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Calcasieu Lock Navigation Study, Louisiana

Calcasieu Lock Diversion Channel Ship Simulation Report

Morgan M. Johnston

September 2019

Coastal and Hydraulics Laboratory

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Morgan M. Johnston

Coastal and Hydraulics Laboratory
U.S. Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Final report

Prepared for US Army Corps of Engineers, New Orleans District
7400 Leake Avenue
New Orleans, LA 70118

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Abstract

Calcasieu Lock is located on the Gulf Intracoastal Waterway just north of Calcasieu Lake in Louisiana. Calcasieu Lock has three main purposes: facilitate navigation, provide flood relief during high flow events, and prevent saltwater intrusion into the Mermentau River Basin. During high flow events, the primary purpose of Calcasieu Lock is draining for flood relief. The upstream and downstream gates open to pass as much water as possible. When in draining mode, currents through the lock increase in strength and can cause eastbound traffic with smaller horsepower towboats to be unable to push upstream through the lock. This causes delays for the eastbound traffic. The US Army Corps of Engineers, New Orleans District (MVN), proposed a diversion channel to alleviate the amount of flow the lock must pass during these high flow events.

In 2019, the US Army Engineer Research and Development Center Ship/Tow Simulator was used to perform a navigation study for the proposed diversion channel at Calcasieu Lock to assist MVN in verifying the proposed design. The final assessment of the diversion channel was accomplished through analysis of ship simulations completed by experienced pilots, discussions, track plots, run sheets, and final pilot surveys.

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Preface

This study was conducted for the US Army Corps of Engineers (USACE), New Orleans District (MVN), under General Investigations, Work Unit 108849, "Calcasieu Lock PED – H&H." The technical lead at MVN was Ms. Danielle Washington. The project manager was Ms. Martha Lucore.

The US Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL), Navigation Branch of the Navigation Division completed this work. At the time of this study, Mr. Tim Shelton was Chief of the Navigation Branch, and Dr. Jacqueline S. Pettway was Chief of the Navigation Division.

At the time of publication of this report, the Deputy Director of CHL was Mr. Jeffrey R. Eckstein, and the Director was Dr. Ty V. Wamsley.

COL Teresa A. Schlosser was the Commander of ERDC, and the Director was Dr. David. W. Pittman.

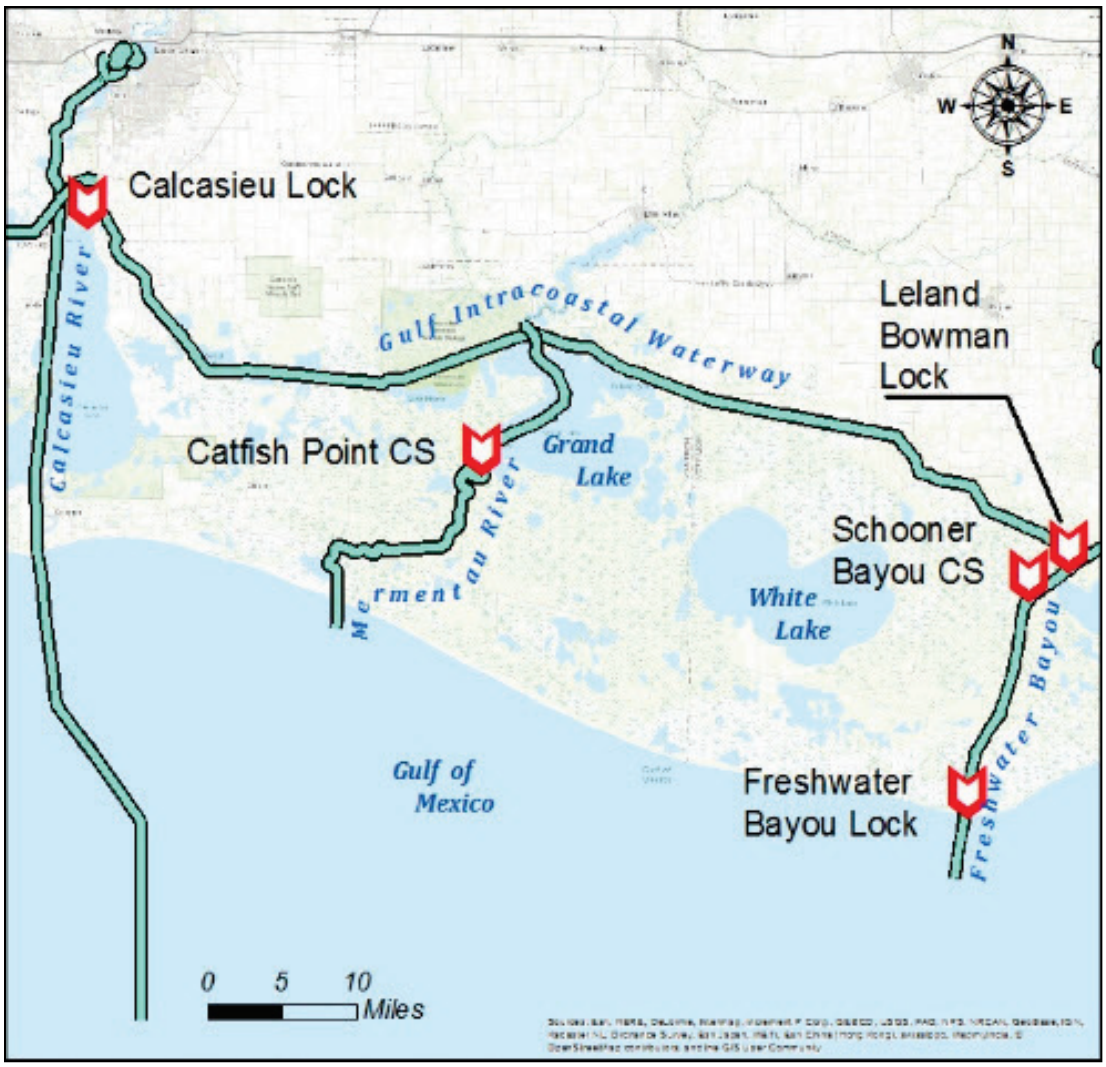
1 Introduction

Background

Calcasieu Lock is located on the Gulf Intracoastal Waterway (GIWW) just north of Calcasieu Lake in Louisiana. Figure 1 shows the location of Calcasieu Lock. Calcasieu Lock has three main purposes: to facilitate navigation, to provide flood relief during high flow events, and to prevent saltwater intrusion into the Mermentau River Basin. The Mermentau River Basin is a freshwater system that is used for crops, livestock, and irrigation. Saltwater intrusion from the coastal wetlands into the GIWW is controlled by the five main structures in the Mermentau River Basin: Calcasieu Lock, Catfish Point Control Structure, Schooner Bayou Control Structure, Leland Bowman Lock, and Freshwater Bayou Lock (Figure 2).

Figure 1. Project location (USACE MVN 2019a).

Figure 2. Control structures for the Mermentau River Basin (USACE MVN 2019b).



Purpose

Calcasieu Lock is the 11th busiest lock in the United States and the busiest lock that is located on the GIWW (USACE MVN 2014). Although rare, if flows go from west to east, Calcasieu Lock must keep its gates closed to prevent saltwater intrusion while still allowing tow traffic to lock through.

High flow (in this report, flood and flow are used interchangeably) events are common, which force the lock into draining mode or open pass. During open pass, flood relief becomes the primary purpose of the lock. Both gates open to allow as much flow as possible through the lock. Figure 3 shows Calcasieu Lock in draining mode. The lock dimensions are 1,206 feet (ft) long, 75 ft wide, and 13 ft deep, which constricts the flow from the GIWW channel. This constriction causes high velocities through the lock,

which tows have difficulty navigating. Westbound tows (traveling with the high currents) are not typically impeded by these high flow events. However, if eastbound tows do not have adequate horsepower to push through the high velocities, then the tow must wait until high tide. High tide causes the lock velocities to decrease. Sometimes tows will break the barges apart and *trip* the barges across either individually or in small groups. This method, although possible, is extremely time consuming, which makes it impractical.

Figure 3. Calcasieu Lock during draining mode.

Objective

To reduce the transit delays that high flow conditions impose upon lower horsepower eastbound tows, the New Orleans District (MVN) has proposed the addition of a flow diversion channel. The diversion channel will not be navigable but will pass additional flow during high flow events through a series of culverts, which will reduce velocity magnitudes in the lock. The diversion channel will contain 13 box culverts, each 9 ft × 14 ft,

that will have the ability to close to prevent saltwater intrusion if necessary. The purpose of this study was to determine if the proposed diversion channel could alleviate navigation delays at Calcasieu Lock without increased risk to navigation.

Approach

Simulations were conducted for the original proposed diversion channel with four pilots over two testing weeks at the US Army Engineer Research and Development Center (ERDC) Ship/Tow Simulator (STS). Session one occurred from January 14-17, 2019, and Session 2 occurred from January 21-24, 2019. Following results from the initial testing, modifications to the design were implemented, and additional testing of the modified design occurred from March 28-29, 2019, with the same pilots who attended testing Sessions 1 and 2. Table 1 is a list of attendees for all testing sessions. Table 2 lists the pilots' experience in the industry. The validity of the original and modified proposed diversion channel was analyzed through a series of ship simulation exercises (performed by pilots with knowledge of Calcasieu Lock), track plots (Appendix A), discussions following simulations, written pilot comments (Appendix A), final wrap-up discussions, and final pilot questionnaires (Appendix B).

Table 1. List of attendees for simulation testing.

Name	Session: Dates Attended	Affiliation
Captain Tracy Cheramie	1: January 14-17,2019 Additional: March 28-29, 2019	Florida Marine Transporters (FMT)
Captain Jeffrey Orr	1: January 14-17, 2019 Additional: March 28-29, 2019	Golding Barge Company
Captain James Bates	2: January 21-24, 2019 Additional: March 28-29, 2019	Kirby Corporation
Captain Lee Hogue	2: January 21-24, 2019 Additional: March 28-29, 2019	Magnolia Marine Transport Company
Mr. Jim Stark	2: January 23-24, 2019	President of GICA
Ms. Marti Lucore	2: January 23, 2019	New Orleans District

Table 2. Pilot experience.

Name	Experience
Captain Tracy Cheramie	19 years on vessels, 12 years serving in management for Florida Marine Transports (FMT)
Captain Jeffrey Orr	22 years on vessels, 14 years as a pilot
Captain James Bates	12 years in the industry, 10 years on vessels, 7 years as a pilot
Captain Lee Hogue	16 years on vessels, 14 years as a pilot

Simulator description

Since the 1980s, the ERDC STS has served as a vital modeling tool for navigation projects for the US Army Corps of Engineers (USACE). The ERDC STS has three full-mission bridges, each having a 270-degree field of view. Each mission bridge can operate independently or can link together. Simulations occur in real time, which means transits take the same amount of time that it would in real life. Figure 4 shows a captain from the project piloting the STS for the Calcasieu Lock project. A virtual database is created for both existing and proposed conditions for each unique project location. A virtual database can include input such as wind, waves, currents, bathymetry, navigational markers, and visual scenes.

Figure 4. Captain piloting the STS during testing.

2 Reconnaissance Trip

A site visit to Calcasieu Lock was conducted on September 20, 2017. The site visit served two major purposes: to view the project site and take digital images of the area necessary to build the STS visual scene and to discuss the project with industry representatives and the lockmaster. The Gulf Intracoastal Canal Association (GICA) organized several industry representatives who attended the site visit and participated in project discussions. A small vessel was used to traverse east and west of Calcasieu Lock so that digital images could be taken and used to build the visual scene for the STS. During the site visit, an eastbound five-barge tow traversed Calcasieu Lock during an open pass situation. The barge's transit emphasized the strength of the currents through the lock as it almost came to a halt as the vessel approached the east sector gate.

During the site visit, a design vessel of a 6-pack loaded barge pushed by a 1,200 horsepower (hp) towboat was selected. This design vessel was chosen as an extreme option of what might traverse through Calcasieu Lock. The towboat pushing the 6-pack barge was 1,200 hp, which is on the low end of towboat that might push a barge of this size. If this vessel was able to navigate by the diversion channel, then many other vessels would, too. A loaded barge was selected, as it would be much more susceptible to strong currents than an empty barge.

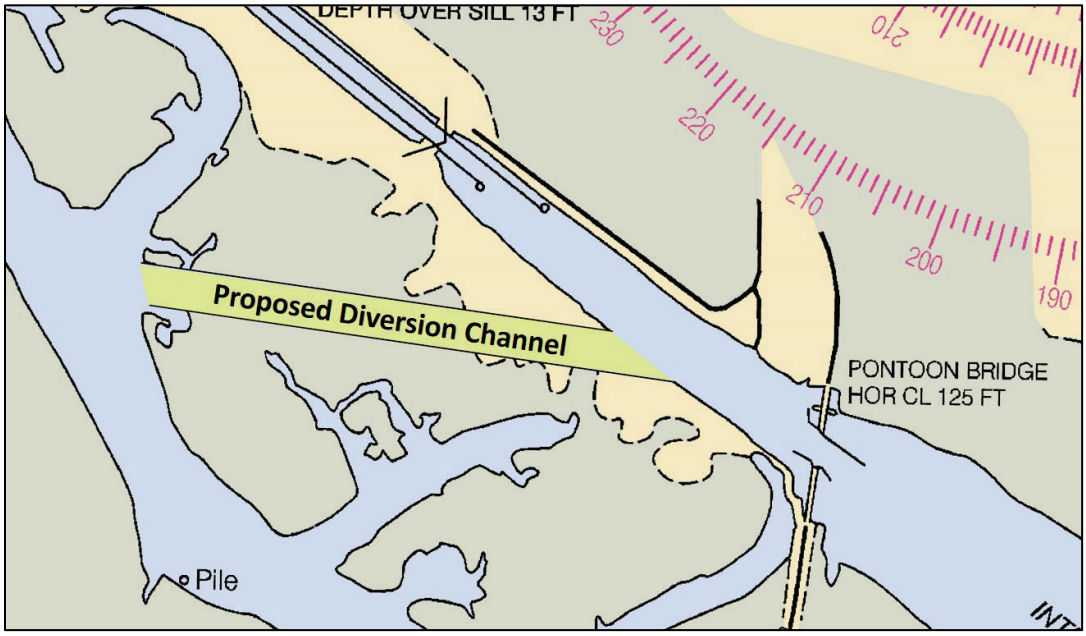
3 Proposed Improvements

Original proposed diversion channel

The original proposed diversion channel, shown in Figure 5, was evaluated during the initial testing sessions. The proposed diversion channel was numerically modeled to have 13 box culverts, each 9 × 14 ft. These culverts will have the ability to close to prevent saltwater intrusion when necessary. If flow went from west to east, the culverts would close and no flow would pass through the diversion channel. Therefore, only flows going from east to west were tested in this study.

The addition of the diversion channel should allow enough flow to pass during high flood events; therefore, releasing water through Calcasieu Lock will no longer be required. This will cause an operational change of eliminating open pass situations, and vessels will be required to always lock through.

Figure 5. Original proposed diversion channel tested during initial testing sessions.

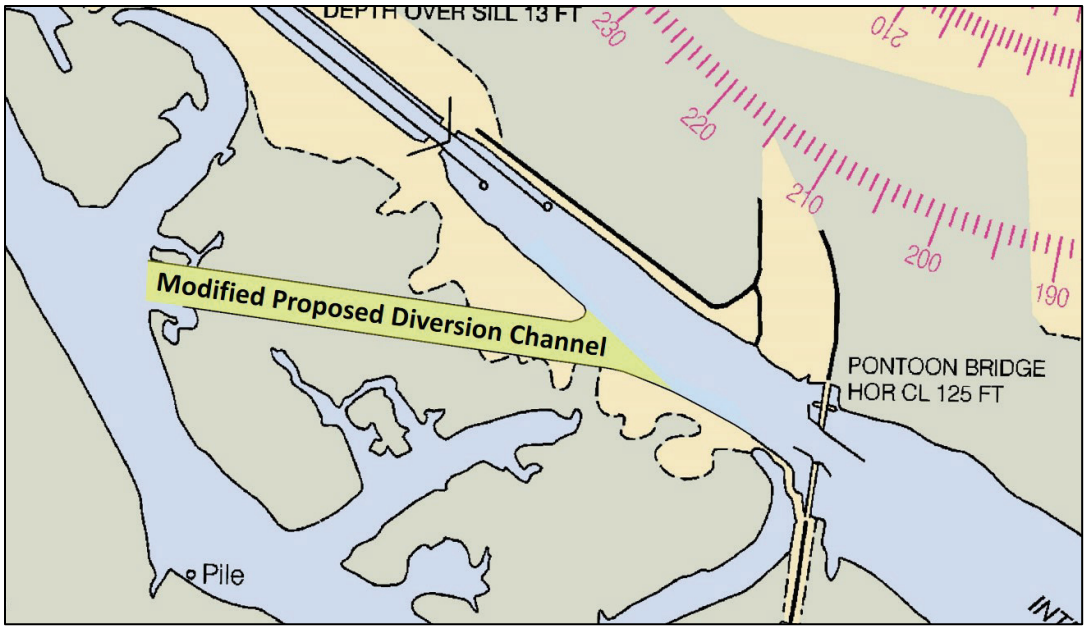


Modified proposed diversion channel

Based on the results of initial testing and the Session 2 final wrap-up discussion (see Final meetings section), several modifications to the design were implemented. Figure 6 shows the modified diversion channel that was evaluated during the additional session. The inlet modifications were

approximated based off feedback from initial simulations that suggested extending and rounding off the inlet could result in a reduction of crosscurrent magnitude. In addition to the modified inlet, an operational change to the lock was implemented for some of the additional testing runs. From initial testing, westbound traffic was found to have a more difficult transit than eastbound traffic; therefore, it was suggested that Calcasieu Lock be open pass for westbound traffic only. In some of the simulations tested during the additional testing session, Calcasieu Lock was numerically modeled as open. Further description of these modifications can be found in Results from initial production runs located in Section 6.

Figure 6. Modified proposed diversion channel tested during additional testing session.



4 Database Development

During a simulation, many environmental forces act upon the vessel during transit. Some of these forces include wind, waves, currents, bathymetry, and ship-to-ship interaction. Virtual databases are developed as input into the ship simulator for the area of interest for existing conditions first. The existing conditions databases are validated with experienced mariners and then modified to replicate proposed future conditions. Testing of the proposed future conditions is referred to as production runs. A thorough description of evaluating channel design through the use of the STS can be found in Webb (1994).

Design vessel

One design vessel was selected for testing as a result of discussions during the site visit:

Kin King: integrated 6-pack barge with 1,200 hp pusher tow. The integrated unit is 655 ft long, 70 ft wide, and drafts 9.5 ft.

This vessel was selected based off input from the towing representatives who attended the reconnaissance trip. A loaded unit was chosen as they are more susceptible to strong currents. This vessel was a conservative testing option. The horsepower of the towboat was on the lower end of what could be expected to push a vessel of that size. If this vessel was able to transit by the diversion channel, then many other vessels would, too. Additional vessel information, in the form of pilot cards, can be found in Appendix C.

Visual database

A visual database was developed for Calcasieu Lock. Digital pictures taken of the area during the reconnaissance trip were used as a guideline to create the visual scene. The radar and ECDIS[1] were also created for the area.

Environmental database

An environmental database was created for Calcasieu Lock that included current, wind, and bathymetric data. The Field Data Collection and

[1] Electronic Chart Display and Information System

Analysis Branch of the Coastal and Hydraulics Laboratory (CHL) collected the bathymetric data.

Wind

While wind has a limited effect on a loaded 6-pack barge, it was still included in the simulations. A 10-knot northerly wind was selected for the runs on the east side of the lock (eastbound and westbound) as it would push the vessel towards the diversion channel. A 10-knot southerly wind was selected for runs on the west side of the lock (eastbound and westbound), as it would work in combination with the currents coming from the proposed diversion channel.

Current development

Currents for the project were developed using the two-dimensional shallow water module of Adaptive Hydraulics by the River and Estuarine Engineering Branch at CHL.[1]

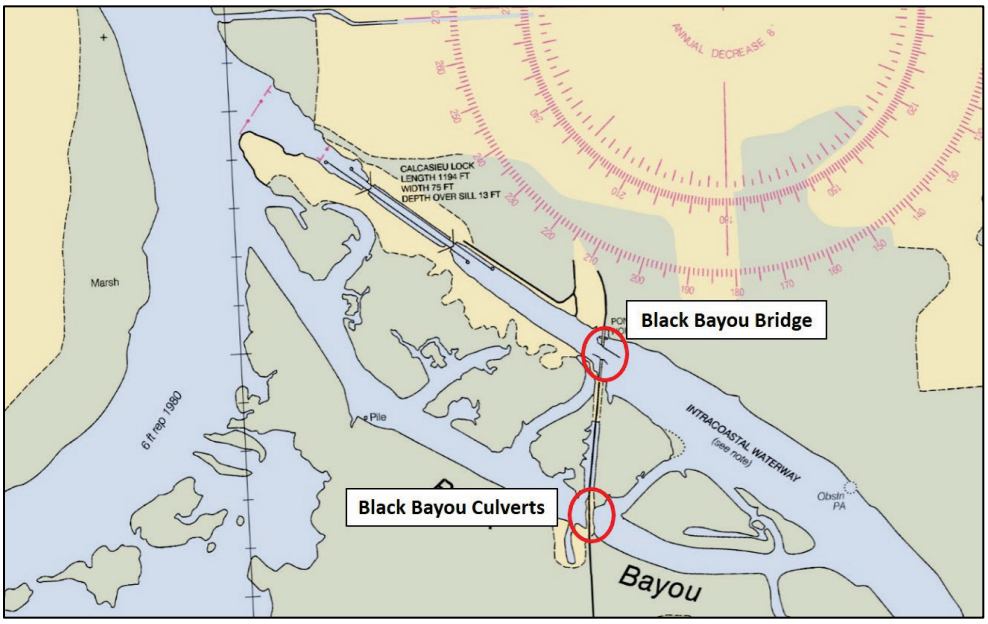
The Field Data Collection and Analysis Branch at CHL collected current validation data. The current development team then used the collected data to validate the existing condition model. Once the existing condition model was validated, production runs were simulated. Two flow conditions were simulated: a 2-year flood event and a 10-year flood event.

In January 2010, the Black Bayou Culverts Hydrologic Restoration Project (CS-29) was completed with the construction of ten, 10 ft × 10 ft box culverts (Roger-White 2017). The Black Bayou culverts were constructed by the State of Louisiana to alleviate high water events by re-establishing the natural outlet of the Black Bayou. Figure 7 shows the location of the Black Bayou Bridge and Black Bayou culverts. These culverts close when water flows from east to west to prevent saltwater intrusion. The structure is not owned or controlled by the USACE; therefore, there is no guarantee that it would be open during high flow events. The numerical team that developed the currents for the ship simulator modeled Black Bayou as a wall (no flow passing through), as an open channel, and as a functioning set of culverts. It was important to establish that the success of the proposed diversion channel was not dependent on the Black Bayou culverts being held open, so

[1] Further information regarding the numerical modeling efforts for this project can be found in McKnight, C. J., T. O. McAlpin, A. G. Emiren, and J. V. Letter. In preparation. Calcasieu Lock Drainage Study. ERDC/CHL Technical Report. Vicksburg, MS: US Army Engineer Research and Development Center.

the culverts were simulated as a culvert and as a wall in the initial testing of the diversion channel. Four different flow conditions were tested by pilots in the STS during initial testing: a 2-year flood event with Black Bayou treated as a culvert, a 2-year flood event with Black Bayou treated as a wall, a 10-year flood event with Black Bayou treated as a culvert, and a 10-year flood event with Black Bayou treated as a wall. Numerically, the lock was modeled closed for all initial testing simulations.

Figure 7. Black Bayou structures near Calcasieu Lock.



Modifications for additional testing

After results and discussions from the initial testing, it was determined additional testing would occur after making several modifications to the design. Simulations were modeled with Calcasieu Lock open and closed. As time and resources were limited, the additional testing session opted for more extreme environment conditions. For this reason, only 10-year flood events with the Black Bayou culverts treated exclusively as a wall were tested. Pilots deemed the original proposed currents weaker than expected for a 10-year flow event at Calcasieu Lock. Original currents were developed using a tide level of mean sea level (MSL). When the currents were developed for the additional testing session, a tide level of mean lower low water (MLLW) was used. Dropping the tide level to MLLW provides a more extreme situation and increases the velocity magnitude of the currents.

5 Validation

The first day of simulation during the first testing session was spent validating existing conditions (no diversion channel). First, pilots tested out Calcasieu Lock in slack water with no environmental conditions. During these initial runs, pilots tested vessel response and noted any visual scene changes that needed to be adjusted. Once those runs were completed, variables were slowly added to each new simulation (wind and then currents) until all variables had been validated.

The 2-year flood event was used to validate existing conditions. Pilots verified that the currents were appropriate and representative of normal operations at the lock. Pilots also tested the 10-year flood event for existing conditions to determine a baseline when going to the proposed conditions. Pilots determined that the 10-year flood was also a reasonable representation of a more extreme flow situation at Calcasieu Lock.

All existing condition currents were numerically simulated with the lock gates open since these conditions (2-year and 10-year flood) would be treated as open pass in present day operations of the lock. Pilots did not test going through the lock. The simulator uses a predetermined current field, so when a vessel blocks a large portion of the flow, the currents are not updated to account for the decrease of flow area and increase of current magnitude. While this increased current effect can be approximated by using multipliers on the current field, it is often a slow, iterative process. Since initially MVN was suggesting an operational change to the lock that would eliminate open pass situations, vessels would be locking through with little to no current passing through the lock. While Calcasieu Lock would be open during some of the additional testing, simulations still ended once the westbound vessel was appropriately lined up for the lock. Pilots felt stopping the simulation there would be sufficient for testing as this would capture the effects from the diversion channel. Once the vessel was lined up, the currents would essentially push the vessel through when the lock was open. Since the vessels would not be traversing through the lock for any proposed conditions, there was not a need to determine multipliers for the existing conditions. Therefore, existing condition and proposed condition testing did not occur with the vessel transiting through the lock.

Pilots agreed that the overall existing condition database was a good approximation of the current operations at Calcasieu Lock. Once the existing condition model was validated, production runs, or simulations of the proposed diversion channel, could begin.

6 Results

This section presents results from the initial testing first and then those from the additional testing. Results are presented in the form of track plots (Appendix A), pilot comments filled out after each run (Appendix A), and final pilot questionnaires (Appendix B). Several pilot comments were summarized or paraphrased in each section, but the entirety of pilot comments can be found in Appendix A following each track plot. For all track plots presented, the transiting vessel was the selected design vessel, a 6-pack barge being pushed by a 1,200 hp towboat. For most track lines, the vessel was in a loaded condition, but two plates are presented for runs completed with the vessel in an empty (unloaded) condition.

Production runs – initial testing

For initial testing, results will be presented first for transits on the east side of Calcasieu Lock for the loaded 6-pack transiting first eastbound and then westbound. These results will be followed by transits on the west side of Calcasieu Lock for the loaded 6-pack transiting first eastbound and then westbound. Each result section for the loaded 6-pack is further divided by flow events (2-year or 10-year). The last initial testing result section presents the empty 6-pack runs on the east side of Calcasieu Lock. Table 3 lists of all the runs completed over the initial 2 weeks of testing that are discussed in this report. Runs 1-16 were production runs from the test matrix created by ERDC and MVN. Simulations vary by location (east side of the lock or west side of the lock), transit direction (eastbound or westbound), flow event (2-year or 10-year), wind condition (10 knots from north or 10 knots from south), vessel condition (loaded or empty) and treatment of Black Bayou culverts (culvert or wall).

Table 3. Scenarios completed over the initial testing sessions.

Plate(s) in Appendix A	Vessel	Black Bayou	Flow Event	Transit Direction	Side of Lock	Wind Condition	Test Matrix Number	Total Runs
1	Loaded 6-pack	Culvert	2 yr	East	East	10 knots from N	7	4
2	Loaded 6-pack	Wall	2 yr	East	East	10 knots from N	1	4
3	Loaded 6-pack	Culvert	10 yr	East	East	10 knots from N	9	8
4	Loaded 6-pack	Wall	10 yr	East	East	10 knots from N	3	4
5, 7	Loaded 6-pack	Culvert	2 yr	West	East	10 knots from N	8	6
6, 7	Loaded 6-pack	Wall	2 yr	West	East	10 knots from N	2	11

Plate(s) in Appendix A	Vessel	Black Bayou	Flow Event	Transit Direction	Side of Lock	Wind Condition	Test Matrix Number	Total Runs
8, 12	Loaded 6-pack	Culvert	10 yr	West	East	10 knots from N	10	8
9-12	Loaded 6-pack	Wall	10 yr	West	East	10 knots from N	4	17
13	Loaded 6-pack	Culvert	2 yr	East	West	10 knots from S	15	4
14	Loaded 6-pack	Wall	2 yr	East	West	10 knots from S	13	4
15	Loaded 6-pack	Culvert	10 yr	East	West	10 knots from S	11	4
16	Loaded 6-pack	Wall	10 yr	East	West	10 knots from S	5	6
17	Loaded 6-pack	Culvert	2 yr	West	West	10 knots from S	16	4
18	Loaded 6-pack	Wall	2 yr	West	West	10 knots from S	14	4
19	Loaded 6-pack	Culvert	10 yr	West	West	10 knots from S	12	4
20	Loaded 6-pack	Wall	10 yr	West	West	10 knots from S	6	6
21	Empty 6-pack	Wall	10 yr	East	East	10 knots from N	N/A	2
22	Empty 6-pack	Wall	10 yr	West	East	10 knots from N	N/A	2

The approximate starting and ending positions for runs on the east side and the west side of the lock can be seen in Figure 8 and Figure 9, respectively. The track lines (Appendix A) presented are zoomed in and do not show the transit in its entirety. This was done so that the impact of the diversion channel could be more easily analyzed.

Figure 8. Approximate westbound starting position and eastbound ending position for scenarios on the east side of the lock.

Figure 9. Approximate eastbound starting position and westbound ending position for scenarios on the west side of the lock.

Several runs were completed that added in stationary traffic on the east and west side of Calcasieu Lock. These runs were accomplished after the original test matrix had been completed without traffic during the second testing session. The locations of the added traffic on the east and west side of Calcasieu Lock can be seen in Figure 10 and Figure 11, respectively. While the addition of traffic created a more representative environment, it did not greatly influence the transits completed or change the impact from the diversion channel. Runs that were completed with the added traffic are shown in blue track lines in Appendix A.

Figure 10. Vessel traffic additions on east side of Calcasieu Lock.

