Sabine Neches Navigation Improvement Project Integrated Section 203 Feasibility Report and Environmental Assessment

Appendix B

Economics

February 2026

Table of Contents

List of Tables

List of Figures

1 Introduction

The analyses described in this Economics Appendix were conducted in support of the Section 203 Integrated Feasibility Report and Environmental Assessment of the Sabine Neches Waterway Navigation Improvement Project for Widening (Widening Project). The feasibility study and resulting project will be carried out under the authority granted by Section 203 of WRDA 1986, as amended, which provides for a non-federal entity to perform the necessary investigations and submit the completed feasibility study to the Assistant Secretary of the Army (Civil Works) for review and potential submittal to Congress for project authorization.

Economic data, assumptions, projections, and calculations used to evaluate alternative plans for navigation improvement at the Sabine-Neches Waterway (SNWW) are presented in this document. The purpose of this document is to describe the data and methods used to calculate the transportation cost savings resulting from widening the navigation channel at the SNWW. As described below, under existing and without-project conditions, the Sabine Pilots Association have imposed daylight-only transiting restrictions and no vessel meeting restrictions on much of the existing and projected future fleet. Widening the channel, or selected channel reaches, would allow the Pilots to reduce transiting restrictions that would result in increased navigation efficiency at the SNWW.

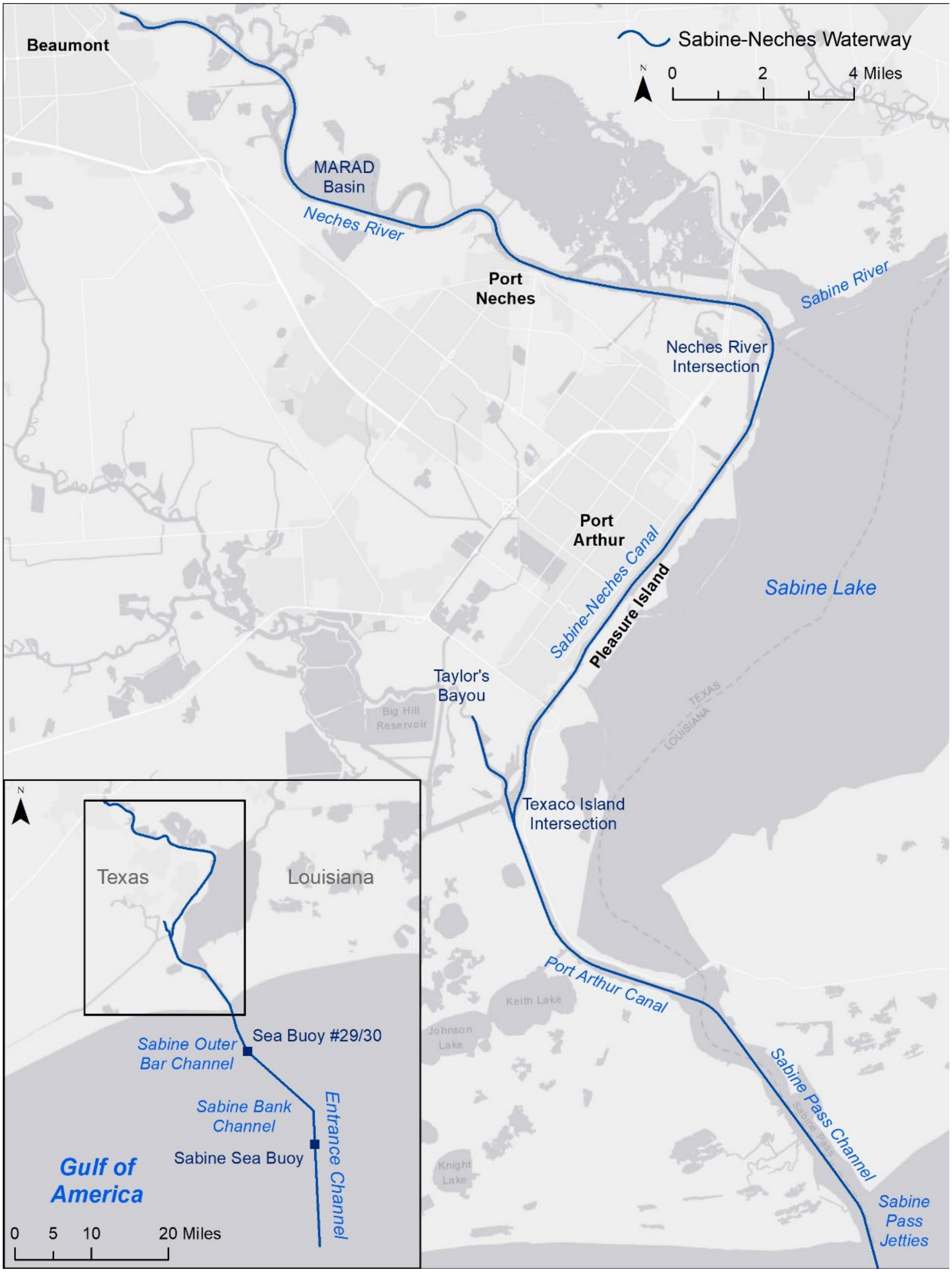
1.1 Project Area Description

The SNWW is a 77-mile federally authorized and maintained waterway located in Jefferson and Orange counties in southeast Texas and Cameron Parish, Louisiana (Figure 1-1). The area surrounding the SNWW is delineated by the three major Texas seaports of Port Arthur, Beaumont, and Orange. Sabine Pass, Sabine Lake, and the Sabine River together form part of the boundary between the states of Texas and Louisiana.

The SNWW is a system of navigation channels in the Sabine-Neches estuary in Texas and Louisiana. The estuary includes Sabine Lake, tidal portions of the Sabine and Neches rivers, and a number of tidally influenced bayous and shallow coastal lakes. The only connection with the Gulf is a long narrow pass called Sabine Pass through which all tidal interchange occurs. Sabine Pass is stabilized by jetties that extend 4.1 miles into the Gulf. The jetties were initially constructed for navigational purposes in the late 1880s.

The SNWW enters from deep water in the Gulf through the Entrance Channel, which is divided into the Sabine Bank Channel and the Sabine Pass Outer Bar Channel. It enters into Sabine Pass through the Sabine Pass Jetty and Sabine Pass channels, and follows the west bank of Sabine Lake to Port Arthur in the Port Arthur Canal. The SNWW includes Taylor Bayou Channels and Turning Basins at the confluence of the Port Arthur Junction Area. On the west side of Sabine Lake, the Sabine-Neches Canal is separated from the lake by an artificially created strip of land called Pleasure Island, that extends to near the mouth of the Neches River. From the northeastern corner of Sabine Lake, another section of the Sabine-Neches Canal connects the mouths of two rivers, the Neches River (to Beaumont, Texas) and the Sabine River to the east (to Orange, Texas). The Neches River Channel ends at Beaumont Turning Basin just south of the Interstate Highway 10 Bridge.

Figure 1-1
Project Location Overview and General Features



Channel Improvement Project Currently Underway

The SNWW is currently being deepened (Deepening Project) from 40 to 48 feet as authorized by the Water Resources Development Act of 2014. Note that all depths presented in this document are mean lower low water (MLLW). Deepening Project construction started in 2022, and the deepening is projected to be fully complete by 2028. In general, the Deepening Project is being constructed by dredging in two passes. The first pass will increase depth by four feet, will run from the entrance channel in the Gulf to the project terminus at the Port of Beaumont, and will include federal anchorages and turning basins. Construction of the first pass began in 2022 and is scheduled to be completed in 2026. The second pass will complete the channel deepening by increasing channel depth from -46 feet to -50 feet at the entrance channel in the Gulf and from -44 feet to -48 feet from the entrance channel in the Gulf to the project terminus at the Port of Beaumont and will include federal anchorages and turning basins. The second pass is scheduled to begin in 2025 (contract has been awarded but construction has not started as of July 2025) and will be completed by 2028.

Table 1-1 provides the SNWW's authorized and fully constructed channel dimensions resulting from the Deepening Project. Note that the federal channel will be extended 13.2 miles farther in the Gulf to achieve the required -50-foot depth. The Deepening Project does not provide channel widening; however, the Sabine Bank Channel will be reduced from 800 feet to 700 feet as a part of the Deepening Project.

Table 1-1
Post-Deepening Project Waterway Dimensions

Channel Reach	Depth (feet MLLW)	Width (feet)	Length (Miles)
Sabine Bank Channel Extension	50	700	13.2
Sabine Bank Channel	50	700 - 800	14.7
Sabine Pass Outer Bar Channel	50	800	3.4
Sabine Pass Jetty Channel	48	800-500	4.0
Sabine Pass Channel	48	500-1,133	5.6
Port Arthur Canal (incl. Taylors Bayou)	48	500-1,788	6.2
Sabine Neches Canal	48	400-1,060	11.3
Neches River Channel	48	400	18.6

1.1.1 Industry Investment Along the SNWW

The SNWW is the third largest waterway in the nation by tonnage with 197 million tons transiting the waterway in 2023 (WCSC, 2025). The SNWW is heavily trafficked, serving deep draft vessels engaged in international and domestic trade.

The waterway also serves barge traffic along the Gulf Intracoastal Waterway (GIWW) that stretches from St. Marks, FL to Brownsville, TX and links Mississippi barge traffic with Texas Gulf coast terminals. Barge traffic along the portion of the GIWW that is co-located with the

Sabine-Neches Canal operates 24 hours a day, 365 days per year. Based on data from the US Coast Guard Vessel Traffic System (VTS), in 2024 there were 48,000 inland tow transits on the SNWW, which is the equivalent of more than 5 barge tow transits per hour on this section of the Waterway. Additionally, there were 2,500 Articulated Tug Barge (ATB) transits that typically have an origin or destination on the Neches River where most of the SNWW terminals are located. The VTS indicates more than 8,000 deep draft cargo vessel transits in 2024.

The SNWW is the focus of a substantial and sustained series of investments that increase waterway tonnage and the number of vessels transiting the waterway. From 2011 to 2021, $53 billion in industry and terminal projects have been completed or are currently under construction. In addition, another $30 billion in proposed investments have been identified. In 2009, there were 3,300 vessel transits with drafts of 20 feet or greater; in 2019, that number increased to 5,600. In the five years from 2014 to 2019, export tonnage more than doubled from 32 million short tons to 85 million short tons. The increase in transits and tonnage is projected to continue as ongoing construction projects along the waterway are completed and proposed projects are implemented. The number of vessel calls is projected to remain steady after 2030, as presented in Section 3: Waterway Vessel Call Lists.

1.2 Waterway Congestion Due to Channel Widths

As previously stated, the SNWW is currently being deepened from -40 feet to -48 feet, but the ongoing Deepening Project does not widen the channel and current navigation restrictions will remain in effect after the channel is deepened. The channel currently is and will remain 400 feet wide in the Sabine-Neches Canal and the Neches River reaches. Detailed vessel operating data for 2019 was obtained from the Sabine Pilots Association, terminal operators, vessel operators, and the US Coast Guard to understand the nature of SNWW congestion and to develop a model to evaluate alternative improvements to reduced channel congestion. In 2019, there were 4,500 deep draft cargo vessel transits along these reaches. Based on navigation rules for the Waterway, Panamax vessels cannot meet other Panamax-size or larger vessels in the 400-foot-width channel reaches. In 2019, there were 4,300 transits by Panamax-size or larger vessels. In addition, Aframax and Suezmax vessels are restricted to transiting the 400-foot channel reaches in daylight only causing 1,200 vessel daylight restricted transits in 2019.

