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Hazardous Liquid Pipeline Strike and Subsequent Explosion and Fire Aboard Dredging Vessel *Waymon Boyd*

Corpus Christi, Texas
August 21, 2020

Virtual Board Meeting Staff Participants

Morgan Turrell	Director, Office of Marine Safety (OMS)
Luke Wisniewski	Investigator-in-Charge (MS-10)
Drew Ehlers	Nautical Operation (MS-10)
Mike Hoepf	System Safety and Human Performance (RPH-40)
Paul Stancil	Pipeline Operations (RPH-20)
Frank Zakar	Materials Engineering (RE-30)
Mary Pat McKay	Medical Officer (RE-1)
Eric Emery	Safety Research (RE-10)
Becca Martini	Writer / Editor (MS-20)

Virtual Board Meeting Staff Participants

Kathleen Silbaugh	General Counsel (GC-1)
Kathryn Catania	Deputy Director, Office of Safety Recommendations and Communications (SRC-1)
Robert Hall	Director, Office of Railroad, Pipeline, and Hazardous Materials Investigations (RPH-1)
Jim Ritter	Director, Office of Research and Engineering (RE-1)
Eric Stolzenberg	Deputy Director, Office of Marine Safety (MS-1)
Liam Larue	Chief of Marine Investigations (MS-10)
Rob Jones	Deputy Chief of Marine Investigations (MS-10)
Mike Budinski	Chief of Materials Laboratory (RE-30)
Sean Lynum	Chief of Pipeline and Hazardous Materials (RPH-20)
Bob Beaton	Chief of System Safety (RPH-40)
Scott Rainey	Safety Recommendations (SRC-50)

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Accident Overview: Hazardous Liquid Pipeline Strike and Subsequent Explosion and Fire Aboard Dredging Vessel *Waymon Boyd*

Luke Wisniewski
Investigator-in-Charge

Staff Who Supported the Investigation

Roger Evans	Pipeline & Hazardous Materials Division (RPH-20)
Benjamin Allen	Office of General Counsel (GC-1)
Bill English	Office of Aviation Safety (AS-10)
John O'Callaghan	Vehicle Performance Division (RE-60)
Edward Komarnicki	Materials Laboratory Division (RE-30)
Joseph Panagiotou	Materials Laboratory Division (RE-30)
Sean Payne	Vehicle Recorder Division (RE-40)
Christy Spangler	Digital Services Division (SRC-60)
Katy Chisom	Transportation Disaster Assistance Division (MD-6)
Stephanie Matonek	Transportation Disaster Assistance Division (MD-6)
Rolando Garcia	Special Operations MD-5
Jennifer Bishop	Investigative Products (MD-2I)
Nicole Ashby	Writer / Editor (MS-20)
Kristyn Jeschelnik	Writer / Editor (MS-20

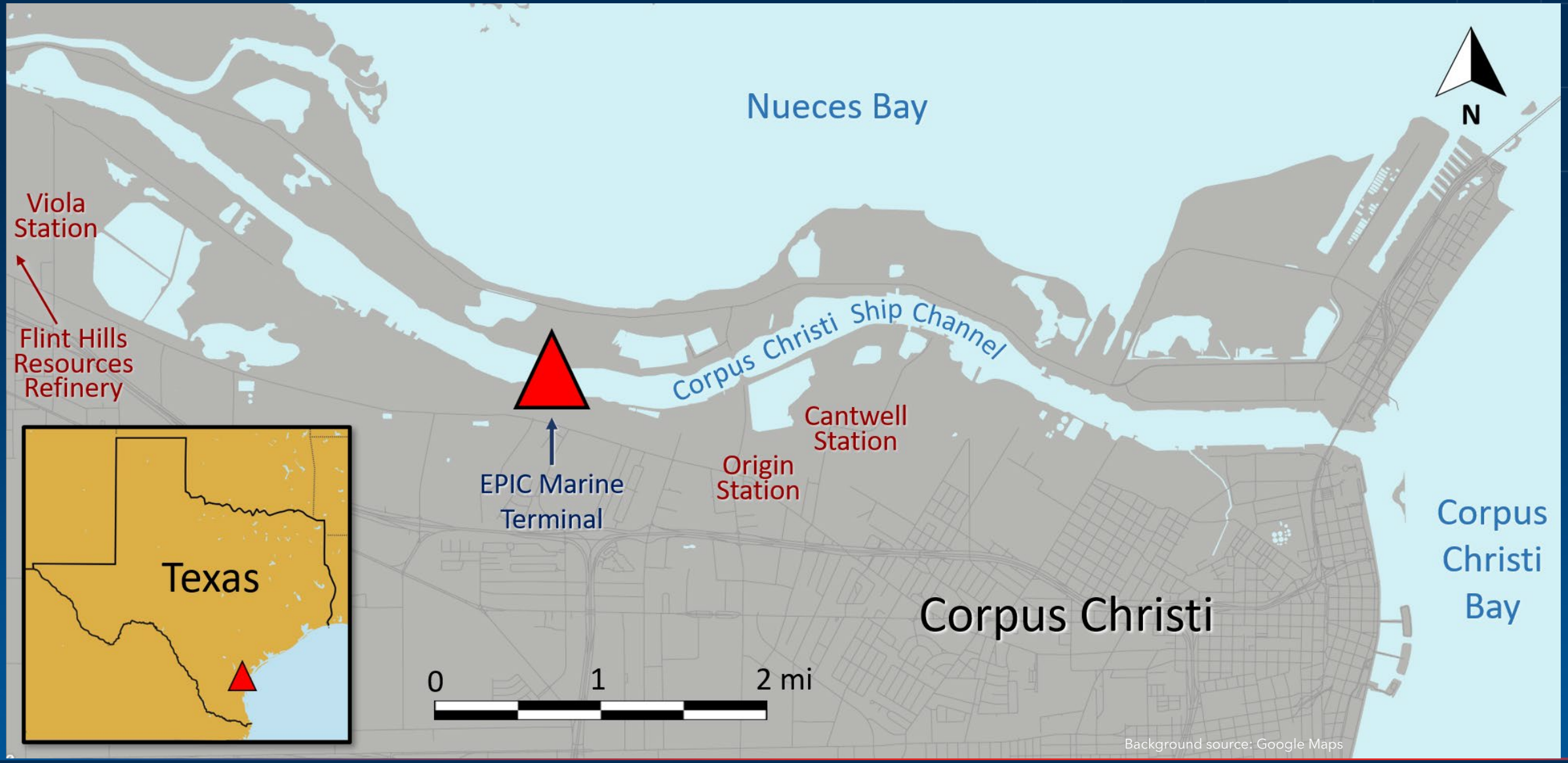
Staff Who Produced Virtual Board Meeting

James Anderson	Audio Visual Production (SRC-60)
Deidre Esters	Management Support Specialist (AD-10)
Kelley Romeo	Enterprise Architect Coordinator (CIO-60)
Rahiq Syed	Enterprise Architect Chief (CIO-60)
Carl Perkins	Management Information Specialist (AD-10)
Barton Barnum	Office of Marine Safety (MS-10)
Brian Young	Office of Marine Safety (MS-10)

Parties to the Investigation

- US Coast Guard
- Pipeline and Hazardous Materials Safety Administration (PHMSA)
- Railroad Commission of Texas
- Orion Group Holdings
- Enterprise Products
- HYPACK, a Xylem brand