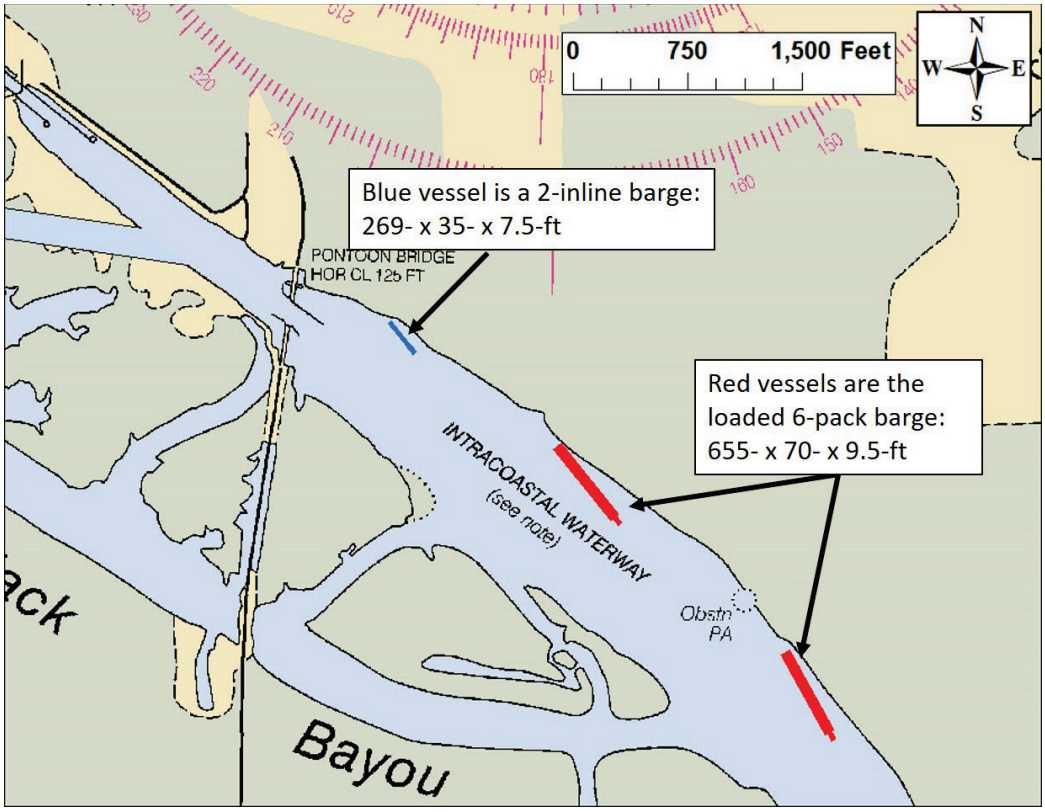
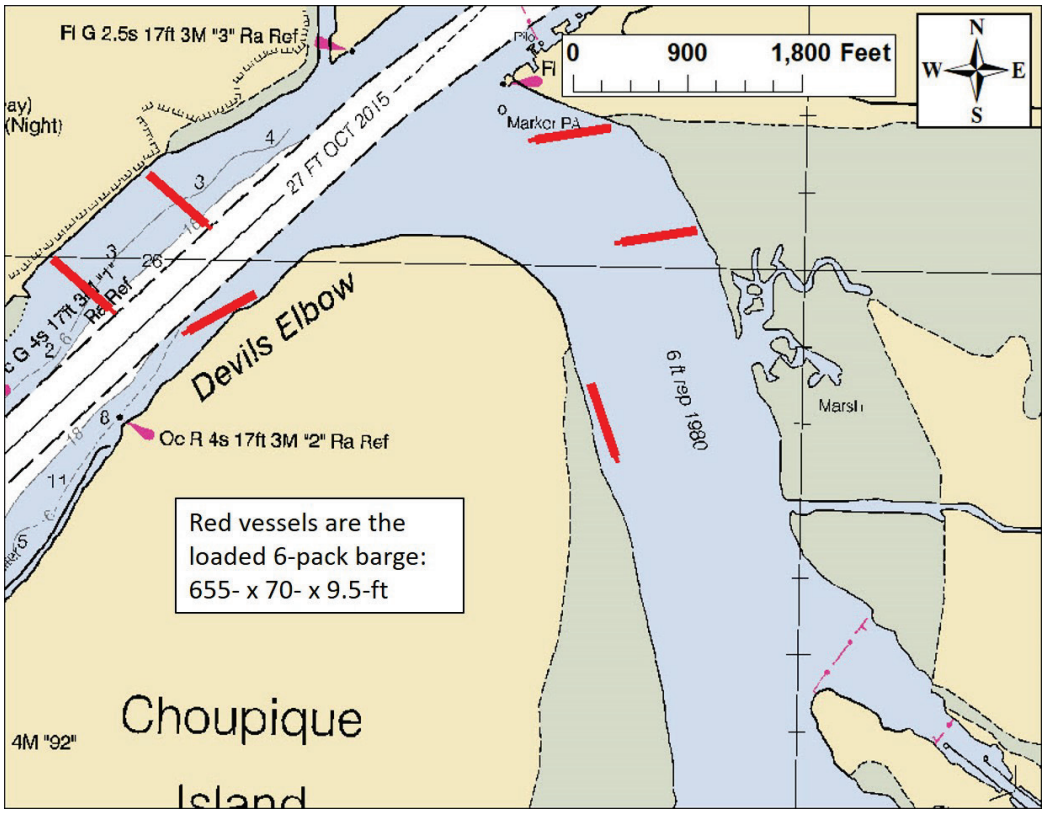


Figure 11. Vessel traffic additions on west side of Calcasieu Lock.



In each initial results section, the track plots from each flow condition are presented first with Black Bayou being numerically treated as a culvert and second, as a wall. In Appendix A, transits that have Black Bayou functioning as a culvert are typically shown in green while transits that have Black Bayou functioning as a wall are typically shown in red.

East side of Calcasieu Lock - loaded 6-pack transiting eastbound

Plate 1 - Plate 4 show all the tracks that were completed on the east side of Calcasieu Lock with the loaded 6-pack transiting eastbound. All scenarios have 10 knots of wind from the north. For all eastbound runs, transits began with the 6-pack leaving the east gates at Calcasieu Lock and ended approximately 0.5 mile below the Black Bayou southern inlet (Figure 8). Vessels began with a starting speed of approximately 1.5-2 knots since the vessel would be leaving Calcasieu Lock after just locking through.

2-year flood

All transits with a 2-year flood with Black Bayou functioning as a culvert can be seen in Plate 1. Plate 1 shows a composite of four total runs each from a different pilot. Pilot comments on this transit varied from “no issues here” to “slight draw (to the diversion channel) at low speed.”

Plate 2 shows all transits completed with a 2-year flood with Black Bayou treated numerically as a wall. Plate 2 shows a composite of four total runs, each from a different pilot. Pilot comments on this transit expressed that there was minimal impact from the diversion channel while other comments conveyed there was some pull the entire time while passing the new cut.

The proposed diversion channel did not have a significant impact on eastbound transits on the east side of Calcasieu Lock for either 2-year flood current sets.

10-year flood

All transits with a 10-year flood with Black Bayou functioning as a culvert can be seen in Plate 3. Plate 3 shows a composite of eight total runs from four different pilots. Two of these runs included added traffic east of the Black Bayou Bridge (Figure 10). While the addition of traffic made the simulations feel more realistic to the pilots, the added traffic did not have

an impact on the transits. The runs with the added traffic are shown in blue. Pilot comments for this transit included “felt a greater suction coming by the proposed cut at low speed, this will create the risk of collision” and “very small draw to the south bank above the bridge.” One of the four pilots said the suction from the diversion channel actually helped the vessel pull away from the lock and line up for the bridge.

Plate 4 shows all transits completed with a 10-year flood with Black Bayou functioning as a wall. Plate 4 shows a composite of four total runs, each from a different pilot. There is very little variation in these track lines and the track lines do not appear to show a substantial effect due to the proposed diversion channel. All pilots agreed there was a slight pull from the diversion channel. Two out of the four pilots suggested the suction from the diversion channel actually helped the vessel pull off the lock to line up for the bridge.

From overall discussions with the pilots, all eastbound transits on the east side of the lock were manageable.

East side of Calcasieu Lock - loaded 6-pack transiting westbound

Plate 5 - Plate 12 show all the tracks that were completed on the east side of Calcasieu Lock with the loaded 6-pack transiting westbound. All scenarios have the same wind condition of 10-knots of wind from the north. For all westbound runs, transits began approximately 0.5 mile below the Black Bayou southern inlet (Figure 8) and ended once the 6-pack was a few barge lengths past the long guide wall dolphin. Pilots had to slow down near the end of the transit to ensure the vessel would be slow enough to safely stop to lock through Calcasieu Lock. This resulted in the vessels being susceptible to the crosscurrents from the diversion channel. Pilots often seemed to feel a greater effect from the diversion channel once the vessel was just past the cut and the front of their tow hit the slack water in front of the lock. In some current sets, a small eddy was evident in the mostly slack water in front of the lock that likely contributed to this effect.

2-year flood

All 2-year flood condition transits, with Black Bayou treated numerically as a culvert, can be seen in Plate 5. Plate 5 is a composite of six total runs from four different pilots. Two runs added vessel traffic on the east side of Black Bayou Bridge (shown in blue). While the added traffic made the simulations

feel more realistic to the pilots, it did not have a significant effect on the transits themselves. The two runs with added traffic were the last runs of the testing week, it can be noticed that the vessel took a more northern approach. This was likely because the pilots had completed this transit many times through the testing week and adjusted their transit line to lessen the effects from the diversion channel. In these westbound transits, the effects of the proposed diversion channel become even more apparent at the lower flow events. Where the eastbound transits on the east side of the lock stayed mostly straight from the bridge to the lock, in westbound transits, the stern begins to be drawn slightly towards the diversion channel and then more significantly as the vessel transits past the diversion channel. Pilot comments on this transit varied from feeling a pull from the diversion channel up to the long wall, to feeling no noticeable set.

Plate 6 shows a composite of 10 transits. These were completed with 2-year flood currents and with Black Bayou functioning as a wall. Two of the runs added vessel traffic on the east side of Black Bayou Bridge. While the addition of traffic made the simulations feel more realistic to the pilots, the added traffic did not have much an effect on the transits themselves. The two runs with added traffic (shown in blue) were some of the last runs completed in the testing week; it can be noticed the vessel took a slightly higher approach when going past the diversion channel. This was likely because the pilots had completed this transit many times through the testing week and adjusted their transit line farther north to lessen the effects from the diversion channel. In westbound transits, the effects from the proposed diversion channel became more prominent even at 2-year flow simulations. Where the eastbound transits on the east side of the lock stayed mostly straight from the bridge to the lock, in westbound transits, the stern begins to be drawn slightly towards the diversion channel and then more significantly as the vessel transits past the diversion channel. This swing occurs from the bridge until the vessel is lined up in the guide walls. While the vessel swing was more prominent once the vessel passed the new cut for the 2-year flow with Black Bayou as a culvert, the 2-year flow with Black Bayou as a wall shows a more constant effect on the vessel from the bridge to the guide walls. Pilot comments on these transits included “still drawn in at slow speed, this will cause a risk of collision” and “no issues if anticipating the set ahead of time.”

Plate 7 shows a composite of the 2-year flow transits of Black Bayou as a wall and as a culvert. Green track lines represent the 2-year flow with

Black Bayou functioning as a culvert, and the red track lines represent the 2-year flow with Black Bayou functioning as a wall. The runs with added vessel traffic have been removed for clarity. The 2-year flow with Black Bayou functioning as a wall appears to have a more significant effect on the vessel transit.

Based on conversations with the pilots and comments made in the final pilot questionnaire (Appendix B), the decision on whether or not transits with the 2-year flood currents for westbound traffic is feasible with the diversion channel was split. Two of the pilots considered the lower flow events manageable for the design vessel while the other two pilots deemed the proposed diversion channel not feasible for westbound traffic even at the lower flows.

10-year flood

All transits with 10-year flood currents and Black Bayou functioning as a culvert can be seen in Plate 8. Plate 8 is a composite of eight total runs from four different pilots. Two of these runs included added traffic east of the Black Bayou Bridge. While the addition of traffic made the simulations feel more realistic to the pilots, the added traffic did not have much effect on the transits themselves. These runs with the added traffic are shown in blue. A much more significant effect from the diversion channel can be seen in the track lines on this plate. The vessel shows more of a "wobble" as the pilots must correct and counteract the effects from the diversion channel. All pilots experienced a significant draw from the diversion channel in these transits. Two of the pilots felt that having Black Bayou functioning as a culvert lessened the amount of suction from the diversion channel. Pilot comments for this run included "this cut is setting up vessels for an incident with the lock and is not a good situation" and "hard draw to the new cut which gets you out of shape for the lock and makes you land on the short wall bull nose."

Plate 9 shows all the transits completed with 10-year flood conditions and Black Bayou functioning as a wall. Plate 9 shows a composite of 17 total runs from four different pilots. Four of the runs included vessel traffic on the east side of the Black Bayou Bridge, which can be seen in the blue track lines. This added vessel traffic did not significantly alter the way the pilots transited the vessel but did provide a more realistic testing environment. Since there were so many runs completed for this transit, Plate 10 and Plate 11 separate the runs by testing week so transit tracks can be more

easily seen. Plate 10 shows 7 runs from the first testing week while Plate 11 shows 10 runs from the second testing week. A pronounced effect from the diversion channel can be seen in the track lines in Plate 9 - Plate 11. In westbound transits, the stern is pulled towards the diversion channel. This swing is most prominent after the vessel has mostly passed the diversion channel cut. In several of the vessel tracks, the vessel was pulled essentially to the bank near the diversion channel. Several of the vessel tracks also breached the guide walls. In the prototype, those transits would have resulted in extensive damage. Several pilots attempted to land the front of the tow on the short wall and then pivot on it to straighten up and push ahead through the lock. However, many of these transits resulted on the tow hitting the front of the short wall too fast and being sheared off into the long wall, which would have resulted in significant damage to the lock and/or vessel. The vessel shows more of a wobble as the pilots had to correct and counteract the effects from diversion channel. This constant back and forth is not ideal when coming into the lock as it adds a level of complexity to the transits that is currently not there. This flow condition proved to be the most difficult as no water was diverted through the Black Bayou structure. Pilot comments for this transit expressed issues with slowing the vessel down enough to safely make it through the lock without experiencing major effects from crosscurrents.

Plate 12 shows a composite of the 10-year flow transits of Black Bayou as a wall and as a culvert. The runs with added vessel traffic have been removed for clarity. Green track lines represent the 10-year flow with Black Bayou functioning as a culvert, and the red track lines represent the 10-year flow with Black Bayou functioning as a wall. The 10-year flow with Black Bayou functioning as a wall appears to have a much more significant effect on the vessel transit.

Based on conversations with the pilots and comments made in the final pilot questionnaire (Appendix B), the 10-year flood events with the proposed diversion channel for westbound traffic were unanimously deemed unfeasible by the pilots.

West side of Calcasieu Lock - loaded 6-pack transiting eastbound

Plate 13 -Plate 16 show all the tracks that were completed on the west side of Calcasieu Lock with the loaded 6-pack transiting eastbound. All scenarios have the same wind condition of 10-knots of wind from the south. For all eastbound runs, transits began just past Devil's Elbow

(Figure 9) and ended once the 6-pack had gone a few barge lengths past the long wall dolphin. Vessels had to slow down near the end of the transit to ensure the vessel would be able to safely stop to lock through. Transits on the west side of the lock are typically much easier than transits on the east side of the lock as the channel opens up significantly, which allows the current to decrease substantially.

2-year flood

All transits with the 2-year flood currents with Black Bayou functioning as a culvert can be seen in Plate 13. Plate 13 shows the composite of four runs, each from a different pilot. The proposed diversion channel did not have a significant effect on the transits of eastbound vessels. Pilots were able to easily counteract the set from the diversion channel, slow down, and be appropriately lined up to go through the lock. The variation in the track lines are likely due to different piloting styles, not due to the currents from the diversion channel. Pilot comments expressed these transits were similar to normal operations, meaning they did not have any issues.

Plate 14 shows transits completed with the 2-year flood conditions with Black Bayou functioning as a wall. Plate 14 shows a composite of four total runs each from a different pilot. The proposed diversion channel did not have a significant effect on the transits of these eastbound vessels. Pilots considered this transit similar to normal operations and did not experience issues.

10-year flood

All transits with 10-year flood conditions and with Black Bayou functioning as a culvert can be seen in Plate 15. Plate 15 shows a composite of four total runs from four different pilots. The proposed diversion channel did not have a significant effect on the transits of these eastbound vessels. Pilot comments expressed there were no issues with these runs.

Plate 16 shows all transits completed with a 10-year flood event with Black Bayou functioning as a wall. Plate 16 shows a composite of six total runs from four different pilots. Two of the runs included vessel traffic on the east side of the Black Bayou Bridge, which can be seen in the blue track lines. This added vessel traffic did not significantly alter the way the pilots transited the vessel but provided a more realistic testing environment. Eastbound transits on the west side of the lock were not significantly

changed by the addition of the diversion channel. Pilot comments demonstrated that this transit was similar to current operations but it did add a slight crosscurrent that had to be accounted for.

Pilots experienced minimal impact from the added diversion channel on eastbound transits on the west side of the lock for either 2-year or 10-year flood events.

West side of Calcasieu Lock - loaded 6-pack transiting westbound

Plate 17 - Plate 20 show all the tracks that were completed on the west side of Calcasieu Lock with the loaded 6-pack transiting westbound. All scenarios have the same wind condition of 10-knots of wind from the south. For all westbound runs, transits began with the 6-pack leaving the west gates at Calcasieu Lock and ended around the curve at Devil's Elbow (Figure 9). The vessels began with a starting speed of approximately 1.5-2 knots since the vessel would be leaving Calcasieu Lock after just locking through. Transits on the west side of the lock are typically much easier than transits on the east side of the lock as the channel opens up significantly, which allows the current to decrease substantially.

2-year flood

Plate 17 shows all the transits completed with the 2-year flood with Black Bayou being numerically treated as a culvert. There are four runs, each from a different pilot, shown in Plate 16. The variation in track lines in this plate likely shows a variation in piloting technique, not complications from the addition of the diversion channel. Pilot comments expressed there were no major issues with this run.

Plate 18 shows a composite of four total runs from four different pilots with the 2-year flood with Black Bayou being treated numerically as a wall. These track lines are very similar to the track lines from the 2-year flood with Black Bayou functioning as a wall shown in Plate 17. Pilots experienced minimal impact from the added diversion channel on westbound transits on the west side of the lock for either 2-year flood events. Pilot comments for this run included "normal operations" and "felt like a normal exit from the lock."

10-year flood

Plate 19 shows all the transits completed with the 10-year flood with Black Bayou being numerically treated as a culvert. There are four runs, each from a different pilot, shown in Plate 19. The variation in track lines in this plate likely shows a variation in piloting technique, not complications from the addition of the diversion channel. Pilot comments for this run included "normal operations" and "very small draw to the north bank as you're leaving the lock. It's just enough to help you get away from the long wall, not bad at all."

Plate 20 shows a composite of six total runs from four different pilots with the 10-year flood and with Black Bayou being treated numerically as a wall. Two of the runs had traffic added west of Calcasieu Lock (Figure 10). While the added vessel traffic allowed for a more realistic environment, the added vessel did not have much of an impact on the transits. The track lines with added traffic can be seen in blue on Plate 20. Pilot comments demonstrated that this transit was similar to current operations, but two pilots expressed that it did add a slight pull, which helped the vessel make the turn to starboard.

Pilots experienced minimal impact from the added diversion channel on westbound transits on the west side of the lock for the 2-year or 10-year flood events.

East side of Calcasieu Lock - empty 6-pack barge scenarios

Plate 21 and Plate 22 show all the transits that were completed using the empty condition of the design vessel (655 ft × 70ft × 6.8 ft for the integrated unit including 1,200 hp pusher tow). Since empty barges draft much less, the biggest factor when piloting them is wind, not current. There were only a few scenarios tested using empty barges because of the limited effect that crosscurrents had on the vessel. All scenarios completed with the empty 6-pack were tested on the east side of Calcasieu Lock and had 10-knots of wind from the north.

Plate 21 shows a composite of two eastbound transits that began with the empty 6-pack leaving the east lock gates and ending approximately 0.5 mile below the Black Bayou southern inlet. Both of these runs included traffic east of the Black Bayou Bridge (Figure 10) and were completed by two different pilots. One pilot experienced a slight draw toward the diversion

channel due to a combination of the wind and the current, but this draw was able to be managed by the speed of the vessel. Pilot comments for this transit expressed that there was a set to the south, but it was manageable.

Plate 22 shows a composite of two westbound transits that began approximately 0.5 mile below the Black Bayou southern inlet. Both of these runs included traffic east of the Black Bayou Bridge (Figure 10) and were completed by two different pilots. One of the pilots was unable to successfully navigate the empty vessel by the diversion channel, and the vessel was pulled into the diversion channel. While both pilots stated that an experienced pilot would have realized the wind was too strong for this sized vessel being pushed by a 1,200 hp tow, a less-experienced pilot might not have waited until the wind had lessened before attempting the transit from the bridge to the lock. The strong pull that the empty barge experienced towards the diversion channel lead to the recommendation of including protection cells in front of the diversion channel inlet. These cells would eliminate the possibility of empty tows being sucked into the cut. Pilot comments for this run expressed that neither pilot would have attempted this run in real life because there was great chance of failing and causing damage.

Results from initial production runs

Following initial simulations, the original proposed diversion channel was deemed inadequate for westbound traffic on the east side of Calcasieu Lock. Pilots considered the amount of pull from the diversion channel on slower moving westbound tows a safety issue for navigation. Several suggestions were made to modify the design to help alleviate the severity of the crosscurrents from the diversion channel. One modification was opening Calcasieu Lock for westbound traffic. As the vessel would not have to stop to lock through, the vessel could pass by the diversion channel at a slightly higher speed. In addition, the crosscurrent magnitude would not be as great since not all of the flow would be forced through the diversion channel but would be split between the lock and the diversion channel. The diversion channel had minimal impact for eastbound traffic, so the lock could remain closed (vessels would have to lock through) for eastbound traffic. The diversion channel inlet was also modified to be slightly extended and rounded off to reduce the crosscurrents effects (Figure 6). Finally, the currents were strengthened slightly by dropping the tide level from MSL to MLLW.

Production runs – additional testing

Based on pilot feedback from the initial testing, several modifications to the design were implemented. These included modeling the currents using a tide level of MLLW, modifying the diversion channel inlet (Figure 6), and opening the lock for westbound traffic during some simulations. The original diversion channel inlet was slightly extended and rounded off to create the modified diversion channel. The inlet modifications were proposed to help reduce the crosscurrents experienced by the pilots from the original proposed diversion channel. Three different alternatives were evaluated during the additional testing session:

- **Alternative 1**: Original diversion channel, lock closed for eastbound traffic, and lock open for westbound traffic.
- **Alternative 2**: Modified diversion channel, lock closed for eastbound traffic, and lock closed for westbound traffic.
- **Alternative 3**: Modified diversion channel, lock closed for eastbound traffic, and lock open for westbound traffic.

All simulations completed during the additional testing were completed with the loaded 6-pack barge. Since time was limited, only the 10-year flow event (MLLW as water level) with Black Bayou modeled as a wall was tested, which provided a conservative answer. The same approximate starting and ending positions used during the initial testing (Figure 8 and Figure 9) were also used during the additional testing session. However, during duplicated runs, the pilots started closer to Calcasieu Lock to save time. Although Calcasieu Lock would be open for westbound traffic in Alternative 1 and Alternative 3, simulations did not test the vessel going through the lock. As previously mentioned, the ship simulator uses a static current field and does not account for blockage. Although the blockage effect can be approximated by applying a multiplication factor to the currents, this process is slow and iterative. Pilots felt stopping the simulation once the westbound vessel was appropriately lined up for the lock would be sufficient for testing as it would capture the most difficult part of that transit. Once the vessel is lined up, the currents essentially push the vessel through. All simulations completed during the additional testing included the traffic that was added during the latter portion of session two (shown in Figure 10 and Figure 11). Table 4 lists the simulations completed during the additional testing. Scenarios vary by location (east side of the lock or west side of the lock), transit direction (eastbound or westbound), wind condition (10 knots from north or

10 knots from south), treatment of lock (open or closed), and diversion channel (original or modified). The following section will provide more detail describing each of these scenarios.

Table 4. Scenarios completed over the additional testing session (BB = Black Bayou).

Plate(s) in Appendix A	Alt.	Vessel	Flow Event (MLLW)	Transit Direction	Side of Lock	Lock	Diversion Channel	Wind Condition	Test Matrix Number	Total Runs
23	1	Loaded 6-pack	10 yr, BB as wall	West	East	Open	Original	10 knots from N	1	4
24	1	Loaded 6-pack	10 yr, BB as wall	West	West	Open	Original	10 knots from S	2	4
25	2	Loaded 6-pack	10 yr, BB as wall	West	East	Closed	Modified	10 knots from N	3	8
26	2, 3	Loaded 6-pack	10 yr, BB as wall	East	East	Closed	Modified	10 knots from N	4	4
27	3	Loaded 6-pack	10 yr, BB as wall	West	East	Open	Modified	10 knots from N	5	8
28	3	Loaded 6-pack	10 yr, BB as wall	West	West	Open	Modified	10 knots from S	6	4

Alternative 1 – original diversion channel cut, lock open for westbound traffic

In Alternative 1, the original diversion channel cut (used during initial simulations) was tested, but the lock was numerically modeled as open for westbound transits. Initial tests showed the original diversion channel cut would be feasible for eastbound traffic with the lock closed. Therefore, only westbound traffic on the east and west side of Calcasieu Lock had to be tested to determine if this alternative would be feasible. Plate 23 and Plate 24 show track plots for the scenarios tested with Alternative 1.

Plate 23 shows a composite of four total runs each from a different pilot. During this scenario, traffic was westbound with the original proposed diversion channel, wind was 10 knots from the south, and the lock was open. Vessels began with an initial speed of 4 knots. Since the lock was open during this simulation, vessels did not have to slow down as much as when the vessel would be locking through. Slight wobbles can be noticed in the track plots as the pilots had to correct and counteract the effects from diversion channel crosscurrents. Pilots concluded that opening the lock substantially reduced effects of the crosscurrents on the vessel than

when the lock was closed but considered the vessel speed approaching the lock too high. The strength of current pushing them toward the lock was now much stronger. To maintain steerage when traveling in the direction of the currents, the vessel must be going faster than the currents; otherwise, the vessel is essentially floating through the water with minimal control. With the vessel being 70 ft wide and Calcasieu Lock being 75 ft wide, there are only 2.5 ft on either side of the vessel. The vessel must be close to perfectly aligned to make a suitable transit through the lock. While a vessel may touch the guide walls at low speed without causing damage, there is no room for error when the vessel is approaching the lock at high speeds. Bumping the guide walls at high speeds or at too harsh of an angle can cause extensive damage to the lock and/or vessel. Pilot comments expressed that there was a small set due to the diversion channel, but the biggest concern was the lock approach speed of the vessel due to the strength of the currents.

Plate 24 shows a composite of four total runs, each from a different pilot. During this scenario, wind was 10 knots from the south, transits were westbound on the west side of the lock with the original diversion channel, and the lock gates were open. Any variations in track plots shown in Plate 24 were likely due to pilot preference as opposed to transit difficulties. Pilots determined that the diversion channel had minimal impact on westbound traffic on the west side of Calcasieu Lock, since despite the strong currents from the diversion channel, they were able to maneuver effectively. Pilot comments for this run included “hard current coming out of the lock, but it seemed to be a normal running” and “no issue with this run.”

Alternative 2 – modified diversion channel cut, lock closed for westbound traffic

In Alternative 2, the diversion channel cut was modified (shown in Figure 6) and the lock was numerically modeled as closed for all traffic directions. Initial testing showed that transits on the west side of Calcasieu Lock were minimally impacted by the addition of the diversion channel when the lock was closed. The modified diversion channel should provide similar currents on the west side of the lock as the original diversion channel since the culvert capacity is identical to the initial simulations. Therefore, only traffic on the east side of Calcasieu Lock was tested to determine the feasibility of Alternative 2. Plate 25 and Plate 26 show the tracks for

scenarios tested for Alternative 2. For both scenarios, wind was 10 knots from the north.

Plate 25 shows a composite of eight total runs, which were simulated by four different pilots. Each pilot repeated this run, but during the repeated run, the vessel's starting position was moved to approximately 0.5 mile east of Black Bayou Bridge to reduce simulation time without altering results. The vessel's initial speed was approximately 4 knots for the first run and approximately 2 knots for the replicated run that started closer to Black Bayou Bridge. During this scenario, traffic was westbound with the modified diversion channel, and the lock was closed. Pilots felt the modification to the diversion channel slightly lessened the strength of the crosscurrents acting upon the vessel compared to the original diversion channel. However, the crosscurrents were much stronger with the lock closed than with the lock open. The track plots shown in Plate 25 displays the pull of the crosscurrents on the vessel. In these westbound transits, the stern is pulled towards the diversion channel, which causes a swing of the vessel. Several of the transits in this scenario would have resulted in damage as the vessel approached the lock too fast at a slight angle due to the crosscurrents. Pilots expressed the vessel would only be able to stop with assistance (helper boats); otherwise, they would collide with the guide walls and cause damage.

Plate 26 shows a composite of four total runs, each from a different pilot. Vessel's starting speed was approximately 1.5 knots. During this scenario, transits were eastbound with the modified diversion channel, and the lock was closed. Pilots had minimal concerns with this scenario. The vessel was headed into the current, which makes maintaining steerage much easier. Pilot comments included "no noticeable draw exiting the lock, felt like normal" and "no issues with this run."

Alternative 3 – modified diversion channel cut, lock open for westbound traffic

In Alternative 3, the diversion channel cut was modified (shown in Figure 6), and the lock was numerically modeled as open for all westbound traffic. Eastbound traffic passing by the new cut with the lock closed was tested in the previous alternative (run #4) and shown in Plate 26. Eastbound traffic on the west side of the lock should experience similar currents as the original diversion channel because the culvert capacity is the same as in the initial simulations. For this alternative to be accepted, the results of

the eastbound traffic scenarios (Plate 26) and westbound traffic scenarios had to be acceptable. Plate 26 - Plate 28 show the track plots for the scenarios tested with Alternative 3. Results from Plate 26 were discussed in the previous section.

Plate 27 shows a composite of eight total runs, which were simulated by four different pilots. Each pilot repeated this run, but during the repeated run, the vessel's starting position was approximately 0.5 mile east of Black Bayou Bridge to reduce simulation time without altering results. The vessel's starting speed was approximately 4 knots for the initial run and approximately 2 knots for the replicated run that started closer to the Black Bayou Bridge. During this scenario, transits were westbound with the modified diversion channel, and the lock was open. The track plots in Plate 27 show slight wobbles as the pilots counteracted the effects from the diversion channel. Pilots felt the crosscurrent effects were reduced by the modified diversion channel and by opening the lock. However, pilots still experienced a slight pull to the diversion channel and a strong current pushing the tow toward the lock. The increased speed, from the effect of the strong current, means the vessel must be perfectly aligned to make a suitable transit through the lock. While a vessel may touch the guide walls at low speed without causing damage, there is no room for error when the vessel is approaching the lock at high speeds. Bumping the guide walls at high speeds or at too harsh of an angle can cause extensive damage to the lock and/or vessel. Several simulations ended in either the vessel grounding or causing damage. Pilot comments for this scenario included "ran slower and cannot pick tow (stern) up in time before the head wedged between the lock walls" and "felt a slower pull to the cut at a greater speed, but I am still not comfortable."

Plate 28 shows a composite of four total runs, each from a different pilot. During this scenario, wind was 10 knots from the south, transits were westbound on the west side of the lock with the modified diversion channel, and the lock was open. Any variations in track plots shown in Plate 28 was likely due to pilot preference as opposed to transit difficulties. Pilots concluded that the diversion channel had minimal impact on westbound traffic on the west side of Calcasieu Lock. Pilot comments for this run included "no issues" and "normal running."

7 Production Runs Summary

The diversion channel had minimal impact on all transits occurring on the west side of the lock. The main channel opens up significantly on the west side of Calcasieu Lock, which allows the current magnitudes to substantially decrease.

The diversion channel also did not significantly impact eastbound transits on the east side of the lock. Since vessels are going against the current when leaving the lock, the vessel does not have to be going faster than the current to maintain steerage. In addition, the vessel does not have to stop to lock through, so the vessel is able to pass by the diversion channel going much faster than when transiting westbound. The faster speed lessens the pull caused by the diversion channel. Easier steerage and faster speed makes eastbound transits on the east side of the lock practical for either proposed diversion channel.

Westbound transits on the east side of the lock were not feasible for the original proposed diversion channel, nor for any of the additional alternatives tested. When going westbound on the east side of the lock, vessels are going with the current, which requires the vessel to go faster than the current speed to maintain steerage; otherwise, the vessel is floating in the water with little to no control. Pilots will want to push ahead when transiting through the bridge to maintain steerage and not have a collision. However, once past the bridge, the pilot must begin to slow down and then stop to lock through (initial design and Alternative 2). As the vessel slows, it becomes susceptible to the crosscurrents from the diversion channel. Either the pilots were unable to keep enough speed on the vessel to not be at the mercy of the diversion channel suction, or they could not slow quickly enough to stop and safely transit the lock. These two conditions worsened with the 10-year flood event. While Alternative 1 and Alternative 3 allowed for westbound traffic to pass through the lock instead of locking through, the current was still too strong for the pilots to transit Calcasieu Lock. In Alternative 1 and Alternative 3, vessels would have to be perfectly aligned with the lock since bumping the guide walls at a sharp angle or at a high speed would result in extensive damage.

8 Conclusions and Recommendations

Overall conclusions and recommendations are based on track plots (Appendix A), run sheets (Appendix A), final pilot surveys (Appendix B), discussions after each simulation, and final wrap-up meetings completed at the end of each testing week.

Final meetings

At the end of session one, a wrap-up meeting occurred with the pilots, MVN, and ERDC personnel. During this meeting, pilots discussed their concern for the original proposed diversion channel. During high flow events in the simulations, the westbound vessels experienced significant suction towards the diversion channel. Pilots considered the addition of the diversion channel a bad decision that would result in increased delays for westbound traffic and possible damage.

At the end of session two, a wrap-up meeting occurred with the pilots, MVN, GICA, and ERDC personnel. The pilots concluded that if the original proposed diversion channel is constructed, helper boats would be considered mandatory for westbound traffic. One of the pilots expressed that a 1,000 ft tow would be unable to maneuver by the diversion channel as the stretch between the Black Bayou Bridge and long guide wall is only 1,500 ft. Possible modifications to alleviate crosscurrents were identified, which included opening the lock for westbound traffic and modifying the diversion channel inlet.

At the end of the additional testing session, a final meeting occurred with the pilots, MVN, and ERDC personnel. The pilots concluded that while the modifications to the diversion channel improved navigation conditions from the initial proposed design, the improvements were not enough to make any of the alternatives feasible. The pilots stated that if any of the proposed designs are implemented, it would be “when” not “if” damage occurred.