Navigation restrictions required for the 400-foot-wide channel combined with the increasing number of vessels transiting the waterway is the cause of substantial congestion and vessel delays. Vessels that are too large to meet in the narrow channel must wait for the channel to clear before entering from the sea or leaving from the dock. Vessels too large for nighttime transits must wait for daylight and a clear channel before entering from the sea or leaving from the dock. These delays also exacerbate weather delays because the more time a vessel spends in the system the more exposed that vessel is to weather delays during the difficult weather season.

There has long been a concerted effort among SNWW users to reduce delays and maximize navigational opportunities along the waterway. Vessel scheduling, the use of “caravans”, and queuing rules are all a part of the choreography of getting vessels to and from their berths as efficiently as possible. The effectiveness of these operational efforts is limited by the physical constraint of a 400-foot-wide channel, the size of vessels using the channel, and the number of these vessels.

1.3 Organization of the Appendix

This appendix is separated into six additional sections.

Section 2: Historic and Projected Commodity Tonnage

Section 2 provides detailed information on the commodities and tonnages along the waterway from 2019 through 2023 for both imports and exports. Commodity forecasts, which are identical for with- and without-project conditions, also are provided in this section.

Section 3: Waterway Vessel Call Lists

Development of the vessel call lists used in this analysis is discussed in Section 3. It is extremely important to note that the vessel call lists used under with- and without-project conditions are identical in every respect. In addition, cargo volumes transiting the waterway on vessels under with- and without-project conditions are identical, as well. This is because the widening alternatives do not provide an opportunity for transportation cost savings through the utilization of larger and more efficient vessels. Rather, the widening alternatives provide an opportunity for transportation cost savings through reductions in time spent by vessels waiting to enter or exit the waterway.

Section 4: Analytical Framework

Section 4 describes the analytical framework under which alternatives are analyzed. The framework consists of a traffic model that simulates deep draft vessel traffic flow to evaluate the effects of various channel widths along select reaches on all vessels' time in the system, including time waiting to enter the channel and time waiting to leave the dock.

Projections of traffic flow along the waterway are evaluated at five-year intervals from 2025 to 2050, and the framework consists of four key components:

1. Waterway geographic configuration,
2. Vessel call lists for Years 2019, 2025, 2030, 2035, 2040, 2045, and 2050,
3. Piloted Vessel Operational Rules, and
4. Traffic Simulator

Note that the economic evaluation of alternatives uses a base year of 2030.

Section 5: Economic Evaluation of Measures

Section 5 addresses the economic evaluation of measures, which is based on the comparison of total time in the system for vessels operating under without-project conditions and under with-project conditions. Vessel time in the system is monetized using hourly vessel operating costs that are based on vessel type, vessel size, and whether the vessel is at sea, at a dock, or at anchorage. The economic evaluation of measures includes an assessment of channel improvements implemented individually (i.e., not in combination with other improvements). Measures included in the preliminary economic evaluation include widening channel reaches and increasing anchorage capacity.

Section 6: Economic Evaluation of Alternative Plans

Section 6 addresses the economic evaluation of alternative plans that maximize net National Economic Development (NED) benefits, which was performed in three phases. Phase 1 identifies the net benefit maximizing plan that addresses the problem of daylight only transit restrictions. In the second phase, incremental widening is added to that plan to identify the widening plan that maximizes net benefits. In the third phase, incremental increases in Anchorage Basin No. 4 (AB4) vessel handling capacity are added to the net benefit widening plan to identify the NED Plan.

Construction costs used in the economic evaluation of alternative plans include costs for Preconstruction Engineering and Design, associated costs, construction management, contingency, and annualized maintenance costs as identified in the Engineering Appendix. Interest during construction is also included and has been calculated at the FY26 federal discount rate of 3.25 percent and at the OMB discount rate of 7 percent.

Section 7: Sensitivity Analysis

Section 7 provides a sensitivity analysis of the TSP under alternative economic assumptions, which include:

1. TSP at OMB discount rate (7.0 percent)
2. TSP with no change in fleet forecast after 2025 at FY26 discount rate (3.25 percent)
3. TSP with no change in fleet forecast after 2025 at OMB discount rate (7.0 percent)
4. TSP using vessel operating costs adjusted for the US Bureau of Labor Statistics Producer Price Index for Deep Sea Freight Transportation at the FY26 discount rate (3.25 percent).
5. TSP using vessel operating costs adjusted for the US Bureau of Labor Statistics Producer Price Index for Deep Sea Freight Transportation at OMB discount rate (7.0 percent)

The analyses shown in Section 7 show that the TSP is economically justified for every scenario considered.

2 Historic and Projected Commodity Tonnage

2.1 Historic Commodity Tonnages

The SNWW predominantly serves the energy and petrochemical industries that line the waterway from Sabine Pass to the Port of Beaumont. The SNWW is the largest foreign trade liquified petroleum and natural gas waterway in the nation and the second largest foreign trade crude oil waterway in the Nation (WCSC, 2025). Refiners along the waterway provide various fuel products to states in the mid-west and northeast via the Explorer Pipeline (660,000 barrels per day) terminating near Chicago, IL and the Colonial Pipeline (3,000,000 barrels per day) terminating outside of New York City in Linden, NJ.

Table 2-1 shows total tonnage along the waterway by commodity group from 2019 through 2023 (the last year of WCSC data available at the time of this writing). The crude oil, liquified petroleum and natural gas, and petroleum products groups combined account for nearly 90 percent of all tonnage on the waterway in each year. This sub-total excludes chemicals that are largely used to support the refining industry. The largest historical growth is exhibited by Liquified Gases that has increased due to an export Liquified Natural Gas (LNG) facility coming on-line at Sabine Pass and due to increases in Propane and Butane (aka Liquified Petroleum Gas (LPG)) exports.

Table 2-1
SNWW Cargo Tonnage 2019 – 2023
(thousands of short tons)

Cargo Type	2019	2020	2021	2022	2023
Chemicals & Chemical Products	15,544	14,276	14,944	15,405	15,757
Crude Petroleum	66,973	45,347	35,543	44,522	42,457
Liquified Gases	27,496	19,707	41,198	43,261	49,375
Petroleum Product	70,030	72,890	74,097	77,818	80,707
Raw Materials	7,672	8,683	4,834	4,225	4,035
Other	4,723	3,018	2,651	3,957	4,318
TOTAL	192,438	163,921	173,267	189,188	196,649
Foreign Trade	107,988	89,139	105,942	113,209	121,795
Domestic Trade	84,450	74,782	67,325	75,979	74,854
Foreign Trade %	56.1%	54.4%	61.1%	59.8%	61.9%

Source: WCSC

Table 2-2 presents domestic tonnage and Table 2-3 presents foreign trade tonnage. Table 2-4 and 2-5 presents total imports and exports to and from the waterway from 2019 through 2023. Crude oil imports have fallen by 58 percent during this time largely due to the increase in production and availability of domestic crude oil that arrives at the refineries along the SNWW via pipeline and rail. Crude oil exports have increased more than 10-fold during this time due to

Congress rescinding the ban on U.S. crude oil exports to countries other than Canada. Crude oil export tonnage from the SNWW has increased from being less than 10 percent of crude oil import tonnage to being 176 percent of crude oil import tonnage in 2019.

Table 2-2
SNWW Domestic Trade Tonnage 2019 – 2023
(thousands of short tons)

Cargo Type	2019	2020	2021	2022	2023
Chemicals & Chemical Products	11,519	12,039	12,811	12,125	12,316
Crude Petroleum	17,717	11,096	7,733	12,608	9,023
Liquified Gases	916	955	652	496	538
Petroleum Product	46,458	42,815	41,344	45,787	47,397
Raw Materials	4,585	5,253	2,570	1,967	1,650
Other	3,255	2,623	2,215	2,996	3,931
Total	84,450	74,782	67,325	75,979	74,854

Table 2-3
SNWW Foreign Trade Tonnage 2019 – 2023
(thousands of short tons)

Cargo Type	2019	2020	2021	2022	2023
Chemicals & Chemical Products	4,025	2,237	2,133	3,280	3,440
Crude Petroleum	49,256	34,251	27,810	31,914	33,434
Liquified Gases	26,580	18,752	40,546	42,765	48,838
Petroleum Product	23,571	30,075	32,753	32,031	33,310
Raw Materials	3,086	3,430	2,264	2,258	2,385
Other	1,469	394	437	961	387
Total	107,988	89,139	105,942	113,209	121,795

The movement of domestic cargo along the waterway (Table 2-2) and the level of import tonnage (Table 2-4) have remained relatively constant from 2019 through 2023 as compared to the 13% increase in exports exhibited during the same time. The increase in exports is largely due to the 84% increase in liquified gas exports and the 41% increase in petroleum product exports between 2019 and 2023. The increase in liquified gas and petroleum product exports is somewhat offset by the 37% decrease in crude oil exports (Table 2-5).

Table 2-4
SNWW Import Tonnage 2019 – 2023
(thousands of short tons)

Cargo Type	2019	2020	2021	2022	2023
Chemicals & Chemical Products	337	517	336	533	798
Crude Petroleum	17,876	17,064	14,195	16,834	18,623
Liquified Gases	-	-	-	-	-
Petroleum Product	2,398	3,012	5,817	4,534	4,876
Raw Materials	2,463	2,724	1,724	1,437	1,408
Other	355	226	306	429	298
Total	23,429	23,543	22,377	23,767	26,003

Table 2-5
SNWW Export Tonnage 2019 – 2023
(thousands of short tons)

Cargo Type	2019	2020	2021	2022	2023
Chemicals & Chemical Products	3,688	1,720	1,797	2,747	2,642
Crude Petroleum	31,380	17,188	13,615	15,080	14,811
Liquified Gases	26,580	18,752	40,546	42,765	48,838
Petroleum Product	21,173	27,063	26,936	27,496	28,435
Raw Materials	624	706	540	821	977
Other	1,114	168	131	532	89
Total	84,559	65,597	83,565	89,441	95,791

2.2 Commodity Forecast

The commodity forecast is identical for both with- and without-project conditions and is based on observed 2019 commodity tonnage and characteristics. Projected future commodity flow is based on two references:

- Terminal-specific improvements (provided under non-disclosure agreements) and associated increases in vessel traffic and commodity tonnage, if any, as described by terminal operators, and
- U.S. Energy Information Administration (EIA) Annual Energy Outlook 2021 (AEO) projections for imports and exports of crude petroleum and petroleum products. The AEO explores potential long-term energy trends in the United States. AEO is published in accordance with Section 205c of the Department of Energy Organization Act of 1977 (Public Law 95-91), which requires the Administrator of the U.S. Energy Information Administration (EIA) to prepare

an annual report that contains trends and projections of energy consumption and supply. These projections are used by federal, state, and local governments; industry; trade associations; and other planners and decisionmakers in the public and private sectors.

Cargo not related to crude oil, petroleum products, LPG, or LNG were held at 2019 tonnages throughout the analysis. After an LNG terminal begins operations, tonnage estimates are held constant throughout the analysis and are not subject to EIA growth estimates. Note that the EIA growth rates are not always positive and that the EIA projects very little growth after 2025 (Table 2-6).

