Brunswick Harbor Navigation Project Modifications and Harbor Dredging Operations and Maintenance Glynn County, Georgia

APPENDIX A

Economics

Final Integrated Feasibility Report and Environmental Assessment

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Contents

List of Acronyms

Acronym	Definition
AAEQ	Average Annual Equivalent
AAPA	American Association of Port Authorities
ARRA	American Recovery and Reinvestment Act
BLS	Bureau of Labor Statistics
BLT	Bulk Loading Tool
CAAM	China Association of Automobile Manufacturers
CAGR	Compound Annual Growth Rate
CDF	Cumulative Distribution Function
CEU	Car Equivalent Unit
CLT	Container Loading Tool
DWT	Deadweight Tons
EGM	Economic Guidance Memorandum
EJ	Environmental Justice
ETTC	Estimated Total Trip Cargo
EV	Electric Vehicle
FE	Far East
FUSRAP	Formally Utilized Sites Remedial Action Program
FY	Fiscal Year
GDP	Gross Domestic Product
GI	Global Insight
GPA	Georgia Ports Authority
GRP	Gross Regional Product
HERO	High Efficiency RO/RO
HMST	HarborSym Modeling Suite of Tools
ICE	Internal Combustion Engine
IDC	Interest During Construction
IMO	International Maritime Organization
IWR	Institute for Water Resources
LCTC	Large Car and Truck Carrier
LFA	Load Factor Analysis
LOA	Length Overall
LPP	Locally Preferred Plan
MLLW	Mean Lower Low Water
MSA	Metropolitan Statistical Area
MXSLLD	Maximum Summer Loadline Draft
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NAVD	North American Vertical Datum
NED	National Economic Development
NOAA	National Oceanic and Atmospheric Administration
NNOMPEAS	National Navigation Operation & Management Performance Evaluation & Assessment System
NPV	Net Present Value
O&M	Operations & Maintenance
OD	Origin-to-Destination

OMRR&R	Operations, Maintenance, Rehabilitation, Repair & Replacement
P&G	Principles & Guidelines
PCTC	Pure Car and Truck Carrier
PIANC	Permanent International Association of Navigation Congresses
PPP	Previous Post Panamax
RECONS	Regional Economic System
RED	Regional Economic Development
RHA	Rivers and Harbors Act
RO/RO	Roll-on/Roll-Off
SMMT	Society of Motor Manufacturers and Traders
TEU	Twenty-Foot Equivalent Unit
TPI	Tons Per Inch Immersion
TSP	Tentatively Selected Plan
UKC	Underkeel Clearance
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VOC	Vessel Operating Costs
WRDA	Water Resources Development Act
XB	Extreme Breadth

1 Introduction

This document presents the economic evaluations performed for the Brunswick Harbor Navigation Improvement Project. The current federally authorized channel is at a depth of -36 feet mean lower low water (MLLW), with an authorized channel width of 400 feet. In Section 1201 of WRDA 2016, the U.S. Army Corps of Engineers (USACE) Savannah District was directed by Congress to begin the multi-year feasibility study to determine if modifying Brunswick Harbor is both economically beneficial and environmentally acceptable to the nation. The Deep Draft Navigation Planning Center of Expertise performed the economic analyses contained within this document in support of the feasibility study.

1.1 Study Purpose and Scope

The purpose of this study is to evaluate problems and opportunities for improved navigation in Brunswick Harbor and identify the plan that best satisfies the environmental, economic, and engineering criteria. The scope of this feasibility study involves analysis of existing conditions and requirements, identifying opportunities for improvement, preparing economic analyses of alternatives, identifying environmental impacts, and analyzing the National Economic Development (NED) plan.

Potential navigation improvements include the widening of navigation channels, including bend wideners and turning basins. The purpose of these potential improvements is to increase the efficiency of cargo vessel operations for roll-on/roll-off (RO/RO) cargo vessels, which are already calling on the Port of Brunswick and are projected to call on the port with increased frequency in the future. This study identifies and evaluates alternatives that will:

- Accommodate recent and anticipated future growth of RO/RO traffic; and
- Improve the efficiency of operations for RO/RO's within the waterways of Brunswick Harbor

1.2 Document Layout

Section 2 details the existing conditions at Brunswick Harbor. Section 3 examines future without and with project conditions and includes an evaluation and description of forecast trade, terminal upgrades, and the vessel fleet and operations at the harbor. Section 4 presents the transportation cost savings benefit analysis. In Section 5, sensitivities to the forecast are explored. Section 6 examines the multiport considerations. Section 7 includes updates to the economic evaluation for the Final Feasibility Report and Environmental Assessment, while Section 8 describes the socioeconomics of Brunswick and the surrounding region.

2 Existing Conditions

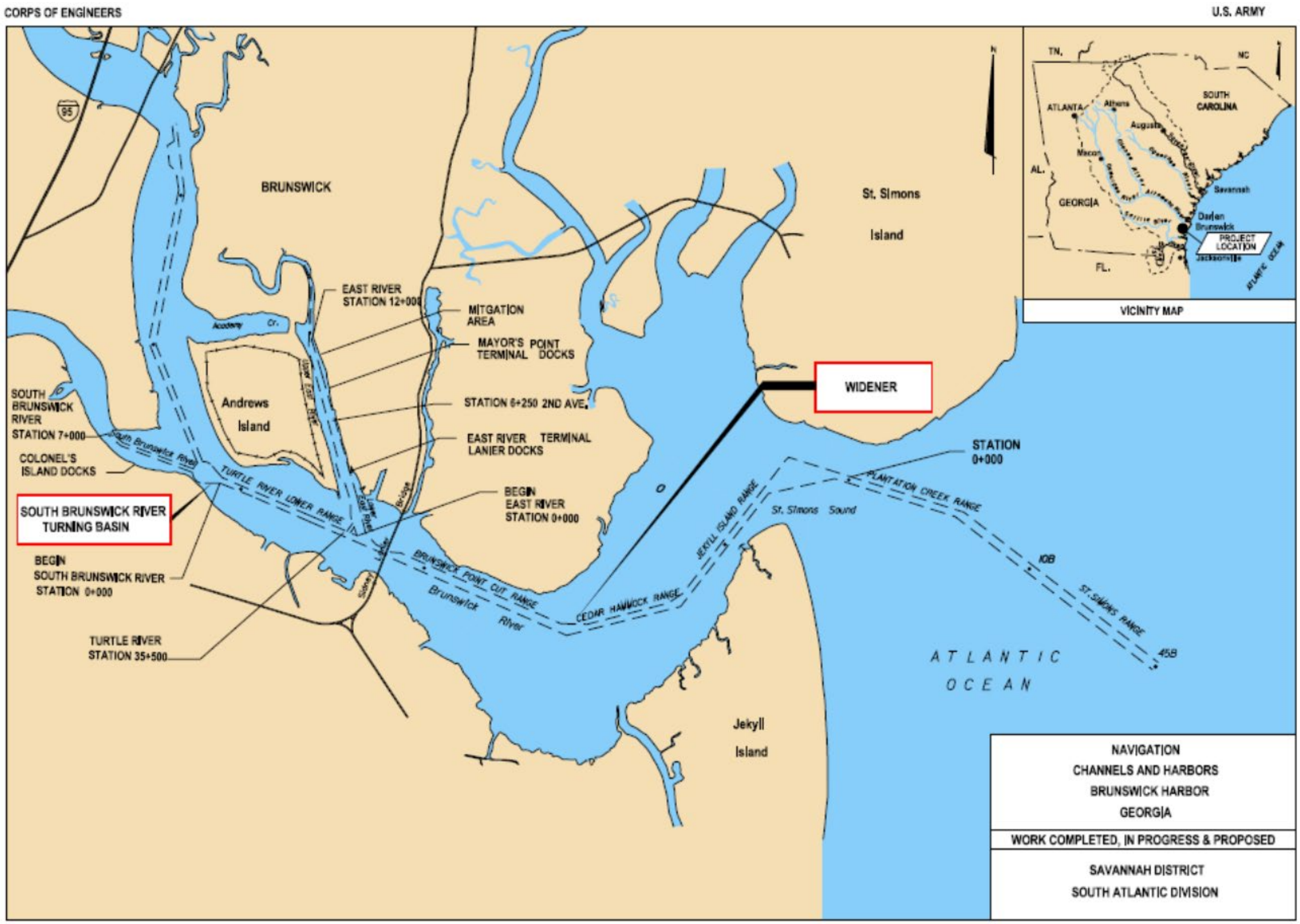
The existing conditions are defined in this report as the project conditions that exist today plus any changes that are expected to occur prior to project year one. Project year one, anticipated in 2026, is referred to as the base year for comparison of alternatives to the without- project condition and among proposed alternatives. The base year is the year the project is expected to be operational and accrue benefits. The year 2017 is the most recent year for which complete data was obtained for cargo volumes and a three-year average from 2015-2017 is used as the baseline for the commodity forecast. The year 2017 data along with historical data dating back to 2007 was thought to be the most reasonable data to use in the development of fleet and commodity forecasts described later in this appendix. The data from this timeframe captures economic highs and lows, including reductions in volumes experienced from 2014 to 2017. It should be noted that while this analysis is based on the most recent and complete data obtained, economic updates will be completed every three to five years until the project is fully implemented and constructed per requirements from ER 1105-2-100. These economic updates will consider changed conditions to determine the scope and scale of economic update(s).

2.1 Economic Study Area (Hinterland)

The federally authorized Brunswick Harbor navigation project is in the southeastern section of Glynn County, GA adjacent to the City of Brunswick. The harbor is 104 miles south of Savannah and 82 miles north of Jacksonville by coastwise routes. The project area of Brunswick Harbor comprises the improved channel across the bar, St. Simons Sound, Brunswick River, South Brunswick River and Turtle River. The entrance channel is 38 feet deep and 400 feet wide and the inner channels are 36 feet deep and 400 feet wide (Figure 2-1). Once over the bar and into St. Simons Sound, the Brunswick River enters from the southwest and provides access for oceangoing vessels to the city of Brunswick. The Andrews Island dredged material containment area divides the river into two branches. The southern branch is known as Turtle River and the northern branch, on with the city of Brunswick is situated, is known as the East River[1]. More information on the study area can be found in Section 1.4 of the main feasibility report.

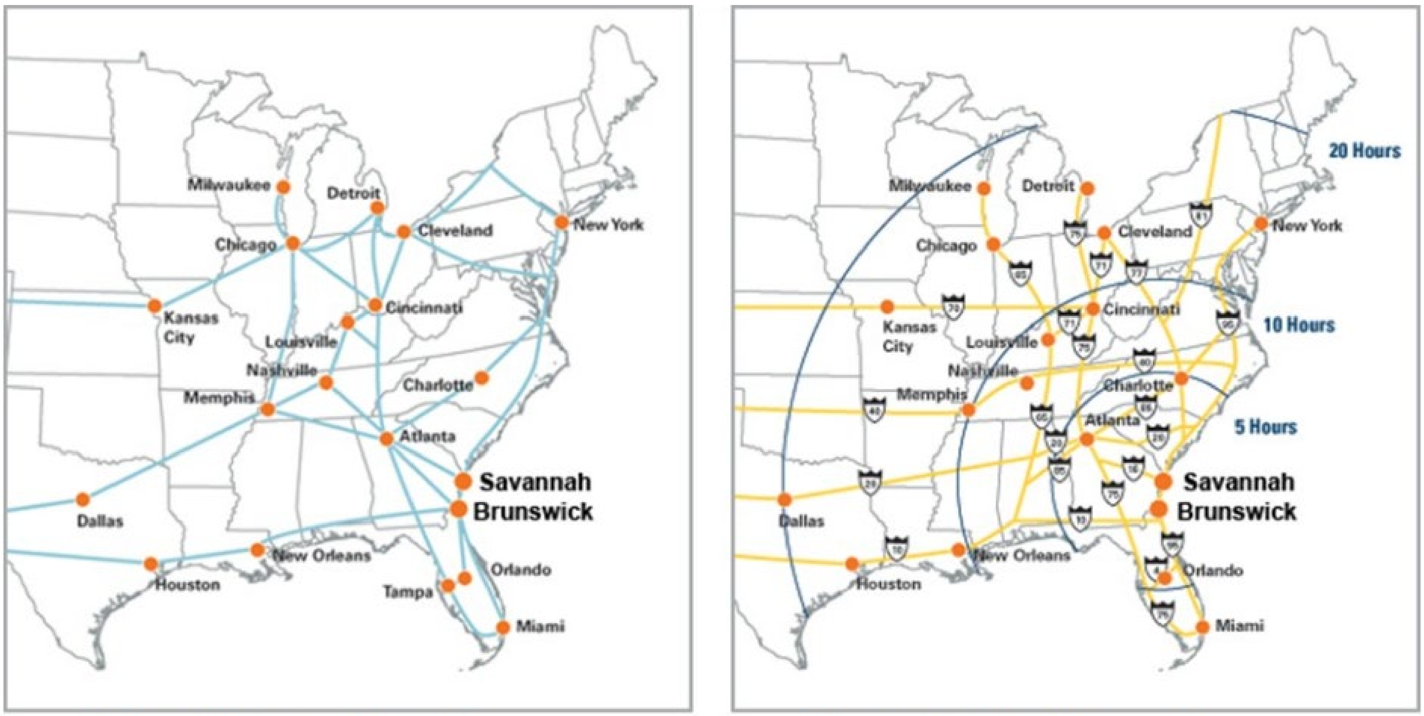
[1] NOAA Coast Pilot, 2019

Figure 2-1. Port of Brunswick



2.1.1 Hinterland

As the westernmost point on the U.S. Eastern seaboard, the Port of Brunswick is a natural gateway to move receipt and shipment cargo to the large population centers in the Southeast as shown in Figure 2-3. The Colonel's Island RO/RO Terminal is within 2.5 miles of Interstate 95 (I-95) via U.S. highway 17 and is one hour from both I-16 and I-10. Colonel's Island is also served by two Class 1 railroads, CSX Transportation (CSXT) and Norfolk Southern Railroad (NS) via the Golden Isles Terminal Railroad (GITM), which provides all rail switching services. Figure 2-3 shows intact intermodal cargo traffic between major US regions and Georgia Ports.



Ports and their railroad connections

Ports and their interstate connections

Figure 2-3. Port of Brunswick Hinterland

2.1.2 Existing Cargo Profile

The Port of Brunswick, GA is the largest auto port (by area) in the U.S. In 2018, over 629,000 combined auto/machinery units moved through the Colonel's Island RO/RO terminal for receipt or shipment (GPA, 2019). This translated into almost 1 million metric tons of vehicles and parts moved. Figure 2-4 below shows the levels of total tonnage moved through all terminals at the port by major commodity between 2013 and 2018.

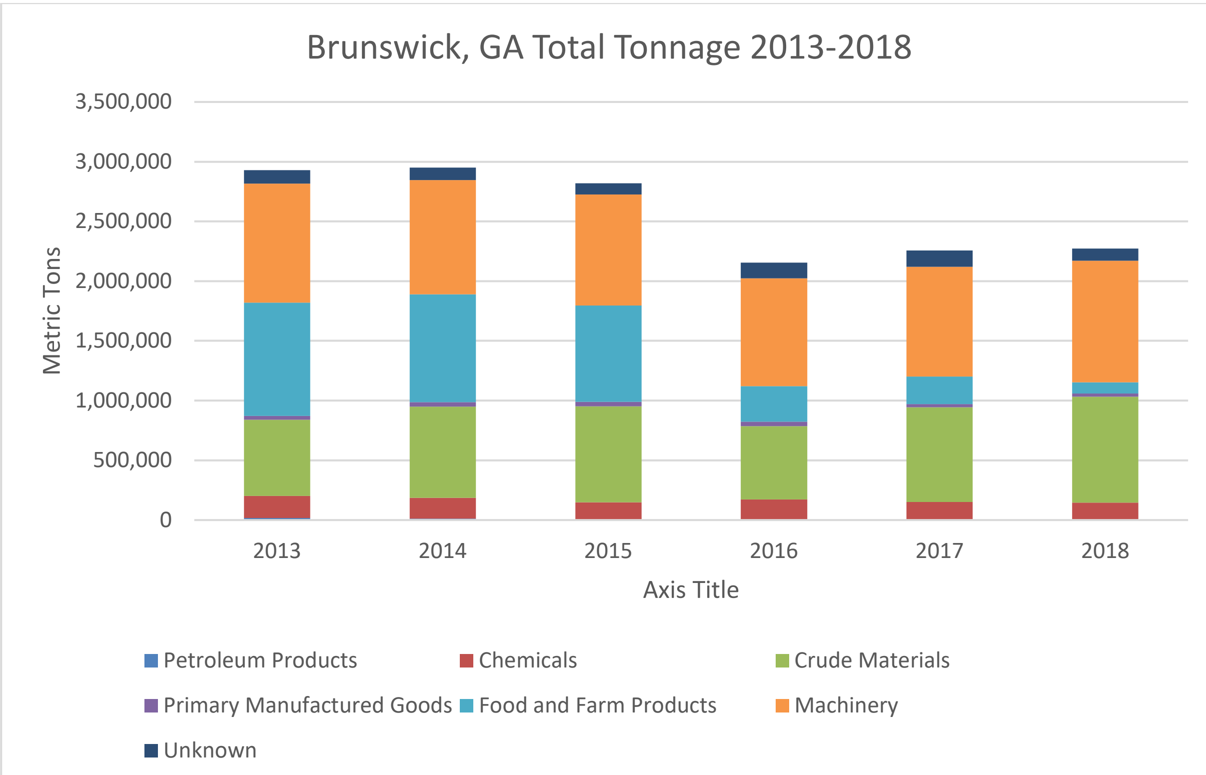


Figure 2-4. Brunswick, GA Total Tonnage 2013-2018. Source: Waterborne Commerce Statistics Center, 2021

In 2017, the three terminals at the Port of Brunswick received 350 vessel calls. These facilities are covered in more detail in Section 2.2 below. These facilities handled over 2.2 million metric tons, down 20 percent from 2013. Port tonnage has decreased since 2014, mainly due to decreases in bulk grain tonnage through the port. The trades in bulk soybeans and corn have been traditionally very cyclical through Brunswick. Since 2013, the customers moving these goods have experienced issues with weather, vessel crews, and railroad scheduling and prices. These issues led to the gradual decline in bulk agricultural volumes. Therefore, most of the grain now is shipped via the Mississippi River. This led to the closure of the grain loading facility at Colonel's Island after it was damaged by a storm in 2018. This facility has since been developed into more parking for vehicles used in RO/RO trades. On average, 2.3 million metric tons has moved annually between 2007 and 2018.

There has been an almost even split of the tonnage between shipments and receipts in the last 3 years at the Port. Receipts have averaged around 1.1 million short tons per year since 2013, and shipments have averaged around 1.5 million short tons per year. As shown in Figure 2-5, vehicles make up about 60 percent of the total inbound tonnage to Brunswick since 2013.

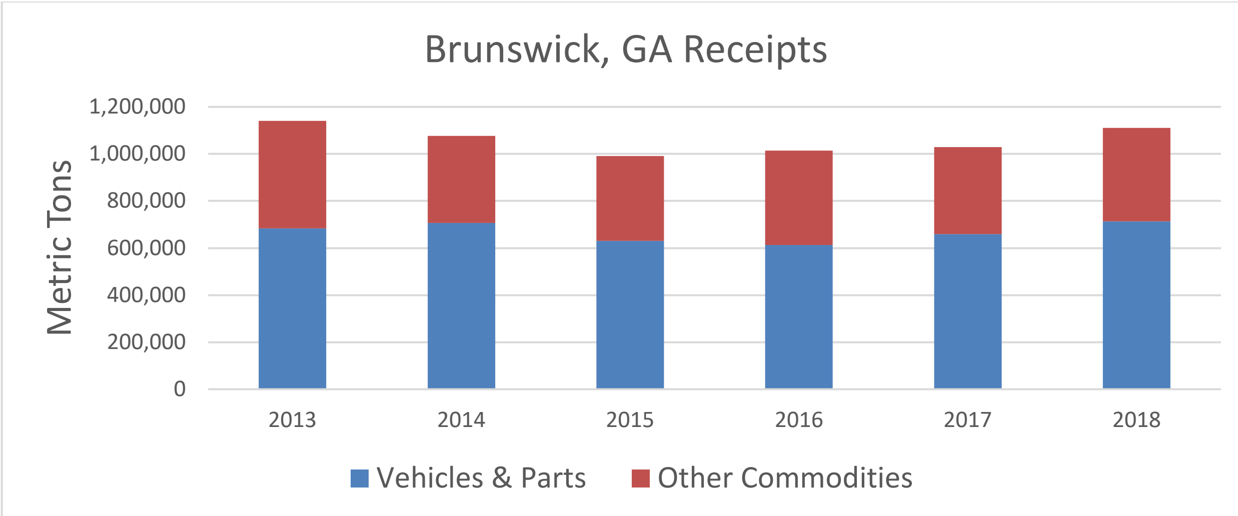


Figure 2-5. Brunswick, GA Receipt tonnage (metric tons), 2013-2018
Source: Waterborne Commerce Statistics Center, 2021

Brunswick's shipments are less centered on vehicles than receipts, as shown in Figure 2-6. Brunswick's shipments primarily consist of wood pellets (566 thousand tons), animal feed (108 thousand tons), and paper products (23 thousand tons). As discussed previously, Brunswick shipments are generally considered more volatile due to bulk grain impacts. This is evidenced by the declines in total tonnage in 2016, 2017, and 2018.

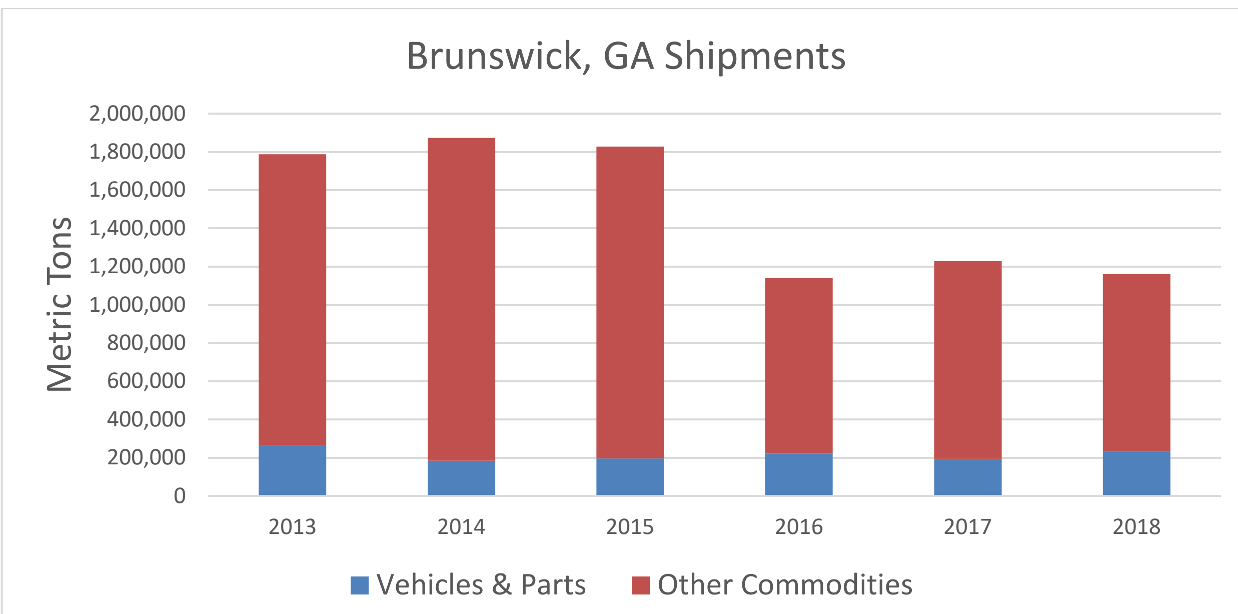


Figure 2-6. Brunswick, GA Shipment tonnage (metric tons), 2013-2018
Source: Waterborne Commerce Statistics Center, 2021

2.2 Facilities and Infrastructure

The Port of Brunswick's seaport is made up of 1,800 acres of waterfront land and nearby properties including RO/RO terminals, general purpose/cargo terminals, break-bulk cargo and storage. There are three terminals in the Port of Brunswick: Colonel's Island (RO/RO), Mayor's Point (breakbulk) and East River (dry and liquid bulk). The Port of Brunswick's three terminals are shown in Figure 2-7.