Concerns for westbound traffic east of Calcasieu Lock

The pilots that were present for both testing weeks had significant experience piloting tows, which provided them with the knowledge to counteract the suction from the diversion channel during most of the

transits. However, pilots expressed concern over less-experienced towing pilots being able to compensate for the pull from the diversion channel and having experience at all with crosscurrents. Another concern was that in an approximately 1,500 ft stretch (from long guide wall to the Black Bayou Bridge), there are three main challenges for westbound traffic: lining up for the lock, lining up to get past the bridge, and counteracting the suction from the diversion channel. The combination of these three obstacles creates a critical navigation situation. The addition of the suction from the diversion channel adds an extra layer of complexity to westbound transits that turn an already difficult situation into a possibly hazardous one.

While this proposed diversion channel could possibly eliminate eastbound transit delays, it would likely create navigational delays for westbound traffic. If an eastbound vessel does not have adequate horsepower to overcome the currents going through Calcasieu Lock, the tow will be pushed out of the lock and be forced to wait for conditions to lessen, or *trip* individual barges or small groups across. While this eastbound navigation obstacle may cause delays, it does not risk damage. However, the proposed design would create a westbound situation that has the potential to damage the lock and/or the vessel. Once the westbound vessel passes Black Bayou Bridge, it may not be able to stop due to the strength of the current and diversion channel suction. If the vessel is not appropriately aligned with the lock, damage to the lock and/or vessel is likely. Pilots agreed that if the proposed diversion channel is implemented, damage would occur.

Currently, pilots communicate with the lockmaster to determine expected flow conditions in preparation for their transit through the lock. If the proposed diversion channel is constructed, it is vital that a flowmeter or similar device be placed in the diversion channel so that the lockmaster would have access to it and be able to communicate flow condition information to approaching tows. This communication would allow pilots to prepare for the transit by the diversion channel and subsequent lock approach.

Recommendations

ERDC recommends the diversion channel not be constructed as proposed based on the results of the simulations. The proposed diversion channel was originally suggested to alleviate the amount of flow the lock must pass during high flow events to eliminate navigational delays experienced by

eastbound lower-horsepower tows. All pilots in attendance for testing concurred that the eastbound traffic concerns (due to high flow) have improved extensively over the last few years due to changing industry standards. Towing companies are also replacing lower-horsepower tugs with higher-horsepower tugs, which is eliminating or lessening wait times of eastbound traffic due to extreme currents. If a diversion channel is deemed necessary to improve navigation conditions, it is suggested the diversion channel not be located between Black Bayou Bridge and Calcasieu Lock as that location is not conducive for safe navigation. If a new location is proposed, a ship simulation navigation study would be necessary to understand the impacts to navigation.

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Appendix A: Track Plots and Pilot Comments

Initial testing track plots and pilot comments

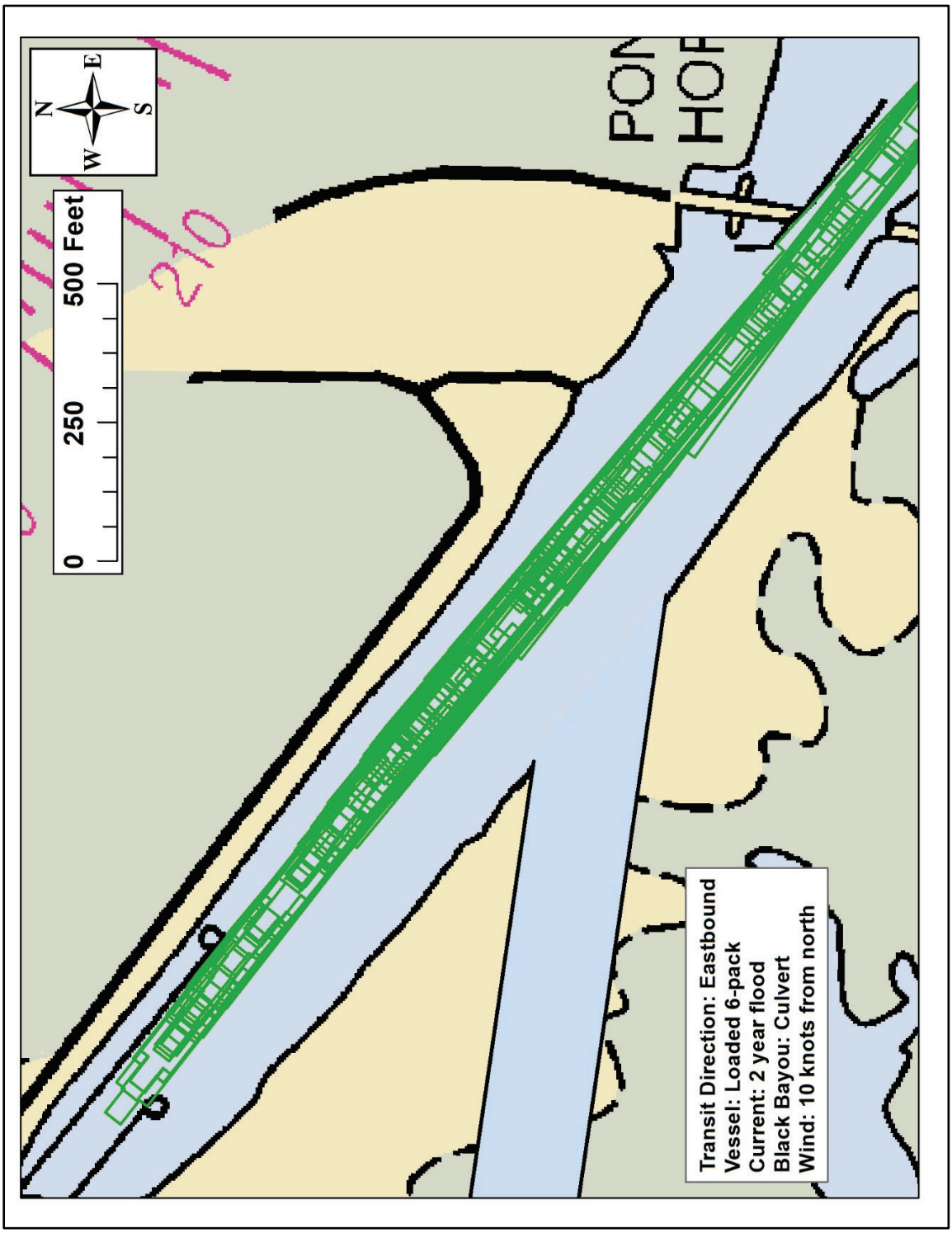
The following section presents first the track plot and then a consolidated sheet(s) of pilot comments for each track plot. Each track plot is presented initially with its paired pilot comment sheet; however, occasionally the track plots will be shown again composited together with other track plots. If a track plot image is not followed by a paired pilot comment sheet, then the original track plots and comments have already been presented in a previous sheet.

In this section, results will be shown first for simulations on the east side of Calcasieu Lock for the loaded 6-pack transiting first eastbound and then westbound. Those results will be followed by transits on the west side of Calcasieu Lock for the loaded 6-pack transiting first eastbound and then westbound. Each result section for the loaded 6-pack is further divided by current magnitude (2-year or 10-year flood). The last result section for initial testing will present the empty 6-pack runs on the east side of Calcasieu Lock.

Green track lines represent Black Bayou being treated numerically as a culvert while red track lines represent Black Bayou being treated numerically as a wall. Blue track lines mean vessel traffic was added in the locations specified in Figure 10 and Figure 11 of the main text.

East side of Calcasieu Lock - loaded 6-pack transiting eastbound

Plate 1.



Pilot comments for plate 1.

Plate 1 Pilot Comments:

Testing session: Initial
Area: East of lock
Transit direction: Eastbound
Current: 2 year flood (MSL), Black Bayou as culvert

Test matrix number: 7
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed):

Slight DRAW At Low SPEED

Pilot 2 comments (1 run completed):

Had a little pull by the new cut when I came by it

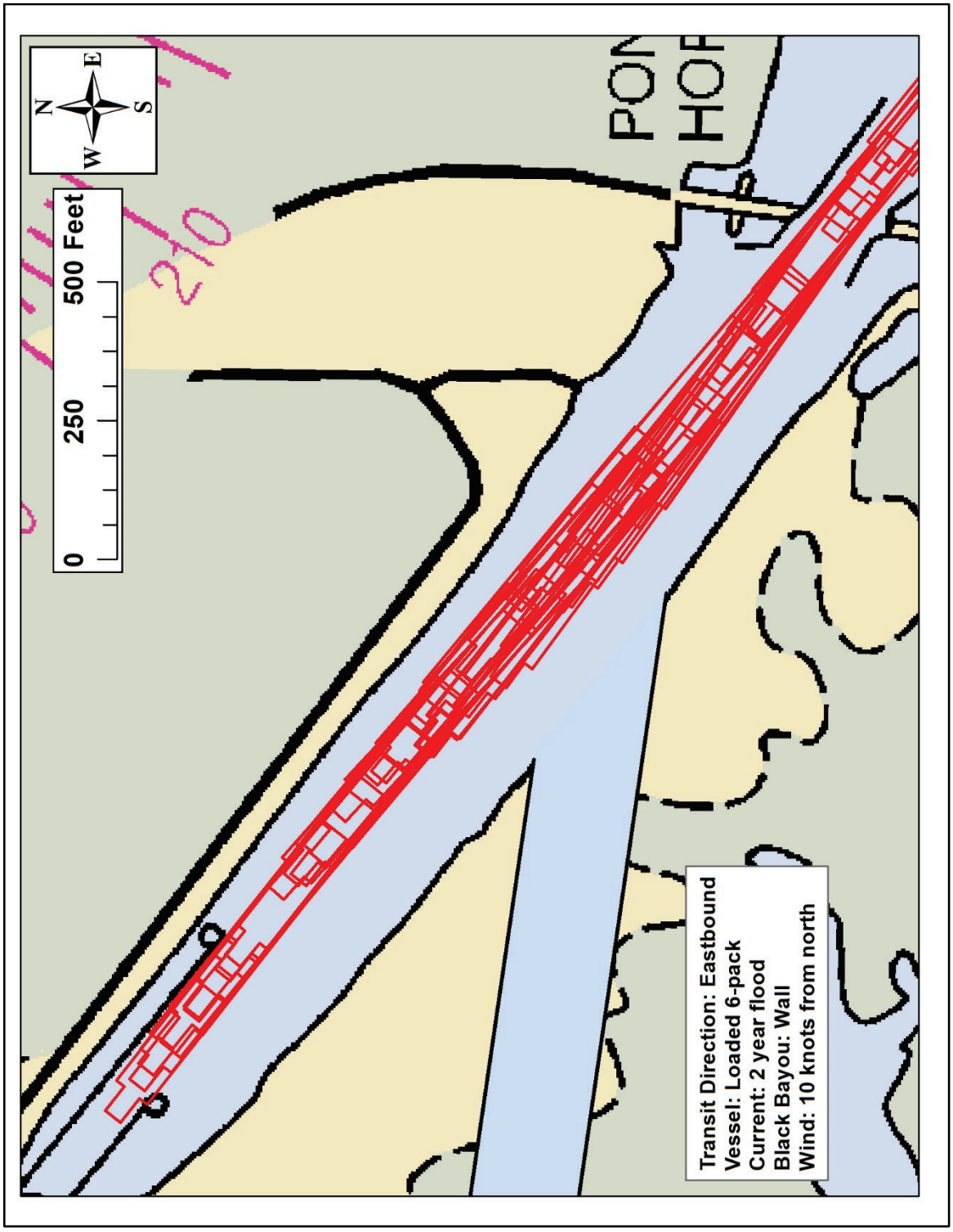
Pilot 3 comments (1 run completed):

Felt like a normal exit from the lock E/B.

Pilot 4 comments (1 run completed):

Minimal current felt throughout the simulation. No issues here.

Plate 2.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Transit Direction: Eastbound
Vessel: Loaded 6-pack
Current: 2 year flood
Black Bayou: Wall
Wind: 10 knots from north

Pilot comments for plate 2.

Plate 2 Pilot Comments:

Testing session: Initial
Area: East of lock
Transit direction: Eastbound
Current: 2 year flood (MSL), Black Bayou as wall

Test matrix number: 1
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed):

Slow speed slight DRAW E/B At cut

Pilot 2 comments (1 run completed):

The new cut had some pull the whole Time I was going By it you had to point away from it it also felt Like you where getting set to Bridge the whole time

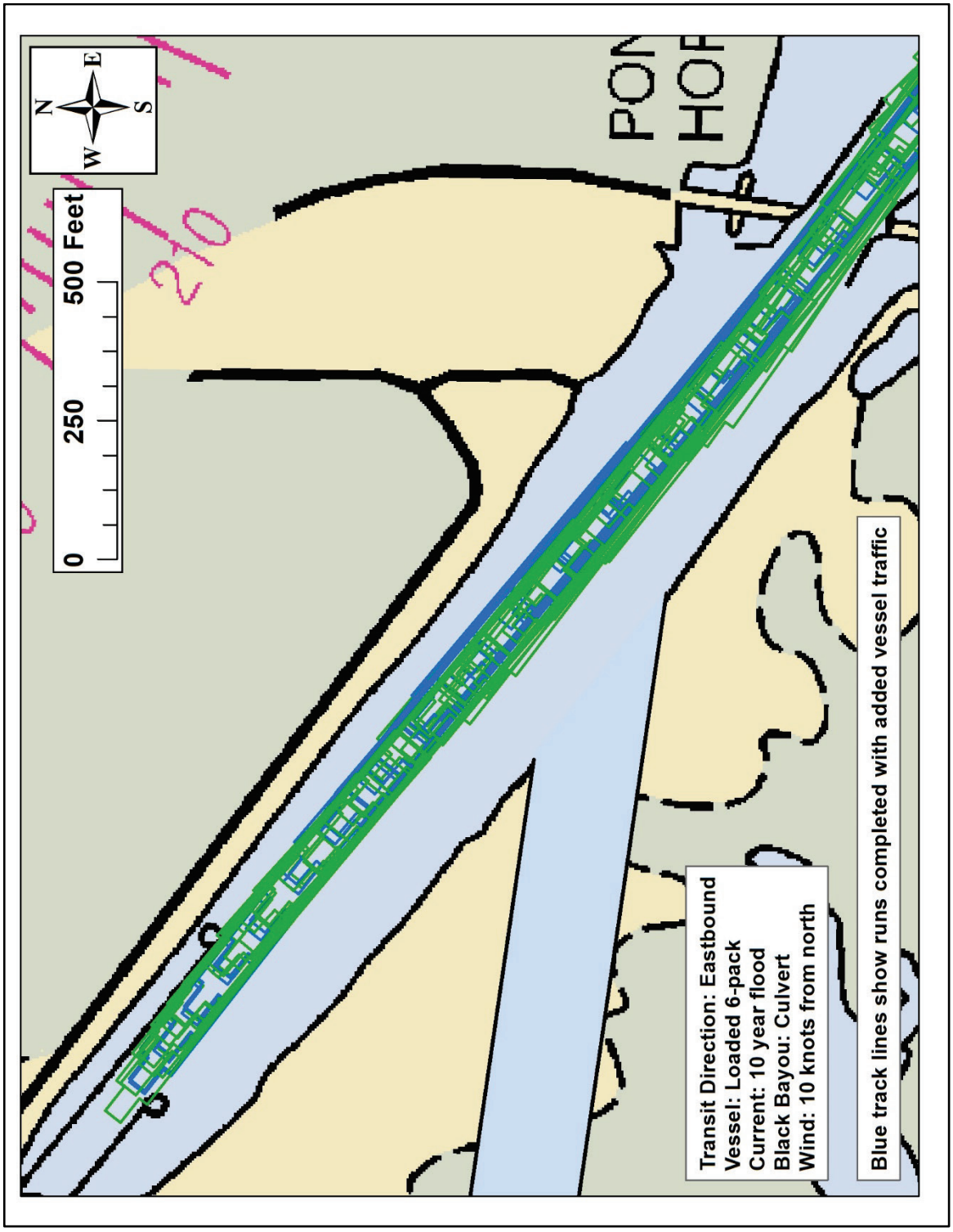
Pilot 3 comments (1 run completed):

Seemed normal conditions no real set either way. Was able to just drive out the lock and through the bridge no problem. If there was any pull going towards the canal it helped to pull you away from the wall but not enough to effect steering.

Pilot 4 comments (1 run completed):

Minimal effect from diversion channel. I could see the speed over ground change when I got out of the slack water pocket on the east side of the lock, but saw no difficulty with this simulation.

Plate 3.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Transit Direction: Eastbound
Vessel: Loaded 6-pack
Current: 10 year flood
Black Bayou: Culvert
Wind: 10 knots from north
Blue track lines show runs completed with added vessel traffic

Pilot comments for plate 3.

Plate 3 Pilot Comments:

Testing session: Initial
Area: East of lock
Transit direction: Eastbound
Current: 10 year flood (MSL), Black Bayou as culvert

Test matrix number: 9
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 1 comments (2 runs completed):

Repetition #1 comment:

WHEN TRANSITING E/B AT PROJECTED CUT I FELT A SUCTION .1 ON HEAD & .3 ON STERN, SO I REALLY FEEL SOMETHING IS WORKING US IN THE WATER

Repetition #2 comment:

FELT A GREATER SUCTION COMING BY THE PROPOSED CUT @ LOW SPEED, THIS WILL CREATE THE RISK OF COLLISION TO VESSEL

Pilot 2 comments (2 runs completed):

Repetition #1 comment:

Seem Like it had a Little pull when first came out of the lock

Repetition #2 comment:

Seemed to have just a little pull not Bad just righ around the new cut

Pilot 3 comments (2 runs completed):

Repetition #1 comment:

Didn't really feel anything coming out the lock up to the bridge. There was just a very small draw to the south bank above the bridge but just enough to be noticable if your looking for it, not bad at all

Repetition #2 comment (with added vessel traffic):

Felt about like a normal exit from the lock.

Pilot 4 comments (2 runs completed):

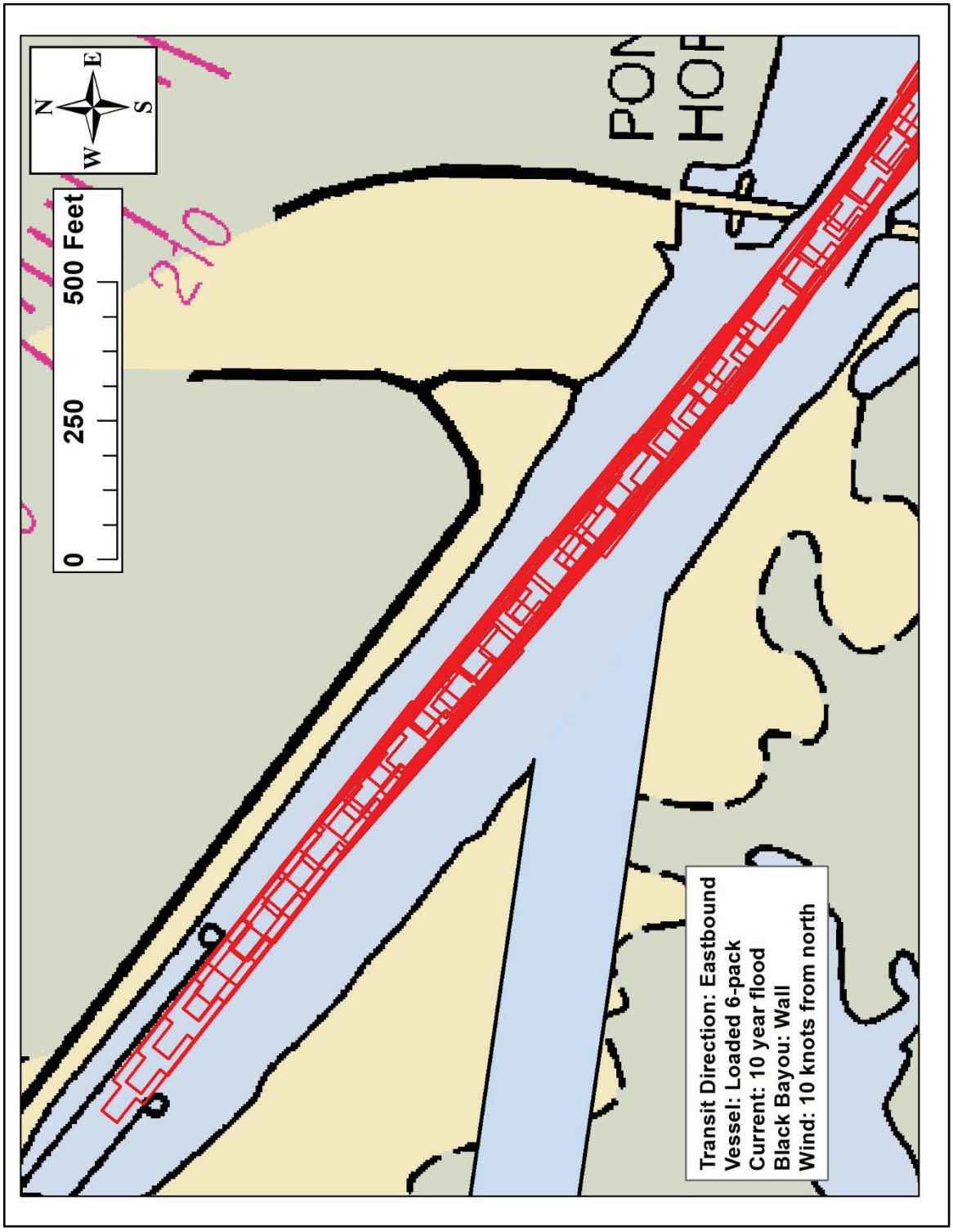
Repetition #1 comment:

Felt very similar to the run with Black Bayou closed. Slight draw to starboard when the head of the tow came abreast of the diversion channel, which actually helps to line up on the bridge. Did not notice any effects when passing by Black Bayou cut. No issues with this run.

Repetition #2 comment (with added vessel traffic):

No issues with this transit.

Plate 4.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Transit Direction: Eastbound
Vessel: Loaded 6-pack
Current: 10 year flood
Black Bayou: Wall
Wind: 10 knots from north

Pilot comments for plate 4.

Plate 4 Pilot Comments:

Testing session: Initial
Area: East of lock
Transit direction: Eastbound
Current: 10 year flood (MSL), Black Bayou as wall

Test matrix number: 3
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed):

I FELT A GRADUAL PULL TO THE PROPOSED CUT WHEN ENTIRE TOW WAS ABREAST OF THEN MORE WHEN TOW BOAT WAS ABREAST

Pilot 2 comments (1 run completed):

It had a little Drag when you got Beside the new cut But was not much had no problem

Pilot 3 comments (1 run completed):

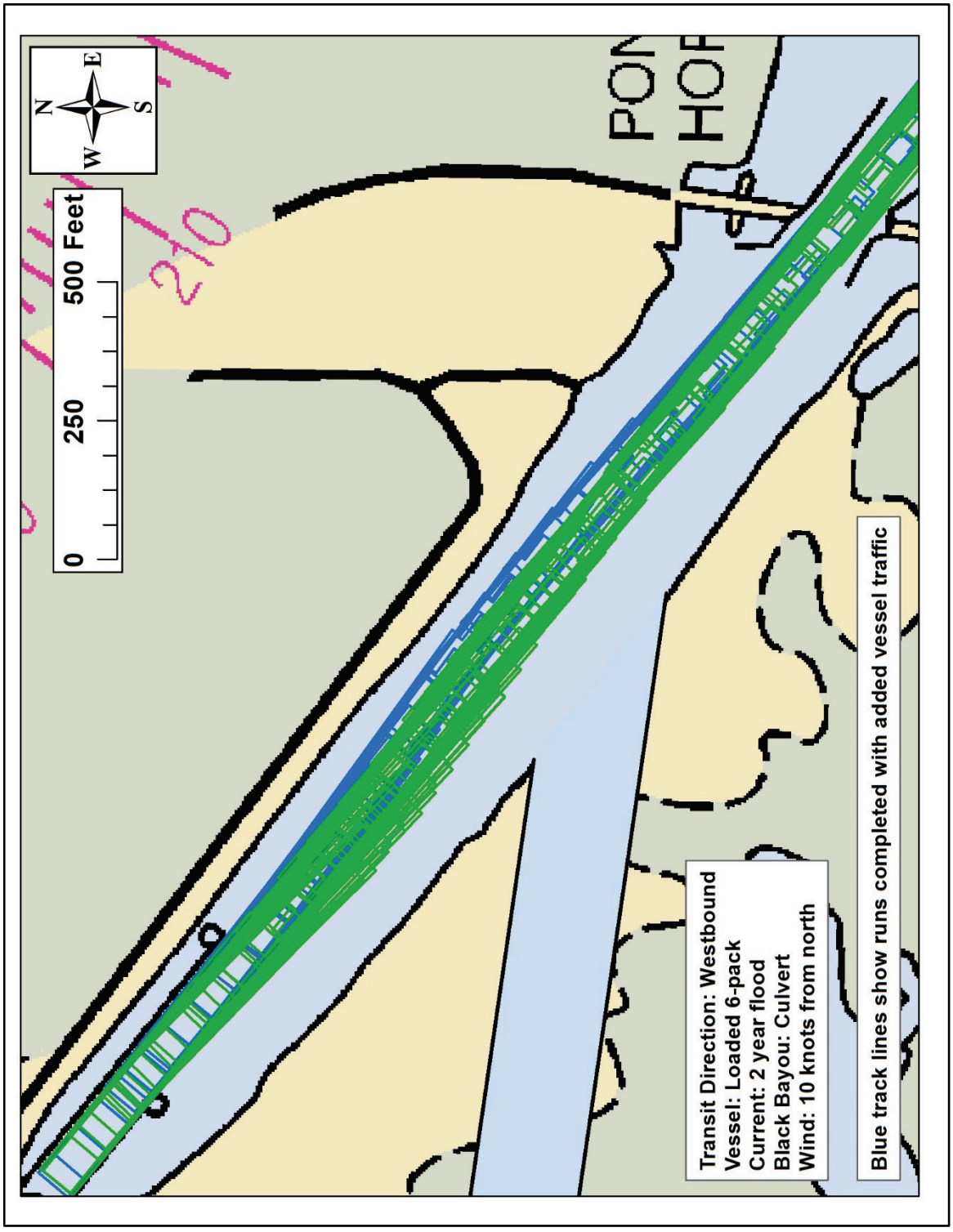
Set helps with leaving the lock E/B, it pulls your head off the wall and starts setting you in the middle of the canal for the bridge. Very nice and easy. There was a slight Set to the port in the bridge but almost unnoticable.

Pilot 4 comments (1 run completed):

No issues w/ exiting the lock to the east. The current does pull the head to starboard as it passes the diversion channel, but it actually helps to line you up with the bridge.

East side of Calcasieu Lock - loaded 6-pack transiting westbound

Plate 5.



Pilot comments for plate 5.

Plate 5 Pilot Comments:

Testing session: Initial
Area: East of lock
Transit direction: Westbound
Current: 2 year flood (MSL), Black Bayou as culvert

Test matrix number: 8
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed):

Comments:

Low SPEED STILL HAD A DRAW @ cut w/slow CURRENT going through cut

Pilot 2 comments (1 run completed):

Pulled me to new cut when I got Beside it and was still pulling me when I was getting By Long wall

Pilot 3 comments (2 runs completed):

Repetition #1 comment: No noticeable pull either way above the bridge. There is a slight draft (suct) on the boat to the South bank once you get most of the tow past dev. canal but very manageable to get in the lock.

Repetition #2 comment (with added vessel traffic):

No draw that I could really feel at this stage, just ran it like normal.

Pilot 4 comments (2 runs completed):

Repetition #1 comment:

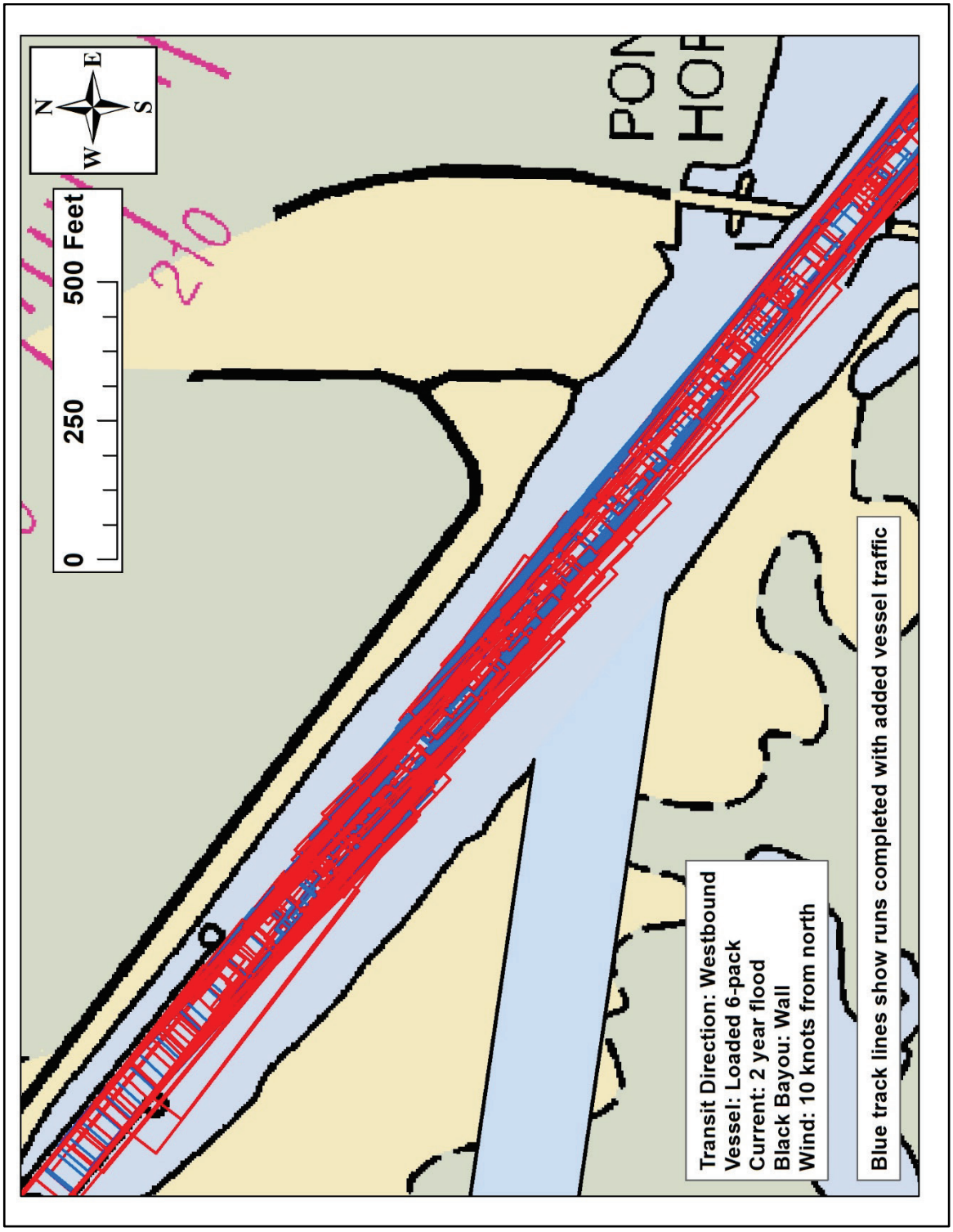
No issues with current on this approach. I felt some slight effects when passing the diversion channel, but they did not pose any challenges.

Repetition #2 comment (with added vessel traffic):

Comments:

No issues with this run. It does still feel like having the culvert open has a lessening effect on the current draw at the diversion channel.

Plate 6.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Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 2 year flood
Black Bayou: Wall
Wind: 10 knots from north
Blue track lines show runs completed with added vessel traffic

Pilot 1 and 2 comments for plate 6.

