0-6807-WP

White Paper: Economic Impact to Barge Operators and Shippers of Closing the GIWW

TxDOT Project 0-6807, Texas Gulf Intracoastal Waterway Master Plan

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WHITE PAPER

Task Purpose

This task analyzed the effect that the March 22, 2014, collision and oil spill in the Houston Ship Channel had on Gulf Intracoastal Waterway (GIWW) barge shipments. Because the incident is so recent, the scope of the analysis was somewhat constrained due to data availability. This task report discusses the following topics:

- The events of March 22, 2014, and the following days.
- The effect of the incident on barge traffic flows.
- Transit delays for shipments already on the water and the cost of those delays.
- Shipments that were postponed because of the channel closure.
- Decontamination requirements.

Background—The Incident

At 12:35 p.m. on March 22, 2014, a collision occurred in the Houston Ship Channel just inside the junction known as the Texas City "Y." This is an extremely busy intersection of various shipping lanes, both deep sea and shallow draft. Figure 1 shows the location of the accident, as well as the routing for the various ship channels and the GIWW in that area.

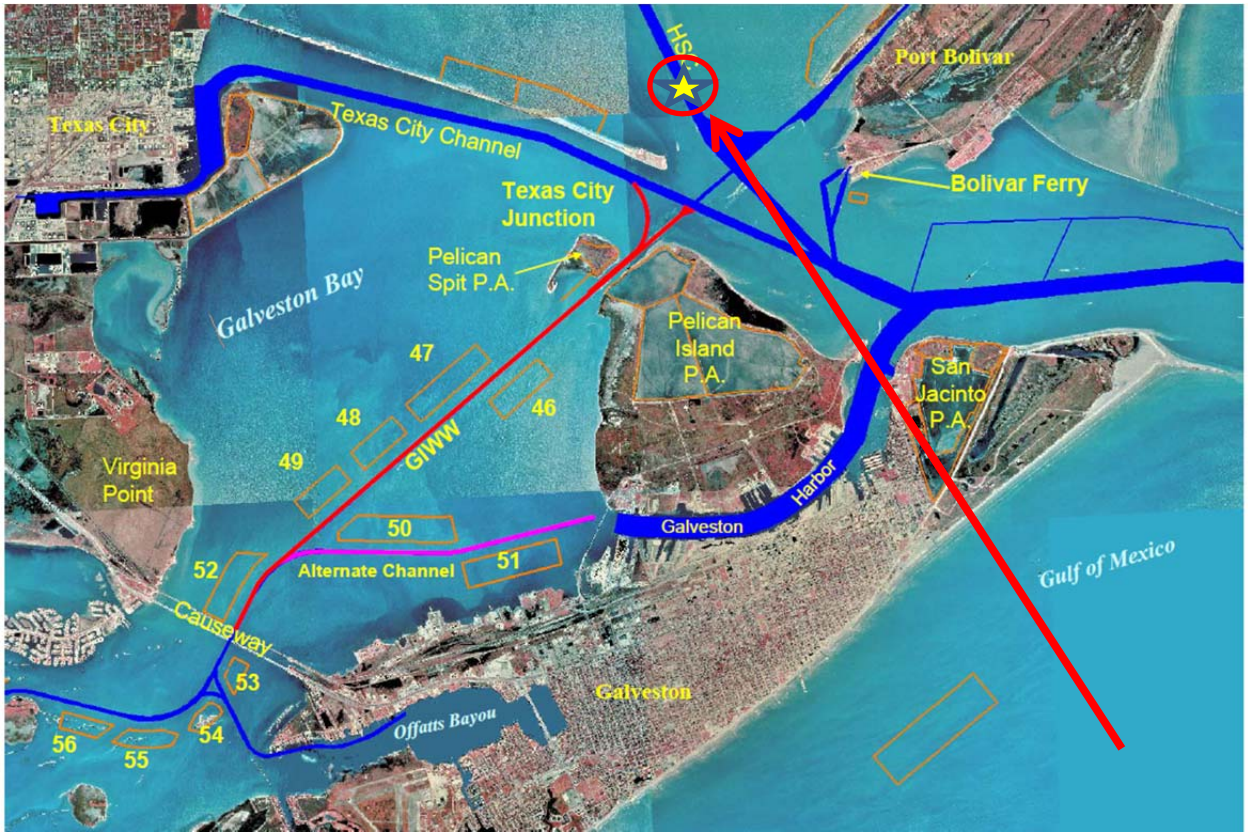

Figure 1. Map of Ship Channels in Vicinity of Oil Spill.

Source: District Channel Maps, U.S. Army Corps of Engineers, Galveston District.

The *M/V Miss Susan*, a towboat, was pushing two barges carrying fuel oil (bunker fuel) en route to the Bolivar peninsula from Texas City. The *Summer Wind*, a 585-foot Liberian-flagged vessel operated by Cleopatra Shipping Agency Ltd., was inbound on the Houston Ship Channel traveling at 12 knots. The *Miss Susan* was traveling at 4 knots. At 12:30 p.m. the crew members on both vessels realized that a collision was imminent, but they were unable to maneuver in such a manner as to avoid it. The barge that was struck was carrying about 22,000 barrels of fuel oil (bunker fuel) in 4 separate compartments. One of the compartments was ruptured, spilling approximately 4,000 barrels (168,000 gallons) of the bunker fuel into the bay.

