouraged because of extensive regional response team protocols required for a permit. Water flooding of the marsh with low-pressure, high-volume pumps might have worked, but would have been a logistical nightmare. Peat moss was used at the leak site to absorb the remaining free oil, allowing personnel to work in the area. Tall marsh grasses prevented peat moss application to the major spill areas; and it would have been almost impossible to recover. Because less manpower and equipment was needed, in-situ burning appeared to be the most effective method of oil removal from the marsh.

In-situ burn

Once the decision to burn was made, the unified command worked expeditiously to obtain consensus approval from all stakeholders. The FOSC was called in Dallas for direction and stated that the decision lay with the Texas Air Control Board (TACB). Exxon Pipeland formally requested permission from the TACB, with assistance from TGLO and after gaining approval from all stakeholders. The TACB permit came back with these directives:[3]

- Burn will be under the direction of the TGLO.
- Burning conducted only to eliminate emergency conditions and threat to the wetland environment.
- Disposal site must stay in compliance with all applicable rules and regulations of appropriate state and federal agencies.

- Burn must always be attended.
- Heavy oils, asphaltic materials, and vehicle tires shall not be burned.
- Burning shall not be commenced when the surface wind speed is predicted to be less than 5 knots or greater than 20 knots during the burn.
- Local TACB office was to be notified during any burning.

Seventy-six hours into the event, a test burn was conducted to determine the oil's ignitability. An isolated area 5 m in diameter was chosen. A small berm was built around the area. Using diesel for ignition, the oil slowly burned then quickly raged with crackling flames 7 m high. It was a successful test. Meanwhile, EPC's crews completed repairs on the line and slowly continued to pump oil from the marsh into the tanks. The unified command needed to prepare quickly for the full burn.

The burn was planned as follows. The ruptured line had to be repaired and covered. Continued site safety had to be maintained. Heavy equipment had to be placed on higher ground. Experts in fire safety and control, like the Texas Forest Service (TFS) and the Refinery Terminal Fire Company (RTFC), Corpus Christi, were called in to conduct and manage the burn. Logistical problems continued to hamper and slow the process. The TFS called for the D-8 tractors to build firebreaks through the surrounding brush. Several ignition sources were considered, and it was determined that mineral spirits would do the job.

The Texas Division of Emergency Management was contacted for assistance. Calls were made notifying all the local fire, sheriff's, and police departments of the controlled burn. Nearby residents were alerted for possible evacuation. The Department of Public Safety maintained traffic control on the nearby county roads. The Federal Aviation Administration was alerted for the potential smoke plume from the burning oil. Finally, the local news media were notified and the evening's newscast provided viewers with a public service announcement to prevent alarm if fire and smoke were seen during the night. The newscast stated that this would be a controlled burn. A control site was prepared by the USFWS for later study. However, the USFWS was told by the unified command that this response effort was for the removal of spilled oil from the marsh and science might have to take a back seat. Communications to Austin headquarters were frequent and support for burning continued.

Before the commencement of the burn, a final meeting was held by the unified command to again secure a consensus decision from all stakeholders at the scene. The decision was unanimous: burn. Recommendations from the TFS and the RTFC was to leave a contiguous layer of oil on the ground to maintain a good burn, and to allow the fire fighters to ignite the oil on the upwind side. The layer ranged from one to several millimeters thick. Mechanical pumping of the oil was stopped and all the equipment removed. Responders and cleanup personnel were placed in safe zones. Six fire fighters positioned themselves and at 5:50 p.m. on January 11, 1992, ignited the oil. At the command post 1.5 km from the spill site, the flames were barely visible with the naked eye—but within minutes the flames towered skyward to heights in excess of 50 m and the smoke plume slowly traveled, and eventually dispersed, several kilometers away over farmland. Fortunately, the nearest populated area was 6 km upwind in the town of Bayside. Through continuing rain, the flames finally died 21 hours later.

Observers from the unified command, along with fire fighters, made aerial inspections of the site and visually estimated that 80 to 85 percent of the oil had been removed. Three small pools remained and the order was given to continue burning. Each burned successfully for approximately 4 hours. Again, visual inspection showed similar removal percentages. The remaining residue was an asphaltic, taffylike material that adhered to anything it came in contact with. That evening heavy rains fell and flooded the marsh. Drainage was directly into Chiltipin Creek. The flooding cleared by the next day. Fortunately, most of the oil had been removed and not allowed to enter the main body of Copano Bay. Residue was visible and EPC personnel continued to conduct smaller burns to remove as much oil as possible. Plywood planks were laid to gain access to the remaining affected areas, preventing any further damage.

Final cleanup

Oil sheen and residue remained. Sorbent sweeps were placed and slowly absorbed the final remnants of floating oil and sorbent pompoms were used to recover the residue. Twenty days from the initial discovery of the leak the site was deemed clean.

Conclusion

It is agreed that this spill damaged the environment; but as in any spill event, concessions and difficult decisions were made. Many times, it is a choice of the lesser of the evils. In this instance, the goals of the unified command were to minimize further damage to the environment. A total of 2,950 barrels of oil was released from the pipeline; of this, 1,250 barrels were removed from the bell hole and pumped into tankage. The remaining 1,700 barrels entered the marsh; of these, 500 barrels were recovered from the marsh and pumped into tankage, 50 barrels went into sorbents, and 1,150 evaporated or burned. The oil was removed, no oil entered the river, and damage to the marsh was minimized. The goals were achieved. Followup inspections to the site revealed that the heartier vegetation had sprouted within two weeks of the burn. Four months later, 75 percent of the impacted area had regrown. Although the vegetation diversity had diminished, the regrowth process was evident and crucial to the restoration of the marsh.

Acknowledgment

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