Plate 6 Pilot 1 & 2 Comments:

Testing session: Initial
Area: East of lock
Transit direction: Westbound
Current: 2 year flood (MSL), Black Bayou as wall

Test matrix number: 2
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 1 comments (4 runs completed):

Repetition #1 comment:

Comments: ON MY APPROACH W/B @ 6 KNTS, I FELT A SMALL EFFECT ONCE I CLEARED BRIDGE 0.1 ON HEAD OF TOW & 0.1 ON STERN OF TOW SUCKING IN @ THE PROPOSED CUT, THIS WAS WITHOUT PULLING BACK TO APPROACH LOCKS @ A SAFE SPEED

Repetition #2 comment:

ON MY APPROACH TO BIDGE I SLOWED MY SPEED WITH MIN. STEERAGE, BOW OF TOW WHEN PASSING PROPOSAL CANAL STAYED PRETTY MUCH ON TRACK, STERN OF TOW GOT PULLED TO CUT TOP SIDE

Repetition #3 comment:

Comments:
STILL @ LOWER SPEED I HAD VERY LITTLE STEERAGE AND HAD TO PICK UP SPEED TO STEER ALSO @ PROPOSAL AREA I WAS STILL DRAWED IN @ SLOW SPEED, THIS WILL CAUSE A RISK OF COLLISION

Repetition #4 comment:

SLOW RATE OF SPEED TO APPROACH & LINE UP ON LOCKS CAUSING WHEN COMING BY CUT IT MESSED UP MY LINE UP TO LOCK DUE TO DRAW @ CUT

Pilot 2 comments (3 runs completed):

Repetition #1 comment:

Run The new cut at 6 mph had Ruby ~~not~~ no set But That speed is to fast for tow size need to slow down to get a fill for set would have no Problem getting in lock going that fast

Repetition #2 comment:

It seem to pull on my Boat But not the tow and it pulled my Boat when It was just about past the new cut did not seem to pull Barges at all does not make since of why did not pull Barges

Repetition #3 comment:

Had some pull when you get Beside the new cut it seems to pull you when you are trying to slow down to go into the Lock it starts to take your Head and you have to Bring it Back up to wall and try to Keep it There

Pilot 3 and 4 comments for plate 6.

Plate 6 Pilot 3 & 4 Comments:

Testing session: Initial
Area: East of lock
Transit direction: Westbound
Current: 2 year flood (MSL), Black Bayou as wall

Test matrix number: 2
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 3 comments (2 runs completed):

Repetition #1 comment:

Nothing new above the bridge W/b. Between the bridge and Lock Wall there was a small port set pulling the stern of the tow towards the canal as the head got closer to the wall and the more the tow slowed down. If the current was affecting the speed of the vessel that h.p. boat w/that tow would need to be only doing about 3.5 coming through the bridge or it would be at risk of not being able to stop.

nothing unmanagable though

Repetition #2 comment (with added vessel traffic):

No hard draw to the south bank, but if you slow down enough you can still feel or get caught in that south set with the stern of your tow setting to the south bank while trying to line up the head to get inbetween the lock walls.

Pilot 4 comments (2 runs completed):

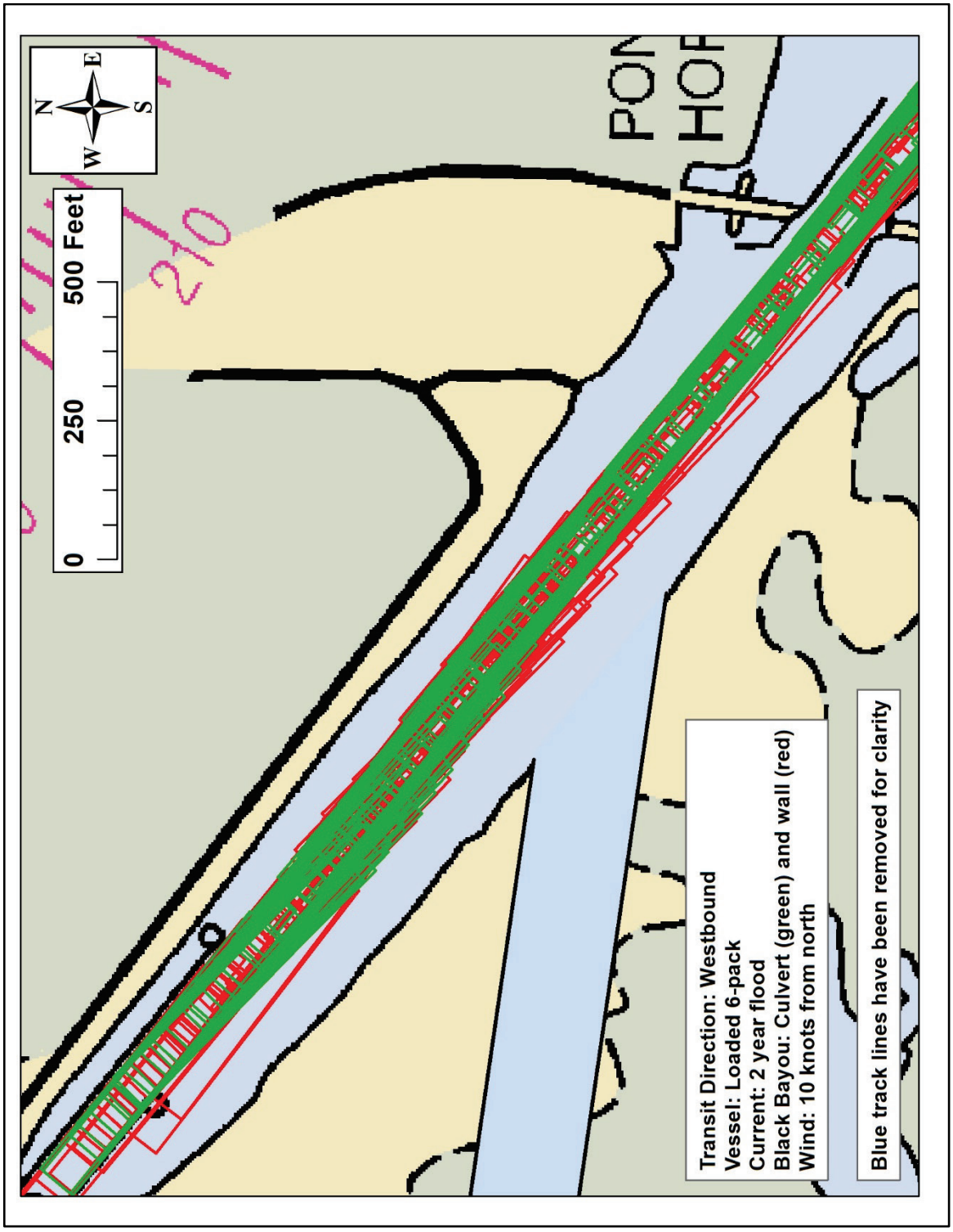
Repetition #1 comment:

Minimal set to port when coming by the diversion channel. It didn't seem to pull the head of the tow to port on the way by, but did seem to have a bit of set as the second half of the tow and boat were passing it. Very tough to stop this tow with this vessel.

Repetition #2 comment (with added vessel traffic) :

I still had to compensate for the draw towards the diversion channel on my final approach to the lock, but the effects are not nearly as pronounced as the 10 yr event currents. No issues if anticipating the set ahead of time.

Plate 7.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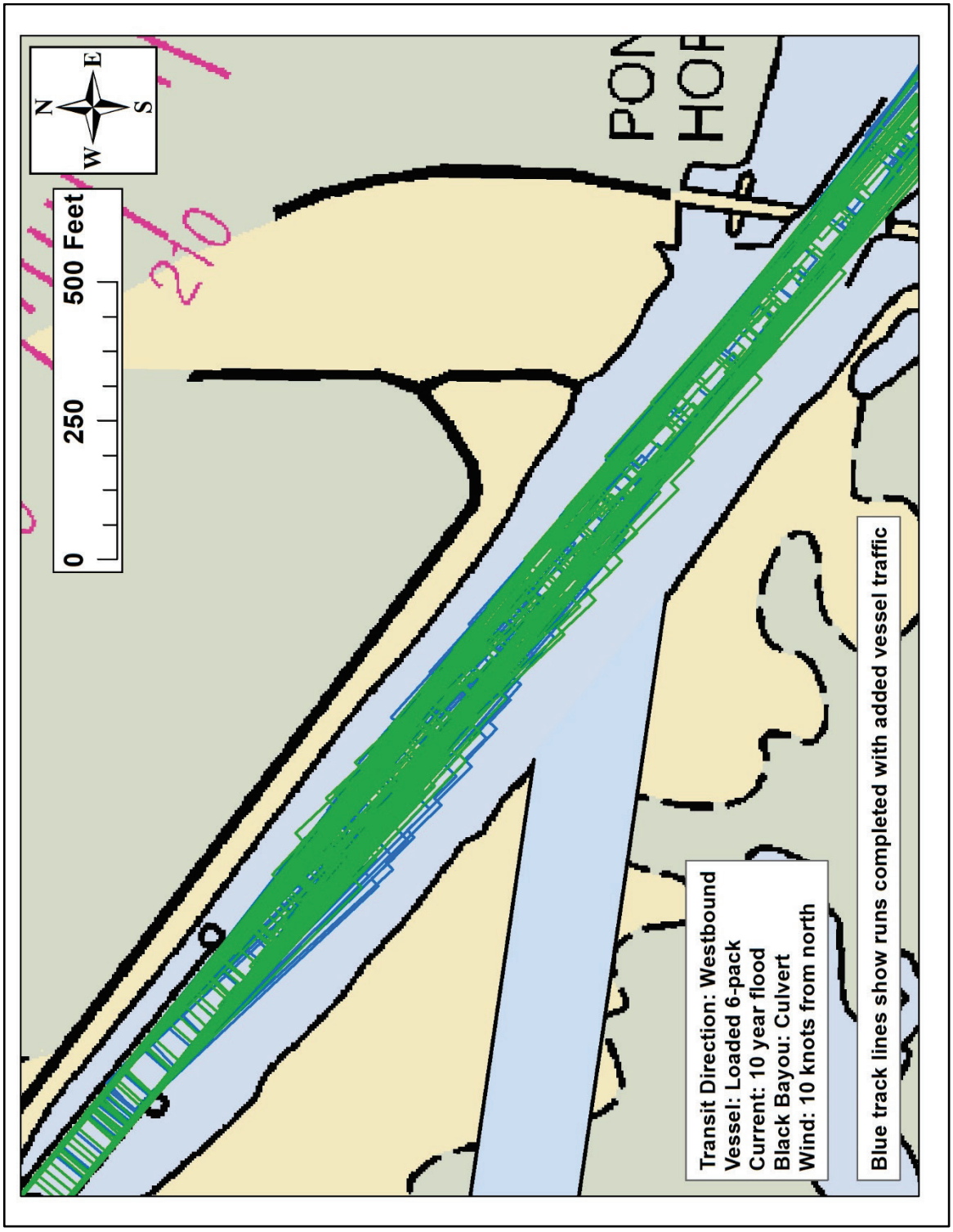
Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 2 year flood
Black Bayou: Culvert (green) and wall (red)
Wind: 10 knots from north
Blue track lines have been removed for clarity

Plate 8.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Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 10 year flood
Black Bayou: Culvert
Wind: 10 knots from north
Blue track lines show runs completed with added vessel traffic

Pilot 1 and 2 comments for plate 8.

Plate 8 Pilot 1 & 2 Comments:

Testing session: Initial
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MSL), Black Bayou as culvert

Test matrix number: 10
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 1 comments (2 runs completed):

Repetition #1 comment:

W/B I FELT A DRAW TO BLACK BAYOU CUT VERY LITTLE, THEN WHEN I CLEARED THE BRIDGE I STARTED TO SLOW DOWN TO MAKE MY APPROACH TO LOCKS AND WAS LINED UP PERFECT THE SOMETHING IN THE CURRENT THROUGH ME OFF COURSE, A EXPIERENCED WHEELMAN COULD ADJUST But A INEXPERIENCED WHEELMAN COULD NOT

Repetition #2 comment (with added vessel traffic):

SLOW RATE OF SPEED FOR A SAFE APPROACH TO LOCKS, APPROACH TO CUT HAD A STRONG DRAW, AND HAD TO COME HARD AHEAD TO MAKE LOCK AT A SAFE APPROACH, THIS CUT IS SETTING UP VESSEL FOR A INCIDENT WITH LOCK, NOT A GOOD SITUATION

Pilot 2 comments (2 runs completed):

Repetition #1 comment:

Had a pull to the new cut had to Back down on tow to Try to slow down so I could ship in lock it pulled me to short wall and I wedged the tow in lock would have Tore wall and tow up getting in there. I would not let a young wheelman make it like that

Repetition #2 comment:

It had a hard draw to the new cut which gets you out of shape for the Lock and makes you land on the short wall Bull nose

Pilot 3 and 4 comments for plate 8.

Plate 8 Pilot 3 & 4 Comments:

Testing session: Initial
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MSL), Black Bayou as culvert

Test matrix number: 10
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 3 comments (2 runs completed):

Repetition #1 comment:

No draw or set above the bridge W/B. Kept the tow angled at the long wall as long as could until most of the tow was past the canal the back the stern away from the canal and dropped the head down in between the lock walls and went straight in. Believe there was less of draw coming down the canal with Black Bayou being open.

Repetition #2 comment (with added vessel traffic):

Held high on B.B. bridge and then started to point at the long wall on the lock as clearing the bridge. Then lined up for the lock about 150' away from the long wall. Backing up from the bridge to the lock.

Draw was less to the south with Black Bayou working.

Pilot 4 comments (2 runs completed):

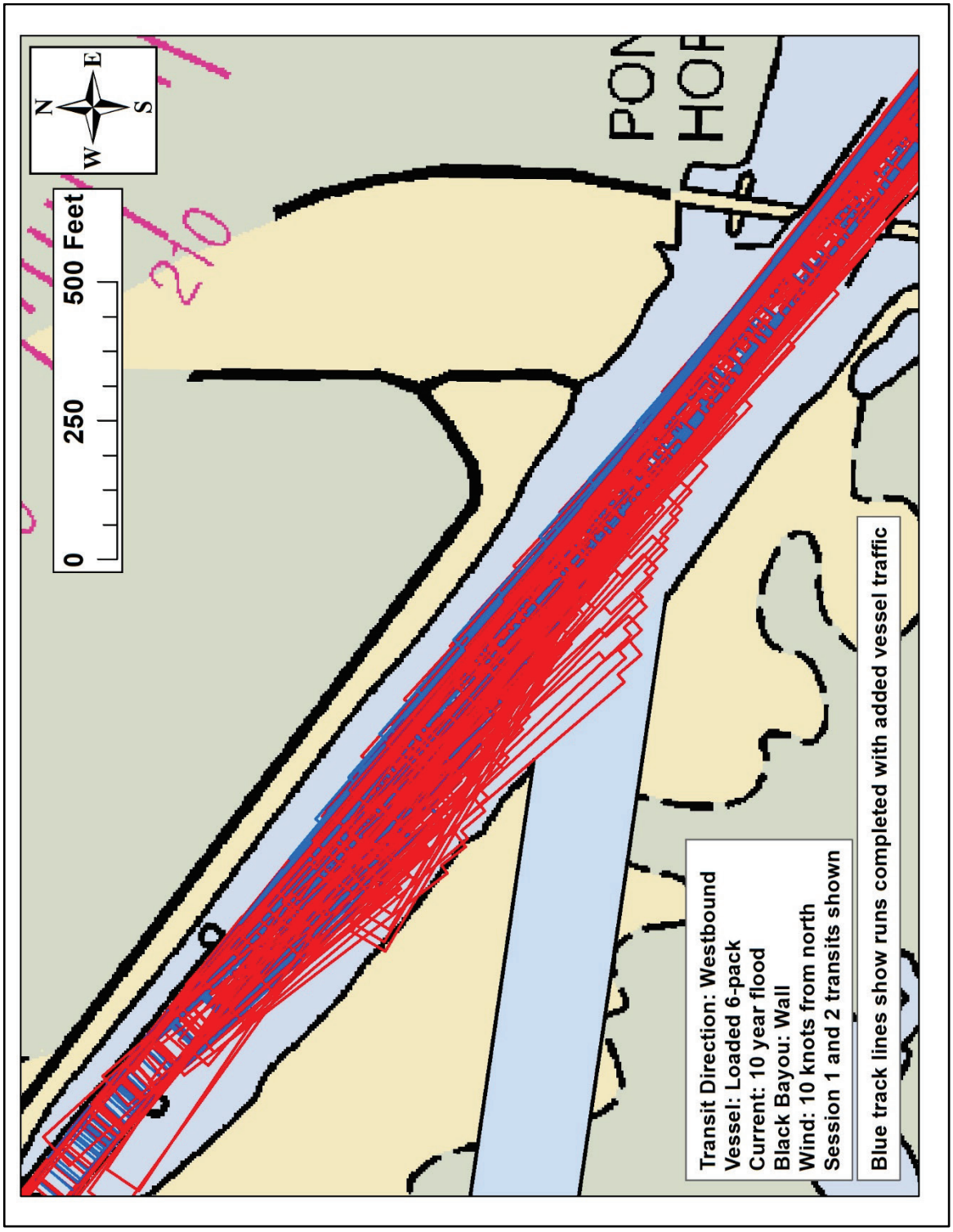
Repetition #1 comment:

I did feel some slight effects from the current when passing by Black Bayou cut, as the steering was a little sluggish. I adjusted my lock approach and steered around the bridge to hold closer to the north bank. It seemed to lessen the effects of the diversion channel, or some combination with Black Bayou cut lessening some of the draw. This approach was the best so far with the 10yr event flow rate.

Repetition #2 comment (with added vessel traffic):

I did not make my transit through the bridge properly and ended up needing to steer around it. I then ended up a little low to the south / not properly lined up on the lock. Might have caused barge damage when I landed on the short wall bull nose. I don't feel that the currents were the cause of my set-up issues on this transit.

Plate 9.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Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 10 year flood
Black Bayou: Wall
Wind: 10 knots from north
Session 1 and 2 transits shown
Blue track lines show runs completed with added vessel traffic

Pilot 1 comments for plate 9.

Plate 9 Pilot 1 Comments:

Testing session: Initial
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MSL), Black Bayou as wall

Test matrix number: 4
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 1 comments (3 runs completed):

Repetition #1 comment:

As I cleared the bridge with bare min steerage (due to running slow to stop my tow in locks) My head started to get sucked in then once my head cleared and got into slack water my vessel started to get sucked down swing the head into long wall and had to drive hard over for my head to swing to short wall,

Repetition #2 comment:

there is defintly a set that pulls the tow towards the projected cut with a possible eddy

Repetition #3 comment:

While trashing w/b slowing speed down when head came through bridge it sucked ~~us~~ tow into cut then screw my approach to locks up (something is happening like a eddy or something

Pilot 2 comments for plate 9.

Plate 9 Pilot 2 Comments:

Testing session: Initial
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MSL), Black Bayou as wall

Test matrix number: 4
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 1 comments (4 runs completed):

Repetition #1 comment:

It had more draw on it it still seems to want to suck your Boat in to the hole harder than the tow was doing around 5mph in the Bridge but it will suck you down and you would have to watch for it

Repetition #2 comment:

went in By the new cut running 1mph and let it float and it pulled me in to the cut pretty hard and fast you could not go to slow by the hole one would not make it By it

Repetition #3 comment:

Had very little pull But I was going fast would not have been able to stop if I had to can not make the lock that fast

Repetition #4 comment:

Had a pull at the new cut and pulled me to shore walk at slow speeds and you have to slow down to get in lock you can not make lock safe at High speeds and when you slow down the new cut pulls you to it.

Pilot 3 comments for plate 9.

Plate 9 Pilot 3 Comments:

Testing session: Initial
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MSL), Black Bayou as wall

Test matrix number: 4
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 3 comments (5 runs completed):

Repetition #1 comment: Came through the bridge at 3.5 kn started backing up halfway through the bridge. Halfway past the canal I was down to 1.5 kn and lined up good for the lock with a noticable port set on the tow. I knocked it out of gear to float down towards the lock but the current was running hard enough to set me back up to 2.5 kn quickly enough that I didn't notice it in time and then had a good port set going with the stern of the vessel headed for the bank and head of tow head for short wall bull nose. In this instance a helper boat to keep you pushed over would greatly help. So your not fighting set and speed.

Repetition #2 comment: Tried to Flank down to the long wall since there is such a strong current, was unable to get enough starboard set going to counter act the port set before the head landed on the South bank. Would not suggest Flanking.

That hp to tow size I would suggest making it a smaller tow or having a helper boat to assist set in the lock.

Repetition #3 comment: W/D came in favoring the north side of the bridge and then let the head point at the long wall while clearing the bridge. Once clear started backing up and straighted the tow up to go between the walls as I got close to the long wall.

Doing it this way seems to counter act the draw from the canal.

Repetition #4 comment: (with added traffic) Ran a little faster coming down on the lock to simulate a higher current speeds. Ended up shearing off the short wall bull nose and hitting the long wall due to not being able to slow down enough.

Repetition #5 comment: (with added traffic) Was able to land on short wall going slow enough to steer off the bullnose to set lined up to shove in the lock.

Still a port draw pulling the stern down to the south once the tow hits the dead water.

Pilot 4 comments for plate 9.

Plate 9 Pilot 4 Comments:

Testing session: Initial
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MSL), Black Bayou as wall

Test matrix number: 4
Wind: 10 knots from north
Vessel: Loaded 6-pack

Pilot 4 comments (5 runs completed):

Repetition #1 comment:
I made my approach slower this time, floated through the bridge. Did not feel much effect from the cut on the head of the tow. I am not confident that this vessel can stop this tow configuration in a reasonable distance so I do not want to drive it into the lock then have to stop. I'm attempting to keep the speed down to minimize damage to the lock structure from a poor approach.

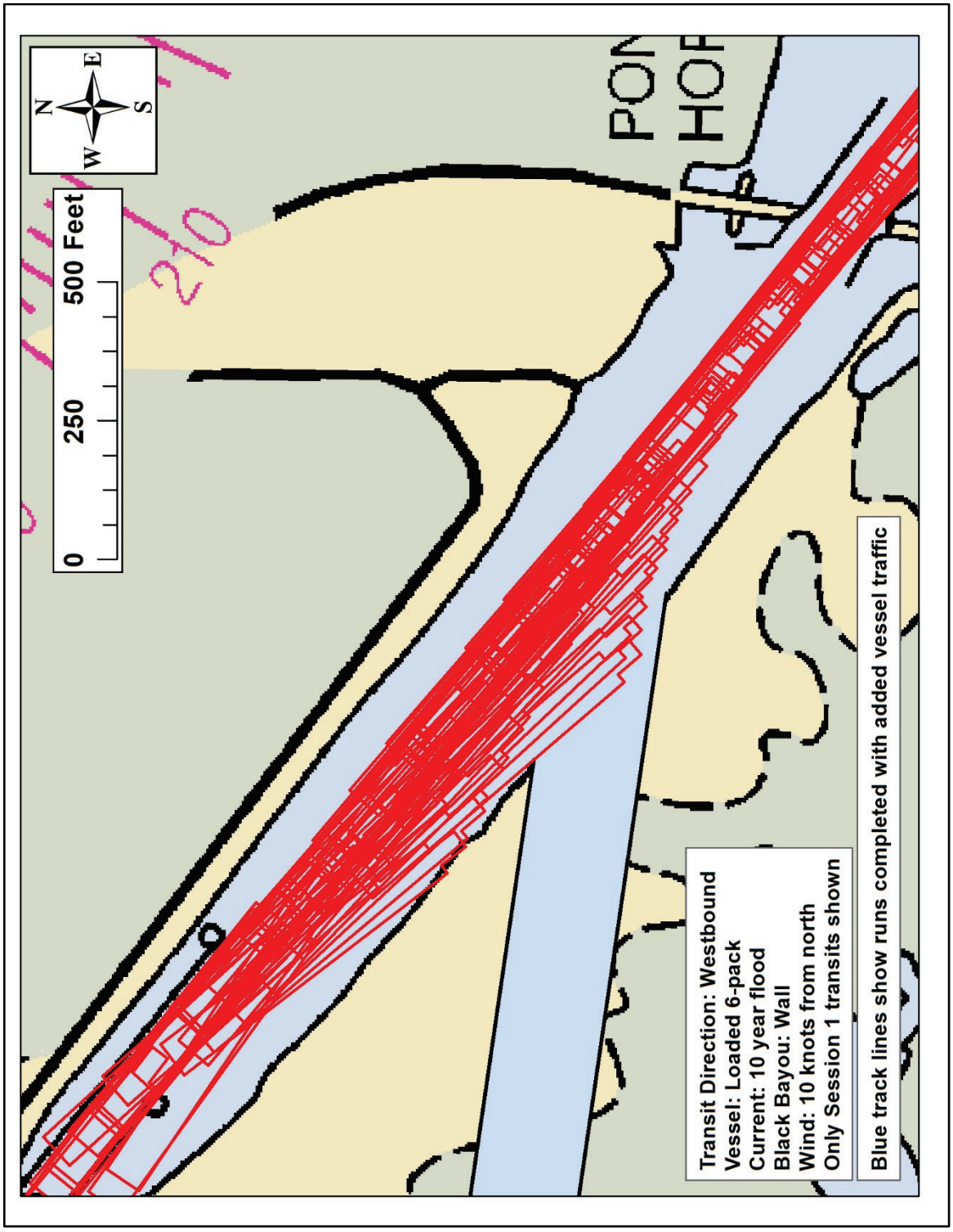
Repetition #2 comment:
Made a very slow approach on this run, almost down to current speed on the way through the bridge. Felt a set towards the port side fenderworks and came ahead to clear the bridge.
Ended up coming ahead and steering into the lock but did not like the approach angle. The vessel was able to stop the tow before clearing the gates.
still too much tow for this size vessel to comfortably make the approach. Recomend an assist vessel or smaller tow.

Repetition #3 comment:
Felt like a better approach due to experience gained with the simulation and the vessel characteristics. setting up high still seemed to help the approach, but it did feel like there was a bit more draw to the diversion channel as the stern wanted to fall to the port when I started backing on my final approach.

Repetition #4 comment: (with added traffic)
The addition of the tows on the bank did not change my approach. I still set up high and was able to stay in good shape until the final approach when I came ahead on both engines to counteract the current. I still feel that I'm making the approach at an unsafe speed.

Repetition #5 comment: (with added traffic)
Made this approach closer to the center of the bridge. As with the other simulations, the approach looked good up until the stern of the vessel was clear of the diversion channel and the stern of the tow was pulled to port, The tow landed on the short bull nose on the port side.

Plate 10.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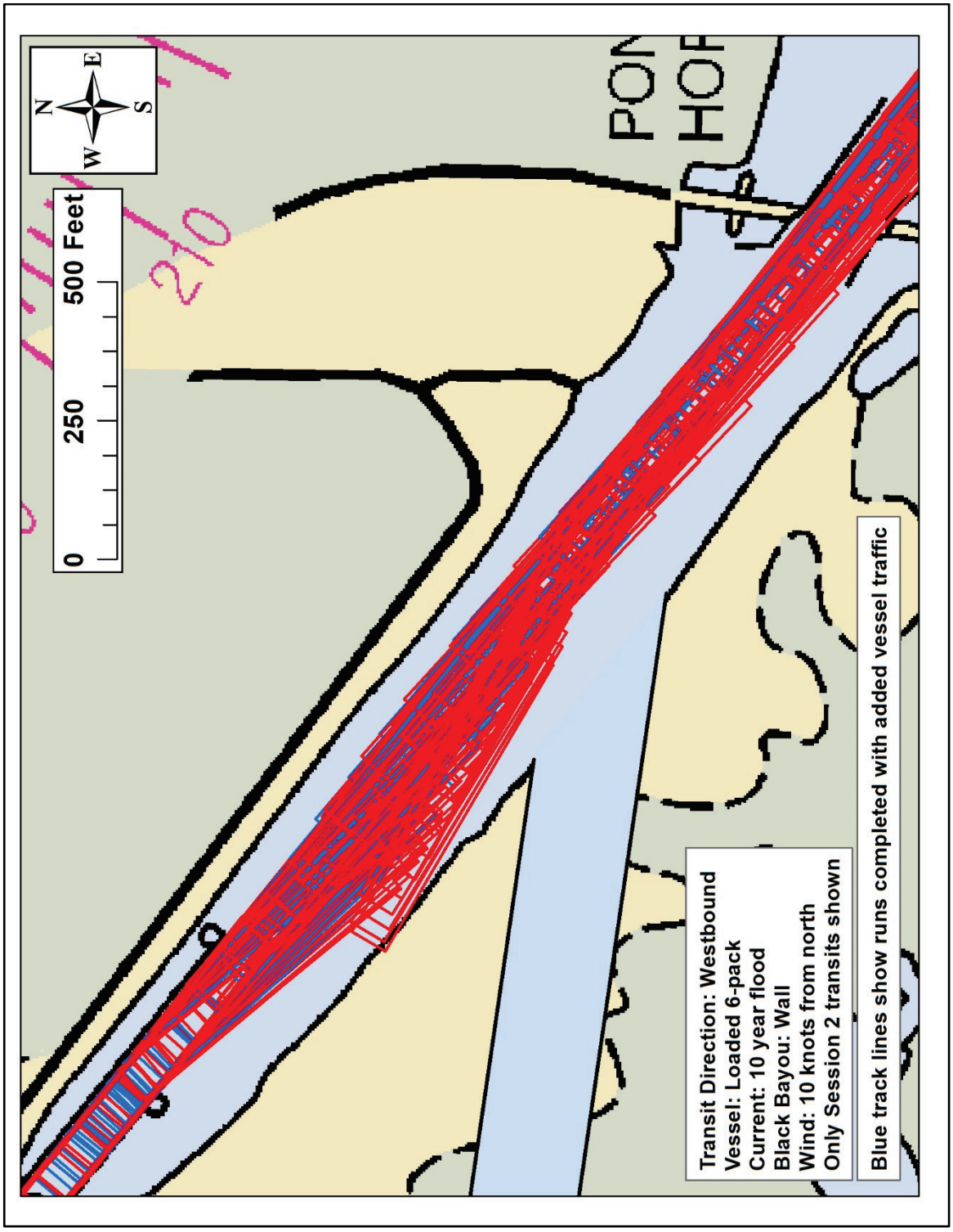
Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 10 year flood
Black Bayou: Wall
Wind: 10 knots from north
Only Session 1 transits shown
Blue track lines show runs completed with added vessel traffic

Plate 11.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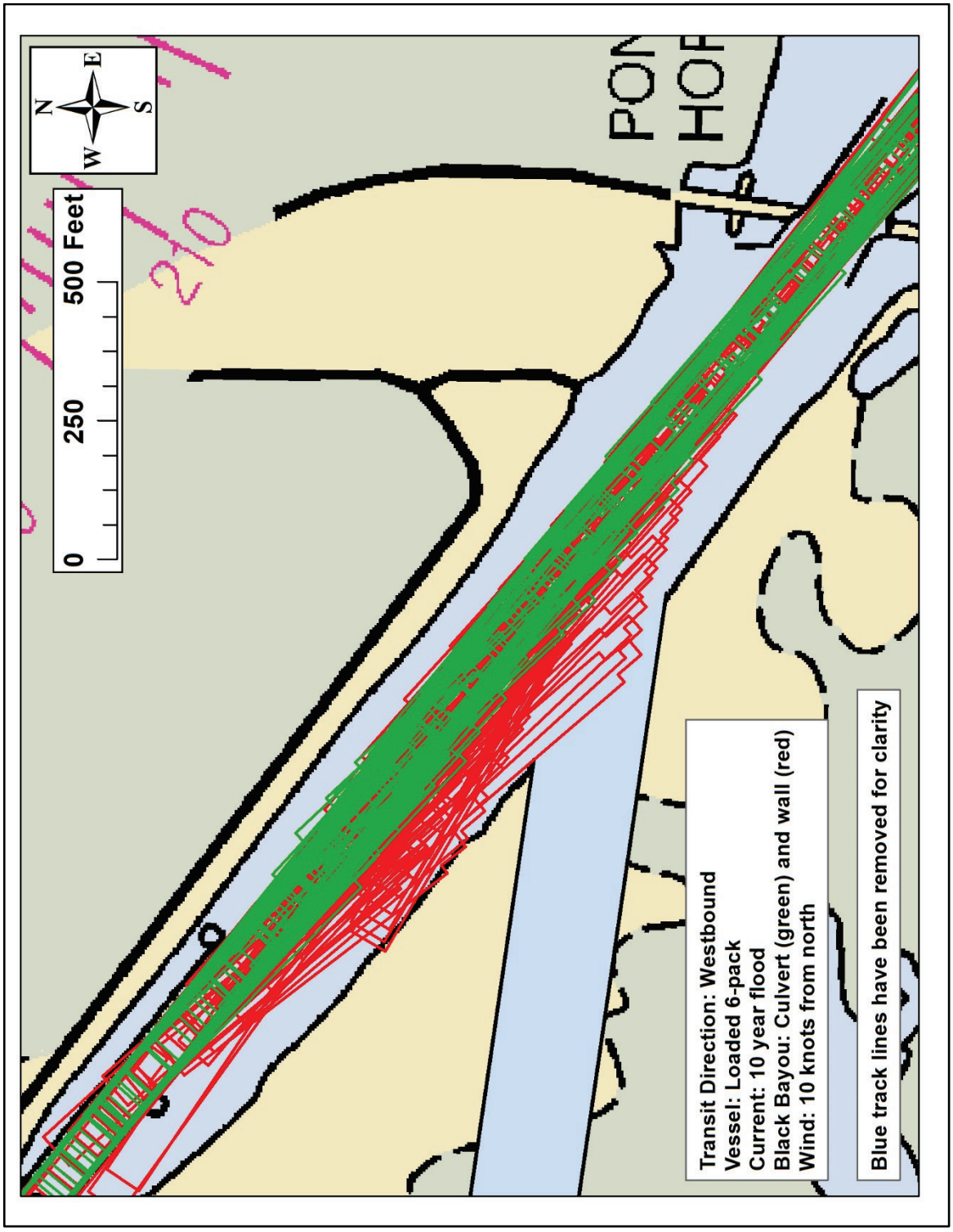
Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 10 year flood
Black Bayou: Wall
Wind: 10 knots from north
Only Session 2 transits shown
Blue track lines show runs completed with added vessel traffic

Plate 12.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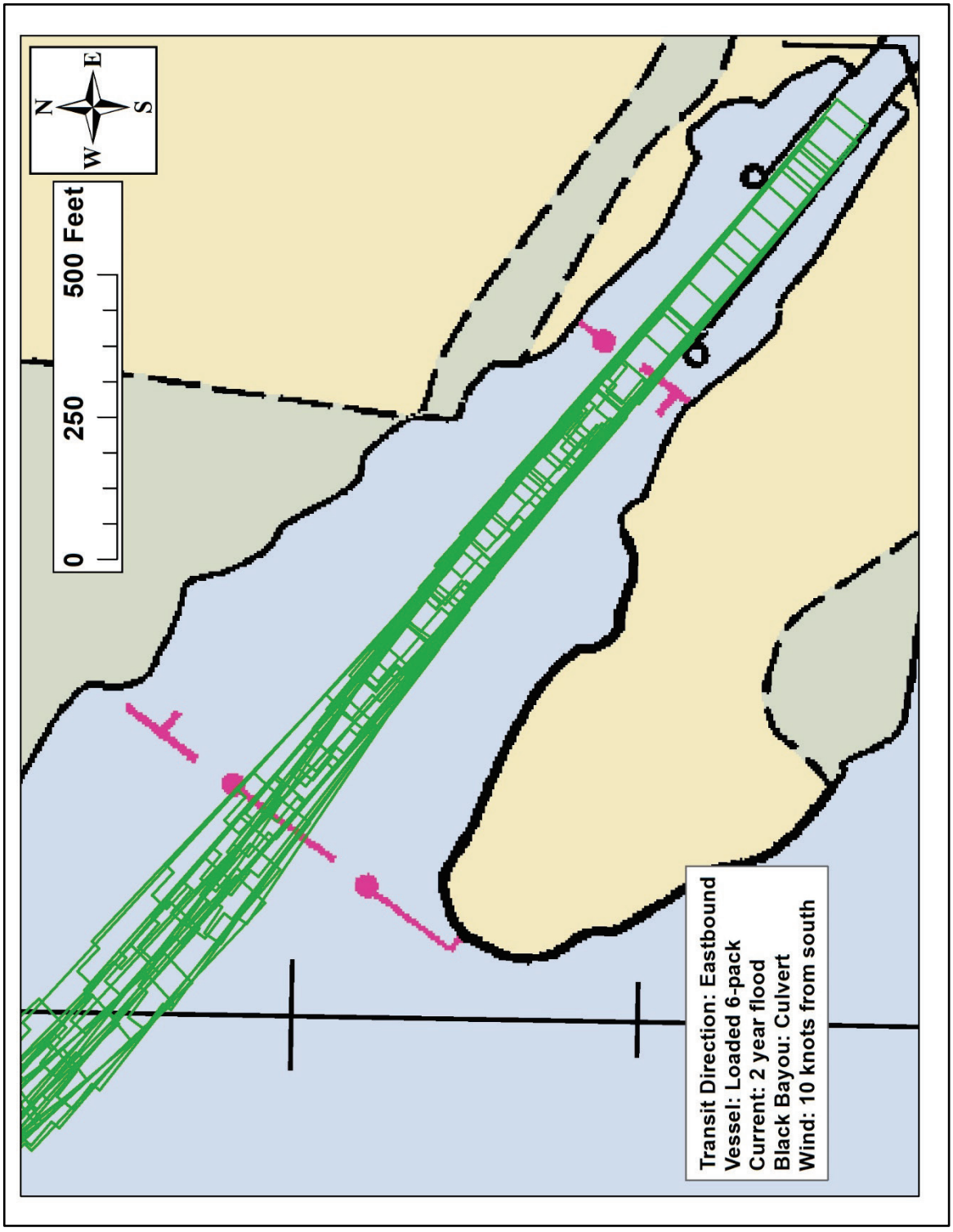
Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 10 year flood
Black Bayou: Culvert (green) and wall (red)
Wind: 10 knots from north
Blue track lines have been removed for clarity

West side of Calcasieu Lock - loaded 6-pack transiting eastbound

Plate 13.