Bunker fuel is primarily used as fuel for oceangoing vessels. After crude oil is extracted from the ground and brought to a refinery, it goes through a process called fractional distillation. Different types of oil within the crude separate during the process due to their different boiling points. Small molecules such as those in propane gas, naphtha, gasoline for cars, and jet fuel have relatively low boiling points, and they are removed at the start of the fractional distillation process. Heavier petroleum products such as diesel and lubricating oil precipitate out more slowly, and bunker oil is literally the bottom of the barrel; the only thing denser than bunker fuel is the residue (asphalt or bitumen), which is mixed with aggregate for paving roads or sealing roofs.

The Houston Ship Channel was closed and response efforts began almost immediately. Initially, the oil began to move inland, but then the tide turned and it began to flow out to the Gulf of Mexico past Galveston Island. At that point, all marine traffic in the area was halted.

The Coast Guard established a safety zone in which no vessels were allowed without prior clearance from the Coast Guard. Essentially, only response vessels were allowed to move in the area. Any vessel that was already in the area when the accident occurred was required to have an inspection and be decontaminated if oil was found on the hull. The same requirements applied to vessels allowed to pass through the safety zone while it was in effect. One example is inbound cruise ships that were allowed to come in and dock, but could not leave without being inspected. Figure 2 shows the safety zone.

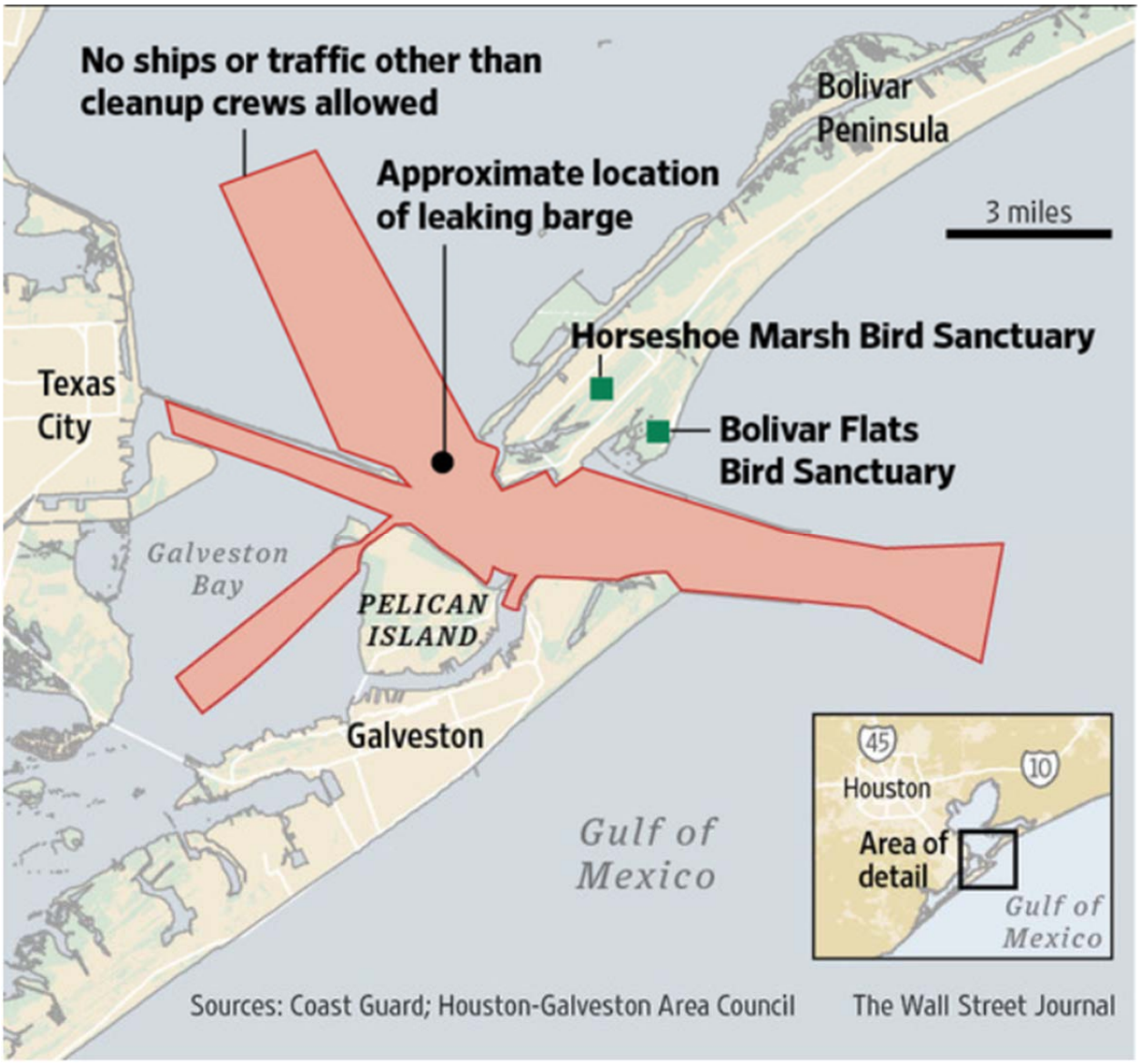

Figure 2. Safety Zone Established after March 22, 2014, Accident.

The table on the following pages provides a brief chronology of events as they relate to the management of marine traffic in the area. Although some in the press have characterized this event as similar to a fog day, it has some important differences. Even on fog days, there are periods during the day when vessel traffic can move. At a minimum, the critical shipments can be handled. During an event such as the March 22 incident, the channel is completely closed to all traffic until further notice. The inability to move anything at all and the uncertain duration of the closure make the management of the situation much more difficult.