Corpus Christi, Texas



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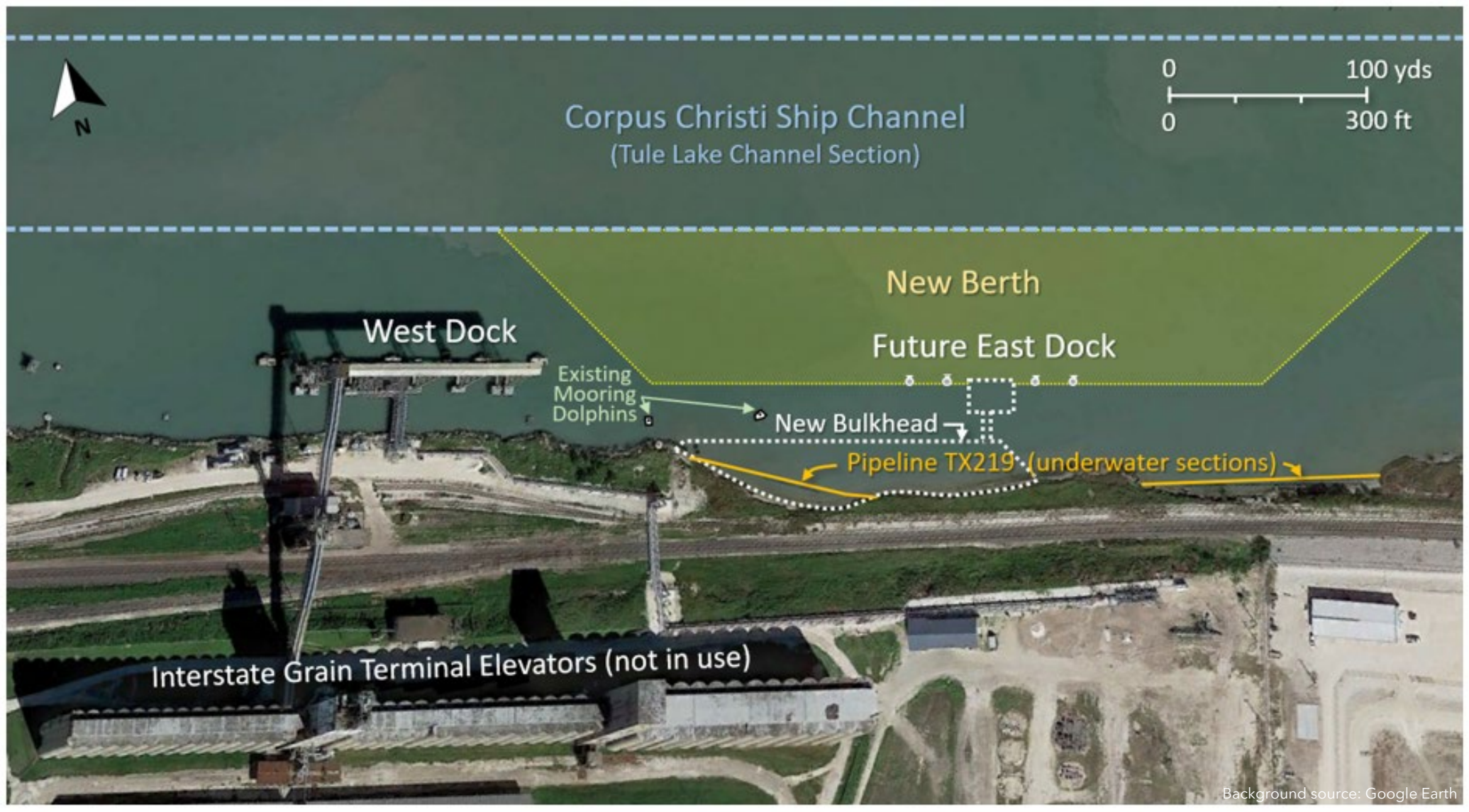
EPIC Marine Terminal



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Orion Group Holdings

Source: Orion

Cutter Suction Dredge *Waymon Boyd*

Source: Orion Marine Group

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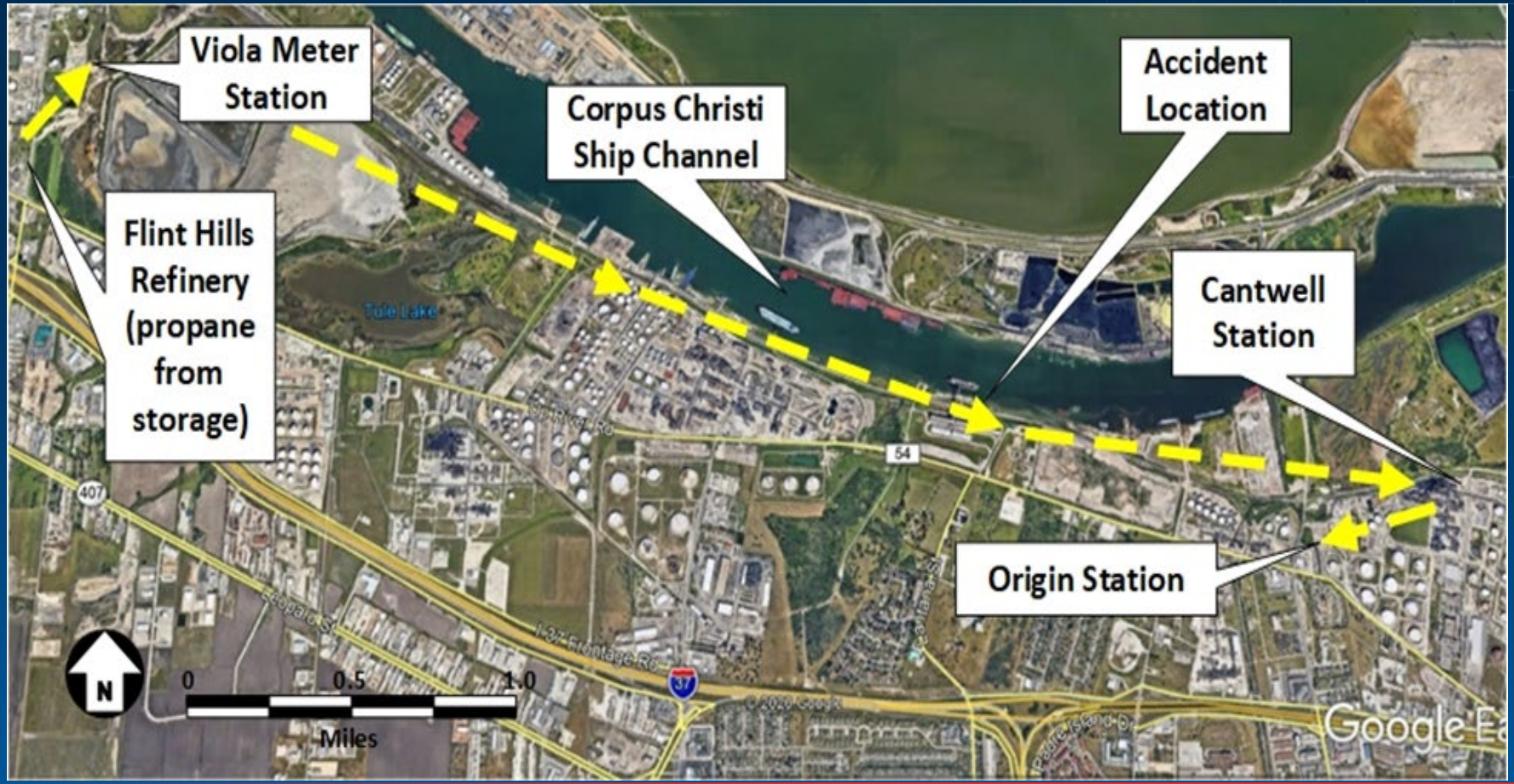
Enterprise Products Pipeline TX219



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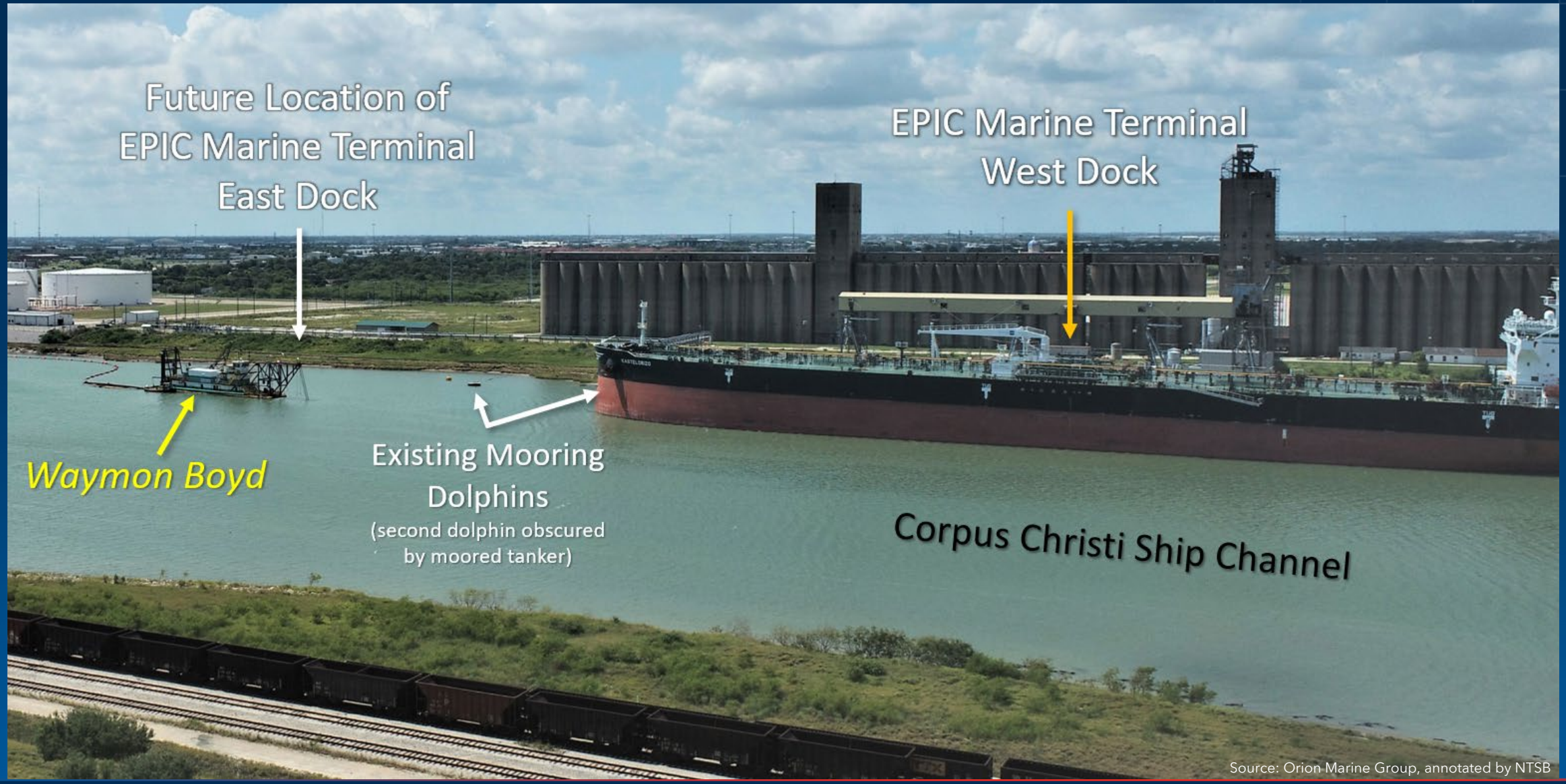
Waymon Boyd at the EPIC Marine Terminal East Dock



