United States Coast Guard

Report of the Investigation into the WAYMON BOYD (O.N. 261512) EXPLOSION, FIRE, AND LOSS OF LIFE ON TULE LAKE CHANNEL IN CORPUS CHRISTI, TX ON AUGUST 21, 2020

MISLE Activity Number: 7039383

U.S. Department of Homeland Security

United States Coast Guard

Commandant
United States Coast Guard

2703 Martin Luther King Jr. Ave. SE
Stop 7501
Washington, DC 20593-7501
Staff Symbol: CG-INV
Phone: (202) 372-1032
E-mail: CG-INV1@uscg.mil

16732/IIA # 7039383
19 December 2025

EXPLOSION AND FIRE ON THE DREDGE VESSEL WAYMON BOYD (O.N. 261512) RESULTING IN THE LOSS OF FIVE LIVES WHILE DREDGING ON TULE LAKE CHANNEL NEAR CORPUS CHRISTI, TEXAS ON AUGUST 21, 2020

ACTION BY THE COMMANDANT

The record and the report of the investigation completed for the subject casualty have been reviewed. The record and the report, including the findings of fact, analysis, conclusions, and recommendations, are approved subject to the following comments. This marine casualty investigation is closed.

ACTION ON RECOMMENDATIONS

Recommendation 1: To achieve the shared goal of increasing safety and proficiency in dredging operations, it is recommended that the Coast Guard institute requirements that mariners, minimally Barge Captains, Dredge Captains, and Leverman, operating on dredge vessels possess a Coast Guard issued Merchant Mariner Credential (MMC). Current regulations do not require MMCs for any crewmembers on dredge vessels. This, in turn, creates a latent unsafe condition that remains dormant until a significant or major marine casualty occurs that brings to light the ineptitude and complacency that exists in the dredging industry. Indeed, the absence of federal laws and regulations that require a national standard for dredge crewmember competency and clear policies for crew training contributes to unsafe conditions in the industry. In this case, the Barge Captain, Dredge Captain, Leverman, and other experienced crew were not trained to identify pipelines and how to appropriately respond to a potential pipeline strike with emergency shutdown procedures and abandoning ship. While there were a lot of possible ignition sources, an immediate shutdown of machinery could have limited them and an immediate call to abandon ship once the pipeline was struck could have saved lives. Without proper training to take these steps immediately, crew members waste valuable seconds determining what happened and what actions to take, which likely cost lives.

> **Action**: I do not concur with this recommendation. The Report of Investigation (ROI) indicates inadequate planning protocols and the successive failure of the Orion Group Holdings subsidiary, Schneider Engineering and Consulting, as the primary causes of the incident. Nost notably, Schneider Engineering and Consulting failed to identify the pipelines in their Dredge Site Plans, resulting in the exclusion of the pipelines into the DREDGEPACK software program that the vessel's crew loaded on the shipboard computer to guide operations. According to the ROI, the Leverman and crew solely relied on the DREDGEPACK software to identify and avoid obstructions, including pipelines,

while dredging. The Site Survey, which is conducted by the Survey Superintendent, should have identified all physical obstructions and hazards for the Leverman and crew to avoid. The investigation did not identify a crewmember error that contributed to the incident. Therefore, a credentialing requirement would likely not have prevented this tragedy.

Recommendation 2: To achieve the shared goal of increasing safety and proficiency in dredging operations, it is recommended that the Coast Guard institute requirements that manned, uninspected dredges over 100 gross tons be subject to inspection under U.S. law and regulations. Existing regulations under Title 46 Code of Federal Regulations (CFR) Table 2.01-7(a)(4) and 46 CFR Subchapter I require self-propelled dredges of 300 gross tons to be inspected. Dredges are considered "manned" if they have personnel onboard for the purposes of operating and navigating the dredge, including operating dredging equipment. The relative nature of non-self-propelled dredging operations does not hinge on whether a dredge is a prescribed tonnage; rather, the dredging components and overall operation are generally the same on most dredge vessels. However, the 300 gross ton self-propelled dredges or manned non-self-propelled dredges under 100 gross tons are designed and maintained in accordance with regulations intended to increase safety in commercial operations. If the WAYMON BOYD had been subject to inspection, the requirements in 46 CFR Subchapters I, J, and F would have mandated stringent lifesaving, fire protection, electrical, and machinery-related measures that would have increased shipboard operations and equipment safety, thereby supporting the intent and goals of the marine safety program.

Action: I do not concur with this recommendation. The proposed inspection framework under 46 CFR Subchapter I, J, and F do not adequately address the primary causal factors identified in the casualty investigation.

The investigation revealed that the WAYMOND BOYD struck a submerged gas pipeline, resulting in a rapid and fatal explosion. The subject recommendation fails to address critical factors, such as the lack of an effective means to identify, detect, and avoid submerged pipelines. Additionally, it does not propose preventative mechanisms to minimize sources of ignition or facilitate safe egress in the event of a pipeline breach.

Instead of expanding regulatory oversight of dredges through the application of 46 CFR Chapter I, dredge operators should consider the development of industry-recommended procedures to accurately identify pipeline locations and ensure their clear representation within the specialized navigation tools and equipment used to support dredging operations.

R. C. COMPHER
Captain, U.S. Coast Guard
Director of Inspections & Compliance (CG-5PC)

U.S. Department of Homeland Security
United States Coast Guard

Commander
Coast Guard Heartland (Eighth) District

Hale Boggs Federal Bldg.
500 Poydras Street
New Orleans, LA 70130
Staff Symbol: dp
Phone: (504) 671-2087

16732

WAYMON BOYD (O.N. 261512) EXPLOSION, FIRE, AND LOSS OF LIFE ON TULE LAKE CHANNEL IN CORPUS CHRISTI, TX ON AUGUST 21, 2020

**ENDORSEMENT BY THE COMMANDER,
COAST GUARD HEARTLAND DISTRICT**

The record and the report of the investigation convened for the subject casualty have been reviewed. The record and the report, including the findings of fact, analysis, conclusions, and recommendations are approved. It is recommended that this marine casualty investigation be closed.

COMMENTS ON THE REPORT

1. The loss of the 5 crew members was a tragic and preventable accident. I offer my sincere condolences to the families of those who lost their lives.

2. The investigation and report contain valuable information which can be used to address the factors that contributed to this marine casualty and prevent similar incidents from occurring in the future.

3. The National Transportation Safety Board (NTSB) also conducted a formal investigation into this incident. Their report, *Hazardous Liquid Pipeline Strike and Subsequent Explosion and Fire aboard Dredging Vessel Waymon Boyd*, adopted December 7, 2021, offers valuable event analysis and recommendations for the future. I concur with the recommendations made to Coastal and Marine Operators (CAMO) by the NTSB to develop: (1) improved safety training materials; (2) processes for obtaining accurate pipeline coordinates; and, (3) guidance for identifying proposed dredging boundaries.

ENDORSEMENT ON RECOMMENDATIONS

Safety Recommendation 1: To achieve the shared goal in increasing safety and proficiency in dredging operations, it is recommended that the Coast Guard institute requirements that mariners, minimally Barge Captains, Dredge Captains, and Leverman, operating on dredge vessel possess a Coast Guard issued Merchant Mariner Credential (MMC). Current regulations do not require MMCs for any crewmembers on dredge vessels. This, in turn, creates a latent

unsafe condition that remains dormant until a significant or major marine casualty occurs that brings to light the ineptitude and complacency that exists in the dredging industry. Indeed, in the absence of federal law and regulations requiring a national standard for dredge crewmember competency areas and promulgate unambiguous policies for crew training. In this case, the Barge Captain, Dredge Captain, Leverman, and other experienced crew were not trained to identify pipelines and how to appropriately respond to a potential pipeline strike with emergency shutdown procedures and abandoning ship. While there were a lot of possible ignition sources, an immediate shutdown of machinery could have limited them and an immediate call to abandon ship once the pipeline was struck could have saved lives. Without proper training to take these steps immediately, crew members waste valuable seconds determining what happened and what actions to take, which likely cost lives.

> **Endorsement 1:** I do not concur with this recommendation. While the stated objective is laudable, the proposed solution represents a misdiagnosis of the underlying systemic failures that contributed to the incident. The recommendation implicitly suggests a direct causal link between the absence of MMCs and a deficiency in crew preparedness regarding pipeline identification and their subsequent response to a pipeline strike. The investigation indicated that the primary and precipitating factor was a fundamental flaw in the Site Safety Plan. The plan, as implemented, failed to adequately identify and delineate the presence of the submerged pipeline. Irrespective of individual crewmember MMC status, this omission created a situation where the potential for a catastrophic event was significantly elevated. Addressing the symptoms of a poorly executed safety plan through the imposition of blanket MMCs represents an inefficient and potentially ineffective solution.

Safety Recommendation 2: To achieve the shared goal in increasing safety and proficiency in dredging operations, it is recommended that the Coast Guard institute requirements that manned uninspected dredges over 100 gross tons be subject to inspection under U.S. law and regulations. Existing regulations under 46 C.F.R. Table 2.01-7(a)(4) and 46 C.F.R. Subchapter I require self-propelled dredges of 300 gross tons, to be inspected. Dredges are considered "manned" if they have personnel onboard for the purposes of operating and navigating the dredge, including operating dredging equipment. The relative nature of non-self-propelled dredging operations does not hinge on whether a dredge is a prescribed tonnage; rather, the dredging components and overall operation are generally the same on most dredge vessels. However, the 300 gross ton self-propelled dredge or manned non-self-propelled dredges under 100 gross tons are designed and maintained in accordance with regulations intended to increase safety in commercial operations. Had the WAYMON BOYD been subject to inspection, the requirements in 46 C.F.R. Subchapters I, J, and F mandate stringent lifesaving, fire protection, electrical, and machinery related requirements that will lead to an increase in shipboard operations and equipment safety, thus supporting the intent and goals of the marine safety program.

> **Endorsement 2:** I do not concur with the recommendation to institute inspection requirements for manned uninspected dredges over 100 gross tons. While the intent to improve safety and proficiency is valid, the proposed inspection framework under 46 CFR Subchapter I, does not adequately address the underlying causal factors identified in this casualty. The investigation revealed that the dredge struck a submerged gas pipeline resulting in a rapid and fatal explosion.

The recommendation does not account for the lack of effective means to plan for, detect and avoid pipelines nor does it provide a specific mechanism to prevent ignition or enable safe evacuation as indicated in the Report of Investigation. Rather than increasing oversight through 46 CFR Subchapter I, a more specific mitigation strategy resides within those recommendation made by the NTSB.

Administrative Recommendation 1: Recommend Officer in Charge of Marine Inspection initiate an investigation involving potential civil penalties involving 33 CFR Part 1.

Endorsement: I concur; the facts and the evidence support an investigation into potential acts of negligence.

[redacted]

J. B. WHEELER
Captain, U.S. Coast Guard
Chief of Prevention
Coast Guard Heartland (Eighth) District
By Direction

U.S. Department of Homeland Security

United States Coast Guard

Commander
United States Coast Guard
Sector Corpus Christi

Valent Hall
249 Glasson Drive
Corpus Christi, TX 78406
Phone: 361-939-5140

16732
November 30, 2023

WAYMON BOYD (O.N. 261512) EXPLOSION, FIRE, AND LOSS OF LIFE ON TULE LAKE CHANNEL IN CORPUS CHRISTI, TX ON AUGUST 21, 2020

ENDORSEMENT BY THE OFFICER IN CHARGE, MARINE INSPECTION

The record and the report of the investigation convened for the subject casualty have been reviewed. The record and the report, including the findings of fact, analysis, conclusions, and recommendations are approved subject to the following comments. It is recommended that this marine casualty investigation be closed.

COMMENTS ON THE REPORT

1. I would like to send my sincerest condolences to the family and friends of Arturo Cavazos, Jose Coca-Avalos, Rafael Espino Garza, Miguel Martinez, and Joel Rivera. My team will continue to work toward implementing the recommendations brought about by this investigation to make the waterway safer for all the people who utilize it.

2. The investigation and report contain valuable information which can be used to address the chain of events that resulted in loss of life, and to prevent similar incidents from occurring in the future.

ENDORSEMENT/ACTION ON RECOMMENDATIONS

Safety Recommendation 1: To achieve the shared goal in increasing safety and proficiency in dredging operations, it is recommended that the Coast Guard institute requirements that mariners, minimally Barge Captains, Dredge Captains, and Leverman, operating on dredge vessel possess a Coast Guard issued Merchant Mariner Credential (MMC). Current regulations do not require MMCs for any crewmembers on dredge vessels. This, in turn, creates a latent unsafe condition that remains dormant until a significant or major marine casualty occurs that brings to light the ineptitude and complacency that exists in the dredging industry. Indeed, in the absence of federal law and regulations requiring a national standard for dredge crewmember competency, we rely on dredge companies to identify critical competency areas and promulgate unambiguous policies for crew training. In this case, the Barge Captain, Dredge Captain, Leverman, and other experienced crew were not trained to identify pipelines and how to appropriately respond to a potential pipeline strike with emergency shutdown procedures and abandoning ship. While there were a lot of possible ignition sources, an immediate shutdown of machinery could have limited them and an immediate call to abandon ship once the pipeline was struck could have saved lives. Without proper training to take these steps immediately, crew members waste valuable seconds determining what happened and what actions to take, which likely costed lives.

Endorsement: I do not concur with this recommendation. While the goal is to enhance the safety and proficiency in dredging operations, I believe that mandating MMCs for all crewmembers is not the most effective solution to address the identified safety concerns. This recommendation implies that the lack of MMCs was a direct cause of crew members not being trained to identify pipelines and respond appropriately to a potential pipeline strike. However, it is crucial to recognize that the core issue lies in the inadequacy of the Site Safety Plan, which failed to identify the pipeline as required. This omission, irrespective of MMC requirements, created a latent unsafe condition that led to the tragic sequence of events. Focusing on improving the development and implementation of such plans, along with crew training specific to identified risks, is pivotal in preventing similar incidents. Rather than mandating MMCs, efforts should concentrate on refining safety plans, ensuring accurate software input, and providing crew members with targeted training on identified risks and emergency response procedures through industry-specific certifications and training programs.