3/22 (Sat.)	Accident occurs. Coast Guard begins shutting down traffic. Vessels in the area are required to have an inspection and, if oiled, be decontaminated. Coast Guard establishes safety zone. Because the oil appears to be flowing inward, the Coast Guard allows the ferries to continue operating. As the tide ebbs and the oil begins to reverse course, the Coast Guard shuts down the ferries.
3/23 (Sun.)	All marine traffic in the area is halted. The Port Coordination Team, a group of industry representatives and the Coast Guard, begins meeting to determine how to determine priorities for vessel movements. The Coast Guard allows three cruise ships to come in and dock. All of them will have to be decontaminated.
3/24 (Mon.)	At 6 a.m., there are 43 outbound vessels in queue, 38 inbound. According to the West Gulf Maritime Association, the majority of private facilities are currently open and operating as though it was a "fog day." Most landside operations are running as normal. The Coast Guard Unified Command sets up decontamination stations. At 9:48 a.m., the Houston Pilots report they have 57 outbound and 50 inbound vessels waiting. The Galveston-Texas City Pilots report 15 outbound and 15 inbound that are waiting. Ferries are told they cannot operate until at least Tuesday, the 24th. Several harbor tugs in the safety zone require decontamination. Safety zone established on Saturday to ensure the well-being of response workers and prevent the further spread of oil is extended from lighted buoy 40 to lighted buoy 3 on the Houston Ship Channel. This safety zone restricts the transit of vessels not involved in the response from entering the area. Coast Guard officials did allow two cruise ships to travel through the incident area late afternoon to minimize inconvenience to the thousands of passengers aboard and limit economic impacts from the spill. However, neither vessel will be allowed to leave the port again until deemed safe to do so. ExxonMobil says production at its 560,000 barrels per day Baytown refinery has been cut due to the closure of the ship channel. It does not say how large the reduction is. It does say, however, that further production cuts could come by mid-week if the channel remains closed. An ExxonMobil spokesman emphasizes that the company expects to meet all its contractual commitments. The press reports that analysts are largely unconcerned, noting that ample inventories in the region provide a cushion for refiners.

3/25 (Tues.)	Ferries begin operating again in the morning and are allowed to run during daylight hours. The Coast Guard grants permission to run a test tow east-west through the GIWW to see if the channel really is clear. A pilot vessel is also allowed to go out to anchorage. Based on the test run, a very limited movement of towing vessels through the safety zone is initiated. Tows are moved at a required spacing from each other with a helicopter and ground observers watching for signs of the fuel oil being stirred up. At 10 a.m., the Houston Pilots report they have 53 inbound and 47 outbound vessels waiting. The Galveston-Texas City pilots report 7 waiting to go out from and 7 waiting to go into Texas City. There are 4 outbound and 7 inbound in the queue for Galveston The Coast Guard begins accepting outbound deep draft ships from Houston and Galveston. This is done in consultation with the Port Coordination Team. Inbound towing is allowed to move from Bolivar to Houston via Bolivar Roads Alternate Inbound Route (BRAIR). The Texas City Channel remains closed because of its proximity to the Texas City dike and ongoing cleanup efforts. Deep draft vessels start moving in to and out of Galveston. At approximately 12:55 p.m., tow movements are allowed in both directions on the GIWW as well as into and out of the Port of Houston. The Coast Guard establishes daylight-only restrictions for all movements of all oceangoing vessels in/out of safety zones. Hours of darkness are defined to begin at 7:30 p.m. As of 4 p.m., the Houston Pilots have made 14 sailings. They report they still have 29 outbound and 46 inbound waiting. They plan to bring 5–7 more vessels in before sunset. The Galveston-Texas City Pilots expect to clear Galveston of outbound vessels before daylight cutoff and begin work on inbounds.
3/26 (Wed.)	It is reported that GIWW tugs ran through the night. First oceangoing vessel departs from Texas City at 8 a.m. At approximately 9:50 a.m., there are still daylight restrictions for deep draft vessels. However, two-way traffic is open throughout the area. The Coast Guard expects to remove the daylight restriction today. At the same time, the Houston Pilots report that they are moving 5 deep sea vessels in and 10 vessels out, with 47 waiting to come in and 29 waiting to go out. The Galveston-Texas City Pilots report that they are back to normal operations in Galveston.

3/26	The Port Coordination Team gives priority to cargoes of crude oil, perishables, refrigerated goods, and cars. At approximately 12:30 p.m., it is reported that there are 51 deep sea vessels waiting inbound to Houston, 36 waiting outbound. There are 2 ships waiting to leave Texas City. The Houston Ship Channel will remain open through safety zones until midnight. With high tide approaching just after midnight, deep draft traffic through the safety zones will be suspended so that any refloated oil is not disturbed by pilot-driven vessels. Towboat operations will be allowed to continue throughout the night without restriction. The Coast Guard announces that safety zones will reopen for deep draft traffic after sunrise. The Galveston Bolivar Ferry resumes 24-hour operations.
3/27 (Thurs.)	The Coast Guard announces that it has opened the bay to all traffic.

GIWW Traffic

All vessels engaged in marine freight transportation are required to have Automated Identification Systems (AIS) on board. These are transceivers that, at a minimum, broadcast a vessel's name, number, location, course, and speed over ground. These transmissions can occur at intervals of 30 seconds up to several minutes. These devices can also exchange information with other vessels.