Pilot comments for plate 13.

Plate 13 Pilot Comments:

Testing session: Initial
Area: West of lock
Transit direction: Eastbound
Current: 2 year flood (MSL), Black Bayou as culvert

Test matrix number: 15
Wind: 10 knots from south
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed):

NORMAL OPS

Pilot 2 comments (1 run completed):

Normal Running Felt nothing

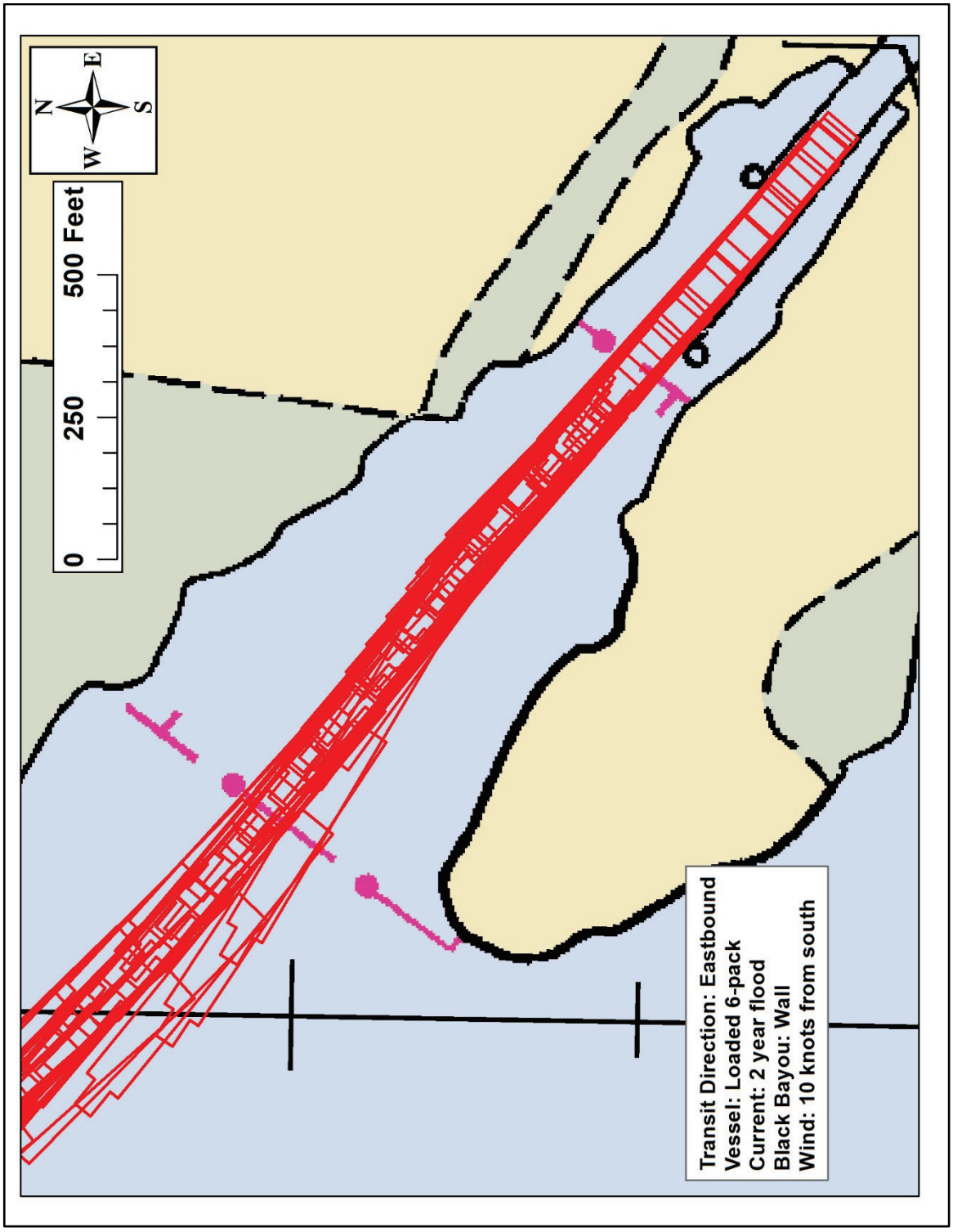
Pilot 3 comments (1 run completed):

Drove down to the entrance for the lock and slowed down to a safe steerable speed and the tow went right on in the lock. Nothing really to report that would cause any issues.

Pilot 4 comments (1 run completed):

No issues with current on this approach. Did not feel much effect when turning into the forebay.

Plate 14.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Transit Direction: Eastbound
Vessel: Loaded 6-pack
Current: 2 year flood
Black Bayou: Wall
Wind: 10 knots from south

Pilot comments for plate 14.

Plate 14 Pilot Comments:

Testing session: Initial
Area: West of lock
Transit direction: Eastbound
Current: 2 year flood (MSL), Black Bayou as wall

Test matrix number: 13
Wind: 10 knots from south
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed):

NORMAL OPS

Pilot 2 comments (1 run completed):

Normal Running

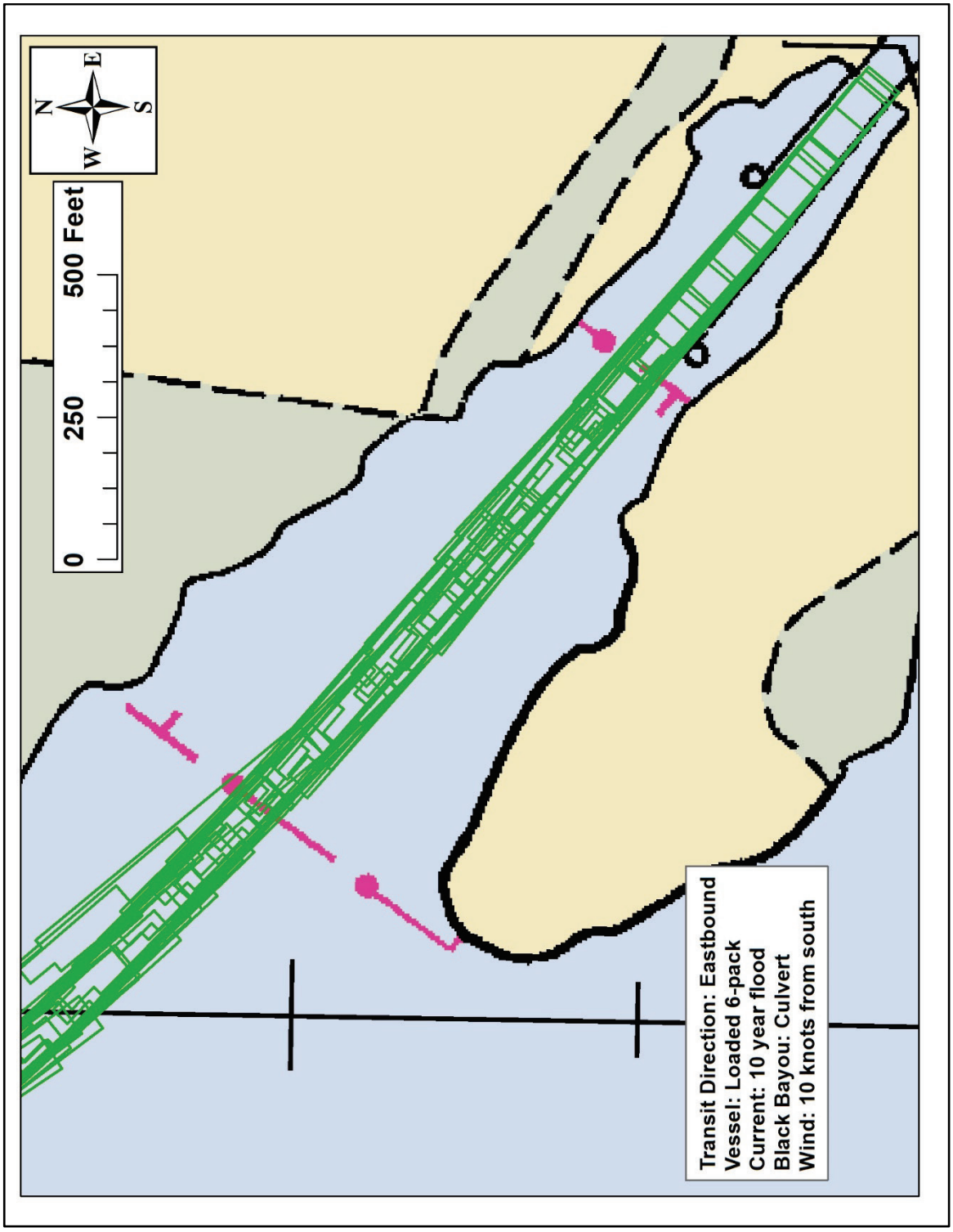
Pilot 3 comments (1 run completed):

Straight foward run into making the lock. Seemed like it normally does.

Pilot 4 comments (1 run completed):

No issues with this run, minimal effects from current.

Plate 15.


N
E
S
W
0
250
500 Feet
Transit Direction: Eastbound
Vessel: Loaded 6-pack
Current: 10 year flood
Black Bayou: Culvert
Wind: 10 knots from south

Pilot comments for plate 15.

Plate 15 Pilot Comments:

Testing session: Initial
Area: West of lock
Transit direction: Eastbound
Current: 10 year flood (MSL), Black Bayou as culvert

Test matrix number: 11
Wind: 10 knots from south
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed):

No issues

Pilot 2 comments (1 run completed):

Did nothing to me made it like always do

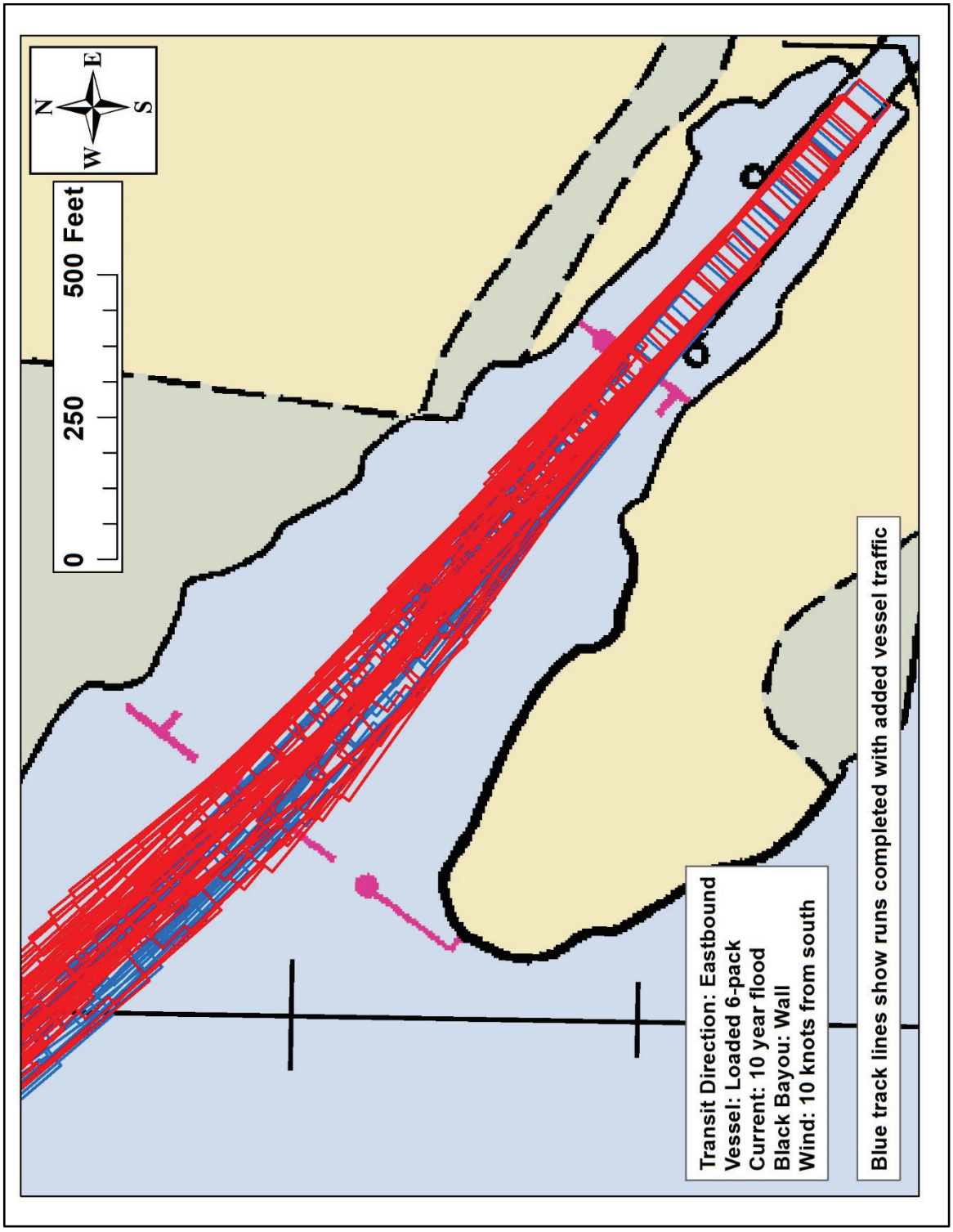
Pilot 3 comments (1 run completed):

No significant changes, still pretty straight forward normal locking conditions.

Pilot 4 comments (1 run completed):

I set up better for this transit than the last one with Black Bayou closed. I started my turn into the forebay sooner and was lined up much better. No issues with the current on this run.

Plate 16.


N
E
S
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0
250
500 Feet
Transit Direction: Eastbound
Vessel: Loaded 6-pack
Current: 10 year flood
Black Bayou: Wall
Wind: 10 knots from south
Blue track lines show runs completed with added vessel traffic

Pilot comments for plate 16.

Plate 16 Pilot Comments:

Testing session: Initial
Area: West of lock
Transit direction: Eastbound
Current: 10 year flood (MSL), Black Bayou as Wall

Test matrix number: 5
Wind: 10 knots from south
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed):

NORMAL OPS

Pilot 2 comments (1 run completed):

Did not feel anything all seem to be the same no problems getting back

Pilot 3 comments (2 runs completed):

Repetition #1 comment:

Very manageable to come E/B. Just slow down early give yourself plenty of room to stop and don't enter the hole for the lock to high come in at the middle. There is port set to the north bank in entrance for the lock but it's not terrible just need to pay attention.

Repetition #2 comment (with added vessel traffic):

Felt like a normal transit E/B to the Lock. Just a slight draw (on the stern of the vessel) to the north bank when the head of tow found the dead water close to the lock. But very manageable.

Pilot 4 comments (2 runs completed):

Repetition #1 comment:

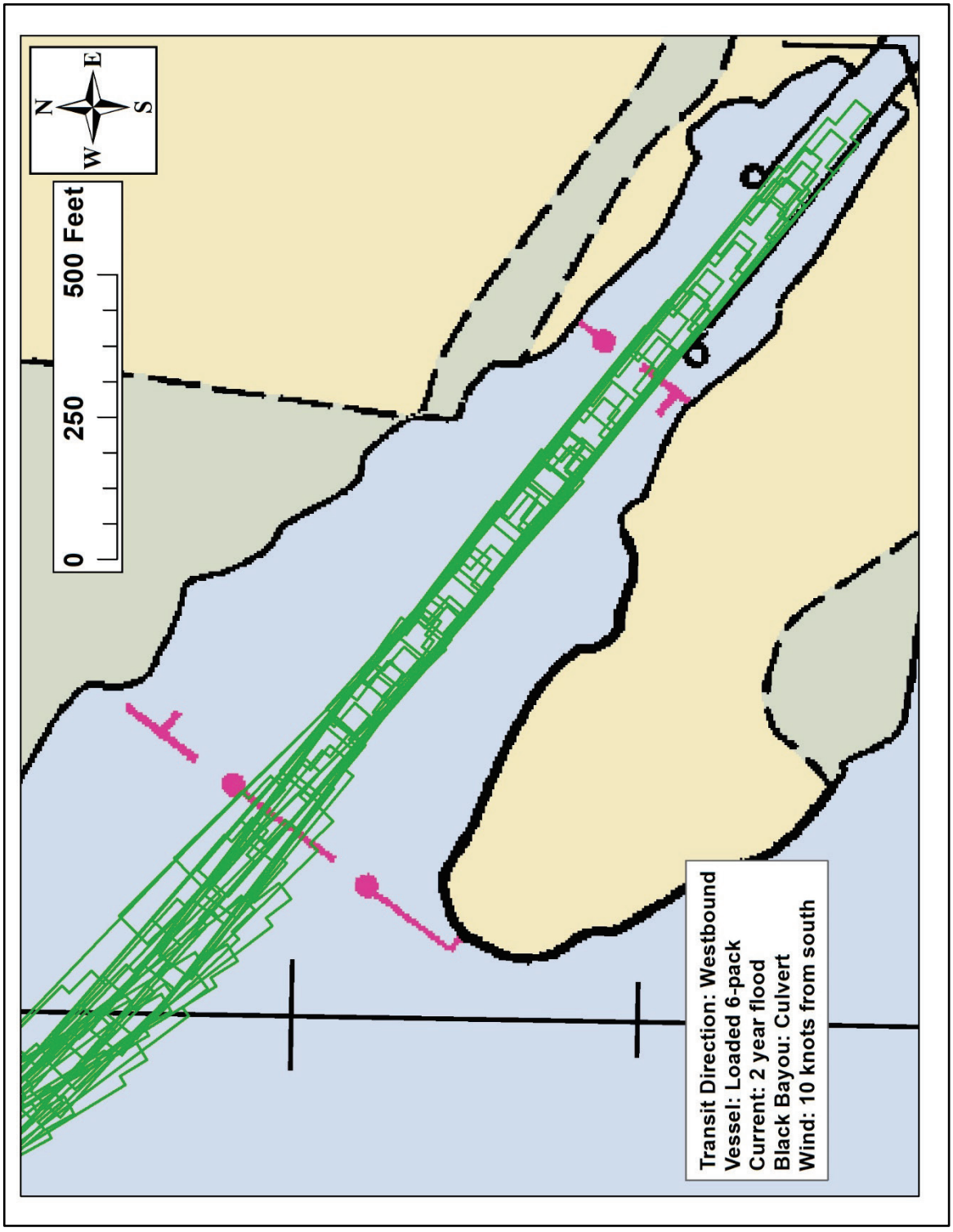
I did not properly anticipate the cross current I was going to experience when making my turn into the forebay. I should have held a bit higher/made the turn a bit later. I ended up out of shape on my approach and had to make a couple of corrections, probably would have damaged timbers when my starboard corner made contact with the wall.

Repetition #2 comment (with added vessel traffic):

No issues with this approach. slight affects felt from cross currents at the entrance to the forebay, but pose no concerns.

West side of Calcasieu Lock - loaded 6-pack transiting westbound

Plate 17.



Pilot comments for plate 17.

Plate 17 Pilot Comments:

Testing session: Initial
Area: West of lock
Transit direction: Westbound
Current: 2 year flood (MSL), Black Bayou as culvert

Test matrix number: 16
Wind: 10 knots from south
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed):

NORMAL OPS

Pilot 2 comments (1 run completed):

Normal Ops

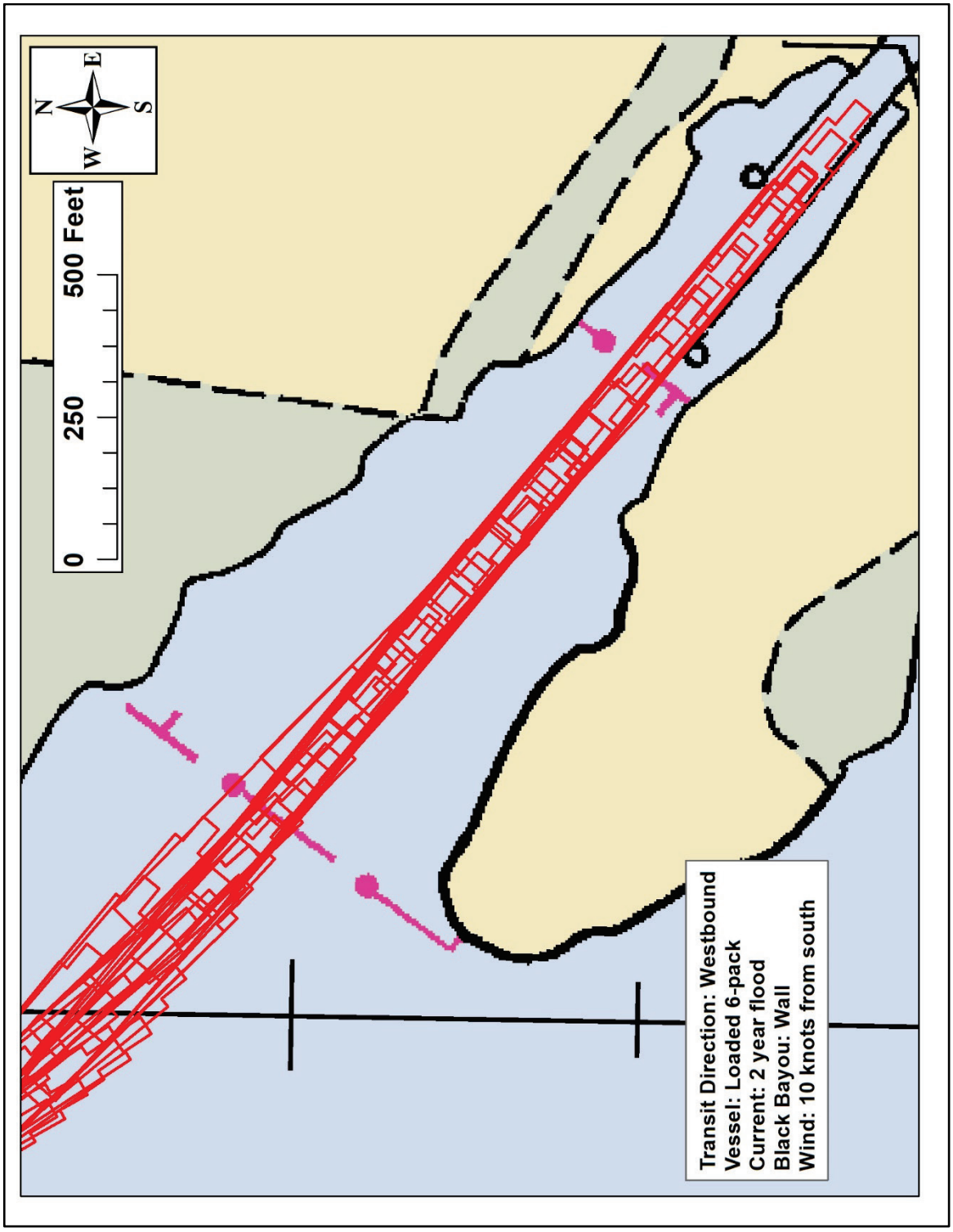
Pilot 3 comments (1 run completed):

Tow came out the lock straight. Once it cleared the long wall the head started to drop down to the port/south bank very slowly but that was easily controled by counter steering the other way just slightly. No major issues.

Pilot 4 comments (1 run completed):

No issues with this run. Did not feel any effects from current.

Plate 18.


N
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250
500 Feet
Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 2 year flood
Black Bayou: Wall
Wind: 10 knots from south

Pilot comments for plate 18.

Plate 18 Pilot Comments:

Testing session: Initial
Area: West of lock
Transit direction: Westbound
Current: 2 year flood (MSL), Black Bayou as wall

Test matrix number: 14
Wind: 10 knots from south
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed):

NORMAL OPS

Pilot 2 comments (1 run completed):

Normal Running felt nothing

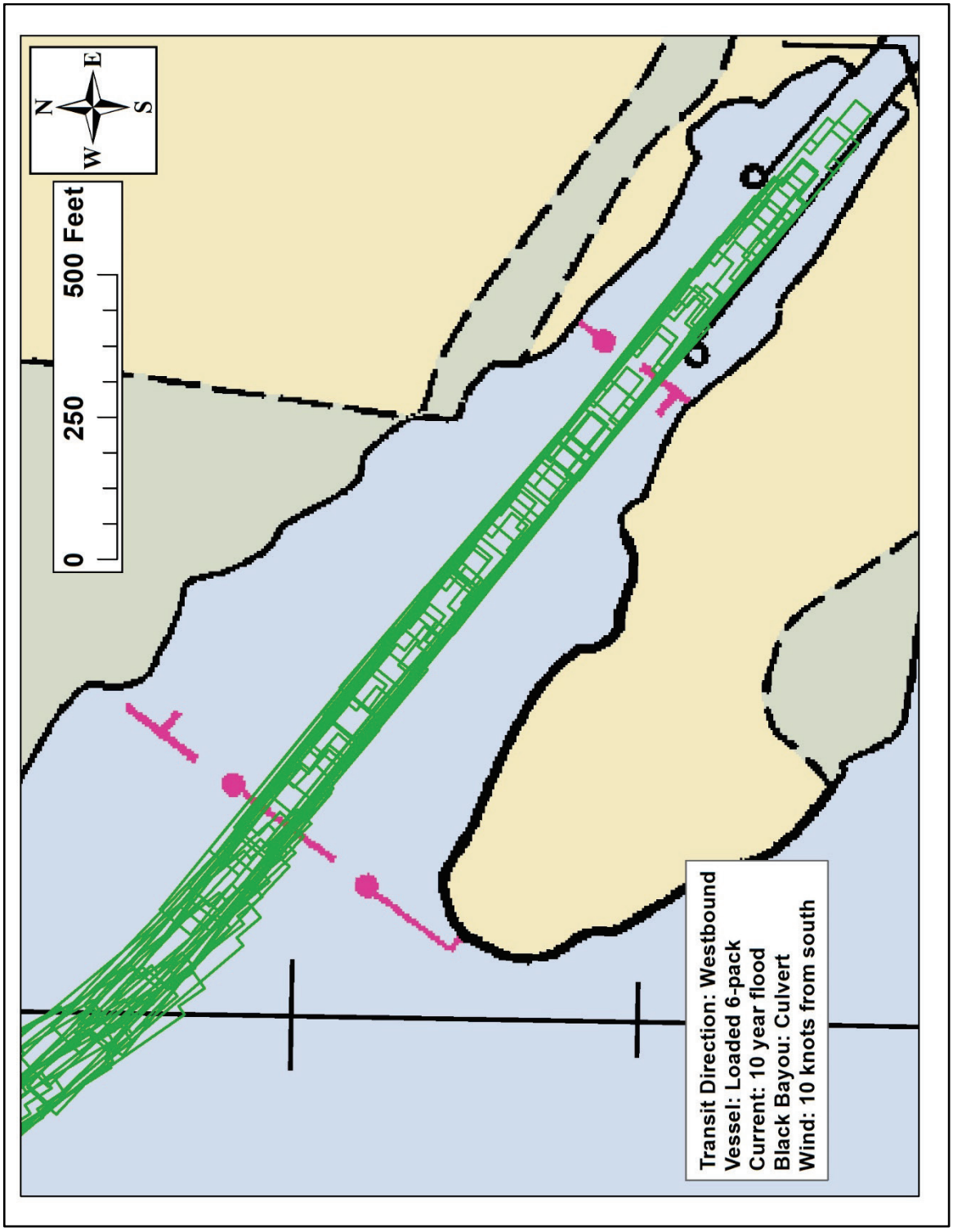
Pilot 3 comments (1 run completed):

Felt like a normal exit from the lock. Nothing reportable

Pilot 4 comments (1 run completed):

No issues with this run.

Plate 19.


N
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0
250
500 Feet
Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 10 year flood
Black Bayou: Culvert
Wind: 10 knots from south

Pilot comments for plate 19.