Table 2-6
U.S. Energy Information Growth Rates (5-Year Increments)

	2025	2030	2035	2040	2045	2050
Crude Oil Gross Imports	4.47%	-1.62%	0.06%	1.40%	-0.57%	0.99%
Crude Oil Exports	0.67%	-1.23%	0.77%	-0.30%	-0.88%	0.39%
Gross Refined Product Imports	-8.09%	2.86%	-0.20%	0.51%	0.69%	-0.29%
Refined Product Exports	7.89%	0.44%	-0.92%	-0.45%	-0.87%	-1.51%

Source: Annual Energy Outlook, February 2021, Table 11

The commodity forecast was developed in five-year increments beginning in 2025 running through 2050. After 2050, commodity tonnage is assumed to remain at the 2050 level. The 2025 commodity forecast is a combination of the observed 2019 commodity tonnage adjusted by the EIA growth rates and the effects of planned terminal improvements including operation of the Golden Pass LNG Terminal. Commodity tonnage associated with these improvements was provided by the terminal operators. The 2030 commodity forecast was developed by applying the appropriate EIA growth rates to the 2025 forecast and includes the projected tonnage for the Port Arthur LNG Terminal (Phase I only). The 2035 commodity forecast was developed by applying the appropriate EIA growth rates to the 2030 forecast. The 2040, 2045, and 2050 commodity forecasts were similarly created by applying the appropriate EIA growth rate to the previous 5-year incremental forecast.

Table 2-7 shows the EIA national tonnage forecast to indicate a sense of scale of the tonnage projected for the SNWW. Table 2-8 presents the SNWW commodity forecast used in this analysis, and Table 2-9 shows the 5-year incremental change in commodity tonnages used in this analysis.

Table 2-7
National Tonnages for Select 2021 AEO Commodities
(thousands of metric tons)

Commodity	2025	2030	2035	2040	2045	2050
Crude Oil Gross Imports	379,651	349,928	351,032	376,385	365,867	384,383
Crude Oil Exports	158,383	148,878	154,664	152,395	145,814	148,684
Gross Refined Product Imports	28,770	33,132	32,809	33,653	34,830	34,330
Refined Product Exports	336,631	344,136	328,527	321,203	307,423	284,969

Calculated from 2021 Annual Energy Outlook (February 2021)

Table 2-8
Sabine-Neches Waterway Commodity Tonnages Used in Traffic Model
(thousands of metric tons)

Commodity	2025	2030	2035	2040	2045	2050
Crude Oil Imports	22,124	20,180	19,974	20,653	20,760	21,037
Crude Oil Exports	47,384	45,337	45,535	44,334	42,572	42,657
LNG (Export)	43,913	65,657	65,657	65,657	65,657	65,657
LPG (Export)	18,813	18,920	18,828	18,673	18,601	18,469
Product & Related Imports	2,559	1,978	2,112	2,483	2,617	2,731
Product & Related Export	39,904	40,808	39,149	37,935	36,991	35,955
Not Oil &Gas Related	4,268	4,266	4,266	4,266	4,266	4,266
Total	**178,965**	**197,146**	**195,521**	**194,002**	**191,464**	**190,773**

Table 2-9
Five-Year Change in Sabine-Neches Waterway Commodity Tonnages
(thousands of metric tons)

Commodity	2025	2030	2035	2040	2045	2050
Crude Oil Imports	2,211	-1,944	-207	679	108	277
Crude Oil Exports	16,419	-2,048	199	-1,201	-1,763	86
LNG (Export)	20,990	21,744	0	0	0	0
LPG (Export)	13,731	107	-93	-155	-73	-131
Product & Related Imports	-930	-580	134	371	134	113
Product & Related Export	10,154	904	-1,659	-1,214	-944	-1,037
Not Oil &Gas Related	1	-2	0	0	0	0
Total	62,576	18,181	-1,625	-1,519	-2,538	-692

2025 represents a six -year growth rate from 2019 to 2025

3 Waterway Vessel Call Lists

3.1 Existing Fleet

The existing fleet calling at SNWW terminals is comprised of a deep draft fleet engaged in foreign trade and domestic coastwise trade, and a shallow draft fleet that consists mainly of barge tows that use the GIWW to enter and exit the SNWW. Barge tow configurations range from a single barge 195 feet long by 35 feet wide to a four-barge configuration (two barges wide) 1,069 feet long by 108 feet wide. Much of the barge traffic along the portion of the GIWW shared with the SNWW is through-traffic.

Table 3-1 shows the number of trips by vessel operating draft category along the SNWW from 2019 through 2023 (WCSC, 2025). Note that a trip may be either inbound or outbound. A vessel call includes both the inbound and outbound trips. A twelve-foot operating draft was used to differentiate between deep draft and shallow draft vessels because the GIWW has a depth of -12 feet before and after it co-locates with the SNWW. Approximately 90 percent of traffic along the SNWW is shallow draft traffic, ranging from 53,000 to 67,000 trips per year. Deep draft vessel trips have ranged from 4,600 to 6,200 per year from 2019 through 2023. In 2023, there were an average of 167 trips along the Waterway per day (365 operating days per year) with 167 trips per day by shallow draft vessels and 17 trips per day by deep draft vessels.

Table 3-1
Waterway Vessel Trips 2019 – 2023

Vessel Draft	2019	2020	2021	2022	2023
Less than or equal to 12 feet	67,495	56,115	48,696	53,401	54,765
More than 12 feet	5,867	4,642	5,107	5,894	6,225
Total Trips	73,362	60,757	53,803	59,295	60,990
Percent Less than or equal to 12 feet	92%	92%	91%	90%	90%
Percent More than 12 feet	8%	8%	9%	10%	10%

Source: WCSC

Deep draft vessels that used the SNWW in 2019 were the basis for categorizing individual vessels into vessel classes based on vessel dimensions and commonly used vessel categories. Deadweight tonnage, length overall, and beam for each deep draft vessel observed using the SNWW in 2019 was obtained from Lloyd's List Intelligence. The average dimensions for each vessel class are shown in Table 3-2.

Table 3-2
Waterway Vessel Class Average Dimensions 2019

Vessel Class	Deadweight Tons	Length Overall (ft)	Beam (ft)
Aframax Tanker	109,202	804	140
Aframax Bulk	50,034	635	119
Articulated Tug Barge	21,175	477	74
Handy Bulk	28,082	551	86
Handy Tanker	19,572	473	76
LNG	89,183	955	149
Long RORO	43,872	888	106
LPG	50,180	717	114
Panamax Tanker	50,162	612	106
Panamax Bulk	55,712	648	105
Panamax RoRo	21,037	653	106
Suezmax Tanker	157,223	900	158

Table 3-3 shows additional detail for deep draft vessels that used the SNWW in 2019. The data indicate that 69 percent (4,010) of vessel transits through the SNWW are to terminals on the Neches River or Sabine Neches Canal reaches. Vessels destined for or departing from terminals on the Neches River or Sabine Neches Canal must pass through the Sabine Neches Canal that is co-located with the GIWW. The combination of more than 4,000 deep draft vessel trips and 62,000 shallow draft vessel trips through the same 400-foot-wide navigation channel ensures frequent meeting of deep draft and shallow draft vessels in this reach.

Table 3-3
Vessel Class Trips by Terminal Location 2019

	Terminal Locations				
Vessel Class	**Neches River Channel**	**Sabine Neches Canal**	**Sabine Pass**	**Taylor Bayou**	**Total**
Aframax Tanker	954	0	0	144	1,098
Aframax Bulk	14	0	0	0	14
Articulated Tug Barge	314	34	0	308	656
Handy Bulk	236	112	0	126	474
Handy Tanker	254	6	0	98	358
LNG	0	0	672	0	672
Long RORO	6	2	0	0	8
LPG	272	0	0	0	272
Panamax Tanker	1,018	238	0	356	1,612
Panamax Bulk	120	176	0	78	374
Panamax RoRo	66	6	0	0	72
Suezmax Tanker	182	0	0	16	198
Total	**3,436**	**574**	**672**	**1,126**	**5,808**

3.2 Fleet Forecast

The fleet observed in 2019 is the basis for the fleet forecast and is referred to as the "baseline fleet" for the remainder of this document. The first year of the fleet forecast is 2025. In the 2025 fleet forecast, future increases (or decreases) in commodity tonnage, as projected by the EIA in the 2021 AEO, were distributed to the baseline fleet on a vessel-by-vessel basis for crude oil and petroleum products. The amount of projected tonnage added to any vessel is constrained by the vessel's tonnage capacity, design draft, and operating draft in a -48-foot channel (-44-foot channel for 2025). The vessel's tonnage capacity is a function of the vessel's deadweight tonnage adjusted for bunkers and stores, immersion rate, vessel design draft, and the vessel's tank volumetric capacity. All vessel dimensions and characteristics were sourced from Lloyd's List Intelligence Seasearcher website.

If the observed baseline tonnage on the vessel plus the EIA projected increase in tonnage:

- is less than or equal to the vessel's adjusted deadweight tonnage capacity, ***and***
- the cubic volume of the projected total tonnage of the vessel is less than or equal to the tank's volumetric capacity, ***and***

- the resulting vessel draft is less than or equal to the vessel's design draft, ***and***
- the resulting vessel draft is less than or equal to the depth (-44 feet for 2025, -48 feet for 2030 and later years)

The EIA projected increase in tonnage was added to the vessel.

Vessel deadweight tonnage was adjusted to account for the deadweight tonnage that must be allocated to stores and bunkers. The percentages of deadweight tonnage allocated to stores and bunkers is derived from a USACE analysis of the world tanker fleet performed for 2014 Port Everglades Harbor Feasibility Study. Vessel deadweight tonnage was adjusted by allocating eight percent of the vessel's listed deadweight tonnage to stores and by allocating an additional 2.7 percent of the vessel's listed deadweight tonnage to bunkers. The cubic volume of the projected total tonnage was based on the metric tons per cubic meter conversion for the commodity type. The resulting vessel draft was based on the vessel's immersion rate, the amount of additional tonnage, and the vessel's operating draft observed in the baseline year (2019).

When additional tonnage allocated to a vessel exceeded the vessel's capacity based on any of the constraints listed above, only the tonnage up to the constrained capacity was added to that vessel and any remaining tonnage was reallocated to another vessel. The tonnage was reallocated only to a vessel that had available capacity after being loaded with its forecasted additional tonnage.

Vessels receiving the reallocated tonnage were selected based on the following hierarchy: same commodity, same dock, same vessel type as the "overflow" vessel. The low growth rates and the variety of vessel loads observed in the baseline year allowed the EIA-based commodity growth to be added to the baseline fleet without the need for adding additional vessel calls to the baseline fleet calls. The only vessel calls added to the baseline fleet calls were additional vessel calls needed to move the additional cargo resulting from planned terminal improvements.

All vessel calls added due to individual terminal improvements were also based on the observed baseline vessel call list so that added vessels matched physical and operational characteristics of vessels that called at the terminal in the baseline year. The baseline vessel call list, because it displays the actual date and time of arrival, identifies the scheduling patterns for each terminal and dock. All added vessel calls were inserted into future-year vessel call lists with arrival dates that mesh with the observed baseline vessel arrivals to avoid schedule conflicts. In future year vessel call lists (i.e., 2025 to 2050 in five-year increments), the time of arrival at the sea buoy is randomized by adding a randomly selected amount of time between 0 and 12 hours. Table 3-4 shows the number of vessel calls by vessel class for the baseline and each modeled year. Note that the vessel call list does not change after 2030 because planned improvements are projected to be completed by that time and there is very little change in commodity tonnages as presented in Tables 2-7 and 2-8.

In addition, vessels in future year vessel call lists have a choice of docks that may be used at each terminal (but not a choice of terminal). Dock choice sets range from one to four docks depending on terminal, commodity type, and vessel type.