The primary uses of AIS are:

- Collision avoidance.
- Fishing fleet monitoring and control.
- Vessel traffic services.
- Maritime security.
- Aids to navigation.
- Search and rescue.
- Accident investigation.

A number of private sector firms have begun recording and storing these transmissions. This recorded information is then used for a variety of custom value-added applications, such as terminal management services. The researchers obtained AIS information from one such provider, PortVision, for the period of March 16 through March 29, 2014. The information was used to record vessel movements, identify delays, and establish baseline traffic patterns.

Since the incident occurred at 12:35 p.m. on March 22, the researchers used the data up through noon on March 22 to establish normal traffic patterns in the area. Several routes were analyzed individually. Specifically, traffic moving both ways on the following segments was analyzed:

- Through traffic (traffic moving along the GIWW crossing the Houston Ship Channel as it moves through the area).
- GIWW East of Bolivar Roads – Houston Ship Channel.
- GIWW East of Bolivar Roads – Texas City Harbor.
- GIWW East of Bolivar Roads – Galveston Harbor.
- GIWW West of Galveston Causeway – Houston Ship Channel.
- GIWW West of Galveston Causeway – Texas City Harbor.[1]
- GIWW West of Galveston Causeway – Galveston Harbor.

In order to extract data in a useable manner, the researchers established a number of zones. Data for movements within and through each zone were analyzed to determine normal traffic patterns and then delays due to the accident. These zones are shown in Figures 3 through 6.

[1] No transits were found in the dataset for this route.

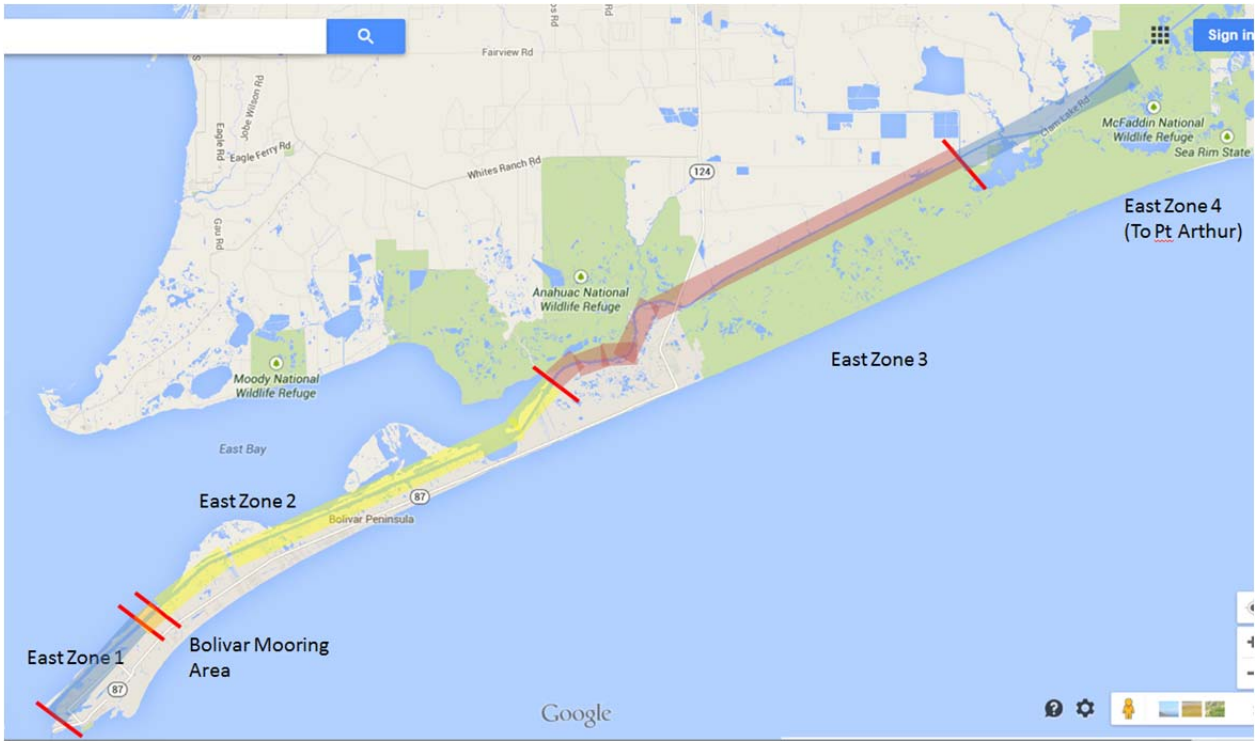

Figure 3. GIWW East Zones.