Figure 2-7. Brunswick Harbor Map[2]

[2] Source: Georgia Ports Authority, State of the Port 2018, June 2019.

2.2.1 Colonel's Island Terminal

The Colonel's Island Terminal is a RO/RO vehicle terminal located along the southern bank of the Turtle River. The terminal size is 650 acres, making it the largest auto port in the country. This terminal includes three berths with an overall length of 3,355 feet at a depth of 36 feet.

Figure 2-8. Colonel's Island Terminal looking southwest. Source: Georgia Port Authority

2.2.2 East River Terminal

The East River Terminal is located along the East River downstream of Mayor's Point near downtown Brunswick. This terminal is used for dry and liquid bulk shipping. The chief commodity shipped from there is wood pellets, which is manufactured at the nearby sawmills and transferred via rail to the terminal for shipment. Logistec runs the East River bulk Terminal. They receive fertilizers, salt from the Bahamas, perlite (to produce ceiling tiles), Miracle-Gro, kitty litter, and bulk liquids. The perlite is shipped to Macon by train where it's used to make the tiles. In 2018, Logistec used 75 vessel calls to move 1,023,076 metric tons of bulk cargo through the East River terminal. In 2018, they shipped 650,000 tons of wood pellets to Europe for use as biofuel. They expect to ship 800,000 tons in 2019. They have 3 berths that are 36 feet deep. Typical maximum draft loaded for vessels there is 34 feet. This terminal sees about 1-2 ships a month. A turning basin adjacent to the docks allows vessels to be facing bow-out upon arrival, as shown in Figure 2-9. Vessels can be as small as 5,000 DWT, but typically don't exceed 40,000. These smaller vessels move on a Cuba, Middle East, and Europe rotation. The terminal has a 60-inch belt feeder that can load ships at the berths with a typical loading rate of 500 tons per hour.

Figure 2-9. East River Terminal and turning basin overview looking southeast. Courtesy: Georgia Ports Authority

2.2.3 Mayor's Point Terminal

The Mayor's Point terminal is also located on the East River near downtown Brunswick. This terminal has two berths that are 36 feet deep, have near dock rail, and specialize in breakbulk cargo. Historically, Speitoff has been a large customer for pulp shipments from the nearby Georgia Pacific and International Paper mills. This pulp is used to manufacture tissue paper and other paper products. Pulp is primarily a breakbulk commodity but can be loaded into containers as well. The primary shipper for pulp movements is G2 OCEAN and they are on a 20-day route from Houston to Mobile, Panama City, Brunswick, Wilmington, and then Northern Europe. The Mayor's Point terminal usually sees one ship a month. Also, from January through June, American Cruise Lines will call at the Mayor's Point Terminal and load or unload about 100 people.

Summary information for all Brunswick Harbor terminals is shown in Table 2-4.

	COLONEL'S ISLAND	MAYOR'S POINT	EAST RIVER
DISTANCE FROM SEA BUOY	15 nm	13 nm	12 nm
CHANNEL WIDTH	400 ft / 121.9 m	350 ft / 106.7 m	400 ft / 121.9 m
CHANNEL PROJECT DEPTH *at Mean Low Water (MLW)*	36 ft / 11 m	36 ft / 11 m	36 ft / 11 m
TIDAL RANGE	7.6 ft / 2.3 m	7.3 ft / 2.2 m	7.3 ft / 2.2 m
TURNING BASIN	900 to 1,400 ft 274.3 to 426.7m x 3,300 ft 1,005.8 m	1,100 ft x 4,700 ft 335.3 m x 1,432.6 m	1,100 ft x 4,700 ft 335.3 m x 1,432.6 m
BRIDGE VERTICAL CLEARANCE *at Mean High Water (MHW), high level, fixed span*	185 ft / 56.4 m	185 ft / 56.4 m	185 ft / 56.4 m
BRIDGE HORIZONTAL CLEARANCE	Unrestricted	Unrestricted	Unrestricted
CARGO HANDLED	Ro/Ro, Project Cargo	Breakbulk	Dry Bulk, Liquid Bulk
TOTAL BERTH LENGTH	3,355 ft / 1,022 m	1,200 ft / 366 m	1,600 ft / 488 m
TERMINAL ACREAGE	1,700+ acres / 688+ hectares	22 acres / 8.9 hectares	66 acres / 26.7 hectares

Table 2-4. Brunswick Harbor Terminals. **Source: Georgia Ports Authority, Brunswick Brochure, November 2018**

2.3 RO/RO Services

2.3.1 Existing RO/RO Terminals and Capabilities

All of Brunswick's RO/RO traffic is handled at the Colonel's Island terminal. Annual throughput capacity at the terminal is over 800,000 Car-equivalent Units (CEUs). Ongoing expansion projects at Colonel's Island are expected to add to this capacity with an additional dock and landside infrastructure improvements and are described in Section 3.1.1. Given forecasted vehicle growth during the study period, the Port of Brunswick is not expected to exceed future capacity estimates of approximately 1.5 million CEUs by the end of the study period.

2.3.2 Carriers and Trade Lanes

As of summer 2019, there were twelve RO/RO services at the Port. All these services call on the Colonel's Island terminal. Table 2-5 summarizes services that were considered for the economic evaluation, including the trade area/shipping line, carrier, and frequency at that time.

Trade Area/Line	Carrier	Frequency
Northeast/Southeast Asia		
Eukor	Inchcape Shipping	Fortnightly
Höegh Autoliners	Höegh Autoliners Inc.	Fortnightly
Hyundai Glovis	Hyundai Glovis	Monthly
"K" Line	"K" Line	Fortnightly
Liberty Global Logistics	Liberty Global Logistics	Inducement
MOL ACE	Norton Lilly International	Weekly
NYK RORO	Inchcape Shipping	Weekly
Nissan Motor Car Carrier Co.	Inchcape Shipping	Fortnightly
Wallenius Wilhelmsen Ocean	Wallenius Wilhelmsen Ocean	Fortnightly
Australia/New Zealand		
"K" Line	"K" Line	Fortnightly
Red Sea/Middle East		
Eukor	Inchcape Shipping	Monthly
Liberty Global Logistics	Liberty Global Logistics	Monthly
NYK RORO	Inchcape Shipping	Inducement
Wallenius Wilhelmsen Ocean	Wallenius Wilhelmsen Ocean	Monthly
Mediterranean		
Liberty Global Logistics	Liberty Global Logistics	Monthly
Northern Europe/UK/Ireland/Scandinavia/Baltic		
American RO/RO	Wallenius Wilhelmsen Ocean	Fortnightly
"K" Line	"K" Line	Weekly
MOL ACE	Norton Lilly International	Weekly
Wallenius Wilhelmsen Ocean	Wallenius Wilhelmsen Ocean	Weekly
Mexico		
American RO/RO	Wallenius Wilhelmsen Ocean	Monthly
Hyundai Glovis	Hyundai Glovis	Fortnightly
MOL ACE	Norton Lilly International	Fortnightly
Wallenius Wilhelmsen Ocean	Wallenius Wilhelmsen Ocean	Weekly
South/Central America		
MOL ACE	Norton Lilly International	Monthly
Wallenius Wilhelmsen Ocean	Wallenius Wilhelmsen Ocean	Weekly
Africa		
MOL ACE	Norton Lilly International	Monthly

The services and carriers presented in this table were current as of 2019.

Table 2-5. Port of Brunswick Colonel's Island Terminal RO/RO Services

Vehicle shippers employ a variety of routes to move goods around the world, and through Brunswick. Even one example of this shows the list of different ports a vessel may visit before and after their calls to Brunswick. The voyage is summarized in Table 2-11 below.

PORT	DAY	ACTIVITY
Panama Canal	1	Transit
Manzanillo, PAN	2	Discharge & Load
Brunswick, GA	6	Discharge & Load
Savannah, GA	7	Discharge & Load
Newport News, VA	9	Discharge
Baltimore, MD	10	Discharge & Load
Philadelphia, PA	12	Discharge
New York, NY	13	Discharge & Load
Zeebrugge, BEL	23	Discharge
Bremerhaven, GER	25	Discharge & Load
Zeebrugge, BEL	26	Load & Discharge
Southampton, UK	27	Discharge & Load
Bristol, UK	29	Load & Discharge
Savannah, GA	39	Discharge & Load
Manzanillo, PAN	43	Discharge & Load
Panama Canal	44	Transit
Port Hueneme, CA	52	Discharge & Load
Tacoma, WA	56	Discharge & Load
Yokohama, JPN	69	Discharge
Tianjin, CHN	73	Discharge

Table 2-11. Example RO/RO Vessel Route through Brunswick

As a result of this large network of pickups and deliveries, shippers rarely load or unload their full vehicle capacity at Brunswick. While many vessels have capacity for 6,000-8,000 CEUs, the maximum shipment seen in Brunswick in one time may be 2,000-2,500 CEUs. An average shipment for a typical RO/RO will transport approximately 1,300 CEU at Colonel's Island. Rarely will an on-load or offload extend for 24 hours, due to the International Longshoremen's Association's (ILA) stevedoring services. The local office has 350 members. Crews will range from 25 to 100 people. For reference, a 25-person crew can move 200 cars an hour, leading typical port calls to last between 4 -8 hours.

2.4 Historical Commerce

In 1980, the Brunswick Port Authority[3] contracted Booze Allen Hamilton (BAH) to conduct a study on which commodities to specialize in order to maximize future cargo growth. Due to the port's relatively shallow draft, BAH recommended focusing on auto receipts since the RO/RO fleet operates at shallower drafts than their bulk or container counterparts. Shortly thereafter, International Auto Processors (IAP) approached the port about importing Yugos. Yugos were imported and processed through the Port of Brunswick beginning in 1987. They continued moving vehicles through the port until Yugo went bankrupt during the Yugoslavian civil war due to a shortage of spare parts. By the end of 1987, multiple manufacturers had begun shipping vehicles into the Port of Brunswick.

[3] In 1988, the Brunswick Port Authority merged with the Georgia Port Authority.

There have been 21 different car manufacturers that have used the port of Brunswick over the years. These manufacturers are shown in Table 2-6, below.

Manufacturer	Import (I)	Export (E)	Both (I/E)
Yugo	X		
BMW			X
Mini/Cooper	X		
Rolls-Royce	X		
Hyundai			X
Kia			X
Mercedes-Benz			X
Toyota			X
Honda			X
General Motors (GM)			X
Maserati			X
Aston Martin	X		
Land Rover	X		
Range Rover	X		
Jaguar	X		
Subaru			X
Volvo			X
Audi	X		
Bentley	X		
Porsche	X		
Volkswagen		X	

Table 2-6. Car Manufacturers at Port of Brunswick

Auto processors, like IAP, are groups that receive vehicles from the ships and arrange for transport to the dealerships. They do not negotiate volume, which is done between the dealers and the manufacturers. The processors simply receive the vehicles and prepare them for final transport. They can paint, repair, upgrade vehicle software prior to final delivery, add floor mats, user's manuals and price tags, and stage vehicles to be shipped out either by truck or by rail based on orders negotiated between manufacturers and dealers. They store vehicles at the port as inventory for the dealers, but vehicles seldom sit in their lots for long.

There are currently four auto processors that do business in Brunswick: International Auto Processors (IAP), Vehicle Services of America (VSA), BMW North America, and Mercedes-Benz USA. Last year, Brunswick and Savannah moved approximately 650,000 CEUs. Of those, 90% were shipped out by truck, given the port's proximity to the Interstate. The rest were moved via rail. These rail movements included Mercedes-Benz shipments and Honda receipts that were shipped to distribution centers. Car manufacturers try to have their sales match their production rates, so they maintain as little excess inventory at the port as possible. Maximum sit time is 90 days, and this does not happen often. Typical turn time is 1-2 weeks. Ships usually arrive and offload the vehicles in the same day with a crew of 50 drivers from the local ILA.

Table 2-6 shows the rankings of North American vehicle ports by vehicles processed in 2018. The Port of Brunswick is the third largest vehicle port in the U.S. by volume, behind Baltimore and Jacksonville.

	Receipts	Shipments	Total
Veracruz, Mexico	445,576	571,385	1,016,961
Baltimore	620,377	229,770	850,147
Jacksonville	523,282	144,011	667,293
Brunswick (Including Savannah)	488,762	164,271	653,033
New York	509,035	63,644	572,679
San Diego	480,000	0	480,000
Lazaro Cardenas, Mexico	297,860	167,029	464,889
Vancouver, Canada	424,806	179	424,985
Portland	262,579	58,105	320,684
Port Hueneme	300,475	16,571	317,046
Total	**4,352,752**	**1,414,965**	**5,767,717**

Table 2-7. Vehicles Processed by Port in 2018, Car Equivalent Units (CEU) Source: Automotive Logistics, North American Ports Survey, 2019.

Volumes of vehicles shipped at Brunswick have increased substantially since 2003. Impacts of the 2008 recession were observed minimally at the Port of Brunswick. Vehicle tonnage volumes were at their lowest point in 2009, but quickly rebounded.

As Figure 2-11 below shows, volumes have more than doubled from 2007 to 2018.

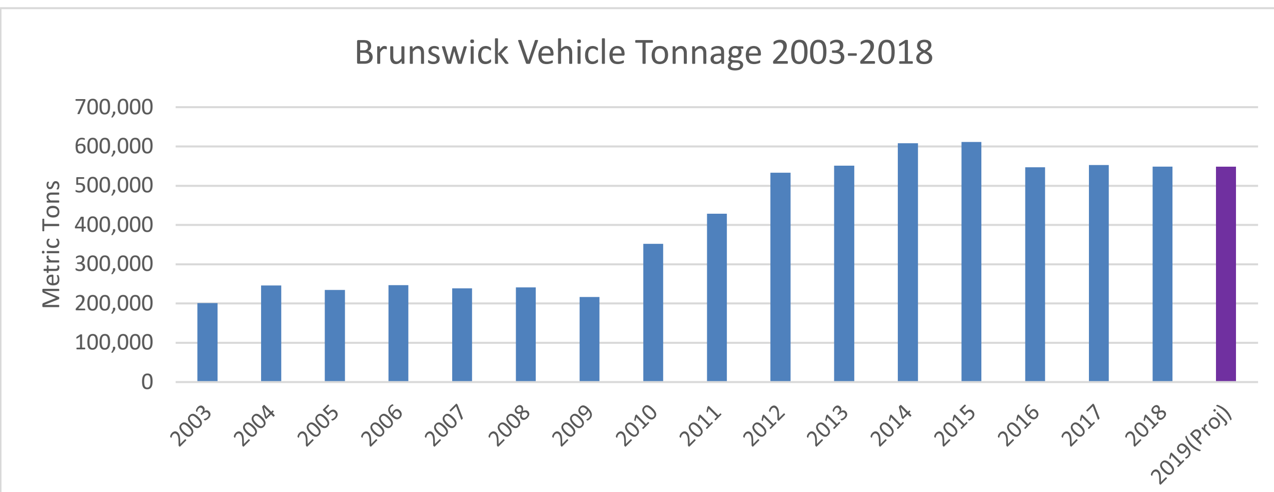


Figure 2-11. Brunswick Vehicle throughput, 2003-2018. Source: U.S. Census Bureau, Economic Indicators Division, Foreign Trade Statistics, accessed January 6, 2020

Volumes of vehicles have plateaued in Brunswick since 2015, as well as in the nearby Port of Jacksonville. Figure 2-12 shows vehicle volumes at Jacksonville from 2009-2018. As shown in the figure, volumes have decreased by 3.8 percent since 2017; however, current reports show that volumes are up more than 6 percent as of the first half of 2019.[4]

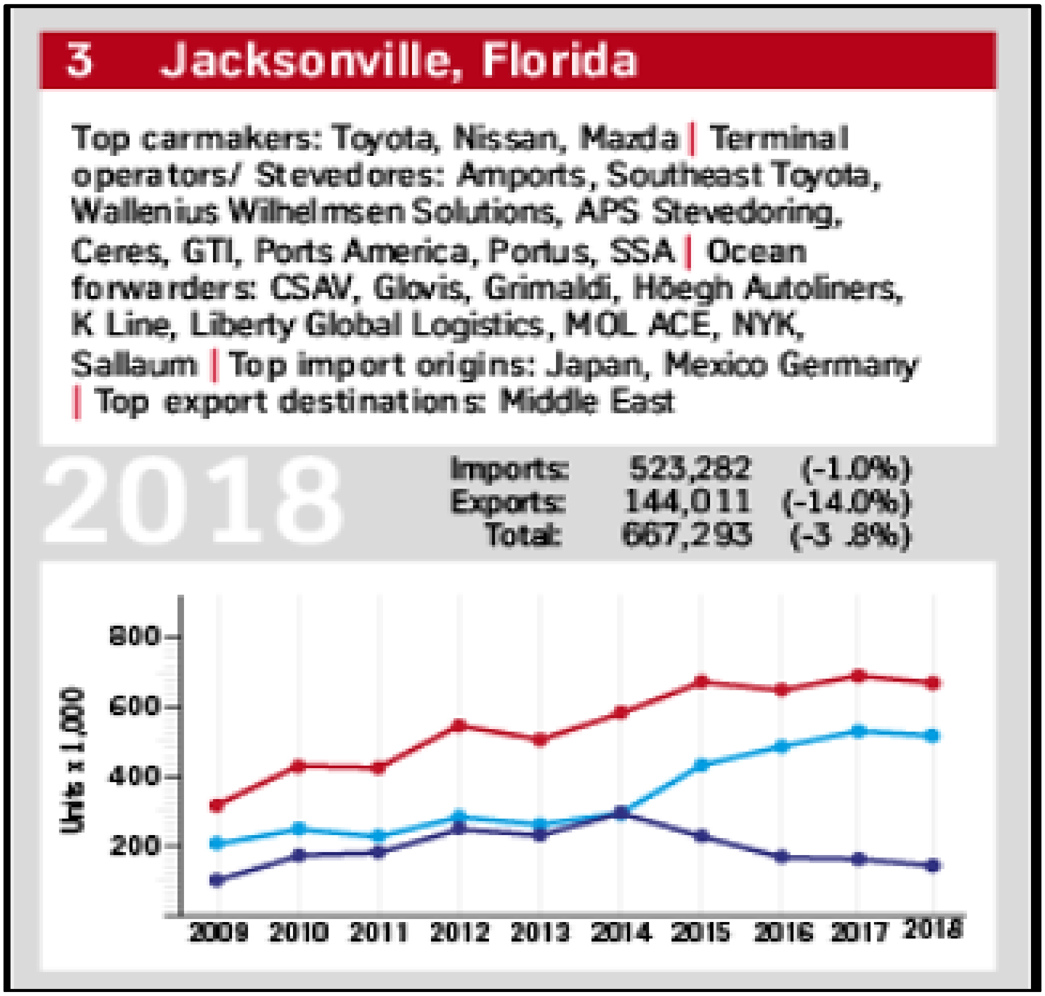


Figure 2-12. Vehicle throughput by CEU at Jacksonville 2009-2018, Source: Automotive Logistics, North American Ports Survey, 2019.

Baltimore, however, has seen steady increases over that time. Figure 2-13 shows vehicle volumes at Baltimore from 2009-2018.

[4] Automotive Logistics, "Baltimore and Jacksonville handling higher vehicle volumes," https://www.automotivelogistics.media/news/baltimore-and-jacksonville-handling-higher-vehicle-volumes/38771.article, July 24, 2019.

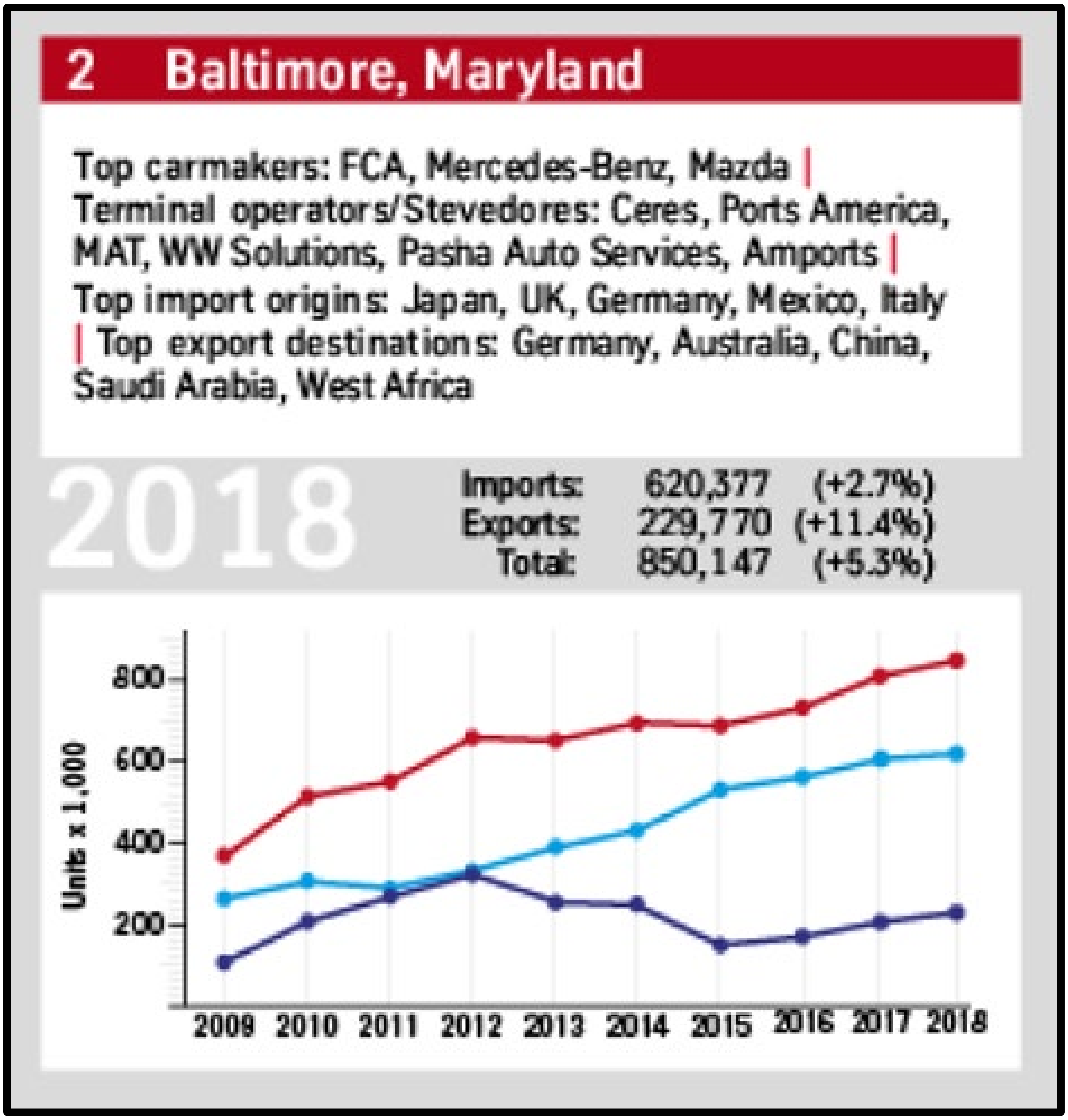


Figure 2-13. Vehicle throughput by CEU at Baltimore 2009-2018, Source: Automotive Logistics, North American Ports Survey, 2019.

Through the first five months of 2019, Baltimore's volumes are up 8 percent, Jacksonville is up 6 percent[5], and Brunswick is down 4.5 percent, according to Census Bureau totals. Currently, Brunswick is on pace for an annual decrease of 3.6 percent in vehicle volumes shipped. This would be after a 1.0 percent decline in volumes in 2018.

[5] Ibid.

Total U.S. vehicle tonnage has been increasing every year since 2009, where there was a sharp decline in tonnage due to impacts of the recession. Increases since 2015 have been smaller, suggesting a slowdown in the market as a whole. Both of these effects can be seen in Figure 2-14 below. Totals are projected to continue to slightly increase in 2019.