Safety Recommendation 2: To achieve the shared goal in increasing safety and proficiency in dredging operations, it is recommended that the Coast Guard institute requirements that manned uninspected dredges over 100 gross tons be subject to inspection under U.S. law and regulations. Existing regulations under 46 C.F.R. Table 2.01-7(a)(4) and 46 C.F.R. Subchapter I require self-propelled dredges of 300 gross tons or more, as well as manned non-self-propelled dredges under 100 gross tons, to be inspected. Dredges are considered "manned" if they have personnel onboard for the purposes of operating and navigating the dredge, including operating dredging equipment. The relative nature of non-self-propelled dredging operations does not hinge on whether a dredge is a prescribed tonnage; rather, the dredging components and overall operation are generally the same on most dredge vessels. However, the 300 gross ton self-propelled dredge or manned non-self-propelled dredges under 100 gross tons are designed and maintained in accordance with regulations intended to increase safety in commercial operations. Had the WAYMON BOYD been subject to inspection, the requirements in 46 C.F.R. Subchapters I, J, and F mandate stringent lifesaving, fire protection, electrical, and machinery related requirements that will lead to an increase in shipboard operations and equipment safety, thus supporting the intent and goals of the marine safety program.

Endorsement: I do not concur with this recommendation. The requirements set forth in 46 C.F.R. Subchapter I would not address the insufficient means to protect the pipeline from excavation damage or minimal time of escape. Given the limited 66-second timeframe to avert an explosion on board, the referenced regulations do not offer an effective mechanism to prevent ignition or ensure evacuation of all personnel. A more appropriate course of action for preventing future incidents of this nature would involve the dredging industry developing recommended procedures for precise pipeline identification and ensuring clear representation within navigation software.

Administrative Recommendation 1: Recommend the Officer in Charge, Marine Inspection, Sector Corpus Christi, initiate an investigation involving potential civil penalties in accordance with 33 CFR Part 1.

Endorsement: Concur. The facts and evidence support an investigation into potential acts of negligence.

Action: Chief of Prevention has taken for action.

Administrative Recommendation 2: Recommend this investigation be closed.

Endorsement: Concur. This investigation should be closed.

[redacted]

J. B. GUNNING
Captain, U.S. Coast Guard
Officer in Charge, Marine Inspection

U.S. Department of Homeland Security
United States Coast Guard

Commander
United States Coast Guard
Sector Corpus Christi

Valent Hall
249 Glasson Drive
Corpus Christi, TX 78406
Phone: 361-939-5140

16732
March 21, 2023

WAYMON BOYD (O.N. 261512) EXPLOSION, FIRE, AND LOSS OF LIFE ON TULE LAKE CHANNEL IN CORPUS CHRISTI, TX ON AUGUST 21, 2020

EXECUTIVE SUMMARY

On the morning of August 21, 2020, the U.S. flagged non-self-propelled cutter suction dredge WAYMON BOYD (O.N. 261512) was conducting Phase 2 of the EPIC Marine Terminal berth dredging project on Tule Lake Channel in Corpus Christi, Texas. It was a clear day with unlimited visibility and calm water.

WAYMON BOYD dredging operations were frequently interrupted by rocks and debris. That morning, the Day Leverman had expressed concerns to the Dredge Captain of hitting debris, leading the cutterhead to be repositioned toward the shoreline, five feet from the edge of the dredge template. At 0802, the WAYMON BOYD cutterhead struck submerged TX219 propane pipeline during the first cut of the bank. Subsequently, the submerged pipeline released an odorless and colorless propane gas unbeknownst to the crewmembers onboard, propelling a water geyser and encompassing the WAYMON BOYD. The propane gas entered the engine room through ventilation fans and met an unknown engine room ignition source, causing an explosion and fire engulfing the dredge 66 seconds after the strike.

This explosion and fire caused the loss of five crewmembers lives and injuries to five more crewmembers.

As a result of its investigation, the Coast Guard determined the initiating event occurred when the cutterhead of WAYMON BOYD struck TX219 pipeline, releasing propane into the water. The subsequent events were an explosion and fire resulting in loss of life. The causal factors that contributed to these events were: (1) Non-existent or inadequate planning protocols for dredging near pipelines, (2) Failure of Orion to incorporate pipeline into dredging software, (3) Latent unsafe condition of Orion's Safety Program, (4) Inadequate training of crewmembers working near pipelines, (5) Lack of professional training requirements for mariners working on dredge vessels, (6) Failure of Orion to teach crewmembers when to de-energize machinery and operational equipment, (7) Failure of Orion to train crewmembers properly on emergency response to striking a pipeline, and (8) Lack of Coast Guard regulations covering basic requirements onboard dredge vessels.

U.S. Department of Homeland Security
United States Coast Guard

Commandant
United States Coast Guard
Sector Corpus Christi

Valent Hall
249 Glasson Drive
Corpus Christi, TX 78406
Phone: 361-939-5140

16732
21 March 2023

WAYMON BOYD (O.N. 261512) EXPLOSION, FIRE, AND LOSS OF LIFE ON TULE LAKE CHANNEL IN CORPUS CHRISTI, TX ON AUGUST 21, 2020

INVESTIGATING OFFICER'S REPORT

1. Preliminary Statement

1.1. This marine casualty investigation was conducted and this report was submitted in accordance with Title 46, Code of Federal Regulations (CFR), Subpart 4.07, and under the authority of Title 46, United States Code (USC) Chapter 63.

1.2. The National Transportation Safety Board (NTSB) was the lead agency for this investigation. They designated the following as parties to the investigation: Pipeline and Hazardous Material Safety Administration (PHMSA), Railroad Commission of Texas, Orion Group Holdings, Enterprise Products, and HYPACK, a Xylem Brand.

1.3. Due to the nationality of some of the crew members, Mexico and El Salvador were named Substantially Interested States.

1.4. All times listed in this report are in Central Standard Time using a 24-hour format, and are approximate.

2. Vessel Involved in the Incident

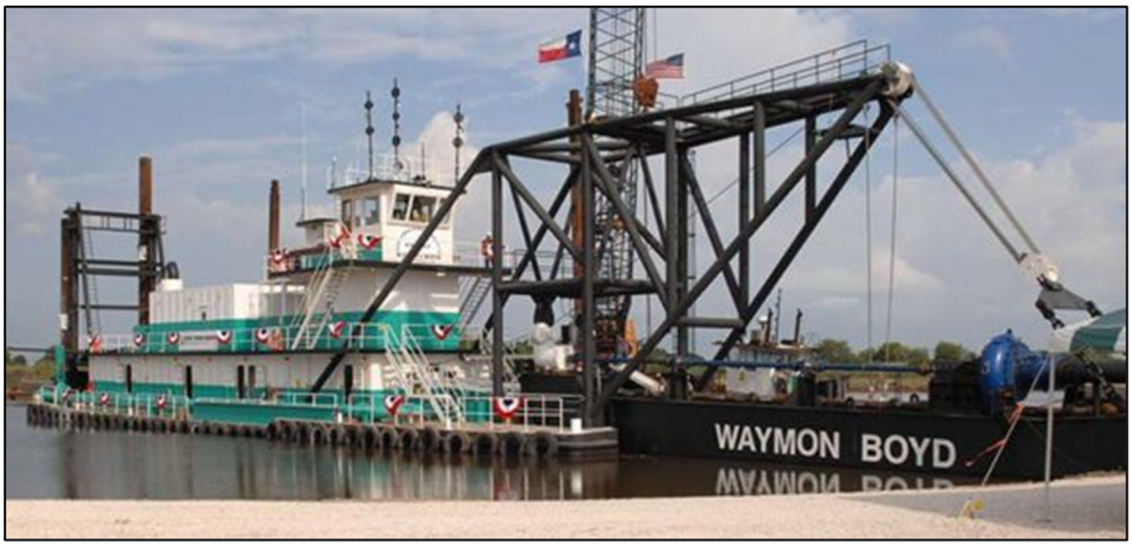

Figure 1. WAYMON BOYD prior to the incident, provided by Orion Marine Group.

Official Name:	WAYMON BOYD
Identification Number:	261512
Flag:	United States
Vessel Class/Type/Sub-Type	Cutter/Dredger/Trailing Suction
Build Year:	1950
Gross Tonnage:	290 GRT
Length:	151.7 Feet
Beam/Width:	33.8 Feet
Draft/Depth:	5.5 Feet
Main/Primary Propulsion: (Configuration/System Type, Ahead Horse Power)	None
Owner:	Orion Marine Construction, Inc. Houston, Texas
Operator:	Orion Marine Construction, Inc. Houston, Texas

3. Deceased, Missing, and/or Injured Persons

Relationship to Vessel	Sex	Age	Status
Night Leverman	Male	50	Deceased
Chief Engineer	Male	58	Deceased
Second Engineer	Male	59	Deceased
Cook	Male	62	Deceased
Deckhand 1	Male	48	Deceased
Dredge Captain	Male	40	Injured
Day Leverman	Male	60	Injured
Mate	Male	41	Injured
Deckhand 2	Male	45	Injured
Deckhand 3	Male	20	Injured

4. Findings of Fact

4.1. The Incident:

4.1.1. On July 29, 2020 the WAYMON BOYD, a non-self-propelled cutter suction dredge, was towed into position to begin Phase 2 of the berth dredging project.

4.1.2. The project was interrupted frequently by rocks and debris, which the dredge sucked up, causing clogs in the pump strainer or other dredge components.

4.1.3. On August 19, 2020, the WAYMON BOYD was positioned to work between two of West Dock's mooring dolphins, which were included in the East Dock's dredge template. (*See Figure 2*)

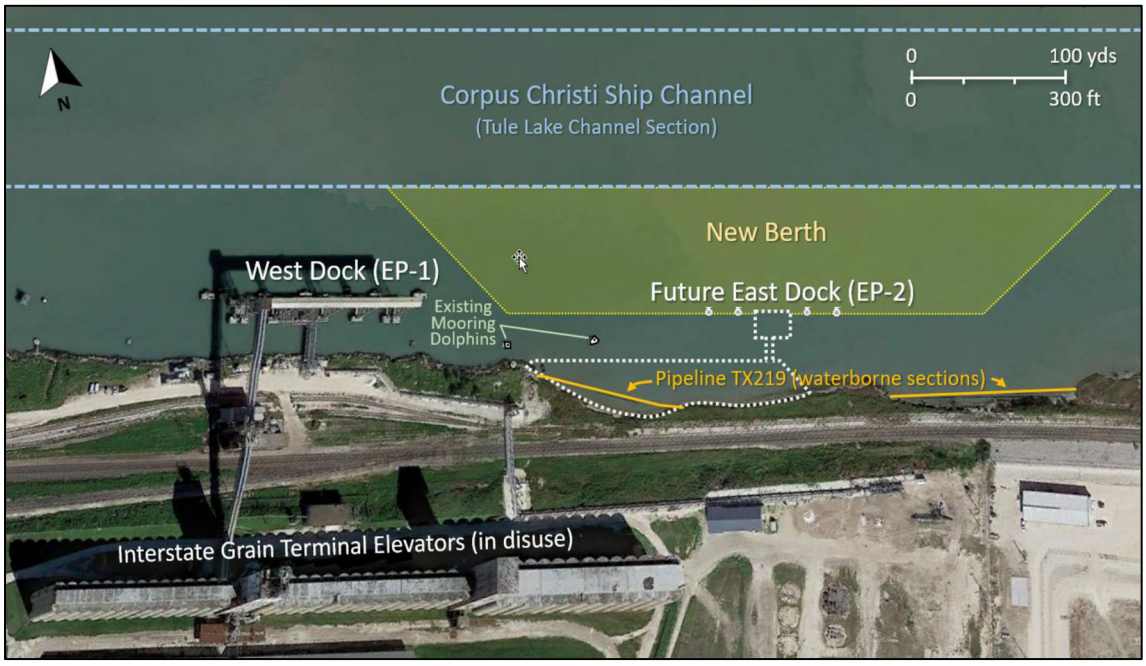

Figure 2. EPIC Marine Terminal with Google Earth Background, taken from NTSB Nautical Operations, Human Performance, and System Safety Group Report

4.1.4. On August 20, 2020, at 1730, a sacrificial coupling on the shaft that drove the cutterhead broke due to hitting hard debris in the area. The casualty shut-down dredge operations until the night shift crew and dredge captain completed the repairs around midnight when dredging operations resumed.

4.1.5. At 0445 on August 21, 2020, the off-going Night Leverman[1] and on-coming Day Leverman conducted a ten to fifteen minute pass-down, including a discussion regarding the struggle with the dredge hitting rocks and debris. Following the pass-down, the Day Leverman took controls of the dredge and began dredging; the Night Leverman went to the dredge's berthing area.

4.1.6. From 0530 to 0545, the day crew met in the lever room[2] for the morning safety meeting, which was held at each 12-hour shift change. Normally, the Dredge Captain or Deck Captain[3] led the meeting, discussed one or two safety topics, and gave the day's assignments. On that day, the Dredge Captain was not at the meeting due to being up late overseeing repairs. The Deck Captain was off rotation and not on the dredge. In their absence, the Day Leverman normally was expected to lead the meeting; however, he did not remember leading the meeting that day or who led it. He typically did not stop working the dredge during these safety meetings unless he was leading the meeting. However, all crewmembers interviewed agreed the meeting occurred that morning. The crew started their assignments for the day at the meeting conclusion.