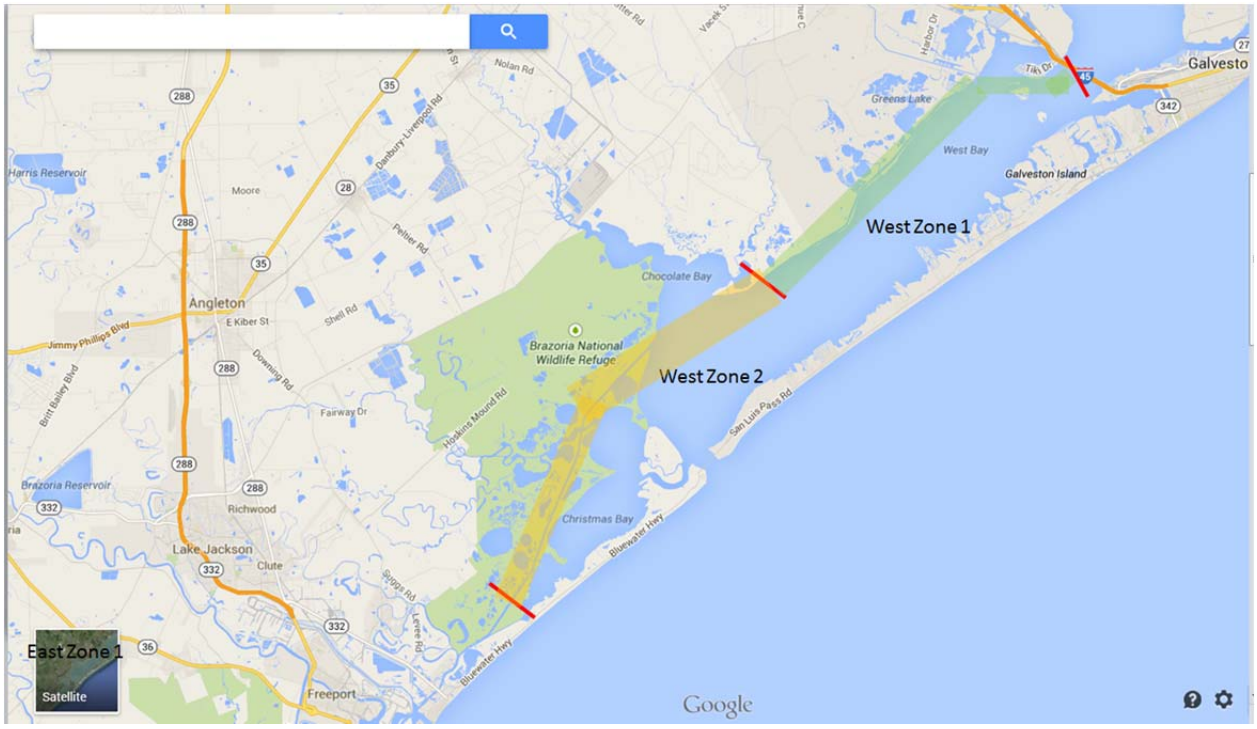

Figure 4. GIWW West Zones– Part 1.

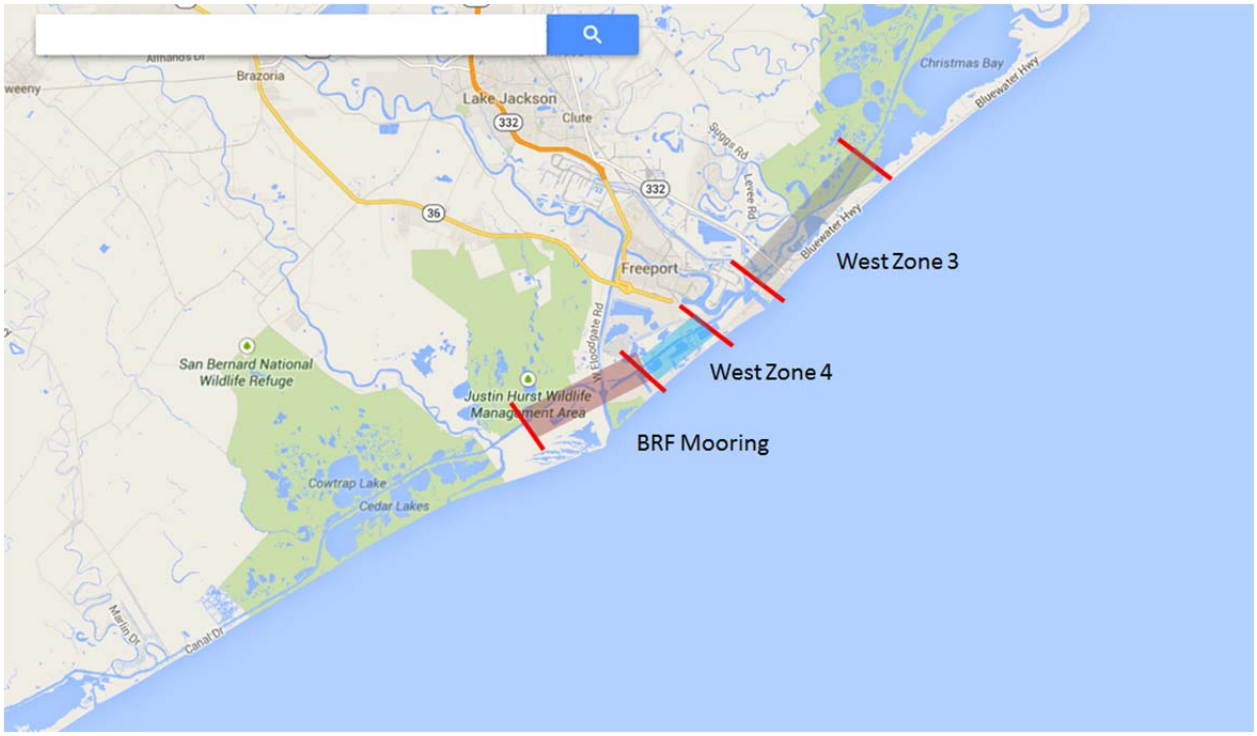

Figure 5. GIWW West Zones – Part 2.

