CANAVERAL HARBOR, FLORIDA

Integrated Section 203 Navigation Study Report
&
Final Environmental Assessment

Economics Appendix
(sub-part of Volume 3)

October 2012
(last revised February 2012)

US Army Corps of Engineers ®

PORT CANAVERAL

ECONOMICS APPENDIX

Canaveral Harbor, Florida

Integrated Section 203 Navigation Study Report & Draft Environmental Assessment

February 2012

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1 Introduction

The Canaveral Port Authority has conducted an economic analysis as a component of the Section 203 study to determine the feasibility of improvements to the Federal navigation project at Port Canaveral. Potential improvements include deepening and widening of navigational channels, expansion of the West Turning Basin, and expanded wideners at the port. The purpose of these potential improvements is to increase the efficiency of cargo vessel operations and to accommodate larger cruise ships, which are already calling at the port, or projected to use the port in the very near future. This economic analysis evaluates alternatives that will:

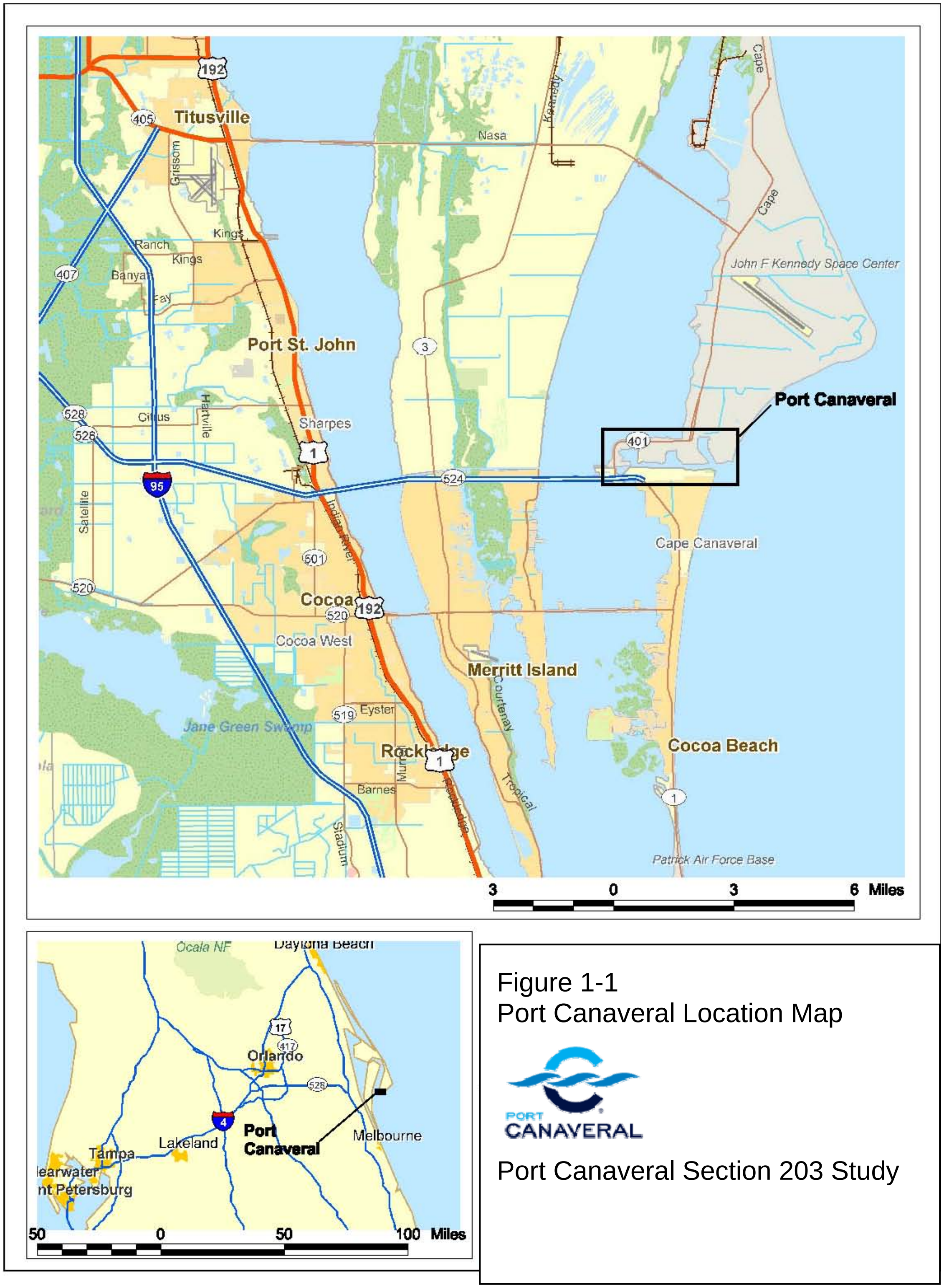
1) reduce congestion at Port Canaveral;
2) improve navigation safety at Port Canaveral;
3) accommodate recent and anticipated future growth in cargo and cruise vessel traffic;
4) improve the efficiency of operations for cargo vessels and cruise ships within the Port complex;
5) allow for use of the Port by larger and more efficient cargo vessels and cruise ships; and
6) allow for development of additional terminals/berths without encroaching on the existing Federal channels and turning basins.

1.1 Project Location

Port Canaveral is located on the east coast of Florida in Brevard County, directly south of the John F. Kennedy Space Center, and five to six miles north of Cocoa Beach. The Port is located about 155 miles south of Jacksonville Harbor, Florida, about 168 miles north-northwest of Miami Harbor, and 50 miles east of Orlando, Florida. The Port occupies both sides of the Canaveral Barge Canal and the Inner Reach of the deepwater entrance channel. A location map is provided on Figure 1-1 and a map showing the major channel and basins is provided on Figure 1-2.

The City of Cape Canaveral, just south of the Port, is located on the north end of the offshore barrier island following the Florida coast line and is connected to the mainland by the Florida State Road (SR) 528 Martin Andersen Beachline Expressway extending across the Banana and Indian Rivers.

Figure 1-1
Port Canaveral Location Map



1.2 Port Description

The deepwater entrance to the Port is via a dredged channel approaching from the southeast, then in an east-west direction across the entrance to the east and middle basins on the north side of the channel. The deep draft channel then continues westerly for approximately 3,570 feet terminating at the entrance to west basin to the north side of the channel. The shallow draft Barge Canal runs adjacent to the south side of the deep draft channel, starting at the west side of middle basin in a westerly direction to the Canaveral Locks, operated by the US Army Corps of Engineers. The north side of the Barge Canal and the south side of the existing 400’ deep draft channel share a common boundary from middle to west basins. The Canaveral Barge Canal continues through the lock, across the Banana River, and through Merritt Island to connect with the Atlantic Intracoastal Waterway running north-south in the Indian River.

The Port is a multiple-use facility composed of cruise ship berths, cargo berths, U.S. Navy, U.S. Coast Guard, and Military Sealift Command (MSC) berths. Commercial waterfront facilities (described in detail in Section 2) are located along the south side of the main channel, along the north side of the channel west of the middle basin, and along the sides of the middle and west basins. Approaching from the Atlantic Ocean, the eastern basin (also referred to as the Trident Basin) is used by U.S. Navy vessels; the middle basin is jointly used by commercial, U.S. Navy and MSC vessels; and the west basin is used by commercial traffic, cruise ships, and home to the U.S. Coast Guard Station, Port Canaveral, Seventh District, Jacksonville Sector. The berths situated on the Inner Reach of the entrance channel are used primarily by cruise ships, cargo ships and tankers. The primary U.S. Navy facilities at Port Canaveral consist of the Trident Wharf on the east side of the east (Trident) basin, the Poseidon Wharf on the southeast side of the middle basin, and the Military Traffic Management Command (MTMC) Wharf on the north side of the middle basin.

Figure 1-2
Port Canaveral Navigation Features

Figure 1-3
Port Canaveral Major Facilities

2 Existing Conditions

2.1 Federal Project Dimensions

The existing Federal project at Port Canaveral was authorized by the Rivers and Harbors Acts of 2 March 1945 and 23 October 1962, and Sections 101, 114, and 117 of the Water Resources Development Act (WRDA) of 30 October 1992. The Federal navigation project consists of four channel segments that lead to the three turning basins and terminate at the Barge Canal (see Figure 1-2 and Table 2-1).

Table 2-1
Port Canaveral Channel Dimensions
(Project depths in Federally Authorized feet MLLW, lengths and width in linear feet)

Reach	Length	Width[1]	Depth
Outer Reach	29,000	400	-44[2]
Middle Reach	5,658	400	-44[2]
Inner Reach	3,344	400	-40
Middle Basin	2,260	NA	-39
West Access Channel (east of Station 260+00)	1,840	400	-39
West Access Channel (west of Station 260+00)	1,730	400	-31 (CPA maintains to -35)
Barge Canal[3]	8,610±	125	-12

Notes: [1]CPA maintains a channel width of approximately 450' in some limited areas
[2]US Navy Project to 44 feet, Civil Works Project authorized to 41 feet
[3]Barge Canal length from start of West Access Channel to Canaveral Locks

The three turning basins have the following dimensions:

- Trident Turning Basin: Approximate 1,600 feet wide by 1,800 feet long basin with an access channel that tapers in width from 650 feet at the north end, to 400 feet at the south end, -41 foot depth. The access channel has an authorized depth of -44 feet.
- Middle Turning Basin: Approximate 2,200 feet long basin (including channel), 1,800 feet wide at the north end, 2,600 feet wide at the south end, -35 foot depth east and north portion, -39 feet west and south portion, 1,200 foot diameter turning circle located in the south west corner.
- West Turning Basin: Trapezoidal basin, 2,750 feet wide at the widest point in the north, 1,400 feet wide at the narrowest point near the existing corner cut off, 1,650 feet long between Cruise Terminals 5 and 10, -31 feet Federal Project depth, -35 feet CPA

maintained depth, 1,400 foot diameter turning circle in the NE quadrant. At the north side is the Cruise Terminal 5 Basin, 650 feet wide by 800 feet long, -35 foot depth.

The channel and turning basin dimensions portray a tightly fitted seaport that heavily relies on pilot, multiple tug, and thruster assistance on all vessel maneuvers within the port. The channel is too narrow for turning a vessel, so all cargo, cruise, and naval vessels (with the exception of Trident submarine operations) use either the Middle Turning Basin or the West Turning Basin for maneuvering.

In order to accommodate regular access by Voyager Class vessels some areas have been dredged and maintained by the CPA which extends the channel width beyond the 400-foot authorization. This “Pilots Dredging” as these areas are known, provides a controlling depth of -33 ft to -36 ft to accommodate cruise ship transits. The effective width of the channel from the middle reach to the beginning of the West Access Channel is 450 feet. The effective width of portions of the West Access Channel is 487 feet. This dredging was originally conducted in 2002 and 2003. In 2009 and in preparation to homeport the wave of new larger cruise vessels, CPA executed the Interim Corner Cut Off (ICCO) new work dredging, shifting the -35’ CPA maintained dredge boundary further to the east and north. As of 2009, the CPA maintains a depth of -35’ at 18.5 acres of navigation area that lie beyond the existing federal project limits at the entrance to west basin.

The ICCO is intended to be an interim measure for cruise ship navigation, and is not anticipated to support access in the full range of conditions encountered at Port Canaveral. Vessel use of the ICCO is included as a without-project condition in all alternative plan evaluations, however the Canaveral Pilots have indicated that this single element of the overall project is not sufficient to ensure that large cruise ships would be able to continue calling at Port Canaveral. The construction and maintenance costs of the ICCO are included as project costs, as this project element was completed in advance of project authorization. It is the CPA’s intention to request that this in-kind construction work be credited against the sponsor’s share of total project costs.

2.2 Existing Conditions: Terminal Facilities

Port Canaveral terminal facilities can be generally grouped into four categories: dry bulk cargo, liquid bulk cargo, cruise, and naval. Naval facilities exist along the east side of the Middle Turning Basin and at the Trident Turning Basin, although naval vessels do layover at cargo berths occasionally. Naval use of the port’s facilities have an insignificant impact on overall port operations and therefore are not addressed in detail in this analysis. Similarly, commercial industries that occur along the Port’s waterfront, such as marinas, restaurants, and small commercial fishing enterprises are not addressed in detail.

A Florida Power and Light (FPL) barge berth is located on the south side of the West Access Channel. The barges take fuel from the on-site FPL fuel storage tank (filled by tankers berthed at Tanker Berth 2) through the barge canal to FPL facilities on the Indian River. FPL barge traffic does not have a significant impact on Port Canaveral operations.

The types of cargo that can be handled at each of the Port’s berths are listed in Table 2-2. Containers are typically handled at a temporary 300-foot berth at the north cargo area, but may also be handled at North Cargo Pier (NCP) 2 and South Cargo Piers (SCP) 3 & 5. The listing of south side tanker berths 1 & 2 may be somewhat misleading because the designation “tanker berth” indicates the presence of a fuel manifold for offloading tankers. The tanker berths are not physically separate berths, but are shared with SCP 4 & 5 on the south side. SCP 3 also has a fuel manifold that is often used to load bunker oil onto barges for delivery to cruise ships in the West Turning Basin. Fuel barges may also be loaded at tanker berths (TB) 1 & 2. The Seaport Canaveral Terminal unloads tankers at NCP 1 & 2. Roll-on/Roll-off capabilities exist at NCP 1 and Cruise Terminal (CT) 2 (formerly used by Premier Cruise Line).

Table 2-2
Port Canaveral Cargo Category by Berth

South Side Berths	Berth Depth	Dry Cargo	Liquid Bulk	Cruise
SCP1	-41	Yes	No	No
SCP2	-41	Yes	No	No
SCP3	-39	Yes	Yes	No
SCP4	-41	Yes	No	No
SCP5	-41	Yes	No	No
TB1	-41	N/A	Yes	N/A
TB2	-41	N/A	Yes	N/A
CT2	-35	No	No	Yes
CT3	-35	No	No	Yes
CT4	-35	No	No	Yes
North Side Berths		**Dry Cargo**	**Liquid Bulk**	**Cruise**
NCP1	-41	Yes	Yes	No
NCP2	-41	Yes	Yes	No
NCP3	-41	Yes	No	No
NCP4	-41	Yes	No	No
CT5	-35	No	No	Yes
CT8	-35	No	No	Yes
CT 9/10	-35	No	No	Yes

Note: SCP = South Cargo Pier, TB = Tanker Berth, NCP = North Cargo Pier, CT = Cruise Terminal
Source: CPA

2.2.1 Existing South Side Cargo Terminal Facilities

The south side of the Inner Reach (a.k.a. the East Access Channel), features nearly continuous cruise and cargo wharfs from the entrance to the Trident turning basin to the west side of the Middle Turning Basin. Three cruise terminal berths (CT2, CT3, and CT4) are located at the east end of the southern berths. Five cargo berths (SCP1-5) and two tanker berths (TB1 and TB2) extend westward from the termination of the cruise terminal berths. From the western end of the south cargo berths westward to the SR401 bridge, the bulkhead wall is leased to commercial fishing, restaurant, small vessel and marina operators.

Use of SCP1 is limited by the narrow pier apron along the eastern end of the berth and by the narrowness of the channel at that point. The Canaveral Pilots Association limits the size and placement of vessels at SCP1 because of the potential need to "crab" (i.e., sail at an angle that increases a vessel's effective beam) cruise ships through this reach under windy conditions. SCP1, SCP2 and SCP3 share a continuous pier that is 1,614 feet long. SCP4 and SCP5 are not continuous. Cement and aggregates are both offloaded at SCP4 due to the location of offloading equipment. An overhead conveyor system is available to transport aggregates from the SCP4, over and across George King Boulevard, to the Ambassador Services, Inc. storage facility. Ambassador Services, Inc. is one of the major shipping agent and stevedore service providers at the port.

TB1 is the primary tanker berth used by Transmontaigne for multiple petroleum products and SCP3 is a secondary berth for tankers. Transmontaigne operates a tank farm off CPA property near the port's south cargo facilities. The tank farm includes 730,000-barrel storage capacity for gasoline, diesel, asphalt, and bunker fuel. TB2 is used by RRI Energy, Inc. and FPL. Historical deliveries to TB2 for FPL have recently been terminated, as the Cape Canaveral Power Plant is currently undergoing modernization as a gas-fired plant. It is important to note that tug/barge combinations are frequently used to deliver petroleum products to Port Canaveral (Transmontaigne and Seaport Canaveral). These tug/barge combinations are often greater than 600 feet long and are no different from tankers in their use of berth facilities, however they typically draft less than 30 feet, and therefore are not projected to benefits from channel improvements. Table 2-3 summarizes Port Canaveral's south side cargo terminal facilities. Additionally, vessels are also offloaded using mobile harbor cranes, ship's gear, and other mobile equipment.

Table 2-3
Port Canaveral Existing South Side Cargo Terminal Facilities Summary

Berth	Length (ft)	Unloading Facilities	Storage facilities
SCP1	655	None	Warehouses (dry, cool, and freezer)
SCP2	660	None	Warehouses (dry, cool, and freezer)
SCP3	400	Petroleum Products Manifold	Warehouses (dry, cool, and freezer)
SCP4	560	Mobile conveyor system[1] Mobile cement unloader	Open Storage Cement silos
SCP5	400	None	Open Storage
TB-1	NA	Petroleum Products Manifold	Off-site tank farm
TB-2	NA	Petroleum Products Manifold	On-Site 325,000 barrel & 268,000 barrel storage tanks

Note: [1] Conveyor system transports materials off CPA property to an open storage facility
Source: CPA

2.2.2 Existing North Side Cargo Terminal Facilities

Cargo berths on the north side of Port Canaveral are located along the western edge of the Middle Turning Basin and along the adjacent north side of the inner reach. The largest single cargo facility on the north side is the Seaport Canaveral Terminal. Seaport Canaveral is a 2.84 million barrel fuel storage and terminal facility on Port Canaveral's north cargo area (Table 2-4).

Table 2-4
Seaport Canaveral (Vitol, S.A., Inc) Terminal Storage Capability

Product	Number of Tanks	Storage Capacity (bbls)
Marine Diesel Oil	3	150,000
#6 Fuel Oil	2	300,000
Ethanol	2	110,000
Diesel	4	600,000
Jet Fuel	2	300,000
Regular Gasoline	5	750,000
Premium Gasoline	3	450,000
Blend Components	3	180,000
Existing Sub-Total	**24**	**2,840,000**
Future Tanks	7	950,000
Full Build Out Total	**31**	**3,790,000**

Source: CPA

Vitol, S.A., Inc. has a 30-year lease agreement with the CPA for 36 acres of land in the north cargo area. The lease agreement includes two 10-year extension options. Vitol, S.A., Inc. is an international fuel trading company operating fuel terminals in seven countries, with Port Canaveral's terminal (Figure 2-1) making the United States the eighth country in their system. The company is operating at Port Canaveral as Seaport Canaveral LLC. Facility operations began in February 2010. Oil tankers and barges use a new petroleum product hook-up system at berths NCP1/NCP2. A more detailed discussion of future operations at the Seaport Canaveral Fuel Terminal is found in Section 3.0 Future Without-Project Conditions.

Since starting operations through July 2011, Seaport Canaveral has used three types of vessels:

- tug/barge combinations, which may be a long as 600 feet and operate with arrival drafts up to 30 feet;
- multi-point service vessels, which are tankers typically in the 400 to 500-foot range with arrival drafts of 32 feet and less, and
- Point-to-point service vessels which are tankers typically 600 feet long with design drafts averaging 39.2 feet and operate at the port with arrival drafts from 34 to 36 feet.

Only the point-to-point tankers are depth constrained at Seaport Canaveral. Table 2-5 presents the total cargo tonnage and total number of trips for each vessel type during February 2010 through July 2011. Additional Seaport Canaveral information through September 2011 indicates that from February 2010 through September 2011 a total of 3,348,133 tons of petroleum products was handled at Seaport Canaveral, but at the time of this writing, detailed vessel operations information was not available after July 2011.

Table 2-5
Seaport Canaveral Vessel Type Summary
February 2010 through July 2011

Vessel / Service Type	Total Tonnage	Total Trips
Tug/Barge Combination	664,293	49
Multi-point Service Tankers	970,473	37
Point-to-point Service Tankers	1,272,625	36
All Vessel Types Totals	**2,907,391**	**122**

Source: CPA

Most roll-on/roll-off activity has taken place at NCP1. Vessels berthed at NCP2 often extend beyond the southern limit of the pier, but this practice is limited by the proximity to the channel. NCP4, although not a dedicated berth, is used typically by vessels bringing cement to the adjacent Cemex (formerly Rinker) silos. Salt has always been offloaded at NCP1 and slag has always been offloaded at NCP2 due to the close proximity of the facilities to these berths. A temporary 300-foot berth, which mostly is used for containers, is the only cargo berth currently located in the West Turning Basin. Plans for future additional cargo berths (NCP5, NCP6, and NCP8) are being developed by the CPA. Table 2-6 summarizes the existing condition of Port Canaveral's north side cargo terminal facilities.

Table 2-6
Port Canaveral Existing North Side Cargo Terminal Facilities Summary

Berth	Length (ft)	Depth (ft)	Unloading Facilities	Storage facilities
NCP1	645	-41	Mobile Conveyor Mobile Hoppers Petroleum Products Manifold	Paved container yard Open and paved storage On-site 2.84 million barrel storage facility
NCP2	645	-41	Mobile Conveyor Mobile Hoppers Petroleum Products Manifold	Slag silo Open Storage On-site 2.84 million barrel storage facility
NCP3	400	-41	None	Dry storage warehouse Paved open storage
NCP4	400	-41	Rail mounted auger cement unloader	Cement silos

Figure 2-1 Seaport Canaveral Fuel Terminal

2.2.3 Cruise Terminal Facilities

Port Canaveral's cruise terminals are located at the eastern end of the Port's south side and in the West Turning Basin. Along the port's south side, CT2, 3, and 4 were the first cruise terminals to be developed at Port Canaveral. The newer cruise terminals (CT5, CT8, and CT9/10), which service the large multi-day cruise ships, are located in the West Turning Basin. Currently the *Carnival Sensation* uses CT5 and the *Carnival Dream*, which replaced the *Carnival Glory*, began using CT9/10 in mid-November 2009. The *Disney Magic and Disney Dream* share CT8, as will the *Disney Fantasy*, which is scheduled to replace the Disney Magic at Port Canaveral when it comes into service in March 2012. CT9/10 is also shared by Royal Caribbean International's (RCI) *Monarch of the Seas* and the *Freedom of the Seas*. The *Norwegian Sun* also berths at CT9/10 during her seasonal homeport use of Port Canaveral. Port-of-call vessels typically use CT5 and small port-of-call vessels may use CT3 or CT4. An additional cruise terminal (CT6/7), to be located at the northwestern end of the West Turning Basin, has been identified in the Port's Master Plan. Recently completed construction activities for Port Canaveral's cruise terminal facilities include an additional mooring dolphin and pier expansion at CT10 to accommodate RCI's Freedom Class vessels. Table 2-7 summarizes Port Canaveral's cruise terminal facilities.

Table 2-7
Port Canaveral Cruise Terminal Summary

South Side				
Berth	Length (ft)	Maximum Vessel Length (ft)	Terminal Size (sq ft) Ticketing/Luggage	Passenger Capacity
CT2	468	440	8,000/16,500	1,800
CT3	694	782	8,000/16,500	1,800
CT4	882	782	9,000/20,700	1,800
North Side				
Berth	Length (ft)	Maximum Vessel Length (ft)	Terminal Size (sq ft) Ticketing/Luggage	Passenger Capacity
CT5	565	960	61,000/19,000	3,000
CT8	795	1,115	70,000/14,900	4,000
CT9/10	725	1,100	89,000/17,500	3,500

2.3 Socio-Economics

The 2010 population of Brevard County (543,346) indicates 14.1% growth over the 2000 population of 476,230. The annual average population growth rate has been 1.6% since 1990. The median household income in the county in 2009 is $45,683, which is an average annual increase of 2.0% since 1989. Approximately 12% of the population was living below the poverty level in 2009. More than 76% of households are owner occupied. The labor force was 268,149 in 2010, an increase from 252,338 in 2005. However, the unemployment rate in Brevard County has increased markedly, from 3.7% in 2005 to 11.5% in 2010.

Neighboring Orange County, which includes the City of Orlando, has experienced a population increase of 27.8% (from 896,354 to 1,145,956) between 2000 and 2010, with an average annual growth rate of nearly 2.5%. Growth in central Florida has been occurring and is projected to continue to occur at a faster rate than the Florida state average. Research conducted for the Orlando Growth Management Plan (City of Orlando Planning and Development, 01 Feb 2005) projects Orange County annual population growth to be 2.06% annually between 2000 and 2030. The table presented below (Table 2-8) is a compilation of growth projections for Orlando. These growth projections provide strong indication of continued growth in construction and petroleum related products and other commodities moving through Port Canaveral.

Table 2-8
Projected Growth for City of Orlando 2004 - 2030

Item	Units	2004	2030	Increase	% Increase
Single Family	units	35,275	48,359	13,084	37.1%
Multi Family	units	67,078	97,072	29,994	44.7%
Office Space	Sq ft	31,294,507	54,048,319	22,753,812	72.7%
Retail Space	Sq ft	27,549,806	40,563,707	13,013,901	47.2%
Industrial Space	Sq ft	35,183,626	53,888,668	18,705,042	53.2%
Hospital Space	Sq ft	5,018,761	7,382,021	2,363,260	47.1%
Gov/Civic Space	Sq ft	16,096,413	26,019,805	9,923,392	61.7%
Total	**Sq ft**	**115,143,113**	**181,902,520**	**66,759,407**	**57.9%**
Hotel Rooms	rooms	19,604	36,252	16,648	84.9%
Employment	employees	223,038	361,941	138,903	62.3%

Source: Orlando Growth Management Plan, 01Feb05

2.4 Port Hinterland

The cargo terminals at Port Canaveral typically service the central Florida region. Some commodities handled at Port Canaveral are distributed throughout the state and beyond, such as newsprint and food products (personal communication Jeff Allen, formerly of Mid-Florida Freezer). A significant proportion of construction related materials are concentrated in the central Florida region, which is roughly defined as the area from Daytona Beach (Volusia County) south to Ft. Pierce (St. Lucie County) extending west to Orlando (Orange County). Delivery of as much as 50% of aggregate material is concentrated in the Orlando region, with the remainder going to central and south Florida (personal communication Brian Hubert, Ambassador Services, Inc.). There are no major aggregate material import terminals on the east coast of Florida, other than Jacksonville and Port Canaveral. The cement terminals at Port Canaveral predominantly service the central Florida region, with southeastern Florida being serviced from terminals in Port Everglades. A large proportion of building materials (60%) goes to The Home Depot and Lowes distribution centers in central and south eastern Florida (City of Frostproof; Polk County and Pompano Beach; Broward County).

2.5 Port Canaveral Historical and Current Cruise Ship Operations

Cruise ship operations at Port Canaveral are integrated with Caribbean cruise ship operations and are increasingly becoming integrated with European and West Coast cruise ship operations as cruise lines expand into these markets. Vessel deployment to the Caribbean has historically been based out of three Florida ports: Miami, Port Everglades and Port Canaveral, the three busiest cruise ports in the world (in that order). New developments in the cruise industry include the expansion of the Caribbean services to include other U.S. ports, increased cruise ship operations out of west coast ports, and the sharing of vessels between the Caribbean and European market.

Table 2-9 provides an example of these developments. Since their introduction as the world's largest cruise ships in 2000, RCI's Voyager Class vessels have been deployed in the Caribbean service. With the single exception of the *Adventurer of the Seas*, which has always been homeported in San Juan, PR, Voyager Class vessels have been homeported in the major south Florida ports:

- *Voyager of the Seas*: Miami;
- *Explorer of the Seas*: Miami;
- *Mariner of the Seas*: Miami and Port Canaveral: and
- *Navigator of the Seas*: Miami and Port Everglades.