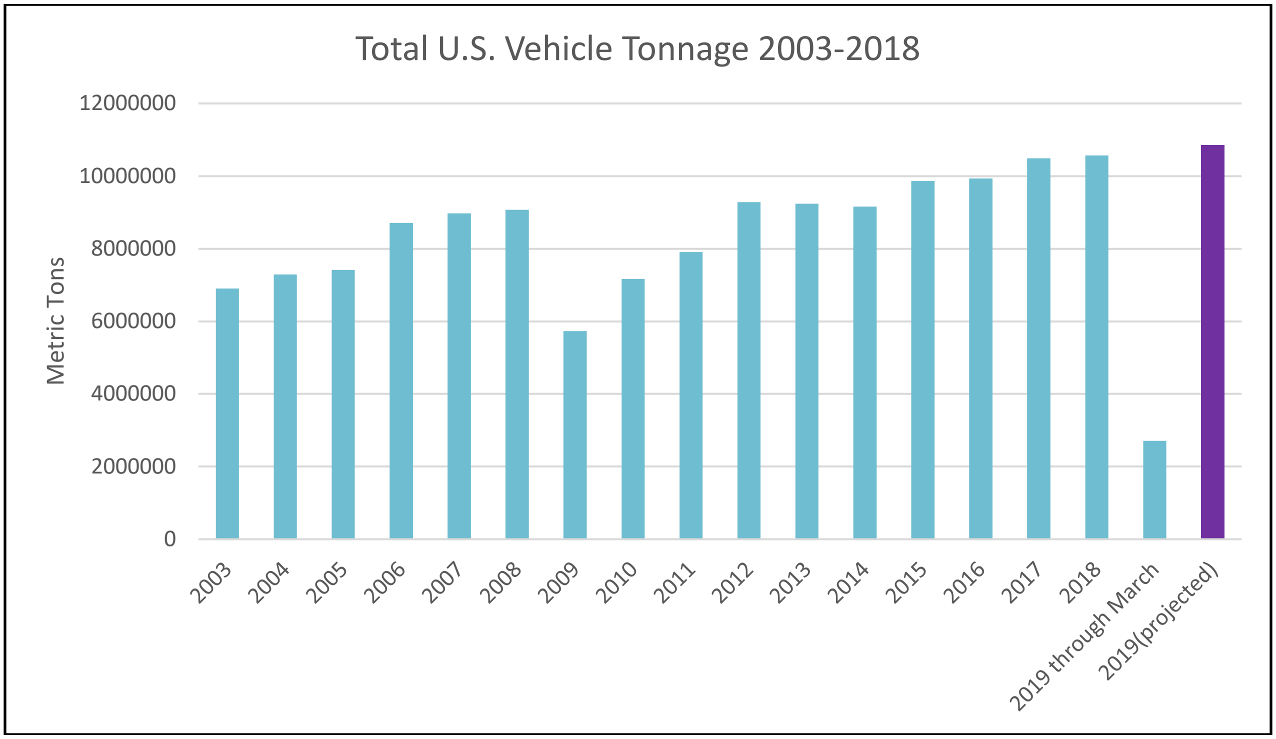


Figure 2-14. U.S Total Vehicle throughput, 2003-2018. Source: U.S. Census Bureau, Economic Indicators Division, Foreign Trade Statistics, accessed July 24, 2019

So, tonnage at southeastern ports like Brunswick and Jacksonville have remained strong, but plateaued in recent years, despite continued slight national growth and growth in other regions, like the northeast. This could be due to logistical constraints or market saturations in the overall U.S. southeast. Volumes elsewhere in the southeast, in places like Charleston, have also plateaued since 2015, as shown in Table 2-7 below.

Charleston, SC RO/RO Tonnage Totals	**Metric Tons (MT)**
2012	485,771
2013	461,936
2014	525,462
2015	540,656
2016	543,925
2017	398,026

Table 2-7. Total Metric Tons shipped via RO/RO Vessels at Charleston, SC, 2012-2017. Source: National Navigation Operation & Management Performance Evaluation & Assessment System, 2019

This plateau effect could also be due to greater volumes being shipped by smaller ports like Port Everglades or Port Canaveral. In Florida alone, there are five ports that handled significant amounts of CEUs in 2018, as shown in Table 2-8 below.

Organization	City/Town	2018 CEU
JAXPORT	Jacksonville, FL	649,876
Port Everglades, Broward County	Ft. Lauderdale, FL	35,795
Canaveral Port Authority	Cape Canaveral, FL	20,747
Port of Palm Beach District	Riviera Beach, FL	11,650
Port Tampa Bay	Tampa, FL	8,500

Table 2-8. Total vehicles processed in 2018 at Florida ports, Source: American Association of Ports Authority, 2018.

Figure 2-14 below shows the change in CEU volumes moved through Brunswick and Savannah since 2009.

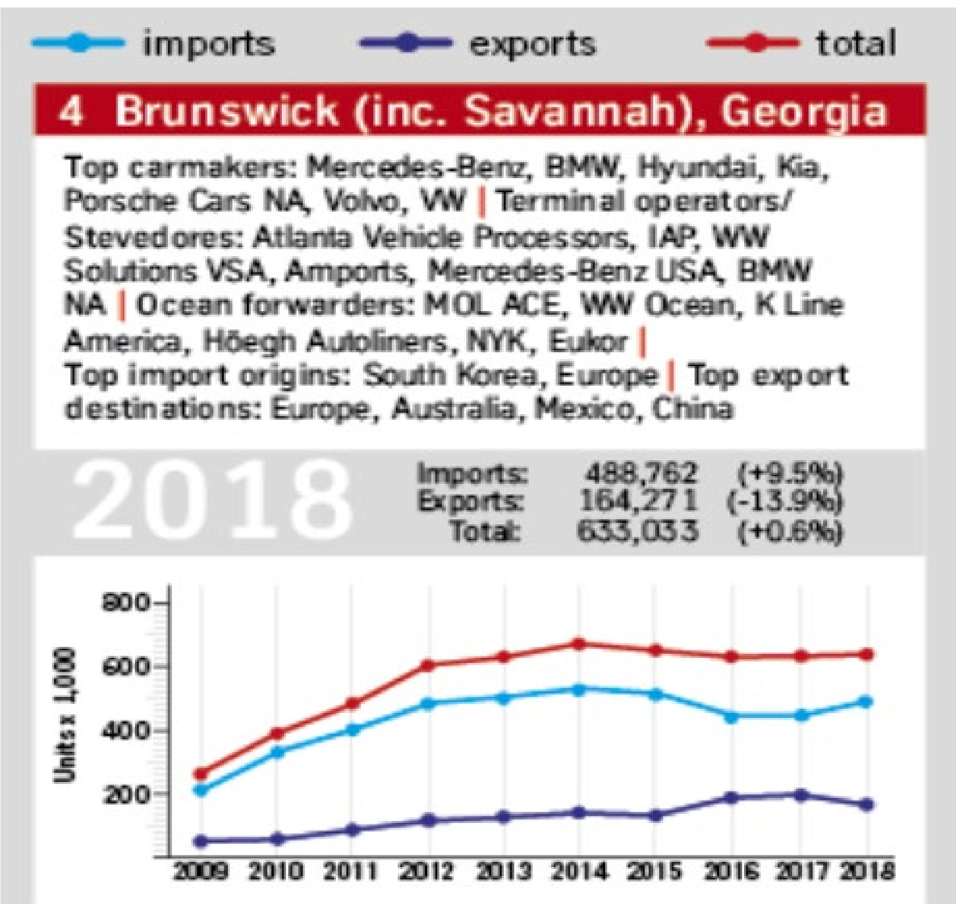


Figure 2-14. Vehicle throughput by CEU at Brunswick 2009-2018, Source: Automotive Logistics, North American Ports Survey, 2019.

Given the relatively flat volumes at Brunswick, there were fluctuations in the number of vessel calls, but only a 5 percent overall reduction in the total number of calls since 2015. Table 2-9 below shows the total vessel calls at Brunswick from 2015-2018.

Year	Number of Vessel Calls	Percent change
2015	466	-
2016	432	-7.2
2017	404	-6.5
2018	446	10.4

Table 2-9. Total Vessel Calls at Brunswick 2015-2018, Source: National Navigation Operation & Management Performance Evaluation & Assessment System, 2019

Table 2-10 below shows vessel calls in the nearby port of Jacksonville. Calls here seem to mirror the trends seen in Brunswick since 2015, as they are fluctuating with a corresponding plateau in CEU volumes.

Year	Number of Vessel Calls	Percent change
2015	666	-
2016	642	-3.6
2017	608	-5.3

Table 2-10. Total Vessel Calls at Jacksonville 2015-2017, Source: National Navigation Operation & Management Performance Evaluation & Assessment System, 2019

Calls in Baltimore have been decreasing, despite the volumes there increasing every year. Table 2-11 below shows vessel calls in Baltimore since 2015.

Year	Number of Vessel Calls	Percent change
2015	774	-
2016	752	-2.8
2017	699	-7.0

Table 2-11. Total Vessel Calls at Baltimore 2015-2017, Source: National Navigation Operation & Management Performance Evaluation & Assessment System, 2019

2.5 Existing Fleet

The vessel fleet moving vehicles is essentially the same at Brunswick as it is elsewhere in the U.S. Recall the vessel schedule in Section 2.3.2, where one vessel would call multiple ports throughout the U.S. on a single voyage. This fleet can accommodate both increases and decreases in cargo volume, suggesting that shippers were reducing total fleet capacity over the years 2016-2018.

RO/RO vessels are broken up into two categories historically: Conventional RO/RO and Vehicle Carriers. The RO/RO's that call on Brunswick are primarily Vehicle Carriers. Only the Mk IV and Mk V classes are considered Conventional RO/RO's. This is an important difference since the categories have behaved differently over the last 20 years. While both categories have seen shrinking fleets, the Conventional RO/RO segment has contracted significantly since 2010, declining by over 170 ships, or 45 percent[6]. Vehicle Carriers have increased in number each year from 2010 to 2015. However, in 2016, the fleet

[6] Deepsea RO/RO Shipping II: Operators, Ships, and Trades. Dynamar B.V. August 2017; https://www.maritime-executive.com/article/understanding-deepsea-roro-shipping, October 2017.

shrank by 8 ships, or 1.5 percent[7]. Conventional RO/RO's were the dominant deep-sea RO/RO carrier since its inception in the 1960's. They were seen as solutions to shipping cargo to places where handling costs were high, port turnaround slow, or port facilities limited[8]. They were small and versatile, and were used worldwide. As the developing world has become significantly more developed over the last 20 years, port infrastructure has improved worldwide. This has led to increases in cargo demand and simultaneous decreases in handling costs. Now, vessels with more capacity and an ability to capture profit margins at lower freight rates were necessary. For vehicle shipping, Vehicle Carriers offered this advantage. Their increased capacity and efficiency enabled shippers to take advantage of economies of scale to operate within smaller margins brought about by lower rates.

Currently, the port of Brunswick receives approximately 40 RO/RO vessels a month at the Colonel's Island terminal. The first Vehicle Carrier that called on Brunswick back in 1987 was a pure car carrier (PCC) that had fixed decks. The authorized Federal channel in Brunswick Harbor Channel is 36' deep (MLLW) by 400' wide. The current channel was deepened in the 1990s for a RO/RO design vessel with dimensions of 660 feet long and 106 feet wide. Today, longer and wider vessels use the channel. Vessels up to 870' long or 134' wide have called on the Colonel's Island terminal to move vehicles. The current fleet of RO/RO vessels are broken up into two categories (Conventional RO/RO and Vehicle Carriers) with five different classes.

- Pure car and truck carriers (PCTC) are the oldest and most prolific class of Vehicle Carrier, having been used since 1995 or before. They are approximately 200 meters (660') in length and have a car equivalent unit (CEU) capacity of 6,600. They provide flexible and efficient operations. This was the previous study's design vessel.

- Large car and truck carriers (LCTC) are longer than a PCTC at around 750' long. These are a slightly newer class that entered use around 2000. They also have a higher loading ramp and deck capacity, expanding the range of cargo that can be transported. They have a CEU capacity of up to 7,900.

- The Mk IV & Mk V classes are heavy Conventional RO/RO vessels with extreme ramp and deck capacity—up to 500 tons. These were designed more specifically for the carriage of heavy equipment and breakbulk cargo while retaining significant car capacity (5,500-6,000 CEU). Mk IV's entered use around 2000, while Mk V's around 2010. They can be between 800-870' long and 106' wide.

- High Efficiency RO/RO (HERO) carriers are the newest, most advanced, Post-Panamax Vehicle Carrier, combining elements of all other vessel types. The typical HERO vessel is about 660' long, has the capacity of an LCTC (7,600 – 8,000 CEU) and capability similar to an Mk IV, all in a highly efficient design. Its width is designed for the expanded locks of the Panama Canal, ranging from 120 to 134' wide. This class entered use in 2015.

[7] ibid
[8] Ibid.

Table 2-12 shows typical vessel characteristics of the five classes of RO/RO vessels that currently utilize the channel. The bottom four rows display how often each of the five classes of RO/RO vessels called on the port from 2015-2018.

Class	**PCTC**	**LCTC**	**Mk IV**	**Mk V**	**HERO**
LOA	650-671 ft	747-763 ft	789-803 ft	868-870 ft	655-656 ft
Beam	77-107 ft	105-107 ft	105-106 ft	105-107 ft	114-134 ft
2015 calls	393	65	5	1	2
2016 calls	315	69	4	9	35
2017 calls	299	60	1	5	39
2018 calls	325	68	0	0	53

Table 1-12. Brunswick Harbor Vessel Characteristics and Port Calls (Sources: National Navigation Operation & Management Performance Evaluation & Assessment System, 2019; Georgia Port Authority, 2019)

PCTC are still the predominant class used in Brunswick, accounting for an average of 77% of RO/RO vessel calls between 2015 and 2018, but the number of HERO vessels is on the rise, accounting for an average of 7% of RO/RO calls within the same time period and 12% in 2018.

Table 2-13 and Figure 2-14 display percent of RO/RO cargo moved by each vessel class for years 2015 to 2018. Total cargo movements on LCTC or larger RO/RO's grew from 10 percent in 2015 to 33 percent in 2018.

	2015	**2016**	**2017**	**2018**
Receipt				
PCTC	86%	57.5%	58.9%	64%
LCTC	12%	23%	20%	16%
Mk IV	1.8%	0.5%	0.1%	0%
Mk V	0.01%	3%	1%	0%
HERO	0%	16%	20%	20%
Shipment				
PCTC	95%	80%	73.9%	72%
LCTC	5%	13%	13%	12%
Mk IV	0.2%	0%	0%	0%
Mk V	0%	0.9%	0.1%	0%
HERO	0%	6%	13%	16%
Total				
PCTC	90%	63%	64%	66%
LCTC	9%	19%	17%	15%
Mk IV	1%	0.3%	0%	0%
Mk V	0.01%	2.3%	0.6%	0%
HERO	0%	15%	18%	18%

Table 2-13. Percent Cargo by Vessel Class, 2015-2018

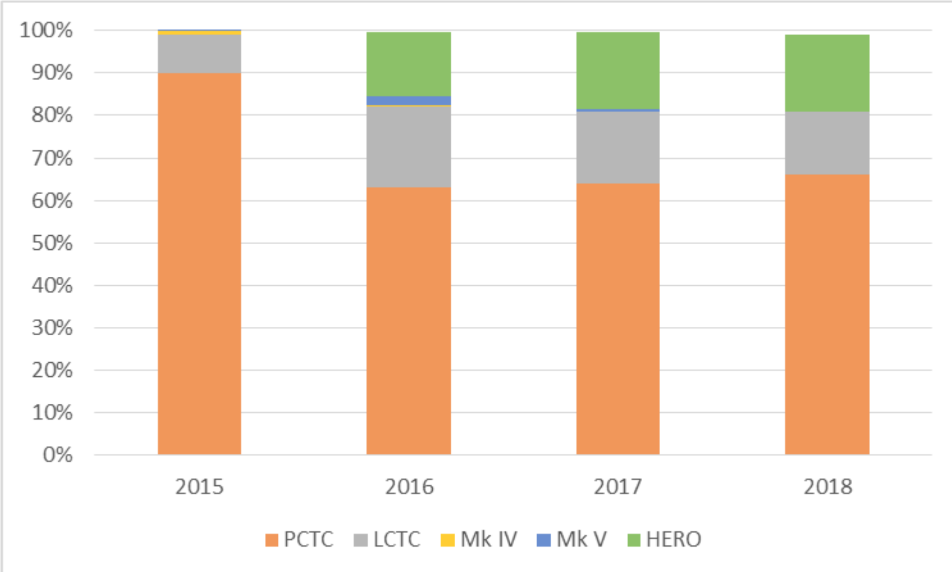


Figure 2-14. Total Tonnage by Vessel Class, 2015-2018

2.6 Shipping Operations

2.6.1 Navigational Guidelines

The Brunswick Bar Pilots, with the concurrence of various maritime interests, have established voluntary navigational safety guidelines for the Port of Brunswick. These guidelines are intended to minimize the risk of collision or grounding by vessels using the various waterways associated with the Port of Brunswick. The pilots have guidelines for vessel operations depending on RO/RO vessel length and draft. Since the channel is 400' wide, traffic is one-way inside the channels. Large tides and strong resulting currents can cause navigation issues for larger vessels transiting to and from Colonel's Island. Vessels destined for one of the three berths there, each parallel to the south bank of the South Brunswick River, must transit from the Turtle River via a 0.9-mile channel approximately 400 feet wide. Vehicle carriers calling at this facility are brought up the full length of the channel stern first with tug assistance. Docking and undocking with vessels greater than 700 feet long that are destined for Colonel's Island will have a tide and current restriction. They can only be inbound at slack water on a high tide. All RO/RO vessels are susceptible to the wind due to their tall sail area, so any RO/RO vessel heading to or from Colonel's Island may face delays when sustained winds are greater than 20 knots. Docking and undocking is typically not attempted whenever the wind is from the northeast at 25 knots or greater[9]. While the pilots do not have a hard rule on maximum draft due to fluctuating maintenance dredging requirements, vessels that do exceed 32 feet of draft may experience delays due to waiting on high tide before beginning their transits.

2.6.2 Tidal Range

USACE conducts annual dredging of the navigation channels and maneuvering basins. The GPA is responsible for dredging of berthing areas in front of the sheet pile docks. Tides in Brunswick are diurnal in type. The mean tidal range published by NOAA for Brunswick, Georgia is 6.62 feet. The great diurnal tidal range is 7.2 feet. With that much tide, current velocities have kept sediment from significantly accumulating in the channel. Figure 12 shows the historic tidal datum measured at Brunswick. For reference, St. Simons Island is at the entrance to Brunswick Harbor.

[9] NOAA Coast Pilot, 2019.

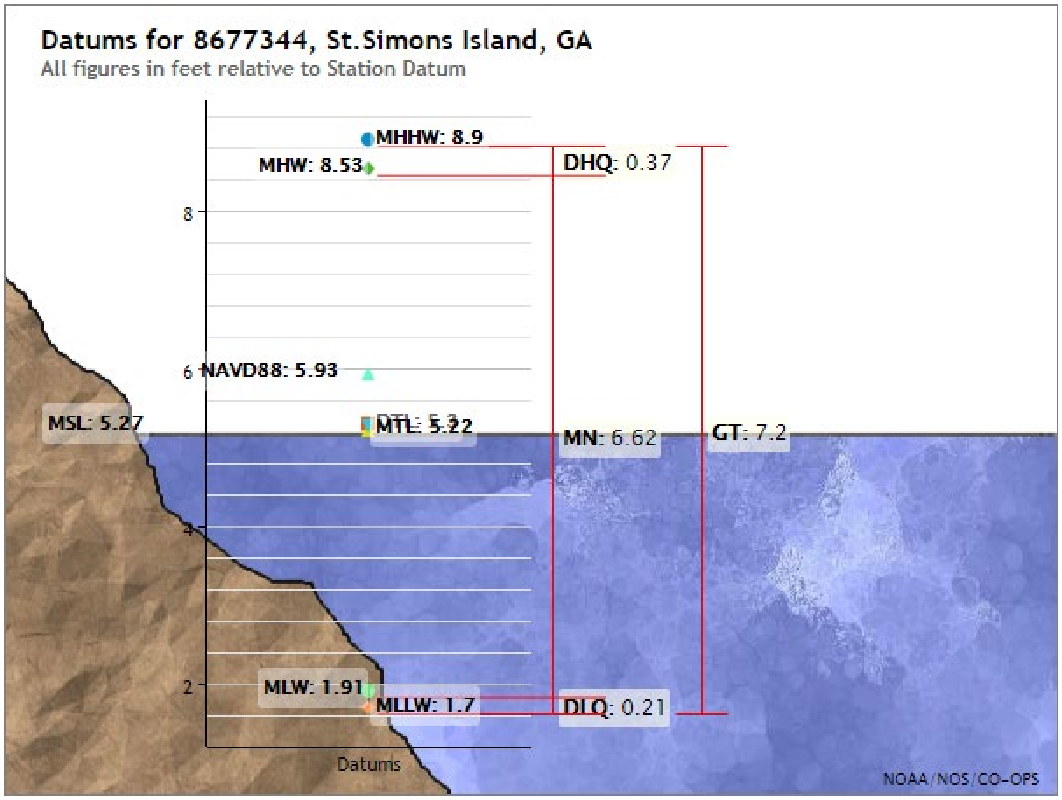


Figure 1. Tidal Datum in Brunswick, 1983-2001 Source: NOAA Tides and Currents, 2011

2.6.3 Current Range

Tidal currents normally follow the general direction of the entrance channel across the bar with a velocity of 2 knots. During northeasterly weather there is a strong southerly set across the bar channel and in southeasterly weather a strong northerly set.

With such a large tidal swing, the currents in the rivers inside the harbor at Brunswick can be large as well. Harbor Pilots have encountered flows as fast as 4 knots at the turning basin near the Colonel's Island terminal. The only active current station near Brunswick is in the Savannah River. However, the data is very similar in frequency and magnitude to what occurs at Brunswick, so it can be used as a substitute. Figure 13 below shows the current data for the Savannah River entrance. While extremes can see a 4 knot ebb or flood current, most of the range is between +/- 3 knots. This is also typical of Brunswick.

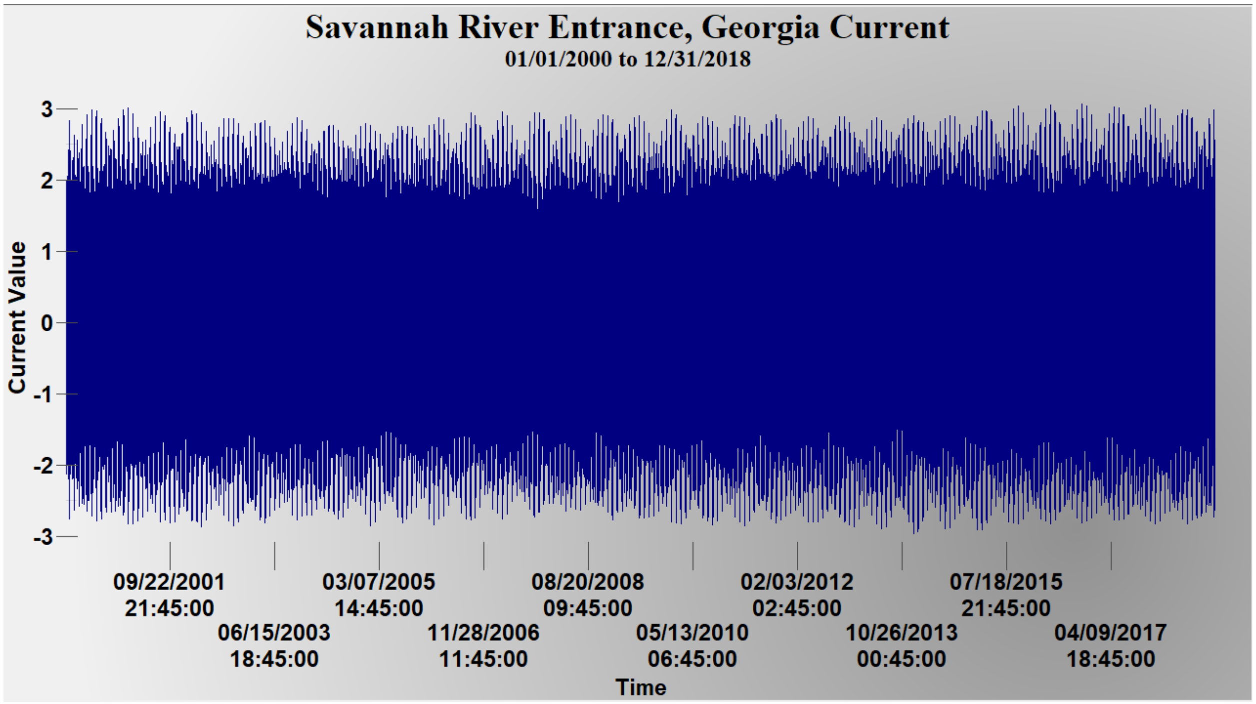


Figure 13. Historical Current Data for Savannah, GA 2000-2018, Source: IWR Tide Tool, MDR Tide Engine, www.wtides.com

2.6.4 Wind Range

Figure 14 below shows wind data from January to February 2019 at Fort Pulaski, GA, near the entrance to the Savannah River. This is the only NOAA meteorological station on coastal Georgia, but it sees similar conditions to those in Brunswick, so it also can be used as a substitute.