Source: Orion Marine Group, annotated by NTSB

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EPIC Marine Terminal Security Camera Video

Source: EPIC

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Initial Information

- August 21, 2020
- 8:02 a.m. Central daylight time
- Dredge *Waymon Boyd*
- Crew Injuries
  - Four fatal
  - Six serious

Source: Coast Guard

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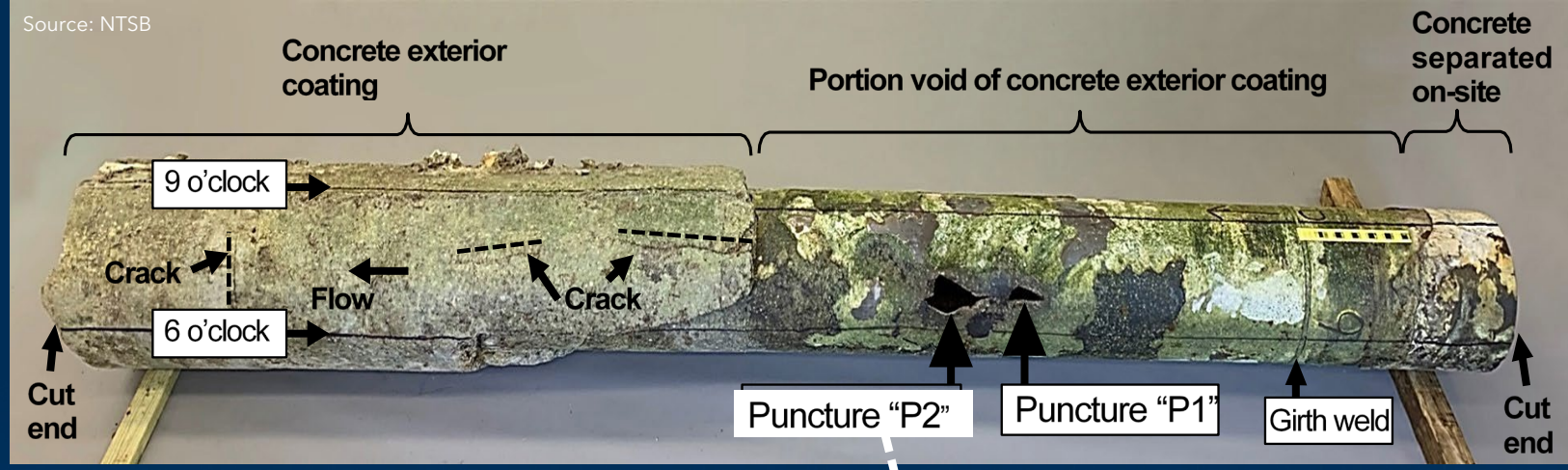
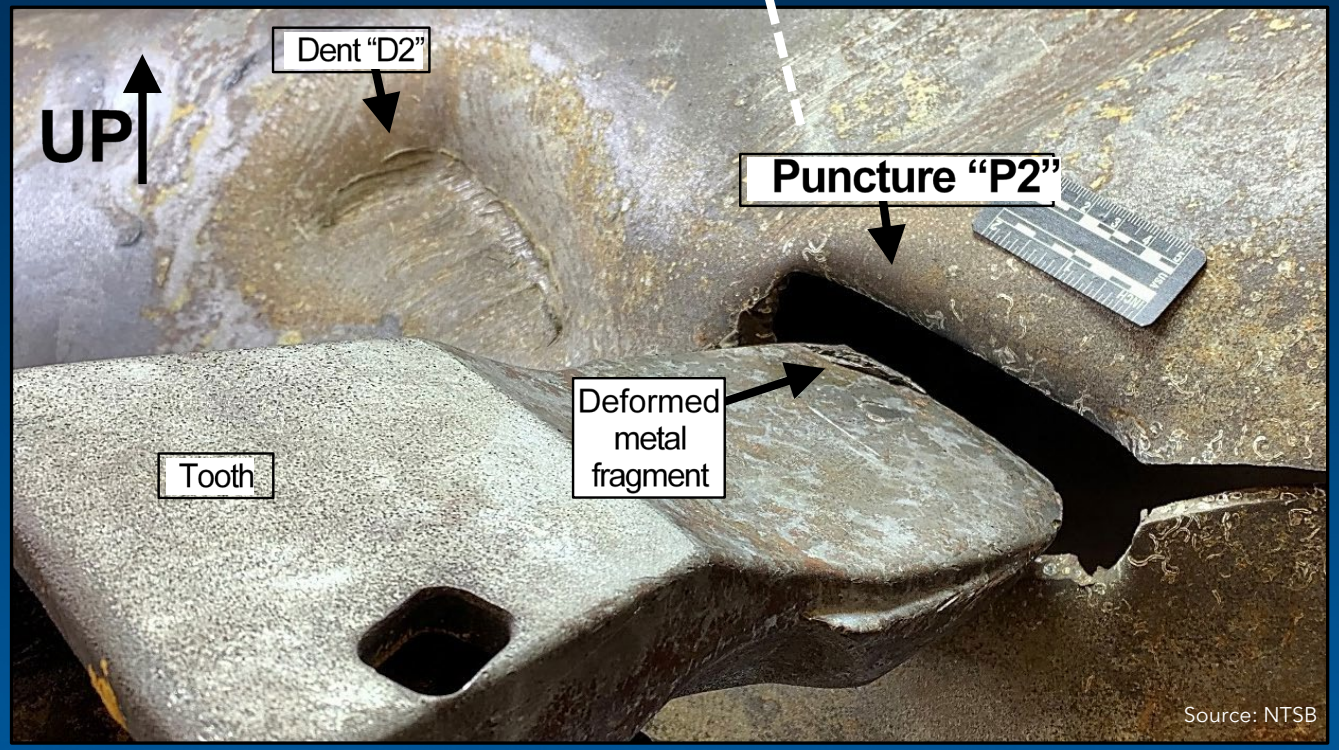
Damages

- TX219 - $2.09 million
- *Waymon Boyd* - $9.48 million
- EPIC Facility -$120,000





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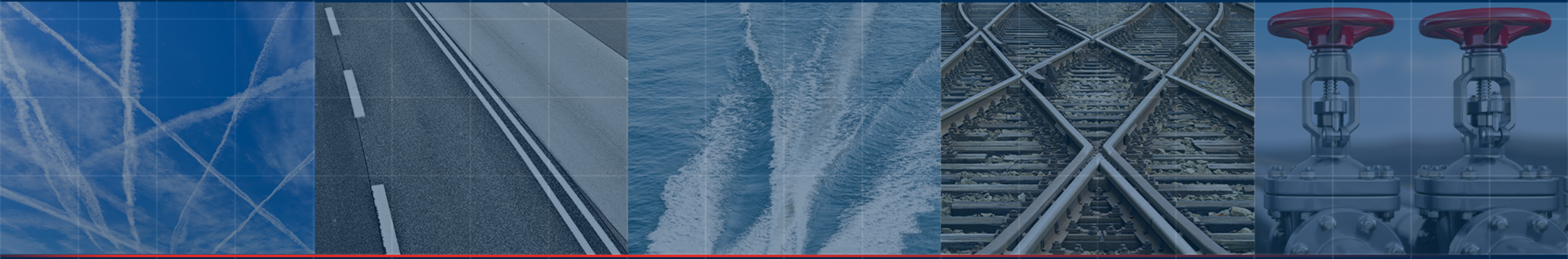
Exclusions