Plate 19 Pilot Comments:

Testing session: Initial
Area: West of lock
Transit direction: Westbound
Current: 10 year flood (MSL), Black Bayou as culvert

Test matrix number: 12
Wind: 10 knots from south
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed):

NORMAL OPS

Pilot 2 comments (1 run completed):

No problems made Like always do

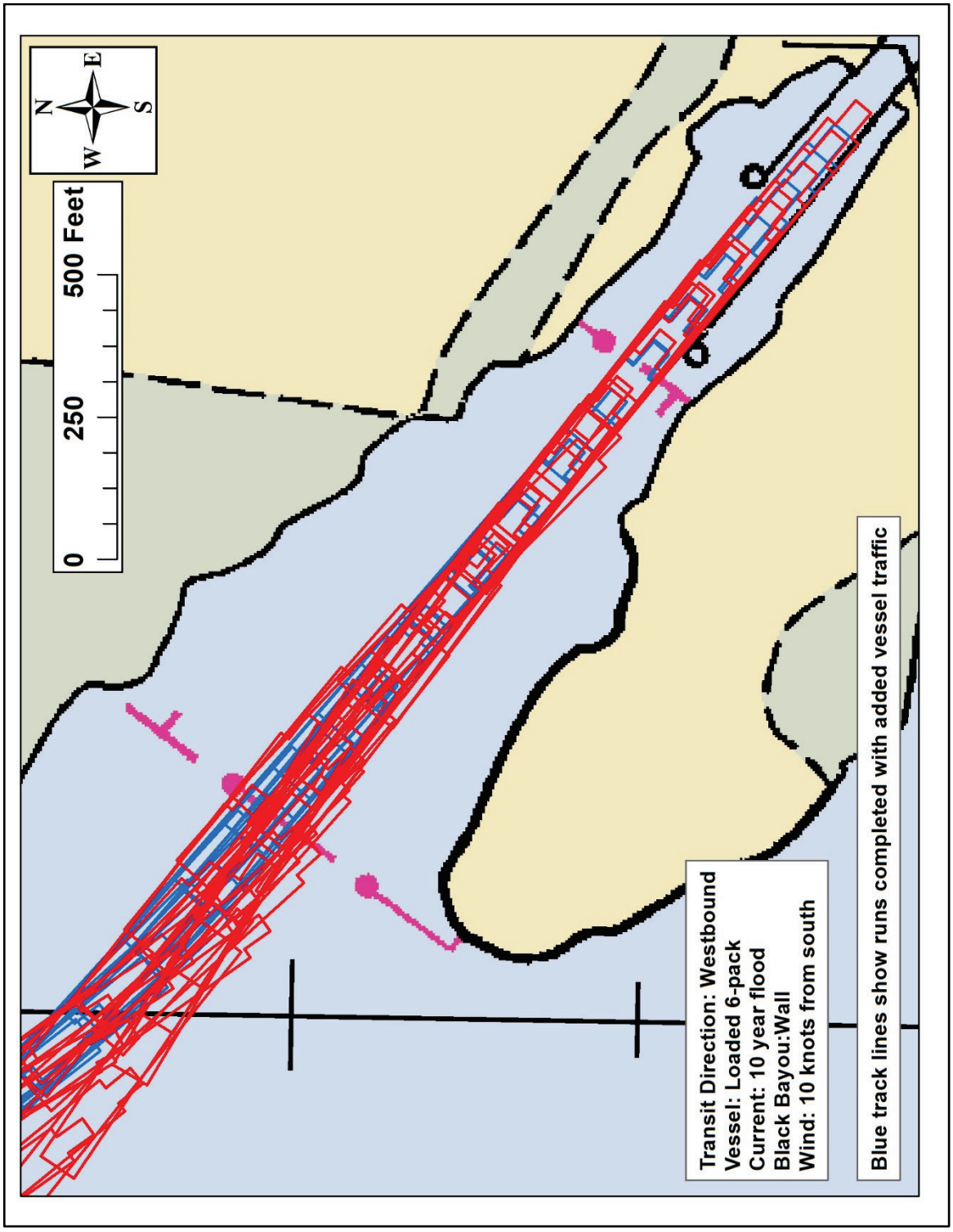
Pilot 3 comments (1 run completed):

Very small draw to the north bank as you're leaving the lock it's just enough to help you set away from the long wall, not bad at all.

Pilot 4 comments (1 run completed):

No issues with this transit. The current does run across the mouth of the forebay as it wants to start pushing the tow to turn to starboard as it enters the current. It actually helps to make the turn.

Plate 20.


N
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0
250
500 Feet
Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 10 year flood
Black Bayou:Wall
Wind: 10 knots from south
Blue track lines show runs completed with added vessel traffic

Pilot comments for plate 20.

Plate 20 Pilot Comments:

Testing session: Initial
Area: West of lock
Transit direction: Westbound
Current: 10 year flood (MSL), Black Bayou as wall

Test matrix number: 6
Wind: 10 knots from south
Vessel: Loaded 6-pack

Pilot 1 comments (1 run completed): NORMAL OPS, FIRST RUN WAS PILOT ERA GETTING TO CLOSE TO BANK

Pilot 2 comments (1 run completed):

No comment listed

Pilot 3 comments (2 runs completed):

Repetition #1 comment: As soon as the simulation started you could see that North set starting to pull the barges away from the long wall slowly, which is fine. It sets you headed in the right direction a little faster than normal which is a good thing in my opinion. Other than that everything else seemed about normal.

Side note - I came out shoving on the tow pretty good.

Repetition #2 comment (with added vessel traffic):

Everything felt normal even more so with the traffic in place.

Pilot 4 comments (2 runs completed):

Repetition #1 comment:

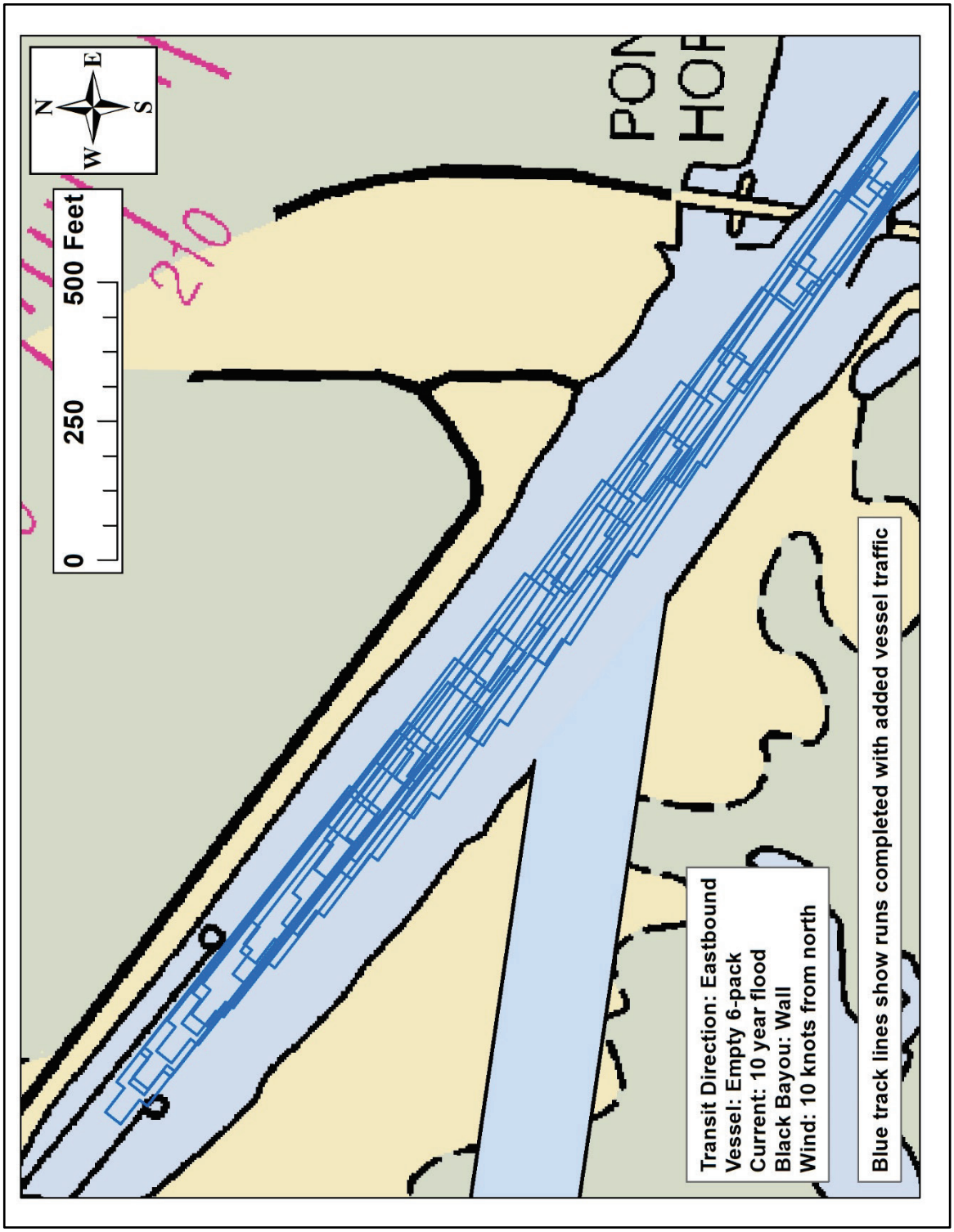
No issues with the westbound departure. Felt the current as the head of the tow cleared the foreboy, and it actually helped make the turn to starboard.

Repetition #2 comment (with added vessel traffic):

No issues with this run. Traffic makes me feel right at home!

East side of Calcasieu Lock - empty 6-pack scenarios

Plate 21.



Pilot comments for plate 21.

Plate 21 Pilot 3 & 4 Comments:

Testing session: Initial
Area: East of lock
Transit direction: Eastbound
Current: 10 year flood (MSL), Black Bayou as wall

Test matrix number: N/A
Wind: 10 knots from north
Vessel: Empty 6-pack

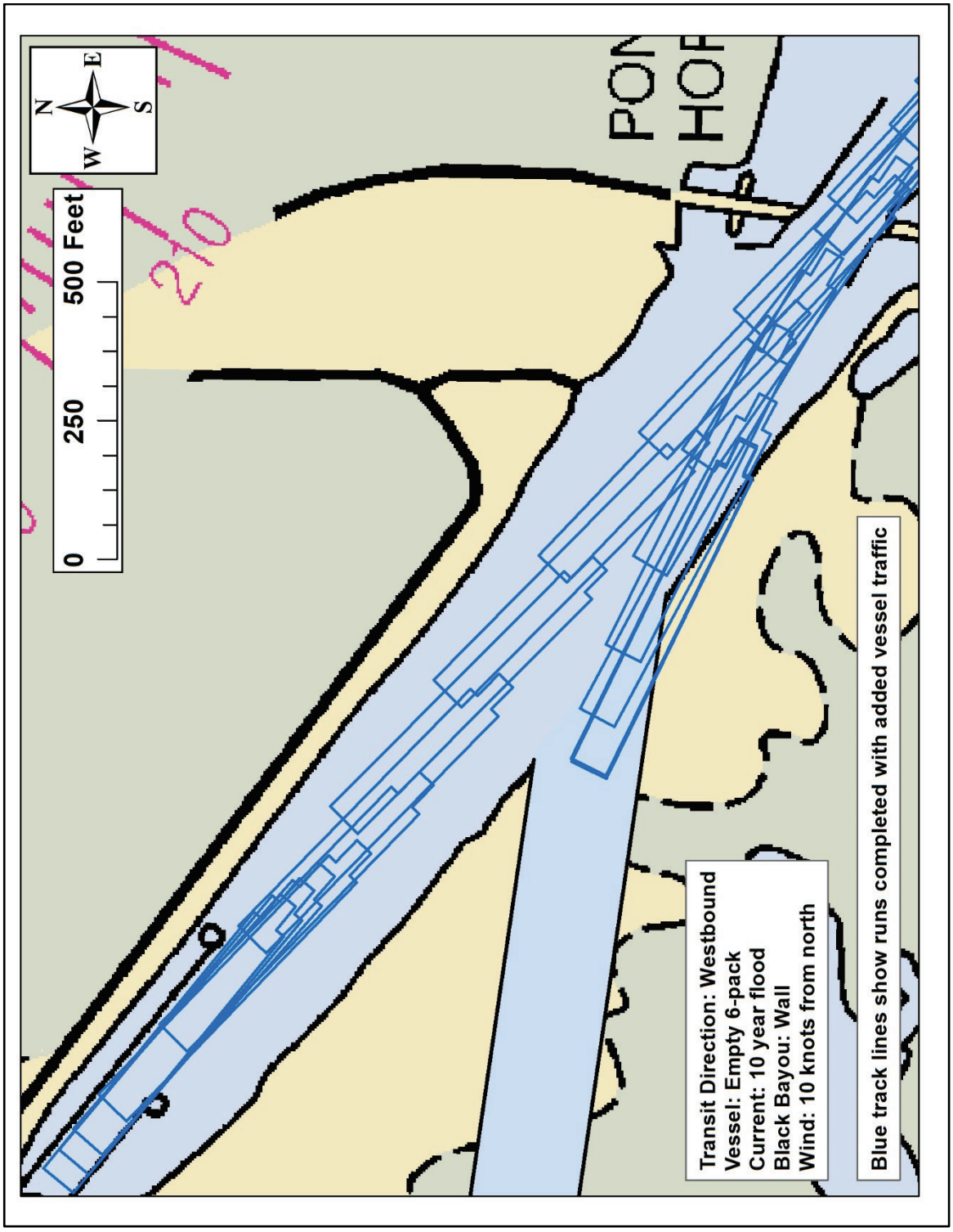
Pilot 3 comments (1 run completed with added traffic):

Your gonna get a some amount of that draw to south but it didn't feel like it pulling that hard. With the wind and that draw working together it does set you down some to the south w/emptys but it was doable no doubt. With the crew on the vessel communicating with the wheelhouse it would have been easier.

Pilot 4 comments (1 run completed with added traffic):

No discernible set from the current with the empty tow. Appears to be enough speed to outrun the set. No issues with this simulation.

Plate 22.


N
E
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0
250
500 Feet
210
Transit Direction: Westbound
Vessel: Empty 6-pack
Current: 10 year flood
Black Bayou: Wall
Wind: 10 knots from north
Blue track lines show runs completed with added vessel traffic

Pilot comments for plate 22.

Plate 22 Pilot 3 & 4 Comments:

Testing session: Initial
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MSL), Black Bayou as wall

Test matrix number: N/A
Wind: 10 knots from north
Vessel: Empty 6-pack

Pilot 3 comments (1 run completed with added traffic):

Wouldn't even attempted to make it in these wind conditions in this type of tow configuration. It probably could be done but there is great chance of failing and not making the lock once you fight your way through the bridge. You most likely will have to stop or hit the lock.

Pilot 4 comments (1 run completed with added traffic):

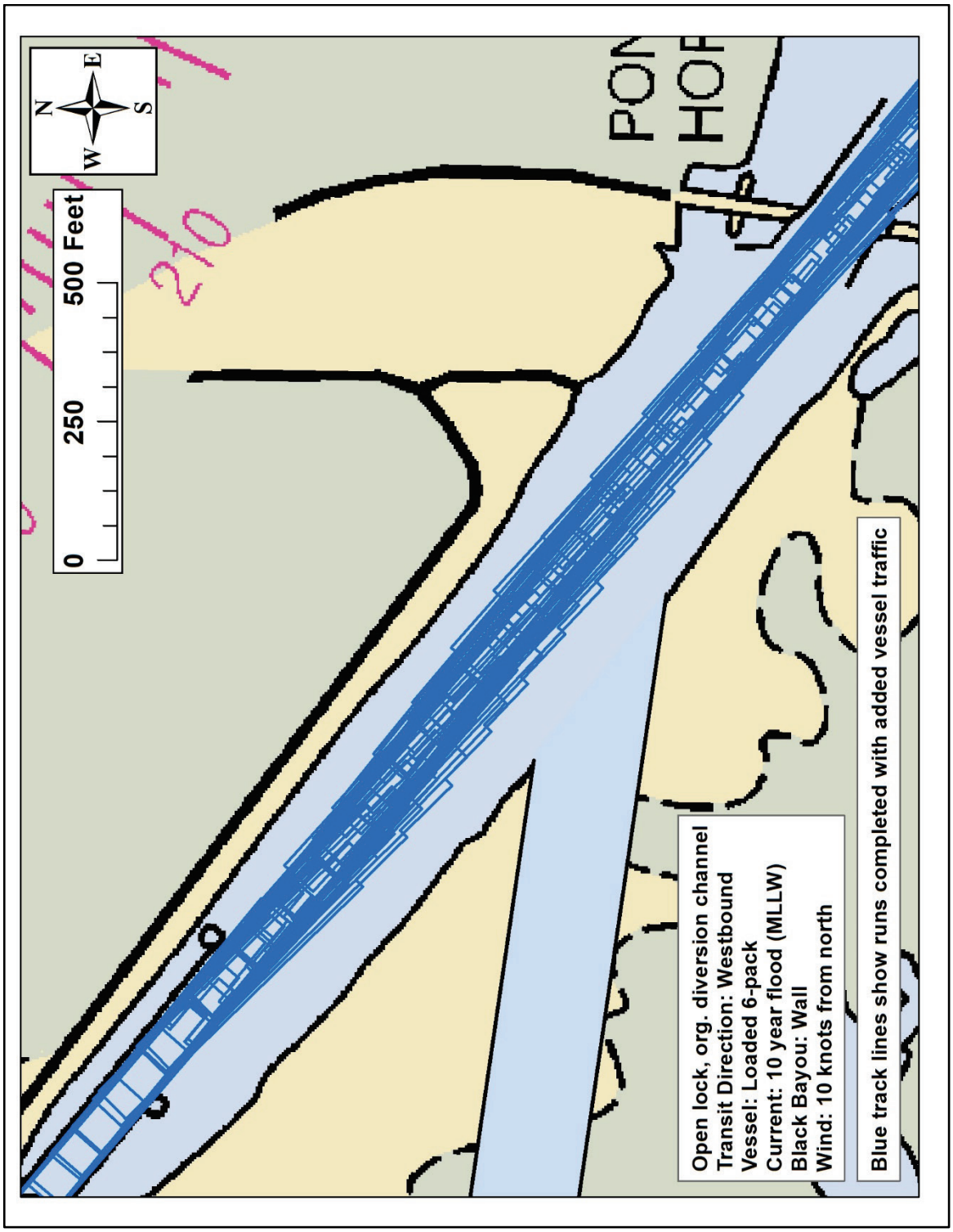
I had to carry an unsafe speed into the final approach to counteract the set from the wind. Probably would have damaged the tow when it landed on the short wall. With the speed I carried by the diversion channel I didnt really feel the current. In real life, with this tow I would be waiting for the wind to die down before making this approach even without the diversion channel.

Additional Testing Track Plots and Pilot Comments

Results will be presented in this section for the additional testing session. The following section presents first the track plot and then a consolidated sheet(s) of pilot comments for each track plot. Alternative 1 transits will be shown first and will be followed by Alternative 2 transits and then Alternative 3 transits. All additional testing session are shown with blue track lines to signify vessel traffic was added in the locations specified in Figure 10 and Figure 11 of the main text.

Alternative 1 – original diversion channel cut, lock open for westbound traffic

Plate 23.



Pilot comments for plate 23.

Plate 23 Pilot Comments:

Testing session: Additional
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MLLW), Black Bayou as Wall
Diversion channel cut: Original

Test matrix number: 1
Wind: 10 knots from north
Vessel: Loaded 6-pack
Lock: Open

Pilot 1 comments (1 run completed with added traffic):

STILL FELT A PULL OF ,2 ONHEAD & ,2 up to ,3 ON STERN WHEN COMING By Cut

Pilot 2 comments (1 run completed with added traffic):

Had a little set to the new cut but not Bad 0.4 was all I seen The tide was running hard in to the lock could not stop the tow

Pilot 3 comments (1 run completed with added traffic):

Running 4.6 kts SW/b about 1/8 mile before bridge I slowed down but speed didn't until I got to the bridge. Once I got to bridge it slowed down a whole knot but never could get the Tow below 2.6 coming down on the lock.

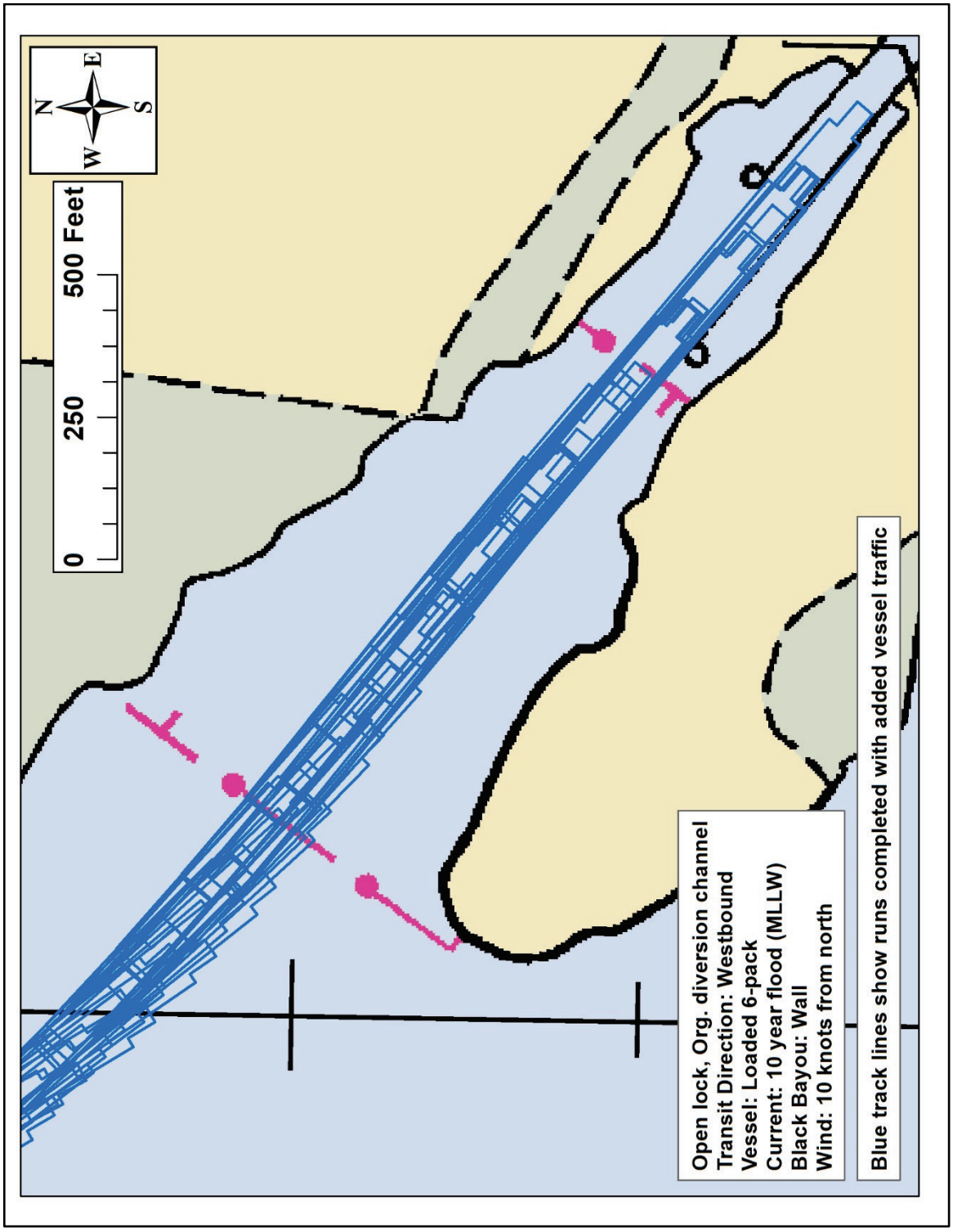
Pilot 4 comments (1 run completed with added traffic):

This approach felt better than it did with the lock closed. The draw to the diversion channel did not feel like it had much influence on the approach.

I pointed up to the north bank when the head of the tow cleared the bridge and started backing full to reduce my speed. The head of the tow did not feel like it was affected by the diversion channel at the time. I then flanked my stern over towards the bank and as the boat was clearing the diversion channel it also did not seem to have much affect.

I would like to run this scenario again if we have time.

Plate 24.


N
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S
W
0
250
500 Feet
Open lock, Org. diversion channel
Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 10 year flood (MLLW)
Black Bayou: Wall
Wind: 10 knots from north
Blue track lines show runs completed with added vessel traffic

Alternative 2 – modified diversion channel cut, lock closed for westbound traffic

Pilot comments for plate 24.

Plate 24 Pilot Comments:

Testing session: Additional
Area: West of lock
Transit direction: Westbound
Current: 10 year flood (MLLW), Black Bayou as Wall
Diversion channel cut: Original

Test matrix number: 2
Wind: 10 knots from south
Vessel: Loaded 6-pack
Lock: Open

Pilot 1 comments (1 run completed with added traffic):

NON ISSUE

Pilot 2 comments (1 run completed with added traffic):

Had cannot coming out of the lock but it seemed to be normal running in set and anything all seem normal

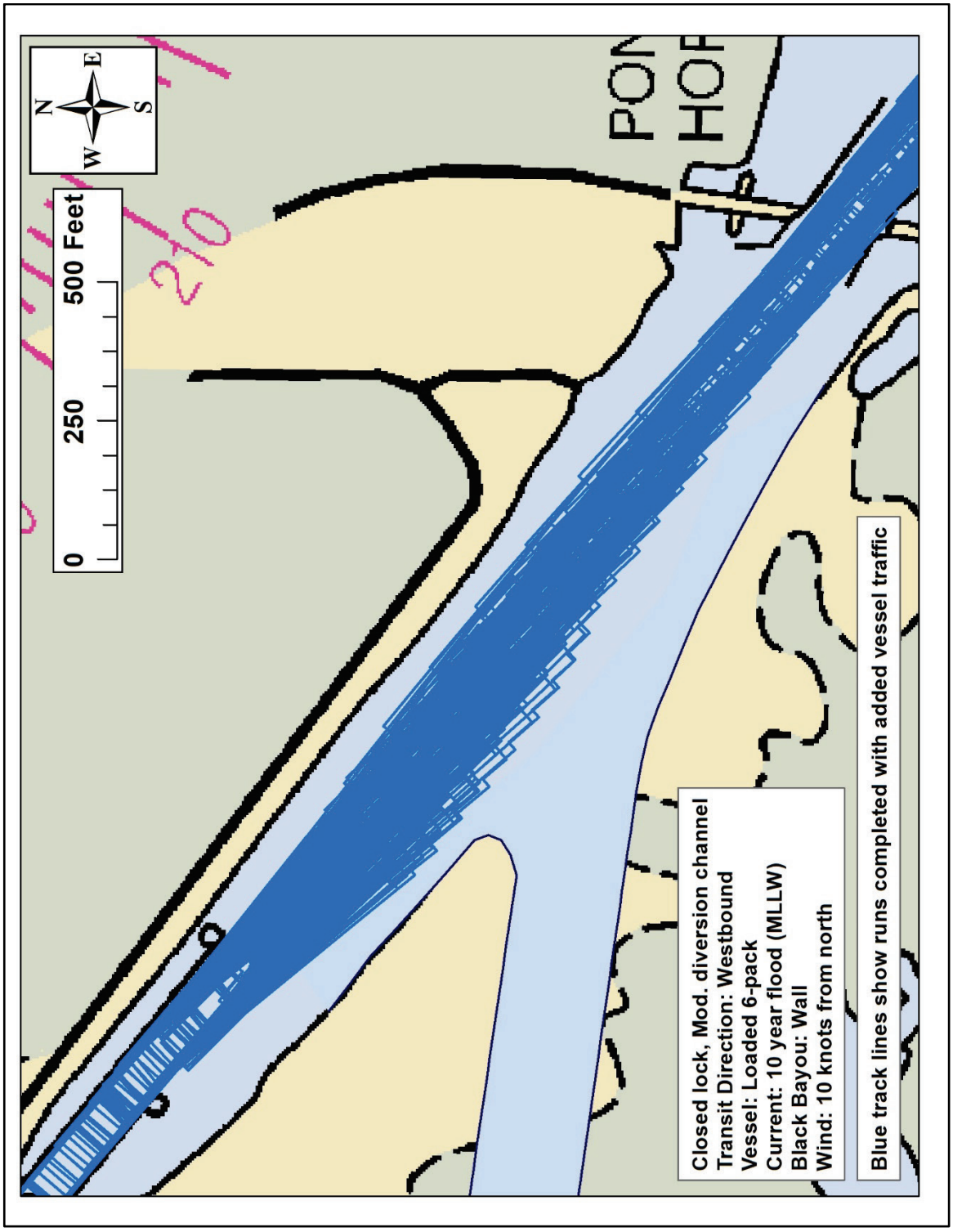
Pilot 3 comments (1 run completed with added traffic):

Nothing crazy, normal exit of Lock except for maybe being a little quicker then if locking.

Pilot 4 comments (1 run completed with added traffic):

No issues with this run.

Plate 25.


N
E
S
W
0
250
500 Feet
210
Closed lock, Mod. diversion channel
Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 10 year flood (MLLW)
Black Bayou: Wall
Wind: 10 knots from north
Blue track lines show runs completed with added vessel traffic

Pilot 1 and 2 comments for plate 25.

Plate 25 Pilots 1 & 2 Comments:

Testing session: Additional
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MLLW), Black Bayou as Wall
Diversion channel cut: Modified

Test matrix number: 3
Wind: 10 knots from north
Vessel: Loaded 6-pack
Lock: Closed

Pilot 1 comments (2 runs completed with added vessel traffic):

Repetition #1 comment:

SLOWED DOWN ON MY APPROACH TO BRIDGE TO 2.6 AND ~~FELT~~ FELT A PULL TO THE CUT & PICKED UP MY SPEED DUE TO THE EDDY WORK @ THE WEST END OF THE CUT TO 2.9

Repetition #2 comment:

AT LOW RATE OF SPEED @ THE CUT I FELT A STRONG DRAW TO THE CUT

Pilot 2 comments (2 runs completed 2 runs completed with added vessel traffic):

Repetition #1 comment:

Had a good set to the new cut while trying to get slowed down to Beable to stop Befor the you get to gates it is setting you to the new cut and getting you out of shape where you can not get in lock without hitting it.

Repetition #2 comment:

Had a set to The new cut when you get down to a safe speed to go in The lock and you can not get it in the lock without hiting one of the walls

Pilot 3 and 4 comments for plate 25.

Plate 25 Pilots 3 & 4 Comments:

Testing session: Additional
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MLLW), Black Bayou as Wall
Diversion channel cut: Modified

Test matrix number: 3
Wind: 10 knots from north
Vessel: Loaded 6-pack
Lock: Closed

Pilot 3 comments (2 runs completed with added vessel traffic):

Repetition #1 comment:

Felt less of pull towards the new cut but it seemed like we picked up speed almost .5 kn. trying to line up on the lock.

So it seemed less set but increase speed in the edie coming down on lock.

unable to stop with out assistance due to current.

Repetition #2 comment:

Run slower to try and control entering the lock at a safe speed. Set did effect me more at slower speed and was unable to pick the tow up enough to get in the lock w/out wedging. Which means we broke timbers,

Pilot 4 comments (2 runs completed 2 runs completed with added vessel traffic):

Repetition #1 comment:

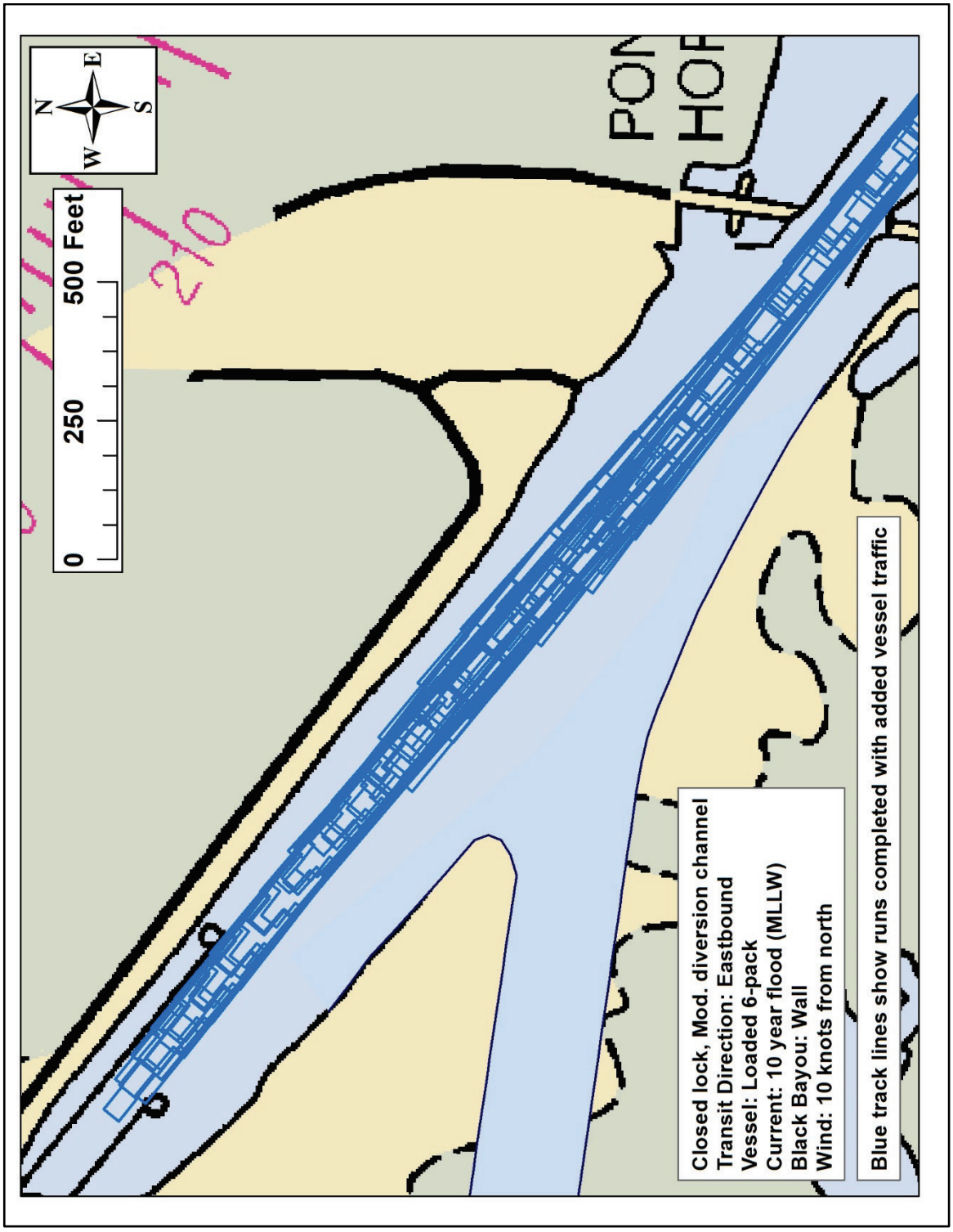
The draw towards the diversion channel seemed to be lessened with the shaped entry. I still set up high towards the north side of the channel and felt I was able to make a controlled approach.