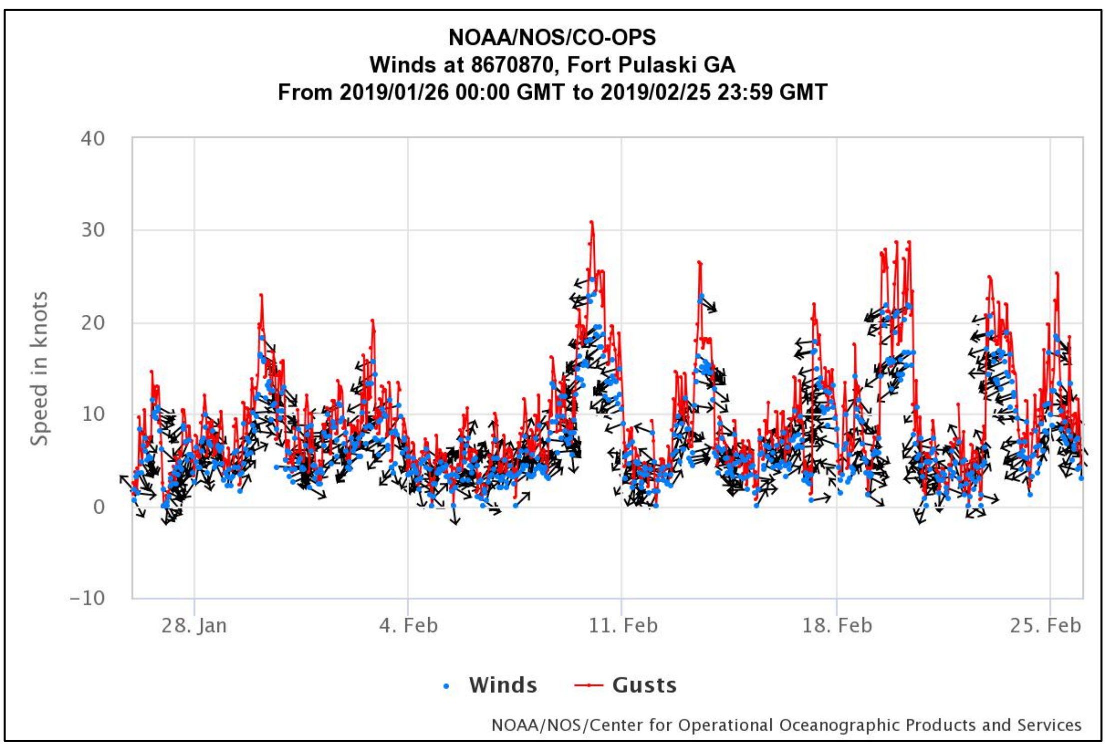


Figure 14. Wind data for Savannah, GA, Jan-Feb 2019

As shown in Figure 15 below, the strongest winds at Brunswick are oriented from the northeast and northwest. Maximum sustained winds are typically seen from these directions at 25-27 knots, with gusts from 30-35 knots. The most frequent winds are seen out of the northeast and southwest, as shown in the peaks in the blue line in the graph. Southwesterly winds are typically around 10 knots, gusting up to 15. Pilot restrictions are that any RO/RO vessel cannot transit to Colonel's Island with sustained winds of greater than 20 knots. From January to February 2019, there were 7,415 wind observations made every 6 minutes at this station. Of those observations, 160 were greater than 20 knots, or 2 percent. Winds are typically stronger in the winter months, so these would represent the higher end of the spectrum of annual wind data and the wind-driven vessel delays.

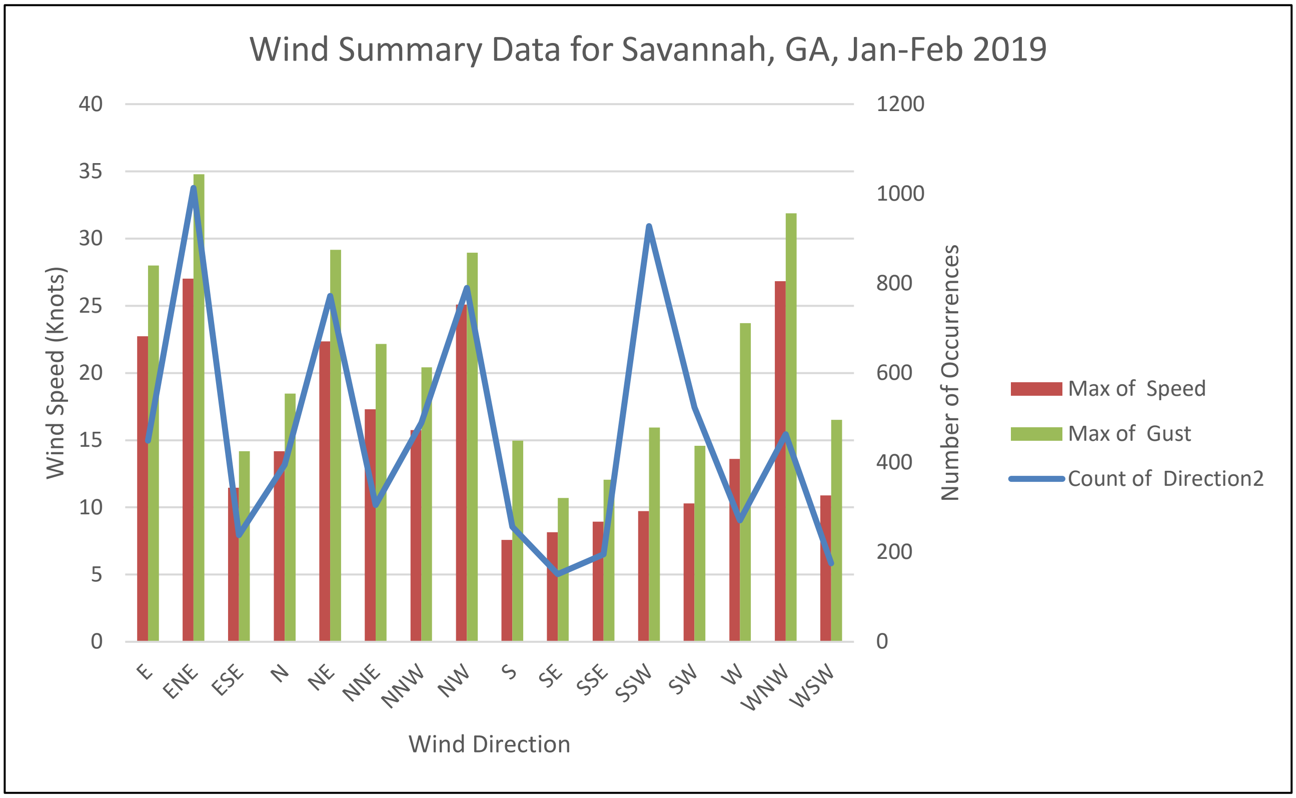


Figure 15. Wind Summary Data for Savannah, GA Jan-Feb 2019. Source: NOAA/NOS/CO-OPS, 2019.

2.6.5 Current Delays

Table 2-11 summarizes the limitations on vessel size for Brunswick Harbor. As an example, a vessel with a length of 700 feet can only transit into or out of the harbor four hours per day given current restrictions at the Cedar Hammock range (where the proposed bend widener is located) and the turning basin.

Table 2-11. Current Limitations on Port of Brunswick Vessel Size

Brunswick Harbor		
Hours/Day available for transit	**Vessel Length (feet)**	**Vessel Width (feet)**
4	660	125
4	700	106
4	800	106

2.7 Design Vessel

"For deep-draft projects, the design ship or ships is/are selected on the basis of economic studies of the types and sizes of the ship fleet expected to use the proposed channel over the project life. The design ship is chosen as the maximum or near maximum size ship in the forecasted fleet" (USACE 1984, 1995, 1999).

For Brunswick, the economics and coastal hydraulics team recommended consideration of the HERO class of RO/RO design vessel. The specifications for the recommended design vessel are as follows:

High Efficiency RO/RO (HERO)

- 114 to 134 feet in beam (extreme breadth (XB))
- 660 feet length over all (LOA)
- Nominal CEU capacity of 7,600 to 8,000
- Deadweight rating of approximately 21,000 metric tons

Studies for Brunswick Harbor are primarily based on the anticipated service regime for future vehicle carrier movements with consideration of PCTC, LCTC, Mk IV/V, and HERO hull designs or specifications. In this context current Panama Canal standards associated with capacity of the new lock system formally allow for vessels up to 160 feet in breadth and 1,200 feet in length.

3 Future Conditions

3.1 Terminal Expansion

Over the last couple of years, 806 acres have been developed specifically for vehicle processing and a further 355 acres have been permitted for development, which is now underway. According to GPA, there are now 61 dockside acres that have been redeveloped for RO/RO cargoes (the former bulk grain terminal), with a fourth berth permitted for Colonel's Island. In addition, there are currently upgrades underway to allow Berth 2 to accommodate larger post-Panamax vessels. Figure 3-1 shows a summary of improvements made to the Colonel's Island terminal.

Figure 3-1 Improvements to Colonel's Island

Improvements to Colonel's Island Auto Terminal at the port of Brunswick

- 189 additional acres developed for vehicle storage, increasing parking slots from 60,000 units to 90,000 units
- New lights added to the Myd Harris railyard
- Two roundabouts built to accommodate the smooth flow of traffic throughout the terminal
- Connector road built to improve by 20% the movement of vehicles to the south side properties
- Relocation of Gate 2
- Funds approved for the design of future rail expansion on a 55-acre site
- Three additional loading and unloading vehicle pads planned on two loop tracks behind Berth 2
- Re-development of the 61-acre site of the former Bulk Terminal behind Berth 2

3.2 Commodity Forecast

3.2.1 Baseline

An essential step when evaluating navigation improvements is to analyze the types and volumes of cargo moving through the port. Trends in cargo history can offer insights into a port's long-term trade forecasts and thus the estimated cargo volume upon which future vessel calls are based. Under future without and future with project conditions, the same volume of cargo is assumed to move through Brunswick Harbor. However, a project will allow shippers to operate their vessels more efficiently. This efficiency translates to savings and is the main driver of National Economic Development (NED) benefits.

The year 2017 is the most recent year for which complete data was obtained for cargo, to include origins and destinations. To minimize the impact of potential anomalies in trade volumes on long-term forecasts, multiple years of data were averaged to establish the baseline tonnage volume for the commodity forecast. Historical data dating back to 2007 was available for developing the baseline. A three-year average of the 2015-2017 data was eventually used as the baseline, given the changes in global trade routes to and from Brunswick over that period. Many cargo routes to and from Brunswick carried significantly lower tonnage prior to 2015, so including previous time periods would artificially lower the baseline (average) tonnage data from those regions. Also, the data from 2015-2017 captures plateaus in volumes experienced since 2013.

3.2.1.1 Vehicle Receipts

Table 3-1 illustrates historical vehicles received at the Port of Brunswick from 2007 to 2017. Since 2013, overall international receipts have declined from nearly 800,000 to 660,000 metric tons in 2017. It should be noted that receipts did increase in 2017 over 2016, both in terms of weight and CEUs. The majority of the Brunswick market is trade with Europe, Africa, and the Middle East. For purposes of this analysis, trade with these regions will be referred to as the trans-Atlantic trade route. Trans-Atlantic trade accounts for about 60 percent of receipt tonnage. A high percentage of Brunswick's receipts are either passenger vehicles or "high and heavy cargo" that are construction vehicles. Average receipts from 2015-2017, from all world regions, were estimated to total 666,000 metric tons, and was used to represent the baseline from which forecasted commerce was projected.

Table 3-1. Historical Vehicle Receipts (Metric Tons)

Route Group	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average 2015-2017
Route 1: Asia and Oceana	190,398	163,313	124,510	153,343	211,613	232,750	234,857	193,376	179,732	251,098	242,123	224,318
Route 2: Europe, Africa and Middle East	214,296	242,677	220,644	401,668	416,096	477,916	494,351	506,380	473,946	392,583	405,844	424,124
Route 3: Mexico and Latin America	32,284	27,966	24,103	43,025	54,900	70,543	64,781	69,630	26,497	11,560	14,032	17,363
Total	436,978	433,956	369,257	598,036	682,609	781,209	793,989	769,386	680,175	655,241	661,999	665,805

3.2.1.2 Vehicle Shipments

Table 3-2 displays historical vehicles shipped from the Port of Brunswick from 2007 to 2017. Since 2007, overall international shipments have increased from 250,000 to 332,000 in 2017. As with receipts, trans-Atlantic trade accounts for nearly 60 percent of shipment tonnage. Average shipments to all world regions were estimated to total 320,000 metric tons and was used to represent the baseline from which forecasted commerce was projected.

Table 3-2. Historical Vehicle Shipments (Metric Tons)

Route Group	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average 2015-2017
Route 1: Asia and Oceana	4,581	4,350	2,314	37,116	68,712	86,657	124,837	108,293	126,557	131,774	134,121	130,817
Route 2: Europe, Africa and Middle East	243,777	212,692	119,057	155,175	156,885	233,547	202,473	160,565	145,533	189,875	166,194	167,200
Route 3: Mexico and Latin America	2	818	-	4,334	6,109	4,968	22	4,232	15,506	18,724	31,650	21,960
Total	248,360	217,860	121,371	196,625	231,706	325,172	327,332	273,090	287,596	340,373	331,965	319,978

Table 3-3 summarizes the baseline for both receipts and shipments by world region and service route.

Table 3-3. Brunswick Harbor Baseline Commodity Forecast (Metric Tons)

Route Group	Receipts	Shipments	Total
Route 1: Asia and Oceania	224,318	130,817	355,135
Route 2: Europe, Africa, and Middle East	424,124	167,200	591,324
Route 3: Mexico and Latin America	17,363	21,960	39,323
Total	665,805	319,978	985,782

3.3.2 State of Global Automotive Trade

Before addressing how vehicle volumes may behave in the future, it's important to examine the underpinning of the vehicle market today. The factors that have affected vehicle manufacturing, and thus movement, may not be the same as they will be in the future. These factors, and their effects on the vehicle trade must be understood prior to making any estimates.

Global automotive manufacturers are currently facing sharply declining global vehicle sales and diminishing profits. A mix of factors including expensive investments in powertrain and digital technologies, tightening regulatory requirements for emissions, pressure from trade wars and slowing economic growth are combining to challenge the established business and operational models of most carmakers. The result is already reshaping the industry, including shifting sales from new to used vehicles, changing model mixes, shared investment and development costs, as well as job and production cuts in some areas. Further, more dramatic change is likely.10

Slowing economic growth has exposed many auto manufacturers to growing risks. Leading economies such and Germany, Japan, the U.K. and the U.S. are slowing and showing some of the early signs of recession. Eurozone sales are in decline with demand for new passenger cars down by 3.1% in 2019. In the U.K., the Society of Motor Manufacturers and Traders (SMMT) reports that the country's vehicle sales are down 3.5%, with car production down 18.9%. However, the sharp drop in global vehicle sales is mainly due to slowing GDP growth in China, the world's largest national car market. The China Association of Automobile Manufacturers (CAAM) has lowered its forecast for China's 2019 full year new sales from 28 million units to 26.68 million, a 4.7% decline from its 2018 total. That would mark a

[10] Harrison, Daniel: "Automotive headwinds align into a perfect storm," Ultima Media, Ltd. September 2019, p. 4.

second year of decline in vehicle sales after 2018 saw China's first drop in decades.11

Part of this drop in demand is attributed to ongoing U.S. sanctions on China, and the trade disputes between the U.S. and China are a source of significant uncertainty going forward. Also, the risk of a "no-deal" Brexit scenario is worrying British and European manufacturers with potential tariffs and supply chain problems. As a consequence, according to the SMMT, automotive investment has collapsed in the U.K. to just £90M in the first six months of 2019, down 74% from £347M in 2018. Instead, U.K. companies have invested at least £330M in contingency planning for Brexit – at a time when working capital is dwindling due to falling sales and squeezed margins. With operating margins in the industry typically in the range of 4-8%, it has only taken a slight downturn in sales and uncertainties in trade to hit profitability hard. This subsequently reduces liquidity and room to maneuver just at a time when there is intense pressure on manufacturers to invest in transitioning to electric vehicles (EV), autonomous vehicles, connected cars, and advanced safety features.[12]

This pressure to invest in these technologies stems from the global effort to enact regulations aimed at reducing carbon dioxide emissions. There are many different plans and policies throughout the globe to begin tackling this, which creates its own kind of risk for manufacturers. To mitigate this, auto makers base the cost to develop this technology on the regional market which has the strictest emissions plan. American auto makers typically use California's state standards, but globally, the European Union's are the strictest.[13] Attempting to build to these standards amounts to a structural change in the auto making industry. Auto makers are investing in the equipment and other technology to build new vehicles to meet or exceed these EU standards. These re-tooling and re-fitting efforts are considerably expensive, and occurring simultaneously with shrinking profit margins from external forces. Also, the powertrains and vehicle materials themselves that will comply with these new regulations are more expensive than traditional internal combustion engine (ICE) vehicles. Electric vehicles (EV) currently cost an average of around $12,000 more to produce than the equivalent ICE vehicle, costs which are difficult to pass onto the consumer.[14] The economies of scale haven't materialized with the large-scale production of electric vehicles like they have with ICE vehicles, adding to the higher cost of production. It may be four to five years before this occurs. In the meantime, auto makers will absorb these losses as well.

One way that manufacturers are mitigating this lack of scale is by industry consolidation through mergers and acquisitions (M&A). A clear example of this is the merger of Fiat-Chrysler Automobile (FCA) and Groupe PSA in December 2019. This combination will create the fourth largest carmaker by volume, and the third largest by revenue. The companies said the merger would enable it to enhance purchasing performance and would "leverage investment efficiency across a larger scale to develop innovative mobility solutions and cutting-edge technologies in new energy vehicles, autonomous driving and connectivity". [15] There are many other examples of this M&A strategy to increase scale, and this activity will likely continue in to the future.

On top of those costs, there are potential fines from the EU looming over carmakers over suspected

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[11] Ibid.
[12] Ibid.
[13] Ibid.
[14] Ibid.
[15] "FCA and Groupe PSA agree terms of merger," Williams, Marcus, Automotive Logistics, 18 December 2019, https://www.automotivelogistics.media/oems/fca-and-groupe-psa-agree-terms-of-merger/39775.article.

shortfalls of emissions regulations in the short term. The current "fleet average" emissions target for the EU is 95 grams of carbon dioxide per kilometer by 2020. The actual fleet average emissions estimate for 2018 was 120 g/km, indicating that manufacturers are likely to fall significantly short of that target when rules go into effect. EU fines for auto manufacturers are estimated to reach €2 Billion in 2020, and €5 Billion in 2021.[16] These fines will provide another hit to earnings on top of the other factors already mentioned, putting even further pressure on production volumes in the short-term.

All of these factors combine to put great pressure on the volumes of vehicles transported. The effects of these factors will hamper vehicle production and transport over the near-term—the next two to three years. Consolidation and failure of some traditional auto makers may become more frequent as these factors bring on large structural change in the industry. In light of this effect, a flat forecast over the near-term, with a low-growth outlook over the medium terms seems the most reasonable path forward. As with most USACE studies, conservative growth over the long-term will be adhered to given the uncertainties inherent in any long-term forecast.

3.3.3 Trade Forecast

The preceding section describes the methodology that was used to develop the receipt and shipment baseline and the basis for the forecasted outlook on the vehicle trade. The following sections discuss the methodology employed to develop the receipt and shipment long-term trade forecasted growth rates.
The long-term trade forecasted rates for the Brunswick Harbor study combined data obtained from IHS Global, Inc., USACE waterborne commerce databases and the Georgia Ports Authority.

First, baseline levels were established from historical trade information as discussed in Section 3.3.1. Next, a global long-term trade forecast for all seaborne trade was obtained from IHS Global Insight in summer 2018. This forecast provided annual growth rates by imports and exports per world region from 2018 until 2046. The commodity forecast for Brunswick was then developed by applying the growth rates from the global forecast for each world region to the baseline tonnage for each trade route calling on the harbor. This methodology is consistent with the approach that has been used to perform long-term commodity forecasts for other Corps' deep draft analyses. This approach was further validated by conducting an ex-post forecast of receipts and shipments at Brunswick for 2018. Growth rates for each respective world region were applied to the 3-year baseline tonnages for each region and projected for 2018. This was compared to the actual 2018 volume in CEUs provided by the GPA. The predicted volume using IHS growth rates was 618,987 CEUs in 2018. The actual volume was 629,000, per GPA figures, an error of 1.6 percent. Given this small error, the IHS growth rates for the forecast period are considered reasonable for use. Volumes for the near-term (2019-2020) were held constant, based on the industry headwinds discussed in the previous section. From 2021-2046, volumes were estimated to grow per the IHS rates. Commodity growth is held constant after 20 years following the base year (2026) due to the uncertainty surrounding such long-term forecasts. However, benefit levels remain constant through the remaining period of analysis as well.

3.3.3.1 IHS Global Trade Forecast

The global trade forecast for Brunswick included 82 countries (e.g. China) or regions (e.g. Other Northeast Asia). First, the data by trade locations were grouped by the world region where they are

[16] Ibid.

geographically located, as shown in Table 3-4. The world regions included Asia, Middle East/Indian Subcontinent, Europe, Latin America and Caribbean, Oceania, Africa, and Canada. Although Canada is a major trading partner with the U.S., most of these cargos are not in the form of ocean transported vehicles and were therefore not included.

Table 3-4. Brunswick Trade Partner and World Region Groupings

World Region	IHS Global Insight World Trade Regions
Far East	China, Japan, South Korea, Hong Kong, Taiwan, Indonesia, Malaysia, Thailand, Vietnam, Philippines, Singapore, Other Southeast Asia, Other Northeast Asia
Middle East/ Indian Subcontinent	India, United Arab Emirates, Saudi Arabia, Pakistan, Egypt, Russia, Indian Subcontinent Islands, Kuwait, Israel, Bahrain, Qatar, Southern Arabian Peninsula, Other Mediterranean, Other Indian Subcontinent, Other Western Asia
Europe	Ukraine, Germany, Turkey, Spain, Italy, Belgium, United Kingdom, Netherlands, Baltics, Portugal, France, South Caucasus, Greece, Bulgaria, Denmark, Austria, Romania, Switzerland, Slovak Republic, Sweden, Czech Republic, Ireland, Other Europe
Latin America & Caribbean	Chile, Peru, Colombia, Brazil, Greater Antilles, Bahamas and Bermuda, Mexico, Ecuador, Lesser Antilles, Bolivia, Argentina, Central America North, Central America South
Oceana	Australia, New Zealand, Pacific Islands
Africa	Southern Africa, Kenya, Morocco, Nigeria, Libya, Algeria, Ghana, Cote d'Ivoire, Southern African Islands, Central Africa North, East Africa Center, Central Africa South, East Africa North, Other Southern Africa, Other Western Africa East

The rates of change from 2021 and beyond were then taken from this annual global forecast and are listed in Table 3-5 below. The rates of change for 2019 and 2020 were set to zero based on previous considerations as well as data gathered from vehicle manufacturers and processors. The data illustrate that economic conditions are cyclical and that the fastest growth will take place in the Africa and Middle East/Indian Subcontinent regions.