- Personnel experience and qualifications of the equipment operators
- Fatigue
- Distraction from cell phone use
- Vessel mechanical and electrical systems failures
- Environmental conditions
- Leak detection systems on pipeline TX219
- Pipeline operating history and operating pressure
- Pipeline integrity
- Transport of non-odorized propane in the pipeline
- Pipeline depth of cover

Safety Issues

- Operations
  - Engineering plans, GPS Accuracy, DREDGEPACK, Training
- Project Planning & Risk Assessment
  - Site Specific Safety Plan, Job Hazard Analysis, Safety Controls
- Pipeline Damage Prevention
  - One-Call, Pipeline Marking, Tolerance Zones



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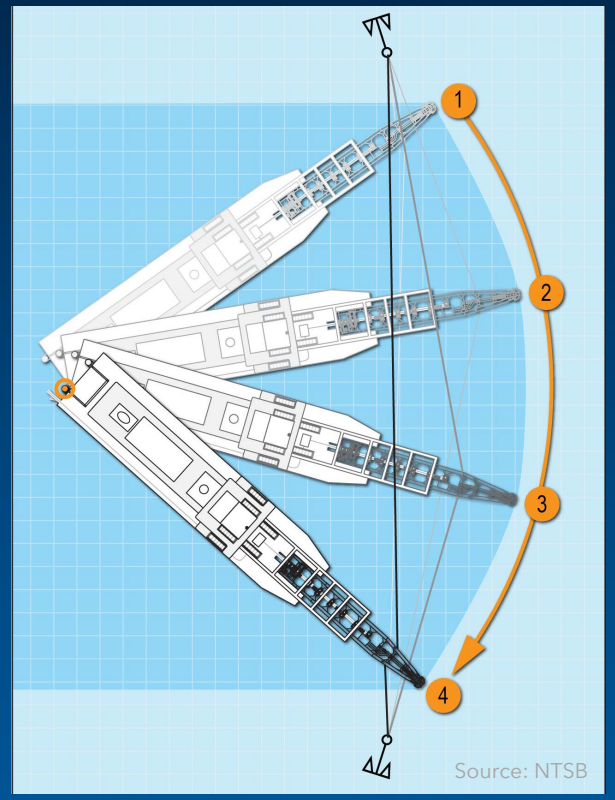

Nautical Operations

Andrew Ehlers
Nautical Operations Group Chairman

Dredge Project Engineering Plans

EPIC Marine Terminal
Dredging Construction Plans

for
EPIC Crude Terminal Company, LP
Corpus Christi, Texas

PROPOSED PRIVATE IMPROVEMENTS
ON LEASE / EASEMENT PREMISES
Information Rec'd:
Reviewed By: [redacted]
No Objections ☒
Comments Noted ☐
Revise & Resubmit ☐
Review is for General Conformance
with PCCA Requirements Only.

PROJECT VICINITY
N.T.S.

LOCATION MAP
N.T.S.

INDEX OF DRAWINGS

DWG. NO.	DESCRIPTION
GENERAL	
G1.1	TITLE SHEET AND INDEX OF DRAWINGS
G2.1	EXISTING SITE PLAN
DREDGING	
DR1.1	DREDGE SITE PLAN
DR2.1	CROSS SECTIONS – 1
DR2.2	CROSS SECTIONS – 2
DR3.1	DREDGE PIPELINE ROUTE

PRINT DATE:
Tuesday, June 23, 2020
9:29am

June 23, 2020

[redacted]

ORION

SCHNEIDER ENGINEERING & CONSULTING

ISSUED FOR CONSTRUCTION

PROJ. NO. 10P-00230
DRAWING NO.
G1.1

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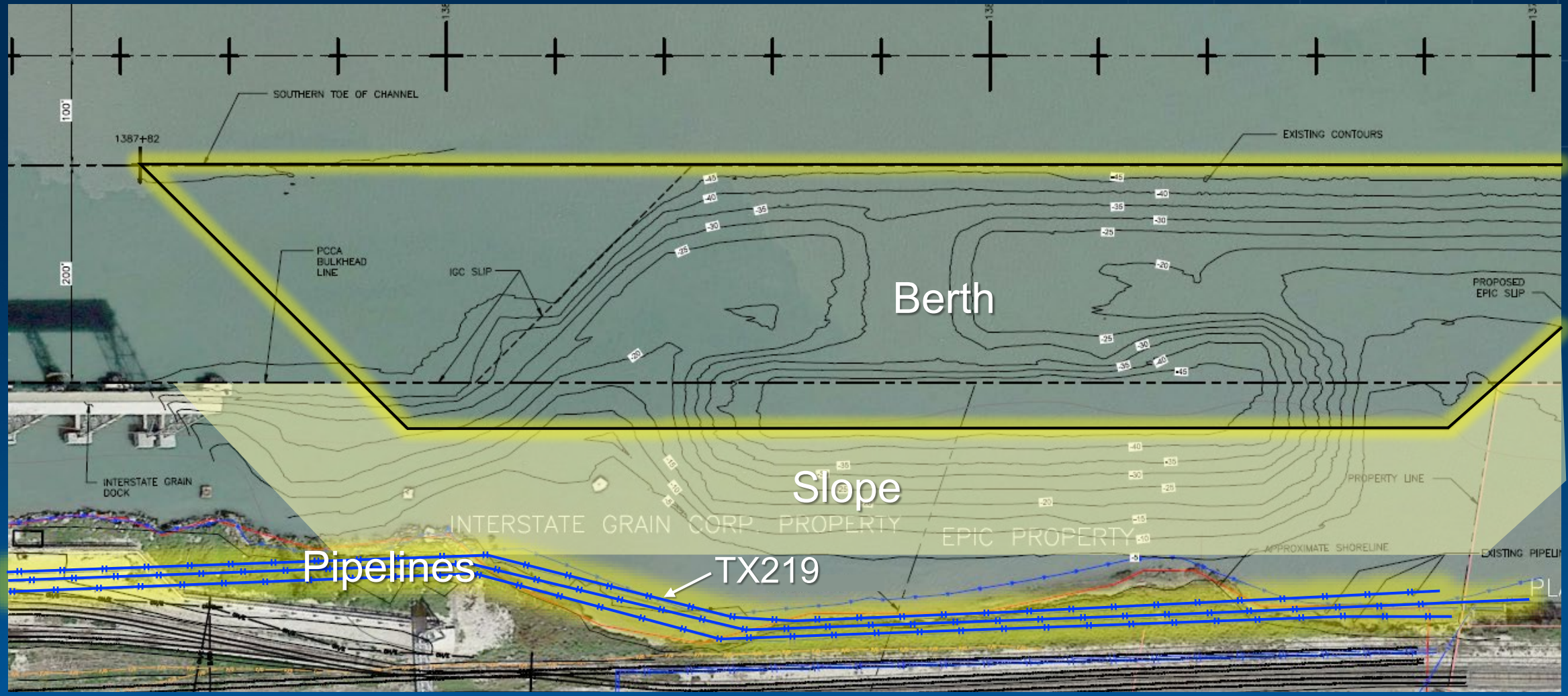
Dredge Project Engineering Plans