As newer, larger cruise ships have entered the world fleet they have historically been homeported at one of the three main Florida ports, displacing the smaller vessels which then have relocated to alternative U.S. West Coast ports or to the European market (Table 2-9). In 2009, when RCI's Freedom Class vessels entered the fleet, RCI broke from the historic trend of deploying the newest and largest ships solely in the Caribbean service. RCI's *Independence of the Seas* was and continues to be deployed in the European market from Southampton, England. RCI's *Freedom of the Seas* entered service in May 2009 and is homeported in Port Canaveral, cruising to the Eastern and Western Caribbean. This Freedom Class vessel replaced the smaller Voyager Class *Mariner of the Seas*, which then relocated from Port Canaveral to the Port of Los Angeles, and is now the largest cruise vessel in service on the U.S. West Coast.

RCI's Oasis Class vessels (previously called the Genesis Class), are currently the world's largest cruise ships. The first vessel in this class, *Oasis of the Seas*, left the shipyard in November 2009 and began regular service out of its inaugural home port at Port Everglades on December 1, 2009. The second vessel, *Allure of the Seas*, was launched in November 2010. Both Oasis Class vessels are homeported in Port Everglades at least through 2014 (their initial contract period). Both vessels are in the Caribbean service. In a letter dated July 2008, RCI has initiated correspondence with the Canaveral Port Authority concerning potential terminal and berth modifications that would be required to accommodate the *Allure of the Seas* at Port Canaveral. However, Oasis class vessels are not projected to be homeported at Port Canaveral in either the without-project or with-project condition and are not included in channel design or benefits calculations.

Table 2-9
RCI Voyager, Freedom, and Oasis Class Vessel Deployment Schedules

Voyager Class		Freedom Class		Oasis Class	
Vessel	**Homeport**	**Vessel**	**Homeport**	**Vessel**	**Homeport**
Voyager	Galveston – Winter Barcelona - Summer	*Freedom*	Port Canaveral	*Oasis*	Port Everglades
Mariner	Los Angeles	*Independence*	Southampton, England	*Allure*	Port Everglades
Navigator	Miami/PE – Winter Spain - Summer	*Liberty*	Miami		
Adventurer	San Juan				
Explorer	Bayonne, NJ				

Source: royalcaribbean.com

2.5.1 Florida's Cruise Ship Industry

Florida's east coast ports are by far the nation's (and the world's) busiest cruise ports. Table 2-10 presents the volume of North American multi-day cruise passengers by departure port for 2003 – 2010. In 2010, Port Canaveral cruise passengers accounted for 12.2% of all North American cruise passengers (MARAD, 2011), ranking it as the 3rd busiest cruise port with more than twice as many passengers as the 4th busiest cruise port, New York. The market dominance of east coast Florida cruise ports is due to the Caribbean's prominence and allure as a cruise destination and Florida's proximity to it. Caribbean cruise destinations, including the Bahamas and Bermuda, accounted for more than 72% of all North American passenger volume in 2010 (Table 2-11). It is important to note that total multi-day cruise passenger counts and Port Canaveral Passenger counts have remained steady in recent years despite the economic recession and continued economic difficulties.

Table 2-10
North American Multi-Day Cruise Passengers by Selected Departure Ports (000's)

Port	2003	2004	2005	2006	2007	2008	2009	2010
Miami	1,867	1,683	1,771	1,890	1,890	2,099	2,044	2,151
Ft. Lauderdale	1,100	1,237	1,199	1,145	1,289	1,187	1,277	1,759
Port Canaveral	1,114	1,230	1,234	1,396	1,298	1,226	1,189	1,299
New York	432	548	370	536	575	435	403	556
San Juan	579	677	581	555	534	521	507	522
Seattle	165	291	337	382	386	435	430	469
Galveston	377	433	531	616	529	403	386	429
Tampa	419	399	408	461	368	393	401	425
Long Beach	171	401	363	380	370	365	415	414
Los Angeles	516	434	615	583	624	607	412	374
Total (all ports)	**8,349**	**9,418**	**9,747**	**9,971**	**10,289**	**9,915**	**9,858**	**10,609**

Source: MARAD, 2009 & 2011

Table 2-11
North American Cruise Passengers By Destination (000's)

Destination	2003	2004	2005	2006	2007	2008	2009	2010
Western Caribbean	2,924	3,094	3,142	3,151	3,107	2,817	2,828	3,264
Bahamas	1,292	1,431	1,390	1,541	1,442	1,448	1,741	1,970
Eastern Caribbean	1,037	1,215	1,315	1,386	1,409	1,407	1,249	1,661
Mexico (Pacific)	731	964	1,130	1,075	1,215	1,265	1,095	875
Alaska	776	880	930	939	1,014	1,015	1,011	872
Southern Caribbean	749	895	788	749	805	859	801	815
Hawaii	222	232	307	402	495	251	193	188
Bermuda	212	195	226	234	211	224	264	269
Canada/New England	173	214	179	165	189	231	226	265
Transatlantic	76	96	146	138	162	168	158	157
Trans-Panama Canal	95	108	112	91	117	102	146	166
Pacific Coast	25	48	56	60	59	58	63	44
South America	12	10	7	18	14	14	35	19
South Pacific/Far East	7	8	9	12	19	27	29	25
Nowhere	17	29	9	9	31	29	18	17
Total	**8,349**	**9,418**	**9,747**	**9,971**	**10,289**	**9,915**	**9,858**	**10,609**
Caribbean Sub Total	4,710	5,204	5,245	5,286	5,321	5,083	4,879	5,742
Percent of Total	56.4%	55.3%	53.8%	53.0%	51.7%	51.3%	49.5%	54.1%
Caribbean/Bahamas/ Bermuda Sub Total	6,215	6,830	6,861	7,061	6,774	6,755	6,620	7,712
Percent of Total	74.4%	72.5%	70.4%	70.8%	67.8%	68.1%	67.2%	72.7%

Source: MARAD, 2009 & 2011

There are 30 new cruise ships scheduled for delivery into the North American market between 2008 and 2012 (Cruise Industry News Annual Report, 2008). Seventeen of these new vessels are larger than 110,000 gross registered tons with passenger capacities of approximately 3,000 or more. The largest of the new vessels (Oasis Class) has a beam in excess of 154 feet and a length overall of nearly 1,200 feet. Four of the largest new vessel classes are the:

- Disney Cruise Lines (two ships at 128,000 tons, 1,115 feet length overall (LOA), and 2,500 passengers, both vessels homeported at Port Canaveral);
- Royal Caribbean International Freedom Class (three ships at 158,000 tons, 1,112 feet length overall (LOA), and 3,600 passengers, one vessel homeported at Port Canaveral);
- Norwegian Cruise Lines Epic (one ship at 150,000 tons, 1,068 feet LOA, and 4,200 passengers, homeported at Miami and Barcelona, Spain); and
- Royal Caribbean International Oasis Class (two ships at 220,000 tons, 1,118 feet LOA, and 5,400 passengers, both vessels homeported at Port Everglades)

Of the 30 new cruise ships scheduled for delivery into the North American fleet between 2008 and 2012, 16 are destined for service in the Caribbean (eight of which are also slated to share service in the European market), eight are slated for world-wide service, and six do not have a service destination identified.

2.5.2 Port Canaveral's Cruise Ship Industry

Port Canaveral has historically been a preferred port for the largest, newest cruise ships and, along with Miami and Port Everglades, a first homeport for new vessels. In 2003, Royal Caribbean International placed one of its new Voyager Class vessels (*Mariner of the Seas*) at Port Canaveral. Disney Cruise Line placed its first two vessels (*Disney Wonder* and *Disney Magic*) at Port Canaveral directly from the ship yard. Royal Caribbean International replaced the *Mariner of the Seas* at Port Canaveral, with the new, larger Freedom Class vessel (the *Freedom of the Seas*) in 2009. Similarly, in November 2009 Carnival Cruise Lines replaced the *Carnival Glory*, previously homeported at Port Canaveral, with the *Carnival Dream*, its newest, largest cruise ship. Most recently, in January 2011 Disney Cruise Lines placed its newest ship, the *Disney Dream* into service at Port Canaveral, replacing the *Disney Wonder*, which has now been redeployed to the West Coast. The *Disney Fantasy* (same dimensions as the *Disney Dream*) will be homeported at Port Canaveral when it enters service in March 2012.

The cruise ships[1] homeported at Port Canaveral in 2011 include:

- *Carnival Dream* (3,646 normal capacity; 4,631 maximum capacity[2])
- *Carnival Sensation* (2,052 norm; 2,634 max);
- *Disney Magic* (1,754 norm; 2,713 max);
- *Disney Dream* (2,500 norm; 4,000 max);
- *RCI Monarch of the Seas* (2,345 norm; 2,744 max); and
- *RCI Freedom of the Seas* (3,634 norm; 4,375 max).

In addition, the port is also a port-of-call for other cruise ships, which in 2011 included: *Carnival Pride, Norwegian Sun, Norwegian Gem*, *Norwegian Jewel*, Royal Caribbean *Enchantment of the Seas*, and others. In the CPA fiscal year 2011 (01 Oct - 30 Sept) the port was either the homeport or a port of call for 587 multi-day voyages (Table 2-12). There are currently 579

[1] Only multi-day cruise ships are included. Gaming vessels have also historically offered partial day cruises from Port Canaveral.
[2] Normal capacity is based on two occupants per stateroom, maximum capacity includes total number of berths – source MARAD Cruise Passenger Statistics Data

homeport or a port of call multi-day voyages scheduled for Port Canaveral in 2012, including the *Disney Fantasy*, which will enter service and be homeported at Port Canaveral in March 2012. The number of calls includes typical 7-day and 4/5-day cruise itineraries for homeported vessels, port-of-call arrivals, and other scheduled itineraries.

Table 2-12
Port Canaveral Multi-day Cruise Ship Operations FY2011 & FY2012

2011 - Actual			2012 - Scheduled		
Berth	**Vessel**	**Calls**	**Berth**	**Vessel**	**Calls**
CT 5	Carnival Sensation (H)	104	CT 5	Carnival Sensation (H)	104
CT 5	Carnival Pride	36	CT 5	Carnival Pride	36
CT 5	Carnival Dream (H)	52	CT 5	Carnival Dream (H)	52
CT 5	Norwegian Gem	20	CT 5	Norwegian Gem	37
CT 5	Norwegian Jewel	38	CT 5	Norwegian Jewel	28
CT5	Norwegian Sun	28	CT5	Norwegian Sun	28
CT 8	Disney Magic (H)	33	CT 8	Disney Magic (H)	29
CT 8	Disney Wonder (H)	26	CT 8	Disney Fantasy (H)	32
CT8	Disney Dream	72	CT8	Disney Dream	94
CT 10	Monarch of the Seas (H)	103	CT 10	Monarch of the Seas (H)	62
CT 10	Freedom of the Seas (H)	53	CT 10	Freedom of the Seas (H)	52
CT10	Enchantment of the Seas	10	CT10	Enchantment of the Seas	9
CT 10	Other	12	CT 10	Other	16

Note: (H) after vessel name designates vessels homeported at Port Canaveral. All other vessels are port-of-call.

Port Canaveral has experienced a 4.1% average annual growth in multi-day cruise passengers between 2000 and 2011, which includes the effects of the recent economic downturn. Day trip cruise (gaming vessel) passenger volumes grew between 2000 and 2004, but then have fallen since then. Table 2-13 presents Port Canaveral revenue passenger volumes for fiscal years 2000 – 2011.

Table 2-13
Port Canaveral Revenue Passengers (Fiscal Years)

Fiscal Year	Multi-Day	Day Trip	Total
2000	1,995,619	1,793,002	3,788,621
2001	1,798,366	1,795,058	3,593,424
2002	1,951,196	1,873,044	3,824,240
2003	2,168,450	1,941,020	4,109,470
2004	2,631,320	1,954,910	4,586,230
2005	2,529,743	1,859,108	4,388,851
2006	2,782,712	1,759,344	4,542,056
2007	2,718,416	1,557,506	4,275,922
2008	2,484,504	1,089,456	3,573,960
2009	2,468,439	782,336	3,250,775
2010	2,722,751	80,200	2,802,951
2011	3,100,199	44,469	3,144,668

Source: CPA

Another important reason for Port Canaveral's major role in the cruise ship industry is the port's high vessel utilization rate, making it an extremely attractive and profitable homeport for the cruise industry. Cruise ship utilization is measured in two ways. A vessel's normal capacity is the comparison between the actual number of passengers and the vessel's capacity assuming two passengers per room. The vessel's maximum capacity compares the actual number of passengers to the total number of berths on-board the vessel, recognizing that many rooms, especially those occupied by families, house more than 2 persons per trip. Port Canaveral consistently displays higher utilization rates than Miami or Port Everglades (Table 2-14). CPA attributes the port's high utilization rates to a higher proportion of families with children traveling together, and to the many nearby landside family attractions, which are available at Port Canaveral but are not available at other Florida ports, such as Walt Disney World, Universal Studios, Sea World, and the Kennedy Space Center.

Table 2-14
Comparative Normal Capacity Utilization (2004 – 2011)

	Port Canaveral	Miami	Port Everglades
2004	122.6%	110.1%	100.8%
2005	123.5%	110.9%	102.5%
2006	121.9%	110.6%	103.7%
2007	122.2%	110.7%	104.2%
2008	123.4%	110.7%	104.2%
2009	123.3%	111.7%	103.6%
2010	120.3%	111.4%	104.7%
2011*	122.3%	110.8%	104.9%

Source: MARAD 2011; *2011 data for 01Jan11 through 30June2011

Cruise ship utilization has consistently been high at Port Canaveral and has not been appreciably reduced during to the economic downturn experienced in 2007 and 2008. It is important to note that the addition of the *Mariner of the Seas* to Port Canaveral's homeport fleet in 2004 did not reduce vessel utilization on the *Sovereign of the Seas* (Table 2-15). The immediately high utilization rate at Port Canaveral for the *Mariner of the Seas* and the *Freedom of the Seas* indicates that shifting the vessel from Miami to Port Canaveral did not reduce its utilization rate at Port Canaveral.

Table 2-15
Port Canaveral Cruise Ship Capacity Utilization (2003 – 2011)

Average Passengers Per Call

	Normal Capacity	2005	2006	2007	2008	2009	2010	2011*
Sovereign of the Seas	2,276	2,553	2,557	2,574	2,591	---	---	---
Mariner of the Seas	3,114	3,486	3,489	3,476	3,466	---	---	---
Freedom of the Seas	3,634	---	---	---	---	4,088	4,005	3,905
Disney Dream	2,500	---	---	---	---	---	---	3,649
Disney Magic	1,754	2,610	2,575	2,571	2,544	2,533	2,545	2,628
Disney Wonder	1,754	2,651	2,540	2,622	2,618	2,627	2,624	
Carnival Dream	3,646	---	---	---	---	---	4,212	4,346
Carnival Glory	2,758	3,331	3,331	3,291	3,341	3,323	---	---

Normal Capacity Utilization

	Normal Capacity	2005	2006	2007	2008	2009	2010	2011*
Sovereign of the Seas	2,276	112%	112%	113%	114%	---	---	---
Mariner of the Seas	3,114	112%	112%	112%	111%	---	---	---
Freedom of the Seas	3,634	---	---	---	---	112%	110%	107%
Disney Dream	2,500	---	---	---	---	---	---	146%
Disney Magic	1,754	149%	147%	147%	145%	144%	145%	150%
Disney Wonder	1,754	151%	145%	149%	149%	150%	150%	---
Carnival Dream	3,646	---	---	---	---	---	116%	119%
Carnival Glory	2,758	121%	121%	119%	121%	120%	---	---

*Data for 2011 for 01 Jan through 30June; Source: MARAD 2011

2.5.3 Port Canaveral Cruise Ship Operations

This section discusses the operations of the large multi-day cruise ships which use Port Canaveral. These vessels are all berthed in the West Basin. Day-trip cruise ships, which are substantially smaller than multi-day cruise ships, operate out of cruise berths on the south shore of the port. The day-trip cruise ships are not constrained by existing channel conditions.

Existing constraints on the large multi-day cruise ships berthed in the West Basin are explained in the following paragraphs.

Large cruise ship operations in the port are constrained by existing channel width and by the close proximity to moored cargo ships, naval vessels, and the day-trip ships that berth at the south side cruise terminals. The Port Canaveral Pilots will only allow small day-trip size cruise ships to moor at the south side cruise terminals because of the narrow channel. The narrowness of the channel and the close proximity to moored vessels results in a "surge effect" when large cruise ships transit the channel at speeds in excess of 6 knots, which may occur during windy conditions (cross-winds greater than 15 knots). These surge effects have caused some incidents of parted lines, minor vessel connection damage, and some personnel injuries over the years.

Port Canaveral's standard operating procedures require loading and unloading of cargo vessels to cease during the transit of large cruise ships during high wind conditions (cross-winds greater than 25 knots). The standard operating procedure also recommends that mooring lines be attended during large cruise ship transits. Port Canaveral operations personnel, port tenants, and the Canaveral Pilots Association all work to minimize the effects associated with surges, however minor delays in vessel loading and unloading along the south side docks regularly occur. In addition, tugs are used to keep moored vessels alongside the piers to offset surge effects, which pull vessels away from their moorings (see Section 1-9 Canaveral Harbor Surge Effects and Modeling of the Engineering Appendix). Tugs are typically used at North Cargo Piers 1 ,2, and 4, at the Poseidon Wharf, and in the Trident Basin.

Cruise ships currently transit Port Canaveral channels twice daily on regular schedules—inbound to the West Turning Basin from early to mid-a.m. hours and outbound from the West Turning Basin during approximately mid-p.m. hours. Often, as many as three cruise ships arrive or depart in 20 minute intervals during the port's busy days. Port Canaveral's largest homeport vessels, as well as various regularly scheduled port-of-call vessels, sail to and from the West Turning Basin in winds of up to 35 knots. These large vessels must travel at relatively slow speeds to minimize surge at critical locations in the west access and inner channels but are greatly affected by channel cross-winds at those speeds due to the vessel's large amount of sail area.

Cruise ships typically do not use assisting tugboats because they are maneuvered through the use of rudder, conventional fixed or azimuthing pod propeller, and bow and stern thrusters. However, tug assist is required under windy conditions. The larger ships have three or four thrusters forward and three or four thrusters aft. Those ships without stern thrusters generally have two or three azimuthing and/or fixed position pods aft. The fixed pod is on the centerline of the ship at the stern. Azimuthing pods are on either side of the centerline at the stern. The pods are positioned to optimize underway propulsion and have an override maneuvering power mode for use in port. However, the two Disney ships currently homeported at Port Canaveral and the new Disney vessel currently under construction, which is scheduled to be homeported at Port Canaveral, have traditional propulsion systems.

The size of cruise ships and cargo vessels entering Port Canaveral is currently constrained by the federally authorized 400-foot channel width. The narrow channel constrains the maximum length and beam of cruise and cargo vessels that can use the port and affects the operation of cruise and cargo vessels using the port. Wind conditions during large cruise ship transits and proximity to moored vessels along the Port's main channel compound the operational impacts imposed by the channel's narrow width. Safe navigation inside the harbor with minimal surge effects to moored vessels requires a balance between vessel speed and good ship handling capability to manage the yaw of the vessel or "crab angle" as it moves through the waterway under the influence of moderate to high wind conditions.

A vessel's "crab angle", also known as drift angle, is defined as the difference between a ship's heading and the actual course made good. Cruise ships transiting the channels at Port Canaveral are susceptible to "crabbing" because of their large superstructure which acts as a sail in the wind and the moderate speeds which must be maintained so as to avoid surge impacts on moored vessels and to maintain braking control of the vessel. The wider the "crab angle", the larger the effective beam of the vessel.

The effective beam is a critical parameter for very large cruise ships such as the *Mariner of the Seas*, which has a length of 1,021 feet and a beam of 127 feet. For two vessels traveling with the same "crab angle" the longer vessel would have the larger effective beam. The extreme length of the *Mariner of the Seas* means that the vessel's effective beam approaches the limits of acceptable safe passage through the current configuration of Port Canaveral's channels.

The *Mariner of the Seas* effective beam was discussed in a letter from the Canaveral Pilot's Association to CPA in December 2002. This letter was written in anticipation of the arrival of *Mariner of the Seas* in 2003 and the need for dredging of certain locations within the harbor, but outside and adjacent to the existing authorized 400-foot channel boundaries. The pilots requested these key areas of dredging to improve the safety of navigation for this new larger cruise ship.

A Port Canaveral Berth Access Simulation Study was conducted in May 2003 to evaluate *Mariner of the Seas* navigation through Port Canaveral in various configurations including the existing channel, the existing channel plus areas requested to be dredged by the pilots adjacent to but outside the authorized channel, and then for a 500-foot channel width. The Canaveral Pilots and RCCL ship captains participated in the simulations at the Simulation, Training, Assessment & Research (STAR) Center, located in Dania Beach, FL.

The simulation was based on the 400-foot channel width as it existed in 2003. Voyager Class vessel speeds were on the order of 6 to 10 knots between the Port entrance and the Navy's Poseidon Wharf in the MTB. Between the Poseidon Wharf and the entrance to the WTB, ship speeds were generally 6 knots or less. The study reported that for Voyager Class vessel speed of 6 knots, crab angles of 2.5 to 3 degrees were observed for 15-knot cross winds. The crab angle increased to approximately 4.5 degrees for 25-knot cross winds. Also noted were minimal clearances to berthed vessels that likely would have resulted in undesirable surge effects on those moored ships and associated operations. For the configuration that included the dredge areas requested by the pilots and for 30-knot cross winds, crab angles of 7 to 8 degrees were observed for transit speeds of 6 knots or less. For 30-knot winds, a more comfortable vessel speed of 6.2 knots limited the crab angle to about 6 degrees.

Prior to the arrival of the Voyager Class vessel, *Mariner of the Seas*, in 2003, and at the request of the Canaveral Harbor Pilots (also with confirmation by simulations at the STAR Center), CPA executed dredging at five locations adjacent to, but outside the federally authorized channel that were considered to be key navigation areas and/or restricted channel areas critical to the safe navigation of this cruise vessel. Those dredge areas effectively provided 50 feet of additional channel width north of the channel at either end of the Inner Reach and 80 feet of additional channel width south of the channel along both cuts of the West Access Channel. In essence, since November 2003, with the pilot's recommended dredging, the channel width at certain key areas is effectively on the order of 450 feet. CPA dredging outside the federally authorized channel is included in the without-project condition.

The arrival of the *Freedom of the Seas* in 2009, which is nearly 100 feet longer than *Mariner of the Seas,* required the CPA to again dredge beyond the limits of the federal channel based on requests from the Canaveral Harbor Pilots and confirmed by simulations at the STAR Center. This additional dredging included expanding the southeast corner of the present entrance to the West Turning Basin to enable access by a Freedom Class vessel. CPA's widening of the West Turning Basin entrance, referred to as the Corner Cut-Off, was completed in 2011. The navigation effects of CPA dredging outside the federally authorized channel at the entrance to the West Turning Basin are included in the without-project condition.

Despite the narrow channel conditions at Port Canaveral, cruise ship arrival and departure delays are not common because of the importance of schedules to passengers and potential expenses to the cruise lines. Normal high wind conditions (20 - 35 miles per hour) may induce excessive "crabbing" as the vessel transits Port Canaveral's narrow channel. Normal high wind conditions typically do not delay cruise ship arrivals and departures because the cruise lines will use tug assist to transit the channel under normal high wind conditions. Wind direction, as well as speed, influences the Pilot's decision to use tug assist. Winds that are abeam of the vessel as it transits through the Port, i.e., winds from northerly and southerly directions, have a greater impact on the vessel's sail area and are more likely to result in tug assist. Tug assist typically consists of one or two tugs, depending on the strength and direction of the wind and other factors, such as vessel size, propulsion equipment, and size of vessels at cargo berths. Table 2-16 presents annual summations of the number of wind-related occurrences of tug assistance for cruise ships. Tug assist occurrences due to equipment failure or berth shifting are not included in the summation calculations. Discussions with representatives of the Canaveral Pilots Association indicate that tug assistance has continued and may be exacerbated by the arrival of the new larger cruise ships at Port Canaveral.[3] Attachment I to this Economics Appendix includes the itemized list of cruise ship tug assist occurrences as compiled by the Port Canaveral Pilots.

Table 2-16
Port Canaveral Historical Wind-Related Cruise Ship Tug Assist Occurrences

	2006	2007	2008	2009
One Tug	10	20	7	16
Two Tugs	4	7	4	1
Total	**14**	**27**	**11**	**17**

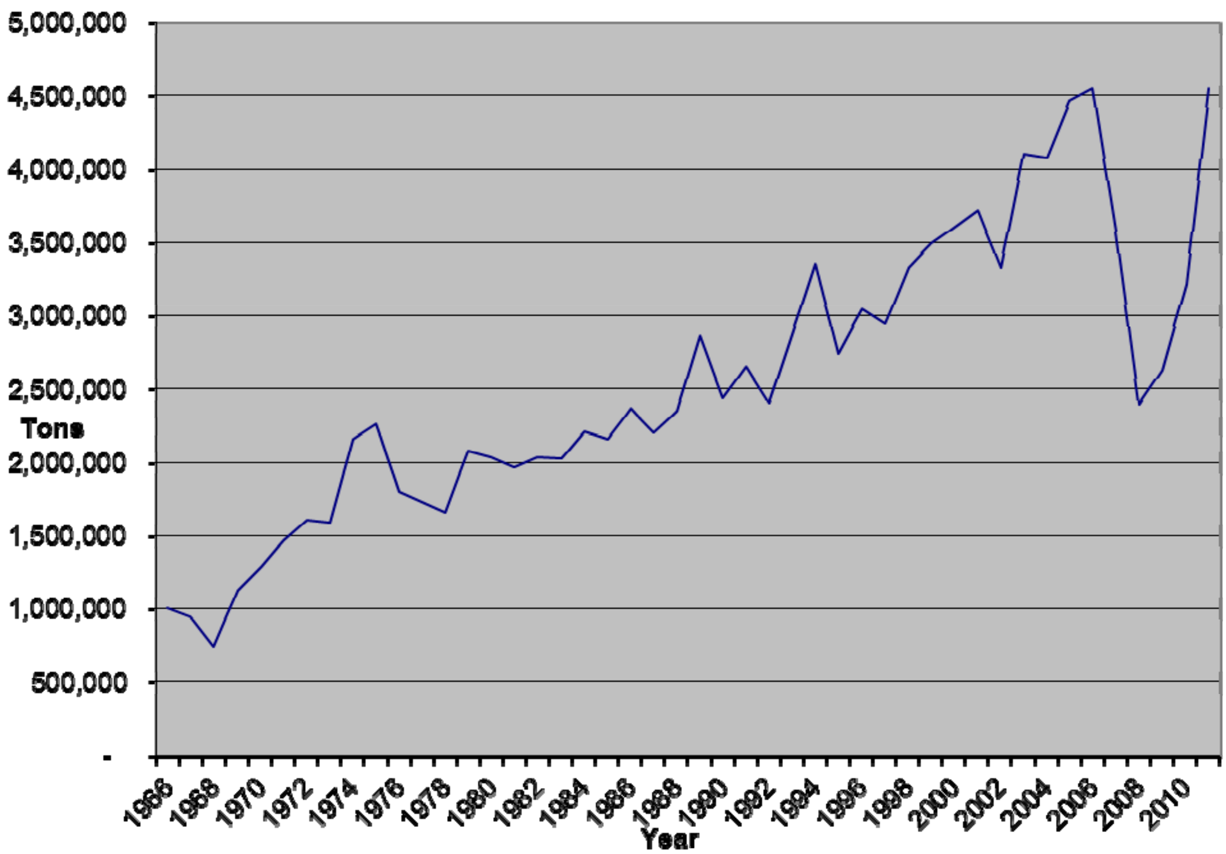
Source: Port Canaveral Pilots

[3] Personal communication with Ben Borgie, Canaveral Pilots Association

2.6 Port Canaveral Historical and Current Cargo

Bulk cargo has been moving through Port Canaveral since the Port opened in 1955. During the early years of the port, petroleum products emerged as the dominant commodity along with the commercial fishing industry. Construction materials such as cement and food goods such as orange juice and citrus were also major commodities. Over time, construction materials and petroleum products remained the largest commodities at the port, by volume. Chart 1 presents total annual cargo tonnage at Port Canaveral since 1966. Table 2-17 presents historical tonnage volumes at the port since 1982.