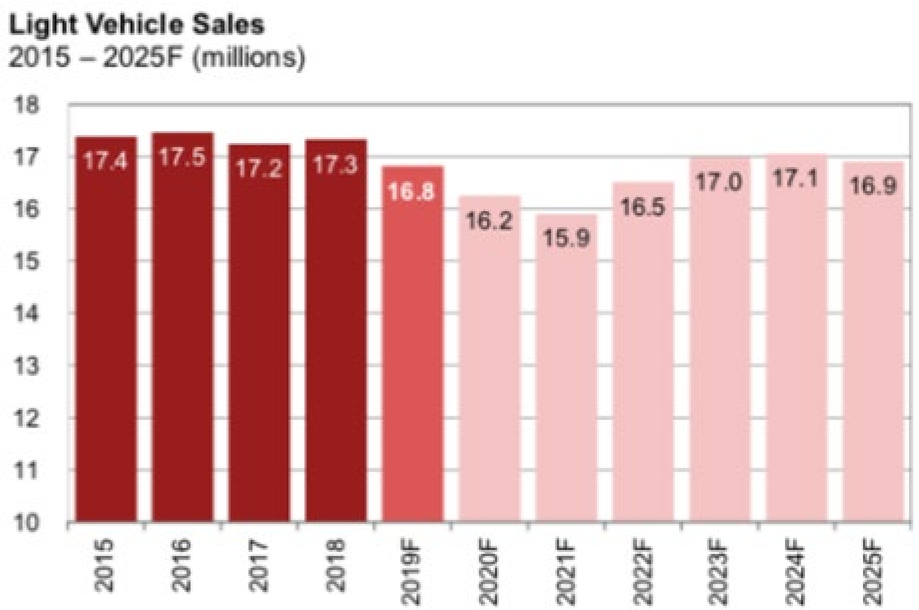
Table 3-5. Brunswick Harbor Receipt Forecast - Rate of Change (%)

Route Group	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2046
Asia	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Middle East	0%	0%	6%	6%	6%	6%	6%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Europe	0%	0%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Latin Amer & Car	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Oceana	0%	0%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Africa	0%	0%	3%	3%	3%	3%	4%	4%	3%	3%	3%	4%	4%	4%	4%	4%	4%	4%

3.3.3.1.1.1 Brunswick Vehicle Receipts Forecast

Next, receipts were forecasted for Brunswick over the forecast period using the growth rates from the global report by region. The assumption to use these growth estimates is based on comparison of 2018 historical Brunswick data to forecasts for 2018 using these rates (ex-post forecast). Auto manufacturers will be facing the headwinds of a weakening macroeconomic climate in the near-term, with a moderate recovery over the medium- and long-term. Industry analysts predict that factors such as expensive investment in powertrain (electric) and digital technologies, tightening regulatory requirements for emissions, pressure from trade wars and slowing economic growth will all restrain growth in the future.17 The consensus outlook for vehicle receipts is, at best, flat over the next two years. Some analysts are forecasting declines in sales in 2019 and 2020. Industry analysts Price Waterhouse Cooper (PWC) predict that auto sales in the U.S., a key predictor of receipt demand, will face a difficult few years ahead. Figure 3-1 below shows their forecast of light vehicle sales to 2025.

Figure 3-1. U.S. Light Vehicle Sales Forecast 2015-2025. Source: Automotive Logistics



US light vehicle sales forecast by PWC, covering 2015-2025

The world region aggregate was developed by combining the tonnage from each country or region identified in Table 3-6. Europe represents 65 percent of vehicle receipts in 2019. The forecast indicates that Europe will continue to be the majority of Brunswick receipts, growing to 1.3 million tons by 2046.

[17] "US automotive market to struggle against backdrop of global challenges," 17 September 2019, *Automotive Logistics*; www.automotivelogistics.media

Table 3-6. Vehicle Trade Forecast – Receipts (Metric Tons)

World Region	2019	2020	2026	2030	2036	2040	2046
Asia	232,393	232,393	279,110	315,362	378,758	427,953	498,528
Middle East/ Indian Sub.	-	-	-	-	-	-	-
Europe	409,339	409,339	455,138	486,885	538,707	576,283	626,962
Oceana	-	-	-	-	-	-	-
Latin America & Caribbean	36,313	36,313	43,612	49,277	59,183	66,870	77,898
Africa	20,409	20,409	24,845	28,235	35,726	41,795	50,850
Total	698,454	698,454	802,705	879,760	1,012,374	1,112,902	1,254,237

3.3.3.1.1.2 Brunswick Vehicle Shipments Forecast

The shipment forecast rate of change estimates are shown in Table 3-9, with the greatest growth occurring for shipments to Asia and Latin America. As with receipts, the rates of change for 2019 and 2020 were set to zero. The consensus outlook for vehicle shipments is essentially flat over the next two years as well, for the same industry difficulties that caused receipt forecasts to be flat. The rates of change from 2021 and beyond were taken from the annual global forecast developed by IHS Global Insight.

Table 3-9. Brunswick Harbor Shipment Forecast - Rate of Change (%)

Route Group	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2046
Asia	0%	0%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Middle East	0%	0%	4%	4%	4%	4%	4%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Europe	0%	0%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Latin Amer & Car	0%	0%	3%	3%	3%	3%	3%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Oceania	0%	0%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Africa	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%

The Asia and Europe world regions represent 92 percent of vehicle shipments in 2019 as shown in Table 3-8. Shipments to Asia are forecast to total 140,000 tons in 2019 and grow to 350,000 tons in 2046. Similarly, shipments to Europe are forecast to total 170,000 tons in 2019 and grow to 250,000 tons in 2046.

Table 3-7 Brunswick Vehicle Trade Forecast - Shipments

World Region	2019	2020	2026	2030	2036	2040	2046
Asia	138,075	138,075	174,875	201,450	249,072	286,922	342,423
Middle East	702	702	869	967	1,134	1,262	1,441
Europe	169,094	169,094	186,724	198,182	216,701	229,998	247,773
Latin America & Caribbean	24,872	24,872	30,045	34,745	43,208	49,967	59,920
Oceana	197	197	225	247	283	310	347
Africa	4,854	4,854	5,796	6,397	7,419	8,189	9,265
Total	337,793	337,793	398,534	441,987	517,817	576,648	661,171

3.3.3 Port of Brunswick Long Term Trade Forecast – Methodology for Vehicle Services

Numerous vehicle services call on Brunswick Harbor which are operated by several carriers and have trade routes which originate in Asia, Europe, or Latin America. See Section 2.3.2 for carriers and trade lanes included in this analysis. The nine services originating in Asia or Oceania which access the U.S. East Coast and Gulf Coast via the Panama Canal were combined into a single route group, "Trans-Pacific" (TP).

The route group "Trans-Atlantic" (TA) represents eight different services which call Brunswick and other U.S. East Coast ports. These services connect to Europe, Africa, and the Middle East.

The route group "Short Sea" (SS) represents four different services which call Brunswick and other U.S. ports on either side of the Panama Canal. These services also connect Central and South America to other global ports.

Distances associated with each route group were not used as part of this analysis, since widening alternatives are being evaluated. There are no origin-to-destination benefits, so at-sea savings were not measured. Only efficiencies gained inside the port are measured due to widening alternatives, and no routes were considered.

3.3.3.1 Receipt Trade

The respective world region receipt rates of change were applied to the baseline to estimate the Brunswick Harbor long-term receipt forecast, as shown in Table 3-12.

Table 3-12. Brunswick Trade Forecast – Receipt Tons

Route Group	Baseline	2026	2030	2036	2046
TP	224,318	279,110	315,362	378,758	498,528
TA	416,743	479,983	515,120	574,433	677,811
SS	35,358	43,612	49,277	59,183	77,898
Total Receipts	**676,419**	**802,705**	**879,760**	**1,012,374**	**1,254,237**

Motor vehicles and high and heavy cargo will benefit from steady, long-term, consumer demand. Most East Coast ports experienced over 5% growth in receipt trades since July 2018.

3.3.3.2 Shipment Trade

The shipment tons forecast is shown in Table 3-13.

Table 3-13. Brunswick Trade Forecast – Shipment Tons

Route Group	Baseline	2026	2030	2036	2046
TP	132,700	175,100	201,697	249,355	342,770
TA	168,447	193,388	205,546	225,254	258,480
SS	24,384	30,045	34,745	43,208	59,920
Total Shipments	**325,531**	**398,534**	**441,987**	**517,817**	**661,171**

European and Middle Eastern countries will continue to be Brunswick's strongest shipment partners.

3.3.3.3 CEU Forecast

Using the trade forecast for receipts and shipments and the average weight per CEU derived from historical CEU volumes provided by the GPA, a CEU forecast was developed. Receipt CEU's are made up of primarily passenger vehicles, while shipment CEU's are primarily high and heavy cargo, like construction equipment; hence the heavier weight per shipment CEU. Table 3-14 provides the receipt and shipment CEU forecast, along with the weight per CEU for the three route groups.

Table 3-14. Brunswick CEU Forecast – Receipt and Shipment

Route Group	Weight per Receipt CEU	2026	2036	2046
TP	1.5	188,331	255,569	336,384
TA	1.5	323,871	387,601	457,356
SS	1.5	29,428	39,934	52,562
Total Receipts		**541,629**	**683,104**	**846,302**
Route Group	**Weight per Shipment CEU**	**2026**	**2036**	**2046**
TP	2.3	76,563	109,032	149,878
TA	2.3	84,560	98,493	113,022
SS	2.3	13,137	18,893	26,200
Total Shipments		**174,261**	**226,418**	**289,100**

The total number of CEUs, by receipt and shipment, and route group are shown in Table 3-16. Receipt CEUs are forecasted to grow from 500,000 in 2026 to 850,000 in 2046. Shipment CEUs are forecasted to grow from 170,000 in 2026 to 290,000 in 2046, an increase of 70 percent. The compound average growth rate (CAGR) for each route represents the geometric average growth of receipts and shipments, which accounts for the effect of compounding over time. For the Trans-Atlantic route, for example, receipts are projected to grow from 324,000 to 457,000 over the 20-year period at a CAGR of 1.7 percent per year.

Table 3-16. Brunswick Total CEU Forecast by Route for Receipts and Shipments

Total CEUs - Receipts	2026	2036	2046	CAGR
TP	188,331	255,569	336,384	2.9%
TA	323,871	387,601	457,356	1.7%
SS	29,428	39,934	52,562	2.9%
Total	**541,629**	**683,104**	**846,302**	**2.2%**
Total CEUs - Shipments	**2026**	**2036**	**2046**	**CAGR**
TP	76,563	109,032	149,878	3.4%
TA	84,560	98,493	113,022	1.5%
SS	13,137	18,893	26,200	3.3%
Total	**174,261**	**226,418**	**289,100**	**2.5%**
Total Overall CEUs	**2026**	**2036**	**2046**	**CAGR**
TP	264,894	364,600	486,262	3.0%
TA	408,431	486,094	570,378	1.7%
SS	42,565	58,827	78,762	3.0%
Total	**715,890**	**909,522**	**1,135,402**	**2.3%**

Georgia Port Authority estimates future CEU throughput capacity at Colonel's Island will exceed 1.5 million CEUs. Forecasted CEU trade is not expected to exceed port capacity over the forecast period.

3.4 Vessel Fleet Forecast

3.4.1 Overview

In addition to a commodity forecast, a forecast of the future fleet is required when evaluating navigation projects. To develop projections of the future fleet calling at Brunswick, the study team obtained a world fleet breakdown of vehicle carriers provided by IWR, and developed a methodology to forecast the makeup of the available world fleet calling at Brunswick Harbor, broken down by vessel class.

The developed world fleet was then linked to the commodity forecast data for Brunswick via a load factor analysis (LFA). LFA was conducted to determine the historical loading percentages (cargo share) for each class of RO/RO vessel that has called on Brunswick since 2015. This matches the available fleet to the number of vehicles that need to be moved from the commodity forecast. Table 3-17 shows the vessel fleet by class with specifications for beam and length overall (LOA). As of 2018, no Mk IV or Mk V vessels had called at Brunswick, according to the pilot's logs and GPA data. Therefore, they were assumed to no longer call at Brunswick during the forecast period as well. This is consistent with shipper inputs that indicated no new Conventional RO/RO traffic would be expected to call on Brunswick in the future.

Table 3-17. Fleet Subdivisions on Beam and LOA (in feet)

Vessel Fleet Subdivision		From	To
Pure Car and Truck Carrier (PCTC)	Beam	77	98
	LOA	650	671
Large Car and Truck Carrier (LCTC)	Beam	105	107
	LOA	747	763
High-Efficiency RO/RO (HERO)	Beam	114	134
	LOA	655	656

By combining information from the commodity forecast with the forecasted fleet and Brunswick's historic average share of cargo per vessel, the study team was able to allocate a number of PCTC, LCTC, and HERO vessel calls to Brunswick's fleet. The number of transits, particularly those made by larger vessels, is a key variable in calculating the total transportation costs. The forecasting technique begins with performing a detailed review of the current world fleet and how it is deployed to Brunswick.

3.4.2 World Fleet Background

Industry analyst Dynamar released the second edition of its Deepsea RO/RO Shipping II report in 2017, charting the history of the segment and analyzing the fleet, as it was in 2017:

> *"Deep-sea RO/RO shipping is a specialization that emerged in the 1960s as one of the offshoots from the once one-concept-fits-all general cargo deep-sea vessel. Actually, this was driven by the container, or more particularly by the high degree of cargo unitization the rectangular box offers.*
>
> *Indeed, it was the combination of a container ship and a RO/RO vessel, the ConRo, which was the initial dominant deep-sea RO/RO carrier. These vessels connected with destinations where handling costs were high, port turnaround slow or port facilities limited. Not needing extensive*

shore-side handling facilities made the ConRo the ideal ship for serving such trades. It has above all been Scandinavian operators taking the challenge to invest in the relatively high capital costs of this type of tonnage.

In 1972, East Asiatic, Transatlantic Steamship and Wallenius Wilhelmsen launched their joint venture ScanAustral, deploying five 22,000-dwt ConRo's incorporating an angled stern ramp. At the time, Australia was a destination where militant port workers accounted for high handling costs and prolonged port stays.

Investment in conventional RO/RO tonnage, ConRo's in particular, peaked in the 1970s when the developing world was not as developed as it is today. Congestion in poorly equipped ports then was the order or the day. Roll-on roll-off ships can load and discharge quickly, taking up a minimum of quay space. The ships usually carry their own forklift-trucks, tug masters, trailers and so on to handle the cargo, including containers, on board and ashore. It made the RO/RO the ideal congestion-beating transport system.

Only 13 smaller ships built during the 1970s still exist. The present conventional Deepsea RO/RO vessel fleet consists of an estimated 210 units. Although exactly 100 of these were built since 2000, the average age of these 210 RO/RO's is 18 years. In additional to a few non-operating owners, it is a limited number of vessel operators having invested in RO/RO's for deep-sea employment. In alphabetical order, they include Bahri, Grimaldi including ACL, Kyowa Shipping, Messina, Nordana (no longer active), NYK Bulk & Projects and Wallenius Wilhelmsen (Mark IV and V units).

While Japan's shipments of passenger cars gained substance in the 1950s, the first pure car carrier (PCC) was launched some 20 years later. Before then, factory-new cars were mainly loaded and discharged in the [Lift-On/Lift-Off] Lo/Lo-mode and transported in bulk carriers provided with hoistable decks in some of their holds. The pure car and truck carrier (PCTC) emerged in the second half of the 1970s. It distinguishes from the PCC by having a heavier ramp and one or more reinforced and higher decks to accommodate higher and heavier vehicles and machinery. The large car and truck carrier (LCTC) is a vehicle carrier with a minimum capacity for 7,000 CEU (car equivalent units). The largest among them are PostPreviousPanamax (PPP), in other words these are too big to pass through the original (old) Panama locks. As of June last, 47 PPP large car and truck carriers were operating with another 45 on order. Höegh Autoliners operates the largest of them all: six 8,500 CEU units.

The question is, as with 22,000 TEU container ships, whether given recent market dynamics such huge vessels are not a bridge too far. While global production of motor vehicles continues to grow, by 4.6 percent in 2016, the number of cars carried declines: some four percent last year. The key driver of this is the expansion of car production closer to demand. This development, which started after crisis year 2009, has now led to a disconnect between expanding global car sales and seaborne trade volumes. Car carrier operators started lifting non-car cargoes on the way back to their car loading areas in North East Asia. As such cargoes could reach a proportion of 30 to 40 percent of the roundtrip liftings, it induced the development of the pure car and truck carrier.

The manufacture or assembly of cars has meanwhile become much more diverse, nowadays taking place in more than 50 countries worldwide. This has greatly increased the number of *destinations to which additionally breakbulk cargoes, including projects and heavy-lifts, are made. The ships of the Top 15 Vehicle Carrier operators in Dynamar's report are calling at 340 ports in 150 countries worldwide.*

Conventional deep-sea RO/RO ships and vehicle carriers have two things in common: a shrinking fleet, and a ramp. For the first time since 2010, the number of vehicle carriers reduced by 12 units in the 18 months between January 2016 and June 2017. In the same period, i.e. from the first month of 2010 onwards, the conventional RO/RO deep-sea and shortsea fleet fell by no less than 170 ships.

Table 3-15: RO/RO Fleet Growth (Source: Dynamar, 2017)

	Conventional Ro/Ro		Vehicle Carriers	
Year	New ships	Scrapped	New ships	Scrapped
2016	6	7	22	30
2015	17	14	20	13
2014	12	40	22	13
2013	14	46	19	14
2012	22	45	35	9

Conventional RO/RO Vessels and Vehicle Carriers have in common that neither would be what they are without a ramp. However, as Table [3-15] above shows, the two segments are going through an opposite development: while the one is contracting, the other is in the expansion mode.”[18]

The total global RO/RO fleet in 2019 is coming off of a downsizing. This began in 2016, after the five-year expansion in shipbuilding mentioned in Table 3-15 above. It saw over 300,000 CEU of capacity built in 2015 alone. Shippers have since drastically decreased the pace of new RO/RO building. Less than 20,000 CEU was built during 2016 and 2017. There were only two RO/RO orders in 2018 at all, totaling 9,200 CEU. As a result, the global fleet’s growth has slowed significantly. In 2017, twenty-two new vessels entered service, and seventeen entered in 2018. The orderbook measured as a percentage of the current fleet stands at 4 percent, the lowest level of any cargo class, except multipurpose / general cargo vessels and refrigerated cargo ships[19].

Over the last 2 years, shippers have been cutting shipping capacity to match slower growth in volumes worldwide. This includes continued scrapping of the older PCTC’s and conventional RO/RO’s.

3.4.3 World Fleet Snapshot 2017

[18] Deepsea RO/RO Shipping II: Operators, Ships, and Trades. Dynamar B.V. August 2017; https://www.maritime-executive.com/article/understanding-deepsea-roro-shipping, October 2017.

[19] “Favouring freight rate recovery over fleet expansion,” MSI, 2018. *Automotive Logistics*, October, 26, 2018.

A snapshot of the World Fleet by class provides more background for evaluating the future fleet forecast for Brunswick. The starting point for this projection was the world fleet by vessel class as provided by IWR. The fleet is shown by class in Table 3-18. Note that as Mk IV and Mk V are Conventional RO/RO, and not vehicle carriers, they were not captured in this IWR query.

Table 3-18. World Vehicle Carrier Fleet by Class - 2017

Class	2017	% Total Fleet	Average Age (yrs)
PCTC	578	92	27
LCTC	32	5	15
HERO	15	2	6
TOTAL	**625**	**100**	

3.4.4 RO/RO Vessels Calling at Port of Brunswick

The study team began to develop a Brunswick-specific fleet forecast using an internal analysis of Port of Brunswick historical calls and the world RO/RO fleet snapshot in 2017. Table 3-19 shows the historical calls at Brunswick by class. Note that in 2018, Brunswick received 53 HERO calls, despite Table 3-18 above only showing their being 15 HERO vessels currently in service. This means that all HERO vessels currently in service called on Brunswick multiple times over the year. The same is true for LCTC's. Examination of the pilot's logs from Brunswick confirm this to be true.

Table 3-19. Historical Vessel Calls at Port of Brunswick by Class, 2015-2018

Class	PCTC	LCTC	Mk IV	Mk V	HERO
2015 calls	393	65	5	1	2
2016 calls	315	69	4	9	35
2017 calls	299	60	1	5	39
2018 calls	325	68	0	0	53

The study team then used the historical fleet utilization as a baseline for forecasting the future fleet. Table 3-20 displays the percent cargo share by each vessel class for years 2015 to 2018.

Table 3-20. Percent Cargo by Vessel Class, 2015-2018

	2015	2016	2017	2018
Receipt				
PCTC	86%	57.5%	58.9%	64%
LCTC	12%	23%	20%	16%
Mk IV	1.8%	0.5%	0.1%	0%
Mk V	0.01%	3%	1%	0%
HERO	0%	16%	20%	20%
Shipment				
PCTC	95%	80%	73.9%	72%
LCTC	5%	13%	13%	12%
Mk IV	0.2%	0%	0%	0%
Mk V	0%	0.9%	0.1%	0%
HERO	0%	6%	13%	16%
Total				
PCTC	90%	63%	64%	66%
LCTC	9%	19%	17%	15%
Mk IV	1%	0.3%	0%	0%
Mk V	0.01%	2.3%	0.6%	0%
HERO	0%	15%	18%	18%

Total cargo movements on PPP (LCTC or larger) RO/RO's grew from 10 percent in 2015 to 33 percent in 2018, a significant trend. Once the baseline cargo share was determined, the forces affecting the composition of the future fleet must be examined to forecast changes.

The upcoming sulfur emissions cap that will be instituted by the International Maritime Organization (IMO) in 2020 has many carriers looking for ways to drastically cut emissions. Before inevitably incurring the large capital expense of installing scrubbers or replacing engines or fuel, one way to reduce emissions in the meantime is to fully utilize the vessel with the smallest engineering plant (combination of main propulsion engines and electric generators). These small plants come standard in PCTC's and HERO's. PCTC's carry most of the cargo into Brunswick, and that is not assumed to change over the forecast period. But a larger share is moving to the HERO, at the expense of both PCTC's and LCTC's, as shown in Table 3-20 above. LCTC cargo seems to have plateaued around 20% and given fuel efficiency and emission concerns around longer vessels with larger engineering plants, as well as maneuverability concerns around LOA in some Asian ports, it may not increase via new shipbuilding or route assignments.

Based on inputs from shippers and car manufacturers, shipping capacity will have stabilized to match reduced vehicle production by around 2023. At that point, shipbuilding is expected to rebound by the base year of 2026, based on the anticipated cycle of automotive production growth. During the last shipbuilding increase from 2012-2015, an average of 20 vehicle carriers were built per year, and 10 were scrapped, as outlined in the Dynamar report quoted in Section 3.4.2. Given their higher average age (27 years), it is assumed that PCTC's are expected to be scrapped during this time. Given their emissions and capacity advantages, HERO's are expected to be added to the fleet. These new HERO's will continue the trend of more fuel efficient design and incorporate new low-emissions technologies such as exhaust gas scrubbers, engines designed for lower-sulfur fuel, or even LNG-powered engines[20].

It is assumed that the previously discussed disconnect between increased vehicle production and decreased vehicle shipping will persist into the future. Lesser developed countries will continue to improve their production capacity closer to the consumer market for vehicles. This will check the desire to continue to build larger and larger RO/RO vessels, as is the case with larger and larger container ship construction. Therefore, it is assumed that HEROs will continue to be the high end of the spectrum of large PPP vehicle carriers over the forecast period.