Source: Orion Marine Group, annotated by NTSB

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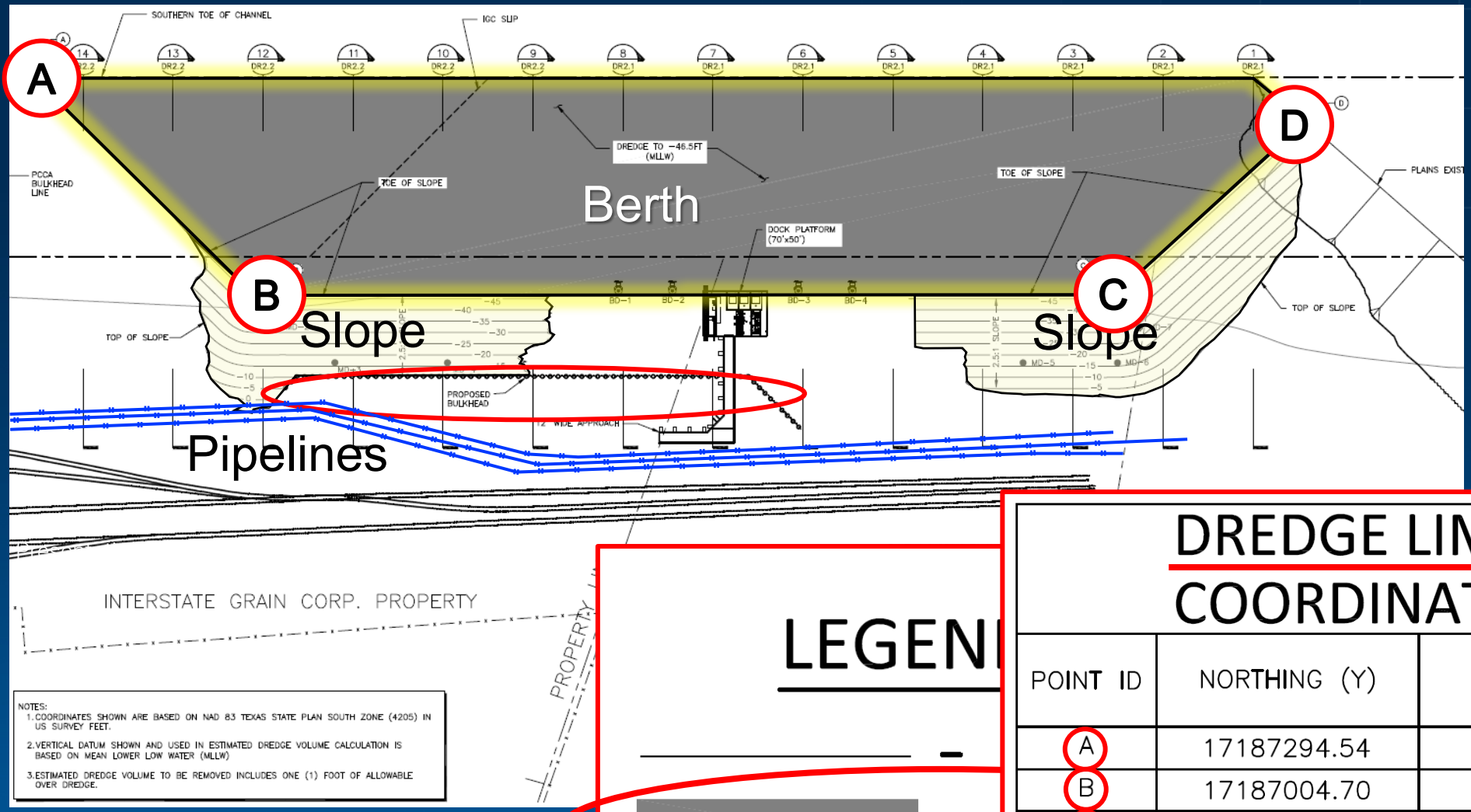
Dredge Project Engineering Plans



DREDGE LIMIT COORDINATES

POINT ID	NORTHING (Y)	EASTING (X)
A	17187294.54	1317351.14
B	17187004.70	1317539.39
C	17186799.66	1318474.89
D	17186942.66	1318723.35

Source: Orion Marine Group, annotated by NTSB

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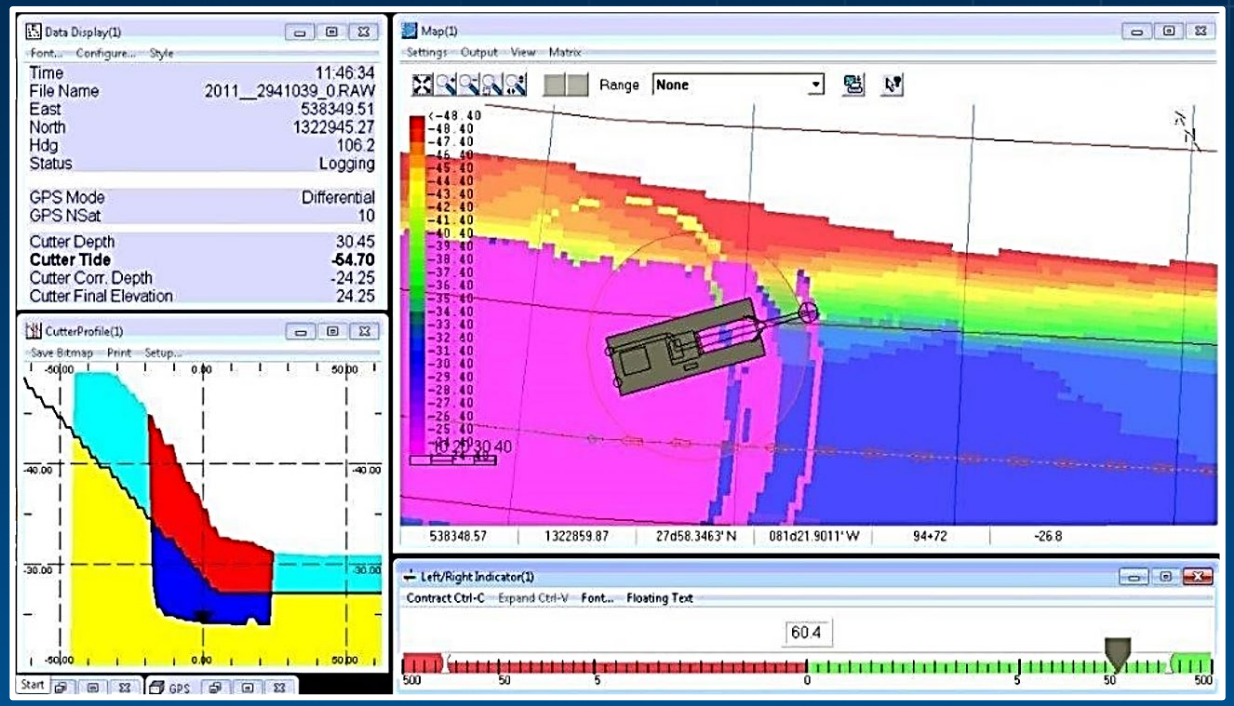
What We Found: Dredge Project Engineering Plans

- Plans for the EPIC dock project did not clearly reflect the proximity of the pipeline to the full dredging area
- Schneider Engineering and Consulting did not have specifications, quality control measures, or best practices for including pipeline hazards and tolerance zones in engineering plans and drawings
- What we propose:
  - One recommendation to Orion Group Holdings

DREDGEPACK Software

Used aboard dredge to aid leverman

- Displays in real time position of cutterhead relative to dredge plan (template)
- Can display hazards, such as pipelines, and tolerance zones around those hazards



Source: HYPACK

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Hazard Awareness

- Incorporation of accurate pipeline location data into dredging software on board is a critical tool for avoiding pipeline strikes and other potential hazards
- Orion had no written procedures requiring pipelines or other utilities be entered into DREDGEPACK software
- Although location data was provided to the company, it was not included in the DREDGEPACK dredge template used by the Waymon Boyd
- Orion Marine Group did not have written policies or procedures for planning dredging operations near pipelines

What We Found: Hazard Awareness

- Orion Marine Group did not have adequate procedures to require that pipelines be identified and included in DREDGEPACK
- Waymon Boyd's leverman was unaware how close he was operating the cutterhead to the pipeline
- Written policies and procedures could have eliminated confusion about the pipeline location and minimum tolerance distances
- What we propose:
  - One recommendation to Orion Group Holdings

Dredging Operation Accuracy

- Leverman stated that he did not operate the cutterhead outside the template
- Pipeline about 1’ outside of dredge template
- Leverman reliant on DREDGEPACK for position of cutterhead relative to dredge template and any hazards
  - GPS accuracy: 1 meter (3.3 feet)
  - Accuracy of cutterhead position relative to GPS antenna and depth dependent on manual/auto inputs
  - Display resolution accuracy and symbology
- *“It’s not scalpel surgery”*