Chart 2-1
Annual Port Canaveral Total Cargo Tonnage (1966 – 2011)



Source: CPA

Table 2-17
Port Canaveral Historical Total Annual Tonnage (short tons)

Fiscal Year	Total Tonnage	Fiscal Year	Total Tonnage
1982	2,036,007	1997	2,862,036
1983	2,027,979	1998	3,234,148
1984	2,206,558	1999	3,410,448
1985	2,156,186	2000	3,490,242
1986	2,322,729	2001	3,596,664
1987	2,102,427	2002	3,160,064
1988	2,291,477	2003	3,867,724
1989	2,468,168	2004	4,083,528
1990	2,314,933	2005	4,467,088
1991	2,521,901	2006	4,553,756
1992	2,285,888	2007	3,572,206
1993	2,722,268	2008	2,395,779
1994	3,232,476	2009	2,626,795
1995	2,647,861	2010	3,218,144
1996	2,940,868	2011	4,547,724

Source: CPA
Note: data is for fiscal years (01 Oct – 30 Sep), excludes potable water

Port Canaveral has experienced a steady and slightly accelerating growth trend in bulk cargo during the years from 1986 through 2006. The port's total FY 2006 tonnage was nearly double its FY 1986 total tonnage. In the ten years from FY 1996 through FY 2006, total tonnage increased by 55%. Table 2-18 presents long term average annual growth rates for Port Canaveral's total tonnage calculated through FY 2011. The recent economic downturn has had a dramatic impact on cargo tonnage at Port Canaveral, especially in FY 2008, however tonnage totals rebounded by 2011, due in large part to Seaport Canaveral activity. Historically, the majority of bulk cargo commodities at Port Canaveral have been building and construction materials. These commodities have been especially hard hit by the downturn in residential and commercial construction in southeastern and central Florida, which began in 2007. Therefore, recovery of this sector of the economy is expected to be a necessary precondition to recovery in Port Canaveral construction-related commodity tonnage to pre-downturn levels. Fuel terminal operations at Seaport Canaveral and resumption of residential, commercial, and municipal infrastructure construction are projected to increase without-project condition total commodity tonnage at Port Canaveral to greater than historical levels.

Table 2-18
Port Canaveral Total Annual Tonnage Long Term Growth Rates

Fiscal Years	Average Annual Growth Rate	Fiscal Years	Average Annual Growth Rate
1972 – 2010	2.71%	1992 – 2011	3.41%
1982 - 2011	2.81%	2002 - 2011	3.53%

Source: CPA

2.6.1 Existing Cargo Traffic Characterization

The growth experienced in central and south Florida population and housing through mid-2007 drove the growth and dominance of construction and energy related commodities at Port Canaveral. The amount of construction-related materials (stone products, cement, lumber, and slag) at Port Canaveral increased from 29% of total tonnage in 2000 to more than 58% of all tonnage in 2006[4]. Construction and energy related commodities combined for 88% of all goods moving through Port Canaveral in 2006 and 91% in 2011. Seaport Canaveral operations, which began in 2010, brought 857,207 tons of petroleum products through the port in 2010 and 2,490,926 tons in 2011. Table 2-19 presents a summary of commodities handled at Port Canaveral between 2001 and 2011.

During 2001 – 2006, although the port demonstrated an overall growth in cargo, only one commodity type, lumber, experienced constant growth from year to year (slag has only been imported to Port Canaveral since 2003). In 2011, only three major commodities: petroleum products, aggregate stone, and limestone, are above their 2006 tonnages. One of Port Canaveral's advantages, apart from proximity to Central Florida, is that it has the real estate – the physical space – available for large volume storage of liquid bulk and dry bulk commodities, such as stone products and petroleum products. The availability of physical space to store commodities is a major reason why two new dry bulk facilities are currently under construction at the Port.

The recent downturn in real estate and housing construction experienced throughout the nation has severely impacted construction-related commodity tonnage at Port Canaveral. For fiscal year 2011 construction-related commodity tonnage is down by 73% from 2006, although total tonnage is nearly equivalent. However, the impact to construction commodities has not been uniform. Cement import tonnage has fallen from 1.3 million tons in 2006 to zero tonnage during the past three years. Imported cement is used to augment domestic supply to meet the national demand. In 2006, the national consumption of cement was 127.7 million tons, of which 25% was met through imports. In 2010, national consumption has fallen to 69.5 million tons and the percentage of consumption met by imports had fallen to 9% (USGS Mineral Commodity Summaries, Jan. 2011). Alternatively, imports of stone commodities at the port (aggregate, granite, and limestone) in 2011 are 38% higher than the 2006 level of imports.

[4] Data reported in Port Canaveral fiscal years (01Oct – 30Sep)

Port tenants are flexible in their ability to accommodate shifts in cargo volumes and types. For example, in response to reductions in lumber imports, warehouse construction on the north side cargo area has been deferred temporarily and the area has been paved over to accommodate car and truck imports and exports. Fiscal year 2011 tonnage for cars and trucks is greater than fiscal year 2006 tonnage by 26%.

Non-Seaport Canaveral petroleum deliveries have fallen by 33% from 2006 to 2011, largely because Florida Power and Light has totally ceased deliveries. The Cape Canaveral Power Plant is currently undergoing conversion to a gas-fired facility.

Table 2-19
Port Canaveral Commodity Tonnage FY 2001 – FY 2011 (Short Tons)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Petroleum	2,060,158	1,491,295	1,867,608	1,598,098	1,587,742	1,359,576	1,251,171	920,585	990,594	1,892,632	3,399,958
Cement	781,754	774,581	950,864	1,036,173	1,098,129	1,292,208	536,471	34,667	0		
Steel Scrap	24,594	13	0	0	0	0	0	0	0		
Salt	166,336	189,908	169,333	193,058	201,050	198,000	192,000	204,100	210,900	192,050	227,708
Newsprint	217,394	179,008	190,914	178,915	104,663	106,952	105,689	71,381	65,377	42,404	0
Juice Con.	47,566	55,973	53,531	56,206	49,550	50,883	50,739	39,427	46,448	37,539	50,972
Juice	86,535	57,456	40,355	64,111	70,206	59,655	34,264	42,580	66,432	41,191	35,492
Lumber	22,551	156,650	180,518	269,845	445,231	582,541	211,805	113,601	30,733	9,297	7,533
Plywood	0	0	11,394	18,845	30,599	17,435	0	0	0	0	0
Citrus	60,296	40,415	44,289	53,044	0	0	11,921	15,007	8,512	16,261	10,159
Fertilizer	0	0	0	0	24,590	0	0	0	0	9,320	55,914
Agg. Stone	34,513	101,221	205,878	350,662	308,750	246,236	306,769	147,170	672,191	545,684	300,701
Rebars	37,523	25,887	2,225	7,593	0	5,931	0	0	0	0	0
Limestone	0	0	0	0	144,515	97,864	476,177	433,468	263,373	65,694	175,732
Pumice	0	44,813	85,964	49,017	0	51,758	28,687	0	8,818	0	0
Sand	7,278	24,406	5,200	6,000	0	0	58,779	4,417	25,000	0	0
Slag	0	0	0	184,108	297,497	398,432	207,458	227,705	137,169	296,064	235,856
Cars	7,040	7,072	6,108	6,232	10,264	10,147	15,428	19,147	9,763	6,057	4,638
Trucks	352	424	1,310	4,023	8,937	8,352	9,059	12,777	11,352	18,405	18,599
Other	11,702	10,942	52,233	7,598	85,365	67,786	75,789	109,747	80,133	45,546	24,462
Total	**3,565,592**	**3,160,064**	**3,867,724**	**4,083,528**	**4,467,088**	**4,553,756**	**3,572,206**	**2,395,779**	**2,626,795**	**3,218,144**	**4,547,724**

Notes: Source – Canaveral Port Authority
Excludes potable water and bunkering fuel; Agg. Stone includes rock aggregate and granite

2.6.2 Existing Cargo Fleet

The cargo fleet calling at Port Canaveral can be characterized by the type of service the carrier is providing. Cargo services at Port Canaveral are generally either point-to-point services, which deliver a full vessel load, or multi-point services, which call at multiple ports delivering a partial load to each port. Lumber and Transmontaigne's petroleum products are examples of multi-point services, which typically deliver partial loads. Lumber vessels arriving from the Baltic region and call at New London, CT, Wilmington, NC, and Savannah, GA before reaching Port Canaveral. Transmontaigne-bound tankers typically call at Port Everglades prior to calling at Port Canaveral. Seaport Canaveral receives a mix of multi-point and point-to-point deliveries. Seaport Canaveral's multi-point deliveries are typically on smaller vessels with drafts less than 30 feet, which would not benefits from channel improvements. Multi-point services usually arrive at Port Canaveral with sailing drafts which are unconstrained by existing channel depths. In 2006 – 2008, cement imports, which previously were nearly always point-to-point deliveries, have included multi-point deliveries. This switch to multi-point cement deliveries was due to the reduced demand for cement during the economic downturn no longer requiring a full vessel load to be delivered to Port Canaveral.

Point-to-point services typically arrive at Port Canaveral more fully loaded and offload the entire cargo at the port. Cargo vessels on point-to-point services arrive at Port Canaveral with the deepest drafts of all vessels using the port. Examples of point-to-point service dry bulk cargo include cement, slag, limestone, and rock products (aggregate and granite). Tables 2-20 through 2-23 provide details for the deepest draft point-to-point dry bulk cargo vessels calls from January 2006[5] through September 2009. Seaport Canaveral also receives point-to-point liquid bulk deliveries and generates point-to-point liquid bulk shipments to other ports. Table 2-20 presents Seaport Canaveral point-to-point vessel calls for the 12 months between August 2010 and July 2011. It is important to note that point-to-point vessel calls at Seaport Canaveral are projected to benefit from channel improvements, but multi-port vessel calls at Seaport Canaveral are not projected to benefit from channel improvements.

[5] There is a gap in available data as the result of a change in data reporting at the port

Table 2-20
Cement Imports – 36 Feet or Greater Arrival Draft (Jan 2006 – Sep 2009)

2006						
Date	**Vessel**	**DWT**	**Origin**	**Berth**	**Tonnage**	**Draft**
11Jan	Nordtide	45,406	Sweden	SCP4	33,347	37.00
16Jan	Spar Sirius	45,402	Taiwan	SCP4	22,102	37.72
30Jan	Talisman	56,019	Thailand	NCP4	45,171	36.00
23Feb	Bled	34,947	Columbia	NCP4	35,910	35.88
18Mar	Ancash Queen	46,673	China	NCP4	46,141	36.00
19Apl	Genco Glory	41,061	Egypt	NCP4	40,254	35.75
16Jul	Fany	43,598	Taiwan	SCP4	34,425	36.56
2007						
Date	**Vessel**	**DWT**	**Origin**	**Berth**	**Tonnage**	**Draft**
05Feb	North Star	42,219	Taiwan	SCP4	27,117	*
17Feb	Tassos N	41,343	Taiwan	NCP4	41,761	36.00
21Feb	Winterset	23,500	Colombia	SCP4	6,437	*
15Mar	Asian Glory	45,194	Brazil	NCP4	26,698	*
26Mar	Maritime Diamond	47,574	Taiwan	SCP4	30,669	*
06Apr	Ince Atlantic	45,608	Taiwan	NCP4	25,850	*
07May	Flag Adrienne	18,289	Columbia	SCP4	13,314	*
31May	New Power	43,665	Brazil	NCP4	19,995	*
31May	BMS Tourloti	37,662	Taiwan	SCP4	22,129	*
23Jun	Flag Adrienne	18,289	Columbia	SCP4	13,403	*
22Jul	Angelina The Great	40,763	Sweden	SCP4	9,915	*
03Aug	Flag Adrienne	18,289	Columbia	SCP4	13,297	*
17Aug	Pontomedon	37,596	Brazil	NCP4	35,549	33.83
16Sep	Flag Adrienne	18,289	Columbia	SCP4	13,602	*
08Oct	KCL Barracuda	17,722	Columbia	SCP4	13,917	*
2008						
Date	**Vessel**	**DWT**	**Origin**	**Berth**	**Tonnage**	**Draft**
30Jan	Jia Quing	47,324	Colombia	SCP4	13,917	36.75
2009						
Date	**Vessel**	**DWT**	**Origin**	**Berth**	**Tonnage**	**Draft**
None						

Source: CPA and Canaveral Pilots Association
Note: * indicates draft 33 feet or less

Table 2-21
Aggregate Rock/Granite Imports – 36 Feet or Greater Arrival Draft (Jan 2006 – Sep 2009)

2006						
Date	**Vessel**	**DWT**	**Origin**	**Berth**	**Tonnage**	**Draft**
10Jan	Tsuru	38,678	Canada	SCP5	39,683	37.50
10Feb	Olga Topic	45,483	Canada	SCP5	47,511	37.00
18May	Dove	38,631	Canada	SCP5	40,765	37.88
25Jun	Bernardo Quintano	67,044	Mexico	SCP4	60,611	39.5
16Aug	Falcon	50,296	Canada	SCP5	41,106	38.5
12Oct	Gdynia	65,738	Canada	SCP5	63,015	39.5
2007						
Date	**Vessel**	**DWT**	**Origin**	**Berth**	**Tonnage**	**Draft**
14Jan	Gdynia	65,738	Canada	SCP5	59,931	37.92
29Jun	Bauta	41,756	Canada	SCP5	43,563	37.25
03Sep	CSL Argossy	74,423	Canada	SCP4	68,333	39.50
2008						
Date	**Vessel**	**DWT**	**Origin**	**Berth**	**Tonnage**	**Draft**
24Apr	Balder	48,184	Canada	SCP4	51,180	38.25
26Jun	Harmen Oldendorff	66,188	Canada	SCP4	58,399	39.50
02Sep	CSL Spirit	70,018	Canada	SCP4	28,967	39.50
03Oct	CSL Spirit	70,018	Canada	SCP4	28,634	39.50
21Oct	CSL Metis		Canada	SCP4	62,893	39.50
16Nov	Top Rich		Canada	SCP5	47,066	37.75
12Dec	Nord Vision		Canada	SCP5	54,844	39.50
20Dec	Stella Maris		Canada	SCP5	54,802	39.25
2009						
Date	**Vessel**	**DWT**	**Origin**	**Berth**	**Tonnage**	**Draft**
10Jan	CSL Metis		Canada	SCP4	62,920	39.50
08Mar	CSL Metis		Canada	SCP4	62,915	39.42
10May	Eastern Power		Canada	SCP4	65,215	39.50
13Jul	Ince Atlantic		Canada	SCP4	48,358	39.17
02Aug	KT Venture		Canada	SCP4	52,943	38.67

Source: CPA and Canaveral Pilots Association
Note: * indicates shallow draft

Table 2-22
Limestone Imports – 36 Feet or Greater Arrival Draft (Jan 2006 – Sep 2009)

2006

Date	Vessel	DWT	Origin	Berth	Tonnage	Draft
08Jul	Swan	34,291	Bahamas	SCP5	37,529	36.00
21Sep	Bernardo Quintana	67,044	Mexico	SCP4	60,335	39.50

2007

Date	Vessel	DWT	Origin	Berth	Tonnage	Draft
13Feb	Balder	51,180	Bahamas	SCP5	49,835	38.58
21Feb	Borc	28,106	Bahamas	SCP5	28,794	34.58
07Apr	Borc	28,106	Bahamas	SCP5	28,874	34.50
10Apr	WH Blount	65,402	Mexico	SCP4	58,950	39.50
10Apr	Bahama Spirit	46,606	Bahamas	SCP5	47,675	37.25
23May	Bahama Spirit	46,606	Bahamas	SCP5	46,848	36.00
14Jun	Bahama Spirit	46,606	Bahamas	SCP5	47,805	37.25
23Aug	Balder	51,180	Bahamas	SCP4	46,985	36.33
14Sep	Ha Skelnar	unk	Mexico	SCP4	15,659	*
26Sep	Bahama Spirit	46,606	Bahamas	SCP4	48,040	37.25
04Nov	Bahama Spirit	46,606	Bahamas	SCP4	47,739	37.25
22Dec	Shelia Ann	70,037	Bahamas	SCP4	50,689	36.00

2008

Date	Vessel	DWT	Origin	Berth	Tonnage	Draft
25Jan	Bahama Spirit	46,606	Bahamas	SCP4	47,854	37.25
05Feb	WH Blount	65,402	Mexico	SCP4	56,000	38.00
06Mar	Bahama Spirit	46,606	Bahamas	SCP4	47,533	37.25
07Apr	Bahama Spirit	46,606	Bahamas	SCP4	47,339	37.25
17Apr	Ballangen	41,630	Bahamas	SCP5	43,036	36.67
19May	Bahama Spirit	46,606	Bahamas	SCP4	47,558	37.25
29Jun	Bahama Spirit	46,606	Bahamas	SCP4	45,700	37.25
04Nov	WH Blount	65,402	Mexico	SCP4	57,820	39.50

2009

Date	Vessel	DWT	Origin	Berth	Tonnage	Draft
17Feb	Ha Skelnar	unk	Mexico	SCP4	65,814	39.42
21Apr	Bahama Spirit	46,606	Bahamas	SCP4	47,759	37.25
26Jul	Bernardo Quintana	67,044	Mexico	SCP4	22,442	38.75

Source: CPA and Canaveral Pilots Association
Note: * indicates shallow draft

Table 2-23
Slag Imports – 36 Feet or Greater Arrival Draft (Jan 2006 – Sep 2009)

Date	Vessel	DWT	Origin	Berth	Tonnage	Draft
2006						
29Jan	Nikkei Phoenix	45,635	France	NCP2	48,759	37.75
04Apr	Nikkei Tiger	45,363	Japan	NCP2	48,060	37.16
2007						
Date	**Vessel**	**DWT**	**Origin**	**Berth**	**Tonnage**	**Draft**
21Feb	Medi Dubai	52,523	Japan	NCP2	45,749	34.08
18Mar	Condor	50,296	Japan	NCP2	45,392	34.58
21May	Ace Bulker	28,498	Japan	NCP2	29,840	32.00
25Sep	Griffon	46,635	Japan	NCP2	43,181	34.42
18Dec	Nikkei Phoenix	45,635	Japan	NCP2	48,562	37.58
2008						
Date	**Vessel**	**DWT**	**Origin**	**Berth**	**Tonnage**	**Draft**
13Jan	Spring Hawk	46,570	Japan	NCP2	42,594	35.00
13Apr	Kang Kong	55,589	Japan	NCP2	46,603	34.33
14Jul	Ocean Prince	52,475	Japan	NCP2	46,685	34.75
2009						
Date	**Vessel**	**DWT**	**Origin**	**Berth**	**Tonnage**	**Draft**
01Jan	Nikkei Phoenix	45,635	Japan	NCP2	48,791	37.67

Source: CPA and Canaveral Pilots Association
Note: * indicates shallow draft

2.6.3 Existing Cargo Fleet Operations and Tidal Advantage

Large bulk cargo vessels calling at Port Canaveral must operate under a combination of constraints that affect the vessel's potential use of tidal advantage, including channel depth and channel transit schedules. The deepest operating draft approved by the Canaveral Pilots Association is 39.5 feet, which requires special coordination so that the vessel arrives at peak high water. Any vessel arriving with a sailing draft of 36 feet or deeper must coordinate arrival with the rising tide, i.e., use tidal advantage. The channel transit schedule constraint is based on the priority given to cruise ship and submarine transits. When cruise ships and submarines are arriving or departing the port, all other vessel traffic must stand-by. Daily cruise ship morning arrival and evening departure times can effectively close the port to cargo vessel transits for an hour or more. Historically, some vessels awaiting tidal advantage have missed the tidal window because it occurred concurrently with cruise ship or submarine transits. Therefore, using tidal advantage at Port Canaveral includes the additional risk of missing a tidal cycle (and potentially two tidal cycles) due to conflicts with transits by cruise ships or submarines.

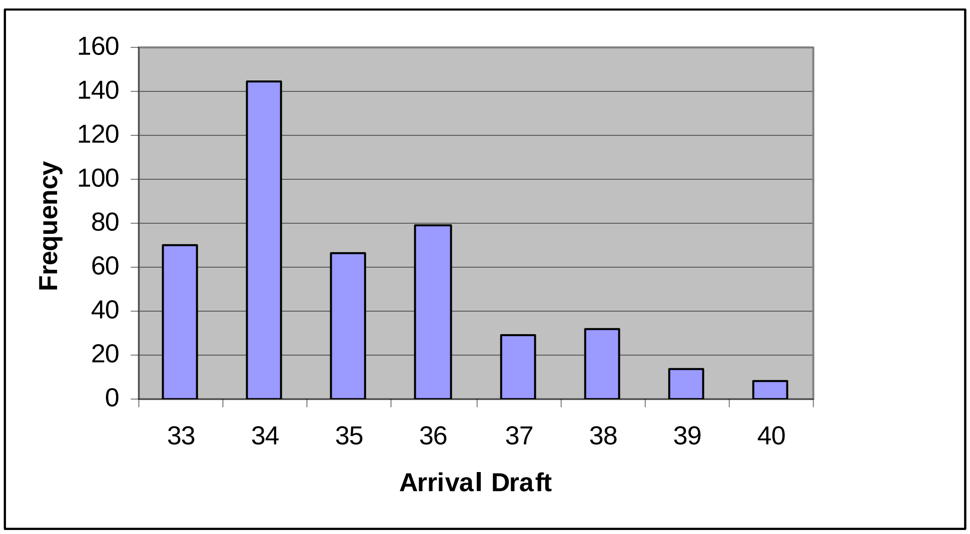
Vessel arrival draft data for the years prior to the recent economic recession (Table 2-24 and Chart 2-2) indicate that vessels were typically loaded to avoid reliance on a rising tide, which is consistent with discussions with the pilots and port personnel. Although most large cargo vessels are typically loaded to avoid channel depth constraints and the additional operational difficulties that would follow, some vessels and cargo types do consistently use tidal advantage. For example, dry bulk carriers delivering aggregates, slag, and cement - which are high volume, low value commodities that are stockpiled at the port - consistently arrive at Port Canaveral with drafts that require tidal advantage (Tables 2-20 through 2-23). These vessels typically take a few days to unload and their cargo may spend days or weeks stockpiled at the terminal facility prior to delivery to an end-user.

Table 2-24
Port Canaveral Deep Draft Vessel Arrival Drafts 2002 - 2006

Arrival Draft	2002	2003	2004	2005	2006	Total
33	12	13	17	16	12	70
34	31	29	39	24	22	145
35	9	6	18	16	17	66
36	4	15	13	30	17	79
37	2	3	2	13	9	29
38	4	6	5	7	10	32
39	4	3	3	2	2	14
40	0	0	0	4	4	8

Source: USACE, Waterborne Commerce Statistics 2002 - 2006

Chart 2-2
Port Canaveral Deep Draft Vessel Arrival Drafts (2002-2006)



Source: USACE Waterborne Commerce Statistics 2002 – 2006

Large vessel point-to-point calls at Seaport Canaveral typically avoid requiring tidal advantage (Table 2-25 and Chart 2-3) because Seaport Canaveral's vessel operations are closely coordinated with landside infrastructure availability, landside transport, and end-user delivery schedules. Between February 2010, when Seaport Canaveral began operations, and mid-July 2011 only two vessels have arrived with drafts deeper than 36.0 feet: one at 36.8 feet (Aug 2010) and one at 38.5 feet (Jun 2010). Avoidance of needing tidal advantage not only affects the vessels operating draft, but also affects the overall size of the vessel. Seaport Canaveral vessels tend to be in a narrow size range (Table 2-25 and Chart 2-4) because this is the vessel size that can efficiently operate within the operating draft constraint. Under improved conditions including a deeper channel, efficient vessel size would increase as the operating draft increases. Regardless of potential channel improvements, large vessel point-to-point calls at Seaport Canaveral will continue to avoid requiring tidal advantage due to the additional operational additional risk of missing a tidal cycle (and potentially two tidal cycles) due to transits by cruise ships or submarines.

Table 2-25
Seaport Canaveral Point-to-Point Vessel Sailing Drafts Aug 2010 – July 2011

				Tonnage		Sailing
Date	**Vessel**	**LOA**	**Origin**	**Inbound**	**Outbound**	**Draft**
13-Aug-10	Piltene	640	Latvia	47,162		32
23-Aug-10	Haruna Express	590	Canada	50,408		36.8
11-Dec-10	Atlantic Grace	601	US	46,709		35
19-Jan-11	Politisa Lady	599	Venezuela	40,285		32
31-Jan-11	Athiri	752	India	66,497		32
10-Feb-11	Citron	600	Algeria	53,388		35
14-Feb-11	Oriental Ruby	620	Venezuela	40,244	39,490	35
24-Feb-11	Cartagena	601	Netherlands	40,246	40,345	34
27-Feb-11	Arendal	601	Venezuela	40,276		34
5-Mar-11	Lichtenstein	601	Canada		41,111	34
9-Mar-11	Box	601	US	40,310		35
2-Apr-11	Ajax	614	Venezuela	40,238	40,245	35
29-Apr-11	United Ambassador	750	Canada	50,211		35
2-May-11	Kate Maersk	601	Venezuela	40,213	39,472	35
6-May-11	Nordic Hanne	600	Venezuela	36,351	40,203	34.6
21-May-11	Marvea	578	Aruba	34,649		35
22-May-11	Amphitrite	600	Venezuela	40,299		31
9-Jun-11	Nordic Hanne	600	Venezuela	40,392		34.6
29-Jun-11	Nordic Agnetha	602	Venezuela	40,250	39,361	34
3-Jul-11	Eskden	600	Venezuela	40,223	307	33
13-Jul-11	Overseas Kythnos	600	United Kingdom	51,394		34.5
23-Jul-11	Mount Hope	597	US	40,223	38,122	26.3
25-Jul-11	Atlantic Queen	601	Aruba	34,002		35.6

Source: CPA

Chart 2-3
Seaport Canaveral Point-to-Point Vessel Sailing Drafts August 2010 – July 2011

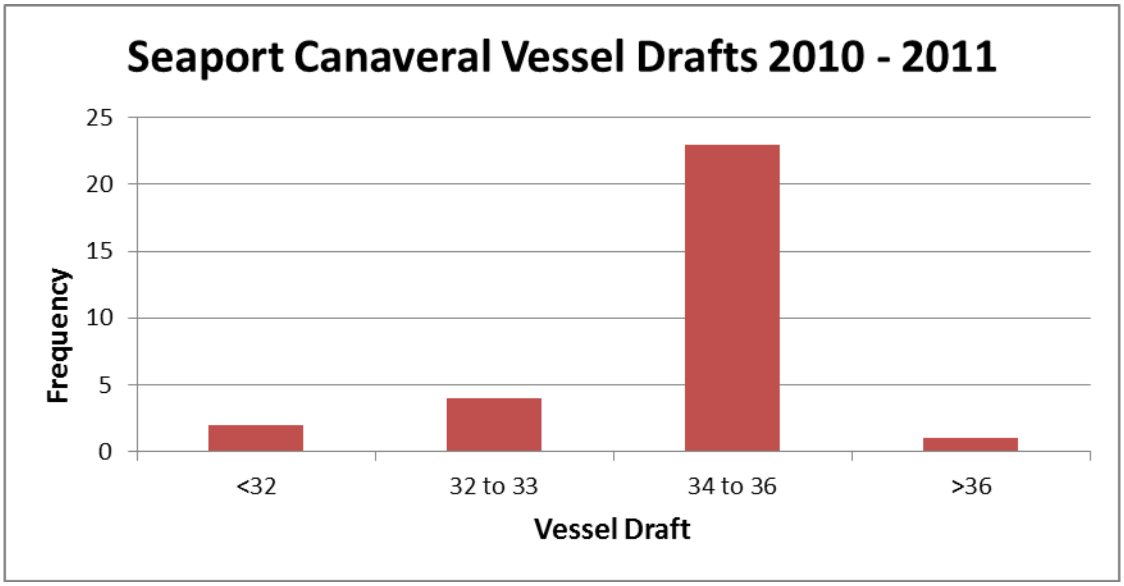
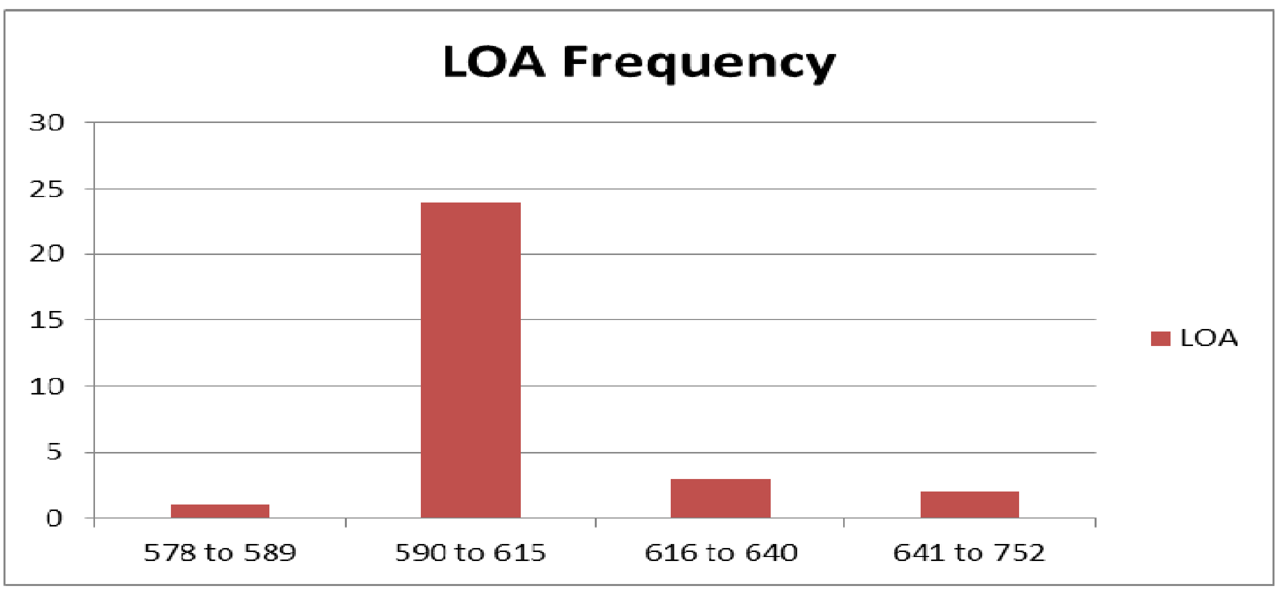


Chart 2-4
Seaport Canaveral Point-to-Point Vessel Length Overall August 2010 – July 2011



3 Without-Project Conditions

Most general conditions relating to climate, winds, waves, and current are expected to be similar to existing conditions. Water quality conditions will continue to be monitored and any necessary corrective actions would be taken. One major change to general conditions will be the projected widening of State Road 528 (Beachline Expressway) which runs between Orlando and Port Canaveral. Currently the road is a four lane (two lanes in each direction) toll road designed in 1960. A Project Development and Environment (PD&E) study was completed by the Florida Department of Transportation in August 2006 recommending a six lane widening project as the selected alternative. In May 2007, Florida's Turnpike Enterprise began Phase I of a project to widen the Beachline West. It encompasses the reconstruction of the mainline toll plaza located near Milepost 5, which is now complete. Ultimate roadway improvements will include four travel lanes in each direction, but due to construction costs, the improvements will be stage-constructed, with the interim improvements including three lanes in each direction. In June 2008, a project began to widen the Beachline from the Turnpike to McCoy Road. Improvements include widening the existing bridge structures at US 441, Landstreet Road, CSX Taft Yard, Orange Avenue and McCoy Road. A new bridge will also be constructed for the access ramp over CSX. The final phase, between Interstate 4 and the Turnpike, has been pushed out due to rising construction costs and expected traffic projections. That project is not included in the Turnpike's current five-year work program.