[1] The Leverman is the person controlling the movement of the cutterhead.
[2] The lever room was the space onboard where the dredge controls were located and the Leverman worked. (*See Figure 3*)
[3] The Dredge Captain was in charge of the vessel. The Deck Captain was second in command.

4.1.7. Throughout the morning on August 21, 2020, the Day Leverman reported persistent issues with hitting rocks and debris, causing operations to halt frequently while crew members cleaned out the pump strainer and suction piping.

4.1.8. At 0700, the Dredge Captain woke up and left his room on the WAYMON BOYD, checked-in with the Day Leverman, and then went to the Captain's office, which was located just aft of the lever room. (*See Figure 3*)

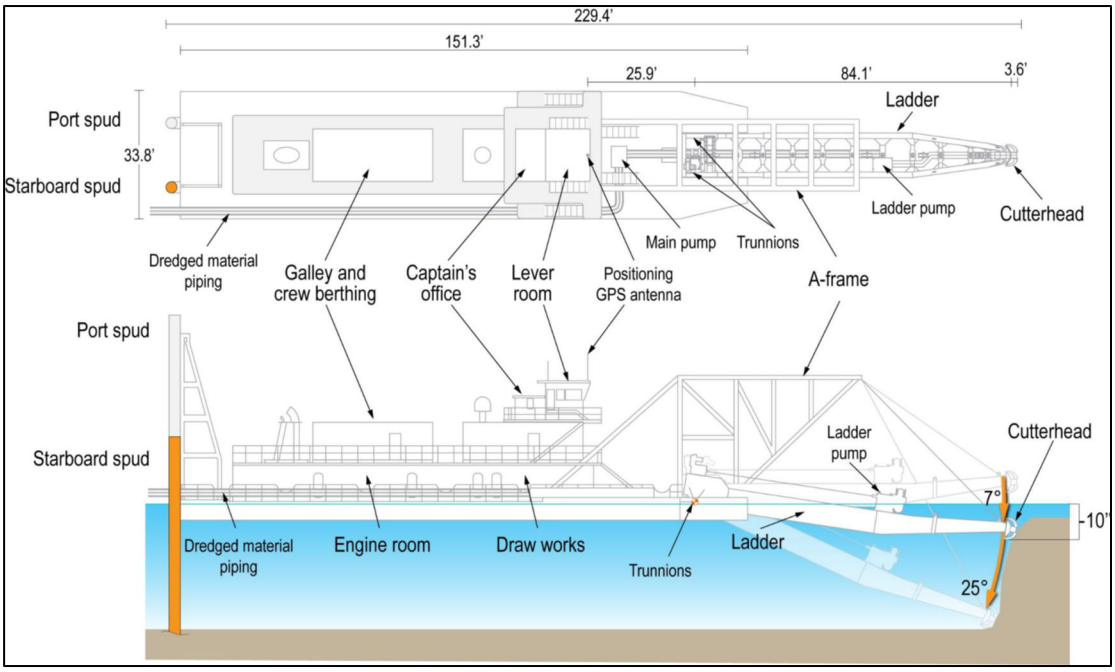

Figure 3. WAYMON BOYD Schematic, taken from NTSB Nautical Operations, Human Performance, and System Safety Group Report.

4.1.9. At 0730, the Day Leverman called the Dredge Captain via the vessel's intercom to report that he was hitting debris. The Captain went to the lever room to assess the situation and instructed the Day Leverman to "just go around it."

4.1.10. At 0802, the Day Leverman positioned the cutterhead toward the shoreline to make the first, top layer, cut of the bank at the dredge's current position. When the cutterhead was approximately five feet from the edge of the dredge template, water suddenly began shooting up as high as the dredge in an area approximately 2 – 3 feet landward of the cutterhead.

4.1.11. Seconds later, the Day Leverman stopped the cutterhead and, utilizing the dredge's anchor winches, swung the dredge to starboard, away from land and the shooting water.

4.1.12. Shortly after, the Day Leverman called the Dredge Captain and told him he thought he hit a water pipe. The Captain walked out of his office and saw the water geyser off the port side of the dredge. He concurred that the dredge hit a water pipe, reportedly because he could not smell anything, so he went back to his office to call an EPIC contractor to notify him of the event.

4.1.13. Unbeknownst to the crew of the WAYMON BOYD or other Orion employees working around the area, 18 personnel, the cutterhead had hit the pipeline TX219,

releasing an odorless and colorless propane gas, which enveloped the dredge. The propane was drawn into the engine room by the ventilation fans.

4.1.14. Approximately 66 seconds after the water geyser erupted, an explosion occurred, and the WAYMON BOYD was engulfed in flames. However, the ignition source within the engine room was unknown.

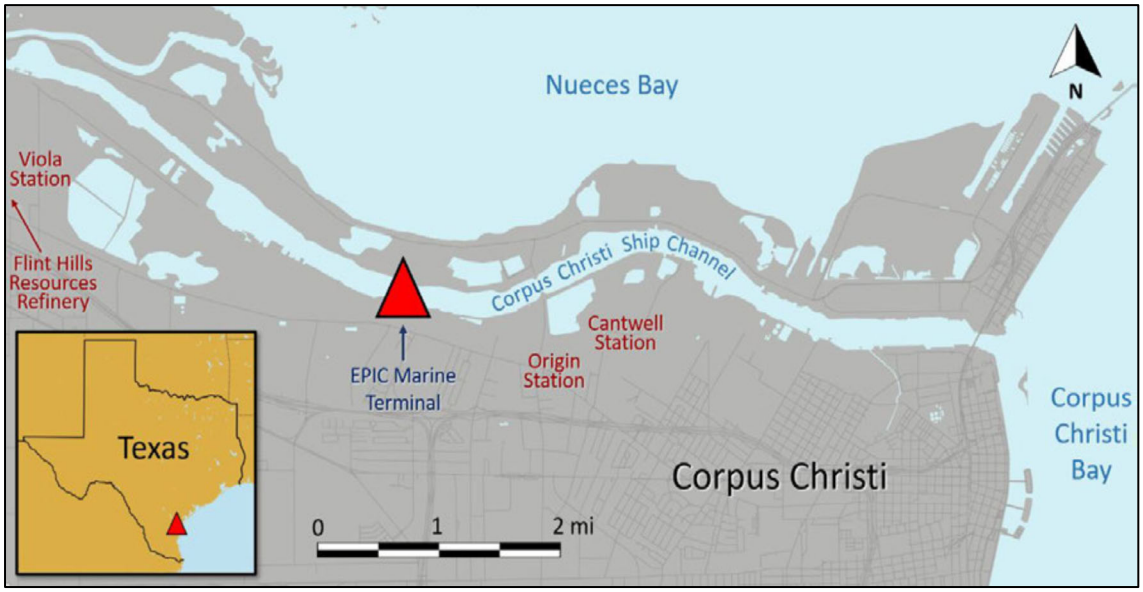

Figure 4. Location of accident with Google Map Background, taken from NTSB Nautical Operations, Human Performance, and System Safety Group Report.

4.1.15. The Dredge Captain's office was overwhelmed with flames and smoke; he escaped by climbing through a window and jumping overboard, after the spreading fire prevented him from getting to the galley and berthing area to warn others onboard. The Day Leverman fell on his back after the explosion and crawled out of the lever room as the fire was coming in through the front windows. He also jumped overboard. Both men swam to shore, were transported to the hospital, and were treated for severe burns.

4.1.16. The Night Leverman, Chief Engineer, Second Engineer, and Cook died in the explosion and fire on the WAYMON BOYD and adjacent anchor barge. Deckhand 1 who escaped, died approximately 10 weeks after the incident from his injuries. Deckhand 2 and a Mate also were hospitalized and treated for severe burns, along with a Deckhand 3 who was treated for minor burns.

4.1.17. The remaining crew on the WAYMON BOYD and aboard the support vessels escaped to shore without sustaining significant physical injuries.

4.1.18. Multiple vessels in the area responded to assist with rescue, firefighting, debris clean-up, and other response activities. Around 1300, the fire on the WAYMON BOYD was extinguished, although residual propane from the pipe continue to burn until 1610.

4.1.19. At 1400, the WAYMON BOYD began taking on water.

4.1.20. The WAYMON BOYD continues to smolder and subsequently re-ignited from 2030 to 2130.

4.1.21. At 2151, the WAYMON BOYD sank.

4.1.22. The crewmembers of the WAYMON BOYD were subject to mandatory chemical testing for evidence of drug and alcohol use in accordance with 46 C.F.R. § 4.06. None of the individuals listed on the CG-2692B as directly involved in a serious marine incident were tested. The company notated that some crew were transferred to the hospital, so they were unable to be tested. The crew who were injured returned home and refused to come back for drug testing.

4.1.23. Orion Marine Group salvaged the WAYMON BOYD and associated equipment and transported it via barge to a shipyard for additional evidence collection and storage.

4.2. Additional/Supporting Information:

Vessel and Weather Condition

4.2.1. Weather conditions were clear with unlimited visibility and calm water.

4.2.2. The WAYMON BOYD functioned with a cutterhead (*see Figure 5*) mounted to framework, which could move up and down, affixed to the bow of the dredge. The cutterhead had teeth, which broke up the rock and dirt as the cutterhead spun. The broken-up debris was then suctioned through a pipe positioned directly behind the cutterhead, and the debris continued to be pumped through the dredge via attached dredge-pipeline. A series of pumps on support vessels moved the dredged material via the dredge-piping to a dredge material placement area.

4.2.3. The dredge operation included a flotilla of the WAYMON BOYD and its associated assist vessels, including tender boats, anchor barges, booster barges, and a supply barge. Each of these vessels supported the dredge or the movement of the dredge material from the dredge site to the placement area via floating or submerged pipelines and booster pumps.

Figure 4. WAYMON BOYD cutterhead, post-accident. (September 17, 2020, USCG)

Pipeline

4.2.4. The TX219 was owned by South Texas NGL Pipelines, LLC and operated by Enterprise Products Operating LLC, both of which were subsidiaries of Enterprise Products Partners L.P.

4.2.5. TX219 is an approximately five mile-long submerged 16-inch propane intrastate hazardous liquid transmission pipeline segment constructed in 1968. In the area of the breached pipeline, the pipe was coated with coal tar and then coated with 2-inch thick concrete, which was protected by an impressed current cathode protection system.

4.2.6. Due to the make-up of the shoreline, the pipeline alternated between being on shore and being in the water. When it ran over water, it was exposed. When it was over land, it was buried.

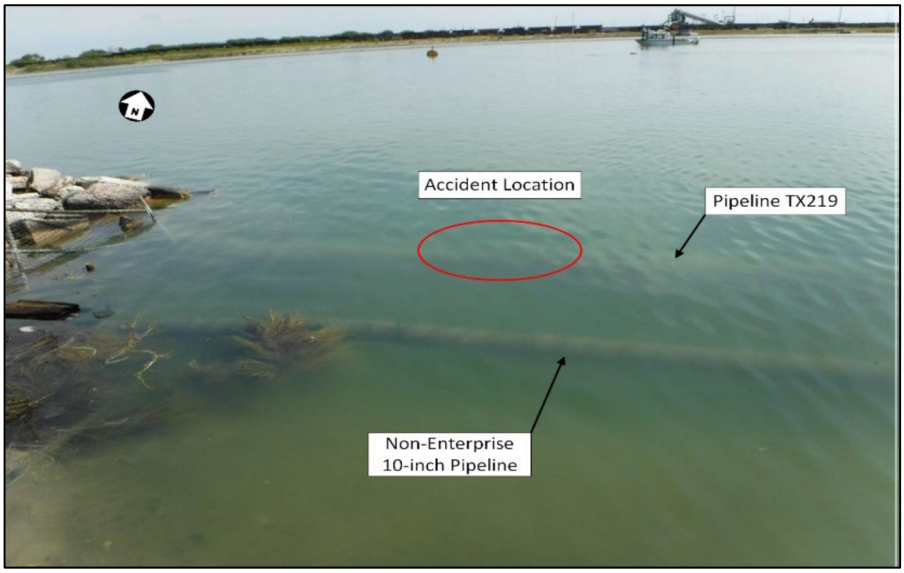

Figure 6. Approximate location of incident from NTSB Pipeline Operations Group Factual Report.

Figure 7. "Post-accident September 30, 2020, Enterprise Products pipeline TX219 KML, temporary and permanent pipeline marker survey locations, and accident location projected on Maxar Technologies, Google Earth imagery of January 31, 2020. Cane pole GPS 2289 was located between the 10-inch non-Enterprise pipeline, which is partially visible as a dark line parallel to pipeline TX219 (green line)", taken from NTSB Pipeline Operations Group Factual Report

4.2.7. Enterprise considered the TX219 an onshore pipeline in its annual reports to the Pipeline and Hazardous Materials Safety Administration (PHMSA) with no reported history of previous incidents in accordance with 49 CFR § 195.50. Enterprise conducted standard cleanings, patrols, and inline inspections of the pipeline and valves and completed any associated repairs as required.

4.2.8. The pipeline did not flow continuously; rather, Flint Hills Refinery produced and stored propane and released it in batches to Enterprise Origin Station via TX219. Between Flint Hills and Enterprise Origin Station, the pipeline traveled through various stations. Product was introduced at Viola Meter Station and flowed east to Cantwell Station and then on to Origin Station.