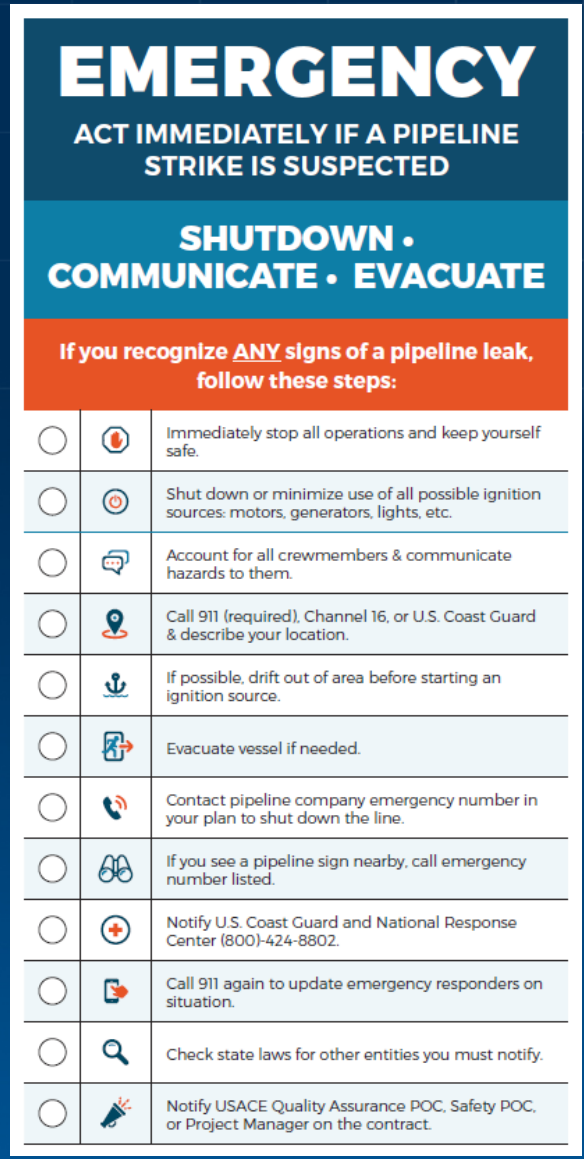
Waymon Boyd cutterhead

What We Found: Dredging Operation Accuracy

- GPS margin of error alone could have put the cutterhead within striking distance of the pipeline
- Probability of strike increased by other potential positional errors
- Dredging area specified in engineering plans was too close to pipeline TX219 for safe excavation using a cutterhead dredge.

Pipeline Hazard Training

- Counsel for Dredging and Marine Construction Safety (CDMCS) guidelines - recommended actions for a pipeline strike:
  - Immediately stop all operations
  - Shut down or minimize the use of all possible ignition sources
  - Account for crewmembers and communicate the hazards to them
  - Evacuate the vessel, if needed
- *Waymon Boyd* crew not trained in recommended actions for pipeline strike
- Orion had no emergency procedures for pipeline strike



EMERGENCY

ACT IMMEDIATELY IF A PIPELINE STRIKE IS SUSPECTED

SHUTDOWN • COMMUNICATE • EVACUATE

If you recognize ANY signs of a pipeline leak, follow these steps:

○	Immediately stop all operations and keep yourself safe.
○	Shut down or minimize use of all possible ignition sources: motors, generators, lights, etc.
○	Account for all crewmembers & communicate hazards to them.
○	Call 911 (required), Channel 16, or U.S. Coast Guard & describe your location.
○	If possible, drift out of area before starting an ignition source.
○	Evacuate vessel if needed.
○	Contact pipeline company emergency number in your plan to shut down the line.
○	If you see a pipeline sign nearby, call emergency number listed.
○	Notify U.S. Coast Guard and National Response Center (800)-424-8802.
○	Call 911 again to update emergency responders on situation.
○	Check state laws for other entities you must notify.
○	Notify USACE Quality Assurance POC, Safety POC, or Project Manager on the contract.

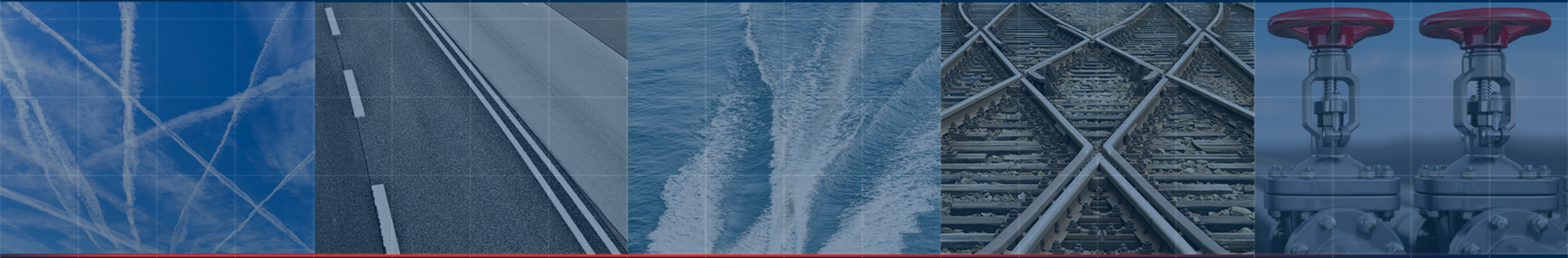
CDMCS checklist of recommended procedures for pipeline strike

What We Found: Pipeline Hazard Training

- Waymon Boyd crew lacked function-specific pipeline safety training and emergency procedures that could have prepared them to react quicker and more effectively to the pipeline strike.
- Postaccident, Orion Marine Group instituted utilities awareness training

What We Found: Pipeline Hazard Training

- Dredging industry would benefit from training on utilities awareness and emergency procedures in the event of a pipeline strike
- The circumstances of this accident also provide a number of lessons learned
- The Coastal and Marine Operators' (CAMO) Pipeline Industry Initiative online training course could be enhanced by lessons learned from this accident
- What we propose:
  - One recommendation to Coastal and Marine Operators (CAMO)



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System Safety: Project Planning & Risk Management

Mike Hoepf, Ph.D.

Project Planning

EPIC

- Had Pipelines identified in a survey
- Requested pipelines included in project drawings

Orion & Schneider

- Specified a dredging area too close to pipeline TX219

Enterprise

- Not included in project planning
- May have discovered that dredging area was too close to pipeline TX219 and suggested safer alternatives

Site-Specific Safety Plan (SSSP)

- Required by Orion's Health Safety and Environmental (HSE) policies manual
- Described as an emergency response plan
- Did not address pipelines, nor any site-specific risk
- Did not help manage risk

Job Hazard Analysis (JHA)

- JHA required during “preplanning stage” – not completed
- Did not complete a risk assessment
- Risk not documented or understood

Individual	Understanding of Distance Between Dredge Area and Pipelines
Schneider Design Engineer	8-10 feet
Orion Regional HSE Manager	Not aware of pipeline TX219
Orion Project Manager	30 feet
Orion Project Engineer	60 feet
***Waymon Boyd* Dredge Captain**	Instructed to remain 20 feet from pipelines
***Waymon Boyd* Deck Captain**	Instructed to remain 20 feet 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 feet

Actual distance about 1 foot

Safety Controls

Effective controls

- Protect workers from workplace hazards
- Help avoid injuries, illnesses, and incidents

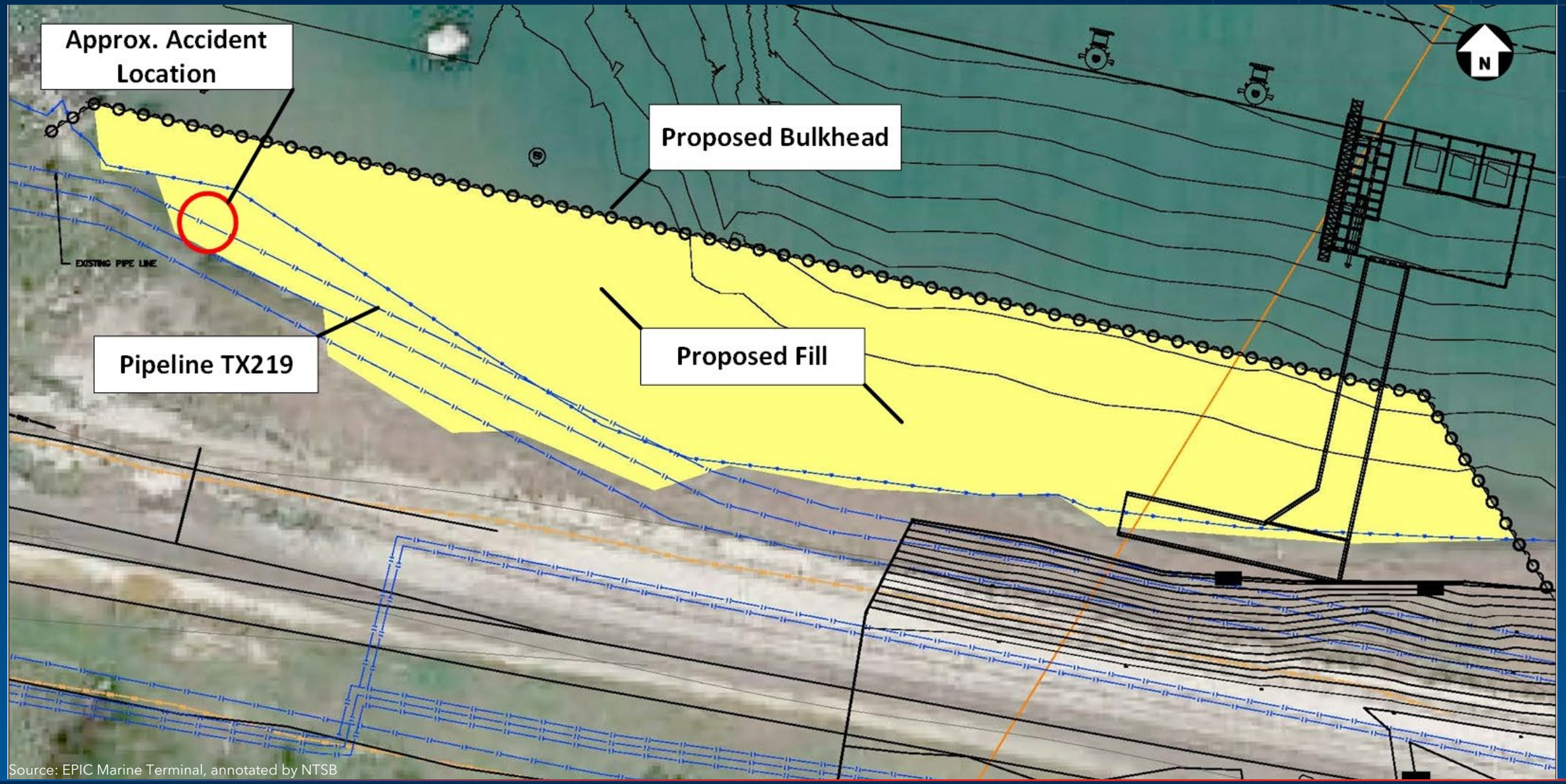
Hierarchy of controls to mitigate hazards