3.1 Navigation Features

3.1.1 Canaveral Ocean Dredged Material Disposal Site (ODMDS)

Under without-project conditions, maintenance dredging is projected to continue with volumes similar to recent historical volumes. Material samples from more than 300 borings indicate that project and future maintenance material will be similar in quality to recent historical dredged material and therefore suitable for disposal at the Canaveral ODMDS. Long-term monitoring of the ODMDS will continue as outlined in the Canaveral ODMDS Long Term Management Plan. Offshore disposal at the Canaveral ODMDS will continue to be the long term disposal plan for port users (CPA, USACE, USN) and is the most cost-effective disposal alternative, consistent with engineering and environmental criteria. Disposal alternatives for dredged material, other than the ODMDS, consist of very expensive and restrictive upland placement alternatives. Use of the Canaveral ODMDS is not expected to cause significant adverse impacts to Essential Fish Habitat. The disposal site is clear of any coral, coral reef, live / hard bottom or artificial reef habitat. The disposal site’s 3 million cubic yard annual capacity limit is sufficient for both maintenance and new project dredging (Table 27, Engineering Appendix).

A draft revised ODMDS Site Monitoring and Management Plan (SMMP) has been released for public comment in January 2012 and is projected to be made final in March 2012. Although the current SMMP limits the use of the ODMDS to 3 million cubic yards of dredged material per year, the revised draft SMMP does not identify an annual volume limit. Additionally, overall planning for the revised SMMP specifically accounts for all construction and maintenance dredging volumes associated with this project. This project requires no changes to the Canaveral ODMDS Long Term Management Plan.

3.1.2 Channel Conditions

Royal Caribbean International (RCI) homeported a new Freedom Class vessel at Port Canaveral in 2009, the *Freedom of the Seas*. The Freedom Class is an additional 91 feet longer than the previous Voyager Class vessel, *Mariner of the Seas*, which was homeported at Port Canaveral (Nov. 2003 – Jan. 2009) prior to the arrival of the *Freedom of the Seas*. Other dimensions are similar to the Voyager Class. As discussed in Section 2.3.3 Existing Port Canaveral Cruise Ship Operations, limited dredging outside of authorized project limits was conducted in order for the *Mariner of the Seas* (Voyager Class) to operate safely within Port Canaveral.

Prior to bringing a Freedom Class vessel to Port Canaveral, additional limited dredging beyond existing authorized channel and turning basin dimensions, as recommended by the Pilots and RCI, was conducted. This additional dredging included expanding the southeast corner of the present entrance to the West Turning Basin to enable access by a Freedom Class vessel. The immediate widening of the West Turning Basin entrance is referred to as the Interim Corner Cut-Off (ICCO). The Pilots have stated their willingness to transit a Freedom Class vessel through Port Canaveral under this interim channel modification, but only under the condition that further improvements (including full length channel widening) would be forthcoming. The Pilots have stated that interim channel modifications are not a long term solution to the restrictions on navigation of a Freedom Class vessel at Port Canaveral. Additional discussion of without-project condition vessel operations is contained in Section 3.4 Port Canaveral Operations.

3.2 Terminal Facilities

3.2.1 Cargo Terminals

Recently completed construction projects include extending SCP4 and widening SCP1. The largest difference between existing and without-project conditions for Port Canaveral's cargo terminal facilities will be the completion of Seaport Canaveral's (formerly Vitol) 36 acre, 2.8 million barrel petroleum product storage facility. This fuel terminal is located on the port's North Cargo Area adjacent to the Middle Turning Basin (North Cargo Piers 1-2). Initial construction, which was completed in December 2009, includes 24 storage tanks with a combined capacity of 2.8 million barrels. Initial construction cost was $45 million. Seaport Canaveral Terminal capacity is more than three times the existing capacity at Transmontaigne's facility (formerly Coastal Fuels). Seaport Canaveral has delivery contracts in place and the first delivery occurred in February 2010. As of September 2011, 3.3 million tons of petroleum products have been delivered to the facility. The facility currently has 24 storage tanks with a capacity of 2.84 million barrels and a six lane truck rack. At full build-out, whenever that might occur, Seaport Canaveral will have 31 storage tanks with a capacity of 3.79 million barrels. Additional development at the facility may also include a pipeline to the Orlando International Airport and potentially a biodiesel production plant. Full build-out, jet fuel pipeline, and the biodiesel plant are all potential developments at Seaport Canaveral, which have not been included as elements that affect project benefits because of their speculative nature.

The Canaveral Port Authority is currently in the design and construction stages for three new cargo berths in the West Basin, North Cargo Berths (NCB) 5, 6 & 8. These projects (including improvements to CT 6 being performed concurrently with NCB 8) are currently estimated to cost between $45 and $65 million.

3.2.2 Cruise Terminals

Under without-project conditions, the Canaveral Port Authority has undertaken a $32 million effort to upgrade and expand Cruise Terminal (CT) 8 to accommodate the new, larger Disney vessels. The first of these new, larger vessels, the *Disney Dream*, entered service at Port Canaveral in January 2011. The second of two new Disney cruise ships, the *Disney Fantasy*, is currently under construction, with expected delivery in February 2012. These vessels are 128,000 Gross Registered Tonnage (GRT), with a draft of 27 feet, length overall of 1,115 feet, and a beam at the waterline of 121 feet. The older Disney ships are 83,000 GRT (with 965 ft LOA, 106 ft beam, and 25 ft draft), so the new vessels are considerably longer and wider, although they will employ traditional propulsion systems. Completed modifications to CT 8 to accommodate the new larger Disney cruise ships include berth extension and additional mooring features without compromising the safety of navigation for cruise vessel traffic to and from adjacent CT 10. The passenger terminal was also substantially upgraded, and additional plans are being drawn up better accommodate up to 4,000 passengers.

CT 10 was modified in 2009 to accommodate RCI's new Freedom Class vessel. Prior to modifications CT 10 was capable of berthing a vessel with a maximum length of 1,020 feet. The new Freedom Class vessels are 1,112 feet LOA. Completed modifications to CT 10 include the construction of a mooring dolphin to the east of the existing pier and additional pier extension, which satisfy the requirements of the larger vessel. The passenger terminal was also enlarged to accommodate up to 3,500 passengers.

3.3 Economic Conditions in the Project Hinterland

Even throughout the recent severe economic downturn, the population of the six-county region encompassing the project area continued to grow at a significant rate. For example, the population of Brevard County grew 14.1% from 2000 to 2010 (see Section 2.2.4). Under a medium growth scenario generated by the Bureau of Economic and Business Research (BEBR)[6] at the University of Florida, the six-county port hinterland region is projected to increase population by 43% (1.4 million people) between 2010 and 2035, an average annual growth rate of 1.45%. This projected regional population growth is proportionately greater than projected statewide growth, which is projected to increase by 33%, an average annual rate of 1.1%. Table 3-1 presents the BEBR population growth estimates for the port's six-county hinterland region.

[6] BEBR, 2010

Table 3-1
Six-County Regional Population Projections (2010 – 2035)

County	2010	2035	Population Increase	Percent Increase	Average Annual Growth Rate
Brevard	554,900	727,200	172,300	31.1%	1.1%
Lake	293,500	487,700	194,200	66.2%	2.1%
Orange	1,111,000	1,623,200	512,200	46.1%	1.5%
Osceola	273,300	506,400	233,100	85.3%	2.5%
Seminole	423,700	548,900	125,200	29.5%	1.0%
Volusia	506,500	636,600	130,100	25.7%	0.9%
Region Total	**3,162,900**	**4,530,000**	**1,367,100**	**43.2%**	**1.45%**
Florida	**18,773,400**	**24,970,700**	**6,197,300**	**33.0%**	**1.15%**

Source: Bureau of Economic and Business Research, University of Florida; Publication 156; March 2010

In addition to the projected population growth within the port's hinterland which will grow demand for Port cargo, commencement of full operations at the new Seaport Canaveral fuel terminal will expand the area historically serviced by fuel terminals at Port Canaveral. Transmontaigne (previously the only fuel terminal facility operating at Port Canaveral) cannot expand or substantially change its operation due to permit and zoning constraints within the City of Cape Canaveral. Transmontaigne's facility is off port property and surrounded by residential development, drastically limiting its growth potential. Seaport Canaveral's business plan and physical plant design do not suffer from the same limitations and are aimed at expanding the existing hinterland for fuel beyond the area serviced by Transmontaigne to include the Orlando area and the Orlando International Airport.

The Florida 2006 Energy Plan states that 90% of the state's waterborne deliveries of fuel oil are handled by three principal ports: Tampa, Jacksonville, and Port Everglades. On Florida's east coast, there is only a very small volume handled at Fort Pierce, apart from Jacksonville, Port Everglades, and Port Canaveral. The hurricane seasons of 2004 and 2005 created severe disruptions of fuel distribution within Florida, which prompted the state to assess its need for expanded distribution and storage infrastructure improvements and contingency planning. The Florida 2006 Energy Plan's first recommendation for transportation fuels was to "facilitate diverse petroleum supply and distribution mechanisms into and within Florida". The new Seaport Canaveral Terminal adds significant additional capacity at a strategic location in central Florida, because of its proximity to Orlando and its mid-coast location between major delivery ports at Jacksonville and Port Everglades.

The Annual Energy Outlook 2011 projects that the South Atlantic region will increase its share of the nation's gasoline consumption from 39.6% in 2010 to 44.3% in 2035 (Table 3-2). Similarly, the South Atlantic region's distillate fuel consumption is expected to increase from 32.7% to 35.1% of national consumption. Overall, gasoline consumption in the South Atlantic region is projected to increase by 15.4% during 2010 through 2035, an annual rate of 0.6%. Distillate fuel consumption in the South Atlantic region is projected to increase by 40.2% from 2010 through 2035, an annual rate of 1.4%. The South Atlantic region's ethanol consumption in gasoline is projected to increase by 86.3% over the same period, an annual growth rate of 2.5%. National ethanol net imports are projected to increase by a factor of more than 300 from less than 1,000 barrels per day in 2010 to more than 250,000 barrels per day by 2035.

Table 3-2
Fuel Consumption Projections in Millions of Barrels per Day (2010 – 2035)

Fuel	2010	2035	Consumption Increase	Percentage Increase	Average Annual Growth Rate
National					
Gasoline	9.02	9.31	0.29	3.2%	0.1%
Distillate	3.73	4.87	1.14	30.6%	1.1%
Ethanol Imports	0.0008	0.2562	0.2554	32,534%	---
South Atlantic					
Gasoline	3.57	4.12	0.55	15.4%	0.6%
Distillate	1.22	1.71	0.49	40.2%	1.4%
Ethanol in Gasoline	0.248	0.462	0.214	86.3%	2.5%

Source: Annual Energy Outlook 2011; South Atlantic Supplemental Regional Table (Table 5)

3.4 Port Canaveral Operations

3.4.1 Commodity Projections

The without-project condition commodity forecast for Port Canaveral is based on recent historical commodity volumes and growth at the port, projected demographic and economic growth in the port's hinterland (see Section 3.3 Economic Conditions), and on existing port development. The base year of the analysis is 2014; however, commodity forecasts use FY11 CPA data as the baseline. As discussed in Section 2.4, growth in overall commodity tonnage at Port Canaveral has been growing steadily over the past 40 years, although volumes of specific commodities have fluctuated significantly. Commodities with the most consistent historical growth have been construction-related commodities such as lumber, cement, and stone products and petroleum products (see Sections 2.4.1 and 2.4.2).

The effects of the recent recession were first seen in a total tonnage reduction from 2006 to 2007. By 2008, total tonnage had been reduced to 53% of 2006 levels. Since 2008, total tonnage at Port Canaveral has risen, though not yet to pre-recession levels. Total tonnage for 2009 was 9.64% greater than total 2008 tonnage, and 2010 total tonnage was 22.5% greater than total 2009 tonnage. By 2011, the Port's total tonnage was 99.9% of 2006 tonnage (Table 2-19). The effects of the recession have not impacted all commodities equally. Tonnage for lumber and cement has substantially reduced, but petroleum products and stone products have increased. Overall, residual tonnage impacts due to the recession are expected to be short-lived.

The commodity forecast used in this analysis focuses only on the four categories of bulk commodities that are carried on vessels large enough to potentially benefit from navigation improvements at Port Canaveral: fuel, rock, slag, and cement. Other commodities handled at

Port Canaveral, such as lumber, salt, food products, etc., will continue to be carried on vessels which are too small to require navigation improvements at Port Canaveral. Therefore, these other commodity groups are excluded from further analysis.

3.4.1.1 Rock Forecast

Rock (aggregate, limestone, and granite) forecasts were provided by the CPA based on term sheets for the two major bulk handling firms operating at the port. The term sheet is a planning document used by both the operator and the CPA to allocate resources and terminal area. The term sheet provides a revenue stream estimate for the CPA and is used to establish minimum guarantee fees. As a consequence of the guarantee fees, the projections contained in the term sheets are both conservative and as accurate as possible. The term sheets for both firms provide commodity projections from 2011 through 2035. In this analysis, there is no further growth projected for these commodities beyond growth identified in the term sheets, due to forecast uncertainty.

Port Canaveral is uniquely situated as the only deep water port on Florida's central east coast with the ability to handle and store the amount of rock products identified in the term sheets. The commercial importance of Port Canaveral's location, as explained by the operators, is that continued infrastructure development along the Orlando/Interstate 4 corridor requires more rock products than can be supplied through existing and historical local sources. The fixed location of rail infrastructure and the inability to develop potential sources within the Everglades due to land use constraints increase the need for imported rock products. At the same time, vessels carrying international rock products are increasing in size, lowering per unit transportation costs and increasing their cost competitiveness in the central Florida market. For example CSL, one of the world's major bulk carriers which calls regularly at Port Canaveral, will have a new fleet of Panamax bulk vessels in service by 2012 with draft capabilities of 44 feet.

3.4.1.2 Fuel Forecast

Seaport Canaveral began operation in February 2010. From February 2010 through September 2011, Seaport Canaveral has handled 3.3 million tons of petroleum products. A detailed analysis of individual point-to-point shipments from the twelve month period from August 2010 through July 2011 was used to inform the Seaport Canaveral forecast (Table 2-25). The Transmontaigne facility, which also handles petroleum products, operates in a very different way than the Seaport Canaveral facility, due to its use as one of three Transmontaigne east Florida facilities which share deliveries and coordinate operations. The Transmontaigne facility, which cannot expand due to its proximity to residential development, does not provide a reference for future operations at Seaport Canaveral.

In early 2010, a short-term (2011 – 2013) forecast for Seaport Canaveral, based on current contracts, was provided by the terminal operator. This forecast, which projected an approximate 50% utilization of the Seaport Canaveral facility, included the recessionary impact of existing and near-term economic conditions. Actual Seaport Canaveral tonnage for point-to-point vessels during the 12 month period from August 2010 through July 2011 was 1,272,625 tons, which is 15.87% larger than the projection provided in 2010 (1,098, 334 tons). The actual 1,272,625 tons was used in place of the 2011 forecast and the remaining two short-term forecast years (1.4 million tons in 2012 and 1.9 million tons in 2013) were increased by 15.87% to 1.65 million tons in 2012 and 2.21 million tons in 2013. The long-term forecast (2014 – 2064) is based on the

South Atlantic annual growth rates for gasoline (0.6%) and distillate fuel (1.4%) consumption, as presented in the Annual Energy Outlook 2011. These growth rates are proportionally applied to the short-term 2013 forecast (2.21 million tons; 1.78 million tons gasoline and 0.44 million tons distillate fuel) to generate the long-term (2014 – 2064) forecast.

3.4.1.3 Cement Forecast

The cement forecast is based on observed recent growth and includes the substantial impact that the recent recession had on cement imports. Domestic cement production is historically supplemented with imported cement. During the period from 1997 through 2007, cement imports, on average, accounted for 20.6% (23.6 million tons) of national cement consumption[7]. In 2009, cement import tonnage had fallen to 6.2 million tons and domestic consumption had fallen to a level equivalent to consumption in 1991. There have been no cement imports to Port Canaveral in 2009 – 2011. Nonetheless, the two cement terminal facilities at Port Canaveral, even though they have recently been idle, are being constantly maintained in operating condition on a monthly basis by Continental Cement (south side terminal) and CEMEX (north side terminal). These terminals have not been closed and the cement industry projects a strong recovery in cement imports due to pent up demand, environmental regulations restricting domestic cement production, and the permanent closure of domestic cement production plants that have not weathered the current economic downturn.

The Portland Cement Association (PCA) produced an analysis of projected future industry characteristics in 2011 titled “Overview Impact of Existing and Proposed Regulatory Standards on Domestic Cement Capacity”. The PCA analysis projects domestic cement consumption, production, and imports through 2025 under two regulatory scenarios. One regulatory scenario includes the effects of five currently enacted environmental regulations and two proposed regulations (the with-current emissions policy condition). The second regulatory scenario excludes these existing and proposed regulatory standards (the without-current emissions policy condition). The implications of these two policy scenarios is that imports are expected to increase more rapidly as a percentage of total cement usage under current emissions policy due to regulatory impacts on the level and cost of domestic production.

Under the with-current emissions policy scenario, the most likely condition for USACE planning purposes, U.S. cement consumption is projected by the PCA to increase from observed 2010 levels (68.9 million tons) to 170.8 million tons in 2025, an annual growth rate of 6.2%. Cement imports under the with-current emissions policy scenario are projected to increase from observed 2010 levels (5.9 million tons) to 82.0 million tons in 2025, an annual growth rate of 19.2%. This reflects an increasing share of imports versus domestic production over this period.

Even under the without-current emissions policy scenario, which favors domestic production over imports, the PCA projects that cement imports are projected to grow at an annual rate of 15.0%, achieving 48.0 million tons in 2025. Under the without-current emissions policy scenario, the PCA projects that cement imports at the national level will more than double between 2010 and 2015. One important contributing factor to the PCA import projections under both policy scenarios is that domestic production is expected to level off beginning in 2015. Under the without-current emissions policy scenario, domestic production levels off at a greater tonnage than under the with-current emissions policy scenario.

[7] USGS Cement Statistics, last modification: December 13, 2010

The cement forecast uses the Port's 2007 level of imports (536,000 tons) as the cement tonnage projected to be achieved in 2015, which represents a much slower return of consumption levels than projected by the Portland Cement Association. This 2007 level of imports is 42% of the peak level (1.3 million tons) achieved in 2006. The projected growth rate for cement imports through Port Canaveral is based on the observed relationship between historical population growth in the port's six-county hinterland and growth in cement imports. This relationship is based on the assumption that increases in population require increases in infrastructure, such as buildings and roads, which are cement intensive structures. During the years from 2000 to 2006, the six-county population grew at an average annual rate of 2.96% and cement imports at Port Canaveral increased at a rate of 5.73%. BEBR population projections indicate an average annual population increase of 1.45% from 2010 through 2035 for the six-county region. Based on the observed proportional relationship between population growth and cement imports during the years from 2000 through 2006, the projected average annual increase in cement imports for a 1.45% population growth rate would be 2.81% [(1.45%/2.96) * 5.73% = 2.81%].

Note that the cement import tonnage growth assumptions used in this Economics Appendix (no resumption of cement imports at Port Canaveral until 2015 with a subsequent growth rate of 2.8% thereafter) are considerably lower than the cement industry's projections. The impact of alternative cement forecasts on project benefits are assessed in Section 5.6 Risk and Uncertainty.

3.4.1.4 Slag Forecast

Ground granulated blast furnace slag is a by-product of iron and steel production that is an input into concrete production and a substitute for Portland cement. Unground blast furnace slag is the import commodity, which is typically ground at and distributed from marine terminal facilities such as the Hanson plant and terminal at Port Canaveral. The forecast for slag is based on observed 2011 tonnage. The annual growth rate for slag is the same growth rate used for cement. The slag facility at Port Canaveral does not have the consistent historical use, due to ownership changes, that would allow for a separate growth rate to be developed in a manner similar to the cement growth rate.

Fly ash, which is a residual product of coal combustion, is also a substitute for Portland cement and an alternative product to slag. Fly ash and slag compete as low cost replacements for Portland cement in concrete production. The USGS reports[8] that USEPA regulations, which reclassify fly ash as a hazardous waste, will likely result in increased sales and market share of slag as a substitute for fly ash as an input into concrete production. The USGS states that long-term growth in the supply of slag is likely to rely primarily on imports because of environmental restrictions on domestic production[9]. A sensitivity analysis for the slag forecast is presented in Section 5.6 Risk and Uncertainty.

Domestic slag consumption has not fallen as much as domestic cement consumption has fallen during the recent recession. This is because the market share of slag as an input to concrete production has been increasing relative to Portland cement as more concrete design specifications are written to include slag as a component of concrete mix. The net reliance on imported slag, as compared to domestically produced slag, has also increased from 2006 to 2010

[8] U S Geological Survey, Mineral Commodities Summaries, Iron and Steel Slag, January 2011.
[9] US Geological Survey, Mineral Commodities Summary, Iron and Steel Slag, January 2011

from 8% to 10% of domestic consumption. The slag facility at Port Canaveral has an annual capacity of 600,000 tons, which is projected to be achieved in this forecast by 2045. Projected growth for slag is discontinued after 2045. Slag is the only commodity at Port Canaveral that reaches a capacity constraint before the end of the evaluation period.

3.4.1.5 Commodity Forecast Summary

The forecasted commodity tonnages for each of the potentially benefitting commodities are presented in Table 3-3. One important perspective on these forecasts is that they do not include the effects of potential future development at the Port. Because its cruise business has not been negatively affected by the recent economic downturn, the port has had the financial resources to continue to improve and expand its infrastructure even during the recessionary period, increasing its competitiveness relative to other ports for new business once the recessionary period is over. For example, the forecasts do not include any new commodity shipments through North Cargo Berths 5, 6 & 8, which are currently under development by Port Canaveral and should be completed within the next several years. The CPA is aggressively looking for opportunities to increase trade opportunities, such as containerized shipping; and has undeveloped, or under-developed real estate available for future port expansion. Additionally, these forecasts do not attempt to account for any future effects of the Panama Canal Expansion on Port trade.

Table 3-3
Base Case Commodity Forecast – Selected Years (Tons)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2030	2040	2050	2060
Aggregate	400,000	500,000	600,000	700,000	800,000	800,000	800,000	800,000	800,000	800,000	800,000	800,000	800,000	800,000
Cement	---	---	---	---	536,471	551,542	567,036	582,965	599,342	616,178	812,881	1,072,376	1,414,710	1,414,710
Limestone	600,000	720,000	840,000	960,000	1,080,000	960,000	960,000	960,000	960,000	960,000	960,000	960,000	960,000	960,000
Granite	400,000	480,000	560,000	640,000	720,000	640,000	640,000	640,000	640,000	640,000	640,000	640,000	640,000	640,000
Slag	235,856	242,482	249,294	256,297	263,497	270,899	278,509	286,333	294,377	302,646	399,260	526,715	604,973	604,973
Gasoline[1]	874,905	1,278,912	1,775,252	1,785,903	1,796,619	1,807,398	1,818,243	1,829,152	1,840,127	1,851,168	1,965,285	2,086,438	2,215,059	2,351,609
Distillate Fuel[1]	223,429	373,016	435,439	441,535	447,717	453,985	460,341	466,785	473,320	479,947	551,534	633,800	728,336	836,973

Note: 2011 data based on observed FY 2011 tonnage reported by CPA
[1] Includes only Seaport Canaveral point-to-point tonnage

3.4.2 Cargo Fleet Forecast

Channel depths at Port Canaveral will be the same under existing and without-project conditions. Large bulk carriers and tankers are constrained by existing channel depths as described in Section 2.4.3, and will continue to be constrained under without-project conditions. Cargo vessels affected by this constraint include vessels carrying stone products (aggregate, limestone, and granite), cement, slag, and petroleum products.

The vessels of the future without-project fleet are based on the vessels observed at the port in from 2006 through 2009[10], with the exception of Seaport Canaveral Terminal tankers, which are instead based on Seaport Canaveral point-to-point vessels which arrived during August 2010 – July 2011. For the other three commodity groups, the number of future vessel calls for each commodity is based on the projected commodity level divided by the average delivered tonnage per vessel call observed in a detailed analysis of 2006 vessel calls. Future without-project fleet operations at the port are expected to exhibit the same characteristics and patterns that were observed in 2006. For example, cement vessels delivered both full and partial loads in 2006, and are projected to deliver similar sized loads under future without-project conditions. The distribution of cargo to vessels of different sizes is also based on the observed 2006 distribution. For example, granite and limestone vessels were sorted into two categories based on average length overall (LOA) and arrival draft. Based on this categorization, 38% of granite and limestone was delivered on vessels with an average LOA of 597 feet and an arrival draft of 36.0 feet, and 62% was delivered on vessels with an average LOA of 753 feet and an arrival draft of 39.5 feet. These proportions and vessel sizes are used in the without-project condition fleet projections. Table 3-4 presents the projected number of vessel calls for the commodities that could potentially benefit from navigation improvements at Port Canaveral.