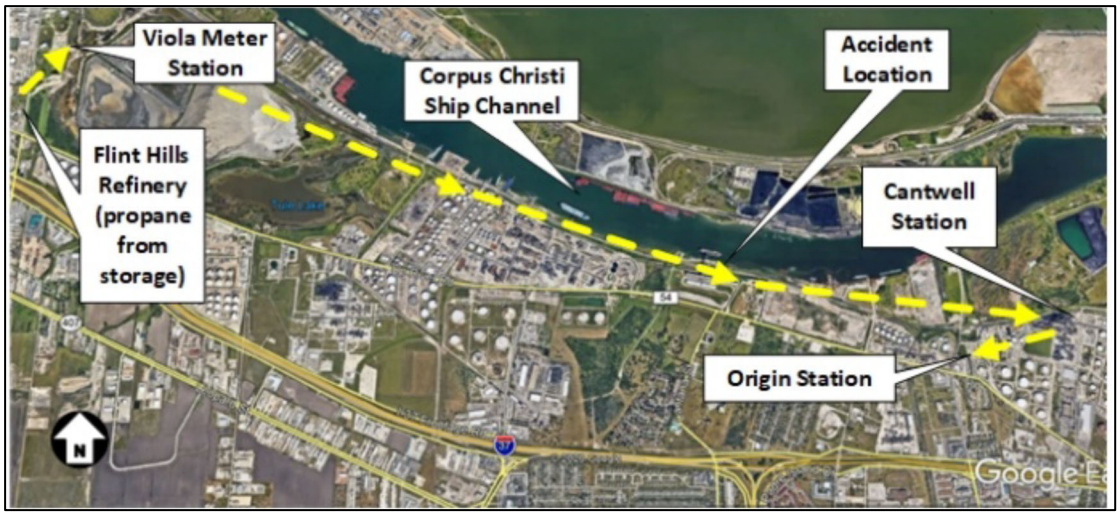

Figure 8. General flow of Pipeline TX219, background image source Google Earth, taken from NTSB Pipeline Operations Group Factual Report.

4.2.9. Enterprise pipeline controllers out of Houston, Texas operated and monitored the pipeline using a supervisory control and data acquisition (SCADA) system. The controllers monitored pressures and flow rates as well as certain control valves, and the system had color-coded visual and audible alarms to alert the controller of abnormal readings. In addition, there were field pipeline operators and technicians who could conduct field checks or operate valves manually, if required.

4.2.10. At 0426 on August 21, 2020, Flint Hills Resources released batch number 75 of non-odorized liquefied propane into pipeline TX219, flowing at approximately 257 to 265 psig (maximum operating pressure was 787 psig). Propane is an odorless, colorless gas, and it is not required to be odorized while being transported in pipelines. It is required to be odorized when loaded into a truck or railcar for transport

4.2.11. At 0802, the cutterhead on the WAYMON BOYD struck the pipeline TX219. Immediately thereafter, the Enterprise pipeline controller acknowledged a low pressure alarm at Viola Station.

4.2.12. At 0804, the Viola Station Control Valve automatically began closing and was closed completely at 0805, causing no additional product to enter the TX219 pipeline from Flint Hills. At 0807, the flow meter measured zero flow. From 0802 until valve closure, approximately 19 barrels of propane entered the pipeline along with the product that was already in the pipeline.

4.2.13. Concurrently, at 0805, the Pipeline Controller called Flint Hills. The Flint Hills Operator informed him that the batch transfer was complete, and they had shut down its delivery pump.

4.2.14. Since the breach and the completion of the batch happened in near succession, the Pipeline Controller was not sure of the cause of the low pressure alarms. He began to telephone pipeline technicians and operators at various locations along the line to investigate. One technician informed him that there had been an explosion, and he could see the fire from his current location.

4.2.15. To avoid backflow and ensure redundant isolation of the breached pipeline, Operators closed manual valves and motor operated valves at 0841 and 0843 and enacted lock-out/tag-out procedures.

4.2.16. Beginning on October 5, 2020, a 14-foot, 4-inch segment of the pipeline (*see Figure 9*) was removed and transported to NTSB for analysis and metallurgic testing. NTSB laboratory facilities noted that the segment had five elongated dents, three dents, and two punctures (located at the 7 o'clock position) connected by a fracture. On the two punctures, the metal was folded into the pipe. Both punctures showed evidence of impact marks.

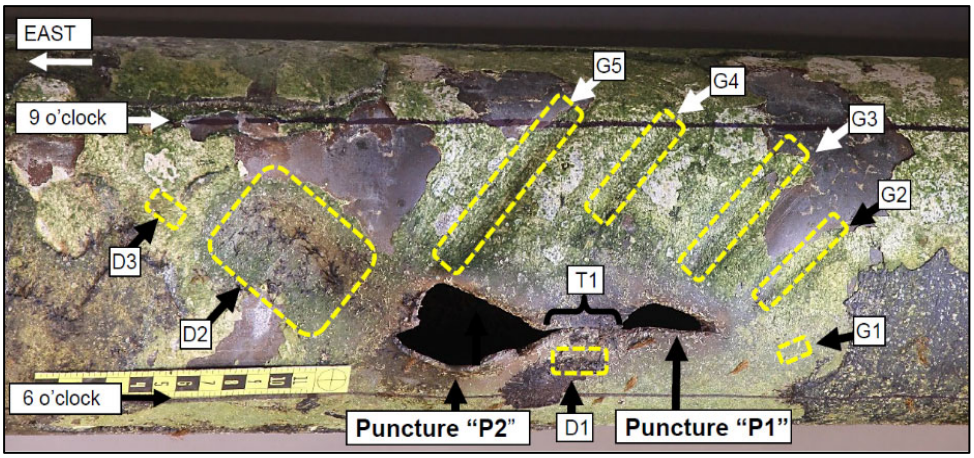

Figure 9. Close-up view of the struck pipeline, taken from NTSB Materials Laboratory Factual Report.

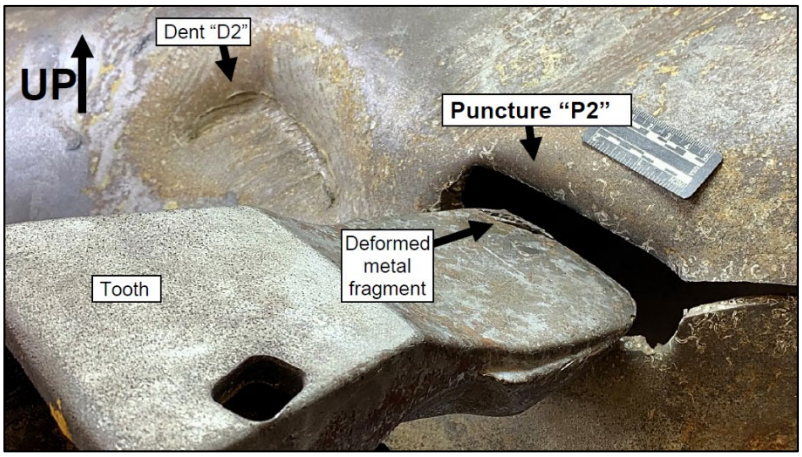

Figure 10. "Oblique view of puncture 'P2' with the tip portion of tooth 'C1' facing the puncture and dent "D3" containing gouges in the background, after cleaning. The tip of tooth 'C1' contained evidence of a deformed metal fragment", taken from NTSB Materials Laboratory Factual Report.

4.2.17. On October 27, 2020, three damaged cutterhead teeth were removed and transported to NTSB for analysis and metallurgic testing (*see Figure 10).*

4.2.18. The estimated propane release from TX219 was about 6,024 barrels (PHMSA estimated 6,034 barrels).

EPIC Dock Project Plans

4.2.19. In December 2018, prior to the dock alteration projects, EPIC Crude Terminal commissioned TMI Solutions LLC to conduct a survey of all utilities transiting their property. The December 28, 2018 TMI utilities survey identified three pipelines—two active, the TX219 was one of these, and one abandoned—running parallel to the shore, stretching across the length of the property.

4.2.20. In 2019, EPIC Marine Terminal (*see Figures 2 and 3*), located in the Corpus Christi Ship Channel, began converting the former Interstate Grain Terminal to a crude oil loading facility. The project was conducted in multiple stages. The West Dock, capable of loading "Aframax" size tankers, was completed first and loaded its first tanker in December 2019. The second part of the terminal modification was the addition of a second pier, East Dock, which would be capable of loading "Suezmax" size tankers. The East Dock would be at the same site as the West Dock, located about 300 yards to the east. In addition to the pier construction, the East Dock required dredging for the ship berth.

4.2.21. Epic Marine Terminal contracted two separate divisions of Orion Marine Group: one division to construct East Dock and another division to dredge the berth. The dredging, which would be done in two phases, was scheduled to be completed prior to the construction of the dock. From May to end of June 2019, Orion completed Phase 1 of the dredging without any known incidents. Phase 2 was scheduled to take place from July to October 2020.

4.2.22. Jacobs, an engineering and construction firm, produced the plans for Phase 1 of the East Dock Project, which did not include the 2018 TMI utilities survey discussed in 4.2.19.

4.2.23. In October 2019, the Army Corps of Engineers approved EPIC Crude Terminal's permit to enlarge the East Dock berth by 167 feet, as well as other amendments. Schneider Engineering and Consulting, a wholly owned subsidiary of Orion Group Holdings, updated the dredge plans from Phase 1 for the Phase 2 project.

4.2.24. EPIC Terminal provided the 2018 TMI utilities survey to Orion to be included in the dredging plans. Orion forwarded the survey to the Schneider design engineer who imported it into his computer-aided drafting (AutoCAD) software. The pipelines were included in some of the June 23, 2020 "EPIC Marine Terminal Dredging Construction Plans" and not in other drawings. The pipelines were included in the Schneider developed Existing Site Plan, but they were not included in the Dredge Site Plan or the cross sectional drawings.

4.2.25. The design engineer was not concerned about the pipeline's location, stating that the distance between the pipelines and the edge of the dredge template was "in the

neighborhood of 8-10 feet" at the closest point. The pipelines were considered outside the dredge template and not a concern.

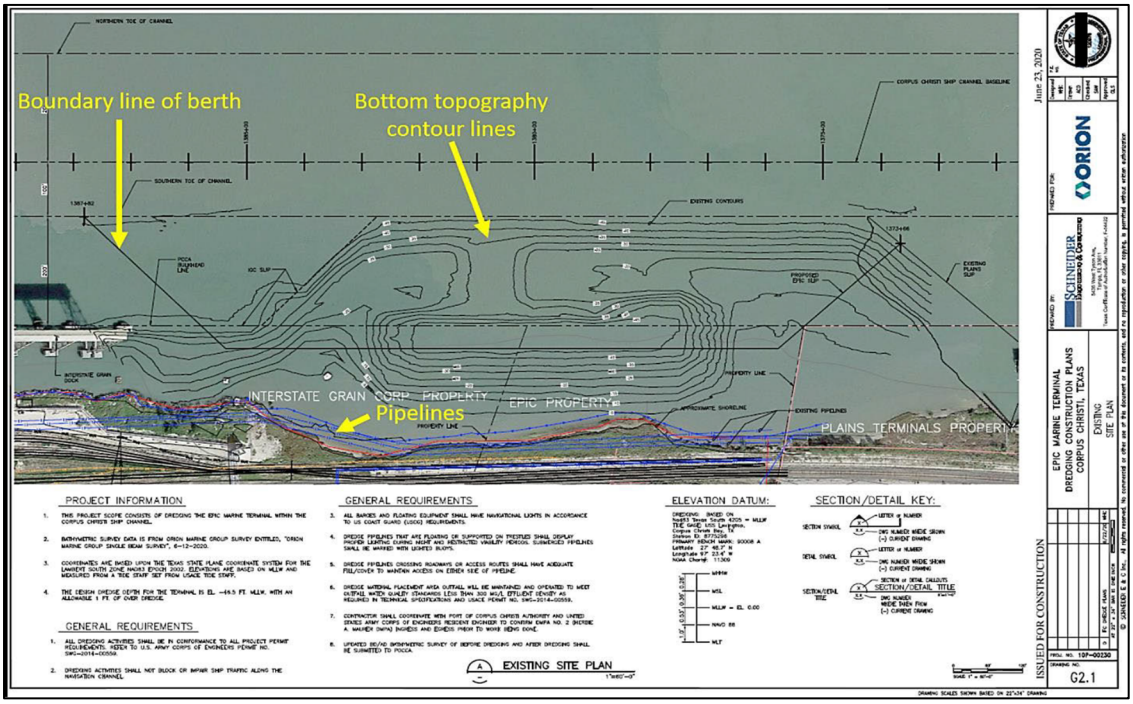

Figure 11.Existing Site Plan from EPIC East Dock, annotated by NTSB Nautical Operations, Human Performance, and System Safety Group Report.

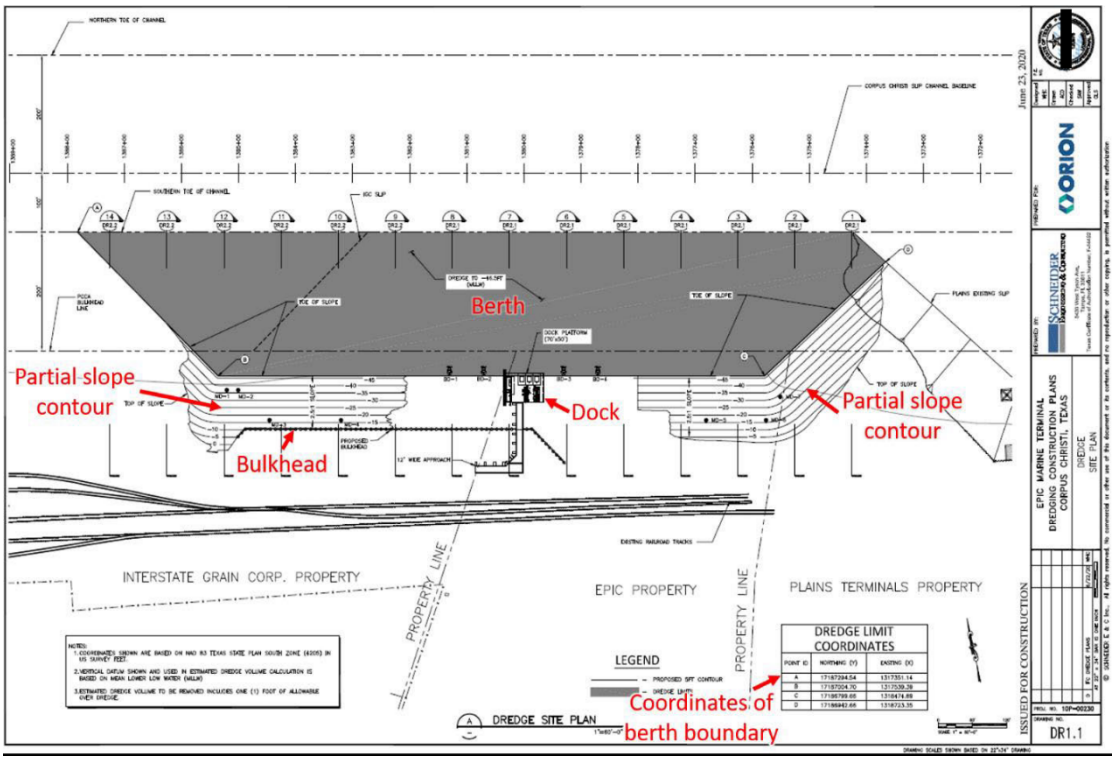

Figure 12. Dredge Site Plan from EPIC East Dock, annotated by NTSB Nautical Operations, Human Performance, and System Safety Group Report.