- Eliminate hazard > Engineering controls
- Engineering controls > Administrative controls

Engineering controls were available

- Establish tolerance zones around the pipelines

Proposed Bulkhead



Source: EPIC Marine Terminal, annotated by NTSB

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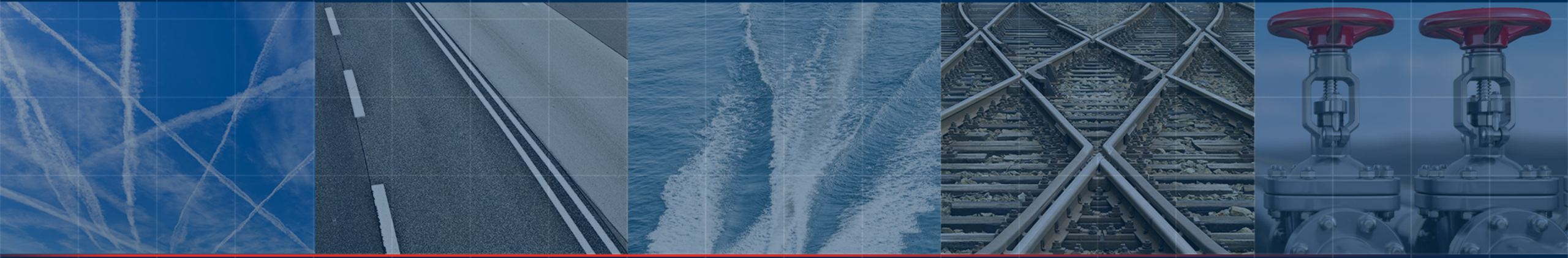
What We Found: Risk Management

- Project planning and risk management were inadequate
- Failure to identify and mitigate the risk of a cutterhead impact with pipeline TX219
- Critical that organizations have project planning steps that support accurate risk assessment and proportionate mitigation
- What we propose:
  - One recommendation to Orion



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Pipeline: Damage Prevention Safety Issues

Paul Stancil
Pipeline Operations Group Chairman

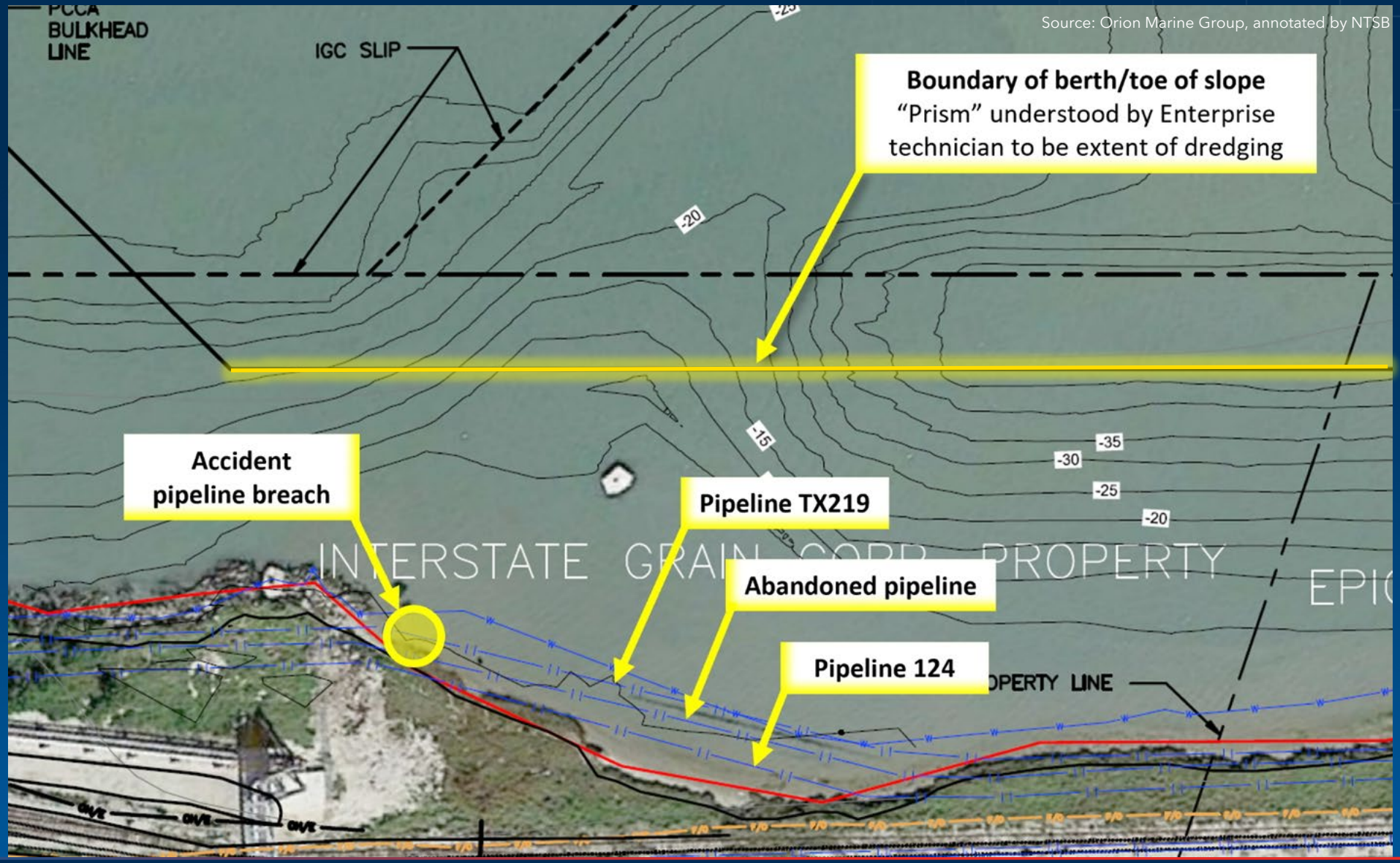
One-Call Notification

- Connect excavators with affected utility operators
- Orion Marine Group one-call notification
- Two pipelines identified near project area
- No on-site plan review
- Incomplete and misleading dredging plans

One-Call Communications

- Orion Marine Group project engineer misinterpreted drawings
- Project engineer communicated incorrect dredging boundaries
  - Dredging would be 60 feet from pipelines
  - Dock platform (near shore) dredging already completed to grade
  - “Shouldn’t be a need for concern”