I feel my experience with the simulations must be considered, and I still have concerns that someone seeing this for the first time could have issues making the approach. Use of assist vessels or posting by someone with experience making the approach could help alleviate these concerns.

Repetition #2 comment:

I was able to maintain steerage keeping the speed around 2 - 2 ½ knots, but I ended up out of shape for my entry into the lock. I ended up needing to drive on it to get the tow in the lock, but still likely would have landed on the short bullnose.

Plate 26.


N
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250
500 Feet
210
Closed lock, Mod. diversion channel
Transit Direction: Eastbound
Vessel: Loaded 6-pack
Current: 10 year flood (MLLW)
Black Bayou: Wall
Wind: 10 knots from north
Blue track lines show runs completed with added vessel traffic

Pilot comments for plate 26.

Plate 26 Pilot Comments:

Testing session: Additional
Area: East of lock
Transit direction: Eastbound
Current: 10 year flood (MLLW), Black Bayou as Wall
Diversion channel cut: Modified

Test matrix number: 4
Wind: 10 knots from north
Vessel: Loaded 6-pack
Lock: Closed

Pilot 1 comments (1 run completed with added traffic):

NO ISSUES

Pilot 2 comments (1 run completed with added traffic):

Had a little pull to the new cut but could make it with no problem

Pilot 3 comments (1 run completed with added traffic):

No noticiable draw exiting the lock, felt like normal.

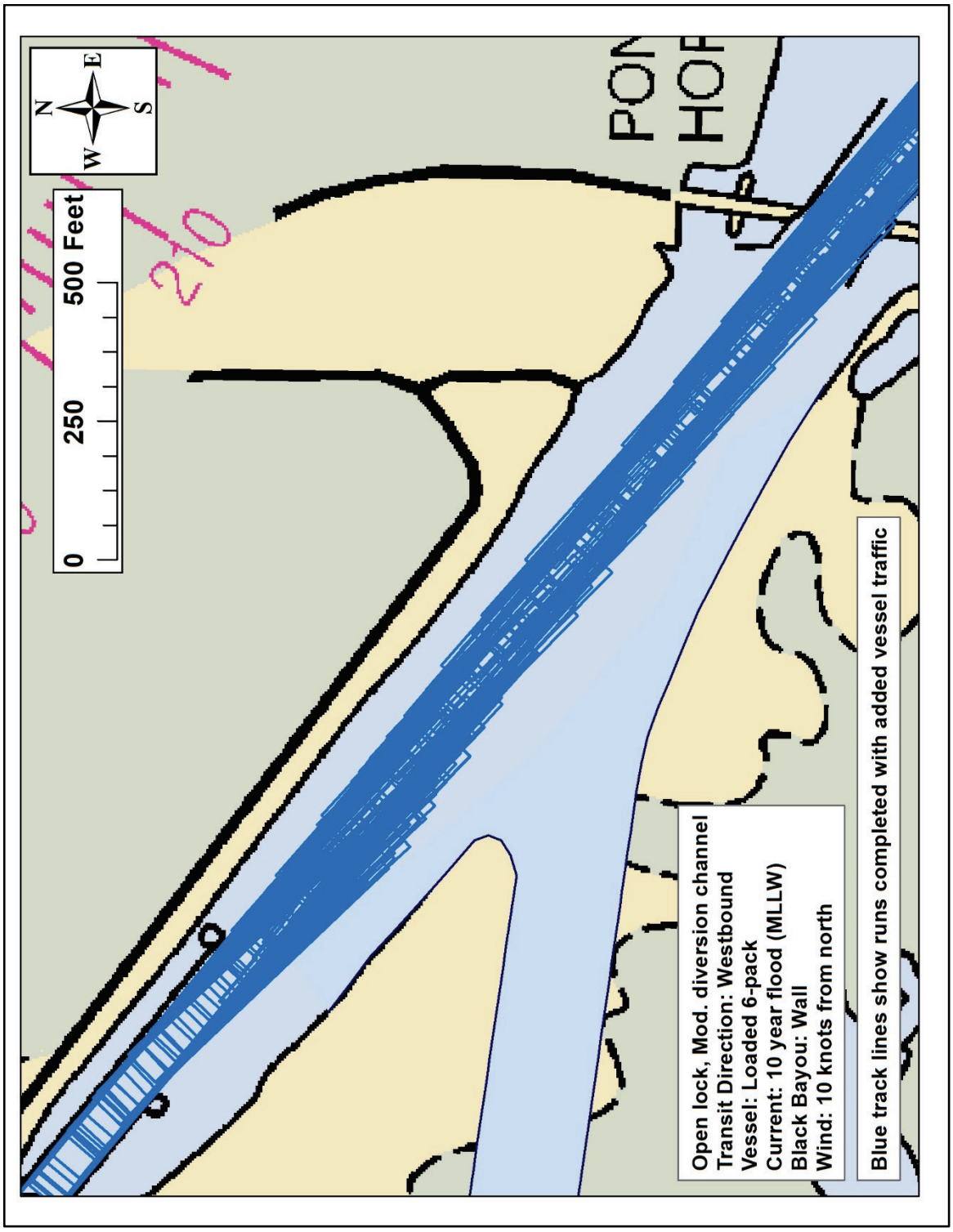
Pilot 4 comments (1 run completed with added traffic):

No issues with this run.

The draw to starboard does seem to be lessened compared to the original cut. I had to steer slightly to get lined up on the bridge, where the original cut design had a strong enough draw to pull my head to starboard to line upon the bridge.

Alternative 3 – modified diversion channel cut, lock open for westbound traffic

Plate 27.



Pilot 1 and 2 comments for plate 27.

Plate 27 Pilots 1 & 2 Comments:

Testing session: Additional
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MLLW), Black Bayou as Wall
Diversion channel cut: Modified

Test matrix number: 5
Wind: 10 knots from north
Vessel: Loaded 6-pack
Lock: Open

Pilot 1 comments (2 runs completed with added vessel traffic):

Repetition #1 comment:

FELT A SLOWER PULL TO THE CUT AT A GREATER SPEED BUT I AM STILL NOT COMFORTABLE

Repetition #2 comment:

NOT AS BAD BUT STILL HAD A DRAW TO CUT

Pilot 2 comments (2 runs completed 2 runs completed with added vessel traffic):

Repetition #1 comment:

has a pull to the cut but not as Bad with the gates open but made it hard to get in lock it seems to pull you harder when you are slowing down

Repetition #2 comment:

had a set to new cut wich made me hit the wall if you are slowing down to get in the lock is when it sets you and you have to slow down Because you can not make it at high speeds

Pilot 3 and 4 comments for plate 27.

Plate 27 Pilots 3 & 4 Comments:

Testing session: Additional
Area: East of lock
Transit direction: Westbound
Current: 10 year flood (MLLW), Black Bayou as Wall
Diversion channel cut: Modified

Test matrix number: 5
Wind: 10 knots from north
Vessel: Loaded 6-pack
Lock: Open

Pilot 3 comments (2 runs completed with added vessel traffic):

Repetition #1 comment:

Felt less draw with the new cut confis., still some draw to the south bank but it is [redacted] doable. Would still be safer with a helper boat there to limit risk factor.

Repetition #2 comment:

Ran slower and can not pick tow(stern) up in time before the head wedged between the lock walls.

Pilot 4 comments (2 runs completed 2 runs completed with added vessel traffic):

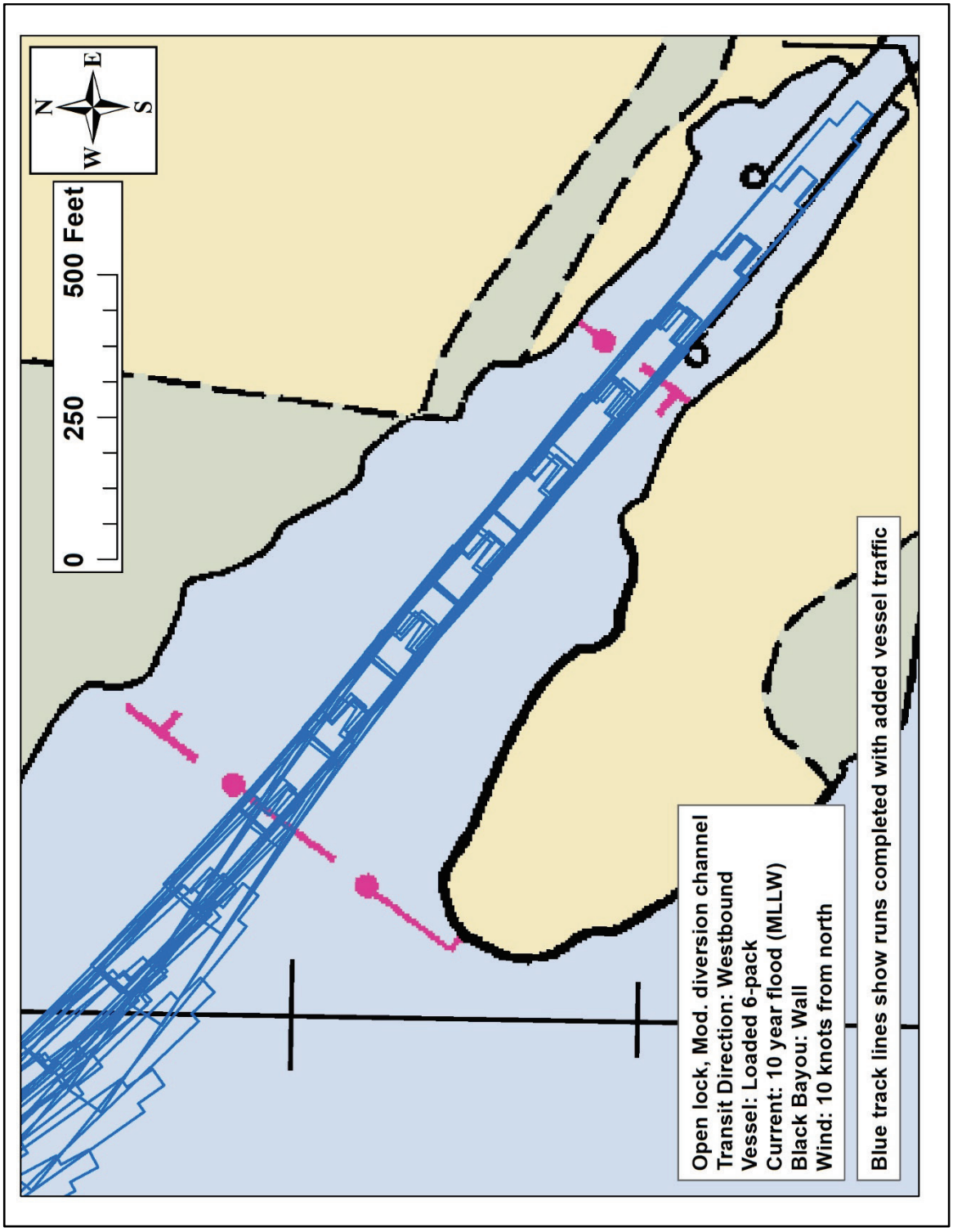
Repetition #1 comment:

The draw to the diversion cut was definitely less than the original cut design, the tow held straight after coming through the bridge.
I still wouldn't feel comfortable with this tow/vessel combination in these conditions without an assist vessel.

Repetition #2 comment:

Grounded
Attempted to set up to flank and allow the current draw towards the lock to line up the tow, but I was too close to the cut to maneuver away from it's affect.

Plate 28.


N
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250
500 Feet
Open lock, Mod. diversion channel
Transit Direction: Westbound
Vessel: Loaded 6-pack
Current: 10 year flood (MLLW)
Black Bayou: Wall
Wind: 10 knots from north
Blue track lines show runs completed with added vessel traffic

Pilot Comments for plate 28.

Plate 28 Pilot Comments:

Testing session: Additional
Area: West of lock
Transit direction: Westbound
Current: 10 year flood (MLLW), Black Bayou as Wall
Diversion channel cut: Modified

Test matrix number: 6
Wind: 10 knots from south
Vessel: Loaded 6-pack
Lock: Open

Pilot 1 comments (1 run completed with added traffic):

NO ISSUES

Pilot 2 comments (1 run completed with added traffic):

Normal Running

Pilot 3 comments (1 run completed with added traffic):

Nothing new, straight drive out of lock

Pilot 4 comments (1 run completed with added traffic):

No issues

Appendix B: Final Pilot Questionnaires

The following appendix contains final pilot questionnaires for the initial and additional testing sessions. Note that several pilots did not differentiate between the east or west side of Calcasieu Lock for westbound traffic in some of their responses.

Initial testing pilot questionnaires

Initial testing - Captain Cheramie page 1.

Calcasieu Lock Ship Simulation Study – Final Questionnaire

Name: TRACY CHERAMIE

New Orleans District has suggested a diversion channel to help alleviate the high velocities which occur at Calcasieu Lock during high flow events. Testing for this project occurred during two testing weeks: January 14-18, 2019 and January 21-25, 2019.

1. Please comment on your experience of using the ERDC ship tow simulator this week for testing.

   VERY IMPRESSIVE IN TECNOLOGY

2. Do you think any additional testing runs should have been completed that were not tested this week?

   MAY A DIFFERENT tow SIZE + hp

3. Do you feel the environmental conditions (wind, current, etc,) and visuals provided a reasonable representation of Calcasieu Lock?

   YES

Initial testing - Captain Cheramie page 2.

4. Did you feel the currents were considerably different based on if Black Bayou was treated as a wall or as culverts numerically?

VERY LITTLE

5. Please comment on the behavior of the design vessel (six-pack barge with 1,200 HP pusher tow). Do you feel the design vessel was adequate as a means of testing the channel?

THE VESSEL WAS UNDER hp FOR THE SIZE OF TOW

6. Do you have any concerns that the proposed diversion channel will impact empty barges?

VERY LITTLE

7. Do you expect the proposed diversion channel would impact navigation on the west side of the lock (eastbound or westbound)?

NORMAL OPERATION NO EFFECT

Initial testing - Captain Cheramie page 3.

8. Do you feel that the proposed diversion channel would be feasible for the following conditions for the chosen design vessel (six-pack barge with 1200 HP tow) for the LOWER magnitude currents tested (2-yr conditions)?
   a. East side of lock, vessel heading eastbound toward the lock and then locking through
   b. East side of lock, vessel heading westbound leaving the lock after locking through

VERY BAD CHOICE, IT IS A SETING FOR FAILURE

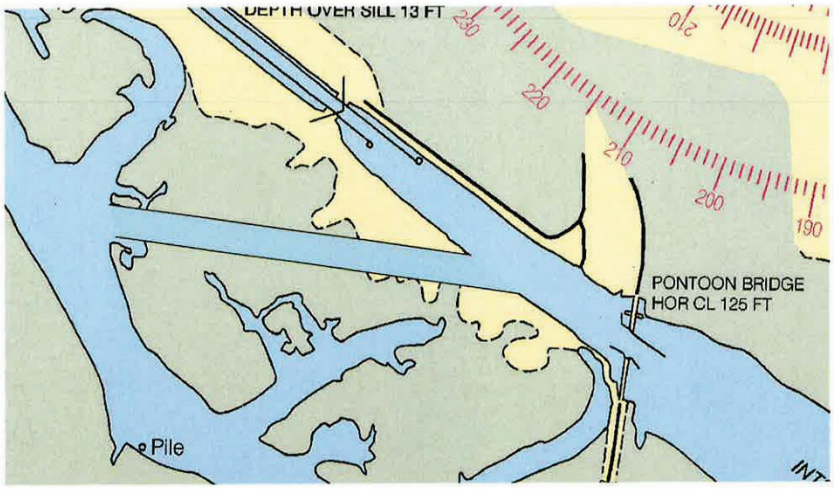
9. Do you feel that the proposed diversion channel would be feasible for the following conditions for the chosen design vessel (six-pack barge with 1200 HP tow) for the HIGHER magnitude currents tested (10-yr conditions)?
   a. East side of lock, vessel heading eastbound toward the lock and then locking through
   b. East side of lock, vessel heading westbound leaving the lock after locking through

VERY BAD CHOICE, IT IS A SETING FOR FAILURE

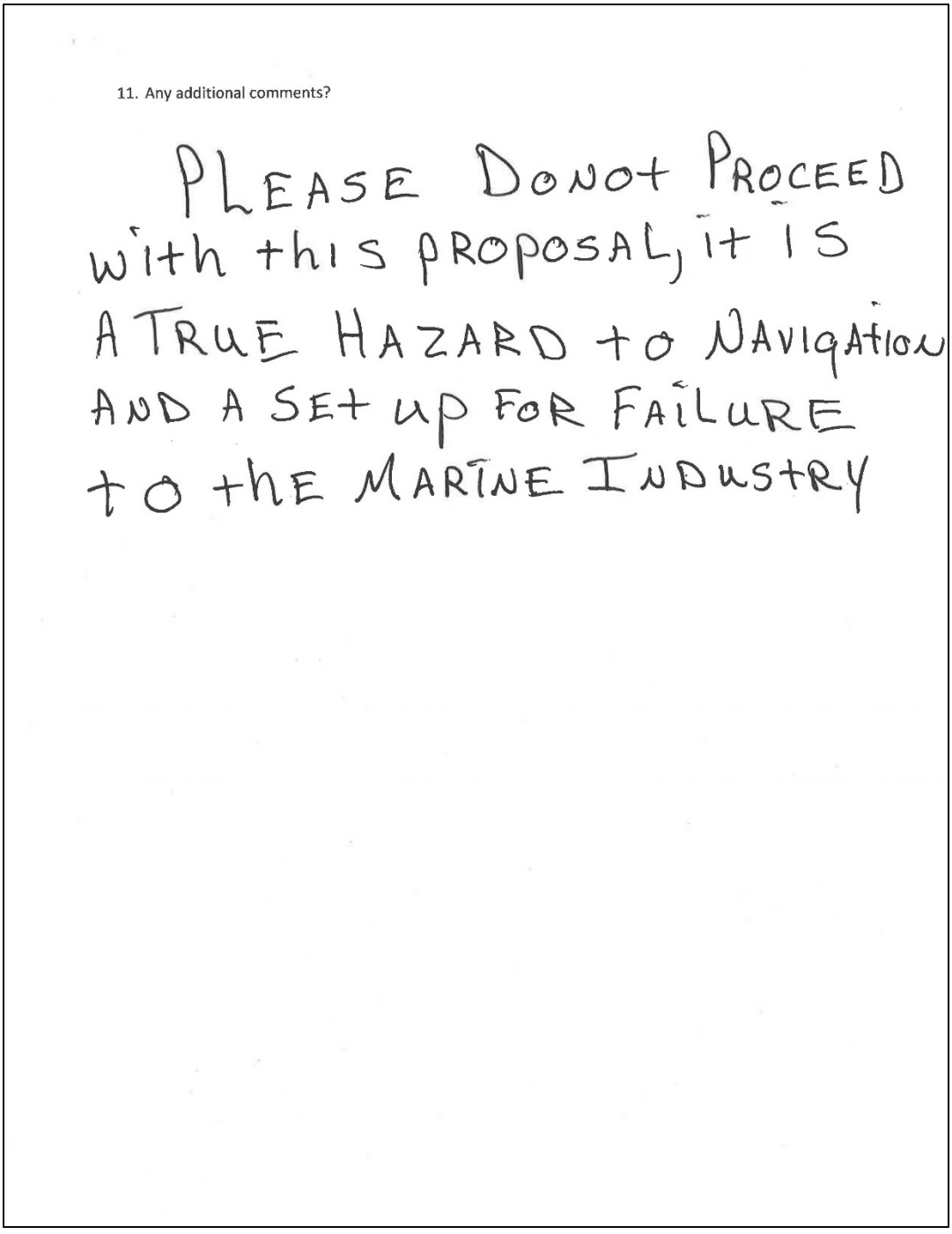
Initial testing - Captain Cheramie page 4.

10. Overall, do you think the addition of the proposed diversion channel would have a positive impact on navigation at Calcasieu Lock?

VERY NEGATIVE IMPACT



Initial testing - Captain Cheramie page 5.



11. Any additional comments?

PLEASE DONOT PROCEED
with this PROPOSAL, it IS
A TRUE HAZARD to NAVIGATION
AND A SET up FOR FAILURE
to the MARINE INDUSTRY

Initial testing - Captain Orr page 1.

Calcasieu Lock Ship Simulation Study – Final Questionnaire

Name: Jeffrey ORR

New Orleans District has suggested a diversion channel to help alleviate the high velocities which occur at Calcasieu Lock during high flow events. Testing for this project occurred during two testing weeks: January 14-18, 2019 and January 21-25, 2019.

1. Please comment on your experience of using the ERDC ship tow simulator this week for testing.

   It was very nice and worked very well everyone working here are very nice and good at there job

2. Do you think any additional testing runs should have been completed that were not tested this week?

   No I think we ran all the ways it could be made

3. Do you feel the environmental conditions (wind, current, etc,) and visuals provided a reasonable representation of Calcasieu Lock?

   yes looks just like real life

Initial testing - Captain Orr page 2.

4. Did you feel the currents were considerably different based on if Black Bayou was treated as a wall or as culverts numerically?

No It felt the same at the new cut with Black Bayou open are closed

5. Please comment on the behavior of the design vessel (six-pack barge with 1,200 HP pusher tow). Do you feel the design vessel was adequate as a means of testing the channel?

you can test with it But no one uses that low of Horse power any more with a tow that size

6. Do you have any concerns that the proposed diversion channel will impact empty barges?

no I dont think it will pull on empty s

7. Do you expect the proposed diversion channel would impact navigation on the west side of the lock (eastbound or westbound)?

No I felt no change on west side of lock at all

Initial testing - Captain Orr page 3.

8. Do you feel that the proposed diversion channel would be feasible for the following conditions for the chosen design vessel (six-pack barge with 1200 HP tow) for the LOWER magnitude currents tested (2-yr conditions)?
    a. East side of lock, vessel heading eastbound toward the lock and then locking through
    b. East side of lock, vessel heading westbound leaving the lock after locking through

no I dont think it will work at all

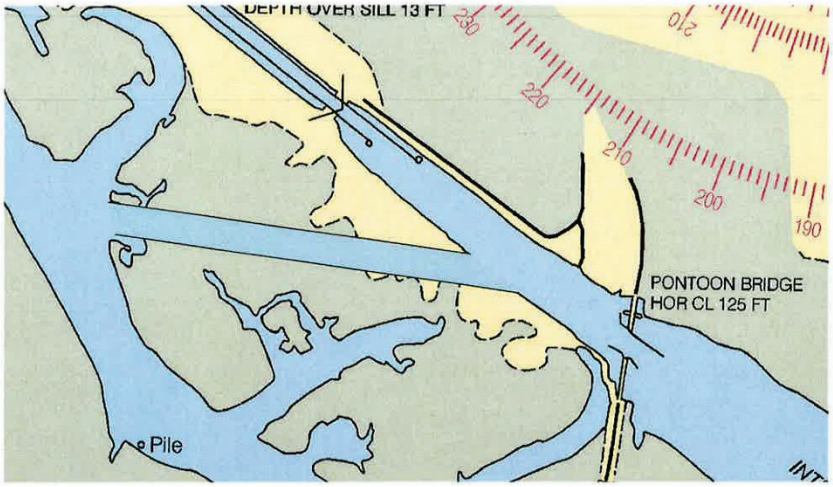
9. Do you feel that the proposed diversion channel would be feasible for the following conditions for the chosen design vessel (six-pack barge with 1200 HP tow) for the HIGHER magnitude currents tested (10-yr conditions)?
    a. East side of lock, vessel heading eastbound toward the lock and then locking through
    b. East side of lock, vessel heading westbound leaving the lock after locking through

No I dont think it will work and Be safe for Transit

Initial testing - Captain Orr page 4.

10. Overall, do you think the addition of the proposed diversion channel would have a positive impact on navigation at Calcasieu Lock?

No I think it will make navigation worse in that area and make it harder to go throught there



Initial testing - Captain Orr page 5.

11. Any additional comments?

I don't want to see The channel past in a searwheel man That make that Trip it would make it very hard to do safley and add Risk for no Reason

Initial testing - Captain Hogue page 1.

Calcasieu Lock Ship Simulation Study – Final Questionnaire

Name: Lee Hogue

New Orleans District has suggested a diversion channel to help alleviate the high velocities which occur at Calcasieu Lock during high flow events. Testing for this project occurred during two testing weeks: January 14-18, 2019 and January 21-25, 2019.

1. Please comment on your experience of using the ERDC ship tow simulator this week for testing.

   Believe the simulator to be very well set up. Feels like a real life situation.

2. Do you think any additional testing runs should have been completed that were not tested this week?

   We suggested some changes to the canal and current speeds and hopefully once those can be entered into the system those will be tested.

3. Do you feel the environmental conditions (wind, current, etc,) and visuals provided a reasonable representation of Calcasieu Lock?

   Yes all seemed fairly real.

Initial testing - Captain Hogue page 2.

4. Did you feel the currents were considerably different based on if Black Bayou was treated as a wall or as culverts numerically?

There did seem to be less draw when Black Bayou was treated as culverts.

5. Please comment on the behavior of the design vessel (six-pack barge with 1,200 HP pusher tow). Do you feel the design vessel was adequate as a means of testing the channel?

Yes, but would not mind seeing a 3,000 hp w/1,000' tow in the same scenario.

6. Do you have any concerns that the proposed diversion channel will impact empty barges?

The only real concern I have is that if the wind pushes that tow down to bad ~~trying to come through the bridge before~~ between the lock and bridge and the tow breaks up the empty barges could end up down the canal if there isn't anything there to stop them.

7. Do you expect the proposed diversion channel would impact navigation on the west side of the lock (eastbound or westbound)?

Yes, westbound tows I do believe would feel some draw maybe even extreem draw in very high flows, to that South bank.

Initial testing - Captain Hogue page 3.

8. Do you feel that the proposed diversion channel would be feasible for the following conditions for the chosen design vessel (six-pack barge with 1200 HP tow) for the LOWER magnitude currents tested (2-yr conditions)?
   a. East side of lock, vessel heading eastbound toward the lock and then locking through
   b. East side of lock, vessel heading westbound leaving the lock after locking through

The 2yr conditions that were simulated do very doable. For a + b.

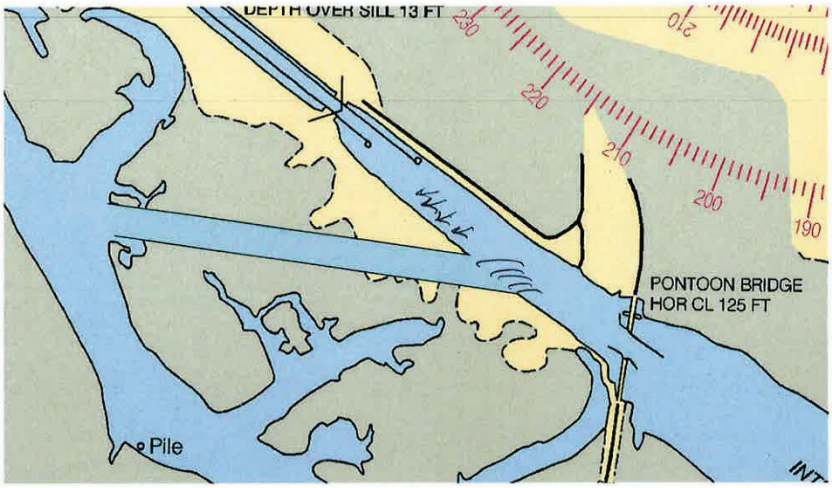
9. Do you feel that the proposed diversion channel would be feasible for the following conditions for the chosen design vessel (six-pack barge with 1200 HP tow) for the HIGHER magnitude currents tested (10-yr conditions)?
   a. East side of lock, vessel heading eastbound toward the lock and then locking through
   b. East side of lock, vessel heading westbound leaving the lock after locking through

Do not believe there would be issues the tows heading eastbound. I do believe there should be concern for the westbound tows because where you would be normally trying to slow down to make the lock you are going to be fighting a cross current try to pull you down to the south bank plus trying to make the lock.

Initial testing - Captain Hogue page 4.

10. Overall, do you think the addition of the proposed diversion channel would have a positive impact on navigation at Calcasieu Lock?

I believe it would benefit the eastbound tows but create an issue for west bound tows,



Initial testing - Captain Hogue page 5.

11. Any additional comments?

Feel confident that everyone I have spoken with and from doing this simulation if Black Bayou could be utilized as the drainage canal instead it work out in favor of everyone.

I believe all this is doing now is gonna solve one issue but create a few more for tows on the west side of the lock.

Initial testing - Captain Bates page 1.

Calcasieu Lock Ship Simulation Study – Final Questionnaire

Name: James Bates

New Orleans District has suggested a diversion channel to help alleviate the high velocities which occur at Calcasieu Lock during high flow events. Testing for this project occurred during two testing weeks: January 14-18, 2019 and January 21-25, 2019.

1. Please comment on your experience of using the ERDC ship tow simulator this week for testing.

   I enjoyed my experience here, this is a great facility. I would like to have had a functioning radar to enhance the realism and improve situational awareness though I understand there were some technical issues there. Thank you for allowing us to help with this project.

2. Do you think any additional testing runs should have been completed that were not tested this week?

   I think assist vessel use for the west bound approach would have been a good test and reccomend they be included in future scenarios. The industry as a whole has shifted it's mentality on the use of assist vessels and it is very common to use them is situations like this.

3. Do you feel the environmental conditions (wind, current, etc,) and visuals provided a reasonable representation of Calcasieu Lock?

   Yes.

Initial testing - Captain Bates page 2.

4. Did you feel the currents were considerably different based on if Black Bayou was treated as a wall or as culverts numerically?

There was definitely a difference, and I would prefer based upon my observations to allow as much water as possible through Black Bayou in order to lessen flows to the lock/ diversion channel.

5. Please comment on the behavior of the design vessel (six-pack barge with 1,200 HP pusher tow). Do you feel the design vessel was adequate as a means of testing the channel?

I believe it is a good test of the conditions, as it is almost underpowered for that tow and is indicative of current practice, though less common today. Most companies are moving to higher HP vessels for that size of tow.

6. Do you have any concerns that the proposed diversion channel will impact empty barges?

Not much concern for empty tows as I felt in our simulations that an empty tow will carry enough speed to outrun any current set. Wind will have a far greater impact to empty tows.

7. Do you expect the proposed diversion channel would impact navigation on the west side of the lock (eastbound or westbound)?

Yes, definitely for westbound traffic. Eastbound departing the lock did not pose any difficulty, but it greatly changed the typical westbound approach. The added difficulty of cross current on final approach, in close proximity to the bridge, does not create an ideal situation.

Initial testing - Captain Bates page 3.

8. Do you feel that the proposed diversion channel would be feasible for the following conditions for the chosen design vessel (six-pack barge with 1200 HP tow) for the LOWER magnitude currents tested (2-yr conditions)?
   a. East side of lock, vessel heading ~~eastbound~~ toward the lock and then locking through
   b. East side of lock, vessel heading westbound leaving the lock after locking through

Yes to both scenarios.