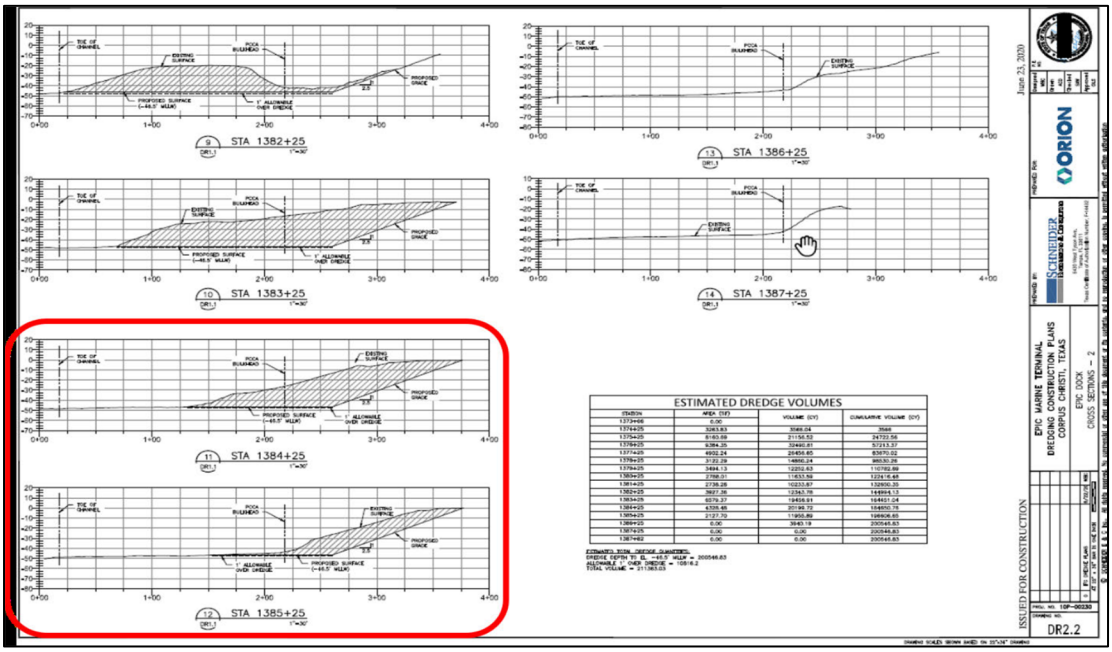

Figure 13. Sample Cross-Sectional View EPIC Dredge Plans, annotated by NTSB Nautical Operations, Human Performance, and System Safety Group Report.

4.2.26. When NTSB investigators asked how this 8-10 foot measurement was determined, Orion provided them a cross sectional drawing dated August 24, 2020 with the pipelines inserted with a dotted line. Using an Adobe Acrobat Pro DC measuring tool, NTSB determined that the distance between the line and the top of the slope in Cross Section 12 (60 feet from accident site) was 2.8 feet.

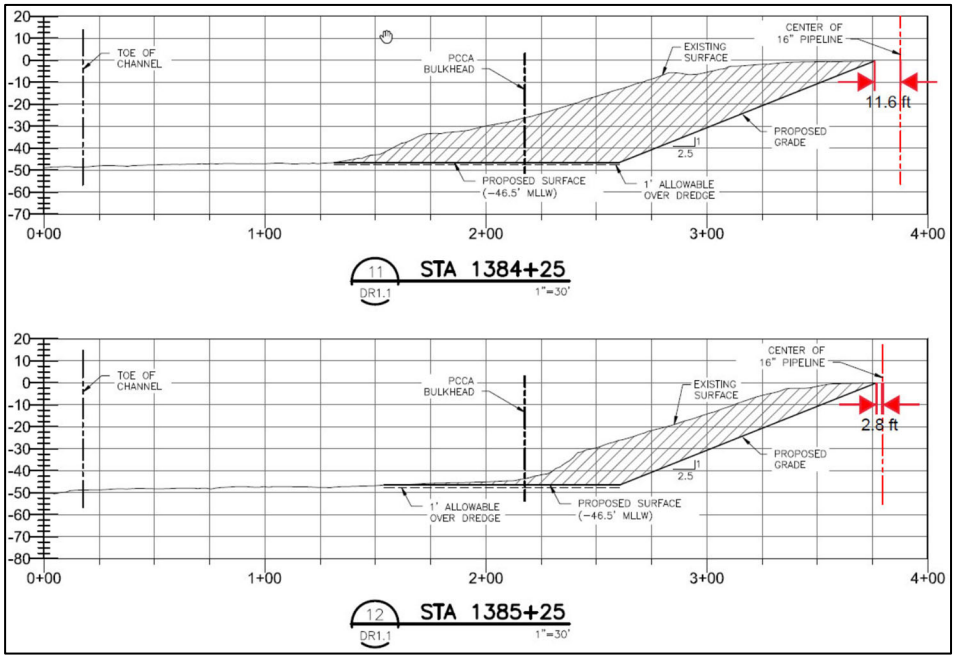

Figure 14. Cross-Sectional drawing annotating pipeline in red in relation to original drawing., taken from NTSB Nautical Operations, Human Performance, and System Safety Group Report.

4.2.27. Once the plans were complete, they were provided to the Orion Survey Superintendent, who was the head of the Survey Department. The Survey Superintendent was responsible for developing the dredge template or dredge plan. To build the template, the Survey Superintendent conducted a pre-dredge hydrographic survey of the project area and periodically conducted surveys during dredging operations to determine progress. He used the dredge plans, as well as the survey results, to make and update the dredge template.

4.2.28. The Survey Superintendent also was responsible for uploading the dredge template in a software program called DREDGEPACK.[4] Once the template was completed, he uploaded the template onto a computer aboard the WAYMON BOYD for it to be incorporated into the DREDGEPACK software.

4.2.29. The Survey Superintendent included pipelines in the DREDGEPACK template if they were in the project area. He normally would be provided the coordinates of the pipeline from the Orion Project Manager and Orion Project Engineer to be included; he did not receive any for this project. During interviews, the Survey Superintendent stated he was aware of pipelines in the area, but he thought they were out of the way on the bank. The pipelines were not included for this template; in fact, he said they "were not considered at all."

4.2.30. As he was digging, the Leverman looked at a DREDGEPACK display screen that showed the dredge template, where the cutterhead was positioned, and where he needed to dredge.

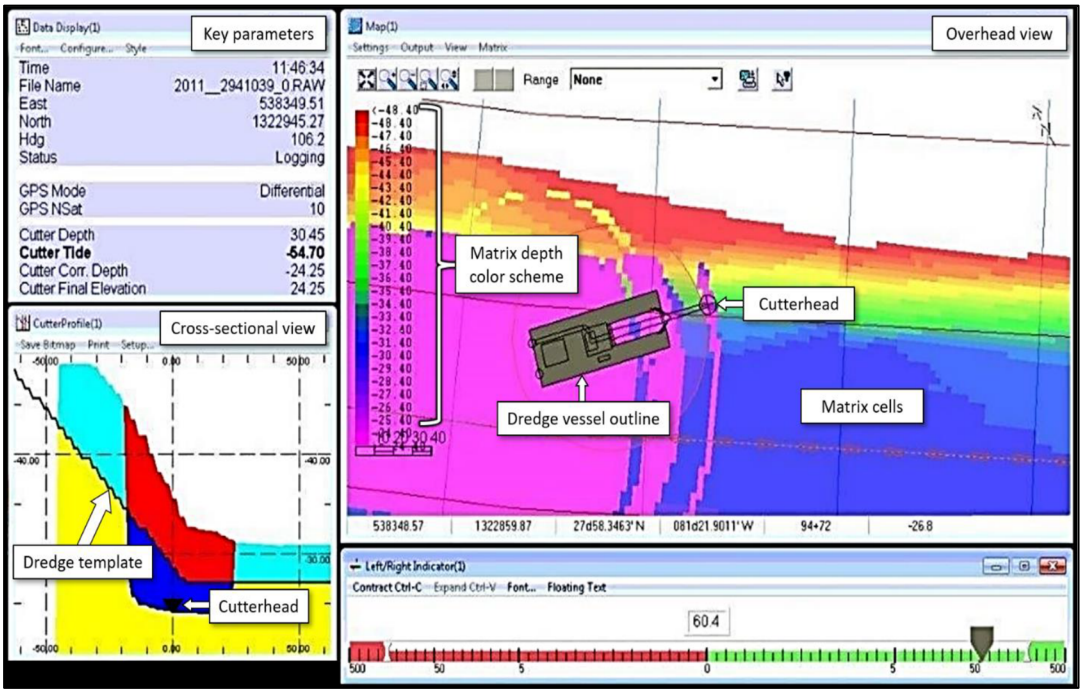

Figure 6. Sample DREDGEPACK Display, NOT related to this incident, taken from NTSB Nautical Operations, Human Performance, and System Safety Group Report.

[4] DREDGEPACK is a module in HYPACK software, which is what the Leverman looked at in real time to position the cutterhead in relation to the dredge template.

4.2.31. The software used a GPS receiver on the cutterhead to mark its real time position to display on the DREDGEPACK screen. The GPS receiver was accurate to one meter (3.28 feet), which was assuming all other data inputs and measurements were correct and the inclinometer was calibrated correctly.

4.2.32. The Leverman did not utilize anything other than DREDGEPACK to conduct dredging operations, including where to dredge and the position and depth of the cutterhead. He did not reference any plans, drawings, or charts.

4.2.33. Because Orion determined the pipeline to be outside the dredge template, it was not included on the DREDGEPACK screen.

4.2.34. Orion had no written procedures dictating the inclusion or exclusion of pipelines from the dredge template or DREDGEPACK.

4.2.35. On September 19, 2020, Orion conducted a post-accident hydrographic survey with a GPS probe to verify the pipe location in relation to the excavated material. The survey showed that dredge material was excavated in accordance with the template, except for the excess material removed from the top of the slope where there was a "pocket" of material removed directly below the damaged pipeline. Additionally, comparing the GPS location of the pipe determined during this survey and the dredge template, the Survey Superintendent estimated TX219 was 6.5 to 7 feet from the template at its closest point.

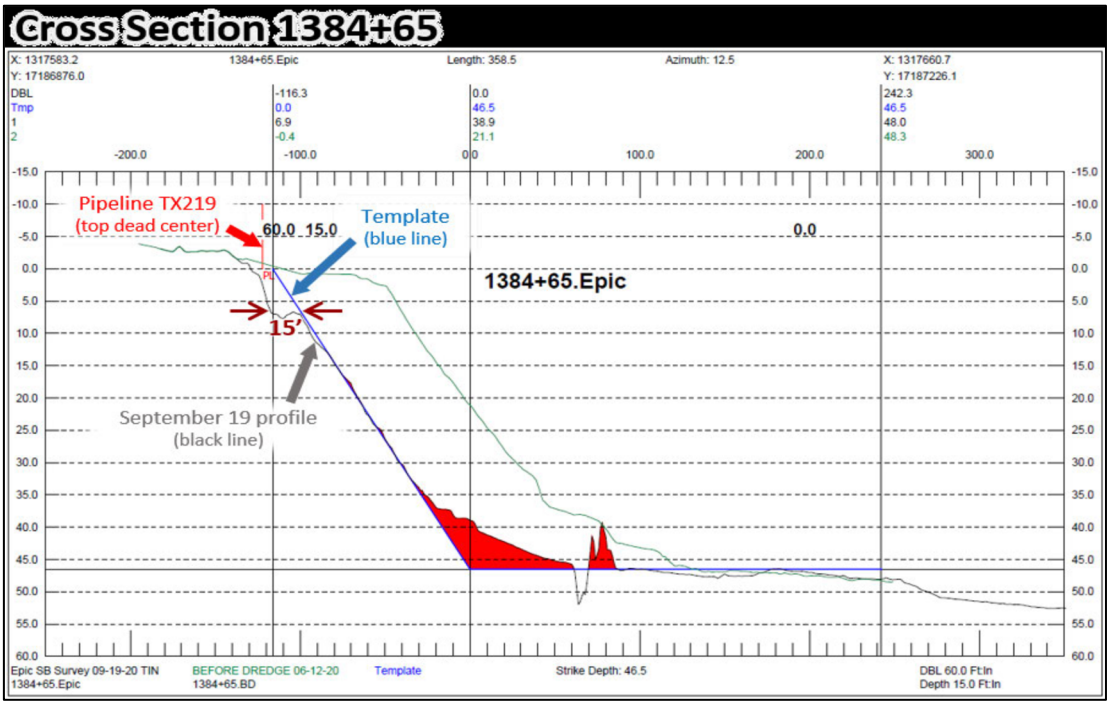

Figure 7. Cross sectional view of dredging area at accident location from September 19, 2020, survey. Red line and "PL," which appear in the original document, denote top dead center of pipeline as located by Orion personnel during the survey, take n from NTSB Nautical Operations, Human Performance, and System Safety Group Report.