Misleading Dredging Plans



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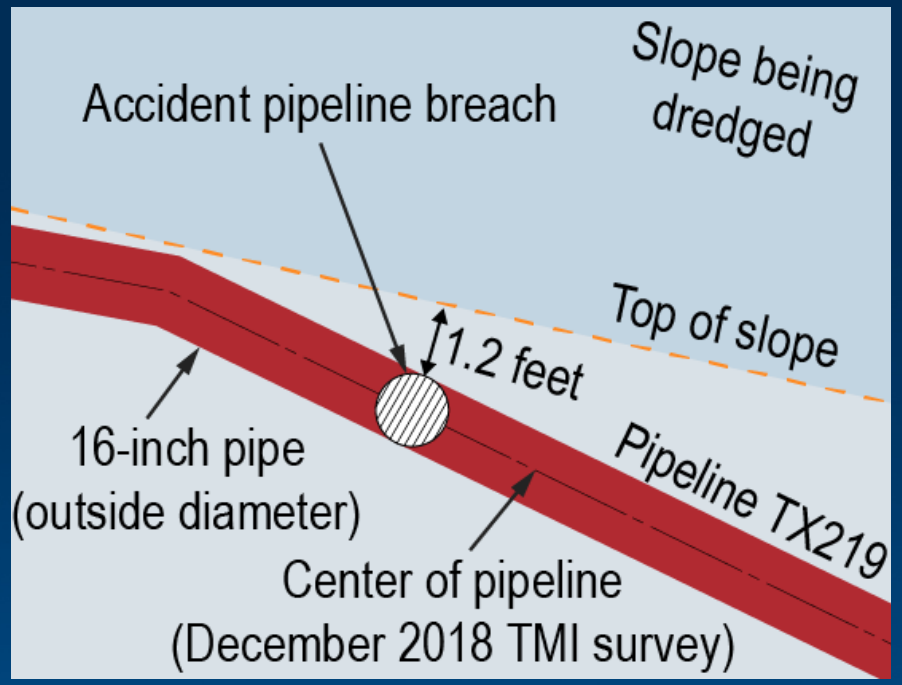
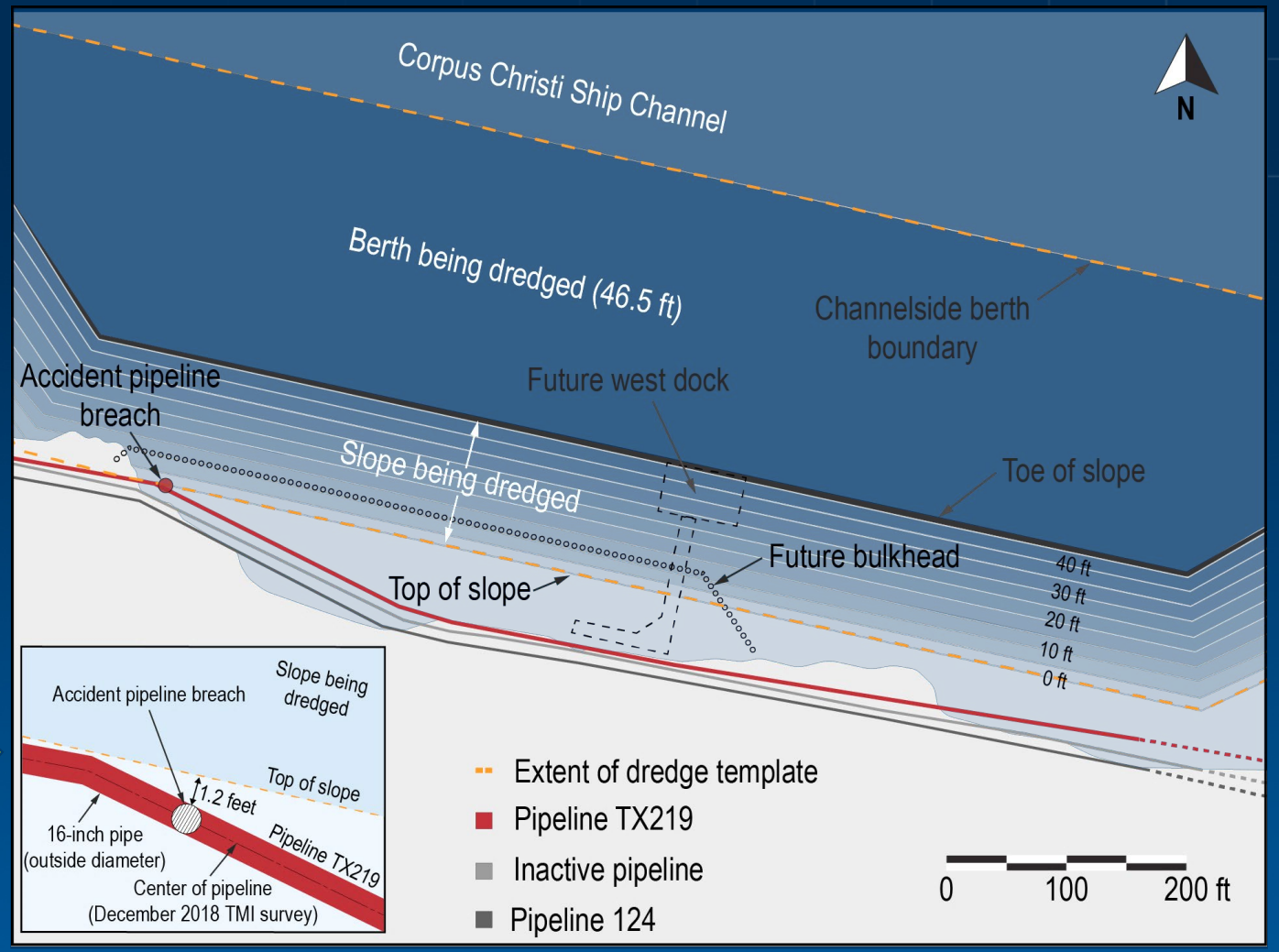
One-Call Closeout

- Believed pipeline TX219 would be clear of project
- Determined dredging boundary exceeded 50-foot limit for mandatory marking

Dredging Plan Analysis



Source: NTSB



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What We Found: One-Call for Dredging Projects

- Inaccurate communications and misinterpreted plans
- No pipeline markings or other protective measures
- Greater collaboration needed between pipeline and dredging companies
- What we propose:
  - One recommendation to Orion Marine Group
  - Recommendations to PHMSA, CAMO, and CDMCS

Pipeline Locating and Marking

- Pipeline was not marked for excavation damage avoidance
- Follow up marking request for dredge anchor avoidance
- Courtesy marked with widely-spaced cane poles

Pipeline Marking Options

Source: Orion Marine Group

Courtesy marking (pre-accident)

Source: Enterprise Products, annotated by NTSB

Mandatory marking (post-accident)

Dredge Area Pre-marking

- Pre-marking informs pipeline operator of proposed excavation areas
- 1997 NTSB safety study: pre-marking helps prevent excavation damage
- State regulations require pre-marking, but do not address marine construction
- Pre-marking could have prompted mandatory pipeline marking

What We Found: Pipeline and Dredge Area Pre-marking

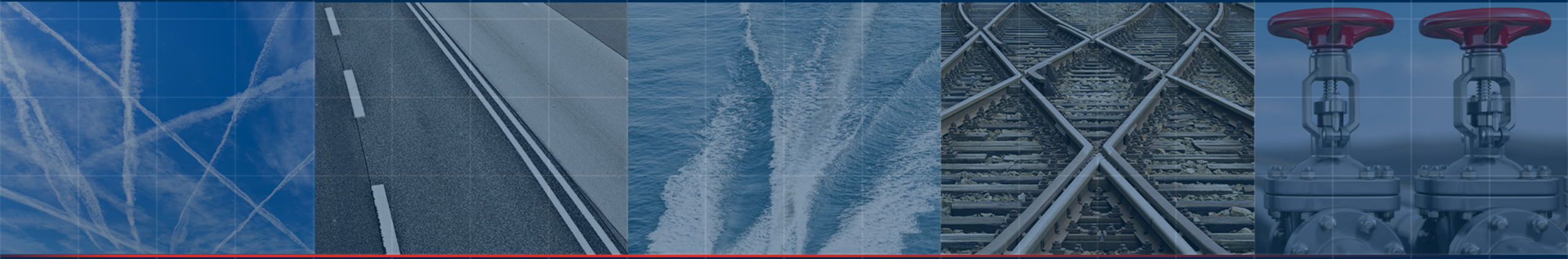
- Courtesy marking was not sufficient visual warning
- Project boundary pre-marking would provide visual confirmation of pipeline encroachment
- What we propose:
  - Recommendations to PHMSA, CAMO, and CDMCS

Pipeline Tolerance Zones for Dredging

- Tolerance zones define areas where no mechanical excavation should occur
- Regulated tolerance zones intended for land-based excavation
- Best-practice tolerance zones developed by some companies
  - Some pipeline companies request up to 500 feet
  - Most dredging companies use 75 feet

What We Found: Tolerance Zones for Dredging

- Inherent cutterhead location inaccuracies make regulated tolerance zones inadequate for safe dredging
- Enterprise damage prevention program does not provide sufficiently large tolerance zone
- What we propose:
  - One recommendation to PHMSA
  - One Recommendation to Enterprise Products



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