Table 3-4
Without-Project Condition Projected Cargo Vessel Calls

	2020	2030	2040	2050	2060
Aggregate	5	5	5	5	5
Cement	10	14	20	26	35
Limestone	16	16	16	16	16
Granite	16	16	16	16	16
Slag	7	9	12	14	14
Gasoline[1]	44	47	50	53	56
Distillate Fuel[1]	11	13	15	17	20

[1] Includes only Seaport Canaveral point-to-point vessels

[10] The 2010 and 2011 operating characteristics of these vessels has not changed since the period of detailed analysis

3.4.3 Projected Cruise Ship Operations

The overall industry demand for cruise ship services is projected to continue to exhibit strong growth in the near-term. Of the 30 new cruise ships currently scheduled for delivery into the North American fleet between 2008 and 2012, 16 are destined for service in the Caribbean, and 8 are slated for world-wide service. All but three of these new vessels are larger than 110,000 gross registered tons with passenger capacities of approximately 2,500 or more. The largest new vessel classes, RCI's Freedom Class, RCI's Oasis Class, the two new Disney vessels, and the Norwegian Cruise Lines Epic (previously Project F3) Class, all have vessels scheduled to be deployed in Caribbean service, as does Carnival's new Dream Class vessels, which are similar in size to RCI's Voyager Class.

The demand for cruise ship services at Port Canaveral is projected to remain strong. The consistently high cruise ship utilization levels at Port Canaveral (Table 2-21) have not been reduced during the recent economic downturn. Discussions with port personnel indicate that cruise lines are marketing their cruise packages as a relatively low cost family vacation and that more passengers are driving to the port in order to reduce total vacation costs. The most recent cruise ship utilization data available for the port indicates that overall multi-day cruise ship utilization levels for 2010 and the first half of 2011 are relatively unchanged from utilization levels during 2005 through 2009.

Cruise ship operations at Port Canaveral under without-project conditions will be very similar to operations under existing conditions, which includes the interim channel modifications that allow temporary use of the channel by the *Freedom of the Seas*. As of January 2011, Port Canaveral is the home port for three new vessels: RCI's *Freedom of the Seas*, the *Disney Dream* and Carnival Cruise Line's *Carnival Dream* (Table 2-15). In spring 2012, a second new Disney vessel, *Disney Fantasy,* will be homeported at Port Canaveral and the last of the smaller Disney vessels currently homeported at Port Canaveral will be re-deployed.

The *Freedom of the Seas* is the largest cruise ship projected to use Canaveral Harbor's Federal channel system in the near-term (Table 3-5). Under without-project conditions, regularly scheduled use of Port Canaveral by the *Freedom of the Seas* is projected to be restricted by wind conditions. The Port Canaveral Pilots consider the Freedom Class vessels to be too large for regularly scheduled unassisted passage through Port Canaveral's existing channels, based on the vessel's length and effective beam under normal high wind conditions. The Interim Corner Cutoff (ICCO) modification to the West Turning Basin was conducted to provide a temporary solution to allow these vessels to call at the Port until a permanent improvement to the navigation project can be implemented. Until that time, the Freedom Class vessels exceed design constraints of the Federal navigation channel and will continue to require tug assist under normal high wind conditions.

The new Disney cruise ships are narrower, but longer than the Freedom Class vessels. The Port Canaveral Pilots project that these vessels will be operated under more restrictive wind condition criteria than the current Disney fleet because, although they are larger than the existing Disney vessels, they will have traditional propulsion equipment. The new Disney vessels also are projected to require tug assist under normal high wind conditions. The new Norwegian F3 Class vessel, *Epic*, is also projected to use Port Canaveral as a port of call.

RCI has been in contact with the CPA concerning Oasis Class vessels using Port Canaveral as a potential port of call and as a port of refuge during emergency conditions. Under without-project conditions, including interim channel modifications, Oasis Class vessels are too large to operate in Canaveral Harbor's Federal channels on a regularly scheduled basis. Simulation-based evaluations conducted for the Oasis Class indicate an Oasis Class vessel could potentially operate in Port Canaveral in a limited fashion under with-project conditions, however; Oasis Class vessels are not projected to use Port Canaveral and the benefits calculations do not include any benefits related to Oasis Class vessels.

Table 3-5
Present and Future Large Cruise Ships and Classes

Cruise Ship or Class	Design Draft (ft)	Length Overall (ft)	Beam at Waterline (ft)	Disp. At Design Draft (m. tons)	Side Wind Sail Area	GRT
Disney *Dream & Fantasy* Homeport 2011 & 2012	27	1,115	121	62,414	132,181	128,000
CCL *Dream* Homeport 2009	27	1,004	122	58,262	126,404	130,000
RCI Voyager Class Homeport 2003 - 2009	28	1,021	127	62,716	119,523	138,000
NCL *Epic* Port of Call	29	1,081	133	73,761	144,959	150,000
Cunard *Queen Mary 2* Potential Port of Call	33	1,131	135	79,827	139,716	150,000
RCI *Freedom of the Seas* Homeport 2009	28	1,112	127	71,019	140,092	158,000
RCI Oasis Class Potential Port of Call	30	1,187	154	106,000	168,664	220,000

With the exception of Miami and Port Everglades, other Florida ports have structural constraints that preclude calls by these new larger cruise vessels. New, larger cruise ships have air drafts in excess of 200 feet. Freedom Class vessels have an air draft of 210 feet, as do Voyager Class vessels. Oasis Class vessels have an air draft of 230 feet. Cruise ship activity at the ports of Tampa and Jacksonville are constrained by bridge heights:

- Tampa: Sunshine Skyway Bridge 175 feet vertical clearance (Tampa Bay Pilots Port Guide 2004); and
- Jacksonville: Dames Point Bridge 169 feet vertical clearance (St. Johns Bar Pilots Association).

Other alternative ports for embarkation to Caribbean cruise destinations include Charleston, SC, Galveston, TX and San Juan, PR. However, each of these ports has constraints which would not allow them to homeport the largest new cruise ships. Charleston is limited by berth space availability. The largest cruise ships cannot fit into Charleston's limited berth space (300 linear feet plus 150 feet provided by a mooring dolphin), although adjacent cargo berth space is occasionally used. Galveston's passenger volumes have shown strong growth up to 2006 (620,000 passengers) but have dropped off to 440,000 passengers in 2010 and are approximately ine-third of Port Canaveral's levels. Continued strong passenger growth at Galveston is constrained by berth availability: only 2 cruise ship berths comprising 2,000 linear feet. San Juan is a limited alternative because of significantly higher air travel costs.

4 Problems Addressed by the Economic Analysis

Five major problems have been identified based on the analysis of existing and without-project conditions at Port Canaveral. These problems are summarized below and discussed in the following paragraphs. The five major problems are:

1. Channel and turning basin dimensions at Port Canaveral limit the size of cruise ships that are able to call at the Port and impact large cruise ship operations within the Port.
2. Channel dimensions and depths at Port Canaveral limit the size and efficient utilization and movement of cargo vessels that call at the Port.
3. Surges occur at cargo piers due to the passage of large cruise ships through the narrow ship channel. Surge effects can cause damages to vessels, such as parted lines and minor connection damage, personnel injuries, and result in cargo ships having to stop loading and unloading activities while the cruise ships pass. Surges due to cruise ship passage may also require the use of tugs to hold vessels alongside cargo piers. Surge effects are increased when cruise ships speed up to maintain steerage during high winds.
4. Congestion at cargo berths is expected (future without project conditions) to result in vessel delays and additional transportation costs.
5. Channel and turning basin dimensions are restricting the port’s ability to develop new cargo and cruise terminals needed to accommodate growing demand and larger vessels.

4.1 Cruise Ship Size Limitations

Current and future cruise ships calling and expected to call at Port Canaveral are constrained by channel widths and the dimensions of the West Turning Basin.

4.1.1 Channel Widths

The existing channels and turning basins were sized for much smaller vessels than are currently calling at Port Canaveral. The navigation project improvements authorized in 1992 (WRDA 1992) and completed in 1995 justified widening and deepening the project to its current dimensions based on a composite design vessel (a 67,000 Dead Weight Tonnage (DWT) tanker and a 45,000 DWT bulk cement carrier) with an average length of 750 feet, a beam of 100 feet, and maximum draft of 40 feet. Cruise ships calling at the Port at that time were not large enough to be constrained by channel dimensions.

Since the time of the 1992 authorization, the cruise ships calling at Port Canaveral have increased substantially in Gross Registered Tonnage (GRT), length, beam, draft, and passenger capacity. As the third busiest cruise port in the world, in terms of number of passengers, serving the world’s largest cruise destination (the Caribbean), Port Canaveral attracts among the largest cruise vessels currently afloat.

The largest cruise vessel currently homeported at Port Canaveral is the Royal Caribbean International (RCI) Freedom Class vessel, *Freedom of the Seas*. The *Freedom of the Seas* has the following dimensions: 160,000 GRT; length 1,112 feet; beam 127 feet; draft 28 feet; and passenger capacity 3,634. This vessel replaced the *Mariner of the Seas* at Port Canaveral, a Voyager Class 138,000 GRT vessel, with a length of 1,020 feet, a beam of 127 feet (at the waterline), a draft of 29 feet, and a capacity of 3,114 passengers.

There are currently two Freedom Class vessels in the RCI fleet, *Liberty of the Seas* and *Freedom of the Seas*. The *Liberty of the Seas* is currently homeported in Miami.

The *Mariner of the Seas,* the smaller Voyager Class vessel that was at the time the largest cruise ship at Port Canaveral, had difficulty during adverse weather conditions navigating the current 400 foot wide channel, maneuvering the channel bends, and operating within the 1,400 foot turning circle in the West Turning Basin. Given its larger size (nearly 100 feet longer), the Freedom Class *Freedom of the Seas* faces even greater difficulties. The wind and wave climate at Canaveral Harbor influence the transit conditions for cruise vessel traffic (Engineering Appendix: section 1.3 Site Environmental Conditions). The wind, in particular, influences cruise ship transits due to the very large freeboard area of these vessels. Safe navigation inside the harbor requires a balance between vessel speed and good ship handling capability to manage the yaw of the vessel or "crab angle" as it moves through the waterway under the influence of moderate to high wind conditions.

A vessel's "crab angle" is defined as the difference between the ship heading and the actual course made good, sometimes also called the "drift angle". Cruise ships transiting the channels at Port Canaveral are susceptible to "crabbing" because their large superstructure acts as a sail in the wind and moderate speeds must be maintained to avoid surge impacts on moored vessels and to maintain control of the vessel. The wider the "crab angle", the larger the effective beam of the vessel.

The newest, largest cruise ships operating at Port Canaveral are designed with propulsion systems intended to allow them to transit ports without tug assists. However, under high wind conditions and considering the narrow channels and turns at Port Canaveral, these vessels sometimes require tug assist to conduct channel transits under extremely high wind conditions. In addition, during cruise ship transits under high wind conditions, tug assist is required for moored vessels to counter the surge effect and keep the moored vessel alongside the pier when cruise ships increase speed to minimize "crab angle".

4.1.2 Turning Basins

As previously stated, the dimensions of the West Turning Basin (WTB) are inadequate for existing vessels homeported at Port Canaveral and cannot safely accommodate future cruise ships projected to call at Port Canaveral. The WTB is currently 1,400 feet in diameter, Federally authorized to -31 feet, and maintained at -35 feet by CPA. Corps design guidelines for turning basins are contained in EM 1110-2-1613 (excerpt below).

> *9-2. <u>Turning Basins</u>. c. Size. (1) The size of the turning basin should provide a minimum turning diameter of at least 1.2 times the length of the design ship where prevailing currents are 0.5 knot or less. Recent ERDC/WES simulator studies have shown that turning basins should provide minimum turning diameters of 1.5 times the length of the design setup where tidal currents are less than 1.5 knots. The turning basin should be elongated along the prevailing current direction when currents are greater than 1.5 knots and designed according to tests conducted on a ship simulator.* ***Turning operations with*** tankers in ballast condition or ***other ships with high sail areas***

and design wind speeds of greater than 25 knots will require a special design study using a ship simulator *[emphasis added]*.

The WTB diameter is considered by the Pilots to be inadequate for the Freedom Class vessels (1.26 times vessel LOA). The minimum acceptable WTB diameter for the Freedom Class vessel, as determined in STAR Center simulations conducted on the *Freedom of the Seas* in 2009, was 1,675 feet. The design cruise ship *(Freedom of the Seas)* is well powered and highly maneuverable. However, the wind sail area of these classes of ultra-large cruise ships is extremely significant and results in large applied forces in the moderate to high (30 knot) design winds experienced at Port Canaveral. Therefore, in consideration of safety and vessel operations under high wind conditions, the minimum effective WTB diameter is 1,725 feet (1.55 times LOA).

The West Turning Basin is federally authorized to -31 feet and maintained at -35 feet by CPA. The authorized depth of -31 feet was justified based on the maximum operating draft of the smaller cargo and cruise vessels using the West Turning Basin at the time of the 1992 authorization. The Voyager, Freedom and Disney cruise ships have operating drafts of 28 to 30 feet and cannot use tidal advantage because of their rigid sailing schedules. In addition, the azimuth steering equipment of these ultra-large modern cruise ships, which allow them to navigate into ports without tug assist under normal weather conditions, also require a significant amount of clearance (typically 1-2 meters) between the vessel and channel bottom in order to function correctly. For these reasons, the authorized depth of -31 feet is not considered adequate for safe navigation of the current cruise ship fleet, which is why CPA currently maintains the WTB to -35 feet. The minimum required depth in the WTB is now considered to be -35 feet and the incremental maintenance costs to maintain the WTB to this depth is included in all with project condition alternatives.

4.2 Cargo Vessel Size Limitations

Current and future cargo vessels calling at Port Canaveral are constrained by channel and turning basin depths.

As stated in the last section, the existing channels and turning basins were sized for smaller cargo vessels than those currently calling at Port Canaveral. The design vessel used for the previous deepening and widening project was a composite design vessel (a 67,000 DWT tanker and a 45,000 DWT bulk cement carrier) with an average length of 750 feet, a beam of 100 feet, and maximum operating draft of 40 feet.

The largest cargo vessels currently calling at Port Canaveral (and those projected to call in the without-project condition), are vessels carrying stone products, slag, cement, and petroleum products. Table 4-1 presents the largest vessels which called at Port Canaveral in 2006. The two dry bulk vessels, the *Gdynia* (65,738 DWT, 738' LOA, 105.6' beam, 42.4' design draft) and the *Bernardo Quintana A* (67,044 DWT, 753' LOA, 105.6' beam, 43.3' design draft) each arrived at Port Canaveral depth limited, with a 39.5-foot operating draft. The only other vessel to arrive with a 39.5-foot operating draft in 2006 was the tanker *Falcon* (dimensions unknown), which delivered power plant fuel oil.

Table 4-1
Largest Cargo Vessels to Call at Port Canaveral in 2006

Ship	Maximum Draft (ft)	Length Overall (ft)	Beam at Waterline (ft)	Deadweight Tonnage (m. tons)
Gdynia (Dry Bulk-Aggregate)	42.4	738	105.6	65,738
Bernardo Quintana A (Dry Bulk-Limestone)	43.3	753	105.6	67,044
Bregen (Liquid Bulk-Gasoline)	44.7	797	105.6	68,159

The tanker, *Bregen* (68,159 DWT, 797’ LOA, 105.6’ beam, 44.7’ design draft), delivered fuel oil to Transmontaigne (formerly Coastal Fuels), arriving with only a 26-foot sailing draft. Vessels delivering fuel oil to Transmontaigne often arrive at drafts less than the port’s operating maximum draft and also less than the vessel’s maximum operating draft. The reason these vessels arrive less than fully loaded is that Port Canaveral is one of several ports of call for these vessels and they often arrive at Port Canaveral partially offloaded after already having delivered fuel oil to other east coast ports during their in-bound voyage.

Under without-project conditions, the commodities projected to demonstrate the most growth, with the exception of lumber, are the same commodities which use the largest cargo vessels calling at the port: i.e., stone products, cement, slag, and petroleum products (see Section 3.4.2). Bulk vessels carrying these commodities to Port Canaveral generally range in size from 60,000 Dead Weight Tons (DWT) to 80,000 DWT. A statistical description of dimensions for vessels ranging from 60,000 DWT and 100,000 DWT is presented in Table 4-2. Tankers currently calling at Seaport Canaveral Terminal are generally in the same dead weight tonnage class as dry bulk carriers; however, Seaport Canaveral is capable of servicing much larger vessels with sizes up to 100,000 DWT or more. A statistical analysis of vessel dimensions in the appropriate DWT range, as opposed to the dimensions of a specific vessel, is presented because, based on the historic record of cargo vessel calls at the Port, no single specific large bulk vessel is likely to make regular repeated calls at Port Canaveral. A discussion of the characteristics of the world fleet in the appropriate DWT range is a better representation of the characteristics of vessels that are likely to use the Port under future without and with project conditions.

Table 4-2
Characteristics of Cargo Vessels from the World Fleet Currently Using and Projected to Use Port Canaveral

CATEGORY	Statistic Dimension	Maximum Draft (ft)	Length Overall (ft)	Beam at Waterline (ft)
60,000 to 70,000 DWT BULK CARRIER (464 vessels)	Maximum	45.8	834	125
	Minimum	32.7	679	104
	Average	42.7	742	106
	90th Percentile	43.7	751	106
70,001 to 80,000 DWT BULK CARRIER (925 vessels)	Maximum	48.8	837	121
	Minimum	37.2	713	105
	Average	45.5	742	106
	90th Percentile	46.8	750	106
80,001 to 100,000 DWT BULK CARRIER (213 vessels)	Maximum	49.3	850	141
	Minimum	37.7	689	106
	Average	45.1	761	118
	90th Percentile	47.3	798	141
60,000 to 70,000 DWT OIL PRODUCTS CARRIER (175 vessels)	Maximum	46.2	800	131
	Minimum	36.5	600	105
	Average	42.7	739	108
	90th Percentile	44.7	791	118
70,001 to 80,000 DWT OIL PRODUCTS CARRIER (244 vessels)	Maximum	49.3	810	138
	Minimum	37.6	700	105
	Average	45.0	749	107
	90th Percentile	47.6	750	106
80,001 to 100,000 DWT OIL PRODUCTS CARRIER (293 vessels)	Maximum	52.8	894	158
	Minimum	38	691	106
	Average	45	792	134.5
	90th Percentile	48.8	814	141

The maximum operational draft allowed at Port Canaveral, as stated in the *Port Canaveral Operational Guidelines*, is currently 39.5 feet. Vessels arriving with an operating draft of 39.5 feet must time their arrival at the port with high water. Vessels arriving with operational drafts greater than 36 feet must arrive with a rising tide. The effects of channel depth constraints on cargo vessels at Port Canaveral were presented previously in Sections 2.4.2 and 2.4.3. These sections show that large cargo vessels typically arrive at the port with operating drafts just less than the 36-foot restriction on unconstrained operations imposed by the port's operational guidelines.

Projected operating drafts for the future large cargo vessel fleet calling at Port Canaveral are expected to be depth constrained in the same manner as under existing conditions, including point-to-point petroleum product vessels calling at the Seaport Canaveral fuel terminal. The point-to-point vessels calling at Seaport Canaveral Terminal are projected to avoid the need for tidal advantage in the same manner as observed under existing conditions. The tug/barges and multi-port delivery vessels arriving at Seaport Canaveral Terminal do not require tidal advantage and are not anticipated to benefit from any project improvements.

Large cargo vessels in the fleet currently calling at the Port and projected to use the Port in the future without-project condition cannot load to their most efficient potential due to channel depth constraints. As shown in Table 4-2, the design drafts of the majority of these vessels are in excess of the channel constraint and the vessels could be filled more deeply if not for the Port's channel restrictions. Because of the 39.5 foot channel restriction, these vessels must lightload in order to transit the navigation channel. Channel depth constraints directly impact Port Canaveral cargo terminal operators and carriers. Port Canaveral's cargo terminal facilities are capable of handling larger vessel loads for each of the following impacted commodities: stone products, cement, slag, and petroleum products. The channel depth constraint reduces the effectiveness and efficiency of cargo terminal operations by restricting the size of individual vessel loads, which causes equipment to be under-utilized. Carriers are similarly operating at less than optimum efficiency when vessels are light-loaded and more trips are required to deliver the same quantity of cargo.

4.3 Surge Effects

Under existing and without-project conditions, cruise ships transiting the channel generate water surges due to the speeds required to maintain headway and reduce crab angles during high winds to provide safe bank clearance in the existing 400 foot wide channel. These surges result from the piston-effect of the large cruise ships transiting the narrow channel, which pushes water into (and then pulls water out of) the Trident Basin and Middle Turning Basin and also pulls vessels away from the multi-use berths adjacent to the channel, primarily at NCP 1 & 2, NCP 3 & 4 and CT3[11]. A hydrodynamic surge study was conducted for this investigation and preliminary results are contained in the Engineering Appendix. Ship passage induced surges have caused damage to cargo and naval vessels, damage to connecting equipment, and have also resulted in several injuries. The port's standard operating procedures include distribution of a Surge Warning Letter to all port users, which recommends appropriate attention to mooring lines and cessation of

[11] Passing ship forces on vessels moored parallel to the channel and perpendicular to the channel are discussed in greater detail in the Engineering Appendix.

loading and unloading activities during cruise ship passage under moderate and more severe wind conditions.

Surge effects directly impact port tenants who must stop loading and unloading activities during cruise ship transits. Cessation of loading and unloading activities causes inefficiencies at the dock and adds to the total time that the vessel must spend in port. Surge effects may be offset by the placement of a tug, which helps hold the vessel against the dock as the cruise ship passes through the channel. Under historical conditions, prior to the new larger cruise ships currently homeported at Port Canaveral and prior to operations at Seaport Canaveral, the use of an assisting tug to offset surge forces has occurred, although infrequently. Under existing and future without-project conditions, which include the substantially larger cruise ships and tankers moored at the vulnerable piers NCP 1 & 2, tug assist is projected to occur more frequently.

4.4 Future Berth Congestion

Berth congestion resulting in vessel delays may become a problem in the future without-project condition. Port facilities are already highly utilized and under without-project conditions will become increasingly congested. The mid-range commodity growth scenario predicts berth usage as high as 80% for the north cargo berths shared by Seaport Canaveral tankers, salt, slag, and lumber products. The frequency and duration of tanker calls at NCP 1 and 2 will likely cause some traffic to shift to other berths as available. South cargo berths are currently shared by petroleum products, stone products, cement, perishable items, newsprint and lumber. Congestion at cargo berths reduces the effectiveness and efficiency of cargo vessels and landside facilities. Vessel delays due to berth congestion have historically occurred sporadically at the multi-purpose berths along the south cargo piers. Projected growth in commodity movements at Port Canaveral will result in a larger number of cargo vessels that will have to wait offshore for a berth to become available.

4.5 Limitations on New Cargo and Cruise Terminals

Channel and turning basin dimensions are restricting the port’s ability to develop new cargo and cruise terminals needed to accommodate growing demand. Because existing large vessels are operating at or above channel design dimensions, there is little or no opportunity to develop new berths and terminals to accommodate future growth in cargo and cruise services. Given the current levels of growth, the Port will need to develop new landside facilities and infrastructure to keep pace with demand. However, inadequately sized channels and turning basins are already beginning to impinge on vessel handling facilities which lie immediately adjacent to the navigation channel and turning basins. Absent expansion of the channels and turning basins, there are limited opportunities to develop new facilities.

5 Alternative Plan Evaluation

Detailed alternative plan evaluation was prepared in accordance with Corps’ guidance on formulation and evaluation of deep draft navigation projects as described in:

- The Planning Guidance Notebook, ER 1105-2-100 (22 April 2000)
- National Economic Development Procedures Manual: Deep Draft Navigation, IWR Report 91-R-13 (Nov 1991)

- Digest of Water Resource Policy and Authorities, EP 1165-2-1 (30 July 99)
- Planning Guidance Letter #97-06, Cruise Ships and Benefits to Navigation (07 Jul 97).

5.1 Detailed Alternative Plan Description

5.1.1 Without-Project Condition Channel Description

The without-project condition includes continuation of the CPA dredging and maintenance of areas outside the current federally authorized channel. These CPA actions include:

- Maintenance of the West Turning Basin to a depth of -35;
- Spot dredging outside of the federally authorized channel in areas recommended by the Canaveral Pilots; and
- Maintenance of the area in the West Turning Basin outside of the federally authorized channel, which the CPA opened to navigation by constructing the Interim Corner Cut Off.

5.1.2 Alternative With-Project Condition Channel Descriptions

The alternative with-project conditions carried forward for detailed economic analysis include:

- Channel widening in two 50-foot increments from 400 to 500 feet: Widening Plan 1 (450 feet) and Widening Plan 2 (500 feet). Both channel widening alternatives extend from the sea to the West Turning Basin and include placement of an outbound range as an aid to navigation, repositioning of the existing inbound range, and extending an existing turn widener at the entrance from the sea; and
- Channel deepening from the sea to the West Access Channel and Middle Turning Basin, in three increments. The name of each increment is based on the channel depth at the Inner Reach, which is the first reach from the sea that is not affected by wave action (Table 5-1). The without-project depth of the Inner reach is -40 feet. The first increment is a two-foot increment (Deepening Plan 1; -42 feet) and each successive increment is a one-foot increment (Deepening Plan 2; -43 feet and Deepening Plan 3; -44 feet). Each depth increment includes any necessary associated berth deepening (non-federal responsibility).

The Canaveral Port Authority is not interested in partnering in a project deeper than the -44-foot plan (Deepening Plan 3) at this time, due to high associated costs (port infrastructure upgrades) which would be required by channel depths deeper than the -44-foot plan. Likewise, CPA is not interested in any widening alternatives greater than 500 feet (Widening Plan 2) because they would involve extensive and extremely expensive relocation and reconstruction of berthing facilities at the South Cargo Piers, as well as at NCP 1 & 2.

5.1.3 Identification of Alternative Plan Increments

The formulation of alternative plans addressed channel widening and channel deepening as separable elements subject to incremental analysis. Each is discussed separately below.

5.1.3.1 Channel Widening Plans

Widening Plans 1 and 2, which are independent of any alternative to deepen channels below existing project depths, include the following components:

- Turn Widener:
    - Widening Plan 1 dimensions are -41' project depth X 22.14 acres (irregular shaped area) bounded to the north and northeast by the civil turn widener and Cut 1 of the outer reach;
    - Widening Plan 2 would provide dimensions of -41' project depth X 11.14 acres (irregular shaped area) bounded to the north and northeast by the civil turn widener and Cut 1 of the outer reach
- Middle Reach: The middle reach extends from the apex of the channel turn westward to the western boundary of the Trident Access Channel. Existing dimensions are -44' project depth X 400' wide X 5,658' long.
    - Widening Plan 1 would increase the project width from 400' to 450', providing a 50' widener of 2,282' in length along the north side of the channel for the portion of the middle reach that is inside of the north jetty. The eastern terminus of the 50' widener transitions from the existing to the new northern channel boundary over a plan distance of 500'
    - Widening Plan 2 would increase the project width to 500', providing a 100' widener of 2,282' in length along the north side of the channel for the portion of the middle reach that is inside of the north jetty. The eastern terminus of the 100' widener transitions from the existing to the new northern channel boundary over a plan distance of 500';
- Trident Access Channel: At the southern boundary of the existing Trident Access channel,
    - Widening Plan 1 will overlay 50' of the Trident Access Channel
    - Widening Plan 2 will overlay a total of 100' of the Trident Access Channel;
- Inner Reach, Cut 2 and Cut 3: Existing dimensions are -40' project depth X 400' wide X 3,344' long.
    - Widening Plan 1 would provide a 50' widener along the entire length of the reach on the north side of the channel. The rip-rap protected shoreline and berm between the Middle and Trident Basins will be relocated northward to accommodate the 50' north side channel widener
    - Widening Plan 2 would increase the project width to 500', providing a 100' widener along the entire length of the reach on the north side of the channel. The rip-rap protected shoreline and berm between the Middle and Trident Basins will be relocated northward to accommodate the 100' north side channel widener
- West Access Channel (east of Station 260+00): Existing dimensions are -39' project depth X 400' wide X 1,840' long.