4.2.36. Noting inconsistencies with pipeline location and estimated distance from the dredge template, NTSB investigators, with the assistance of HYPACK technical representatives, subsequently inputted each reported pipeline location into DREDGEPACK to measure the distance between the pipeline and the edge of the

dredge template. While none of the data put the pipeline within the dredge template, some of the surveys put it as close as 0.8 (closest point) to 1.9 feet (accident location) from the template.

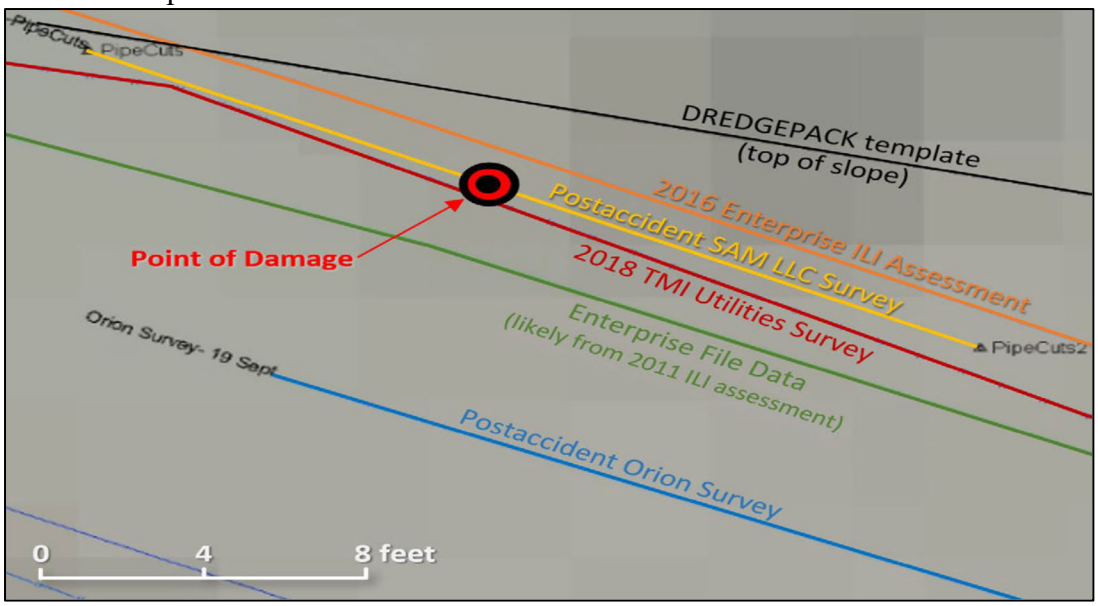

Figure 97. Sample of various pipeline location data near accident site, taken from NTSB Nautical Operations, Human Performance, and System Safety Group Report.

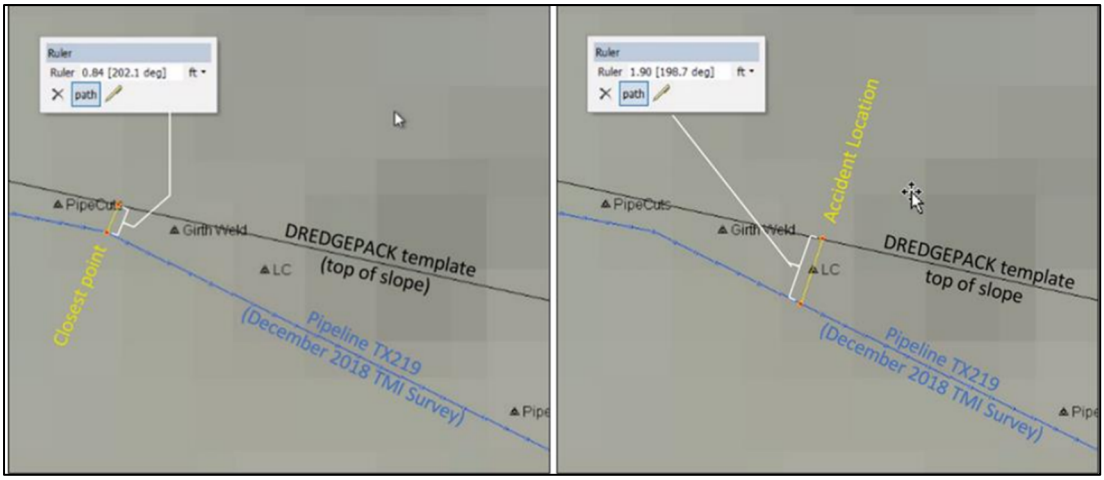

Figure 88. Screen captures from DREDGEPACK dredge template for the EPIC dock project, with imported location data for pipeline TX219 from 2018 TMI Solutions utilities survey. Left image shows distance between pipeline and template at closest point. Right image shows distance from pipeline to template at the accident location, taken from NTSB Nautical Operations, Human Performance, and System Safety Group Report.

"One-Call" Ticket and Pipeline Marking

4.2.37. On May 7, 2019, Orion Group Project Manager filed two One-Call (811)[5] pipeline locate requests for pipeline TX219 and natural gas pipeline 124 (one ticket for each pipeline) to verify any conflicts with the two active pipelines in the area prior to Phase 1 dredging operations.

[5] 811 is the phone number a person can call prior to conducting excavation work to identify possible utilities in the area.

4.2.38. Enterprise technicians visited the EPIC site and concluded, along with EPIC personnel, that the pipelines would not affect dredge operations. The EPIC representative agreed to install 18 feet tall bamboo cane pole himself to mark the pipeline, and the pipeline technicians came out of a few days later to confirm their installation. Enterprise technicians closed both tickets, indicating neither pipeline would be affected.

4.2.39. On June 23, 2020, the Orion Project Engineer filed a One-Call ticket for Phase 2 of the dredge project. The Project Engineer had not been part of the Phase 1 project.

4.2.40. Enterprise pipelines TX219 and 124 again were identified as being in the vicinity of the work area based on the latitude and longitudinal coordinates provided to them by the Orion Project Engineer.

4.2.41. Based on the information provided in the One-Call ticket and a subsequent phone discussion on June 23, 2020 between the Orion Project Engineer and Enterprise Pipeline Technician, they decided the pipelines would likely need to be marked. They scheduled a meeting at EPIC for June 30, 2020. Orion would provide the boat and cane poles. However, that meeting was cancelled due to COVID-19 concerns.

4.2.42. Because they could not meet in person, the Orion Project Engineer emailed the Schneider Engineering Plans, Figures 11, 12 and 13 without the NTSB annotations in red, to the Pipeline Technician on June 29, 2020. The body of the email stated: "I've attached the latest plans. Page 2 shows existing pipelines in blue, I'm assuming a couple of those are yours. Page 3 shows our new dredge prism for phase II of dredging. It looks as though we will be about 60' off the shoreline, and the areas where the shoreline and pipeline are furthest in the water (closest to the new template), we have already completed dredging to grade (where the dock platform is on page 3) so there shouldn't be a need for concern."

4.2.43. The pipeline technician looked at the plans, and after a follow-up phone call with the Project Engineer, they decided they did not need to mark the pipelines. On June 30, 2020, another Pipeline Technician closed-out the "One-Call" Ticket as a "3-CLEAR" and explaining, "EFQ pipeline TX219 will be clear from work area by 55ft. There will be no dredging near the channel shoreline."

4.2.44. The pipeline technicians were not trained to read dredge plans, and they were primarily familiar with identifying and marking pipelines for on-land excavation projects.

4.2.45. Following the closure of the "One-Call" Ticket, the Orion Dredge Superintendent and Project Manager were concerned about the location of the pipeline in relation to the possible placement of the dredge swing anchors, not actual excavation, which could possibly need to be placed outside the dredge template. The Project Manager requested that the Project Engineer follow-up with Enterprise to mark the pipelines, who then requested a meeting with Enterprise.

4.2.46. On July 15, 2020, the Orion Project Engineer confirmed with the Enterprise Pipeline Technician via email that Orion would arrange for a skiff and cane poles to mark the pipeline.

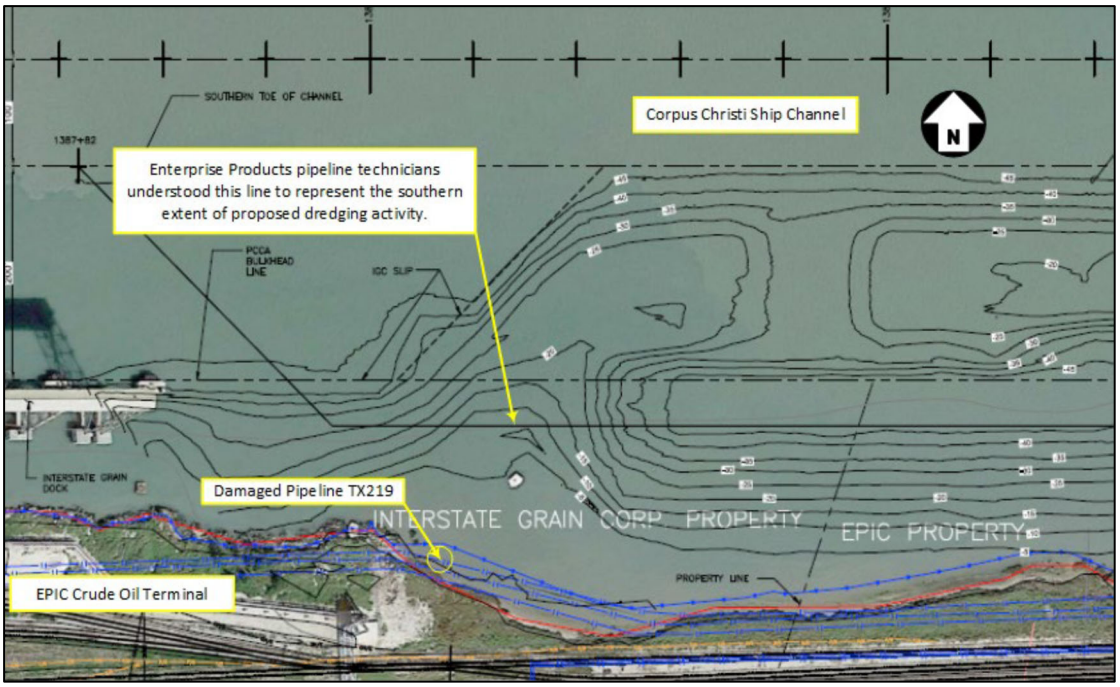

Figure 10. Annotated drawing of dredge plans showing where Enterprise technicians understood the end of the dredge template to be located, taken from NTSB Pipeline Operations Group Factual Report.

4.2.47. On July 16, 2020, the Orion Project Engineer and Enterprise Pipeline Technicians met at the EPIC dredge site to do a "courtesy" marking of the pipeline.[6]

4.2.48. Enterprise Technician utilized electronic line locating equipment to identify TX219. Since some of the cane poles were still in place from when the pipeline was marked in 2019 during the phase 1 construction, the technicians filled in any gaps by placing an additional five or six poles approximately 5 to 10 feet from the pipeline to provide a safeguard area. The poles were spaced approximately 20-150 feet apart (reported spacing varied significantly in the interviews; the technician estimated every 50 feet; the dredge captain estimated 100-150 feet), no exact measurements were taken of their spacing. After the incident, the closest cane pole was about 145 feet east of the incident area.[7]

[6] From Enterprise Products Damage Prevention Procedures, Section 6.1.3.3: "In situations where the planned excavation is greater than 50 feet from the centerline of a Company pipeline(s) and is not on a Company ROW, the Line Locator may perform a courtesy locate, if he/she believes the circumstances surrounding the planned excavation could pose a risk to Company pipelines. The distance between any two courtesy markings shall not exceed 200 feet."

[7] For a mandatory marking, Texas Administrative Code, Title 16, Part 1, Chapter 18, RULE §18.8 (f): A locator shall mark at sufficient intervals to indicate clearly the approximate horizontal location and direction of the underground pipeline or pipelines. The distance between any two marks indicating the same line shall not exceed 20 feet; however, a shorter distance between marks may be necessary because of site conditions or directional changes of the underground pipeline.

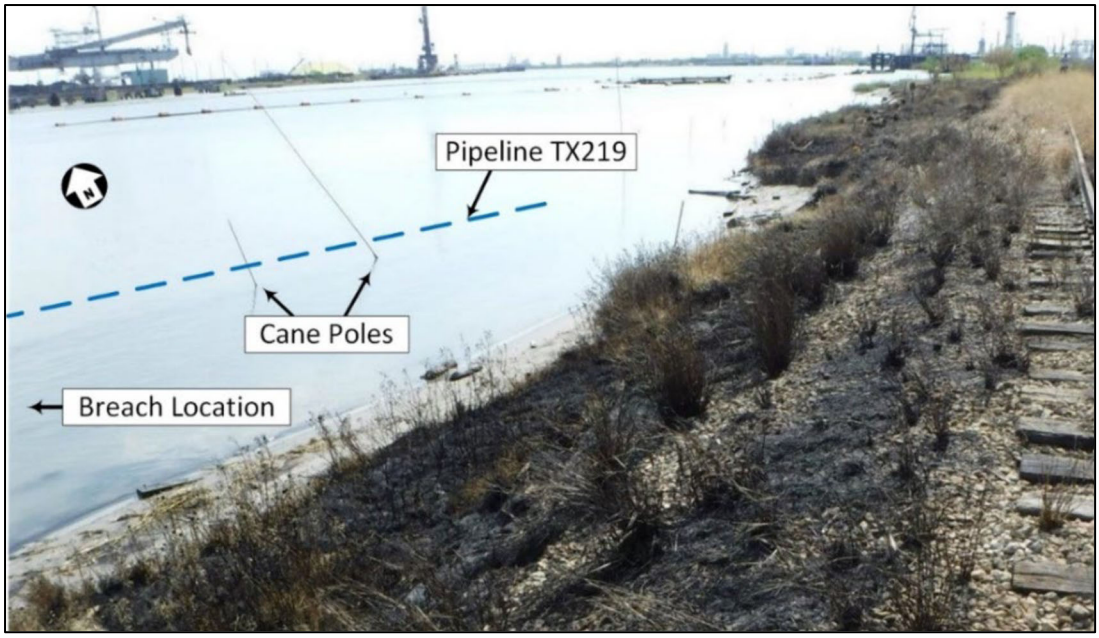

Figure 11. Photo of cane poles taken after the incident with annotations by NTSB, taken from Pipeline Operations Group Factual Report.