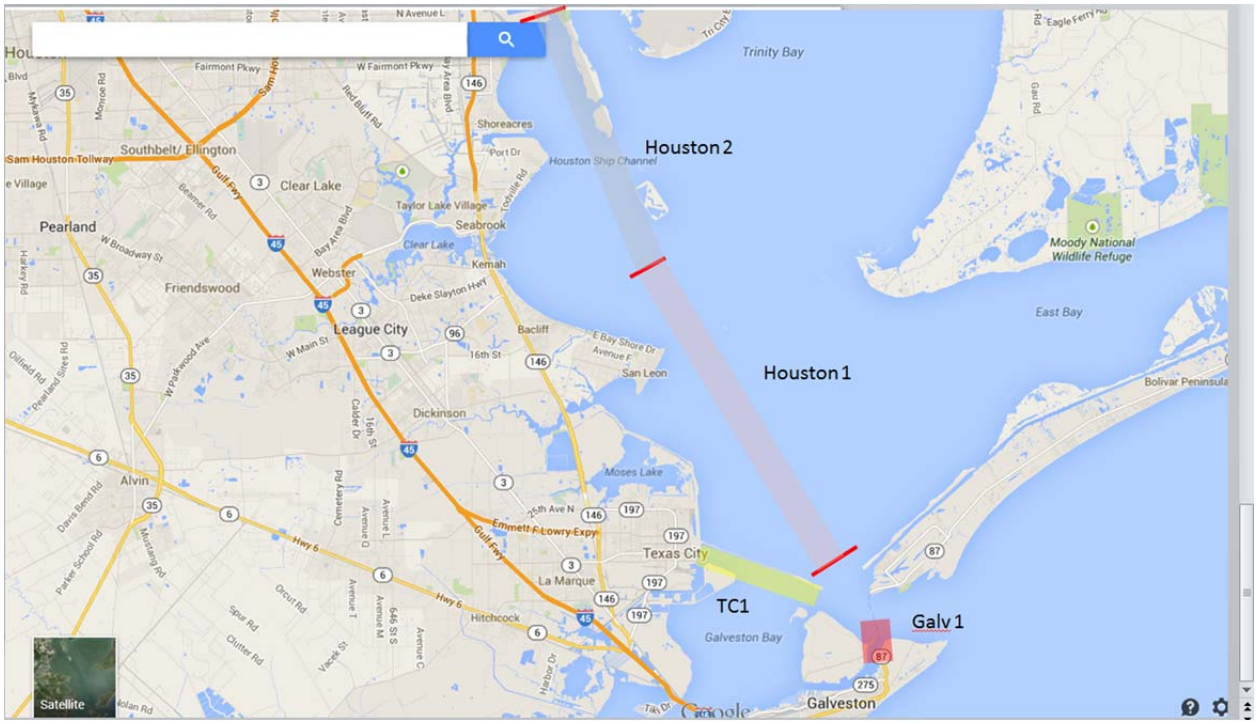

Figure 6. Port Zones.

The transits that were identified as following one of the routes identified in the list above are shown in Table 1. A few additional transits were identified for GIWW-type traffic that moved between ports without actually entering a GIWW zone.

Table 1. Transits through Safety Zone Area.

	Transits by Date (All within March)														
Route	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**TOTAL**
Houston – East GIWW	24	60	39	38	38	28	11			22	58	35	12	71	436
Houston – West GIWW	10	20	15	24	22	14	1			3	23	15	6	23	176
Galveston – East GIWW	1	4	6		4	5	2			2	2	5	6	5	42
Galveston – West GIWW	1	6					1				1				9
Texas City – East GIWW												1			1
Galveston – Houston	2	8	9	4	10	5	1			1	3	5	1	14	63
Houston – Texas City	2		2		2	1	2			1	1		3		14
Galveston – Texas City								2		1					3
Through Traffic	4	24	21	20	19	21	3			10	35	15	6	23	201
TOTAL	44	122	92	86	95	74	21	2	0	40	123	76	34	136	945

Researchers took a snapshot of marine traffic that was on the water at the time of the accident. All vessels that were in one of the defined GIWW zones, the Port of Galveston, or the Port of Texas City, and were stationary or had a course that could lead to the accident site were noted and investigated. This did not include vessels that were in the Port of Houston above the Fred Hartman Bridge nor oceangoing vessels that were in anchorage areas waiting for clearance to enter the port. Table 2 lists the number of vessels by type.

Table 2. Vessel Types on the Water at Time of Accident.

Vessel Type	Number
Anti-pollution	3
Barge Cleaning	1
Coast Guard	1
Deep sea - Container	1
Deep sea - Non-container	14
Dredging Assist	3
Fishing Vessel	4
GIWW - Not Affected	64
GIWW - Potentially Affected	32
Harbor Tug	4
Ocean Tug	2
Offshore Supply/Service	13
Pleasure/Recreational	13
Research Survey Vessel	3
Undetermined	1
TOTAL	159

The researchers then used the AIS data provided by PortVision to determine the movement of each vessel through each zone. This exercise revealed several instances were vessels were detained for extended periods during the time the port area was closed. Table 3 provides a summary of the detained vessels and the duration of their delay.

Table 3. Vessels Detained Due to Closure.