Table 3-4
Vessel Calls by Vessel Class for Baseline and Modeled Years

	2019 Baseline	2025	2030	2035	2040	2045	2050
Aframax Tanker	549	595	595	595	595	595	595
Aframax Bulk	7	7	7	7	7	7	7
ATB	328	326	326	326	326	326	326
Handy Bulk	237	237	237	237	237	237	237
Handy Tanker	179	178	178	178	178	178	178
LNG	336	643	961	961	961	961	961
Long RORO	4	4	4	4	4	4	4
LPG	136	420	420	420	420	420	420
Panamax Tanker	806	1,008	1,008	1,008	1,008	1,008	1,008
Panamax Bulk	187	187	187	187	187	187	187
Pmax RoRo	36	36	36	36	36	36	36
Suezmax	99	245	245	245	245	245	245
TOTAL	**2,904**	**3,886**	**4,204**	**4,204**	**4,204**	**4,204**	**4,204**

4 Analytical Framework

The Sabine Neches Traffic Simulation Model (Traffic Model) was developed to evaluate how different channel widths along select reaches would reduce SNWW congestion delays. For each analysis year, the Traffic Model simulates a full year of deep draft vessel traffic flow to evaluate the effects of various conditions on all vessels' time in the system, including time waiting to enter the channel and time waiting to leave the dock. Simulations for different analysis years reflect projected future traffic, tonnage, and terminal configurations for that year.

Projected future channel width dimensions are characterized as either without-widening or with-widening conditions. Under without-widening conditions, the dimensions of the waterway channels include the Deepening Project's phased construction: 44-foot depth in 2025 and 48-foot depth in 2030 and future years. The without-widening condition is the reference against which alternative improvements are compared. With-widening conditions include widening the channel to varying widths at multiple locations.

The Traffic Model evaluates projections of traffic flow along the waterway at five-year intervals from 2025 to 2050 to determine impacts of future commodity and fleet distributions on projected future vessel traffic. Model output is used to evaluate traffic flow under alternative future channel width conditions to identify opportunities for potential traffic flow improvements.

The Traffic Model consists of four key components:

- Waterway geographic configuration,

- Vessel call lists for Years 2019, 2025, 2030, 2035, 2040, 2045, and 2050,
- Piloted Vessel Operational Rules, and
- Traffic Simulator

The geographic configuration includes detailed data that describe the entire federal navigation channel and associated terminals, docks, turning areas and anchorages. Vessel call lists (see Section 3) include all deep draft traffic, including articulated tug-barges (ATBs). The waterway geographic configuration and vessel call lists are based on historical and projected data.

The Traffic Model contains logic that reflects alternative traffic rules, resource availability, operating procedures, and operating conditions such as daytime/nighttime and weather. Each vessel's total time within the simulated Waterway is calculated and includes time spent waiting to enter the federal channel from the sea, time spent working at the dock, time spent waiting to leave the dock, time at anchorage, and time spent delayed by weather.

Outputs are aggregated for the entire waterway to avoid the risk of violating any confidentiality agreements. That said, the simulation output for with-widening and without-widening conditions are available for every vessel in the call lists for each modeled year, and can be displayed and analyzed by terminal, dock, and vessel type.

4.1 Waterway Geographic Configuration

The geographic representation of the waterway and associated port facilities was mapped using GIS software and consists of channels, docks, turning areas, and anchorages.

4.1.1 Navigation Channels

The federal navigation channel is measured in feet from the entrance in the Gulf of America to the Neches River upstream of the Port of Beaumont, including a fork allowing access into Taylor Bayou. In 2019 model runs, channel depth is -40 feet and the beginning of the federal channel is located at the current location of the Sabine Sea Buoy (model-foot-marker 69,695); however, channel deepening will move the entrance more than 13 miles farther offshore to reach deep water.

4.1.2 Channel Depths

Model runs for 2025 include a 44-foot channel depth (based on completion of the first pass of Deepening Project construction), therefore the channel entrance begins at model-foot-marker 34,847.5. Model runs for 2030 and future years include a 48-foot channel depth, with the channel entrance beginning at model-foot-marker 0. Federal anchorage depths are equivalent to channel depths in all modeled years.

4.1.3 Channel Widths

Channel widths are a variable parameter of the model. Future without-widening condition channel widths are equivalent to existing condition channel widths, with the exception of the SabineBank Channel that will be reduced from 800 feet to 700 feet as a part of the Deepening Project. Future with-widening channel widths can be varied in alternative model runs to assess the effects on traffic flow. The length and location of widened reaches are also variable within the model.

4.1.4 Terminals, Docks, Turning Areas, and Anchorages

The geographic distribution of terminals, turning areas, and anchorages are inter-related. Figures 4-1, 4-2, and 4-3 show each.

4.1.4.1 Terminals

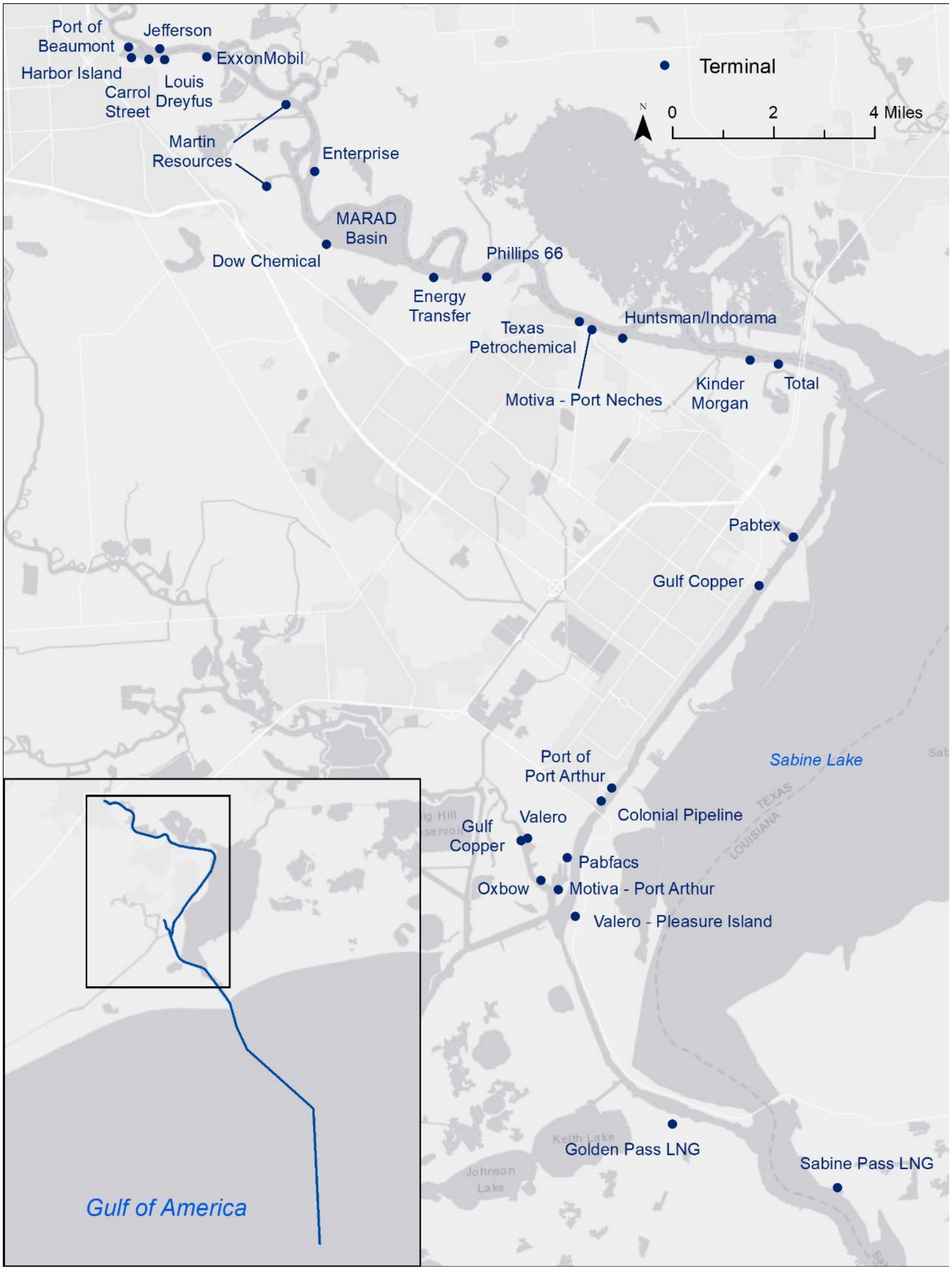
There are 28 existing commercial terminals along the waterway capable of mooring deep draft vessels (Figure 4-1). There are also two Liquefied Natural Gas (LNG) export terminals under construction on the Port Arthur Canal (Sempra LNG and Golden Pass LNG). Three of the nation's ten largest refineries (Motiva, ExxonMobil, and Valero), and the nation's largest crude oil terminal (Nederland Terminal) are located on the Waterway. The Port of Beaumont is the largest commercial military outload port in the nation. The ready reserve fleet at the U.S. Maritime Administration (MARAD) basin on the Neches River is the largest in the nation. Terminals on the Waterway have access to 57 percent of the nation's Strategic Petroleum Reserve.

Future improvements identified by terminal operators include construction of new terminals, construction of additional docks at existing terminals, new pipeline connections to domestic production facilities, and increased storage facilities. Refiners at two facilities are also substantially increasing refining capacity. Future conditions terminal facilities include all terminals identified under existing conditions plus the following improvements.

The Golden Pass LNG Terminal on the Port Arthur Ship Channel is under construction and scheduled to start operations in late 2025. The facility will produce 16 million tons of LNG annually for export with a permit request to increase capacity to 18 million tons annually.

- Phase I of the Port Arthur LNG Terminal is under construction and is projected to begin exporting LNG in 2027. Phase II of the Port Arthur LNG project would produce an additional 13.5 million tons of LNG annually for export by 2030.
- Three crude oil terminals along the Waterway have been issued permits to construct five new docks, each capable of handling Suezmax tankers.
- Two crude oil terminals are adding new pipeline services to increase their crude oil export capacities, and two terminals are adding storage capacity to support increased exports.
- The Valero refinery at Port Arthur is currently increasing capacity by more than 30,000 barrels per day with the construction of its green diesel production facility.
- The ExxonMobil refinery complex in Beaumont became the largest refinery complex in the nation (more than 600,000 barrels per day) with the 2023 completion of its BLADE project.