4.2.49. While on-scene marking the pipeline, the Enterprise Technicians and the Orion Project Engineer also discussed safe distances from the pipeline. Although the intricacies of the conversation are in dispute, the Orion Project Engineer remembered the Pipeline Technician stating, "If we stayed about 20 foot off, we would be good." One Pipeline Technician remembered a conversation agreeing that the anchor would not be placed within 20 feet of the cane poles. Another Pipeline Technician does not recall any conversation about a 20-foot distance.

4.2.50. On July 20, 2020, the Project Engineer emailed the WAYMON BOYD, the project manager, and two dredging superintendents, "There are 2 pipelines near the shoreline at EPIC. They are marked with cane poles and we've been asked to stay 20' away from them. Please keep in mind when working in the area and placing swing anchors."

4.2.51. The Deck Captain and Dredge Captain both received the email and were aware of the cane poles and pipelines along the shoreline. The Leverman stated that he was unaware of the purpose of the cane poles and that there were no cane poles in the area he was dredging. The Leverman also stated he was aware of a pipeline, but he thought there was only one that he could visibly see under the water. He recalled that the Dredge Captain had told him to keep the dredge anchors away, but did not give a specific distance. The Dredge Captain did not remember discussing the cane poles with the Leverman, but assumed he knew what they were due to the Leverman's experience.

4.2.52. Most crew members were unaware of the pipelines or cane poles. The more senior crew members who knew about them were primarily concerned about their location in relation to the swing anchors. Additionally, various people involved in the project each had a different indication of the location of the pipeline.

Individual	Understanding of Distance between Dredge Template and Pipelines
Schneider design engineer	8-10 ft
Orion regional HSE manager	Not aware of pipeline TX219
Orion project manager	30 ft
Orion project engineer	60 ft
Waymon Boyd dredge captain	Instructed to remain 20 ft from pipelines
Waymon Boyd deck captain	Instructed to remain 20 ft from pipelines
Waymon Boyd accident leverman	Not aware of pipeline TX219
Majority of *Waymon Boyd* crew	Not aware of pipeline TX219
Enterprise one-call technicians	55 ft

Note: Actual distance between dredge template and accident location was about 1 foot, per the Enterprise 2016 ILI survey.

Figure 12. Table taken from NTSB Hazardous Liquid Pipeline Strike and Subsequent Explosion and Fire aboard Dredging Vessel Waymon Boyd Report.

Orion Training, Operations, Safety, Crew Experience, and Emergency Procedures

4.2.53. The dredge WAYMON BOYD operated 24 hours a day in two 12-hour shifts.

4.2.54. Orion Marine Group had a *Site Specific Safety Plan – Epic Dock*, which did not contain any information about pipelines, working near pipelines, identifying pipeline markings, hazards associated with dredging near pipelines, possible signs if the dredge hit a pipeline, or emergency response procedures if the dredge struck a pipeline.

4.2.55. Orion Marine Group's regional Health, Safety, and Environmental (HSE) Manager was in charge of the safety program, including training, for the WAYMON BOYD. He also was responsible for writing the Site Specific Safety Plan, along with the Project Manager. The Regional HSE Manger was not aware of the pipeline during any stage of the Epic Dock construction.

4.2.56. One element of the Safety Plan was the use of Job Safety Analyses (JSA's), which were completed each day at the safety meeting. The topics typically included use of personal protective equipment and personal safety such as slips, trips, falls and pinch points.

4.2.57. During interviews, all crewmembers agreed that pipeline safety was not discussed during any of the shift-change safety meetings and none of the JSA's included any pipeline training.

4.2.58. At the time of the accident, Orion did not have any written company policies or procedures for protecting pipelines outside the dredge template or when excavating near them, including no mention of tolerance zones for how close dredging operations could get to a pipeline. They had general practices and procedures that they followed, and each crewmember had a different idea of what those tolerances were. The Dredge Captain said it was 25 feet tolerance zone for a "virgin" or first cut. The Deck Captain did not know of any company policy for how close a cutterhead could get to a pipeline during dredging operations; rather, it was supervisor discretion. The Leverman was not aware of any distances for pipeline running parallel to the channel (he and other crew were more accustomed to pipelines crossing the channel). Orion Director of Operations stated that each job was different, and for this job, the stated distance was 20 feet based on guidance from the pipeline operator.

4.2.59. The WAYMON BOYD did not have emergency procedures for a pipeline strike.

4.2.60. The WAYMON BOYD did not have written procedures or manual for standard operations. Most company guidance and job-specific procedures were passed down through on-the-job training. An "Emergency Procedures for Dredges" card, dated 9/20/01 provided brief, non-specific descriptions of what the crew was supposed to do in a Collision, Man Overboard, Fire, Sinking, and Abandon Ship scenario. For example, in all scenarios, the Captain's actions are listed as: "In charge" and many of the deckhands are instructed to "assist as directed."

EMERGENCY PROCEDURES FOR DREDGES

DRILLS	COLLISION	MAN OVERBOARD	FIRE	SINKING	ABANDON SHIP
Captain	In Charge	In Charge	In Charge	In Charge	In Charge
Leaverman	Sound 5 short blasts on the dredges whistle. Lift spuds Slack anchor cable on the side of the collision Call for tenders to tow dredge	Sound 2 long and 1 short blast on the dredges whistle Secure the engines Lock out controls Call for assistance on channel 16 VHF FM Muster all personnel	Sound 2 long and 3 short blasts on the dredges whistle Call for assistance on channel 16 VHF FM Secure all equipment Lock out controls	Sound 2 long and 5 short blasts on the dredges whistle. Call for assistance on channel 16 VHF FM	Sound 2 long and 7 short blasts on the dredges whistle Call for assistance on channel 16 VHF FM Secure all equipment Lock out controls Muster all personnel
Chief Engineer	On scene leader Make temporary repairs	Assist as directed	On scene leader	On scene leader Make temporary repairs	Secure all engines
Deckhand 01	Assist with tow	Throw life ring to person in the water Point to person in the water	Man fire hose 01	Assist with tow	Launch skiff if tender is not avail
Boatman 01	Tow dredge clear	Maneuver boat to recover man in the water	Assist as directed	Tow dredge to shallow water	Pickup crew from dredge
Deckhand 02	Assist with tow	Assist as directed boat man 01 Throw life ring to man in the water Assist man overboard onboard Perform first aid as needed	Man fire hose 02	Assist with tow	Assist as directed boatman 01
Boatman 02	Tow dredge clear	Recover man in the water	Assist as directed	Tow dredge to shallow water	Pickup crew from dredge
Deckhand 03	Assist as directed	Assist as directed boat man 02 Throw life ring to the man in the water Assist man overboard onboard Perform first aid as needed	Provide fire extinguishers	Provide pump and pump out compartment	Assist as directed boatman 02
Engineer 02	Assist as directed	Assist as directed	Man engineer room	Assist with repairs	Assist as directed
Oiler	Assist as directed	Assist as directed	Assist engineer 02	Assist as directed	Assist as directed
Deckhand 04	Assist as directed	Assist as directed	Provide fire extinguishers	Provide pump and pump out compartment	Provide survival supplies
Deckhand 05	Assist as directed	Assist as directed	Provide fire extinguishers	Assist as directed	Assist as directed
Remaining crew	Assist as directed	Assist as directed	Assist as directed	Assist as directed	Assist as directed

Safety/forms/ drills 9/20/01

Figure 13. Orion Marine Group Emergency Procedures for Dredges, taken from NTSB Nautical Operations, Human Performance, and System Safety Group Report.

4.2.61. The crew did routine drills onboard, but with an unknown frequency. The Dredge Captain reported the crew did drills weekly, while other crewmembers reported drills were conducted every two to four months.[8]

4.2.62. According to the Dredge Captain, the WAYMON BOYD did have two engine-kill buttons located on the second deck, one on each side of the dredge. There also was an "emergency voltage disconnect" in the engine room and a winch motor shutdown in the lever room. None of the cut-offs were employed.

4.2.63. Crewmembers onboard had various levels of experience and training. The more senior members onboard, Dredge Captain, Deck Captain, and Leverman, had 20 or more years of experience on dredges and worked their way up from entry-level positions each. Most of their knowledge came from their vast experience vice formal training. None of the three had a Coast Guard issued Merchant Mariner Credential.

4.2.64. The other crew had no formal training or formal on-the-job training, other than basics such as CPR. They acquired their skills through informal processes of learning on the job from more senior members of the crew.

Regulations/Guidance/Procedures

4.2.65. The WAYMON BOYD was not subject to Coast Guard inspection under 46 U.S.C. Chapter 33.

4.2.66. The WAYMON BOYD was an uninspected vessel and subject to minimum safety, engineering, and operations standards under 46 C.F.R. Chapter I, Subchapter C.

4.2.67. The WAYMON BOYD was not required to be under the control of a licensed mariner under 46 C.F.R. Part 15.

4.2.68. The WAYMON BOYD was not required to conduct drills under 46 C.F.R. Chapter I, Subchapter C.

4.2.69. The Council for Dredging & Marine Construction (CDMCS) formed the Pipeline Task Force (PTF) following a May 2018 accident in Matagorda Bay, Texas where the dredge JONATHAN KING BOYD's spud hit a gas pipeline. The PTF later published "Pipeline Incident Best Practices" in January 2020, with the following recommendation:

"A tolerance zone is a predefined horizontal distance extending from the outer edge or wall of a pipeline/utility. The exact distance is defined by law, and it varies from state to state, ranging from 18 to 30 inches on each side. Those small distances, however, were designed for on-land application and may not apply to marine activities like dredging. . . . Although tolerance zones vary among dredging companies, 75 feet appears to be the no-go working distance for most."

[8] Drill Records were kept onboard and were lost in the fire.

4.2.70. The CMDCS published the "Checklist for Safe Dredging Near Underwater Gas & Hazardous Liquid Pipelines." The checklist included 17 best practices, including:

4.2.70.1. Verify all pipelines have been properly surveyed and marked.

4.2.70.2. Verify all known pipeline locations and maps are uploaded into onboard navigation guidance software of all floating plant, especially dredges.

4.2.70.3. Verify all known pipeline locations are identified in onboard dredge plan.

4.2.70.4. Verify a pipeline company representative will be onsite before work begins.

4.2.70.5. Review tolerance zone distances ("No Go Zones") around each pipeline and confirm they are agreed to by pipeline operator and dredger.

4.2.70.6. Discuss updates and concerns from previous days regarding the pipelines.

4.2.70.7. Review emergency response and evacuation procedures

4.2.71. Orion Marine Group was a member of the CDMCS.

5. Analysis[9]

5.1. *Non-existent or Inadequate Planning Protocols for dredging near pipelines*. The trickle-down failure began with Orion Group Holdings subsidiary, Schneider Engineering and Consulting, which did not identify the pipelines in their Dredge Site Plans, and thereby did not alert that the pipelines then needed to be included in DREDGEPACK and the pipeline company, Enterprise, clearly informed. Clear guidance on the inclusion of pipelines in the dredge plans, specifically pipelines outside the dredge template, but close to it, would ensure that those drafting the plans would do a thorough job of identifying pipeline locations to determine how close they were and then making informed decisions on their inclusion. The initial exclusion of the pipelines from all views of the dredge planning documents kicked off a cascading trail of misinformation. Because the pipelines were initially deemed outside the dredge template, in additional to a seeming lack of understanding across the organization about how the dredge area was depicted in the dredge plans, the Survey Superintendent did not put them in DREDGEPACK. Additionally, the Orion Project Engineer miscommunicated their distance to Enterprise Technicians as described in section 4.2.42. Due to this miscommunication, Enterprise understood that they would consider it a "courtesy" marking in accordance with their policies. This failure points to a need for Schneider and Orion to have better policies internally, but also for there to be greater collaboration and information-sharing between pipeline and dredge companies, specifically for maritime dredge operations

[9] This investigation was multi-faceted and crossed multiple jurisdictional authorities with the other involved state and federal agencies. Since other agencies have primary authority, knowledge, and training in dealing with pipeline operations, inspections, markings, and other governance/guidance, this investigation only discusses those topics to the extent that they intersected with maritime operations.

given the imprecise nature of submerged cutterhead excavation. Everyone who was part of this process should not only have understood what Orion expected to include in the dredge plans, but also how to read the dredge plans to understand the exact parameters of all the locations the cutterhead would be digging. Additionally, had a more robust coordination meeting between Orion and Enterprise occurred where all parties looked at and understood the exact parameters of the dredge plans in relation to the pipelines, Enterprise may have been alerted to the fact that Orion would be excavating closer to their pipelines than they were told. Thus, had adequate planning protocols been in place, the pipelines likely would have been identified as a hazard, another method could have been used to excavate near that area given the actual proximity of the pipeline to the dredge area, which could have prevented the pipeline strike.