- Widening Plan 1 provides 50' of widening along the entire length of the channel by redefining the northern channel boundary 12' north of the existing northern boundary, and widening the channel by 38' along the south side and into the barge canal
- Widening Plan 2 would increase the project width to 500', providing 100' of widening along the entire length of the channel by redefining the northern channel boundary 12' north of the existing northern boundary, and widening the channel by 88' along the south side and into the barge canal

- West Turning Basin and West Access Channel, Cut A (west of Station 260+00): The existing federally authorized turning basin and Cut A of the west access channel take up 78.6 acres with a federally authorized project depth of -31' and a current depth of -35' as maintained by the CPA. The existing federal project basin provides a turning circle diameter of 1,400'. Since the mid-1980's and as recently as 2003, the CPA also maintains additional areas adjacent to the northeast shoreline at the entrance to the West Turning Basin to -35' at the request of the pilots for cruise ship navigation access. In 2009, in order to be able to homeport RCI's *Freedom of the Seas*, CPA executed the Interim Corner Cut Off (ICCO) new work dredging in advance of project authorization, shifting the -35' CPA maintained dredge boundary further to the northeast. As of 2009, the CPA maintains a depth of -35' at 18.5 acres of navigation area that lie beyond the existing federal project limits at the entrance to West Basin. The ICCO was intended to be an interim measure for cruise navigation, not anticipated to support access in the full range of conditions encountered at Port Canaveral. The construction costs of the ICCO are not included as project costs in this analysis, as this project element was completed in advance of project authorization and cost sharing agreement. It is the CPA's intention to request that project authorization specifies that this in-kind construction work be credited against the sponsor's share of total project costs. Therefore, for the purposes of this decision document, the ICCO is included as part of the without-project condition in both widening and deepening plan evaluations.
  - Channel Widening Plans 1 and 2 include identical expansion of the federal project limits in the northern and western portions of the West Turning Basin to enlarge the entrance to the west basin providing a turning circle diameter of 1725'. The turning circle and entrance widening will be created by dredging beyond the present federal and CPA project boundaries to the northeast and to the south within the barge canal. Approximately 18.5 acres of existing bank, shoreline, and uplands adjacent to the CPA -35' project boundary and 6.9 acres within the existing barge canal will be dredged to the currently maintained depth of -35'.

5.1.3.2 Channel Deepening Plans

Channel deepening increments are identified in a manner typical of Corps deep draft navigation feasibility studies, i.e., the first increment of deepening evaluated is a two-foot increment and successive increments are one-foot in depth. Existing channel depths and potential with-project depths vary among the multiple sections of the channel from the entrance-from-the-sea to each of the turning basins. Essentially, the Port Canaveral project is a stepped channel, deepest at the ocean entrance and becoming progressively shallower as it moves inland. The design vessel used in the alternatives analysis of channel depths is an Aframax Tanker displacing 94,000 tons partially loaded with an operational draft in Port Canaveral of 39.5 feet, which is the projected maximum unrestricted operational draft allowed in Port Canaveral. The design analysis assumes vessel transit at 0.0 MLLW tide height.

Water depth requirements in channel sections vary based on vessel speed, wave motions, and safety clearance (Engineering Appendix: section 1.0 Engineering Design). The water depths required in any section of the channel is the sum of wave motion, squat, and safety clearance. The derivation of the 2.5-foot safety clearance is based on the actual practice of the Port Canaveral Pilots Association, which has established a minimum under keel clearance requirement of 2.5 ft for all ships underway, in all channel reaches and basins, and for all stages of the tide (MLLW to MHHW). This is similar to the USACE design guidance that suggests a safety clearance of at least 2 ft between the bottom of the ship and the design channel bottom. The pilots require at least 6 inches of clearance under the keel at berth for all tides and stages of unloading or loading operations.

In order to achieve the 2.5-foot safety clearance during typical vessel operations, the impacts of vessel squat and wave motion must be taken into consideration. Adequate clearance in the innermost channel section (the West Access Channel) which is well within the harbor and therefore has less squat and wave motion, requires that the channel be 3.5 feet deeper than the 39.5-foot sailing draft of the design vessel. As the channel progresses towards the open ocean, channel depth requirements increase because the effects of squat and wave action are greater. At the Outer Reach of the Entrance Channel, which is the closest to the open ocean, the 39.5-foot design vessel sailing draft requires that the channel be 6.6 feet deeper than the vessel's sailing draft to provide adequate safety clearance during typical operations. Future vessels calling at Port Canaveral may arrive at operating drafts greater than 39.5 feet under advantageous tide conditions.

Table 5-1 presents the design depth requirements for large cargo vessels arriving at Port Canaveral with an unrestricted operating draft of 39.5 feet. Figures 5-1 through 5-3 present drawings of the two widening alternatives used in the ship simulations. Note that the plan naming convention used for the ship simulation analysis is slightly different than the naming convention used throughout this Economics Appendix. The Widening 1 plan, which is a 450-foot channel, is identified in the simulation modeling as Plan B. The Widening 2 plan, which is a 500-foot channel, is identified as Plan A. The channel depths and widths associated with each alternative plan are presented in Table 5-2. Note that the Port Canaveral terminal facilities are in the Middle Turning Basin, West Access Channel, and West Turning Basin.

Table 5-1
Channel Depth Design Requirements (feet below MLLW)

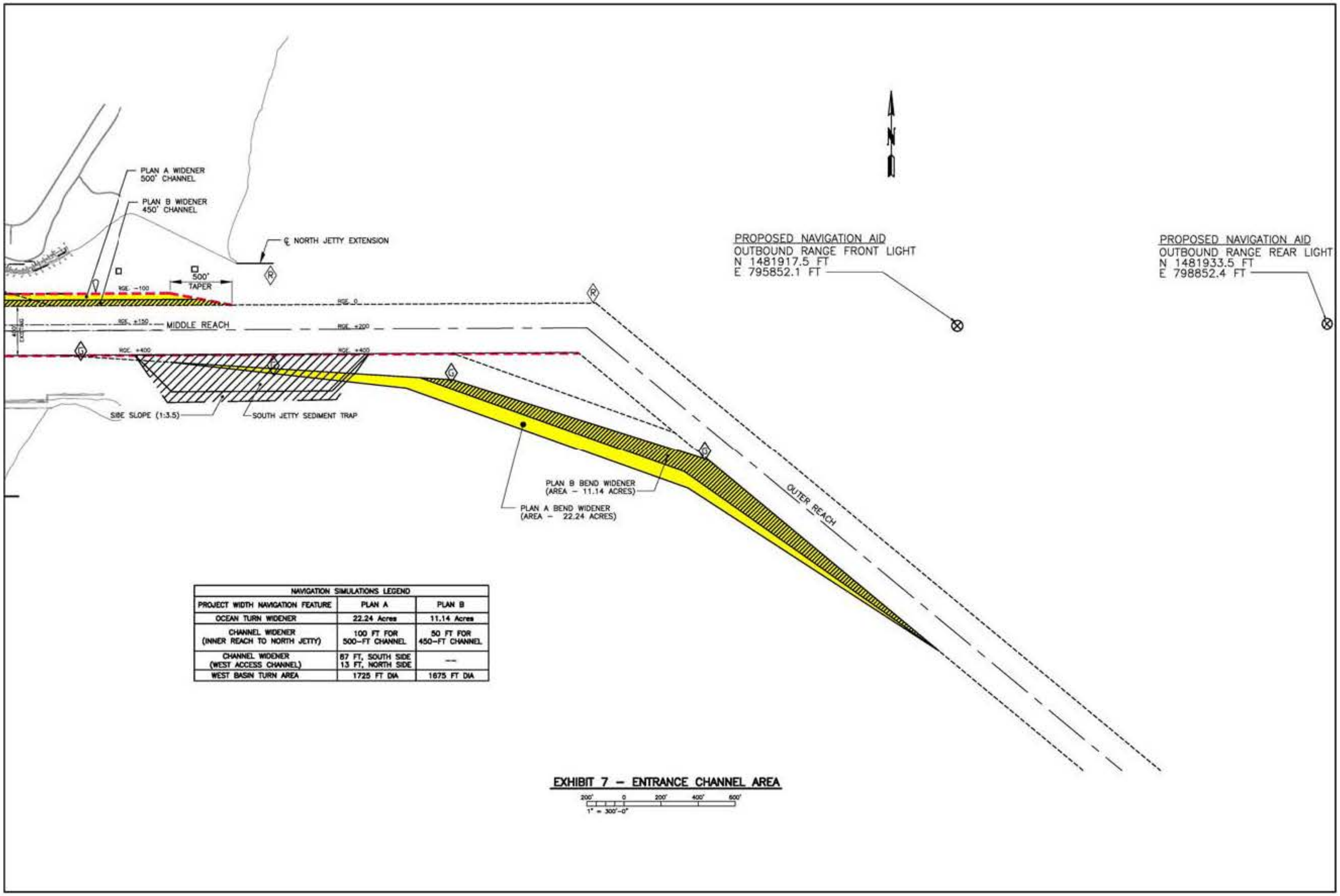
Parameter	WAC	MTB	INNER CHANNEL		ENTRANCE CHANNEL				
			INNER REACH		MIDDLE REACH		OUTER REACH		
	NCP3/4 Sta 255+00	NOTU/SCP2 Sta 215+00	Cut 2 (CT3) Sta 200+00	Cut 2 (TTB) Sta 185+00	Cut 2 (Jetties) Sta 165+00	Cut 2 (Jetties) Sta 150+00	Cut 1 Sta 85+00	Cut 1 (B7/8) Sta 55+00	Cut 1A/1B
Vessel Speed (knots)	4.5	5	6	7	7	8	8	9	10
Draft (ft)	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5
Salinity & Temp Corr (ft)	--	--	--	--	--	--	--	--	--
Wave Motions (ft)	--	--	--	--	1.4	1.4	1.4	1.4	1.4
Squat (ft)	1.0	1.3	1.7	2.0	2.0	2.5	2.0	2.2	2.7
Safety Clearance (ft)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total Required Water Depth (ft)	43	43.3	43.7	44	45.4	45.9	45.4	45.6	46.1
Existing Authorized Depth (ft)	39	39	40	44	44	44	44	44	44
Proposed Project Depth (ft, MLLW)	43	43	44	44	46	46	46	46	46

Table 5-2
Alternative Plan Channel Depths and Widths (feet below MLLW)

	Existing Authorized Depth	Deepen Plan 1	Deepen Plan2	Deepen Plan3
Outer Reach	41	44	45	46
Middle Reach	41	44	45	46
Inner Reach	40	42	43	44
Middle Turning Basin	39	41	42	43
West Access Channel	39	41	42	43
West Turning Basin	31*	35	35	35
	Existing Authorized Width		**Widen Plan 1**	**Widen Plan 2**
Channel Width	400 feet		450 feet	500 feet

*Maintained by CPA to 35

Figure 5-1
Alternative Plans: Sheet 1



NAVIGATION SIMULATIONS LEGEND		
PROJECT WIDTH NAVIGATION FEATURE	PLAN A	PLAN B
OCEAN TURN WIDENER	22.24 Acres	11.14 Acres
CHANNEL WIDENER (INNER REACH TO NORTH JETTY)	100 FT FOR 500-FT CHANNEL	50 FT FOR 450-FT CHANNEL
CHANNEL WIDENER (WEST ACCESS CHANNEL)	87 FT, SOUTH SIDE 13 FT, NORTH SIDE	—
WEST BASIN TURN AREA	1725 FT DIA	1675 FT DIA

Figure 5-2
Alternative Plans: Sheet 2

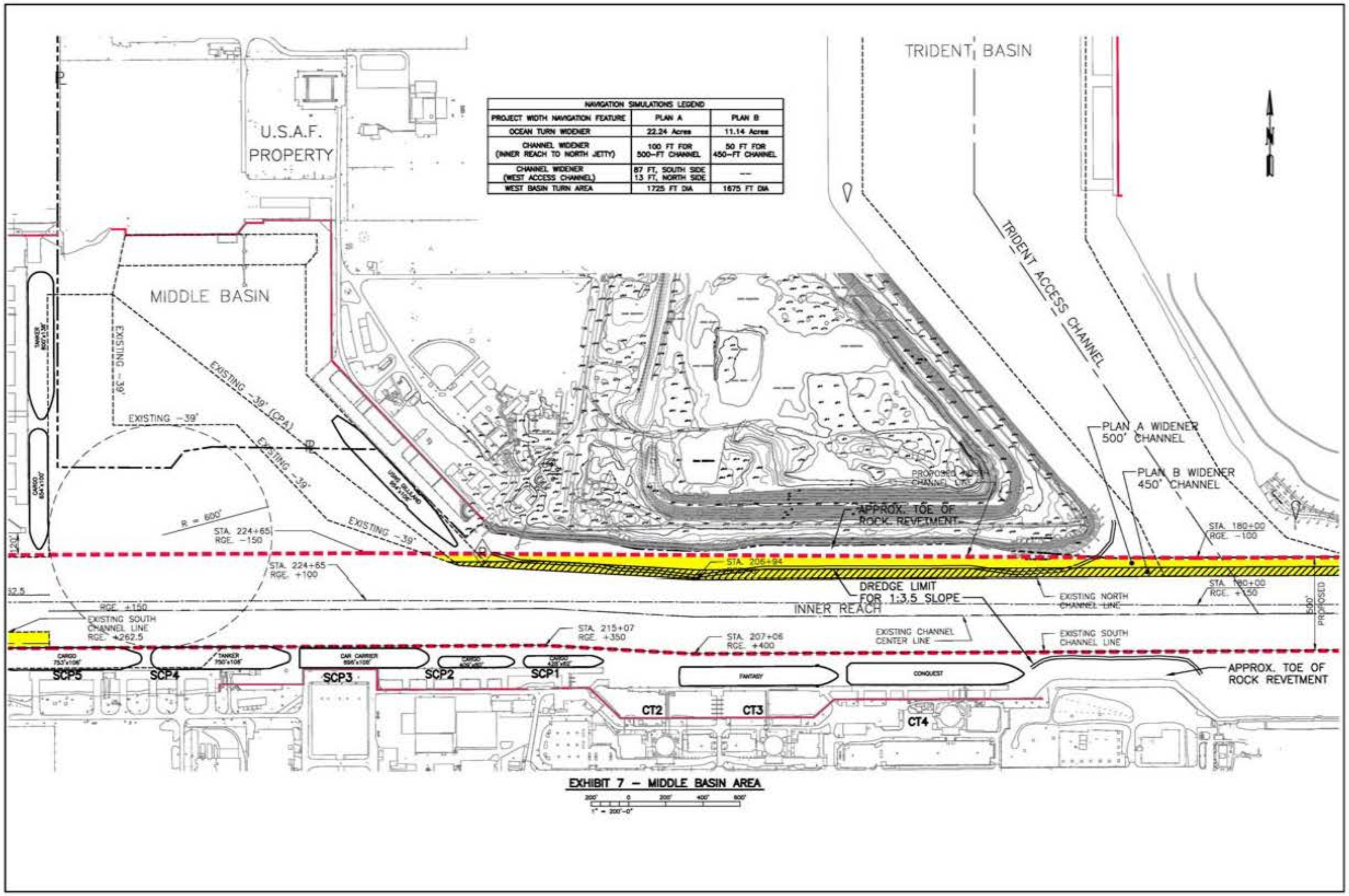
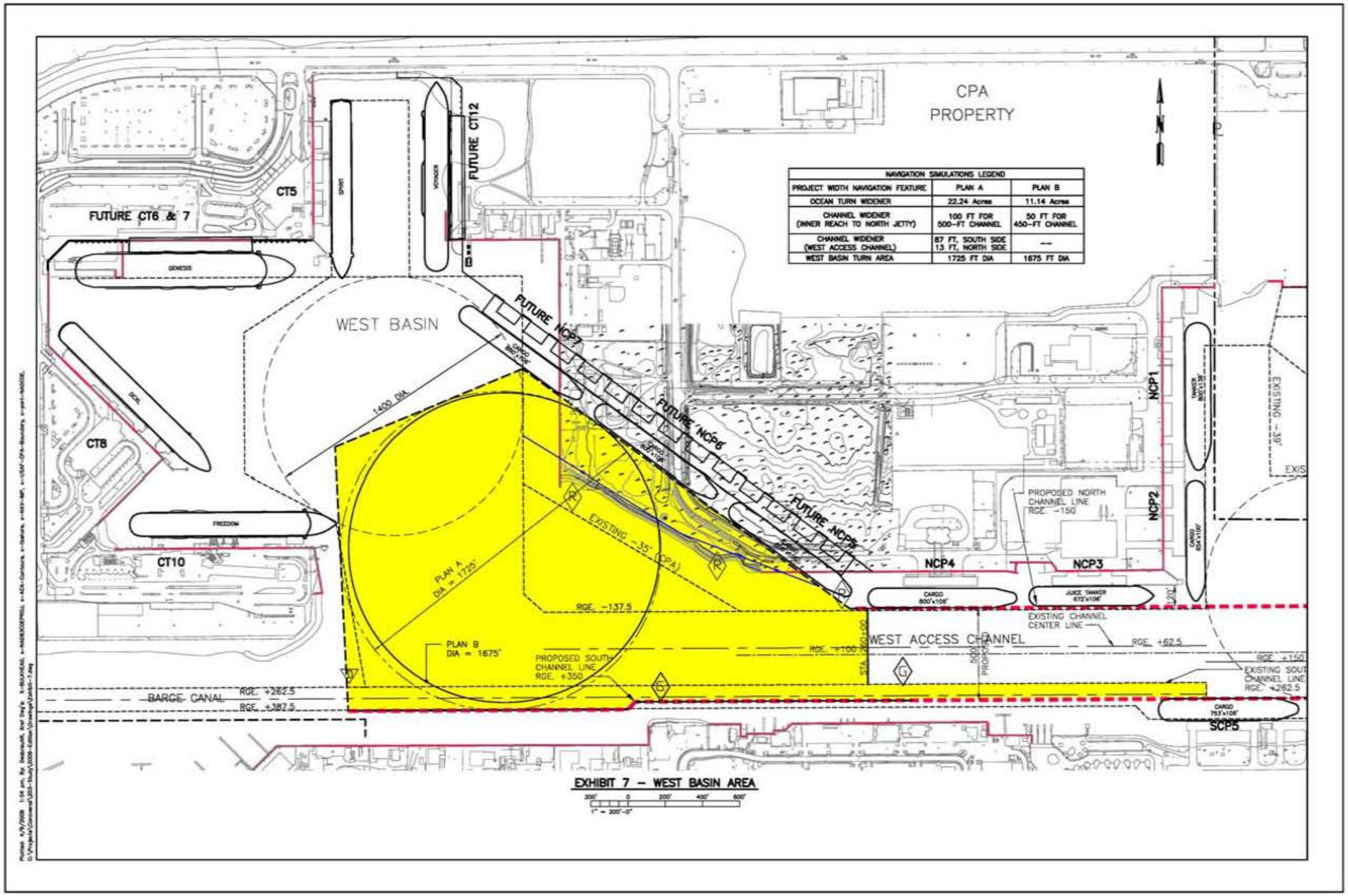


Figure 5-3
Alternative Plans: Sheet 3



5.2 Alternative Plan Costs

Potential project costs include construction costs, real estate costs, financial costs (interest during construction), engineering and design, supervision and administration, and operation and maintenance costs (Engineering Appendix: Section 10 Cost Estimates). Project costs also include any non-financial (i.e., non-cost shared) associated non-Federal costs, such as berth deepening, landside infrastructure, or other modifications that must be performed in order for project benefits to be realized. A Cost Risk Analysis was conducted, which resulted in a project cost contingency of 20.97% (see Engineering Appendix). All total project costs used in this analysis (not based on actual costs for CPA work already performed), include 20.97% contingency. All costs are calculated using FY 2012 dollars, a 50-year project life, and all discounting is conducted at the current FY 2012 Federal discount rate (4.00%). The following sub-sections provide detailed cost information for the alternative plans.

5.2.1 Construction and Investment Costs

Project elements which compose the construction cost for the widening alternatives, including West Turning Basin improvements include:

- Dredging and disposal or reuse: channel widening, turn widener, and turning basin extension;
- Upland excavation with materials relocation, disposal, and reuse: along north side of inner reach, western end of middle reach and at eastern end of West Turning Basin;
- Aids to Navigation: two inbound and two outbound range structures;
- Rip rap revetment: construct revetment along north side of inner reach;
- Real estate costs: upland area (8.0 acres) along north side of inner reach;
- Interest during construction: fourteen month construction duration;
- Engineering and design (E&D) and supervision and administration (S&A);
- Relocation costs; mooring dolphin, submarine sail, fence, tower guy, warning sign, Grouper Road and utility corridor; and
- Seawall construction to protect existing Air Force structures.

In addition to the construction first costs listed above, a contingency factor of 20.97% was determined through a cost and schedule risk analysis as the appropriate level of contingency for this project (Engineering Appendix Attachment M: Cost and Schedule Risk Analysis). Interest during construction was calculated on a monthly basis to reflect the opportunity cost of funds allocated to the project. Work conducted in advance by the CPA (Interim Corner Cutoff), including engineering, design, supervision, and administration, is included in project cost calculations at the actual cost expended. Contingencies and interest during construction are not added to the actual costs expended by the CPA. Table 5-3 presents construction costs for the widening alternatives, which includes widening the channel only to existing depths. There is no channel deepening included in the widening alternatives and therefore Table 5-3 does not include deepening costs.

Table 5-3
Construction Costs: Widening Alternatives*

Cost Category	Widening Plan 1 (450 feet)	Widening Plan 2 (500 feet)
Real Estate	$822,623	$1,645,245
Upland Excavation	$2,186,521	$4,588,251
Revetment	$2,890,370	$2,890,370
Fence	$100,758	$100,758
Tower Guy	$17,267	$17,267
Warning Sign Replacement	$90,301	$90,301
Retaining Wall	$1,189,696	$1,189,696
Submarine Sail Relocation	$43,888	$43,888
Aids to Navigation	$1,975,000	$1,975,000
Mooring Dolphin Demolition and Replace	$190,000	$190,000
Dredging (w/disposal, mob, & de-mob)	$5,105,230	$7,679,180
S&A and E&D (7.5% each)	$2,454,447	$2,814,707
Interest During Construction	$357,840	$518,637
Sub-Total	**$17,423,940**	**$23,743,299**
Contingency (20.97%)[12]	$3,653,800	$4,978,970
Total Widening Plan Construction Costs	**$21,077,740**	**$28,722,269**

*Widening to existing depths only – no channel deepening

Construction costs for the channel deepening alternatives include dredging and disposal costs and a small amount of associated costs required for some berth deepening. Dredge material volumes and costs are based on existing conditions and reflect the various existing channel depths presented in Table 5-2. There are no utility relocations associated with the channel deepening alternatives. Table 5-4 presents the construction costs for deepening the channel at the existing 400-foot authorized channel width (excludes any channel widening). Construction

[12] The appropriate contingency level was identified by the Cost and Schedule Risk Analysis (Engineering Appendix Attachment M: Cost and Schedule Risk Analysis Report

costs for combined widening and deepening alternatives are presented in Table 5-5 (Widening Plan 1 plus deepening alternatives) and Table 5-6 (Widening Plan 2 plus deepening alternatives).

Table 5-4
Construction Costs: Channel Deepening Alternatives*

Cost Category	**-42 feet**	**-43 feet**	**-44 feet**
Unrestricted Operating Draft	38 feet	39 feet	40 feet
Channel Dredging (w/disposal, mob, & de-mob)	$2,287,271	$5,891,577	$10,021,292
Berth Dredging (100% non-Federal cost)	$126,750	$190,125	$253,500
S&A and E&D (7.5% each)	$343,091	$883,737	$1,503,194
Interest During Construction	$47,791	$74,072	$84,737
Sub-Total	**$2,804,903**	**$7,039,510**	**$11,862,723**
Contingency (20.97%)[13]	$588,188	$1,476,185	$2,487,613
Total Deepening Only Construction Costs	**$3,393,091**	**$8,515,695**	**$14,350,336**

*Excludes channel widening – deepening at existing widths only

[13] The appropriate contingency level was identified by the Cost and Schedule Risk Analysis (Engineering Appendix Attachment M: Cost and Schedule Risk Analysis Report

Table 5-5
Construction Costs: Widening Plan 1 (450 feet) and Channel Deepening

Cost Category	**-42 feet**	**-43 feet**	**-44 feet**
Unrestricted Operating Draft	38 feet	39 feet	40 feet
Real Estate	$822,623	$822,623	$822,623
Upland Excavation	$2,186,521	$2,186,521	$2,186,521
Revetment	$2,890,370	$2,890,370	$2,890,370
Fence	$100,758	$100,758	$100,758
Tower Guy	$17,267	$17,267	$17,267
Warning Sign Replacement	$90,301	$90,301	$90,301
Retaining Wall	$1,189,696	$1,189,696	$1,189,696
Submarine Sail Relocation	$43,888	$43,888	$43,888
Aids to Navigation	$1,975,000	$1,975,000	$1,975,000
Mooring Dolphin Demolition and Replace	$190,000	$190,000	$190,000
Dredging (w/disposal, mob, & de-mob)	$6,327,537	$10,274,373	$14,749,236
Berth Dredging	$126,750	$190,125	$253,500
S&A and E&D (7.5% each)	$2,074,942	$2,622,481	$3,242,001
Interest During Construction	$371,200	$434,170	$444,263
Sub-Total	**$18,406,852**	**$23,027,572**	**$28,195,424**
Contingency (20.97%)[14]	$3,859,917	$4,828,882	$5,912,580
Total Widening 1 Plus Deepening Plan Construction Costs	**$22,266,769**	**$27,856,454**	**$34,108,004**

[14] The appropriate contingency level was identified by the Cost and Schedule Risk Analysis (Engineering Appendix Attachment M: Cost and Schedule Risk Analysis Report

Table 5-6
Construction Costs: Widening Plan 2 (500 feet) and Channel Deepening

Cost Category	-42 feet	-43 feet	-44 feet
Unrestricted Operating Draft	38 feet	39 feet	40 feet
Real Estate	$1,645,245	$1,645,245	$1,645,245
Upland Excavation	$4,588,251	$4,588,251	$4,588,251
Revetment	$2,890,370	$2,890,370	$2,890,370
Fence	$100,758	$100,758	$100,758
Tower Guy	$17,267	$17,267	$17,267
Warning Sign Replacement	$90,301	$90,301	$90,301
Retaining Wall	$1,189,696	$1,189,696	$1,189,696
Submarine Sail Relocation	$43,888	$43,888	$43,888
Aids to Navigation	$1,975,000	$1,975,000	$1,975,000
Mooring Dolphin Demolition and Replace	$190,000	$190,000	$190,000
Berth Dredging	$126,750	$190,125	$253,500
Dredging (w/disposal, mob, & de-mob)	$9,590,087	$13,849,784	$18,637,509
S&A and E&D (7.5% each)	$3,120,355	$3,768,816	$4,496,481
Interest During Construction	$563,586	$617,672	$629,839
Sub-Total	**$26,131,554**	**$31,157,174**	**$36,748,105**
Contingency (20.97%)	$5,479,787	$6,533,659	$7,706,078
Total Widening 2 Plus Deepening Plan Construction Costs	**$31,611,341**	**$37,690,833**	**$44,454,182**

5.2.2 Operations and Maintenance Costs

Operation and maintenance costs generated by the project are defined as additional incremental operations and maintenance costs, over and above what is required to operate and maintain the existing Federal navigation project. The operations and maintenance costs of the alternative plans are based on increased maintenance dredging volumes due to the widening of the existing channels. Analysis of historical maintenance dredging patterns and the hydrodynamic analysis of without and with-project conditions indicate that very minor changes in hydraulic conditions due to channel deepening would result in no additional maintenance dredging volumes due to the deepening alternatives. Therefore, no additional operations and maintenance costs are allocated to the channel deepening only alternatives.