Figure 4-1
Sabine-Neches Waterway Deep Draft Terminal Locations



4.1.4.2 Docks

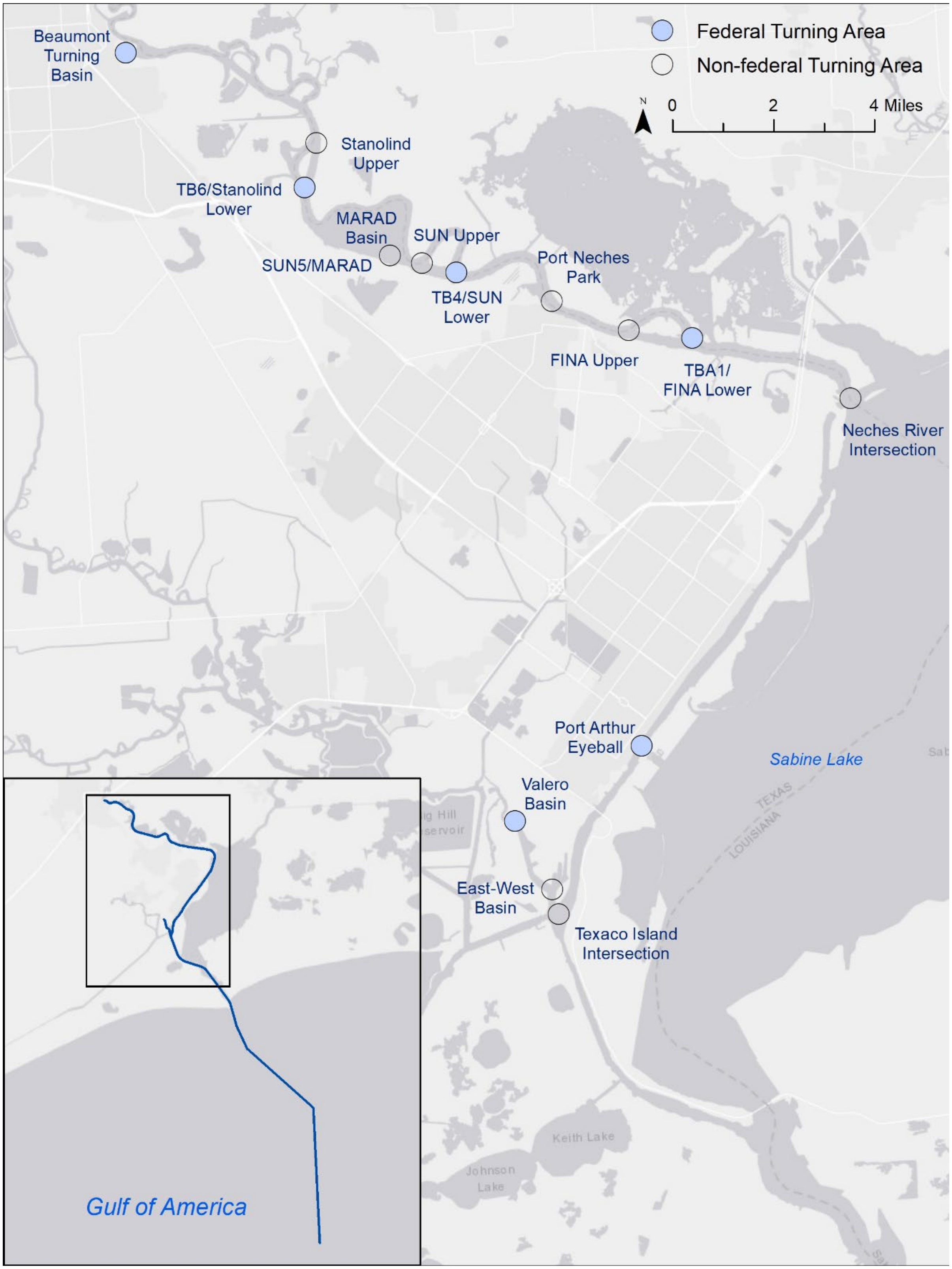
Terminal operators on the Waterway use one or more docks to service deep draft vessels and barges. Dock properties used in this analysis include dock name, route, and model-foot-marker (distance from the channel entrance in the Gulf of America). Each dock is situated at a unique location within the waterway in the Traffic Model. Additional dock characteristics include the vessel type and commodity type(s) accommodated at the dock and commodity transfer rate. Commodity tonnage and transfer rate are used to determine the work-time duration of a dock visit within the vessel call list. Dock depth is identical to the adjacent channel depth.

Terminal operators provided information on current and projected future use of their docks, including projected dock modification and future dock construction. In addition, Transportation Model output for future years was analyzed for docks with exceptionally high utilization that were causing unacceptably long delays. At some terminals, an additional dock was included in a vessel's choice set (either as modification of underutilized existing docks to accommodate additional vessel types or as construction of a new dock adjacent to or near to existing terminal facilities) to reduce vessel delays attributable to exceptionally high dock utilization rates. This adjustment was made to better reflect likely future conditions.

4.1.4.3 Turning Areas

Turning areas in the Waterway (Figure 4-2) are used to turn vessels in light-loaded or ballast conditions (i.e., export vessels on the inbound trip, and import vessels on the outbound trip) as is standard operating procedure on the waterway. There are 14 turning areas, including six federal turning areas and eight non-federal turning areas. Turning area characteristics include name, route, and model-foot- marker. In addition, the maximum vessel length and maximum vessel deadweight tonnage are properties assigned to each turning area used to determine whether a vessel may use a turning area. Turning area depth is coincident with channel depth. Dock-turning area associations for each SNWW terminal were verified with the Sabine Pilots Association (SPA).

Figure 4-2
SNWW Federal Turning Basins and Turning Areas



4.1.4.4 Anchorages

The Traffic Model includes seven anchorages in the Waterway (Figure 4-3), all of which are found in the Neches River. Anchorage characteristics include name, route, model-foot-marker, and controlling draft, such that only those vessels with a current draft less than or equal to the controlling draft may use the anchorage.

In-bound vessels may go to an anchorage and wait for their dock to be vacated. This practice occurs regularly on the waterway and allows vessels to avoid being impacted by the daylight restrictions (discussed in Section 4.2.1). Vessels do not typically move from a dock to an anchorage for the purpose of freeing up the dock for another vessel. Doing so may be advantageous to the terminal operator, but it is expensive for the vessel because it creates two separate vessels movements each requiring tugs and pilots. The minimum time at anchorage is assumed to be four hours, based on an examination of VTS anchorage data.

Under existing conditions there are no federally maintained anchorages in the Waterway, though there are five privately maintained anchorages of varying depth. Some in-bound vessels go to an anchorage to wait for an appropriate dock to be vacated. This practice occurs regularly on the waterway and allows vessels to avoid being impacted by the daylight restrictions imposed on larger vessels (see Section 4.2).

The addition of federally maintained anchorages (currently being constructed as part of the Deepening Project) is projected to provide some vessels the opportunity to avoid delays imposed by the daylight restrictions. The additional anchorages will allow some daylight-restricted vessels to transit the Sabine Neches Canal and Neches River during the day, sit at anchorage while waiting for its assigned dock to be vacated, and transit to its assigned dock without being subject to the daylight restriction as allowed by the SPA’s vessel operating protocols.

4.2 Piloted Vessel Operational Rules

Piloted vessel operations were analyzed with cooperation from terminal operators, the Sabine Pilots Association (SPA), the Gulf Intracoastal Canal Association, and U.S. Coast Guard Vessel Traffic System operating personnel. Important vessel operation attributes include turning area usage, Pilot Ship Traffic Operating Protocol, anchorage usage, and weather.

4.2.1 Daylight Restrictions

According to the SPA’s operations protocol, vessel movement within the Waterway is currently restricted to daylight-only for certain vessels moving above Texaco Island (i.e., vessels transiting the Sabine Neches Canal and the Neches River). If the vessel has a deadweight tonnage greater than 85,000, a length overall of 875 feet or greater, or a beam of 125 feet or greater (i.e., Aframax and Suezmax vessels), then the vessel is restricted to daylight-only transits. In 2019 about 1,200 deep draft vessel trips were subject to daylight-only restrictions.

The daylight restriction is imposed on large vessels to accommodate the constant flow of barge tow traffic on the Sabine Neches Canal and the Neches River. The SPA considers it unsafe to meet large vessels and barge tow traffic at night in the Sabine Neches Canal and the Neches River because of nighttime impacts to the visual perception needed to maintain safe distances between the large vessel, the barge tow, and the edge of the channel. Despite the use of flood lights, GPS,

Figure 4-3
SNWW Federal Anchorage Basins and Non-federal Anchorage Areas

and computerized navigational aids, the 400-foot channel width is insufficient for safe nighttime meeting of large vessels and barge tow traffic. During daylight, when visual perception is not impacted, the meeting of large vessels and barge tow traffic is a regular occurrence on the waterway.

SPA operations protocols permit moving a daylight-restricted vessel between docks and nearby anchorages at night, such that vessels below Neches River Beacon 26A may move to another point on the Neches River below Beacon 26A and vessels above Beacon 26A may move to another point above Beacon 26A, but not above the Stanolind Anchorage (Figure 4-3).

4.2.2 Vessel Meeting Restrictions

The meeting of two vessels on the SNWW is determined by the SPA's assessment of channel dimensions at the location of the predicted meeting and the characteristics of both vessels. For the meeting to be permitted, the following SPA operations protocols must be satisfied:

1. Vessels with a combined beam that equals or exceeds ½ the channel width will not meet day or night.
2. Vessels 85,000 DWT or more will not meet vessels of either 30,000 DWT or more, or 25- foot draft or more above Texaco Island intersection.
3. Vessels 85,000 DWT or more will not meet vessels of 30,000 DWT or more with a draft of 30 feet or more, above buoys 29 and 30.
4. Vessels 48,000 DWT or more with a draft of 30 feet or more will not meet above buoys 29 and 30.
5. Vessels with a combined draft of 70 feet or more will not meet between the Neches River intersection and daybeacon #40 (Smith's Bluff) at night.
6. Vessels with a combined draft of 65 feet or more will not meet above daybeacon #40 at night.

Figure 4-4 shows locations relevant to daylight restrictions and meeting area restrictions.

4.2.3 Future SPA Operating Protocol

Per discussions with SPA, existing vessel operating protocols will remain in effect. It is important to note that vessel operating restrictions employed by the SPA are largely a function of vessel displacement and maneuverability within the confines of the narrow channels. Deepening the channel to -48 feet and the corresponding deeper operating draft of vessels sailing in the same narrow channel does not relieve the difficulties of maneuvering vessels when meeting in the channel. Daylight restrictions would remain in effect under without-project conditions, as well.

Future SNWW operations are based on a depth of -44 feet (-46 feet offshore) throughout the waterway in 2025. A depth of -48 feet (-50 feet offshore) is assumed to be available in 2030. Terminal improvements identified in this analysis, except construction of the two new LNG facilities, are short-term projects that were identified in 2020 and verified in 2021. Short- term terminal improvements and construction of the Golden Pass LNG Terminal are projected to be fully operational by 2025. The first phase of the Port Arthur LNG facility is projected to be operational by 2030. The Port Arthur Phase II improvements are not included in this analysis because these improvements were only in the conceptual stage at the time of this analysis.

Figure 4-4
Navigation Restrictions Reference Locations

Traffic Simulator

The Sabine Neches Traffic Simulator (Traffic Simulator) is a configurable engine for processing the vessels and cargo in a vessel call list through the navigation channel, docks, turning areas, and anchorages in the SNWW according to the SPA navigation rules (See Section 4.2). The Traffic Simulator is specifically designed to emulate deep draft vessel operations of the SNWW and is not directly applicable to other ports.

For each analysis year (i.e., 2025, 2030, 2035, 2040, 2045, and 2050), the vessel call list for that year is used to provide the day and time the vessel arrives "over the horizon" at the waterway, number and order of docks to be visited, working duration of each dock visit (including total time for docking, commodity transfer – based on the vessel's cargo volume and dock productivity , and undocking), and turning area(s) to be used. Anchorage use is opportunistic according to anchorage availability and is not scripted by the vessel call list. An arriving vessel will use an anchorage if using the anchorage allows the arriving vessel to avoid being delayed by the daylight restriction. Note that SPA will move an otherwise daylight restricted vessel from the anchorage to a nearby dock at night.

4.2.4 Timestep

The Traffic Simulator implements a time series used to track vessel movements through the waterway over the simulation duration. The fundamental unit of time is the timestep, a configurable value measured in integer minutes. The model timestep used throughout the analyses presented here is 10 minutes, such that all vessels and associated navigation conditions are assessed in 10-minute intervals throughout the full simulation duration.