End Date of Delay	Zone	Time in Zone (hrs)	Standard for Zone (hrs)	Delay (hrs)
24-Mar	Bolivar Mooring	45.22	2.39	42.83
24-Mar	Bolivar Mooring	24.85	2.39	22.46
25-Mar	Bolivar Mooring	69.23	2.39	66.84
26-Mar	Bolivar Mooring	6.73	2.39	4.34
26-Mar	Bolivar Mooring	19.82	2.39	17.43
26-Mar	Bolivar Mooring	15.88	2.39	13.49
26-Mar	Bolivar Mooring	19.57	2.39	17.18
22-Mar	West 1	7.07	3.58	3.49
25-Mar	West 1	86.62	3.58	83.04
25-Mar	West 1	90.85	3.58	87.27
25-Mar	West 1	71.98	3.58	68.40
25-Mar	West 1	74.28	3.58	70.70
26-Mar	West 1	27.42	3.58	23.84
26-Mar	West 1	9.72	3.58	6.14
26-Mar	West 1	9.73	3.58	6.15
26-Mar	West 1	10.90	3.58	7.32
25-Mar	West 2	17.81	3.29	14.52
25-Mar	West 2	29.25	3.29	25.96
25-Mar	West 2	47.75	3.29	44.46
26-Mar	West 2	70.83	3.29	67.54
26-Mar	West 2	7.68	3.29	4.39
23-Mar	East 1	16.92	3.07	13.85
25-Mar	East 1	23.85	3.07	20.78
25-Mar	East 1	49.10	3.07	46.03
25-Mar	East 1	89.40	3.07	86.33
26-Mar	East 1	143.05	3.07	139.98
26-Mar	East 1	9.18	3.07	6.11
23-Mar	East 2	27.47	4.29	23.18
23-Mar	East 2	17.25	4.29	12.96
25-Mar	East 2	88.62	4.29	84.33
25-Mar	East 2	76.08	4.29	71.79
25-Mar	East 2	9.36	4.29	5.07
25-Mar	East 2	75.80	4.29	71.51
25-Mar	East 2	72.70	4.29	68.41
26-Mar	East 2	84.93	4.29	80.64
23-Mar	East 3	16.33	3.93	12.40
24-Mar	East 3	43.12	3.93	39.19
TOTAL				1,480.35

There is no readily available source of information regarding the number of barges that were in each tow. The Corps of Engineers, however, recently conducted a statistical analysis of GIWW traffic along the Texas Coast using trip data from 2011. Their analysis resulted in the statistics are shown in Table 4.

Table 4. Barge Statistics.

GIWW Reach	Barges per Tow	Liquid Barges Percentage
Sabine to Galveston	1.61	85%
Galveston to Corpus Christi	1.46	84%

These statistics were applied to the delayed tows based on the zone in which the delay occurred. All delays in zones east of Bolivar used the Sabine to Galveston statistics. All delays in zones west of Galveston used the Galveston to Corpus Christi statistics.

There were 37 instances of delay, 23 in the eastern portion and 14 in the western portion. The calculated number of towboats and barges that were delayed are shown in Table 5.

Table 5. Towboat and Barge Totals for Delayed Tows.

GIWW Reach	Number of Towboats	Liquid Barges	Dry Barges
Sabine to Galveston	23	31	6
Galveston to Corpus Christi	14	17	3
TOTAL	37	48	9

The towboat and the barges must remain together as a unit, even when a tow is delayed in transit. The towboat crew must be on duty and making sure that the barges are not damaged or threatened. Therefore, it is reasonable to apply the normal hourly operating cost of towboats and barges to the hours of delay to arrive at an estimate of the increase in operating costs caused by the delays.

There were a total of 1,480.35 hours of delay. The average cost of towboats, dry cargo barges, and liquid cargo barges were previously calculated in Technical Memorandum 4 and are shown in Table 6. Applying these hourly rates yields the calculated cost increase is shown in Table 6.

Table 6. Estimated Increase in Operating Cost Caused by Delays Induced by Accident.

Asset Class	Number	Hourly Rate	Total Cost
Towboat	37	$490.08	$725,489
Liquid Barge	48	$34.32	$50,806
Dry Barge	9	$6.20	$9,178
TOTAL			**$785,473**

This is strictly the increase in operating costs. Depending on the terms of individual contracts, a carrier could be penalized for late delivery or for holding a barge beyond a certain number of days (demurrage). These are confidential business arrangements that cannot be analyzed without insider knowledge, but they are real concerns for operators.

Postponed Shipments

Traffic moving through the area that was designated as a safety zone could follow one of the seven basic routings listed in the section on GIWW traffic. In the week leading up to the accident, there was a daily average of 86 tow trips moving through the safety zone area. Following the accident, there were two-plus days where virtually no trips were allowed through the area. On March 25 (the third day), traffic resumed at a somewhat slow pace and then was allowed to move freely on March 26, resulting in a spike of activity. Table 7 shows how the traffic volume changed as a result of the accident.

Table 7. Daily Trip Counts through the Security Zone.

Date	Number of tow trips	Tows Postponed
Daily average prior to accident	86	0
March 22 (day of accident)	21	65
March 23	2	84
March 24	0	86
March 25	40	46
March 26	123	0
March 27	76	0[2]
TOTAL		**281**

Assuming that the daily average is a valid representation of expected activity, it would appear that there were 65 postponed shipments on the 22nd, 84 on the 23rd, 86 on the 24th, and 46 on the 25th. The spike on the 26th represents an attempt to catch up. Therefore the figures indicate that a total of 281 shipments had to be postponed. To avoid double counting, it is necessary to remove the shipments already accounted for in the analysis of delays, i.e., 37 shipments. This means that a net of 244 shipments were actually postponed because of the accident.