9. Do you feel that the proposed diversion channel would be feasible for the following conditions for the chosen design vessel (six-pack barge with 1200 HP tow) for the HIGHER magnitude currents tested (10-yr conditions)?
   a. East side of lock, vessel heading ~~eastbound~~ westbound toward the lock and then locking through
   b. East side of lock, vessel heading ~~westbound~~ eastbound leaving the lock after locking through

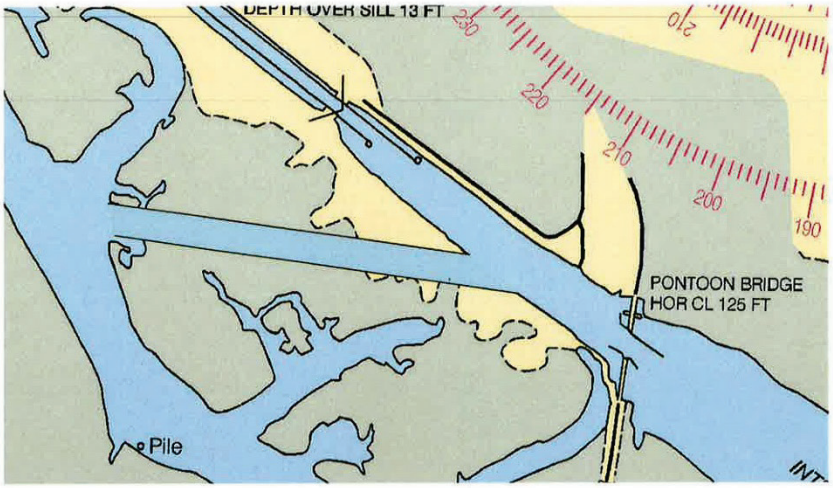
No, not in its' present configuration, for the westbound approach to the lock, for reasons noted in # 7.

There are no issues with departing the lock and heading eastbound past the diversion channel in any of the scenarios we tested.

Initial testing - Captain Bates page 4.

10. Overall, do you think the addition of the proposed diversion channel would have a positive impact on navigation at Calcasieu Lock?

Not in its' present configuration. Solves one problem and creates another.



Initial testing - Captain Bates page 5.

11. Any additional comments?

I look forward to seeing the results of additional simulations after the proposed changes can be modeled.

I believe there is still a chance that this could be a valuable project to increase navigation efficiency at the lock if the concerns for the west bound approach can be mitigated,

Thank you ~~for~~ the opportunity to test the scenarios and provide feedback.

Initial testing - Captain Bates page 6.

Calcasieu Lock Ship Simulation Study – Final Questionnaire

Name: James Bates

New Orleans District has suggested a diversion channel to help alleviate the high velocities which occur at Calcasieu Lock during high flow events. Testing for this project occurred during two testing weeks: January 14-18, 2019 and January 21-25, 2019.

1. Please comment on your experience of using the ERDC ship tow simulator this week for testing.

   I enjoyed my experience here, this is a great facility. I would like to have had a functioning radar to enhance the realism and improve situational awareness though I understand there were some technical issues there. Thank you for allowing us to help with this project.

2. Do you think any additional testing runs should have been completed that were not tested this week?

   I think assist vessel use for the west bound approach would have been a good test and reccomend they be included in future scenarios. The industry as a whole has shifted it's mentality on the use of assist vessels and it is very common to use them is situations like this.

3. Do you feel the environmental conditions (wind, current, etc,) and visuals provided a reasonable representation of Calcasieu Lock?

   Yes.

Additional testing pilot questionnaires

Additional testing - Captain Cheramie page 1.

Calcasieu Lock Ship Simulation Study Additional Effort – Final Questionnaire

Name: TRACY CHERAMIE

New Orleans District has suggested a diversion channel to help alleviate the high velocities which occur at Calcasieu Lock during high flow events. Initial testing for this project occurred during two testing weeks: January 14-18, 2019 and January 21-25, 2019. During this testing, it was determined that the proposed diversion channel needed additional modifications for westbound traffic on the east side of Calcasieu Lock. Subsequent testing occurred March 28-29, 2019.

1. Please comment on your experience of using the ERDC ship tow simulator for testing.

   It is set up VERY WELL FOR the TASK At hAND

2. Do you think any additional testing runs should have been completed that were not tested?

   NO

3. Do you feel the environmental conditions (wind, current, etc,) and visuals provided a reasonable representation of Calcasieu Lock? Did the currents for the 10 year flow event feel more representative during this set of testing?

   ALL ELEMENT WHERE ON ~~THE~~ spot FOR tASK AtHAND

4. Do you have any concerns that the proposed diversion channel will impact empty barges?

   YES this IS A VERY BAD LOCATION FOR this PROSOSAL

Additional testing - Captain Cheramie page 2.

5. During this testing set, three alternatives were tested. Please comment on the feasibility of each alternative for **westbound** traffic on the **east** side of the lock (from bridge to lock).
   a. **Original** diversion channel cut, lock **open** for westbound traffic, lock **closed** for eastbound traffic

this cut had a draw to the cut which set vessel up for a accident on each run

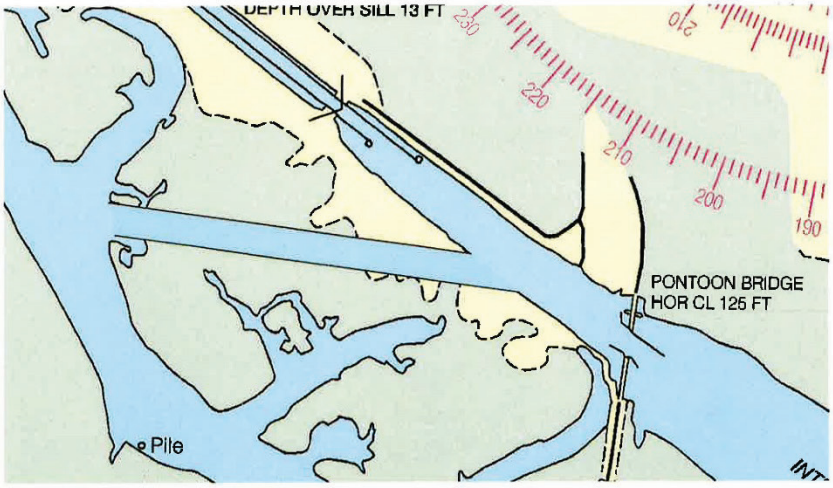


Figure 1. Original diversion channel cut

Additional testing - Captain Cheramie page 2.

b. **Modified** diversion channel cut, lock **closed** for westbound traffic, lock **closed** for eastbound traffic

STILL HAD A DRAW WHEN CROSSING cut IN A CRITICAL AREA

c. **Modified** diversion channel cut, lock **open** for westbound traffic, lock **closed** for eastbound traffic

STILL HAD A DRAW ON VESSEL WHEN CROSSING

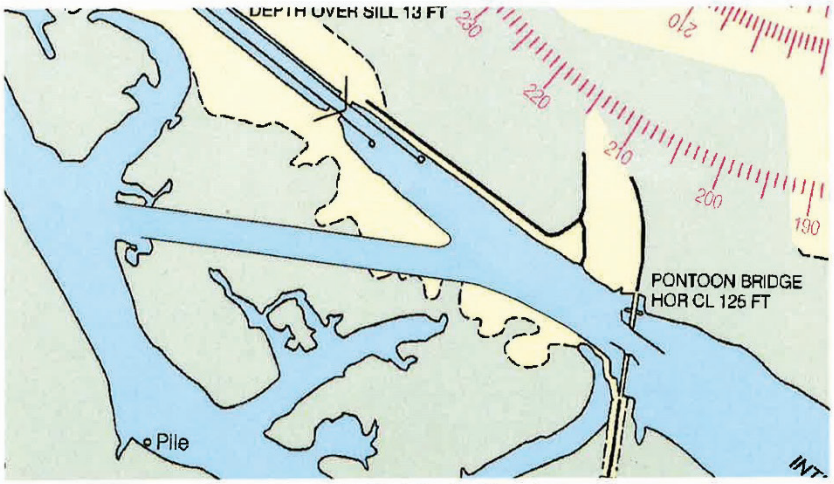


Figure 2. Modified diversion channel cut

Additional testing - Captain Cheramie page 4.

6. Do you have any concerns for **eastbound** traffic on the **east** side of the lock (from lock to bridge) with the addition of the diversion channel?

NO ISSUE

7. Do you expect the proposed diversion channel would impact navigation on the **west** side of the lock (eastbound or westbound)?

NO ISSUE

8. Did modifying the diversion channel inlet strongly impact the ability of a vessel (eastbound or westbound) to pass by the diversion channel?

YES But not so much ON EASTBOUND

9. Did allowing Calcasieu Lock to be open for westbound traffic greatly impact the ability of a westbound vessel to pass by the diversion channel?

YES DUE to the DRAW WHEN PASSING cut W/ TOW

Additional testing - Captain Cheramie page 3.

10. Overall, do you think the addition of the proposed diversion channel would have a positive impact on navigation at Calcasieu Lock?

NO this IS A VERY ~~NOPOSITIVE~~ NONPOSITIVE IMPACT to NAVIGATION AND WILL put OUR MARINERS At RISK OF COLLISION

11. Any additional comments?

AS A PROFESSIONAL MARINE I AM VOTING NO ON this PROPOSAL, it is putting OUR VESSELS At A VERY High RISK OF ~~COLLISION~~ COLLISION,

Additional testing - Captain Orr page 1.

Calcasieu Lock Ship Simulation Study Additional Effort – Final Questionnaire

Name: Jeffrey ORR

New Orleans District has suggested a diversion channel to help alleviate the high velocities which occur at Calcasieu Lock during high flow events. Initial testing for this project occurred during two testing weeks: January 14-18, 2019 and January 21-25, 2019. During this testing, it was determined that the proposed diversion channel needed additional modifications for westbound traffic on the east side of Calcasieu Lock. Subsequent testing occurred March 28-29, 2019.

1. Please comment on your experience of using the ERDC ship tow simulator for testing.
   IT was good every Thing worked good and was Real

2. Do you think any additional testing runs should have been completed that were not tested?
   No I Think we ran all that needed to be run

3. Do you feel the environmental conditions (wind, current, etc,) and visuals provided a reasonable representation of Calcasieu Lock? Did the currents for the 10 year flow event feel more representative during this set of testing?
   yes all felt real like it does in real life

4. Do you have any concerns that the proposed diversion channel will impact empty barges?
   yes if the wind sets your down you could end up in the new Channel

Additional testing - Captain Orr page 2.

5. During this testing set, three alternatives were tested. Please comment on the feasibility of each alternative for **westbound** traffic on the **east** side of the lock (from bridge to lock).
   a. **Original** diversion channel cut, lock **open** for westbound traffic, lock **closed** for eastbound traffic

Has a hard set to the new cut making it where if you try to get in the lock you will most likely hit one of the walls

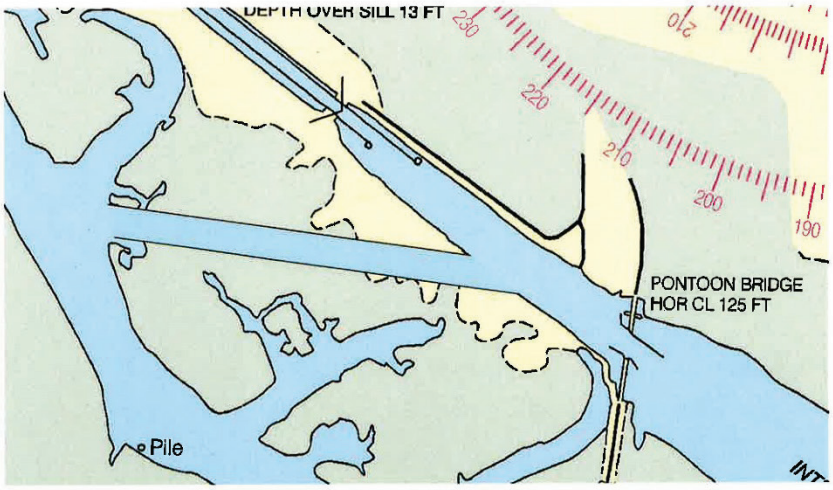


Figure 1. Original diversion channel cut

Additional testing - Captain Orr page 3.

b. **Modified** diversion channel cut, lock **closed** for westbound traffic, lock **closed** for eastbound traffic

Has a hard set to the new cut and would most likly hit one of the walls I would not go in there with a tow The new cut seems to be a little better Than the old cut

c. **Modified** diversion channel cut, lock **open** for westbound traffic, lock **closed** for eastbound traffic

Has a little set to the new cut but I think we could get in the lock you would have to be real careful

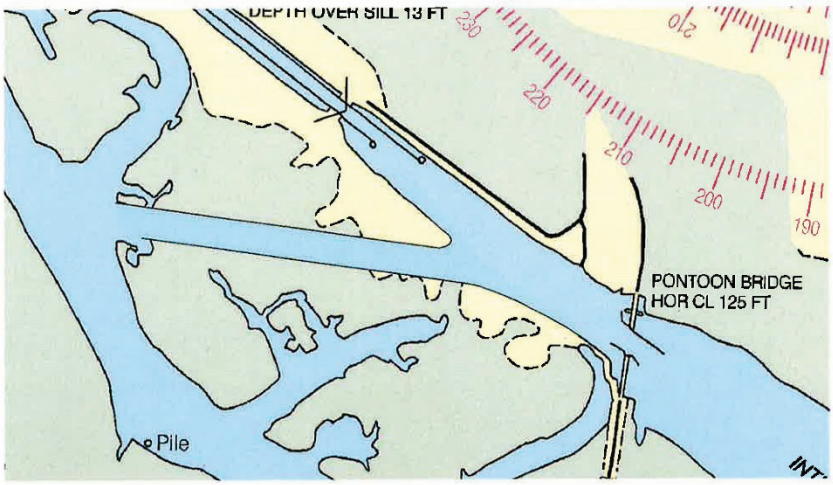


Figure 2. Modified diversion channel cut

Additional testing - Captain Orr page 4.

6. Do you have any concerns for **eastbound** traffic on the **east** side of the lock (from lock to bridge) with the addition of the diversion channel?

no I think that it will be fine

7. Do you expect the proposed diversion channel would impact navigation on the **west** side of the lock (eastbound or westbound)?

yes I Think you will have problems getting in the lock going west Bound

8. Did modifying the diversion channel inlet strongly impact the ability of a vessel (eastbound or westbound) to pass by the diversion channel?

It still has a set that could cause you to not get in the Lock with out hitting it

9. Did allowing Calcasieu Lock to be open for westbound traffic greatly impact the ability of a westbound vessel to pass by the diversion channel?

No ya Just have to watch for the set but I think you can get in the Locks with the gates open

Additional testing - Captain Orr page 5.

10. Overall, do you think the addition of the proposed diversion channel would have a positive impact on navigation at Calcasieu Lock?

No I think that it is a bad place for this and is going to make Boats hit the Locks and do damage to the Lock

11. Any additional comments?

I do not like this I feel like this is a bad idea and should not be put in I tell like a lot of people are going to hit the Lock and tear it up and cause more delay and cost Boat companys money I do not want To see this done

Additional testing - Captain Hogue page 1.

Calcasieu Lock Ship Simulation Study Additional Effort – Final Questionnaire

Name: Lee Hogue

New Orleans District has suggested a diversion channel to help alleviate the high velocities which occur at Calcasieu Lock during high flow events. Initial testing for this project occurred during two testing weeks: January 14-18, 2019 and January 21-25, 2019. During this testing, it was determined that the proposed diversion channel needed additional modifications for westbound traffic on the east side of Calcasieu Lock. Subsequent testing occurred March 28-29, 2019.

1. Please comment on your experience of using the ERDC ship tow simulator for testing.

   Great simulator, really like the feeling of it.

2. Do you think any additional testing runs should have been completed that were not tested?

   Would have liked to of seen a 1,000' tow 54' wide tested.

3. Do you feel the environmental conditions (wind, current, etc,) and visuals provided a reasonable representation of Calcasieu Lock? Did the currents for the 10 year flow event feel more representative during this set of testing?

   currents felt much more real this go around.

4. Do you have any concerns that the proposed diversion channel will impact empty barges?

   The risk factor to emptys is far less than to loads

Additional testing - Captain Hogue page 2.

5. During this testing set, three alternatives were tested. Please comment on the feasibility of each alternative for **westbound** traffic on the **east** side of the lock (from bridge to lock).
   a. **Original** diversion channel cut, lock **open** for westbound traffic, lock **closed** for eastbound traffic

With the lock being in the open position when locking W/B it does help with setting down to the lock better in both cuts but like the new cut better but still feel it is unsafe to lock westbound with out help.

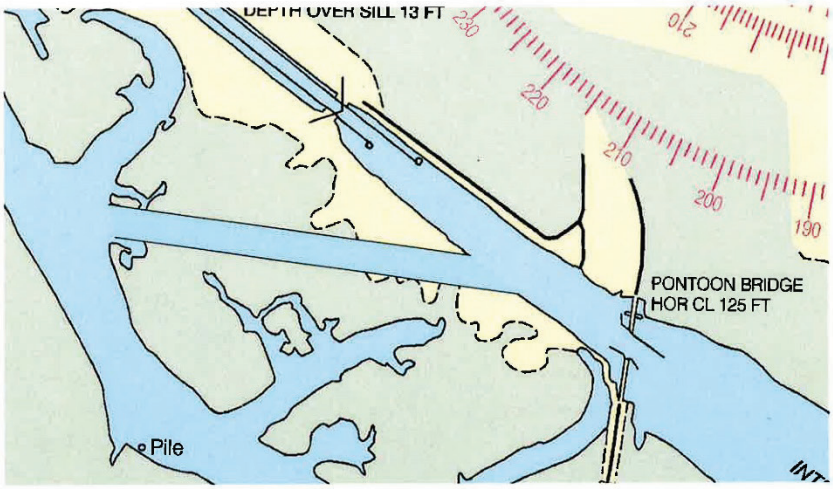


Figure 1. Original diversion channel cut

Additional testing - Captain Hogue page 3.

b. **Modified** diversion channel cut, lock **closed** for westbound traffic, lock **closed** for eastbound traffic

look at a.

c. **Modified** diversion channel cut, lock **open** for westbound traffic, lock **closed** for eastbound traffic

look at a.

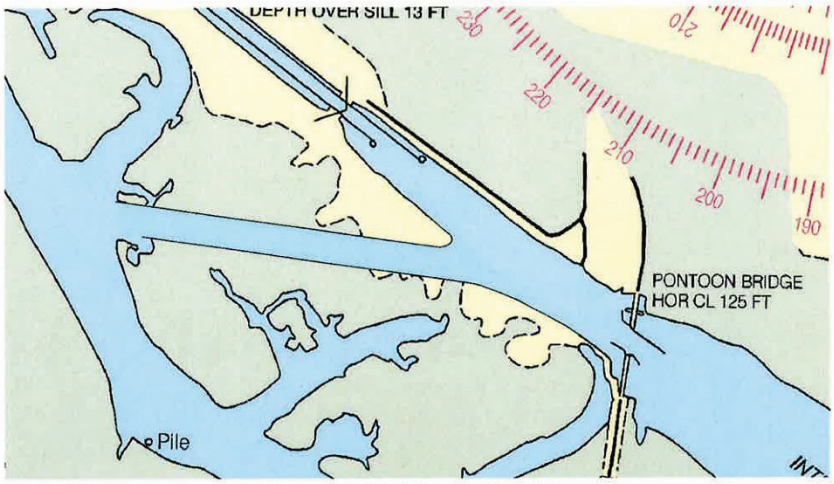


Figure 2. Modified diversion channel cut

Additional testing - Captain Hogue page 4.

6. Do you have any concerns for **eastbound** traffic on the **east** side of the lock (from lock to bridge) with the addition of the diversion channel?

No issues

7. Do you expect the proposed diversion channel would impact navigation on the **west** side of the lock (eastbound or westbound)?

not c/b
yes w/b, very high risk of damage to tows and lock with canal.

8. Did modifying the diversion channel inlet strongly impact the ability of a vessel (eastbound or westbound) to pass by the diversion channel?

The new inlet is less draw but increase current towards the lock.

9. Did allowing Calcasieu Lock to be open for westbound traffic greatly impact the ability of a westbound vessel to pass by the diversion channel?

It does help greatly with the lock being open but still feel unsafe.

Additional testing - Captain Hogue page 5.

10. Overall, do you think the addition of the proposed diversion channel would have a positive impact on navigation at Calcasieu Lock?

No, believe we create a issue for westbound by causing damage to tows and, or the lock.

11. Any additional comments?

Additional testing - Captain Bates page 1.

Calcasieu Lock Ship Simulation Study Additional Effort – Final Questionnaire

Name: James Bates 12 yrs in the industry.

New Orleans District has suggested a diversion channel to help alleviate the high velocities which occur at Calcasieu Lock during high flow events. Initial testing for this project occurred during two testing weeks: January 14-18, 2019 and January 21-25, 2019. During this testing, it was determined that the proposed diversion channel needed additional modifications for westbound traffic on the east side of Calcasieu Lock. Subsequent testing occurred March 28-29, 2019.

1. Please comment on your experience of using the ERDC ship tow simulator for testing.

   I've enjoyed my time here; this is a very nice facility. I was glad to see the radars working this time.

2. Do you think any additional testing runs should have been completed that were not tested?

   No.

3. Do you feel the environmental conditions (wind, current, etc,) and visuals provided a reasonable representation of Calcasieu Lock? Did the currents for the 10 year flow event feel more representative during this set of testing?

   Yes. The Lock is modeled accurately, and the environmental conditions are accurate as well.

4. Do you have any concerns that the proposed diversion channel will impact empty barges?

   The current will not have much impact on the empties, but high winds would make a westbound approach ~~easier~~ more difficult.

Additional testing - Captain Bates page 2.

5. During this testing set, three alternatives were tested. Please comment on the feasibility of each alternative for **westbound** traffic on the **east** side of the lock (from bridge to lock).
   a. **Original** diversion channel cut, lock **open** for westbound traffic, lock **closed** for eastbound traffic

The effect from the diversion channel was lessened with the lock open, but could still be felt.

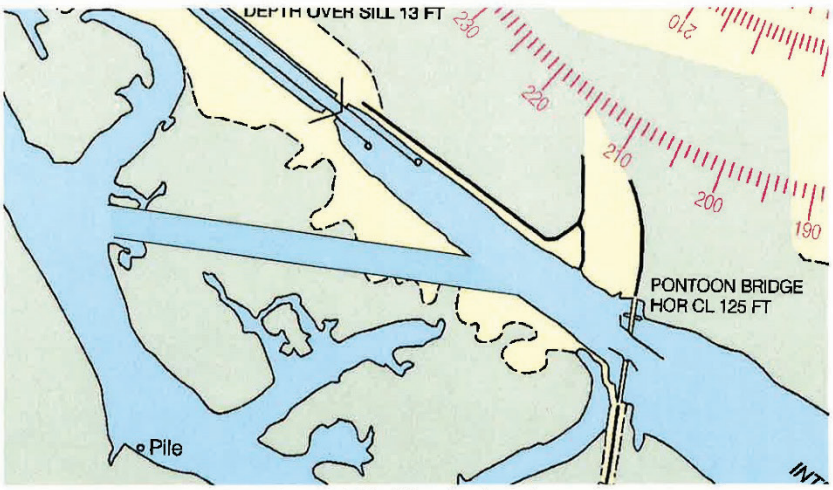


Figure 1. Original diversion channel cut

Additional testing - Captain Bates page 3.

b. **Modified** diversion channel cut, lock **closed** for westbound traffic, lock **closed** for eastbound traffic

The modified channel lessened the effects but they were still present.

c. **Modified** diversion channel cut, lock **open** for westbound traffic, lock **closed** for eastbound traffic

Best combination so far for making the lock approach, but effects were still present, especially when approaching at a slow, safe speed to enter the lock.

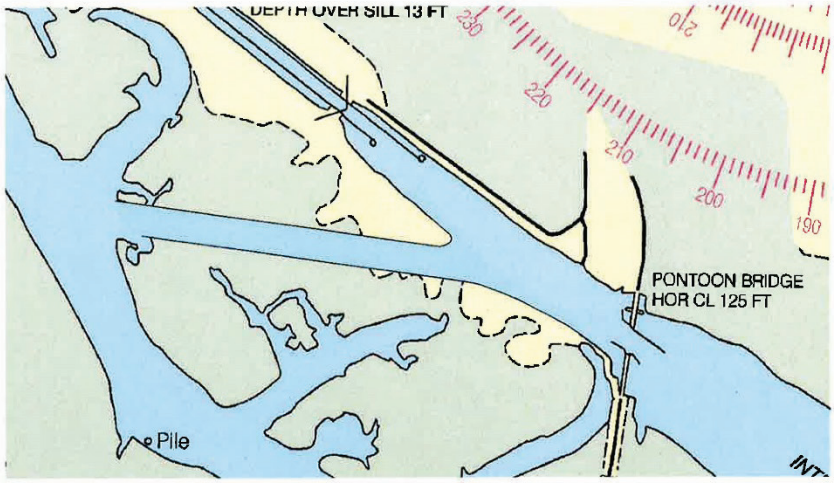


Figure 2. Modified diversion channel cut

Additional testing - Captain Bates page 4.

6. Do you have any concerns for **eastbound** traffic on the **east** side of the lock (from lock to bridge) with the addition of the diversion channel?

   None.

7. Do you expect the proposed diversion channel would impact navigation on the **west** side of the lock (eastbound or westbound)?

   Yes.

8. Did modifying the diversion channel inlet strongly impact the ability of a vessel (eastbound or westbound) to pass by the diversion channel?

   No. Impacts were lessened, but not enough to permit a safe approach for westbound tows.

9. Did allowing Calcasieu Lock to be open for westbound traffic greatly impact the ability of a westbound vessel to pass by the diversion channel?

   Same as above,

Additional testing - Captain Bates page 5.

10. Overall, do you think the addition of the proposed diversion channel would have a positive impact on navigation at Calcasieu Lock?

No. While it would solve any delay issues for eastbound tows, it would create a difficult approach for westbound tows that would likely result in damage to barges and lock infrastructure.

11. Any additional comments?

Thank you for the opportunity to be a part of this process!

Appendix C: Pilot Cards

Pilot card – loaded 6-pack.

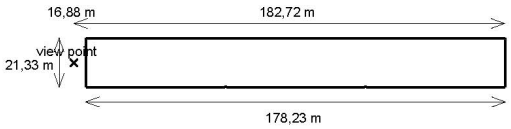
PILOT CARD

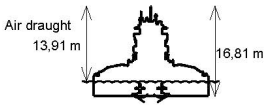
TUGBA57
Version 1

Ship's name Kin King
Call Sign WDG5328 **Deadweight** 0 tonnes **Year built** 2012
Draught aft 2.895 m / 9 ft 6 in **Forward** 2.895 m / 9 ft 6 in **Displacement** 10928 tonnes

SHIP'S PARTICULARS

Length overall 199.6 m **Anchor chain:** **Port** _____ shackles **Starboard** _____ shackles
Breadth 21.33 m
Bulbous bow No **(1 shackle = 27,432 m = 15 fathoms)**





PROPULSION PARTICULARS

Type of engine Diesel **Maximum power** 883 kW (1200 hp)

Manoeuvring engine order		RPM	Pitch	Speed (knots)	
				Loaded	Ballast
Full sea speed	1	279.2	N/A	6.2	N/A
Full Ahead	0.8	248.0	N/A	5.6	N/A
Half Ahead	0.5	200.0	N/A	4.5	N/A
Slow Ahead	0.25	125.0	N/A	2.8	N/A
Dead Slow Ahead	0.125	60.0	N/A	1.1	N/A
Dead Slow Astern	-0.125	-60.0	N/A		
Slow Astern	-0.25	-125.0	N/A		
Half Astern	-0.5	-200.0	N/A		
Full Astern	-1	-279.2	N/A		

Pilot card – loaded 6-pack.

STEERING PARTICULARS

Type of rudder Normal/Normal/Flanking/Flanking Maximum angle 45 °
Hard-over to hard-over 5.8 s
Rudder angle for neutral effect 0 °

Thruster: Bow N/A kW (N/A hp) Stern N/A kW (N/A hp)

CHECKED IF ABOARD AND READY

Anchors				Indicators:	
Whistle				Rudder	
Radar		3 cm	10 cm	Rpm/pitch	
ARPA				Rate of turn	
Speed log		Doppler:	Yes / No	Compass system	
Water speed				Constant gyro error ±	°
Ground speed				VHF	
Dual-axis				Elec. pos. fix. system	
Engine telegraphs				Type	
Steering gear					
Number of power units operating					

OTHER INFORMATION:

Pilot card – empty 6-pack.

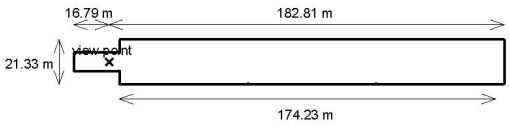
PILOT CARD

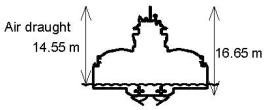
TUGBA59V1
Version 1

Ship's name Kin King
Call Sign WDG5328 **Deadweight** 0 tonnes **Year built** 2012
Draught aft 2.1 m / 6 ft 11 in **Forward** 0.457 m / 1 ft 6 in **Displacement** 1654 tonnes

SHIP'S PARTICULARS

Length overall 199.6 m **Anchor chain:** **Port** _____ shackles **Starboard** _____ shackles
Breadth 21.33 m
Bulbous bow No **(1 shackle = 27.432 m = 15 fathoms)**





PROPULSION PARTICULARS

Type of engine Diesel **Maximum power** 883 kW (1200 hp)

Manoeuvring engine order		RPM	Pitch	Speed (knots)	
				Loaded	Ballast
Full sea speed	**1**	279.2	N/A	N/A	7.9
Full Ahead	**0.8**	248.0	N/A	N/A	6.9
Half Ahead	**0.5**	200.0	N/A	N/A	5.6
Slow Ahead	**0.25**	125.0	N/A	N/A	3.4
Dead Slow Ahead	**0.125**	60.0	N/A	N/A	1.6
Dead Slow Astern	**-0.125**	-60.0	N/A		
Slow Astern	**-0.25**	-125.0	N/A		
Half Astern	**-0.5**	-200.0	N/A		
Full Astern	**-1**	-279.2	N/A		

Pilot card – empty 6-pack.

STEERING PARTICULARS

Type of rudder Normal/Normal/Flanking/Flanking Maximum angle 45 °
Hard-over to hard-over 5.8 s
Rudder angle for neutral effect 0 °

Thruster: Bow N/A kW (N/A hp) Stern N/A kW (N/A hp)

CHECKED IF ABOARD AND READY

Anchors				Indicators:	
Whistle				Rudder	
Radar		3 cm		Rpm/pitch	
ARPA			10 cm	Rate of turn	
Speed log		Doppler:	Yes / No	Compass system	
Water speed				Constant gyro error ±	°
Ground speed				VHF	
Dual-axis				Elec. pos. fix. system	
Engine telegraphs				Type	
Steering gear					
Number of power units operating					

OTHER INFORMATION:

Unit Conversion Factors

Multiply	By	To Obtain
degrees (angle)	0.01745329	radians
feet	0.3048	meters
horsepower (550 foot-pounds force per second)	745.6999	watts
knots	0.5144444	meters per second
miles (US statute)	1,609.347	meters

Acronyms and Abbreviations

CHL	Coastal and Hydraulics Laboratory
ECDIS	Electronic Chart Display and Information System
ERDC	US Army Engineer Research and Development Center
FMT	Florida Marine Transporters
ft	foot/feet
GICA	Gulf Intracoastal Canal Association
GIWW	Gulf Intracoastal Waterway
hp	horsepower
MLLW	mean lower low water
MSL	mean sea level
MVN	New Orleans District
STS	Ship/Tow Simulator
USACE	US Army Corps of Engineers

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14. ABSTRACT
Calcasieu Lock is located on the Gulf Intracoastal Waterway just north of Calcasieu Lake in Louisiana. Calcasieu Lock has three main purposes: facilitate navigation, provide flood relief during high flow events, and prevent saltwater intrusion into the Mermentau River Basin. During high flow events, the primary purpose of Calcasieu Lock is draining for flood relief. The upstream and downstream gates open to pass as much water as possible. When in draining mode, currents through the lock increase in strength and can cause eastbound traffic with smaller horsepower towboats to be unable to push upstream through the lock. This causes delays for the eastbound traffic. The US Army Corps of Engineers, New Orleans District (MVN), proposed a diversion channel to alleviate the amount of flow the lock must pass during these high flow events.

In 2019, the US Army Engineer Research and Development Center Ship/Tow Simulator was used to perform a navigation study for the proposed diversion channel at Calcasieu Lock to assist MVN in verifying the proposed design. The final assessment of the diversion channel was accomplished through analysis of ship simulations completed by experienced pilots, discussions, track plots, run sheets, and final pilot surveys.

15. SUBJECT TERMS
Calcasieu Lock (La.), Gulf Intracoastal Waterway, Hydraulic structures, Inland navigation, Locks (Hydraulic engineering), River channels, Water diversion

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