4.2.5 Simulation Duration

Each model simulation has a begin date and an end date, as defined by a starting date and the number of minutes to simulate. The model analysis period begins January 1 at 00:00 and a duration of 525,600 minutes (one year); however, to avoid model simulations beginning with empty terminals, an additional two months of model simulation (November and December of the previous year) are used to simulate a fully waterway at the time of model initiation. As such, the full simulation duration is typically 613,440 minutes, but all analyses of model output are restricted to only one year (January 1 through December 31).

4.2.6 Channel Entrance

A vessel transit begins when a vessel "arrives" at the channel start location according to the arrival time provided in the vessel call list; however, given the traffic and weather conditions in the waterway at the arrival time, the vessel may be required to wait at sea before entering. Waiting at sea is a common occurrence and there are multiple offshore areas where a vessel may wait at sea. Neither the vessel call list nor the Traffic Simulator designates where the vessel might wait.

4.2.7 Channel Widths

Channel widths are a part of the port configuration for the Traffic Simulator run; however, the existing channel width may be overridden within the Traffic Simulator to create with-widening conditions, such that one or more reaches of the waterway is modified according to project alternatives within the simulation.

4.2.8 Weather Delays

Weather-induced delays due to fog or high seas are a common occurrence during the winter months on the SNWW, and are implemented in the model so that all vessels in motion or attempting a move (entering the waterway, departing a dock, or departing an anchorage) are held in their present position and may not move again until the end of the weather delay. During a weather delay, vessels transferring cargo or bunkering when the weather delay begins continue those operations unimpeded (i.e., vessels at dock continue to accrue dock working time associated with commodity transfer and vessels at anchorage continue to accrue anchorage time associated with bunkering). Once a weather delay has elapsed, vessels in motion prior to the delay continue their movements through the waterway.

Weather delay data covering the 13-year period of 1 January 2007 through 31 December 2019 were obtained from the SPA. The data include a description of whether the channel was closed or open, the date and time the event began, the type of event (fog, high seas, etc.) and the time and date the event ended. A statistically equivalent synthetic year of weather events was developed from these data, and mirrors the 13-year period's median frequency of events per year and median frequency of events per month.

4.2.9 Pilot Availability

The number of pilots used by a vessel depends on vessel type and dimensions. Two pilots are used when piloting a vessel with a beam 120 feet or more or a length over all of 860 feet or more. All other deep draft vessels use one pilot. Pilots are assumed to be available for deployment when the vessel is ready to be underway, as such, the time it takes for a pilot to arrive at a vessel is not considered in the Traffic Simulator. The Traffic Simulator tracks the number of pilots used at every timestep and can constrain the total number of pilots available for use. When pilots are constrained, vessels must wait at dock or at sea until the appropriate number of pilots are available.

4.2.10 Tug Availability

The number and type of tugs (pusher tugs vs tractor tugs) used to guide deep draft vessels through the channel and at turning areas and docks varies with vessel characteristics and location within the channel. The Traffic Simulator tracks the number and type of tugs used at each timestep. Terminals with dedicated tugs are not considered when tracking tug usage. Tugs are used in the following situations:

- Two tugs are used during the 15 minutes prior to turning;
- Two tugs are used during turning;

- Two tugs are used during the first 60 minutes of dock time during the mooring process;
- Two tugs are used during the first 40 minutes of the unmooring process;
- One tug is used to accompany inbound and outbound Aframax and Suexmax vessels transiting the channel above Texaco Island;
- Loaded vessels mooring at Pleasure Island Dock use three tugs.

The time it takes for a tug to arrive from a different location within the channel is not considered in the Traffic Simulator. The number and type of tugs available during a simulation run can be constrained. Unless constrained, the appropriate number and type of tugs are assumed to be available for use during the timestep when and where they are required. When tugs are constrained, vessels must wait at dock until the appropriate number and type of tugs are available. Inbound vessels arriving from the sea are not affected by the number of available tugs.

4.2.11 Daylight Restrictions

As described in Section 4.2.1 above, there are daylight-only restrictions on vessel movement within the SNWW for vessels moving above Texaco Island if the vessels have a deadweight tonnage greater than 85,000, have a length overall of 875 feet or greater, or have a beam of 125 feet or greater (i.e., Aframax and Suezmax vessels). The Traffic Simulator determines whether it is daylight by accessing astronomical tables for Port Arthur, TX. Dawn and dusk times vary throughout the year and according to the definition of daylight used, with the determination of the daylight status occurring at each 10-minute timestep.

4.2.12 Vessel Meetings

Before initiating a vessel movement, the Traffic Simulator determines if the vessel attempting to move will encounter another moving vessel within the SNWW. If an oncoming vessel will be met, the channel dimensions at location of the predicted meeting and the characteristics of both vessels are used to determine if the meeting will be permitted according to the SPA rules described in Section 4.2.2 above.

All SPA meeting rules involving vessel drafts are unmodified in future conditions, despite additional channel depth. This is in accordance with consultation with SPA who advised that a reasonable additional draft allowance cannot be assessed at this time and that a conservative assumption is that no additional draft for vessel meetings would be granted.

4.2.13 Dock Assignment and Use

The vessel destination within the SNWW is at a terminal; however, for some vessel and cargo types as many as three different docks at a terminal (the dock choice set) may be plausibly used by the vessel. The actual dock to be used by the vessel is determined dynamically when the vessel meets the Traffic Simulator requirements to transit the waterway to the dock, either entering from the sea or leaving an anchorage and subsequently arriving at dock.

4.2.14 Turning Area Use

All vessels entering the SNWW must turn around at some point in their voyage in a turning area in order to exit the SNWW (see Figure 4-2). Loaded vessels arrive at dock in a "head in" orientation (will turn after visiting the dock) and light loaded vessels arrive at dock in a "head out" orientation (turns before visiting the dock). Light loaded vessels turn in the nearest upstream turning area capable of facilitating the overall length of the vessel. Vessels occupy the turning area for thirteen minutes based on the average turning time identified by SPA.

4.2.15 Bunkering

Analysis of bunkering practices in the waterway reveals that vessels receive bunkering at anchorage and at some terminals. All vessels visiting an anchorage are assumed to bunker at the anchorage and must stay at anchorage a minimum amount of time to facilitate bunkering (see Section 4.3.13). Vessels visiting multiple docks where one dock does not show a commodity transfer are assumed to bunker while at dock.

4.2.16 Anchorage Use - From Sea

If all suitable terminal docks are occupied at the time a vessel can enter the SNWW from sea, the vessel may reserve and transit to an unoccupied and unreserved anchorage suitable to the vessel's current draft. Once a vessel arrives at the destination anchorage, it must occupy the anchorage for a minimum amount of time to accommodate bunkering. The minimum time at anchorage is configurable, with a default value of four hours, which is consistent with historical anchorage use and SPA experience. Once the minimum anchorage time has expired, the vessel may proceed to the terminal dock when the dock becomes available and channel transit rules are satisfied.

4.2.17 Anchorage Use - From Dock

Vessels do not typically go from a dock to an anchorage for the purpose of freeing up the dock for another vessel. Doing so may be advantageous to the terminal operator, but it is expensive for the vessel because it creates two separate vessel movements, each requiring tugs and pilots. Nevertheless, the Traffic Simulator may be configured to enable anchorage use from a dock. If there is a vessel movement from dock to anchorage, similar to a vessel arriving from sea (Section 4.3.13), once the vessel arrives at the destination anchorage, it must occupy the anchorage for a minimum amount of time before being permitted to exit the waterway.

4.2.18 Order of Vessel Movements within a Timestep

Vessels in the vessel call list with an arrival date prior or equal to the current timestep date that have not already exited the simulation are evaluated within each timestep. To accommodate pilot operating rules, the sequence of assessment is:

1. Vessels traveling within the waterway, either inbound or outbound, are processed first so that vessels underway continue to move.
2. Vessels at dock, from low model-foot-marker to high model-foot-

marker within the waterway (e.g., a vessel at dock at Sabine Pass LNG is assessed prior to a vessel at dock at Enterprise).

3. Vessels at anchorage, in order of arrival date so that vessels that have been active in the waterway longest are given priority when determining if they can continue their transit (e.g., a vessel at Anchorage Basin 4 that is waiting for a dock to become available is assessed prior to a vessel at sea attempting to reach the same dock).
4. Inbound vessels at sea, in order of dock location, from high model-foot-marker to low model-foot-marker within the waterway (e.g., a vessel going to ExxonMobil is assessed prior to a vessel going to Valero).

The order of operations within each timestep creates a system of vessel queuing within the Traffic Simulator that mimics the queuing operations used by the pilots. Vessels exiting the waterway are given priority over those entering the waterway and vessels entering the waterway are queued such that vessels at the front of the queue are headed farthest into the SNWW.

4.2.19 Initiating a Vessel Move

Prior to initiating a vessel move, either from sea, anchorage, or dock, the Traffic Simulator considers multiple factors to determine if the vessel may begin the move. If all conditions for the move are met, the vessel may proceed. If the conditions are not met, the vessel must wait at the current location until such time as the conditions permit a move.

Once a vessel is in motion, only a weather event can halt its progress.

The following conditions must be met before a vessel can enter the waterway from the sea:

1. The waterway must not be closed due to a weather event.
2. There must be enough pilots available for the vessel **if** the number of pilots is constrained.
3. All vessels use the same point of entry into the waterway; therefore the point of entry must not already be occupied by a vessel. The minimum distance between vessels entering the waterway is 1.5 miles. Only one vessel may enter the channel during each timestep.
4. At least one dock capable of handling the vessel type and cargo type must be available at the vessel's designated terminal. If no docks are available, the vessel may be able to reach a nearby anchorage instead.
5. If daylight restrictions are in place, the vessel seeking to enter the SNWW must not be subject to daylight restrictions.
6. If the entering vessel will meet another vessel during the transit, the meeting must be permitted to occur according to SPA meeting rules.

The following conditions must be met before a vessel can leave an anchorage:

1. The vessel must have been at anchor for the minimum amount of time to

allow for bunkering. Bunkering time is a parameter setting with a default value of 4 hours.

2. The waterway must not be closed due to a weather event.
3. If daylight restrictions are in place, the vessel must not be subject to daylight restrictions.
4. There must be enough pilots available for the vessel **<u>if</u>** the number of pilots is constrained.
5. There must be enough tugs available to move the vessel **<u>if</u>** the number of tugs is constrained.
6. The channel must be clear for one mile both upstream and downstream of the anchorage.
7. The vessel leaving the anchorage must not encounter other vessels moving within the waterway or, if the vessels will meet, the meeting is permitted to occur according to the pilotage meeting rules.
8. If the destination for the vessel is a dock, at least one suitable dock at the terminal must be available.

The following conditions must be met before a vessel can leave a dock:

1. The vessel must have been at dock enough time to accommodate docking, commodity transfer, and undocking. This duration is specific to the commodity, quantity, and terminal used.
2. The waterway must not be closed due to a weather event.
3. If daylight restrictions are in place, vessel specifications must not exceed pilot restriction limits.
4. There must be enough pilots available for the vessel **<u>if</u>** the number of pilots is constrained.
5. There must be enough tugs available to move the vessel **<u>if</u>** the number of tugs is constrained.
6. The channel must be clear for one mile both upstream and downstream of the dock.
7. The vessel leaving the dock, must not encounter other vessels moving within the waterway or, if the vessels will meet, the meeting is permitted to occur according to the pilotage meeting rules.