The estimated annual volume of additional maintenance dredging material generated by the Widening 1 alternative is 52,125 cubic yards. The resulting additional Widening 1 alternative plan-related maintenance dredging cost is $467,561 ($8.97/CY). The estimated annual volume of additional maintenance dredging material generated by the Widening 2 alternative is 69,500 cubic yards. The resulting additional Widening 2 alternative plan-related maintenance dredging cost is $623,415 ($8.97/CY).

5.2.3 Total Average Annual Equivalent Costs

Tables 5-7 through 5-10 present the total average annual equivalent (AAEQ) project costs for each alternative plan and the incremental AAEQ cost for each successive plan increment. For tables presenting the combined widening and deepening project AAEQ cost information (Tables 5-9 and 5-10), the first project increment is channel widening. Channel widening is the appropriate first increment because channel widening is the only type of improvement that benefits both the cargo and cruise industries operating at the Port (Section 5.3 With-Project Benefits). The succeeding increments are channel deepening starting with a two-foot increment followed by successive one-foot increments, where necessary to achieve the required depths identified in Tables 5-1 (rounded up to the nearest full foot) and 5-2. All average annual equivalent costs are calculated at the FY 2012 discount rate (4.00%) over a period of 50 years and with prices at the FY 2012 price level.

Table 5-7
Average Annual Equivalent (AAEQ) Project Costs: Channel Widening

Alternative Plan	Total First Costs	Total AAEQ First Costs	Annual Maintenance Costs	Total AAEQ Costs	Incremental AAEQ Costs
Widening Plan 1 (450 feet)	$21,077,740	$981,173	$467,561	$1,448,734	$1,448,734
Widening Plan 2 (500 feet)	$28,722,269	$1,337,027	$623,415	$1,960,442	$511,708

Note: Discount rate = 4.00%, period 50 years

Table 5-8
Average Annual Equivalent (AAEQ) Project Costs: Channel Deepening

Alternative Plan	Total First Costs	Total AAEQ First Costs	Annual Maintenance Costs	Total AAEQ Costs	Incremental AAEQ Costs
-42-foot Plan	$3,393,091	$157,949	$0	$157,949	$157,884
-43-foot Plan	$8,515,695	$396,407	$0	$396,407	$238,458
-44-foot Plan	$14,350,336	$668,011	$0	$668,011	$271,604

Note: Discount rate = 4.00%, period 50 years

Table 5-9
Average Annual Equivalent (AAEQ) Project Costs: Widening Plan 1 (450 feet) and Channel Deepening

Alternative Plan	Total First Costs	Total AAEQ First Costs	Annual Maintenance Costs	Total AAEQ Costs	Incremental AAEQ Costs
450-foot widening (W1) only	$21,077,740	$981,173	$467,561	$1,448,734	$1,448,734
W1 and -42-foot deepening	$22,266,769	$1,036,523	$467,561	$1,504,084	$55,350
W1 and -43-foot deepening	$27,856,454	$1,296,724	$467,561	$1,764,285	$260,201
W1 and -44-foot deepening	$34,108,004	$1,587,734	$467,561	$2,055,296	$291,011

Note: Discount rate = 4.00%, period 50 years

Table 5-10
Average Annual Equivalent (AAEQ) Project Costs: Widening Plan 2 (500 feet) and Channel Deepening

Alternative Plan	Total First Costs	Total AAEQ First Costs	Annual Maintenance Costs	Total AAEQ Costs	Incremental AAEQ Costs
500-foot widening (W2) only	$28,722,269	$1,337,027	$623,415	$1,960,442	$1,960,442
W2 and -42-foot deepening	$31,611,341	$1,471,514	$623,415	$2,094,929	$134,487
W2 and -43-foot deepening	$37,690,833	$1,754,516	$623,415	$2,377,931	$283,002
W2 and -44-foot deepening	$44,454,182	$2,069,351	$623,415	$2,692,766	$314,835

Note: Discount rate = 4.00%, period 50 years

5.3 With-Project Condition Benefits

The NED Procedures Manual Deep Draft Navigation (IWR Report 91-R-13) presents three general examples of NED navigation project benefits, which are based on the conceptual basis for navigation benefits identified in the Principles and Guidelines (1983). The NED Procedures Manual states as an example of navigation benefits (page 11):

"Reduced cost of transportation through use of vessels (modal shift), through safer or more efficient operation of vessels and/or use of larger more efficient vessels (channel enlargement), and through use of new or alternative vessel routes (new channels or port shift)."

The with-project condition transportation cost savings calculated in this analysis fully coincide with this example presented in the NED Procedures Manual. With-project condition cargo vessel transportation cost savings are based on safer, more efficient operation of cargo vessels and use of larger, more efficient cargo vessels. With-project condition cruise ship transportation cost savings are based on safer, more efficient cruise ship operations at the port and on reduced cruise ship impacts to cargo operations within the port.

The following sub-sections describe the NED benefit estimation processes and present the NED benefits for with-project channel widening and channel deepening conditions. Channel widening, with associated aids to navigation and turning basin extension, generate cargo ship and cruise ship-related NED benefits. Channel deepening generates cargo ship-related NED benefits. There are no cruise ship related benefits from channel deepening.

In addition to transportation cost savings generated by the project, the channel widening and deepening reduces surge effects in the Middle Turning Basin, Trident Basin, and at berths NCP3 & 4. The direct benefits to the Navy and Air Force vessels using the Middle and Trident Turning Basins due to reduced surge effect, such as damage reduction or line handling cost reductions, has not been quantified in monetary terms; however, the tug assist cost savings for Trident Basin vessels under with-project conditions has been included in the benefits calculations (Section 5.3.1.2 Port Operations Analysis).

5.3.1 Channel Widening Benefits

Channel Widening Plans 1 & 2, including associated aids to navigation and turning basin extension components, are stand-alone alternative plans. The two channel widening alternative plans do not require a channel deepening component to generate transportation cost savings. A wider channel would beneficially affect cruise ship operations in the Port, reduce the incidence and severity of surge effects on moored cargo vessels during cruise ship passage through the Port, and would allow larger, although not deeper draft, tankers to navigate the channel to and from the Seaport Canaveral Terminal. Transportation cost savings would be generated by fewer incidences of tug assist during cruise ship passage through the Port, by fewer incidences of tug assist for cargo vessels in the Port, and by efficiencies gained through the use of larger (longer) tankers at the Seaport Canaveral Terminal.

There are two components to the beneficial effects of the alternative channel widening plans. One component is that a wider channel would allow longer (greater Length Overall [LOA]) tankers to call at Seaport Canaveral Terminal. At the request of Seaport Canaveral, the Canaveral Pilots Association has made determinations concerning maximum vessel LOA for Seaport Canaveral tankers. Under without-project conditions, the maximum LOA for Seaport Canaveral tankers is 800 feet. Under Channel Widening Plans 1 and 2, the maximum LOA for Seaport Canaveral tankers increases to 850 feet and 900 feet, respectively.

The second component of alternative widening plan beneficial effects is directly related to wind conditions at the Port. Under perfectly calm conditions (winds ranging from 0 to 5 knots) the existing channel is adequate for most vessel operations. As wind speeds increase, safe navigation within the channel becomes more challenging. At relatively high winds, additional tug assistance is required to maintain navigation safety within the channel and to provide stabilizing force to offset surge effects on vessels moored at vulnerable piers within the Port. Wind-related beneficial effects on port operations projected to result from the alternative widening plans, which are assessed in this analysis include:

- Reduction in the frequency of tug assistance for the largest cruise ships under strong wind conditions;
- Reduction in the frequency of tug assistance for the largest Seaport Canaveral tankers (tankers 800 feet LOA and larger); and
- Reduction in the frequency of tug assistance to offset surge impacts for vessels moored at:
    - Trident Basin
    - North Cargo Piers 1 and 2
    - North Cargo Piers 3 and 4.

5.3.1.1 Wind Analysis

An analysis of wind conditions at the Port was conducted to project the effects of winds on large cruise ship operations within the Port. Wind speed, direction, and duration data were obtained from the following sources:

- NASA Space Shuttle Landing Facility: March 1978 – August 2009;
- Patrick Air Force Base: March 1945 – December 2004;

- Trident Submarine Basin (NOAA Station TRDF1): April 2005 – December 2008; and,
- NOAA Sea Buoy Station 41009: January 1988 – August 2008.

Wind data recorded during cruise ship transit times (4 – 8 am and 3 – 7 pm) were sorted from the overall wind data and were exclusively used in the analysis. Wind data was adjusted for elevation differences between recording station and cruise ship instrumentation. Wind direction was also taken into account by reducing the effect of winds that are not directly abeam of a vessel transiting the channel within the Port (winds from due north or due south). Wind effectiveness ranges from 100% for winds from the north and south (directly abeam of vessels transiting the channel) to 0% for winds coming directly from the east or west. The wind speeds used in this analysis represent an "effective wind speed" which discounts the effects of winds that are not directly abeam of the vessel during channel transit within the Port. This adjustment reduces the frequency of effect of winds on vessels approaching the Port and in the turn at the entrance to the Port. However, the intent of the wind analysis is to assess the effects of winds on large cruise ship operations within the Port, not in the approaching channels.

A comparison of wind data was conducted to identify an appropriate data set to represent wind conditions at the Port. Although the Trident Submarine Station wind recording device is within the Port and closest to the channel, the recording device is located in a protected area and regularly records substantially less velocity than all other recording stations. The Patrick Air Force Base is the farthest from the port, approximately 20 miles to the south. Therefore, an average of NASA Space Shuttle Landing Facility and NOAA Sea Buoy Station 41009 was used in the analysis as representative of wind conditions in the channel and at the Port. The combined data set includes more than 50 years of data. A detailed analysis of all wind data is provided in the Engineering Appendix, Section 1.3.3 Wind and Wave Climate.

The lowest maximum wind speed for a continuous three hour period was calculated for cruise ship transit times (morning and afternoon) for Summer (April – October) and Winter (November – March) for NASA Space Shuttle Landing Facility and NOAA Sea Buoy Station 41009 wind records. The lowest maximum wind speed for a continuous three hour period indicates that winds of at least a certain speed were experienced during those three hours. Using this measure of wind speed and duration avoids having the analysis unduly influenced by peak wind speeds and gusts. Lowest maximum wind speed calculations were conducted in 5 knot increments: 10 to 15 knots, 15 to 20 knots, 20 to 25 knots, etc. The number of occurrences for each wind speed increment during cruise ship transit time periods was divided by the total number of cruise ship transit time periods to calculate the probability for each wind speed increment during cruise ship transit time periods. The probability for each wind speed increment was multiplied by the probability that a large cruise ship would transit the channel (50 days per year for weekly cruises and 100 days per year for bi-weekly cruises) to obtain a joint probability for each wind speed increment during a large cruise ship transit. The resulting joint probabilities (Table 5-11) are used to estimate the number of vessel transits that would be affected by wind conditions. Note that the probabilities for Seaport Canaveral tanker tug assists very annually because the number of calls varies; therefore the Seaport Canaveral tanker joint probabilities are not presented in the table.

For example, the raw probability that the lowest maximum wind speed during a continuous three hour period in the Summer during the afternoon cruise ship transit time period (3 – 7 pm) would range from 20 to 25 knots is 4.80%. The probability that a cruise ship on a weekly schedule is transiting the channel on any given day is 13.7% (50/365 = .1370). The joint probability for sustained Summer afternoon wind speeds ranging from 20 to 25 knots during a cruise ship transit is 0.66% (4.8% * 13.7% = 0.658%). The appropriate cell is highlighted in Table 5-11.

Similar calculations were conducted to obtain the joint probabilities of potential wind-related effects on other port operations (Table 5-11). The joint probability for wind speed increments and large Seaport Canaveral tanker transits was calculated by multiplying the raw wind speed increment probability by the probability of the tanker transiting the channel. The joint probability for vessels moored at surge vulnerable piers was calculated by multiplying the joint probability for cruise ship transit by the probability that a vessel would be moored at the vulnerable pier (berth utilization rates). These berth utilization rates are based on the mid-level cargo forecast and a very conservative assumption concerning berth utilization at the Trident Basin. Berth utilization rates indicate that at least one vessel will be at the affected pier: North Cargo Piers 1 and 2 - 79%; North Cargo Piers 3 and 4 - 50%, Trident Basin – 10%.

Table 5-11
Joint Probability of Occurrence (Sustained Winds and Vessel Transits)

	Sustained* Wind Speeds (Knots)					
	10-15	**15-20**	**20-25**	**25-30**	**30-35**	**35-40**
Cruise Ship Tug Assist						
Summer Morning Weekly schedule	-	1.26%	0.49%	0.20%	0.07%	0.01%
Summer Morning Bi-weekly schedule	-	2.52%	0.97%	0.40%	0.14%	0.03%
Summer Afternoon Weekly schedule	-	1.33%	0.66%	0.27%	0.12%	0.05%
Summer Afternoon Bi-weekly schedule	-	2.66%	1.32%	0.53%	0.25%	0.10%
Winter Morning Weekly schedule	-	1.99%	1.03%	0.62%	0.39%	0.13%
Winter Morning Bi-weekly schedule	-	3.97%	2.07%	1.23%	0.78%	0.26%
Winter Afternoon Weekly schedule	-	1.32%	0.99%	0.59%	0.31%	0.12%
Winter Afternoon Bi-weekly schedule	-	2.64%	1.97%	1.18%	0.62%	0.23%
Cargo Vessel Tug Assist NCP 1&2						
Summer Morning Weekly schedule	-	1.00%	0.38%	0.16%	0.05%	0.02%
Summer Morning Bi-weekly schedule	-	1.99%	0.77%	0.31%	0.11%	0.03%
Summer Afternoon Weekly schedule	-	1.05%	0.52%	0.21%	0.10%	0.04%
Summer Afternoon Bi-weekly schedule	-	2.10%	1.04%	0.42%	0.19%	0.08%
Winter Morning Weekly schedule	-	1.57%	0.82%	0.49%	0.31%	0.10%
Winter Morning Bi-weekly schedule	-	3.14%	1.63%	0.97%	0.62%	0.21%
Winter Afternoon Weekly schedule	-	1.04%	0.78%	0.47%	0.24%	0.09%
Winter Afternoon Bi-weekly schedule	-	2.09%	1.56%	0.93%	0.49%	0.18%
Cargo Vessel Tug Assist NCP 3&4						
Summer Morning Weekly schedule	-	0.63%	0.24%	0.10%	0.03%	0.01%
Summer Morning Bi-weekly schedule	-	1.26%	0.49%	0.20%	0.07%	0.02%
Summer Afternoon Weekly schedule	-	0.66%	0.33%	0.13%	0.06%	0.02%
Summer Afternoon Bi-weekly schedule	-	1.33%	0.66%	0.27%	0.12%	0.05%
Winter Morning Weekly schedule	-	0.99%	0.52%	0.31%	0.20%	0.07%
Winter Morning Bi-weekly schedule	-	1.99%	1.03%	0.62%	0.39%	0.13%
Winter Afternoon Weekly schedule	-	0.66%	0.49%	0.29%	0.15%	0.06%
Winter Afternoon Bi-weekly schedule	-	1.32%	0.99%	0.59%	0.31%	0.12%
Trident Basin Tug Assist						
Summer Morning Weekly schedule	-	0.13%	0.05%	0.02%	0.01%	0.00%
Summer Morning Bi-weekly schedule	-	0.25%	0.10%	0.04%	0.01%	0.00%
Summer Afternoon Weekly schedule	-	0.13%	0.07%	0.03%	0.01%	0.00%
Summer Afternoon Bi-weekly schedule	-	0.27%	0.13%	0.05%	0.02%	0.01%
Winter Morning Weekly schedule	-	0.20%	0.10%	0.06%	0.04%	0.01%
Winter Morning Bi-weekly schedule	-	0.40%	0.21%	0.12%	0.08%	0.03%
Winter Afternoon Weekly schedule	-	0.13%	0.10%	0.06%	0.03%	0.01%
Winter Afternoon Bi-weekly schedule	-	0.26%	0.20%	0.12%	0.06%	0.02%

* Lowest maximum wind speed during a consecutive three hour period

5.3.1.2 Port Operations Analysis

An Operations Matrix was developed by CPA's consulting engineers in consultation with the Canaveral Pilots Association and the operations personnel at the Canaveral Port Authority (Tables 5-12 and 5-13). The Operations Matrix identifies the amount of tug assistance required under various wind speeds under without and with-project conditions. The Operations Matrix also identifies other port operation activities which may be required under various wind conditions, such as relocation of cargo vessels from docks that are vulnerable to surge from passing vessels and the maximum wind speed for entering and exiting the Port. The beneficial effects of channel widening on these other port operation activities were not assessed in this analysis. The Operations Matrix was developed by two senior pilots and then reviewed and approved by the Canaveral Pilots Association at one of their monthly membership meetings as accurately reflecting actual operating conditions and projected future operating conditions.

Table 5-12
Operations Matrix: Widening Plan 1 (Number of Tugs)

	Sustained* Wind Speeds (Knots)					
	10-15	**15-20**	**20-25**	**25-30**	**30-35**	**35-40**
Cruise Ship Tug Assist						
Without-project	0	0	0	1	2	2
With-Project	0	0	0	0	1	2
Cargo Vessel Tug Assist NCP 1&2						
Without-project	0	0	0	1	1	1
With-Project	0	0	0	0	1	1
Cargo Vessel Tug Assist NCP 3&4						
Without-project	0	0	1	1	1	1
With-Project	0	0	0	1	1	1
Trident Basin Tug Assist						
Without-project	0	0	0	1	1	1
With-Project	0	0	0	0	1	1
Largest Tanker Additional Tug						
Without-project	0	1	1	1	1	1
With-Project	0	0	1	1	1	1

* Lowest maximum wind speed during a consecutive three hour period

Table 5-13
Operations Matrix: Widening Plan 2 (Number of Tugs)

	Sustained* Wind Speeds (Knots)					
	10-15	**15-20**	**20-25**	**25-30**	**30-35**	**35-40**
Cruise Ship Tug Assist						
Without-project	0	0	0	1	2	2
With-Project	0	0	0	0	1	1
Cargo Vessel Tug Assist NCP 1&2						
Without-project	0	0	0	1	1	1
With-Project	0	0	0	0	0	1
Cargo vessel Tug Assist NCP 3&4						
Without-project	0	0	1	1	1	1
With-Project	0	0	0	0	1	1
Trident Basin Tug Assist						
Without-project	0	0	0	1	2	2
With-Project	0	0	0	0	1	1
Largest Tanker Additional Tug						
Without-project	0	1	1	1	1	1
With-Project	0	0	0	0	1	1

* Lowest maximum wind speed during a consecutive three hour period

5.3.1.3 Widening Plan Benefit Calculations – Tug Assistance Reductions

Alternative Widening Plan benefits (Table 5-16) were calculated for the two widening-only plans using the same assumptions for each widening plan concerning cruise ship schedules, tug operations, and tug costs. By 2012, three of the world's largest cruise ships are projected to work out of Port Canaveral on a weekly schedule (*Freedom of the Seas, Carnival Dream, and Disney Dream*) and one of four largest cruise ships (*Disney Fantasy*) is projected to work on a bi-weekly schedule. Three of these vessels, the *Freedom of the Seas, The Disney Dream* and the *Carnival Dream*, are currently homeported at the Port. The *Disney Fantasy* is expected to be homeported at Port Canaveral upon its entry into service in March 2012.

Cruise ship related benefits are calculated based on the operations of these four vessels only. The three weekly scheduled ships are projected to all arrive and depart on the same day of the week (similar to existing weekly schedule operations). For the base case analysis, it is assumed that a single tug would be sufficient for each wind event. For example, under without-project conditions and a 25-30 knot wind event on a day when the three large cruise ships are entering or exiting the Port, the base case analysis assumes that the same tug would be able to service all three cruise ships at the cost of a single tug call plus stand-by charges for two of the cruise ships. Tug costs are based on the current rates charged by the two tug companies operating in the Port. Table 5-14 presents a sample tug cost calculation for the *Freedom of the Seas*.

Table 5-14
Sample Tug Cost Calculation: Freedom of the Seas (160,000 GRT)

1) Base Fee up to 25,000 GRT	$1,504
2) *Freedom of the Seas* additional GRT fee (note below)	$7,560
3) Total GRT based fee = (1 + 2)	$9,064
4) Time of day surcharge (before 8:00 AM and after 4:00 PM) @ 35% of #3	$3,172
5) Weekend and Holiday surcharge @ 35% of #3	$3,172
6) Fuel surcharge @ 37 % of #3	$3,354
Total Cost = (3 + 4 + 5 + 6)	**$18,762**

Note: Calculated at $56 per each 1,000 GRT above 25,000

Tug assist costs for each tug assist event were also calculated for two sizes of tankers (79,000 and 110,000 DWT) needing assistance to enter the Seaport Canaveral Terminal, three sizes of tankers needing alongside assistance at North Cargo Piers 1 and 2 (45,000; 79,000; and 110,000 DWT), one size of bulker needing alongside assistance at North Cargo Piers 3 and 4 (45,000 DWT), and three sizes of cruise ships (128,000; 130,000; and 160,000 DWT). Tug assist costs for the Trident Basin were calculated using the weighted average size cruise ship (139,000 DWT). Weighted average tug costs (Table 5-15) account for weekday and weekend calls and for a 37% fuel surcharge (as reported by the tug firms). Cruise ship tug assist costs for the *Freedom of the Seas* include the costs of a single working tug and two standby tugs for each tug assist event.

Table 5-15
Weighted Average Tug Assist Costs*

Tug Assist Event Type	Weighted Average DWT	Weighted Average Cost
Seaport Canaveral Tanker Movement	90,625	$7,613
Trident Basin Alongside Assist	139,333	$14,766
North Cargo Piers 3&4 Alongside Assist	45,000	$4,901
North Cargo Piers 1&2 Alongside Assist	78,000	$8,352
Cruise Ship Movement	139,333	$22,149

*Costs per each tug assist event

Table 5-16
Alternative Widening Plan Annual Benefits – Tug Assistance Reductions: 2020

	Tug Assist Events		Tug Assist Costs		
	Without Project	With Project	Without Project	With Project	Transportation Cost Savings
Channel Widening Plan 1 (450 feet)					
Seaport Canaveral Tankers	10	4	$49,125	$23,924	$25,201
Trident Basin Tug Assist	2	1	$20,418	$8,411	$12,007
North Cargo Piers 3 & 4 Tug Assist	17	8	$144,787	$70,628	$74,159
North Cargo Piers 1 & 2 Tug Assist	13	6	$111,592	$49,709	$61,883
Cruise Ship Tug Assist	24	10	$754,663	$310,883	$443,780
Total					**$617,030**
Channel Widening Plan 2 (500 feet)					
Seaport Canaveral Tankers	10	0.5	$49,125	$4,689	$44,436
Trident Basin Tug Assist	2	1	$20,418	$6,934	$13,484
North Cargo Piers 3 & 4 Tug Assist	17	4	$144,787	$31,462	$113,326
North Cargo Piers 1 & 2 Tug Assist	13	2	$111,592	$16,739	$94,853
Cruise Ship Tug Assist	24	8	$754,663	$256,301	$498,362
Total					**$764,461**

Avoided trip costs for tankers (Table 5-18) are calculated using the most recent Corps of Engineers vessel operating costs for the appropriate vessel size and for an estimated trip one-way distance. Point to point tankers are assumed to arrive at the Port's maximum unconstrained operating draft (36.0 feet) under without-project and alternative with-project (widening only) conditions. Seaport Canaveral purchases spot cargoes rather than maintain multiple deliverable contracts with refineries. The terminal does not maintain time-charter relationships with carriers or long-term contracts with individual refiners that would constrain their selection of vessels. Under these "spot market" operations, vessels and imported cargo may reasonably come from any of the countries that export petroleum products to the U.S. on the most efficient vessel that can be chartered to deliver the product.

Actual Seaport Canaveral point-to-point distance data mostly includes imports but also includes some domestic movements to Seaport Canaveral and some export movements which have been observed between February 2010 and July 2011. Houston, Texas was the only specifically identified domestic origin and was therefore also used as a proxy domestic port for shipments which identified the origin only as the United States (no port identified).

One-way travel distance per trip (2,014 miles) was calculated as a weighted average of the distances from the actual ports of origin or destination for all Seaport Canaveral point-to-point tanker calls observed between February 2010 and July 2011 (Table 5-17). The weights are based on the proportion of the origin's or destination's total Seaport Canaveral point-to-point tanker tonnage for February 2010 through July 2011.

Tables 5-18 and 5-19 provide an example from one year during the period of analysis (2020) how costs per trip increase with the use of larger vessels under with-project conditions, but total annual costs decrease due to the fewer number of trips. Total annual cost savings (Table 5-18) for point-to point vessels calling at Seaport Canaveral are due to the economies of scale associated with larger vessels taking fewer trips to deliver the same annual amount of cargo.

Table 5-17
Actual Seaport Canaveral Point-to-Point Distances Feb2010 – July2011*

Country	Port	Tonnage Percentage	Actual Distance	Weighted Distance
Algeria	Algiers	2.4%	4157	98.94
Argentina	Rosario	0.9%	5864	50.32
Aruba	Oranjestad	3.4%	1225	42.15
Bahamas	Freeport	2.9%	152	4.45
Belgium	Antwerp	0.3%	4035	12.11
Brazil	Fortaleza	0.4%	3116	11.42
Canada	Point Tupper	12.2%	1417	173.52
India	Chennai	3.0%	9713	287.94
Latvia	Lielupe	2.1%	4751	99.89
Netherlands	Rotterdam	6.2%	4030	250.46
Nigeria	Lagos	1.7%	5076	86.60
Spain	Algeciras	1.4%	3767	51.41
United Kingdom	Glasgow	2.3%	3733	85.53
US & Texas	Houston	19.7%	1119	220.09
Venezuela	Maracaibo	40.1%	1319	528.71
Virgin islands	San Juan	1.1%	1001	10.85
	Total	**100.0%**	**Weighted Average**	**2014.41**

Source: CPA and www.sea-distances.com
*Distances in nautical miles

Table 5-18
Alternative Channel Widening Transportation Costs – Large Tankers: 2020

	Without Project (400 feet)	Widening Plan 1 (450 feet)	Widening Plan 2 (500 feet)
Vessel LOA	600 feet	850 feet	900 feet
Vessel DWT	50,000	70,000	90,000
Arrival Draft	36 feet	36 feet	36 feet
Tons per trip	41,323	57,852	74,381
Number of trips	55	39	30
One-way Transportation Cost per Trip	$135,744	$156,421	$172,801
In Port Costs per Trip	$20,799	$34,229	$48,658
Total Cost per Trip	$156,543	$190,650	$221,459

Table 5-19
Alternative Channel Widening Plan Annual Benefits – Large Tankers: 2020

	Without Project (400 feet)	Widening Plan 1 (450 feet)	Widening Plan 2 (500 feet)
Vessel LOA	600 feet	850 feet	900 feet
Arrival Draft	36 feet	36 feet	36 feet
Tons per trip	41,323	57,852	74,381
Number of trips	55	39	30
Total Annual Cost	$8,639,226	$7,479,649	$6,708,974
Transportation Cost Savings	**---**	**$1,159,577**	**$1,930,252**

Note: Trips reported in the table are rounded. Total annual costs include fractional trips.

Total annual channel widening plan benefits are the sum of the benefits due to reduced tug assistance and avoided tanker import trips (Table 5-20). It is important to note that the without-project condition includes the navigation effects of the CPA's widening beyond the federal channel, which includes the Interim Corner Cut Off and channel notching as described in Section 3: Without-Project Conditions.

Table 5-20
AAEQ Total Annual Channel Widening Benefits

	Total Benefits
Channel Widening Plan 1 (450 feet)	
Reduced Tug Assist	$606,126
Avoided Tanker Trips	$1,277,842
Total	**$1,883,968**
Channel Widening Plan 2 (500 feet)	
Reduced Tug Assist	$745,426
Avoided Tanker Trips	$2,084,322
Total	**$2,829,748**

5.3.2 Channel Deepening Benefits

With-project condition channel deepening benefits will result from cargo vessels arriving at Port Canaveral with deeper drafts and larger loads than under without-project conditions. Larger loads and deeper drafts allow vessels to operate more efficiently. This efficiency gain is calculated as the difference in operating costs for vessels delivering the projected commodity tonnage under without and with-project conditions. In the assessment of alternative plans, the annual projected tonnage is the same under without and with-project conditions, but the number of trips required and annual operating costs (ocean voyage costs plus landside costs) will decrease due to deeper with-project channel depths.