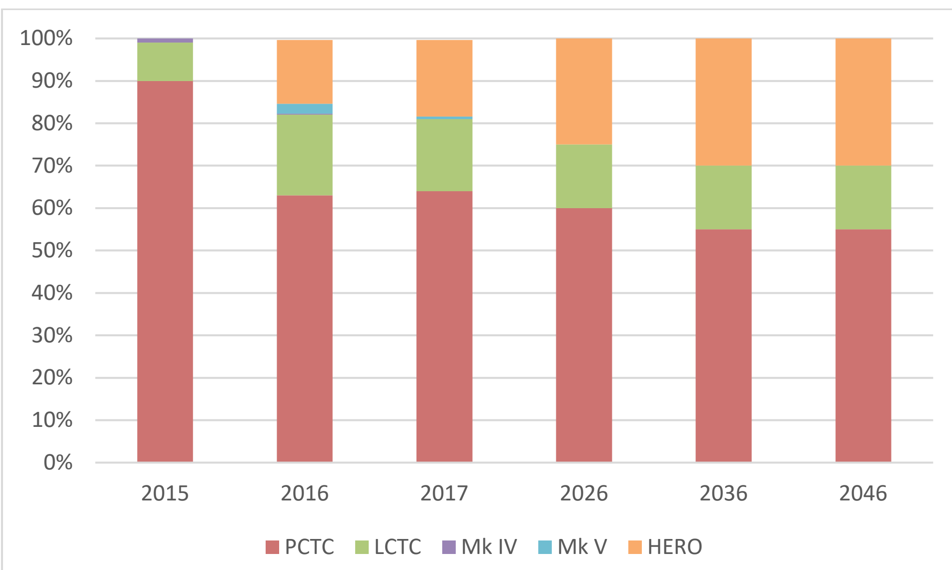
HEROs are the most fuel efficient and cost-effective option to ship vehicles in the fleet. Shipper feedback has been very positive on the performance of the HERO class over the last 2 years, citing better than expected performance in carrying capacity and fuel economy. Consistent with economic production theory, shipping firms will seek to maximize profits by lowering costs. Therefore, shifting cargo share to HERO vessels is consistent with that rationale. With an additional 10-20 HERO vessels in the world fleet by 2026, HEROs would be poised to take a larger share of the cargo moving at Brunswick. As Table 3-21 shows, HERO cargo share is about 18% already. With this projected fleet shift, a cargo share of 25% is likely by 2026, and an ultimate share of 30% is likely by the end of the forecast period, 2046, as shown in Table 3-21 and Figure 3-1 below.

[20] "NYK to introduce world's largest PCTC powered by LNG," *Automotive Logistics*, September 25, 2019. www.Automotivelogistics.media.

Table 3-21 Historical and Forecasted Cargo Share by Class at Brunswick

	2015	2016	2017	2026	2036	2046
Receipt						
PCTC	86%	57.50%	58.90%	58%	53%	53%
LCTC	12%	23%	20%	17%	17%	17%
Mk IV	1.80%	0.50%	0.10%	0%	0%	0%
Mk V	0.01%	3%	1%	0%	0%	0%
HERO	0%	16%	20%	25%	30%	30%
Shipment						
PCTC	95%	80%	73.90%	63%	58%	58%
LCTC	5%	13%	13%	12%	12%	12%
Mk IV	0.20%	0%	0%	0%	0%	0%
Mk V	0%	0.90%	0.10%	0%	0%	0%
HERO	0%	6%	13%	25%	30%	30%
Total						
PCTC	90%	63%	64%	60%	55%	55%
LCTC	9%	19%	17%	15%	15%	15%
Mk IV	1%	0.30%	0%	0%	0%	0%
Mk V	0.01%	2.30%	0.60%	0%	0%	0%
HERO	0%	15%	18%	25%	30%	30%

Figure 3-1 Historical and Forecasted Cargo Share by Class at Brunswick



This increase in cargo share, given today's loading practices consistent with the LFA, would result in substantial increases in calls from HERO vessels in Brunswick. As mentioned before, all PPP RO/RO vessels (LCTC and HERO) in the world fleet would call on Brunswick multiple times each year. The projected number of vessel calls through 2019, based on partial year's data from GPA, and the initial forecast of RO/RO vessels through the year 2046 is depicted in Table 3-22. Note that 2019 projections are slightly lower than 2018 totals. This reinforces the assumption of flat shipping volumes in the near term.

Table 3-22. Historic and Baseline Vessel Call Forecast for Port of Brunswick by Year (Source: GPA, 2019)

Vessel Class	2018	2019 (Projected)	2026	2036	2046
PCTC	318	285	301	353	444
LCTC	67	87	78	99	125
HERO	52	60	143	219	277
Total	**437**	**432**	**522**	**671**	**845**

4 Project Alternatives

An array of nine alternatives underwent an initial round of qualitative screening. Alternatives were formulated to address the objectives through the combinations of screened management measures. The formulation strategy focused on the information provided by the harbor pilots who are responsible for maneuvering the RO/RO fleet into and out of Brunswick Harbor.

Alternative 1: No Action Alternative

The No Action Alternative is analyzed as the future without-project conditions for comparison with the action alternatives. Taking no action would mean continuing standard operations at Brunswick Harbor with no improvements to the Federal navigation channel. All physical conditions at the time of this analysis are assumed to remain. The new berth at Colonel's Island and terminal expansion are expected in the No Action Alternative. The No Action Alternative assumes one-way RO/RO traffic within Brunswick Harbor and assumes O&M dredging would occur within the Federal navigation channel at authorized depths (-36 MLLW).

Alternative 2: Bend Widener

Alternative 2 proposes to widen the federal channel near the Cedar Hammock Range bend widener (station 20 and 23) in order to allow the harbor pilots to remove transit restrictions for tide, current, and wind for large RO/RO vessels currently calling at Brunswick. Widening this bend would reduce transit restrictions to 2 kinds of RO/RO vessels.

Alternative 3: Turning Basin Expansion

Alternative 3 would include expanding the existing turning basin at the Colonel's Island facility along approximately 3,200 feet increasing the width by a maximum of 395 feet. This would allow the harbor pilots to further remove transit restrictions for large RO/RO vessels calling at Brunswick. Expanding the turning basin would reduce transit restrictions to 2 kinds of RO/RO vessels during times of high wind and high current.

Alternative 4: Meeting Area west of Sidney Lanier Bridge

Alternative 4 proposes to widen the federal channel from the Sidney Lanier Bridge up to the Colonel's Island turning basin. This will focus on providing safe two-way passage for all classes of RO/RO vessels. The intent is to expand to create a suitable meeting space. The harbor pilots would then be able to hold a vessel to the side of the federal channel (before it reaches the turning basin) while another vessel is leaving a berth, alleviating delays from congestion in the harbor.

Alternative 5: Meeting Area at St. Simons Sound

Alternative 5 would create a RO/RO vessel meeting area located at St. Simons Sound near the entrance channel to Brunswick Harbor. Since that area is naturally deep water, no dredging would be required. The existing channel centerline would not change. Alternative 5 would expand the Federal channel at St. Simon's Sound by 800 feet north of the existing channel along a length of approximately 10,000 feet. This would also focus on providing safe two-way passage for all classes of RO/RO vessels by creating a suitable meeting area. This would also alleviate delays from congestion in the harbor.

Alternative 6: Bend Widener and Turning Basin Expansion

Alternative 6 would be a combination of Alternatives 2 and 3.

Alternative 7: Bend widener, turning basin expansion, and meeting area upstream of Sidney Lanier Bridge.

Alternative 7 includes the dredging to occur at the bend widener and turning basin plus creation of a RO/RO vessel meeting area upstream of the Sidney Lanier Bridge to the turning basin at the Colonel's Island facility.

Alternative 8: Bend widener, turning basin expansion, and meeting area at St. Simon's Sound.

Alternative 8 includes the dredging to occur at the bend widener and turning basin plus creation of a RO/RO vessel meeting area located at St. Simon's Sound near the entrance channel to Brunswick Harbor.

Alternative 9: Bend widener, turning basin expansion, meeting area upstream of the Sidney Lanier Bridge and meeting area at St. Simon's Sound.

Alternative 9 includes the dredging to occur at the bend widener and turning basin plus creation of a RO/RO vessel meeting area upstream of the Sidney Lanier Bridge to the turning basin at the Colonel's Island facility and creation of a meeting area at St. Simon's Sound, as described in the previous alternatives.

5 Transportation Cost Savings Benefit Analysis

The purpose of this economic analysis is to evaluate proposals to widen sections of the Brunswick Harbor navigation channels. The width extensions will allow for an easing of the current and wind restrictions that are placed on vessels transiting the harbor. The benefits generated will result from transit time savings due to fewer delays within the harbor, and a reduction in transportation costs that result from those delays. Currently, vessels are not anticipated to carry additional cargo due to the channel widening. NED benefits were estimated by calculating the reduction in transportation cost at each alternative using the HarborSym Modeling Suite of Tools (HMST) developed by IWR. The HMST reflects USACE guidelines on transportation cost savings analysis[21].

5.1 Methodology

Channel improvement modifications result in reduced transportation cost by creating fewer delays and less congestion when traversing the port. The HMST was designed to allow users to model these benefits.

While lesser in magnitude when compared to channel widening, additional transportation cost saving benefits result from the channel modifications aimed at reducing congestion within the harbor. The creation of a meeting area reduces wait times within the harbor. HarborSym allows for detailed modeling of vessel movements and transit rules on the waterway.

To begin, HarborSym was setup with the basic required variables. To estimate cost saving benefits, the Bulk Loading Tool (BLT), a module within the HMST, was used to generate a vessel call list based on the commodity and fleet forecasts at the Port of Brunswick for a given year, under the various alternatives. The resulting vessel traffic was simulated using HarborSym, producing average annual vessel transportation costs. The transportation costs saving benefits were then calculated for each additional project alternative. The Tentatively Selected Plan (TSP) was identified by considering the highest net benefit based on the transportation cost saving benefits and project costs.

5.1.1 HarborSym Model

IWR developed HarborSym as a planning level, general-purpose model to analyze the transportation costs of various waterway modifications within a harbor. HarborSym is a Monte Carlo simulation model of vessel movements at a port for use in economic analyses. While many harbor simulation models focus on landside operations, such as detailed terminal management, HarborSym instead concentrates on specific vessel movements and transit rules on the waterway, fleet and loading changes, as well as incorporating calculations for both within harbor costs and costs associated with the ocean voyage.

HarborSym represents a port as a tree-structured network of reaches, docks, anchorages, and turning areas. Vessel movements are simulated along the reaches, moving from the bar to one or more docks, and then exiting the port. Features of the model include intra-harbor vessel movements, tidal and current influence, the ability to model complex shipments, and incorporation of turning areas and anchorages. The driving parameter for the HarborSym model is a vessel call at the port. A HarborSym analysis revolves around the factors that characterize or affect a vessel movement within the harbor.

5.1.1.1 Model Behavior

HarborSym is an event driven model. Vessel calls are processed individually and the interactions with

[21] HarborSym, the Container Loading Tool (CLT), and the Bulk Loading (BLT) are USACE certified planning models

other vessels are considered. For each iteration, the vessel calls for an iteration that fall within the simulation period are accumulated and placed in a queue based on arrival time. When a vessel arrives at the port, the route to all the docks in the vessel call is determined. This route is comprised of discrete legs (contiguous sets of reaches, from the entry to the dock, from a dock to another dock, and from the final dock to the exit). The vessel attempts to move along the initial leg of the route. Potential conflicts with other vessels that have previously entered the system are evaluated according to the user-defined set of rules for each reach within the current leg, based on information maintained by the simulation as to the current and projected future state of each reach. If a rule activation occurs, such as no meeting allowed in each reach, the arriving vessel must either delay entry or proceed as far as possible to an available anchorage, waiting there until it can attempt to continue the journey. Vessels move from reach to reach, eventually arriving at the dock that is the terminus of the leg.

After the cargo exchange calculations are completed and the time the vessel spends at the dock has been determined, the vessel attempts to exit the dock, starting a new leg of the vessel call; rules for moving to the next destination (another dock or an exit of the harbor) are checked in a similar manner to the rule checking on arrival, before it is determined that the vessel can proceed on the next leg. As with the entry into the system, the vessel may need to delay departure and re-try later to avoid rule violations and, similarly, the waiting time at the dock is recorded. For Brunswick, two rules were implemented based on the harbor pilot's restrictions on larger RO/RO vessels:

1) Vessels over 700 feet in length, or HERO class vessels (to capture width effects), can only transit the system if the current is less than 1 knot (slack water)
2) There is no meeting of vessels at any point in the harbor (one-way traffic)

A vessel encountering rule conflicts that would prevent it from completely traversing a leg may be able to move partially along the leg, to an anchorage or mooring. If so, and if the vessel can use the anchorage (which may be impossible due to size constraints or the fact that the anchorage is filled by other vessels), then HarborSym will direct the vessel to proceed along the leg to the anchorage, where it will stay and attempt to depart periodically, until it can do so without causing rule conflicts in the remainder of the leg. In the case of Brunswick, there are no anchorages or berths between the entrance and Colonel's Island, so vessels encountering a rule conflict must wait either at the entrance to the harbor, or at the dock prior to moving. The determination of the total time a vessel spends within the system is the summation of time waiting at entry, time transiting the reaches, time turning, time transferring cargo, and time waiting at docks or anchorages. HarborSym collects and reports statistics on individual vessel movements, including time in system, as well as overall summations for all movements in an iteration.

The model calculates receipt and shipment tons, receipt and shipment value, and receipt and shipment allocated cost. This information allows for the calculation of total tons and total cost, allowing for the derivation of the desired metrics at the class and total level. The model can thus deliver a high level of detail on individual vessel, class, and commodity level totals and costs.

Either all or a portion of the at-sea costs are associated with the subject port, depending on whether the vessel call is a partial or full load. The at-sea cost allocation procedure is implemented within the HarborSym Monte-Carlo processing kernel and utilizes the estimate total trip cargo (ETTC) field from the vessel call information along with receipt tonnage and shipment tonnage. In all cases the ETTC is the user's best estimate of total trip cargo.

5.1.1.2 Data Requirements

The data required to run HarborSym are separated into six categories, described below. Key data for the Brunswick Harbor study are provided.

Simulation Parameters. Parameters include start date, the duration of the iteration, the number of iterations, the level of detail of the result output, and the wait time before rechecking rule violations when a vessel experiences a delay. These inputs were included in the model runs for the Brunswick Harbor study. The base year for the model was 2026. A model run was performed for the following years: 2036 and 2046. After 2046, the forecast number of CEUs was held constant until the end of the period of analysis. Each model run consisted of 50 iterations.

Physical and Descriptive Harbor Characteristics. These data inputs include the specific network of Brunswick Harbor such as the node location and type, reach length, width, and depth, in addition to tide and current stations. This also includes information about the docks in the harbor such as length and the maximum number of vessels the dock can accommodate at any given time. Figure 5-2 displays the Node network used for Brunswick Harbor.

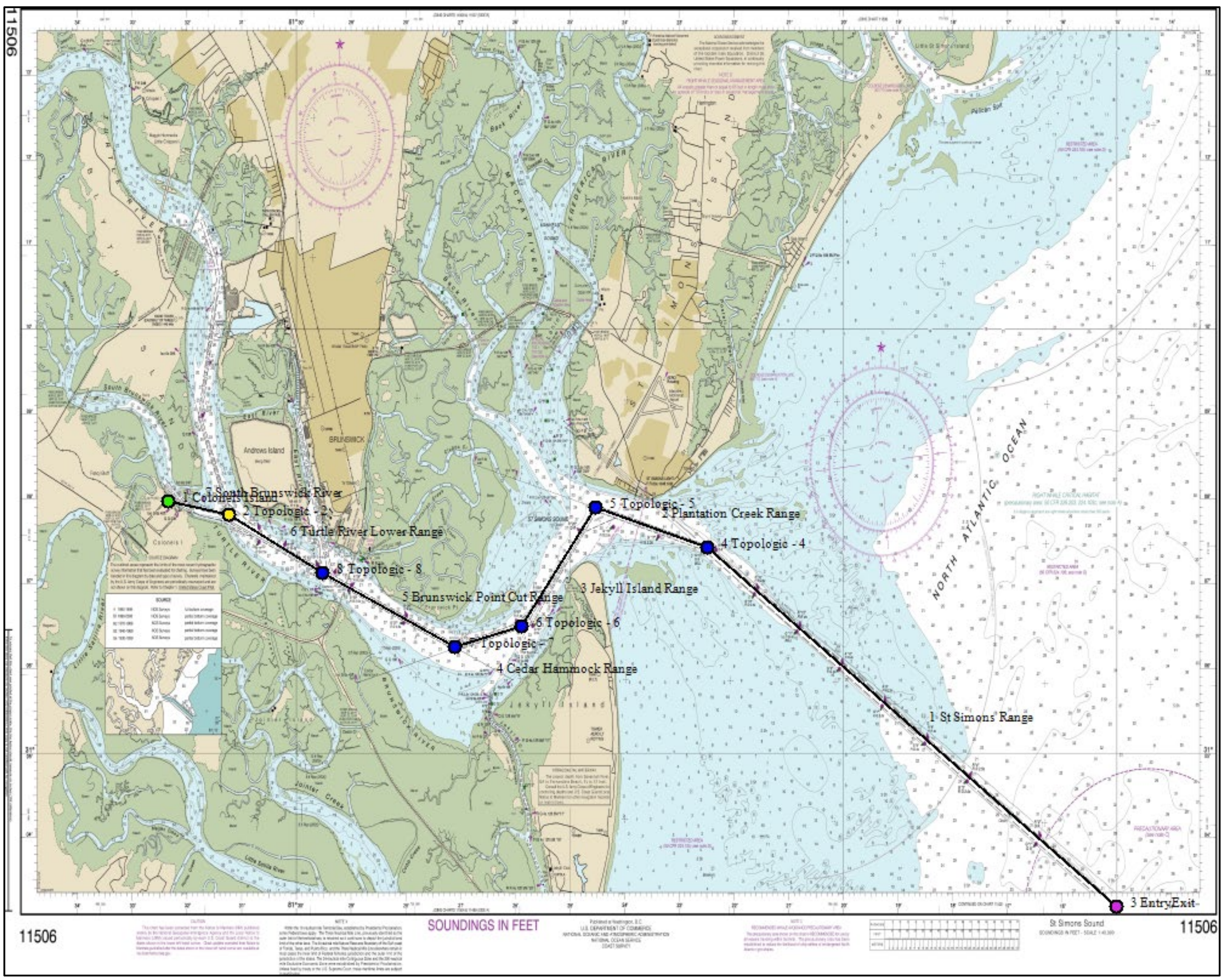


Figure 5-2. Brunswick Harbor HarborSym Node Network

General Information. General information used as inputs to the model include: specific vessel and commodity classes, commodity transfer rates at each dock (Table 5-2), and specifications of turning area usage at each dock within the harbor. Since this is a widening model, and no origin-to-destination benefits were estimated, route groups were all set to the Default group in the model.

Table 5-2. HarborSym Commodity Transfer Rates for Vehicles (Vehicles per hour)

	RO/RO Vessel		
Dock Name	Min	Most Likely	Max
Colonels Island	150	200	400

Vessel Speeds and Operations. The speed at which vessels operate in the harbor, by vessel class both loaded and light loaded, were determined for each channel segment by verifying with the pilots. Hourly operating costs while in-port and at-sea were determined for both domestic and foreign flagged RO/RO vessels from the Institute for Water Resources (IWR) Vessel Operating Cost spreadsheets and Economic Guidance Memorandum (EGM) 17-04 (dated 24 April 2017), Deep-Draft Vessel Operating Costs FY 2016 Price Levels, Supplemental Guidance. Vessel operating costs and speeds at sea are entered as a triangular distribution (minimum, most likely, maximum). Vessel harbor speed inputs are provided in Table 5-3 for each reach of the node network for vessels. Because vessels do not unload their entire cargo of vehicles at Brunswick, they never transit the channels “empty”, like a bulk import vessel might on their outbound leg. Therefore, light and loaded harbor speeds are listed as the same. Vessel operating costs are not shown as some or much of the information integral to the estimates is considered sensitive or proprietary by commercial sources and is protected from open or public disclosure under Section 4 of the Freedom of Information Act.

Table 5-3. HarborSym Vessel Speed in Reach for RO/RO Vessels (knots)

	RO/RO Vessel	
Reach	Light	Loaded
St. Simons Range	13	13
Plantation Creek Range	12.5	12.5
Jekyll Island Range	12	12
Cedar Hammock Range	11	11
Brunswick Point Range	10.5	10.5
Turtle River Lower Range	5	5
South Brunswick River Range	2	2

Reach Transit Rules. Vessel transit rules for each reach reflect restrictions on meeting in particular segments of Brunswick Harbor, and are used to simulate actual conditions in the reaches. For the Bend Widener, Turning Basin and Meeting Area analyses, vessel LOA and width are also used along with current to determine if a vessel can enter the system, as previously discussed.

Vessel Calls. The vessel call lists consist of forecasted vessel calls for a given year as generated by the BLT (see Section 5.1.2). Each vessel call list contains the following information: arrival date, arrival time, vessel name, entry point, exit point, arrival draft, receipt/shipment, dock name, dock order, commodity, units, origin/destination, vessel type, Lloyds Registry, net registered tons, gross registered tons, dead weight tons, capacity, length overall, beam, draft, flag, tons per inch immersion factor, ETTC, and the route group for which it belongs.

5.1.2 Vehicle Vessel Call List

The forecasted commodities for Brunswick Harbor were allocated to the future fleet using the BLT. The BLT module produces a RO/RO-only future vessel call list based on user inputs describing commodity forecasts at the dock and the available fleet. The module is designed to process in two unique steps to generate a shipment list for use in HarborSym. First, a synthetic fleet of vessels is generated that can service the port. This fleet includes the maximum possible vessel calls based on the user provided availability information. Second, the commodity forecast demand is allocated to individual vessels from the generated fleet, creating a vessel call and fulfilling an available call from the synthetic fleet.

5.1.2.1 RO/RO Vessel Calls

Vessel calls by class are shown in Table 5-4. These are a result of the BLT loading algorithm, the vehicle trade forecast for Brunswick Harbor, the available vessel fleet by service, and historical loading data inputs.

Table 5-4. Vessel Calls by Vessel Class

Vessel Class	2018	2019 (Projected)	2026	2036	2046
PCTC	318	285	301	353	444
LCTC	67	87	78	99	125
HERO	52	60	143	219	277
Total	437	432	**522**	**671**	**845**

5.2 Transportation Cost Savings Benefits by Measure and by Alternative

Transportation cost benefits were estimated by summarizing and annualizing HarborSym results from multiple simulations. The transportation costs from various model run output files were collected and the transportation cost reduction for all project years was calculated, then annualized to produce an Average Annual Equivalent (AAEQ).

Transportation costs were estimated for a 50-year period of analysis for the years 2026 through 2075. Transportation costs were estimated using HarborSym for the years 2026, 2036, and 2046. Commodity and transportation cost growth is held constant after 20 years following the base year (2026) due to the uncertainty surrounding such long-term forecasts. However, benefit levels remain constant through the remaining period of analysis (2046-2075) as well. The net present value (NPV) was estimated by interpolating between the modeled years. Transportation costs were annualized to determine AAEQ cost savings by discounting the cost stream from year 2026 to 2075 at the current FY 2022 Federal Discount rate of 2.25 percent. Estimates were determined for each measure and alternative. The Total and AAEQ transportation cost saving benefits are provided in Table 5-6.

Table 5-6. AAEQ Transportation Cost Savings Benefits by Alternative (in Thousands $)

Alternative/Depth	Total Benefits (NPV) ($1,000s)	AAEQ Benefits ($1,000s)
Alternative 1 (Without Project)	$0	$0
Alternative 2 (Bend Widener)	$30,570	$1,025
Alternative 3 (Turning Basin)	$37,559	$1,259
Alternative 4 (Meeting Area @ St. Simon's)	$2,851	$96
Alternative 5 (Meeting Area @ S.L. Bridge)	$8,543	$286
Alternative 6	$85,277	$2,858
Alternative 7	$88,443	$2,964
Alternative 8	$88,197	$2,956
Alternative 9	$91,375	$3,063

5.3 Benefit-Cost Analysis

The benefit-cost analysis presented in this section is for each alternative evaluated. Parametric costs have been annualized using the current discount rate of 2.25 percent and are presented at the FY 22 price level. The costs include all economic costs such as project first costs (construction cost) for the Federal project, interest during construction, operations and maintenance (O&M) dredging expenses associated with maintenance of those alternatives, and aids-to-navigation.