5.2. *Failure of Orion to incorporate pipeline into dredging software*. The Leverman and crew only used the DREDGEPACK software program while dredging. Thus, any obstructions, including pipelines, would have been required to be in the DREDGEPACK software for the Leverman to identify the TX-219 pipeline to avoid contact. Here, the Survey Superintendent was responsible for uploading the dredge template in a software program called DREDGEPACK. Once the template was completed, he uploaded the template onto a computer aboard the WAYMON BOYD for it to be incorporated into the DREDGEPACK software. Generally, the Survey Superintendent included pipelines in the DREDGEPACK template if they were in the project area. The Orion Project Manager or Orion Project Engineer, as noted in section 4.2.49, would usually provide the coordinates of the pipeline to the Survey Superintendent. However, neither provided any coordinates for this project to the Survey Superintendent. In fact, the Survey Superintendent stated *he was aware* of pipelines in the area, but he thought they were out of the way on the bank. As the dredging contractor, it was allegedly Orion's duty to investigate utility and pipeline crossing for the dredging areas. This responsibility should have included extensive review of line drawings, available charts, and other resources to ensure all pipelines were identified. Consequently, the Survey Superintendent failed to incorporate the identified pipelines into the DREDGEPACK software. This failure led to a false assumption that the dredging area was free of submerged pipelines or underwater utilities. As such, had the Project Engineer ensured there were no submerged pipelines in the dredging area, the vessel would have been aware of the pipeline and subsequently could not have struck the pipeline.

5.3. *Latent unsafe condition of Orion's Safety Program*. The lack of specificity in the Site Safety Plan discussed in section 4.2.54 is inconceivable from a risk mitigation standpoint. A Site Safety Plan should have all the reasonable risks specific to a job-site, how to identify them, and how to mitigate them. The fact that Orion's HSE Manager was responsible for drafting the Site Safety Plan and did not even have knowledge of the pipelines demonstrates the lack of safety-focus Orion operates under. The person occupying that position at a dredge company should have a keen understanding of pipeline hazards and be included in discussions related to their location. The Site Safety Plan should have included a section on pipelines in the area, what product they contained, their properties and hazards, and how to identify them. Before the beginning of any excavating, the entire crew should have had training on all the identified local hazards and how to respond to them. Had the Site Safety Plan contained the collision risk of the pipelines, mitigating procedures would have been developed, thus reducing the chance of the dredge striking the pipeline.

5.4. *Inadequate training of crewmembers working near pipelines*. It is operationally essential that the more senior crew, such as the Dredge Captain, Deck Captain, and Leverman have training on the proper way to dredge near pipelines. This should include consistent and clear guidance on how close the cutterhead or other equipment get can to pipelines, who to notify if you get within a certain distance from a pipeline, and how to safely dredge near a pipeline. The second facet of training is to ensure that the entire crew is aware of the location of all pipelines in the area, how to identify their marking, signs to look for if one might have been struck, and how to respond. Providing the entire crew this knowledge, would increase the situational awareness of everyone onboard. Potentially, a Deckhand may have the best vantage point to inform the Leverman if he is operating the dredge too close to a pipeline. Thus, had the crewmembers been properly trained on working near pipelines, the crew could have been aware of how close they were to the pipelines and could have informed the Leverman, thus mitigating the risk of striking the pipeline.

5.5. *Lack of professional training requirements for mariners working on dredge vessels.* Because there are no requirements for mariners on board dredges to have Coast Guard issued Merchant Mariner Credentials (MMC), the entirety of their maritime training is at the discretion of the company for whom they work. Separate and apart from the MMC requirements, the maritime training at Orion Marine Group did not include professional training on how to work on a dredge or read nautical charts to identify hazards, let alone work near explosive pipelines. The Leverman and crew relied upon the DREDGEPACK software alone, rather than simultaneously using charts or plan drawings to ensure they were avoiding known hazards. This reliance on one source of information produced by human input resulted in an unsafe condition, as the crew was unable to verify whether there were pipelines in the area they were dredging. If the Coast Guard had a credentialing system for senior positions onboard dredge vessels with operation specific requirements, there would be an established baseline of knowledge that the personnel filling those positions would possess. As the senior crew members are responsible for training the new or junior crew, having basic maritime familiarity and knowledge related to dredging in the maritime environment would help ensure the overall knowledge of each crew member. Thus, had the Coast Guard required training requirements for mariners working on dredge vessels, these mariners would have been trained on recognizing common dredge hazards, such as pipelines, which could have prevented the striking of the pipeline.

5.6. *Failure of Orion to teach crewmembers when to de-energize machinery and operational equipment*. An emergency stop button is a safety device that switches off all the machines and equipment that are connected to the same circuit. Typically, this shared circuit is protected by a residual-current device and one or more emergency stop buttons. Several emergency stop buttons are usually fixed in easily accessible places, enabling anyone to switch off all equipment and machinery in order to prevent an accident. In conjunction with this safety mechanism, crewmembers need to know where the emergency stop buttons are located and when to de-energize equipment. In this case, the WAYMON BOYD was equipped with various means to shutdown ignition sources onboard. Had the crew training included the identification of a possible pipeline strike and the immediate actions to take—including hitting all stop buttons—the crew, upon believing they may have struck a submerged pipeline, could have expeditiously de-energized operational equipment and machinery, thus reducing the ability of the gas to find an ignition source.

5.7. *Failure of Orion to train crewmembers properly on emergency response to striking a pipeline.* In an emergency, there is no room for second-guessing. Emergency procedures should be as clear and as unambiguous as possible. All crew should know what it looks like if a pipeline might have been hit so that they can respond immediately by shutting down machinery to minimize possible ignition sources and abandoning ship immediately. Crew should be aware of basic properties of the materials contained in the pipelines they are operating close to – is this material odorized? Is it a health hazard if touched or inhaled? The crew also should know how to respond immediately; do we muster before we abandon ship? When the crew only have 66 seconds of available time, every second counts. Finally, crew should be empowered to take the safest course of action if the exact threat is unknown. Orion's lack of training created a latent unsafe condition that remained dormant until crewmembers were required to respond. Had Orion trained the crew of the WAYMON BOYD how to respond to an emergency, the loss of life may have been prevented.

5.8. *Lack of Coast Guard regulations covering basic requirements onboard dredge vessels.* There are currently no Coast Guard requirements for dredge vessels to have a Safety Management System (SMS) or conduct basic safety inspections. Having a Safety Management System and some additional interaction with Coast Guard inspectors would ensure that basic procedures onboard were outlined, training and drills were conducted regularly, and emergency procedures were scripted – all of which are items that have been identified above as having been lacking in the prevention of and crewmember response to this incident. Additionally, an annual visit or inspection from Coast Guard members provides an opportunity for experienced inspectors to come onboard to review the procedures, watch a drill being performed, and identify any items that might be lacking that could help improve the overall safety of the vessel and crew. Had there been more oversight of the WAYMON BOYD, the inadequate training and safety programs could have been identified, and the loss of life or extensive injuries may have been prevented.

6. Conclusions

6.1. Determination of Cause:

6.1.1. The initiating event for this casualty was the cutterhead of the WAYMON BOYD striking TX219 pipeline, releasing propane into the water. Casual factors contributing to this event were:

6.1.1.1. Lack of inclusion of the pipeline in all dredge plans.

6.1.1.2. Lack of inclusion of the pipeline in DREDGEPACK.

6.1.1.3. Lack of comprehensive planning coordination meeting between Orion and Enterprise.

6.1.1.4. Lack of training of the crew in pipeline identification and working near pipelines.

6.1.1.5. Inadequate Orion Safety Program and Site Safety Manual.

6.1.1.6. Lack of professional training requirements for mariners working on dredge vessels.

6.1.1.7. Lack of Coast Guard oversight of dredge vessels.

6.1.2. The first subsequent event was the explosion and fire onboard. The causal factors contributing to this event were:

6.1.2.1. Lack of training for the crew to hit the "all stop" to minimize ignition sources.

6.1.3. The second subsequent event was the loss of life onboard. The causal factors that contributed to this event were:

6.1.3.1. Lack of drills and training for the immediate identification of a possible pipeline strike.

6.1.3.2. Lack of drills and training for the emergency procedures for a pipeline strike, including immediately abandoning ship.

6.1.4. The third subsequent event was the progressive flooding and sinking of the dredge WAYMON BOYD. The causal factors that contributed to this event were:

6.1.4.1. Lack of training for the crew to hit the "all stop" to minimize ignition sources, which caused the explosion that allowed for water intrusion.

6.2. Evidence of Act(s) or Violation(s) of Law by Any Coast Guard Credentialed Mariner Subject to Action Under 46 USC Chapter 77:

6.2.1. There were no acts by Coast Guard Credentialed Mariners found to meet these criteria.

6.3. Evidence of Act(s) or Violation(s) of Law by U.S. Coast Guard Personnel, or any other person:

6.3.1. There were no acts by U.S. Coast Guard Personnel found to meet these criteria.

6.4. Evidence of Act(s) Subject to Civil Penalty:

6.4.1. The actions described above represent a potential violation of 46 U.S.C. § 2302(a) Penalties for Negligent Operations, by the operator, Orion Marine Group for failure to set proper planning and risk mitigation procedures for dredging near pipelines and failure to conduct appropriate crew training for working near pipelines and responding to emergencies.

6.5. Evidence of Criminal Act(s):

6.5.1. No acts found that met this criterion.

6.6. Need for New or Amended U.S. Law or Regulation:

6.6.1. The actions described in paragraph 5.5 represent the potential need to amend 46 U.S.C. 8101 et seq. and 46 C.F.R. 15.101 et seq. to require Barge Captains, Leverman,

and other crewmembers working on the dredge to possess a Coast Guard Merchant Mariner Credential. See Safety Recommendation 1.

6.6.2. The actions described in paragraph 5.8 represent the potential need to amend 46 U.S.C. Subtitle II, Part B and applicable regulations in Title 46 to require non-self-propelled dredges over 100 gross tons that do not meet the requirements under 46 C.F.R. Table 2.01-7(a)(4), such as the WAYMON BOYD, be subject to inspection. See Safety Recommendation 2.

6.7. Unsafe Actions or Conditions that Were Not Causal Factors:

6.7.1. None identified.

7. Actions Taken Since the Incident

7.1. On December 7, 2021 the National Transportation Safety Board adopted the "Hazardous Liquid Pipeline Strike and Subsequent Explosion and Fire aboard the Dredging Vessel *Waymon Boyd*" Report, as well as issuing safety recommendations during a public board meeting.

7.2. Orion Marine Group implemented "Underwater Utilities Training" for dredge crew and shore side personnel to be conducted twice a year.

7.3. Orion Marine Group assigned safety supervisors to its dredges to focus solely on implementing the safety program onboard.

7.4. Enterprise Products is evaluating alternative means of protecting the shallow water pipelines in the incident area since EPIC terminated the East Dock Project, which would have built a bulkhead and backfill to safeguard the pipelines.

8. Recommendations

8.1. Safety Recommendation:

8.1.1. Safety Recommendation 1. To achieve the shared goal in increasing safety and proficiency in dredging operations, it is recommended that the Coast Guard institute requirements that mariners, minimally Barge Captains, Dredge Captains, and Leverman, operating on dredge vessel possess a Coast Guard issued Merchant Mariner Credential (MMC). Current regulations do not require MMCs for any crewmembers on dredge vessels. This, in turn, creates a latent unsafe condition that remains dormant until a significant or major marine casualty occurs that brings to light the ineptitude and complacency that exists in the dredging industry. Indeed, in the absence of federal law and regulations requiring a national standard for dredge crewmember competency, we rely on dredge companies to identify critical competency areas and promulgate unambiguous policies for crew training. In this case, the Barge Captain, Dredge Captain, Leverman, and other experienced crew were not trained to identify pipelines and how to appropriately respond to a potential pipeline strike with emergency shutdown procedures and abandoning ship. While there were a lot of possible ignition sources, an immediate shutdown of machinery could have limited them and an immediate call to abandon ship once the pipeline was stuck could have saved lives. Without proper training to take

these steps immediately, crew members waste valuable seconds determining what happened and what actions to take, which likely costed lives.

8.1.2. Safety Recommendation 2. To achieve the shared goal in increasing safety and proficiency in dredging operations, it is recommended that the Coast Guard institute requirements that manned uninspected dredges over 100 gross tons be subject to inspection under U.S. law and regulations. Existing regulations under 46 C.F.R. Table 2.01-7(a)(4) and 46 C.F.R. Subchapter I require self-propelled dredges of 300 gross tons or more, as well as manned non-self-propelled dredges under 100 gross tons, to be inspected. Dredges are considered "manned" if they have personnel onboard for the purposes of operating and navigating the dredge, including operating dredging equipment. The relative nature of non-self-propelled dredging operations does not hinge on whether a dredge is a prescribed tonnage; rather, the dredging components and overall operation are generally the same on most dredge vessels. However, the 300 gross ton self-propelled dredge or manned non-self-propelled dredges under 100 gross tons are designed and maintained in accordance with regulations intended to increase safety in commercial operations. Had the WAYMON BOYD been subject to inspection, the requirements in 46 C.F.R. Subchapters I, J, and F mandate stringent lifesaving, fire protection, electrical, and machinery related requirements that will lead to an increase in shipboard operations and equipment safety, thus supporting the intent and goals of the marine safety program.

8.2. Administrative Recommendations:

8.2.1. Administrative Recommendation 1: Recommend the Officer in Charge, Marine Inspection, Sector Corpus Christi, initiate an investigation involving potential civil penalties in accordance with 33 CFR Part 1.

8.2.2. Administrative Recommendation 2: Recommend this investigation be closed.

[redacted]

Lieutenant Commander, U.S. Coast Guard
Investigating Officer