4.2.20 Wait Time Calculation

Whether at sea, dock, or anchorage, vessels are not permitted to transit the channel unless the aforementioned conditions are met. If a vessel is ready to begin a transit but the transit conditions do not permit movement, wait time is accrued and tracked by the Traffic Simulator. Wait times are categorized as either weather-related or non-weather related. Wait times due to weather conditions are unavoidable and affect all vessels attempting motion within the waterway. Non-weather-related wait times may be caused by pilotage rules (e.g., daylight restrictions or vessel meeting requirements), waterway traffic conditions (e.g., waterway congestion, limited tug or pilot availability), or dock and anchorage availability.

5 Economic Evaluation of Measures

Model results compare traffic flow under the without-project condition to traffic flow under with-project conditions. The economic evaluation of measures is based on the comparison of total time in the system for vessels operating under without-project conditions and under with-project conditions. Total time in the system is monetized using hourly vessel operating costs that are based on vessel type, vessel size, and whether the vessel is at sea, at a dock, or at anchorage.

The preliminary economic evaluation of measures includes an assessment of channel improvements implemented individually (i.e., not in combination with other improvements). Measures included in the preliminary economic evaluation include widening channel reaches and increasing anchorage capacity (Table 5-1). Widening channel reaches individually does not relieve the daylight restriction on navigation of large vessels through the Sabine Neches Canal and the Neches River Channel.

Channel widening does allow for additional vessel meeting opportunities that reduce vessel delays that are the cause for transportation cost reductions associated with these measures. Creating additional anchorage capacity at AB4 provides additional space where vessels can wait for a Neches River terminal berth to become available. Transportation cost savings would result if a daylight restricted vessel that traveled to AB4 during daylight were to have access to a berth as soon as the berthed vessel departed, rather than having to wait for the departed vessel to travel the entire length of the system before being able to begin the transit from the sea to the open berth.

5.1 Preliminary Economic Evaluation of Measures

Of the many measures that were identified during plan formulation, widening measures and anchorage basin expansion were advanced for economic evaluation (Table 5-1). The preliminary economic evaluation of measures compares costs and benefits of individual measures as standalone improvements. None of the measures implemented individually would relieve the daylight restriction on large vessels.

5.2 Costs

Preliminary Average Annual Equivalent (AAEQ) costs include construction costs and contingency (23%), as determined by the Cost and Schedule Risk Analysis, discounted over 50 years at the FY26 federal discount rate (3.25 percent). Note that costs for PED, Construction Management, and Interest During Construction were not included in this preliminary analysis. Construction costs (Table 5-1) used in the economic evaluation of measures are preliminary cost estimates. Widening costs were developed for the Neches River Channel and the Sabine-Neches Canal North and South by widening only to the red side of the channel to avoid transportation and municipal infrastructure on the green side of the channel.

Widening for the Port Arthur Canal and the Sabine Pass Channel was designed to occur equally on both sides of the channel. Note that channel reaches selected for widening were identified by the SPA as areas where widening would improve navigation. There are areas in the channel where the SPA would not utilize additional width for meeting vessels, including tows, such as the confluence between the Sabine Neches Canal and the Neches River, approaches to bridges, and the area from the Martin Luther King Bridge to the “eyeball” turning area.

Table 5-1
Measures Included in the Economic Evaluation

Channel Reach	Width (feet)	Abbreviation	Construction Cost ($)
Neches River Channel	500	NR500	78,600,000
Neches River Channel	600	NR600	187,400,000
Port Arthur Canal	600	PAC600	64,935,000
Port Arthur Canal	700	PAC700	99,900,000
Sabine Neches Canal North	500	SNN500	100,100,000
Sabine Neches Canal North	600	SNN600	247,200,000
Sabine Neches Canal North	700	SNN700	610,500,000
Sabine Neches Canal South	500	SNS500	18,800,000
Sabine Neches Canal South	600	SNS600	43,500,000
Sabine Neches Canal South	700	SNS700	100,700,000
Sabine Pass Channel	600	SPC600	27,495,000
Sabine Pass Channel	700	SPC700	42,500,000
Anchorage Basin 4	1,000	AB4-2	19,602,000
Anchorage Basin 4	1,500	AB4-3	39,798,000
Anchorage Basin 4	2,000	AB4-4	59,400,000

Incremental widening for the Neches River Channel and the Sabine-Neches Canal North and South exhibits substantial cost increases, such that each 100 feet of additional width costs more than twice as much as the previous 100-foot increase. This level of incremental costs is not exhibited for the Port Arthur Canal, the Sabine Pass Channel, or AB4 (Table 5-1).

Preliminary average annual equivalent benefit values (AAEQ) were developed by using the model to calculate benefits for 2025 and extrapolating those benefits out to year 2050 based on proportional increases or decreases in tonnage projections. Table 5-2 shows the preliminary net benefits for each measure as stand-alone elements. Note that none of the measures, implemented alone relieve the daylight restriction on large vessels.

The largest net benefits occur in the channels where most of the terminals are located: The Neches River Channel and the Sabine Neches Canal South. All widening increments of the Port Arthur Canal and the Sabine Neches Canal North exhibit negative net benefits as stand-alone improvements (Table 5-2).

Table 5-2
Individual Measures Net Benefits ($)

Channel Reach	Width (feet)	Abbreviation	AAEQ Net Benefits
Neches River Channel	500	NR500	15,284,000
Neches River Channel	600	NR600	9,435,000
Port Arthur Canal	600	PAC600	(1,910,000)
Port Arthur Canal	700	PAC700	(1,712,000)
Sabine Neches Canal North	500	SNN500	(5,935,000)
Sabine Neches Canal North	600	SNN600	(6,710,000)
Sabine Neches Canal North	700	SNN700	(20,933,000)
Sabine Neches Canal South	500	SNS500	4,063,000
Sabine Neches Canal South	600	SNS600	10,521,000
Sabine Neches Canal South	700	SNS700	8,282,000
Sabine Pass Channel	600	SPC600	6,446,000
Sabine Pass Channel	700	SPC700	5,868,000
Anchorage Basin 4	1,000	AB4-2	(4,731,000)
Anchorage Basin 4	1,500	AB4-3	8,358,000
Anchorage Basin 4	2,000	AB4-4	3,089,000

6 Economic Evaluation of Alternative Plans

Alternative plans were developed by combining measures to improve navigation along the waterway. The economic evaluation of alternative plans was performed in three phases. Phase 1 identifies the net benefit maximizing plan that addresses the problem of daylight only transit restrictions. The net benefit maximizing plan identified in Phase 1 is Alternative 1. In the second phase, incremental widening is added to Alternative 1 to identify the widening plan that maximizes net benefits. In the third phase, incremental increases in Anchorage Basin No. 4 (AB4) vessel handling capacity are added to the net benefit widening plan to identify the NED Plan.

Construction costs used in the economic evaluation of alternative plans include costs for Preconstruction Engineering and Design (PED), associated costs, construction management, contingency, and annualized maintenance costs as identified in the Engineering Appendix. Interest during construction is also included and has been calculated at the FY26 federal discount rate of 3.25 percent and at the OMB discount rate of 7 percent. Interest during construction is calculated monthly for each alternative including PED and construction. The base-year for all economic benefit calculations is 2030 although commodity forecasts, fleet forecasts, and traffic simulations were performed for 2025. For all economic evaluations of alternatives, model runs produce benefits in five-year increments from 2030 through 2050 and benefits are interpolated for the years between the model run years. Benefits are always held constant after 2050.

6.1 Economic Evaluation of Alternative Plans: Phase 1

The primary operational goal of combining measures in Phase 1 is to reduce or eliminate the daylight only restriction on large vessels transiting the Sabine Neches Canal and the Neches River. Two alternative plans directly address the problem of daylight only transits. Widening only the Sabine Neches Canal (South and North reaches) to 500 feet addresses this problem of daylight only transits. Widening the Sabine Neches Canal to 500 feet reduces the length of channel reaches where large vessels are restricted to daylight only transit (Figure 4-4 above) from approximately 30 miles (Sabine Neches Canal South to the Port of Beaumont) to 18.6 miles (Sabine Neches Canal North confluence with the Neches River to the Port of Beaumont). This reduction allows large vessels to transit the length of the Sabine Neches Canal at night but does not change the daylight restriction on large vessels transiting the Neches River. The 11.4-mile reduction in the length of "daylight restricted" channel allows large vessels to be closer to Neches River terminals at daybreak when arriving from the sea thereby reducing waiting time at sea. Vessels departing from Neches River terminals would still have to wait for daybreak prior to leaving the dock.

Widening both the Sabine Neches Canal and the Neches River to 500 feet is the smallest alternative plan that eliminates the daylight restriction. This alternative plan provides 24-hour access to the Neches River for all vessels. Both alternative plans also reduce vessel delays by providing opportunity for larger vessels to meet in the navigation channel.

Output from the Traffic Simulator was used to develop the economic evaluation of alternatives. The Traffic Simulator calculates the total time that the vessel is in the waterway system. The time within the system is categorized as either working time or non-working time. Working time includes time spent transiting the channel, turning, docking, and loading or discharging cargo. Non-working time includes vessel hours spent waiting upon arrival or for departure, vessel hours at anchorage, and the hours that vessels were delayed by weather. In the Phase 1 evaluation, the Traffic Simulator calculated the working and non-working times for each vessel call for the without project condition and for the two smallest alternatives that address the daylight only restriction on large vessels.

Table 6-1 is an example of summary Traffic Simulator output for 2025 that displays the average hours per vessel call for each of the non-working categories for the without-project condition and for the two alternatives.

Table 6-1
Summary Traffic Simulator Output for 2025 Without-Project and Alternatives that Address the Daylight Only Restriction

	Without-Project Condition	Sabine Neches Canal 500 feet	Sabine Neches Canal and Neches River 500 feet
Total Vessel Calls	3,887	3,887	3,887
Calls with Non-working Time	3,268	3,153	3,020
Calls without Non-working Time	619	734	867
Arrival Delay (average hours per vessel call)	3.6	2.6	2.1
Departure Delay (average hours per vessel call)	10.8	7.2	4.4
Anchorage Time (average hours per vessel call)	4.4	2.2	1.5
Weather Delay (average hours per vessel call)	3.7	3.2	2.8
Total Non-working Time (average hours per vessel call)	22.5	15.2	10.8

Both reducing and eliminating the daylight only restriction (Sabine Neches Canal 500 feet and Sabine Neches Canal and Neches River 500 feet, respectively) substantially improve navigation efficiency along the waterway. Fewer vessels accumulate non-working time and the average hours per vessel call for each category of non-working time is reduced with these improvements. Arrival and departure delays are reduced because large vessels can use the improved channels reaches 24 hours per day and because larger vessels can meet in the widened channel reaches. Anchorage time is reduced because there is a reduced need for vessels to go to an anchorage to wait for a daylight restricted vessel to depart from the dock. Weather delay time is reduced because vessels that spend less time overall in the waterway system are less likely to be caught in a weather delay. Table 6-2 shows the delay reductions attributable to the two alternatives.

Table 6-2
Time Savings for Alternatives that Address the Daylight Only Restriction (2025)

	Sabine Neches Canal 500 feet	Sabine Neches Canal and Neches River 500 feet
Total Vessel Calls	3,887	3,887
Calls with Non-working Time	3,153	3,020
Calls without Non-working Time	734	867
Arrival Delay Reduction (average hours per vessel call)	1.0	1.5
Departure Delay Reduction (average hours per vessel call)	3.6	6.4
Anchorage Time Reduction (average hours per vessel call)	2.2	2.9
Weather Delay Reduction (average hours per vessel call)	0.5	0.9
Total Time Savings (average hours per vessel call)	7.3	11.7

Table 6-3 shows the comparison of Average Annual Equivalent (AAEQ) net benefits for the two smallest alternatives that address the daylight restriction.