Alternative costs are presented in Table 5-7 below, including interest during construction (IDC), operations and maintenance cost assumptions. Estimated first costs include the cost to construct the alternative, including contingency, Real Estate costs, Cultural Resource Preservation costs, aids-to-navigation, Preconstruction, Engineering and Design (PED) and Construction Management (CM) costs presented at current price levels (FY 22). Interest during construction is based on an assumed 12-month construction duration for each measure and alternative. Total economic costs represent implementation costs and includes project first costs, interest during construction, and environmental mitigation costs.

Table 5-7. Alternative Costs (in $1,000s, FY 22 prices, 2.25% discount rate)

Alternative	Project First Costs	Aids to Navigation (ATONS)	Construction Duration (months)	Interest During Construction	Total Economic Costs	Annual OMRR&R	Average Annual Equivalent Cost
Alt 2 - Bend Widener	$9,445	$29	12	$213	$9,687	$12	$330
Alt 3 - Turning Basin	$8,462	-	12	$190	$8,652	$137	$418
Alt 4 - Meeting Area (SLB)	$20,569	-	12	$463	$21,032	$0	$689
Alt 5 -Meeting Area (StS)	$899	$81	12	$20	$1,000	$0	$33
Alt 6	$14,368	$29	12	$323	$14,721	$150	$629
Alt 7	$31,390	$29	12	$718	$32,678	$150	$1,218
Alt 8	$15,312[1]	$110	12	$345	$15,767	$150	$664
Alt 9	$32,027	$110	12	$721	$32,858	$150	$1,224

1 Conceptual project first cost listed for comparison of Alternatives. Once Alt. 8 was selected as the recommended plan the conceptual cost was revised based on feasibility level design and a certified cost estimate of $14,369,000 was developed.

The results of the transportation cost saving benefit analysis are displayed in Table 5-8. As shown, Alternative 8 provides the greatest total net benefits in the benefits analysis. Although Alternative 6 provides a relatively similar level of net benefits, the incremental congestion relief benefits of Alternative 8 ($98,000) outweigh the minimal incremental costs ($35,000) above Alternative 6. Alternative 8 provides a meeting area for two-way traffic in the port, while incurring no additional dredging. Further explanation of the selection of Alternative 8 over 6 as the recommended plan is found in Section 3.8 of the Main Report. At the time of this analysis in October 2021, no environmental mitigation costs were anticipated for Alternative 8. Further explanation on environmental effects are in Section 2 of the Main Report, but it lists no impacts to the project area for Alternative 8. The estimated construction cost of the proposed alternative is approximately $15 million. The total economic cost of the alternative, including interest during construction (IDC) and associated O&M of $150,000 every year, is approximately $16 million.

Table 5-8. Benefit Cost Analysis (FY 22 prices, 2.25% discount rate)

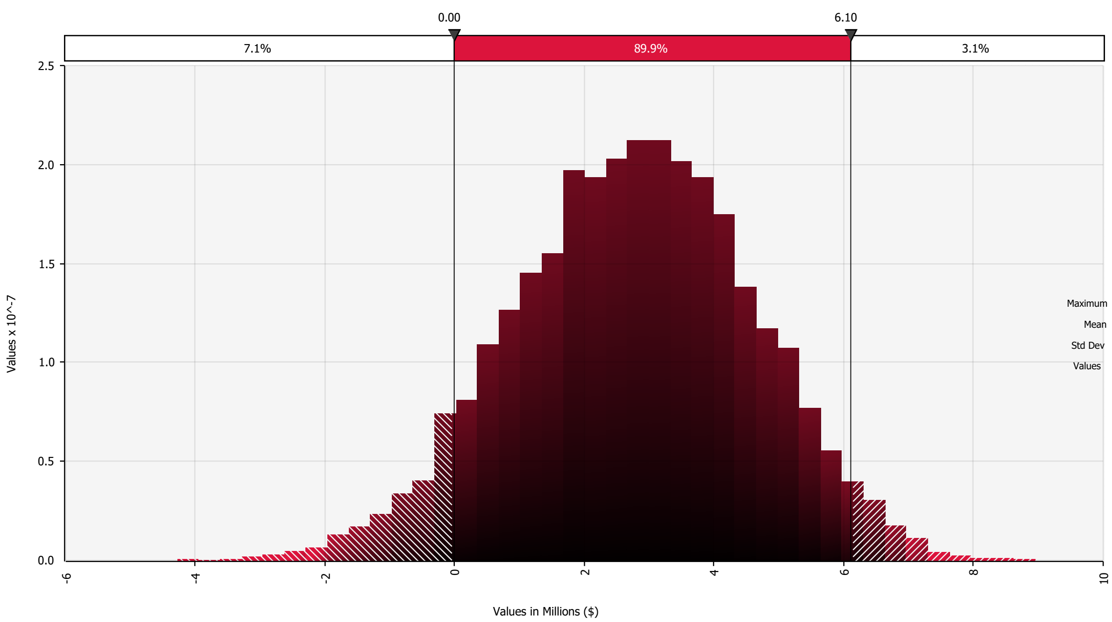
Alternative	Total AAEQ Costs	Incremental AAEQ Costs*	Total AAEQ Benefits	Total Net Benefits	BCR
Alt 2	$330,000	-	$1,025,000	$695,000	3.1
Alt 3	$418,000	-	$1,259,000	$841,000	3.0
Alt 4	$689,000	-	$286,000	-$403,000	0.4
Alt 5	$33,000	-	$96,000	$63,000	2.9
Alt 6	$629,000	-	$2,858,000	$2,229,000	4.5
Alt 7	$1,218,000	$589,000	$2,964,000	$1,746,000	2.4
Alt 8	$664,000	$35,000	$2,956,000	***$2,292,000***	4.5
Alt 9	$1,224,000	$595,000	$3,063,000	$1,839,000	2.5

*** Incremental AAEQ costs are differences in Alternatives 7, 8, and 9 from Alternative 6 (Bend Widener plus Turning Basin)**

6 Uncertainty and Sensitivity Analysis

The benefits of the recommended plan for this project are uncertain. The Principles and Guidelines (P&G) and subsequent Engineering Regulation (ER) 1105-2-100, recognize the inherent variability to water resources planning and navigation projects. The HarborSym modeling tool computes numerous vessel operating costs for each vessel class in each iteration that is modeled. For example, in the modeling year 2026, HarborSym ran 50 iterations and calculated voyage costs for 14,550 PCTC's, 3,800 LCTC's and 6,950 HERO vessels. A single average transportation cost is calculated for each vessel class and is used to calculate a total transportation cost for each alternative and respective year. This is then subtracted from the FWOP total transportation cost to arrive at an alternative's benefits. However, using all the vessel costs, and not the average, produces a distribution of costs as a result of multiple iterations, complete with descriptive statistics like maximum, minimum, mean, and standard deviation. Using the differences in these distributions to display benefits, instead of averages, can illustrate the uncertainty inherent in navigation project benefits. When the average annual benefit of the Tentatively Selected Plan, Alternative 8, is displayed using a distribution of benefits, the frequency distribution in Figure 6-1 below results. This is the distribution of AAEQ benefits that results from the difference in 10,000 sampled combinations of FWP and FWOP costs taken from the complete HarborSym results. The resultant confidence interval is highlighted across the top of the graph. At a 90% level of confidence, the AAEQ benefits of the TSP are between $0.00 and $6.1M. The reported AAEQ benefit for Alternative 8 of $2,929,000 falls within this range among the most frequent occurrences in the distribution below.

Figure 6-1 AAEQ Benefit Distribution for the Tentatively Selected Plan, Alternative 8 (Million $)



There are two kinds of uncertainty in this analysis: Knowledge Uncertainty and Natural Variability. Knowledge Uncertainty pertains to knowable facts that the study team was not aware of. These included orderbook data for RO/RO vessels and historical RO/RO vessel operating costs. The study team relied on management measures to address and reduce the uncertainty associated with these issues. For lack of orderbook data, the study team relied on other sources for shipbuilding trends and data; including journal articles, industry reports, and shipper feedback. USACE estimates Deep Draft Navigation Vessel Operating Costs for use in navigation studies, so lack of specific vessel cost data was mitigated by certified estimates based on vessel class and size.

The other source of uncertainty is Natural Variability: or things that vary naturally and that can't be exactly known. In this study, these areas were: exact future totals for vehicle tonnage, fleet sizes, vessel calls at Brunswick, vessel speed, turning times, and delay times. To address and manage these uncertainties, the study team either used the sampling inherent to the Monte Carlo simulator in HarborSym or conducted sensitivity runs to test how affected the recommended plan would be to changes in that variable. Monte Carlo simulation addressed the uncertainty around vessel speed and turning time by taking sample values from within a range for each parameter for each individual vessel call or covering the potential range of reasonable values. Sensitivity analyses were required to assess the effect on the outcome from changes to future tonnage forecasts, changes in fleet sizes and cargo share, and delay times.

6.1 No Growth Scenario

For the first sensitivity scenario, effects were tested on the reduction of commodity volumes over the forecast period. Since commodity volumes drive fleet sizes and vessel calls, the benefits could be very sensitive to volume drops. Volumes were assumed to remain at 2018 levels through 2019 and 2020 in the original analysis due to macroeconomic forces and industry slowdowns. So, in this scenario, 2018 levels were projected to persist beyond 2020, throughout the forecast period until 2075. Also, because the commodity volumes did not grow, the fleet mix did not change either. So, the same number and proportion of PCTC's, LCTC's, and HERO's carried cargo to and from Brunswick over the forecast period. There was no fleet shift to HERO's carrying a larger share of the cargo, as there was in the FWOP and FWP conditions. This captures the effects of commodity volumes, fleet sizes, and cargo share on project benefits. The results of this scenario are shown in Table 6-1 below.

Table 6-1 No Growth Scenario Economic Analysis

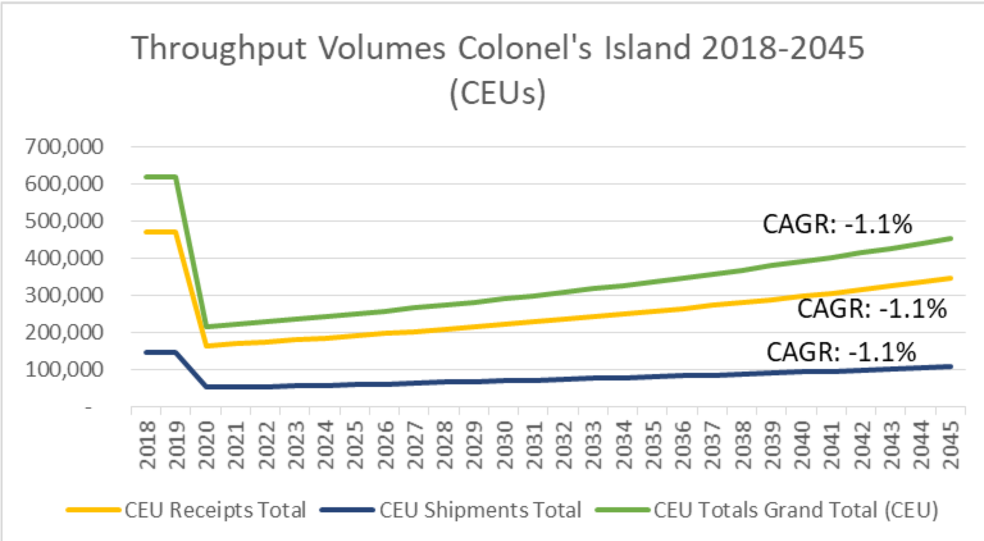
Alternative	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	BCR
Alt 8 No Growth	$637,000	$1,149,000	***$512,000***	1.8

The resulting benefits from this scenario reflect an approximate 60% decrease from the primary analysis. So, even when combining the effects of commodity volume decreases, stagnant fleet sizes and cargo shares, the recommended plan was still economically justified. So, another scenario was run to explore how low volumes would need to drop before the alternative wasn't economically justified.

6.2 Unity Scenario

The second scenario began with the same settings as the No Growth scenario. Commodity volumes remained flat from 2018 through 2019. The fleet mix was frozen at 2018 proportions as well. Then, in 2020, commodity volumes were adjusted significantly downward, and given a recovery period of slow growth over the remaining 25 years of the forecast period. This was repeated until the resulting fleet was small enough not to generate enough AAEQ benefits to cover the costs of the TSP. The resulting scenario reflected a 65% decrease in volumes in 2020, with a slow recovery over the next 25 years. At the end of the forecast period, 2045, volumes had only recovered to 75% of their 2019 levels, with an annual growth rate of -1.1% over the period. Figure 2 below shows the commodity forecast for this scenario in CEUs.

Figure 6-2 Unity Scenario Commodity Forecast for Vehicles at Colonel's Island, 2018-2045, in CEUs



This forecast resulted in a significant drop in vessel calls. Table 6-2 below compares forecasted vessel calls from the base scenario to the decreased calls in this scenario. Base scenario calls are in parentheses next to their adjusted counterparts.

Table 6-2. Vessel Calls by Vessel Class, Unity Scenario compared to Base scenario

Vessel Class	2018	2019 (Projected)	2026	2036	2046
PCTC	318	285	133 (301)	179 (353)	233 (444)
LCTC	67	87	29 (78)	38 (99)	49 (125)
HERO	52	60	22 (143)	30 (219)	39 (277)
Total	437	432	**184 (522)**	**247 (671)**	**321 (845)**

The results of this scenario are shown in Table 3 below.

Table 6-2 No Growth Scenario Economic Analysis

Alternative	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	BCR
Alt 8 Unity Scenario	$637,000	$728,000	***$91,000***	1.1

Given the unlikelihood of a 65% drop in vehicle volumes in one year, combined with the meager recovery shown above, the benefits for the TSP would seem to be resilient to potential economic shocks.

6.3 50% Alternative Effectiveness

The final scenario addressed benefit sensitivity to the effectiveness of the proposed alternative on reducing the amount of delays in the harbor navigation system. The base scenario assumed that the TSP would completely eliminate all conditions-based restrictions in the harbor. In this scenario, it was assumed that the TSP would only reduce the amount of delays by 50%. This was estimated by adjusting the current restrictions in HarborSym for vessels over 700 feet and HERO vessels. In the base scenario, a limit of 1 knot of current was set for those vessels to coincide with the pilot's preference around slack water. Since max current was assumed to be 3 knots in Brunswick, as previously discussed in Section 2, this scenario adjusted the current limit to 2 knots for those vessels. The commodity and fleet forecasts were kept at the No Growth Scenario levels, so this scenario combines the effects of no commodity growth, no fleet size or makeup changes, and reduced effectiveness on harbor restrictions and delays. The results of this scenario are shown in Table 6-4 below.

Table 6-4 50% Alternative Effectiveness Scenario Economic Analysis

Alternative	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	BCR
Alt 8 50% Effectiveness Scenario	$637,000	$1,001,000	***$364,000***	1.6

The resulting benefits from this scenario reflect an approximate 66% decrease from the primary analysis. So, even when combining the effects of commodity volume decreases, stagnant fleets, and limited delay reductions, the recommended plan is still economically justified.

6.4 COVID-19

The coronavirus pandemic is having widespread and perhaps long-lasting impacts on the world and U.S. economies. At this point in time, the study team can only speculate on how severe these effects might be and on the potential effects on the economic benefits and costs of USACE Civil Works projects. These speculations could include drastic changes in starting points for forecasts, changes in forecasts growth rates, changes in prices and costs, and long-term disruptions of trade. The sections above have identified the key sources of uncertainty about this project. The unity scenario provided a glimpse into the potential effects of these uncertainties, hopefully to an extreme degree. The study team will continue to track developments in the auto industry and overall economic growth as it progresses but make no adjustments at this time for any shocks.

7 Multiport Analysis

Multiport competition was assessed qualitatively for this study as it relates to shifting of cargo from one port to another port based on factors such as widening of a harbor. The recommended plan includes a wider channel to more efficiently operate larger RO/RO vessels. Larger vessels alone do not drive growth for the harbor. Many factors may influence the growth of a particular harbor: landside development and infrastructure, location of distribution centers for receipts, source locations for shipments, population and income growth and location, port logistics and fees, business climate and taxes, carrier preferences, labor stability and volatility, and business relationships. Harbor dimensions are just one of many factors involved in determining growth and market share for a particular port.

Market share between the Port of Brunswick and nearby regional ports like Savannah and Jacksonville, FL is multi-faceted and very dynamic. Specific business relationships that drive the fluctuation of market share between them are the manufacturer-to-shipper relationships, shipper-to-port, or port-to-processor relationships. Some companies only ship to one port, others may ship to and from all three, depending on those involved. Given the relative closeness of these three ports geographically, it is likely that the market share will continue to fluctuate between the ports as capital improvements are made and the demand for vehicles change. It should be acknowledged that under the GPA, cargo operations between the Ports of Savannah and Brunswick are shared and therefore cargo share may more easily fluctuate between them in the future. The previously mentioned structural changes in the auto industry may also play a role in the share between the three ports as manufacturers consolidate and relationships change.

Shipper input has also revealed that modifications to the channel framework at Brunswick alone will not be sufficient to cause changes in the vessel fleet servicing the U.S. (such as a shift to larger vessels). As mentioned previously, vehicle carriers visit multiple ports in the U.S. on a typical voyage. In general, East Coast and Gulf Coast ports are upriver ports, meaning vessels need to navigate up a river system to reach their respective terminals. Conversely, West Coast ports are more coastal and require shorter transits through deeper, wider approaches. Even though the ports of Savannah and Jacksonville have completed large channel dredging projects in the last 20 years, more comprehensive change to the East Coast/ Gulf Coast port system as a whole would be needed to result in changes to the fleet.

Ultimately, this economic analysis was conducted with the historical Brunswick cargo share remaining the same in both the future without-project and future with-project conditions. To restate the multiport considerations in another way, justification of the recommendation for this study is not based on the assumption that cargo will shift to Brunswick with widening alone. The analysis assumes Brunswick receives the same share of regional cargo volumes with or without the widening of the waterway.

8 Economic Evaluation

8.1 Costs

Feasibility-level cost estimates were developed at FY 22 price levels. A detailed "Basis of Cost Estimate" that outlines cost assumptions appears in the Cost Engineering Appendix. Potential risk events were evaluated and incorporated into a risk model to determine appropriate contingency levels. Costs of the recommended plan were further refined during cost certification and are reflected below.

Table 8-1 summarizes the certified cost information for the NED plan which were used in the final economic evaluation. Construction first costs were revised to $14,369,000. Interest during construction was computed on the construction first cost using a 12-month construction duration and the current discount rate of 2.25%. There were no service facility costs to capture the widening benefits. The addition of aids-to-navigation was included. The total investment cost is the sum of the construction first cost, interest during construction, and aids-to-navigation.

Table 8-1. NED Economic Costs (FY 22 prices)

Cost	*NED Plan*
Construction First Cost	$14,369,000
IDC (12 months @ 2.25%)	$323,000
Aids to Navigation	$110,000
Total Investment Cost	$14,803,000
AAEQ Cost	$482,000
AAEQ OMRR&R	$150,000
Total AAEQ Cost	$632,000

Note: Transportation costs are based on FY16 vessel operating costs updated from EGM 17-04.

8.2 Net Benefits and Benefit-Cost Ratio (BCR)

Table 8-2 displays the updated costs, benefits, and net benefits for the NED plan at the FY 22 price level and 2.25% discount rate. The NED plan maximizes net benefits at $2,324,000 and a BCR of 4.7.

Table 8-2. Summary of NED Plan (FY 22 prices)

Alternative	Total AAEQ Costs	Total AAEQ Benefits[1]	Total Net Benefits	Incremental Net Benefits	Benefit/Cost Ratio (BCR)
Alt 8	$632,000	$2,956,000	$2,324,000	--	4.7

[1]Transportation cost savings benefits are based on FY16 vessel operating costs updated from EGM 17-04.

Table 8-3 provides a summary of the costs and benefits of the NED. O&M dredging expenses have been estimated to occur every year at $150,000 per dredge cycle at the FY 22 price level. AAEQ cost is estimated at $613,000, which includes an AAEQ cost for O&M of $150,000. AAEQ benefits include origin-to-destination transportation cost savings of approximately $2,956,000, resulting in total net benefits of $2,324,000 (AAEQ benefits minus AAEQ costs) and a 4.7 BCR. First costs for authorization are estimated at $14,369,000 (FY 22 price level).

Table 8-3. Average Annual Equivalent (AAEQ) Benefits and Costs of the Brunswick Harbor NED Plan

	Cost and Benefit Summary of the NED Plan (FY 22 price level)
Interest Rate (Fiscal Year 2022)	2.25%
Construction Period, Months	12
Period of Analysis, Years	50
Construction First Costs	$14,369,000
Interest During Construction (First Costs only)	$323,000
Estimated Local Service Facilities	$0
Estimated Aids to Navigation	$110,000
Estimated Economic Costs (FY 22 price level)	***$14,803,000***
AAEQ Costs	
Amortized Cost	$482,000
OMRR&R	$150,000
Total AAEQ Costs	***$632,000***
AAEQ Benefits	
Origin-to-Destination Transportation Cost Savings[1]	$2,956,000
Total AAEQ Benefits	***$2,956,000***
AAEQ Net Benefits (AAEQ Benefits – AAEQ Costs)	**$2,324,000**
Benefit-to-Cost Ratio (computed at 2.25%)	**4.7**

[1] Transportation costs and cost savings benefits are based on FY16 vessel operating costs updated from EGM 17-04.

9 Socioeconomic and Regional Analysis

The socioeconomics of the state of Georgia, Glynn County, and the City of Brunswick are summarized in this section. This section will largely focus on Glynn County, which is the community surrounding the Port of Brunswick. The boundary of Glynn County and its location as it relates to Brunswick Harbor is displayed in Figure 9-1. The parameters used to describe the demographics and socioeconomic environment include population trends, private sector employment, and wage earnings. Other social characteristics such as race composition, age distribution, and poverty will be examined in order to recognize any potential environmental justice issues that the improvement project may induce.

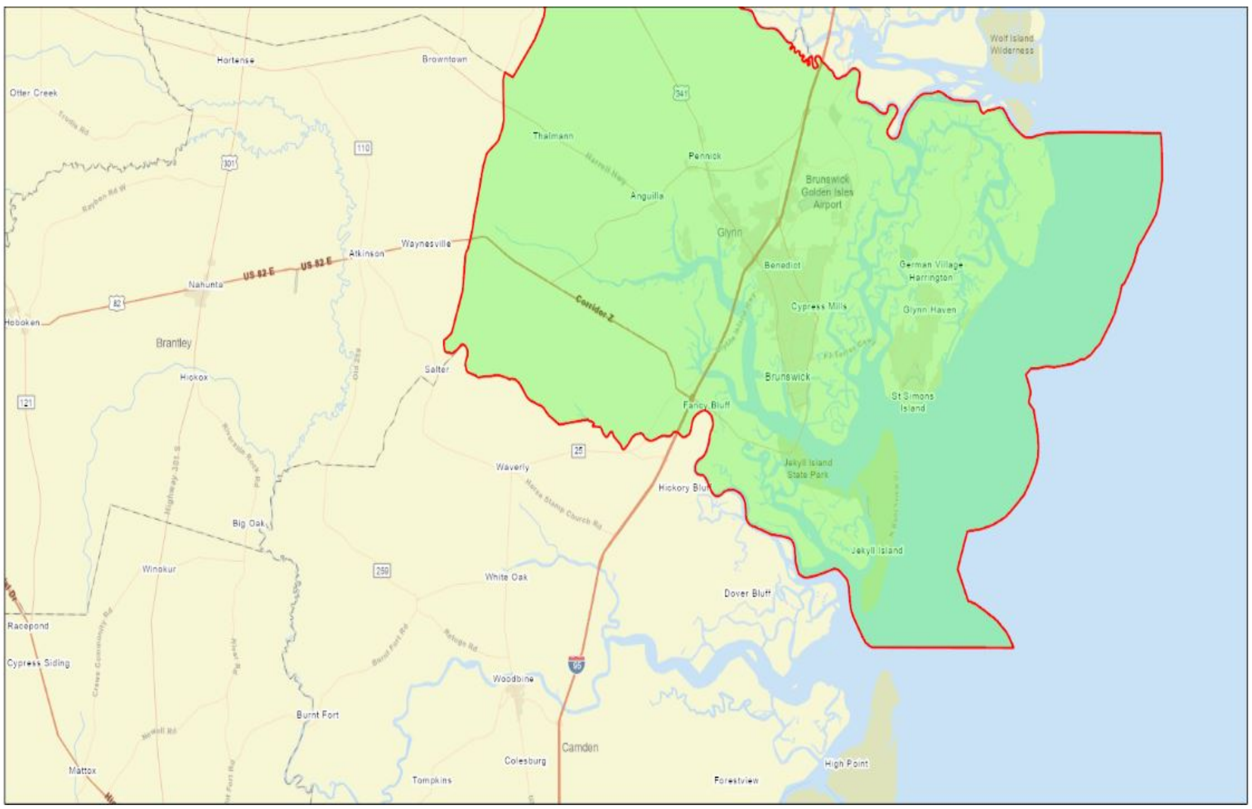


Figure 9-1. Glynn County Boundary

9.1 Overview

The economy of Glynn County is diverse, with many sources of employment. Tourism, recreation, and port-related activity are center to the economy. The City of Brunswick is the only municipality in the County. Most people working in Glynn County also live in the County.