These 281 shipments represent a large amount of cargo. It is informative to equate this cargo to equivalent truck traffic. Publicly available data do not make it possible to determine where the origins were for the postponed shipments. Using the parameters specified in Table 4 for the Sabine to Galveston reach (by far the busiest and thus the most representative of actual traffic), it can be seen that there were approximately 392 barges affected (244 × 1.61). Of this total, 85 percent, or 333 barges, would be liquid barges; 15 percent, or 59, would be dry barges. The Corps statistics referenced earlier indicate that approximately 40 percent of the liquid barges, or 133, would be fully loaded. For dry barges, 41 percent, or 24 barges, would be fully loaded. In a modal comparison study done by TTI,[3] it was determined that a liquid cargo barge carries the equivalent of 144 tank truckloads and a dry cargo barge carries the equivalent of 70 truckloads. This means that the equivalent of almost 21,000 truckload shipments had to be postponed.

[2] There were no identifiable delays from the accident at this point.

[3] C. James Kruse, Annie Protopapas, and Leslie E. Olson. *A Modal Comparison of Domestic Freight Transportation Effects on the General Public*. Texas A&M Transportation Institute, College Station, TX, October 2007.

Because each individual barge shipment is governed by specific contract terms, it is not possible to estimate the economic effect of the postponed shipments. Depending on the terms, it is possible that operators could be liable for late delivery or for demurrage fees (holding the barge over). There are other miscellaneous costs as well, not the least of which is the disruption to the schedule of towboat fleets and their crews.

Decontamination

The Coast Guard Sector Houston-Galveston office provided statistics regarding the decontamination of vessels due to the accident. Table 8 shows how many were required to undergo decontamination as of April 2, 2014.

Table 8. Decontaminated Vessel Counts by Vessel Type.

Vessel Type	Number Decontaminated
Towing Vessels	32
Barges	4
Cruise Ships	4
Deep Draft Freighters/ Tankers	18
Offshore Supply Vessels	6
Oil Spill Response Vessels	10
Recreational	6
Shrimping Vessels	18
Small Passenger Boats	3
US Coast Guard Cutters	3
Pilot Boats	3
Army Corps of Engineers Survey Boat	1
National Oceanic Atmospheric Administration Survey Boat	1
TOTAL	**109**

Additionally, 105 recreational boats and 57 commercial fishing/shrimping vessels underwent examination and were not found to be oiled. The historic sailing vessel ELISSA was also verified as not oiled. These examinations represent additional costs.

Vessels were not the only assets affected by the spill; there were also costs to decontaminate marine terminals. The Coast Guard reports that 10 marine terminals (which included multiple berths at the Port of Galveston) were decontaminated. The decontamination team also checked an additional 163 recreational and commercial fishing vessels that were docked in Galveston and determined that they were not oiled.

Because of pending litigation, it was not possible to obtain the cost of these decontamination procedures. It is clear, however, that there were significant costs incurred due to decontamination and to having the vessel out of service for that period of time.

Other Concerns

Last year about 2.15 million barrels per day of fuel products, including gasoline and diesel, were exported via the Houston Ship Channel from the Gulf Coast, while 3.76 million barrels per day of crude were imported, according to the Energy Information Administration. When imports are delayed, refiners may use more domestic crude from pipelines. However, the Gulf Coast refiners export around 11% of the nation's fueling capacity.[4]

Refineries depend on both shallow draft and deep draft vessels to supply them with feedstock and to move their products out. Typically, they hold enough feedstock to keep the operation going for three to five days without any shipments. In this case, the closure lasted just over three days. While ExxonMobil reported they slowed down production, no refinery was forced to close. Refinery shutdowns and restarts are extremely long and costly processes. Had any of the refinery units been shut down, it would have had an immediate effect on the national economy.

Data from the Energy Information Agency (EIA) suggested that at the time of the incident refiners in the region had ample crude oil in storage, so that supply was not an immediate issue. Aaron Brady, senior director at IHS CERA was quoted as saying, Gulf refineries are exporting a lot of product, some of which comes through Galveston Bay. If access to the Channel remains limited they may eventually have to run at lower rates.

Two refineries at Texas City and several associated chemical plants could have been affected owing to their close proximity to the cleanup effort, notes Chris McCloskey, director/aromatics, IHS Chemical. “After several days of restricted traffic south of the Texas City dike, the production of 800,000 m.t./year (2,200 m.t./day) of benzene and 1.1 million m.t./year (3,000 m.t./day) of xylenes may be impacted.” Fortunately, traffic was resumed before production was affected.

Acetic acid and formaldehyde producers could have also experienced trouble obtaining feedstock if the channel had remained closed for a longer period. “A lot of methanol is supplied via water to the seven area plants that are producing acetic acid and formaldehyde,” says Marc Laughlin, director/methanol and acetone, IHS Chemical. “In a case of extended closure of Galveston Bay…, production and shipment of 1.2 million m.t./year (3,300 m.t/day) of acetic acid and 800,000 m.t./year (2,200 m.t./day) of formaldehyde could be impacted.” [5]

Although it is primarily a deep draft concern, there were some perishable cargoes, such as bananas, that could not wait more than just a few days for delivery. The Project Coordination Team recognized this and ensured that they were given priority status once the channel was reopened.

[4] *Houston Ship Channel Traffic Jams on Oil Spill Cleanup*, Natural Gas Intelligence, March 24, 2014.
[5] Clay Boswell, *IHS: Houston oil spill unlikely to affect chemical markets*, Jadavji & Sons archives, March 24, 2014. http://www.jadavjisons.com/?p=97