Table 6-3
Economic Evaluation of Alternatives that Address Daylight-Only Restriction

	Sabine Neches Canal 500 feet	Sabine Neches Canal and Neches River 500 feet
Construction Costs (FY26)	$182,319,000	$310,827,000
Interest During Construction	$5,986,000	$16,012,000
Total Construction Cost	$188,305,000	$326,839,000
AAEQ Construction Cost	$7,670,000	$13,312,000
AAEQ Maintenance Cost	$1,101,000	$2,444,000
AAEQ Total Cost	$8,771,000	$15,756,000
AAEQ Benefits	$21,972,000	$49,144,000
AAEQ Net Benefits	$13,201,000	$33,388,000

Note: IDC and AAEQ calculated at the FY26 federal discount rate (3.25%); AAEQ calculated over 50 years

Alternative plans that eliminate the daylight restriction on the Sabine Neches Canal and the Neches River must necessarily include widening of both channel reaches. The smallest alternative that eliminates the daylight restriction is widening both the Sabine Neches Canal and the Neches River from 400 feet to 500 feet. This alternative provides more than double the AAEQ net benefits than widening only the Sabine Neches Canal, which reduces the length of channel subject to the daylight restriction but does not eliminate the restriction. Widening the Sabine Neches Canal and the Neches River to 500 feet is identified as Alternative 1, which is the plan that addresses the problem of daylight restricted transits and provides the greatest economic net benefit.

6.2 Economic Evaluation of Alternative Plans: Phase 2

The goal of Phase 2 of the economic evaluation of alternative plans is to identify the widening plan that maximizes net benefits. Incremental widening measures are added to Alternative 1 as displayed in Table 6-4. Incremental widening greater than Alternative 1 provides increased opportunity for vessel meeting resulting in improved traffic flow and reduced vessel delays (Table 6-5). Alternatives 1 – 4 and alternative 6 fully eliminate the daylight restriction. Alternative 5 does not eliminate the daylight restriction in the Neches River, which is where many of the terminals are located (Figure 4-1). All widening alternatives 1 – 6 increase the size of vessels allowed to meet in the various channel reaches because the Pilots Operational Rules state that vessels with a combined beam equal to or greater than one-half the channel width will not meet day or night.

Table 6-4
Alternative Widening Plans Developed for Economic Evaluation

Alternative Plan	Neches River	Sabine Neches Canal	Port Arthur Canal	Sabine Pass Channel	Anchorage Basin 4 Vessel Capacity
	Channel Width (feet)				
WOP	400	400	500	500	1
Alt1	**500**	**500**	500	500	1
Alt2	**600**	**600**	500	500	1
Alt3	**500**	**500**	**700**	**700**	1
Alt4	**500**	**500**	**600**	**600**	1
Alt5	400	**500**	500	500	1
Alt6	**600**	**600**	**600**	**600**	1

Table 6-5
Time Savings of Alternative Widening Plans (2025)

	Alt1	Alt2	Alt3	Alt4	Alt5	Alt6
Total Vessel Calls	3,887	3,887	3,887	3,887	3,887	3,887
Calls with Non-working Time	3,020	3,019	2,992	2,997	3,153	3,018
Calls without Non-working Time	867	868	895	890	734	869
Arrival Delay Reduction (average hours per vessel call)	1.5	1.4	1.5	1.5	1.0	1.6
Departure Delay Reduction (average hours per vessel call)	6.4	6.6	6.7	6.7	3.7	6.9
Anchorage Time Reduction (average hours per vessel call)	2.9	2.9	2.9	2.9	2.2	2.9
Weather Delay Reduction (average hours per vessel call)	0.9	0.8	0.9	0.9	0.5	0.9
Total Time Savings (average hours per vessel call)	11.7	11.7	12.1	12.1	7.3	12.2

Average annual equivalent (FY26 discount rate) net benefits of the six alternative widening plans are shown in Table 6-6. Alternative 1 provides the greatest net benefit of all the widening plans evaluated.

Table 6-6
AAEQ Net Benefits of Alternative Widening Plans
($ thousands)

	Alt1	Alt2	Alt3	Alt4	Alt5	Alt6
Construction Costs (FY26)	310,827	887,301	634,559	457,084	182,319	890,128
Interest During Construction	16,012	63,765	41,390	28,306	5,986	79,889
Total Construction Cost	326,839	951,065	675,949	485,391	188,305	970,017
AAEQ Construction Cost	13,312	38,737	27,532	19,770	7,670	39,509
AAEQ Maintenance Cost	2,444	4,804	3,961	3,203	1,101	5,905
AAEQ Total Cost	15,756	43,541	31,493	22,973	8,771	45,414
AAEQ Benefits	49,144	49,602	51,223	51,134	21,972	57,928
AAEQ Net Benefits	**33,388**	6,060	19,730	28,161	13,201	12,513

6.3 Economic Evaluation of Alternative Plans: Phase 3

The goal of Phase 3 of the economic evaluation of alternative plans is to evaluate the net benefits of adding incremental increases in AB4 vessel holding capacity to net benefit maximizing widening plan (Alternative 1). The increments of vessel holding capacity include increasing the AB4 capacity from one vessel (without-project condition) up to four vessels. Note that Alternative 1 includes the without-project condition capacity for a single vessel at AB4. The incremental time savings of adding holding capacity at AB4 to the improvements included in Alt 1 are marginal (Table 6-7).

Table 6-7
Time Savings: Alternative 1 and Increases in AB4 Vessel Capacity (2025)

	Alt1 (1 Vessel)	Alt1+AB4-2 (2 Vessels)	Alt1+ AB4-3 (3 Vessels)	Alt1+ AB4-4 (4 Vessels)
Total Vessel Calls	3,887	3,887	3,887	3,887
Calls with Non-working Time	3,020	3,025	3,019	3,015
Calls without Non-working Time	867	862	868	872
Arrival Delay Reduction (average hours per vessel call)	1.5	1.5	1.5	1.5
Departure Delay Reduction (average hours per vessel call)	6.4	6.3	6.4	6.4
Anchorage Time Reduction (average hours per vessel call)	2.9	2.8	2.7	2.8
Weather Delay Reduction (average hours per vessel call)	0.9	0.9	0.9	0.9
Total Time Savings (average hours per vessel call)	11.7	11.5	11.5	11.6

The net benefits of Alternative 1 and three incremental increases in AB4 capacity are presented in Table 6-8. Alternative 1 without additional vessel capacity at AB4 provides the greatest net benefit of all the plans evaluated.

Table 6-8
Net Benefits: Alternative 1 and Increases in AB4 Vessel Capacity
($ thousands)

	Alt1 (1 Vessel)	Alt1+AB4-2 (2 Vessels)	Alt1+ AB4-3 (3 Vessels)	Alt1+ AB4-4 (4 Vessels)
Construction Costs (FY26)	310,827	350,654	386,760	421,803
Interest During Construction	16,012	19,989	23,951	28,210
Total Construction Cost	326,839	370,643	410,711	450,013
AAEQ Construction Cost	13,312	15,096	16,728	18,329
AAEQ Maintenance Cost	2,444	2,647	2,857	3,060
AAEQ Total Cost	15,756	17,744	19,585	21,389
AAEQ Benefits	49,144	49,122	34,743	33,822
AAEQ Net Benefits	**33,388**	31,378	15,158	12,433

7 Sensitivity Analyses

Sensitivity analyses were conducted to evaluate the performance of the TSP under alternative economic assumptions. The following sensitivity analyses were performed:

1. TSP at OMB discount rate (7.0 percent). This analysis evaluates the TSP using budgetary criteria.
2. TSP with no change in fleet forecast after 2025 at FY26 discount rate (3.25 percent). This analysis evaluates that TSP under a no-growth scenario.
3. TSP with no change in fleet forecast after 2025 at OMB discount rate (7.0 percent). This analysis evaluates that TSP under a no-growth scenario using budgetary criteria.
4. TSP using vessel operating costs adjusted for the US Bureau of Labor Statistics Producer Price Index for Deep Sea Freight Transportation at the FY26 discount rate (3.25 percent).
5. TSP using vessel operating costs adjusted for the US Bureau of Labor Statistics Producer Price Index for Deep Sea Freight Transportation at OMB discount rate (7.0 percent)

Sensitivity Analysis #1 evaluates the TSP (Alt #1) using a 7 percent discount rate for calculating all costs and benefits including interest during construction, AAEQ construction and maintenance costs, and AAEQ benefits.

Sensitivity Analysis #2 evaluates the TSP (Alt #1) but restricts the fleet forecast to 2025 forecast as presented in Table 3-4 and repeats that same forecast for 2030, 2035, 2040, 2045, 2050. Sensitivity Analysis #2 uses the FY26 3.25 percent discount rate for calculating all costs and benefits including interest during construction, AAEQ construction and maintenance costs, and AAEQ benefits.

Sensitivity Analysis #3 evaluates the TSP (Alt #1) but restricts the fleet forecast to 2025 forecast as presented in Table 3-4 and repeats that same forecast for 2030, 2035, 2040, 2045, 2050. Sensitivity Analysis #3 uses a 7 percent discount rate for calculating all costs and benefits including interest during construction, AAEQ construction and maintenance costs, and AAEQ benefits.

Sensitivity Analysis #4 evaluates the TSP (Alt #1) using vessel operating costs adjusted for the US Bureau of Labor Statistics Producer Price Index for Deep Sea Freight Transportation. Sensitivity Analysis #4 uses the FY26 3.25 percent discount rate for calculating all costs and benefits including interest during construction, AAEQ construction and maintenance costs, and AAEQ benefits.

Sensitivity Analysis #5 evaluates the TSP (Alt #1) using vessel operating costs adjusted for the US Bureau of Labor Statistics Producer Price Index for Deep Sea Freight Transportation. Sensitivity Analysis #5 uses a 7 percent discount rate for calculating all costs and benefits including interest during construction, AAEQ construction and maintenance costs, and AAEQ benefits.

Note that Sensitivity Analyses #4 and #5 address uncertainty in the vessel operating costs used throughout this Appendix. The most recent vessel operating costs developed by USACE are FY23 costs. The most recent publicly available vessel operating costs are from FY13. Informal consultation with USACE resulted in a recommendation to reduce the FY13 vessel operating costs by 37% to approximate the FY23 vessel operating costs. This was done as recommended and the reduced FY13 costs were used throughout this Appendix. An alternative to the 37% reduction in USACE vessel operating costs is the 52% increase in the US Bureau of Labor Statistics Producer Price Index (PPI) for Deep Sea Freight Transportation. The 52% increase was calculated as the average FY21 through FY23 PPI (390) divided by the average FY11 through FY13 PPI (256).

Table 7-1 presents the results for the five sensitivity analyses.

Table 7-1
AAEQ Net Benefits of Sensitivity Analyses 1 - 5 ($ thousands)

	Sens 1 TSP 7 % DR	Sens 2 TSP 2025 Traffic Level 3.25 % DR	Sens 3 TSP 2025 Traffic Level 7.0 % DR	Sens 4 TSP VOC PPI Adjust 3.25 % DR	Sens 5 TSP VOC PPI Adjust 7 % DR
AAEQ Construction Cost	25,076	13,312	25,076	13,312	25,076
AAEQ Maintenance Cost	2,237	2,444	2,237	2,444	2,237
AAEQ Total Cost	27,313	15,756	27,313	15,756	27,313
AAEQ Benefits	48,973	46,411	48,339	118,725	118,312
AAEQ Net Benefits	21,660	32,574	21,026	102,969	90,999
Benefit/Cost Ratio	1.8	3.4	1.8	7.5	4.3