9.1.1 Population

The state of Georgia is ranked as the ninth largest state in terms of resident population as of the 2010 census, with a population of 9,687,653. Population estimates for the state of Georgia, Glynn County, and Brunswick are displayed in Table 9-1 below. As of 2010, the population estimate for Glynn County was 79,626. Between 2000 and 2017, Georgia's population experienced a 25% growth, while Glynn County experienced similar growth at 24%. The state is expected to grow by 39% between 2016 and 2050 while the County grows by 27%.

Table 9-1. Population Estimates and Projections (2000, 2010, 2017, 2050)

Geographical Area	2000 Population Estimate	2010 Population Estimate	2017 Population Estimate	2050 Population Projection
Georgia	**8,186,453**	**9,687,653**	**10,201,635**	**14,186,991**
Glynn County	**67,568**	**79,626**	**83,467**	**106,185**
Brunswick	**15,600**	**15,383**	**15,919**	**N/A**
Source: U.S. Census Bureau, Population Division (2000, 2010 Estimates); U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates (2017 Estimate); State of Georgia, Governor's Office of Planning and Budget (2050 Projections)				

9.2.1 Employment by Industry

The labor force by industry is characterized in Table 9-2. The largest majority of Glynn County is employed in the Educational services, and health care and social assistance sector at 21%, followed by the Arts, entertainment, and recreation, and accommodation and food services sector at 17%, the Retail Trade sector at 13%, and the Professional, scientific, management, and administrative sector at 11%. The remaining sectors each employ less than 10% of the workforce in Glynn County.

Table 9-2. Employment by Sector (2017)

Industry	Georgia		Glynn County		Brunswick	
	Number	%	Number	%	Number	%
Agriculture, forestry, fishing and hunting, and mining	52,374	1%	355	1%	98	1%
Construction	301,027	7%	2,118	6%	472	7%
Manufacturing	487,467	11%	2,366	6%	415	6%
Wholesale trade	132,095	3%	769	2%	22	0%
Retail trade	543,971	12%	4,711	13%	678	10%
Transportation and Warehousing, and utilities	285,663	6%	1,629	4%	322	5%
Information	113,019	2%	425	1%	67	1%
Finance and insurance, and real estate and rental and leasing:	290,246	6%	2,047	5%	242	4%
Professional, scientific, and management, and administrative, and waste management services	543,837	12%	3,995	11%	891	14%
Educational services, and health care and social assistance	959,259	21%	7,840	21%	1,361	21%
Arts, entertainment, and recreation, and accommodation and food services	435,062	9%	6,464	17%	1,371	21%

Other services, except public administration	226,826	5%	2,054	5%	265	4%
Public administration	235,483	5%	2,620	7%	366	6%
Total	**4,606,329**	**100%**	**37,393**	100%	**6,570**	100%
Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates (2017 Estimate)						

9.2.1 Income and Poverty

Median household and per capita incomes for selected geographies in 2017 are displayed in Table 9-3. The median household income within Glynn County was comparable to the state of Georgia in 2017, at $52,977 and $47,546, respectively. In terms of per capita income, Glynn County's income of $29,209 was slightly higher than that of the state, which had a median per capita income of $28,015.

Also displayed in the table is the percentage of individuals and families whose incomes were below the poverty level within the last twelve months. In 2017, Glynn County had a higher percentage of both families and people with incomes below the poverty level when compared with the state. Approximately 16% of people and 19% of families had incomes below the poverty level in the past twelve months at the time of the survey.

Table 9-3. Median, Per Capita Income and Poverty Data (2017)

Geographical Area	Median Household Income	% of Families with Incomes Below Poverty Level (Last 12 months)	Per Capita Income	% of People with Incomes Below Poverty Level (Last 12 months)
Georgia	$52,977	12.8%	$28,015	16.9%
Glynn County	$47,546	16.1%	$29,209	19.2%
Brunswick	$24,417	37.7%	$18,254	39.0%
Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates (2017 Estimate)				

9.2.2 Labor Force and Employment

Details on the labor force and unemployment rates are displayed in Table 9-4 below. In Glynn County, the labor force is comprised of 39,838 individuals, 1,887 of which were unemployed in 2017. The 2017 annual average unemployment rate in the state of Georgia was equal to that of Glynn County at 4.7%.

Table 9-4. Labor Force, Employment and Unemployment Rates (2017 Annual Averages)

Geographic Area	Civilian Labor Force	Number Employed	Number Unemployed	Unemployment Rate
Georgia	5,061,399	4,821,622	239,777	4.7%
Glynn County	39,838	37,951	1,887	4.7%
Source: Bureau of Labor Statistics, Current Population Survey (State estimate, 2017), LAUS (County estimates, 2017)				

9.2.3 Race and Ethnicity

Table 9-5 displays race and ethnicity for the selected geographies. Within Glynn County, 64% of the population is White, 26% is Black, 7% is Hispanic or Latino, 1% is Asian, and 1% is two or more races. By comparison, within the state of Georgia, 54% of the population is White, 31% is Black, 9% is Hispanic or Latino, 4% is Asian, and 2% is two or more races. In general, Glynn County has a slightly smaller minority population than that of Georgia.

Table 9-5. Racial Composition by Geographical Area (2017)

Race/Ethnicity	Georgia		Glynn County		Brunswick	
	Number	%	Number	%	Number	%
White	5,469,446	54%	53,220	63.8%	4,862	30.5%
Black	3,150,514	31%	21,414	25.7%	8,751	55.0%
American Indian and Alaskan Native	18,199	0%	354	0.4%	67	0.4%
Asian	386,669	4%	1,076	1.3%	214	1.3%
Native Hawaiian or Pacific Islander	4,605	0%	39	0.0%	18	0.1%
Some other race alone	28,662	0%	105	0.1%	17	0.1%
Two or More Races	193,160	2%	1,652	2.0%	272	1.7%
Hispanic or Latino	950,380	9%	5607	6.7%	1,718	10.8%
Total	**10,201,635**	**100.0%**	**83,467**	**100.0%**	**15,919**	**100.0%**
Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates (2017 Estimate)						

9.2.4 Age

The distribution of population by age group is displayed in Table 9-6 for the selected geographies. The age distribution among the two regions is similar. Glynn County has a slightly larger population ages 55 and over when compared to the state of Georgia. 18% of Glynn County's population was 65 or over in 2017 compared to 13% of the state's population.

Table 9-6. Population by Age Group (2017)

Area	Age Group												
	<5	5 to 9	10 to 14	15 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 59	60 to 64	65 to 74	75 to 84	85 and over
Georgia	6%	7%	7%	7%	7%	14%	13%	14%	6%	6%	8%	4%	1%
Glynn County	6%	6%	7%	6%	6%	12%	12%	13%	7%	7%	11%	5%	2%
Brunswick	7%	7%	6%	7%	8%	13%	13%	11%	6%	8%	9%	4%	2%
Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates (2017 Estimate)													

9.2.5 Demographic Indicators for Environmental Justice

Environmental justice (EJ) is addressing, as appropriate, disproportionately high and adverse human health or environmental effects of Federal programs, policies, and activities on minority and/or low-income populations. The Executive Order (EO) 12898 on EJ requires an analysis of environmental effects, including human health, economic and social effects, of Federal actions, including effects on minority and/or low-income communities, when such analysis is required by the NEPA. The intent of EJ is that no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental, and commercial operations or policies. This section uses the EJSCREEN tool to determine whether minority, low income, and Native American Tribal populations may exist within the project area of potential effect and evaluates whether the environmental impacts of each alternative would result in a disproportionately high and adverse impact on EJ communities (EO 12898, February 11, 1994).

Figure 9-2 displays the results for Glynn County in terms of six demographic indicators and a demographic index. The demographic indicators shown on the graph are: Low-income (the percent of an area's population in households where the household income is less than or equal to twice the federal poverty level), minority population (the percent of individuals in an area who list their racial status as a race other than white alone and/or list their ethnicity as Hispanic or Latino), less than high school education (Percent of people age 25 or older in an area whose education is short of a high school diploma), linguistic isolation (percent of people in households in which all members age 14 years and over speak a non-English language and also speak English less than "very well"), individuals under age 5, and individuals over age 64.

As shown in the figure, Glynn County's minority population is at the 43rd percentile in the state, meaning that the region's percentage of minority population is equal to or higher than 43% of the state. When compared with the U.S., the County is at the 56th percentile. The county is in the 56th percentile in the state in terms of low income population (65th in the national percentile); it is in the 65th percentile in the state in terms of linguistically isolated population (57th in the national percentile); it is in the 52nd percentile in terms of population with less than a high school education (59th in the national percentile); 51st in population under the age of five (53rd in the national percentile); and 81st in population over age 64 (71st in the national percentile). The demographic index, which is based on the average of two demographic indicators: percent low-income and percent minority, shows that county is in the 49th percentile when compared to the state and 60th percentile in the nation.

The EJSCREEN demographic indicators for Glynn county did not identify a specific need for further review, given that the Minority and Low-Income Population indicators were near or below the median for the state of Georgia. The Census block groups surrounding the project area, block group 131270010001 and 130390101002 were screened for potential Environmental Justice concerns as well, and it was found that the indicators for these geographic areas were lower than that of Glynn County when compared to the State and the USA.

Given the screening described in this section, no minority or low-income populations have been identified that would be adversely impacted by the proposed project as determined above. Therefore, in accordance with the provisions of E.O. 12898 and FHWA Order 6640.23A, no further EJ analysis is required.

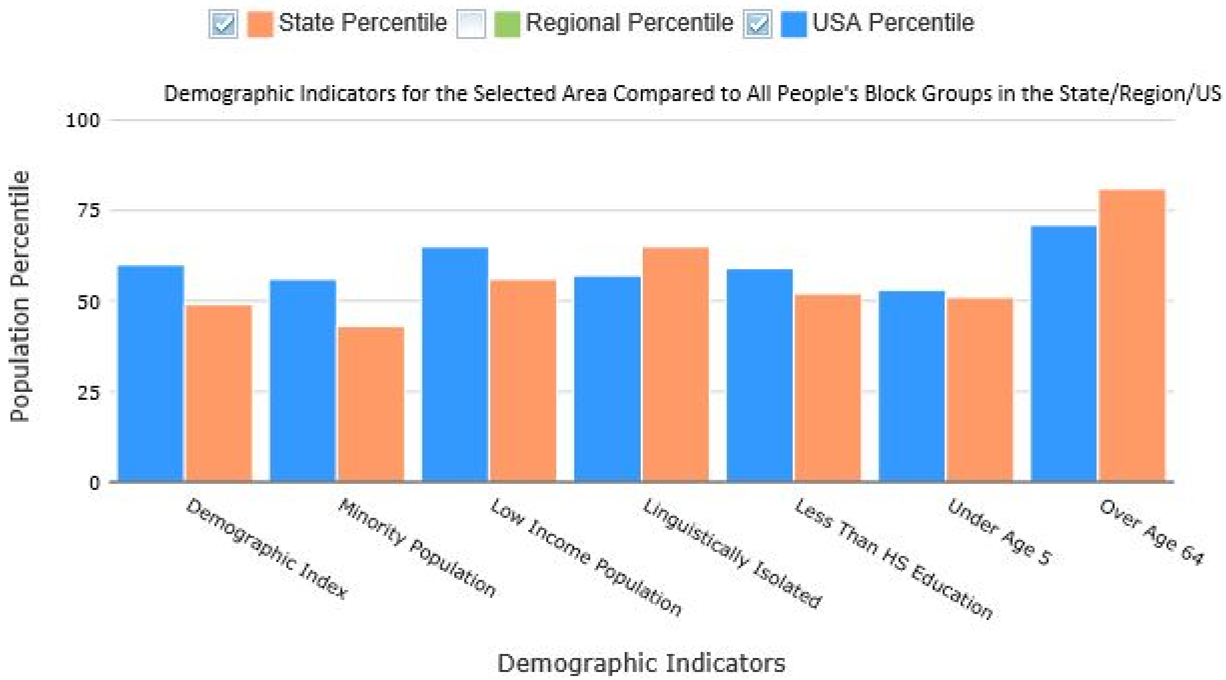


Figure 9-2. Environmental Justice Demographic Indicators for Glynn County

9.3 Regional Economic Development (RED) Analysis

The regional economic development (RED) account measures changes in the distribution of regional economic activity that would result from each alternative plan. Evaluations of regional effects are measured using nationally consistent projection of income, employment, output and population.

The U.S. Army Corps of Engineers (USACE) Institute for Water Resources, Louis Berger, and Michigan State University have developed a regional economic impact modeling tool, RECONS v2.0 (Regional ECONomic System), that provides estimates of jobs and other economic measures such as labor income, value added, and sales that are supported by USACE programs, projects, and activities. This modeling tool automates calculations and generates estimates of jobs, labor income, value added, and sales through the use of IMPLAN®'s multipliers and ratios, customized impact areas for USACE project locations, and customized spending profiles for USACE projects, business lines, and work activities. RECONS allows USACE to evaluate the regional economic impact and contribution associated with USACE expenditures, activities, and infrastructure.

The expenditures associated with Brunswick Harbor are estimated to be $13,804,000. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in the following tables. The regional economic effects are shown for the local, state, and national impact areas. In summary, the Civil Works expenditures $13,804,000 support a total of 57.3 full-time equivalent jobs, $3,777,000 in labor income, $5,535,000 in the gross regional product, and $10,465,000 in economic output in the local impact area. More broadly, these expenditures support 141.4 full-time equivalent jobs, $10,129,000 in labor income, $15,560,000 in the gross regional product, and $29,625,000 in economic output in the nation.

Table 9-3. RECONS Project Information

Project Name	BRUNSWICK HARBOR
Project ID	61062080
Type of Analysis	Civil Works Budget Data and Work Activities
Year of Expenditure	2025

Table 9-4. RECONS Economic Impact Area

Local Impact Area	Brantley (GA), Glynn (GA), McIntosh (GA)
Counties included	Brantley (GA), Glynn (GA), McIntosh (GA)
State Impact Area	Georgia
State(s) included	Georgia

Table 9-5. RECONS Project Expenditure

Business Line	Navigation
Work Activity	NAV - CWB - General
Year of Expenditure	2025
Expenditure	$13,804,000

Table 9-6. RECONS Spending Profile

	Spending Category	Percentage (%)
1	Dredging -- Fuel	9%
2	Metals and Steel Materials	3%
3	Dredging Consumables -- Textiles, Lubricants, and Metal Valves and Parts	4%
4	Insurance (bond) and Workman's Comp	2%
5	Cement Materials	1%
6	Machinery Materials	1%
7	Dredge Equipment (Depreciation and Capital Expenses)	11%
8	Construction of Other New Nonresidential Structures	9%
9	Electrical Materials	2%
10	Environmental Compliance, Planning, and Technical Services	1%
11	Industrial Machinery and Equipment Repair and Maintenance	17%
12	Dredging Consumables -- Restaurants	1%
13	Dredging Consumables -- Food and Beverages	3%
14	USACE Overhead	7%
15	USACE Wages and Benefits	13%

16	Private Sector Labor or Staff Augmentation	16%

Table 9-7. RECONS Local Purchase Coefficients

IMPLAN Code	Industry	Expenditure	Local Purchase Coefficients		
		($000)	Local	State	US
58	Construction of other new nonresidential structures	$1,243	98%	100%	100%
105	All other food manufacturing	$260	0%	20%	91%
156	Petroleum refineries	$1,027	0%	3%	81%
205	Cement manufacturing	$108	49%	54%	87%
217	Iron and steel mills and ferroalloy manufacturing	$342	0%	5%	74%
254	Valve and fittings, other than plumbing, manufacturing	$472	0%	4%	52%
271	All other industrial machinery manufacturing	$125	0%	4%	69%
334	Switchgear and switchboard apparatus manufacturing	$236	0%	15%	54%
363	Ship building and repairing	$1,489	3%	4%	98%
395	Wholesale trade	$423	73%	96%	100%
399	Retail - Building material and garden equipment and supplies stores	$74	93%	98%	100%
408	Air transportation	$9	1%	77%	80%
409	Rail transportation	$15	82%	97%	99%
410	Water transportation	$8	94%	94%	100%
411	Truck transportation	$82	97%	97%	99%
413	Pipeline transportation	$23	94%	94%	100%
437	Insurance carriers	$276	6%	68%	87%
455	Environmental and other technical consulting services	$138	19%	47%	100%
462	Office administrative services	$966	82%	91%	100%
502	Limited-service restaurants	$138	93%	100%	100%
507	Commercial and industrial machinery and equipment repair and maintenance	$2,347	41%	91%	100%
535	Employment and payroll of federal govt, non-military	$1,794	100%	100%	100%
5001	Private Labor	$2,209	98%	100%	100%
	Total	**$13,804**			

Table 9-8. RECONS Impact Summary

Area	Local Capture ($000)	Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
Local					
Direct Impact		$7,723	38.5	$2,990	$3,987
Secondary Impact		$2,742	18.8	$787	$1,547
Total Impact	$7,723	$10,465	57.3	$3,777	$5,535
State					
Direct Impact		$9,531	50.5	$3,880	$5,267
Secondary Impact		$6,223	36.4	$2,010	$3,556
Total Impact	$9,531	$15,755	86.9	$5,891	$8,823
US					
Direct Impact		$13,045	62.7	$4,950	$6,787
Secondary Impact		$16,579	78.8	$5,178	$8,773
Total Impact	$13,045	$29,625	141.4	$10,128	$15,560

* Jobs are presented in full-time equivalence (FTE)

Table 9-9. Local Impacts

		Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
	Direct Impacts				
58	Construction of other new nonresidential structures	$1,219	8.6	$381	$508,496
105	All other food manufacturing	$0	0.0	$0	$0
156	Petroleum refineries	$0	0.0	$0	$0
205	Cement manufacturing	$53	0.1	$6	$17
217	Iron and steel mills and ferroalloy manufacturing	$1	0.0	$0	$0
254	Valve and fittings, other than plumbing, manufacturing	$0	0.0	$0	$0
271	All other industrial machinery manufacturing	$0	0.0	$0	$0
334	Switchgear and switchboard apparatus manufacturing	$0	0.0	$0	$0
363	Ship building and repairing	$48	0.2	$12	$14
395	Wholesale trade	$309	1.0	$108	$203
399	Retail - Building material and garden equipment and supplies stores	$68	0.6	$25	$42
408	Air transportation	$0	0.0	$0	$0
409	Rail transportation	$12	0.0	$3	$5
410	Water transportation	$7	0.0	$1	$1
411	Truck transportation	$79	0.4	$28	$34
413	Pipeline transportation	$21	0.1	$4	$10
437	Insurance carriers	$17	0.0	$3	$7
455	Environmental and other technical consulting services	$26	0.4	$13	$11
462	Office administrative services	$794	12.0	$522	$546
502	Limited-service restaurants	$128	1.2	$30	$72
507	Commercial and industrial machinery and equipment repair and maintenance	$970	4.6	$468	$714
535	Employment and payroll of federal govt, non-military	$1,794	9.2	$1,379	$1,794
5001	Private Labor	$2,167	0.0	$0	$0
	Direct Impact	**$7,722**	**38.5**	**$2,989**	**$3,987**
	Secondary Impact	**$2,741**	**18.8**	**$786**	**$1,547**
	Total Impact	**$10,464**	**57.3**	**$3,776**	**$5,534**

* Jobs are presented in full-time equivalence (FTE)

Table 9-10. State Impacts

		Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
	Direct Impacts				
58	Construction of other new nonresidential structures	$1,241	8.8	$448	$597
105	All other food manufacturing	$52	0.1	$8	$9
156	Petroleum refineries	$28	0.0	$1	$5
205	Cement manufacturing	$58	0.1	$6	$19
217	Iron and steel mills and ferroalloy manufacturing	$17	0.0	$1	$2
254	Valve and fittings, other than plumbing, manufacturing	$20	0.1	$3	$7
271	All other industrial machinery manufacturing	$5	0.0	$1	$1
334	Switchgear and switchboard apparatus manufacturing	$36	0.1	$7	$13
363	Ship building and repairing	$58	0.3	$14	$17
395	Wholesale trade	$404	1.4	$141	$266
399	Retail - Building material and garden equipment and supplies stores	$72	0.6	$28	$46
408	Air transportation	$6	0.0	$1	$2
409	Rail transportation	$14	0.0	$4	$6
410	Water transportation	$7	0.0	$1	$1
411	Truck transportation	$79	0.4	$28	$34
413	Pipeline transportation	$21	0.1	$6	$12
437	Insurance carriers	$187	0.4	$42	$87
455	Environmental and other technical consulting services	$65	1.0	$63	$37
462	Office administrative services	$878	13.3	$626	$652
502	Limited-service restaurants	$137	1.3	$33	$77
507	Commercial and industrial machinery and equipment repair and maintenance	$2,133	11.2	$1,030	$1,569
535	Employment and payroll of federal govt, non-military	$1,794	11.2	$1,379	$1,794
5001	Private Labor	$2,206	0.0	$0	$0
	Direct Impact	**$9,531**	**50.5**	**$3,880**	**$5,267**
	Secondary Impact	**$6,223**	**36.4**	**$2,010**	**$3,555**
	Total Impact	**$15,754**	**86.9**	**$5,890**	**$8,823**

* Jobs are presented in full-time equivalence (FTE)

Table 9-11. US Impacts

		Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
	Direct Impacts				
58	Construction of other new nonresidential structures	$1,242	8.8	$491	$639
105	All other food manufacturing	$236	0.6	$36	$44
156	Petroleum refineries	$828	0.1	$42	$268
205	Cement manufacturing	$93	0.2	$14	$38
217	Iron and steel mills and ferroalloy manufacturing	$253	0.2	$22	$46
254	Valve and fittings, other than plumbing, manufacturing	$245	0.6	$56	$97
271	All other industrial machinery manufacturing	$86	0.3	$24	$30
334	Switchgear and switchboard apparatus manufacturing	$126	0.3	$29	$47
363	Ship building and repairing	$1,465	6.7	$512	$577
395	Wholesale trade	$423	1.5	$148	$279
399	Retail - Building material and garden equipment and supplies stores	$74	0.6	$30	$47
408	Air transportation	$6	0.0	$1	$3
409	Rail transportation	$15	0.0	$4	$8
410	Water transportation	$8	0.0	$1	$2
411	Truck transportation	$80	0.5	$28	$35
413	Pipeline transportation	$23	0.1	$17	$16
437	Insurance carriers	$241	0.6	$54	$131
455	Environmental and other technical consulting services	$138	2.1	$133	$84
462	Office administrative services	$966	14.6	$750	$785
502	Limited-service restaurants	$138	1.3	$33	$80
507	Commercial and industrial machinery and equipment repair and maintenance	$2,346	12.3	$1,134	$1,726
535	Employment and payroll of federal govt, non-military	$1,794	11.2	$1,379	$1,794
5001	Private Labor	$2,208	0.0	$0	$0
	Direct Impact	$13,045	62.7	$4,949	$6,787
	Secondary Impact	$16,579	78.8	$5,178	$8,772
	Total Impact	$29,624	141.4	$10,128	$15,560

* Jobs are presented in full-time equivalence (FTE)

10 References

References are cited throughout the appendix.

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