Identification of the commodities and vessel fleet that will benefit from deeper channel depths is based on observed historical (fiscal years 2000 – 2009) commodity movements, and calendar year 2006 vessel operations and loading data. Only four commodity types (rock, cement, slag, and fuel oil) are delivered in large quantities on cargo vessels of sufficient size to potentially take advantage of a deeper channel. For future fuel oil deliveries to the Seaport Canaveral Fuel Terminal, the projected fleet and projected volumes are based on their first 18 months of operational data, Seaport Canaveral's operational projections as presented to the CPA, and discussions with port planning and operations personnel.

Table 5-21 presents the calendar year 2006 vessel and load characteristics (with the exception of projected Seaport Canaveral Fuel Terminal vessel calls) used to project with-project condition drafts and loads. Vessel type classifications were used to differentiate between different size vessels carrying the same commodity, and to differentiate among vessels carrying the same commodity to different terminals at Port Canaveral. Vessel type classifications are based on a detailed analysis of vessel origins and loading patterns observed in the 2006 data. For example, vessels carrying cement to NCP 4 and cement to SCP 5 are designated as different vessel types because, in 2006, cement vessels calling NCP4 consistently loaded more deeply and had different origins than cement vessels calling at SCP5. The allocation of commodity tonnage to each vessel type is based on the observed 2006 proportion of the commodity carried on that vessel type. For example, a 60,000 DWT vessel delivering aggregate carried 41% (171,137) of the total 412,598 tons of aggregate delivered to Port Canaveral in calendar year 2006.

Vessel and load characteristics for vessels projected to call at the Seaport Canaveral Fuel Terminal are based on their first 18 months of operational data, discussions with CPA personnel and the projections provided to the CPA by Seaport Canaveral. Point-to-point calls at Seaport Canaveral accounted for 44% of all petroleum products moved through the facility from February 2010 through July 2011.

Under without-project conditions, Seaport Canaveral point-to-point fuel oil tanker length is based on observations presented in Section 2.6.3 Existing Cargo Fleet Operations and Tidal Advantage. Although 800 feet LOA is the longest cargo vessel the Canaveral Pilots will bring into the harbor, at the existing unconstrained operating draft (36 feet) large tankers are required to light load to the extent that they are less efficient than a smaller tanker, which can be more fully loaded when operating with a draft of 36 feet. Because Seaport Canaveral point-to-point tankers do not use tidal advantage, they are regularly 600 feet LOA, which allows more efficient operations under the without-project depth constraint. Under channel widening and deepening conditions, Seaport Canaveral point-to-point tankers are projected to increase in length and operate at deeper drafts, which allow the longer vessels to operate efficiently.

- without-channel widening conditions (800 feet LOA maximum);
- with-project Widening Plan 1 (850 feet LOA maximum); and
- with-project Widening Plan 2 (900 feet LOA maximum).

Vessel arrival draft is based on the without-project condition unrestricted maximum vessel operating draft (no tidal advantage required; 36.0 feet).

Table 5-21
Large Cargo Vessel Characteristics

	2006 Observed Averages				
Commodity	**DWT**	**Length**	**Arrival Draft**	**Tonnage per call**	**Percent of Commodity Total**
Aggregate	60,000	700	38.7	57,046	41%
Cement	35,000	589	33.3	34,117	16%
Cement	35,000	609	33.5	39,295	47%
Cement	40,000	634	34.5	23,155	7%
Limestone	35,000	597	36.0	37,529	38%
Granite	60,000	753	39.5	60,335	62%
Slag	35,000	599	34.8	41,882	100%
Fuel Oil w/o*	50,000	600	36.0	41,323	44%
Fuel Oil Wide Plan 1	70,000	850	36.0	57,852	44%
Fuel Oil Wide Plan 2	90,000	900	36.0	74,381	44%

Source: CPA data
*Note: Fuel oil vessels based on actual (without-project) and projected with-project Seaport Canaveral Terminal fleet characteristics

Table 5-22 presents the without and with-project condition operating drafts and tonnages-per-call for selected large cargo vessels. Operating drafts under future with-project conditions are estimated based on observed 2006 operating drafts. Large deep draft cargo vessels arriving at Port Canaveral typically arrive with loads just less than the 36-foot constraint in order to avoid tide and priority traffic delays (see discussion in Section 2.4.3 Existing Cargo Fleet Operations). In 2006, 51 vessels arrived with drafts between 33 and 36 feet and only 19 vessels arrived at drafts greater than 36 feet. Projected with-project operating drafts maintain the observed relationship between a vessel's arrival draft and the port's maximum unconstrained arrival draft. In this way the carrier's observed reliance on tidal advantage, or conversely, the carrier's observed reluctance to use the tide is mirrored in how they are expected to operate in the alternative depth scenarios under with-project conditions. For example, in 2006 slag vessels arrived, on average, with an operating draft of 34.8 feet, which is 1.2 feet less than the 36-foot maximum unconstrained arrival draft. Under with-project conditions, slag vessel operating drafts are constrained to maintain that 1.2–foot differential, so that under a two-foot deepening with-project condition the maximum unconstrained arrival draft increases to 38 feet and slag vessels are then projected to arrive at 36.8 feet (38 – 1.2 = 36.8).

With-project unconstrained vessel operating drafts are truncated at 39.5 feet. Port terminal operators and the pilots have identified 39.5 feet as the limit on unconstrained maximum operating draft for existing and future vessels. Currently, vessels arriving with drafts greater than 36 feet are constrained by channel depth conditions. Most port terminal operators do not project that future vessels will regularly arrive at operating drafts greater than 39.5 feet, although occasional vessels may arrive with deeper drafts. The reason for this unconstrained maximum operating draft (39.5 feet) is that 40 feet of depth at the port's berths is considered approximately the maximum depth that can be achieved without the need for major reconstruction at some berths. A depth of 40 feet at the berth provides the required minimum one-half foot of underkeel clearance for vessels berthed with a draft of 39.5 feet. For these reasons, the deepest future unconstrained operating draft at the port would be no greater than 39.5 feet in accordance with the limitations of the port's existing berths and the dimensions of the projected fleet. No benefits are associated with channel depths greater than the design requirements identified in Table 5-1.

Table 5-22
Without and With-project Operating Drafts and Tons per Call

			Operating Drafts		
Commodity	**DWT**	**Without Project (-40 feet)**	**-42 feet**	**-43 feet**	**-44 feet**
Aggregate	60,000	38.7	39.5	39.5	39.5
Cement	35,000	33.3	35.3	36.3	37.3
Cement	35,000	33.5	35.5	36.5	37.5
Cement	40,000	34.5	36.5	37.5	38.5
Limestone	35,000	36.0	38.0	39.0	39.5
Granite	60,000	39.5	39.5	39.5	39.5
Slag	35,000	34.8	36.8	37.8	38.8
Fuel Oil w/o	50,000	36.0	38.0	39.0	39.5
Fuel Oil Wide Plan 1	70,000	36.0	38.0	39.0	39.5
Fuel Oil Wide Plan 2	90,000	36.0	38.0	39.0	39.5
			Tons per Call		
Commodity	**DWT**	**Without Project (-40 feet)**	**-42 feet**	**-43 feet**	**-44 feet**
Aggregate	60,000	57,046	57,174	57,174	57,174
Cement	35,000	34,117	36,749	38,066	39,382
Cement	35,000	39,295	41,928	43,245	44,561
Cement	40,000	23,155	26,015	27,446	28,876
Limestone	35,000	37,529	40,162	41,478	42,136
Granite	60,000	60,335	60,335	60,335	60,335
Slag	35,000	41,882	44,515	45,832	47,148
Fuel Oil w/o	50,000	41,323	44,717	46,414	47,263
Fuel Oil Wide Plan 1	70,000	57,852	62,061	64,165	65,217
Fuel Oil Wide Plan 2	90,000	74,381	79,323	81,794	83,030

The number of projected cargo vessel calls for the mid-level (base case) commodity forecast is presented in Table 3-9. Only a sub-set of Port Canaveral commodities and vessels would benefit from channel deepening as discussed above. Table 5-23 presents the total number of vessel calls for benefiting commodities for the base case commodity forecast at alternative plan depths without channel widening. Forecast year 2020 is presented in Table 5-23 as an example.

Table 5-23
Projected Benefiting Cargo Vessel Calls (without widening): 2020

	Without Project (-40 feet)	-42 feet	-43 feet	-44 feet
Aggregate	5	5	5	5
Cement	10	9	9	9
Limestone	16	15	14	14
Granite	16	15	14	14
Slag	6	6	6	6
Gasoline[1]	44	41	39	39
Distillate Fuel[1]	11	10	10	10
Totals	**108**	**101**	**97**	**97**

[1] Seaport Canaveral point-to-point tankers only

Channel deepening allows the use of larger vessels and/or allows existing vessels to load more efficiently. More efficient vessel use results in fewer vessel calls for the projected volume of cargo (Table 5-23). Channel widening has a similar effect on gasoline and distillate fuel vessels calling at Seaport Canaveral because longer vessels are able to use the channel under widening conditions. The use of larger vessels and the more efficient use of existing vessels reduce transportation costs. Table 5-24 provides an example (2020) of the transportation costs for benefitting cargo under without-project conditions and alternative deepening and widening conditions.

Total and incremental average annual equivalent transportation costs for large cargo vessels under without and with-project conditions are presented in Table 5-24. Benefits are calculated with and without alternative widening plans in effect. Channel widening impacts deepening benefits because the projected tanker fleet (gasoline and distillate fuel oil vessels only) calling at Seaport Canaveral Terminal will shift to larger vessels under Widening Plans 1 and 2. Channel deepening benefits decline slightly with widening plans in effect because without-deepening project transportation costs are less due to the use of larger tankers resulting in fewer tanker calls. Projected benefits exhibit diminishing returns to channel deepening in that incremental benefits decline at successively deeper project depths.

Table 5-24
Projected Benefiting Cargo Vessels Transportation Costs: 2020

	No Deepening	-42 feet	-43 feet	-44 feet
Aggregate	$780,715	$780,715	$780,715	$780,715
Cement	$5,966,563	$5,478,117	$5,478,117	$5,478,117
Granite	$968,030	$926,885	$885,741	$885,741
Limestone	$1,424,103	$1,374,220	$1,324,337	$1,324,337
Slag	$3,525,773	$3,059,702	$3,059,702	$3,059,702
Gasoline (no widening)	$6,904,473	$6,497,242	$6,225,755	$6,225,755
Distillate Fuel (no widening)	$1,734,753	$1,599,009	$1,599,009	$1,599,009
Total (no widening)	**$21,304,409**	**$19,715,890**	**$19,353,376**	**$19,353,376**
Gasoline (Widening Plan1)	$5,944,315	$5,631,474	$5,475,053	$5,475,053
Distillate Fuel (Widening Plan1)	$1,535,334	$1,378,913	$1,378,913	$1,378,913
Total (Widening Plan1)	**$20,144,832**	**$18,630,026**	**$18,382,578**	**$18,382,578**
Gasoline (Widening Plan2)	$5,358,201	$5,185,400	$5,012,599	$5,012,599
Distillate Fuel (Widening Plan2)	$1,350,772	$1,350,772	$1,177,971	$1,177,971
Total (Widening Plan2)	**$19,374,156**	**$18,155,811**	**$17,719,182**	**$17,719,182**

Table 5-25
Average Annual Equivalent Transportation Cost Savings: Deepening Alternatives

Plan	Total Transportation Cost	Total Transportation Cost Savings	Incremental Cost Savings
Without Channel Widening			
Without-deepening	$26,708,104		
-42 feet	$25,074,989	$1,633,114	$1,633,114
-43 feet	$24,345,037	$2,363,067	$729,953
-44 feet	$23,767,018	$2,941,086	$578,019
With Widening Plan 1 (450 feet)			
Without-deepening	$25,430,262		
-42 feet	$23,976,241	$1,454,021	$1,454,021
-43 feet	$23,306,902	$2,123,360	$669,339
-44 feet	$22,755,178	$2,675,084	$551,724
With Widening Plan 2 (500 feet)			
Without-deepening	$24,623,781		
-42 feet	$23,231,700	$1,392,081	$1,392,081
-43 feet	$22,621,773	$2,002,008	$609,927
-44 feet	$22,092,217	$2,531,564	$529,556

Tables 5-20 and 5-25, above, separately present the benefits of alternative widening and deepening plans. Projects that employ widening and deepening plans would generate the cumulative benefits of both types of improvement. For example, a project that combines Widening Plan 1 (450-foot channel width) with a -42-foot channel depth would generate $1,883,968 in widening plan benefits (Table 5-20) and $1,454,021 in deepening plan benefits (Table 5-25) for a total average annual project benefit of $3,337,989. Table 5-26 presents a matrix of total project benefits which would be generated by combining Widening Plan 1 (450 feet) or Widening Plan 2 (500 feet) with incremental deepening from -42 feet to -44 feet.

Table 5-26
Total Project AAEQ Benefits: Widening and Deepening Plan Combinations

	No Deepening	-42 feet	-43 feet	-44 feet
No Widening	-	$1,633,114	$2,363,067	$2,941,086
Widening Plan 1 (450 feet)	$1,883,968	$3,337,989	$4,007,328	$4,559,051
Widening Plan 2 (500 feet)	$2,829,748	$4,221,830	$4,831,756	$5,361,312

5.4 Net Benefits of Alternative Plans

The alternative plan net benefits presented in Tables 5-27 through 5-30 are calculated as the difference between the total annual average equivalent costs and benefits of each alternative. The incremental net benefits of the alternative plans are decreasing with successive plan increments, but remain positive overall, which indicates that the incremental benefits of each successive alternative are greater than the incremental costs. The incremental plan providing the greatest net benefits is the plan that includes both widening increments and all three deepening increments. This plan is identified as W2 and -44-foot deepening in Table 5-30.

Table 5-27
Cost – Benefit Analysis: Channel Widening Only

Alternative Plan	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	B/C Ratio
Widening Plan 1 (450 feet)	$1,448,734	$1,883,968	$435,233	$435,233	1.3
Widening Plan 2 (500 feet)	$1,960,442	$2,829,748	$869,306	$434,073	1.4

Note: Discount rate = 4.00%, period 50 years

Table 5-28
Cost – Benefit Analysis: Channel Deepening Only

Alternative Plan	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	B/C Ratio
-42 feet	$157,949	$1,633,114	$1,475,165	$1,475,165	10.3
-43 feet	$396,407	$2,363,067	$1,966,660	$491,494	6.0
-44 feet	$668,011	$2,941,086	$2,273,075	$306,415	4.4

Note: Discount rate = 4.00%, period 50 years

Table 5-29
Cost – Benefit Analysis: Widening Plan 1 (450 feet) and Channel Deepening

Alternative Plan	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	B/C Ratio
450-foot widening (W1) only	$1,448,734	$1,883,968	$435,233	$435,233	1.3
W1 and -42-foot deepening	$1,504,084	$3,337,988	$1,833,905	$1,398,671	2.2
W1 and -43-foot deepening	$1,764,285	$4,007,328	$2,243,043	$409,138	2.3
W1 and -44-foot deepening	$2,055,296	$4,559,051	$2,503,756	$260,713	2.2

Note: Discount rate = 4.00%, period 50 years

Table 5-30
Cost – Benefit Analysis: Widening Plan 2 (500 feet) and Channel Deepening

Alternative Plan	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	B/C Ratio
500-foot widening (W2) only	$1,960,442	$2,829,748	$869,306	$869,306	1.4
W2 and -42-foot deepening	$2,094,929	$4,221,830	$2,126,900	$1,257,594	2.0
W2 and -43-foot deepening	$2,377,931	$4,831,756	$2,453,826	$326,925	2.0
W2 and -44-foot deepening	$2,692,766	$5,361,312	$2,668,546	$214,721	2.0

Note: Discount rate = 4.00%, period 50 years

5.5 Summary of Accounts

The National Environmental Quality (EQ) account impacts of alternative plans are described in detail in Section 7: Environmental Consequences of the Section 203 Study. Contributions to the Regional Economic Development (RED) account are presented here, based on the Canaveral Port Authority FY 2009 Economic Impact Study (September, 2010). The alternative plans are not projected to affect total cargo volume at the port. Cargo is projected to be delivered more efficiently on more deeply laden vessels, but growth in the overall volume will not be influenced by the project. Table 5-31 presents Port Canaveral's estimated economic impact on business revenues, employment, and wages.

Table 5-31
Port Canaveral Economic Impacts

Port Canaveral Business Line	Business Revenues	Employment	Wages
Cruise	$916,011,000	8,908	$392,195,000
Cargo	$126,187,000	2,389	$178,393,000
Other	$98,711,000	1,796	$78,179,000
Total	**$1,140,910,000**	**13,093**	**$648,767,000**

Source: The 2009 Economic Impact of Port Canaveral, Martin Associates, September 2010.

Alternative plan contributions to the Other Social Effects (OSE) account are limited by the nature of with-project beneficial effects, which are reduced transportation costs for some commodities and cruise ships. Transportation cost reductions at the Port would improve the relative efficiency and competitive advantage of Port Canaveral as compared to other ports. Improved competition at Port Canaveral would support job, income, and revenue stability at the Port. Improved local economic stability, although not measured or assessed in this analysis, would be considered a positive contribution to the OSE account.

5.6 Risk and Uncertainty

The Engineering Appendix Attachment M: Cost and Schedule Risk Analysis addresses risk and uncertainty on the cost side of the project's economic analysis. The Cost and Schedule Risk Analysis identified 20.97% as the appropriate contingency level for the proposed project. On the benefit side of the economic analysis, sensitivity analyses are conducted on parameters that affect cargo and cruise ship related benefits:

- Commodity forecast uncertainty is addressed by ranking base-case commodity projections from most certain to least certain and assessing the benefit to cost ratio at alternative levels of certainty (Table 5-32);
- Reduced cruise ship schedule and lower commodity forecast as compared to the base case;
- Higher commodity projection as compared to the base case;

- Alternative Seaport Canaveral point-to-point vessel origins and destinations; and
- Alternative tonnage forecasts for:
  - Seaport Canaveral point-to-point vessels;
  - Cement;
  - Slag; and
  - Aggregate materials.

5.6.1 Commodity Forecast Uncertainty Ranking

An additional assessment of the impact of commodity forecast uncertainty is developed by ranking commodity projections based on perceived levels of certainty, from the most confident forecast to the least confident. Benefits based on commodities with the highest level of certainty (fuel) are presented as Scenario 1. Using fuel oil alone, as the single benefitting commodity, results in a benefit to cost ratio of 1.3 for the recommended plan. The addition of construction-related commodities (Scenario 2) increases the benefit to cost ratio up to the base case level (2.0) for the recommended plan. This assessment of uncertainty indicates that each alternative plan is economically justified using the most confident forecast assumptions. Therefore, the risk of recommending too large a plan is acceptable because the recommended plan is justified under the most restrictive commodity forecast.

Table 5-32
Port Canaveral Commodity Forecast Uncertainty Ranking

Scenario 1 Tug and Fuel Vessels Only (Most Certain)				
	500-foot widening only (W2)	W 2 and -42-foot deepening	W 2 and -43-foot deepening	W 2 and -44-foot deepening
Tugs	$745,426	$745,426	$745,426	$745,426
Fuel Vessels	$2,084,322	$2,476,427	$2,637,048	$2,719,182
Total Benefits	$2,829,748	$3,221,853	$3,382,474	$3,464,608
Costs	$1,960,442	$2,094,929	$2,377,931	$2,692,766
Net benefits	$869,306	$1,126,924	$1,004,543	$771,842
BCR	1.4	1.5	1.4	1.3
Scenario 2 Tug, Fuel Vessels, & Other Commodities (Less Certain)				
	500-foot widening only (W2)	W 2 and -42-foot deepening	W 2 and -43-foot deepening	W 2 and -44-foot deepening
Tugs	$745,426	$745,426	$745,426	$745,426
Fuel Vessels	$2,084,322	$2,476,427	$2,637,048	$2,719,182
Other Commodities	$ -	$999,976	$1,449,282	$1,896,704
Total Benefits	$2,829,748	$4,221,830	$4,831,756	$5,361,312
Costs	$1,960,442	$2,094,929	$2,377,931	$2,692,766
Net benefits	$869,306	$2,126,900	$2,453,826	$2,668,546
BCR	1.4	2.0	2.0	2.0

5.6.2 Reduced Cargo Forecast and Cruise Schedule

The first sensitivity analysis evaluates the effects of using the low cargo growth scenario and a reduced cruise ship schedule. The low growth scenario extends the impacts resulting from the recent economic down turn, such that rock products remain at one-half their projected 2012 through 2020, at which time they return to the base case forecast levels. Under this low growth sensitivity analysis Seaport Canaveral gasoline and distillate fuel imports remain at projected 2013 levels through 2020, at which time growth begins using the base case growth rates. This sensitivity analysis also reduces large cruise ship calls by 25%. Table 5-33 presents the cost-benefit analysis of the low forecast scenario for incremental increases in the project, from Widening Plan 1 to Widening Plan 2 with the -44-foot deepening.

Table 5-33
Cost – Benefit Analysis: Low Forecast Scenario

Alternative Plan	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	B/C Ratio
450-foot widening (W1) only	$1,448,734	$1,823,291	$374,557	$374,557	1.3
500-foot widening (W2) only	$1,960,442	$2,760,320	$799,878	$425,321	1.4
W2 and -42-foot deepening	$2,094,929	$4,087,131	$1,992,202	$1,192,324	2.0
W2 and -43-foot deepening	$2,377,931	$4,673,059	$2,295,128	$302,926	2.0
W2 and -44-foot deepening	$2,692,766	$5,177,039	$2,484,273	$189,145	1.9

Note: Discount rate = 4.00%, period 50 years

5.6.3 Increased Cargo Forecast

The most substantial differences between the high commodity forecast and the base case commodity forecast concerning Seaport Canaveral tanker and cement shipments to the Port. Under the high forecast Seaport Canaveral terminal grows at a faster short-term rate so that the facility achieves approximately 75% capacity by 2015, which is a 25% increase over the base case. The high commodity forecast for cement has cement imports returning to 2007 levels by 2012 instead of 2015. In addition, a third rock product terminal comes into operation by 2020. This higher estimate of projected calls increases channel widening benefits and channel deepening benefits, as presented in Table 5-34.

Table 5-34
Cost – Benefit Analysis: High Forecast Scenario

Alternative Plan	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	B/C Ratio
450-foot widening (W1) only	$1,448,734	$2,212,348	$763,614	$763,614	1.5
500-foot widening (W2) only	$1,960,442	$3,365,043	$1,404,601	$640,987	1.7
W2 and -42-foot deepening	$2,094,929	$4,990,449	$2,895,520	$1,490,919	2.4
W2 and -43-foot deepening	$2,377,931	$5,680,659	$3,302,728	$407,208	2.4
W2 and -44-foot deepening	$2,692,766	$6,238,321	$3,545,555	$242,827	2.3

Note: Discount rate = 4.00%, period 50 years

5.6.4 Increased Seaport Canaveral Forecast

Alternative Seaport Canaveral forecasts used as a sensitivity analysis include forecasts ranging from 80% of the base case forecast to 120% of the base case forecast (Table 5-35). The sensitivity analysis indicates proportionately similar impacts to net benefits for the higher and lower alternatives. The highest alternative (120% of the base case forecast) increases the net benefits of Widening Plan 2 (500 feet) with the -44-foot deepening by 19.95%. The lowest alternative (80% of the base case forecast) decreases net benefits by 19.97%. Total AAEQ net benefits for Widening Plan 2 (500 feet) with the -44-foot deepening range from $2,847,125 for the higher forecast to $1,899,611 for the lower forecast. The benefit/cost ratio similarly ranges from 2.2 to 1.8.

Table 5-35
Cost – Benefit Analysis: Alternative Seaport Canaveral Forecasts

Alternative Forecast	Total Net Benefits	Impact to Net benefits	B/C Ratio
120%	$3,205,840	$537,294	2.2
110%	$2,918,011	$249,464	2.1
105%	$2,802,391	$133,845	2.0
Base Case	**$2,668,546**	**- - -**	**2.0**
95%	$2,516,379	-$152,167	1.9
90%	$2,393,951	-$274,595	1.9
80%	$2,101,632	-$566,923	1.8

Note: Discount rate = 4.00%, period 50 years

5.6.5 Alternative Seaport Canaveral Vessel Origins

The actual origin distance data (Table 5-17) shows that Maracaibo, Venezuela is the import origin with the highest proportion of total tonnage (40.1%). Three sensitivity analyses were conducted by assigning the next two highest volume alternative ports as having 40.1% of import tonnage and with Maracaibo, Venezuela assuming the actual tonnage proportion of the alternative port (Table 5-36). Point Tupper, Canada was selected as an alternative major port because it has the next highest proportion of tonnage after Venezuela and because Canada is known to be expanding its oil production capabilities. Fortaleza, Brazil was selected as alternative port, rather than Rotterdam, Netherlands (the next largest proportion of tonnage), because Brazil is expanding production capabilities based on the discovery of the Tupi Field in 2007 and is projected to be one of the leading non-OPEC contributors (along with Canada and the United States) to world liquid fuel production growth[15]. Houston, Texas was selected as an alternative domestic origin based on potential increased US production.

Table 5-36: Weighted Average Distances (nautical miles)

	Major Port	Country	Weighted Average
Actual Origins	Venezuela	Maracaibo	2,014
Sensitivity 1	Point Tupper	Canada	1,945
Sensitivity 2	Houston	U.S. (Texas)	1,939
Sensitivity 3	Fortaleza	Brazil	2,728

The results of the sensitivity analyses (Table 5-37) using the actual weighted average origin distance indicates that there are very small differences between the deepening benefits cited in the Economics Appendix presented for the AFB and the benefits using actual weighted average origin distance (change of less than 1%). Similarly, there are only very small differences for sensitivity analyses that shift the major import location to Canada (Sensitivity 1) and Texas (Sensitivity 2). The largest change in benefits would occur with a shift to Brazil as a major origin for Seaport Canaveral imports (Sensitivity 3). A shift to Brazil would increase deepening benefits in a range of 12% to 14%. The revised Economics Appendix will use the actual weighted average distance in the benefits calculation as the most likely representation of future conditions.

[15] International Energy Outlook 2011, Analysis and Projections, U.S. Energy Information Administration, 19Sp11

Table 5-37: Seaport Canaveral Origins Sensitivity Analyses Average Annual Equivalent Transportation Cost Savings: Channel Deepening Only

	Actual Origins (Base Case)		Sensitivity 1		Sensitivity 2		Sensitivity 3	
Deepening Plan	**Total Benefits**	**% Change from Base Case**	**Total Benefits**	**% Change from Base Case**	**Total Benefits**	**% Change from Base Case**	**Total Benefits**	**% Change from Base Case**
-42 feet	$1,475,165	0.00%	$1,460,870	-0.97%	$1,459,627	-1.05%	$1,623,086	10.03%
-43 feet	$1,966,660	0.00%	$1,947,984	-0.95%	$1,946,360	-1.03%	$2,159,917	9.83%
-44 feet	$2,273,075	0.00%	$2,253,452	-0.86%	$2,251,746	-0.94%	$2,476,128	8.93%

5.6.6 Alternative Cement Forecasts

The Portland Cement Association (PCA) produced an analysis of projected future industry characteristics in 2011 titled "Overview Impact of Existing and Proposed Regulatory Standards on Domestic Cement Capacity". The PCA analysis projects domestic cement consumption, production, and imports through 2025 under two regulatory conditions. One regulatory condition includes the effects of five currently enacted environmental regulations and two proposed regulations (the with-current emissions policy condition) and the second regulatory condition excludes these existing and proposed regulatory standards (the without-current emissions policy condition). The implications of these two policy conditions is that imports are expected to increase more rapidly as a percentage of total cement usage under current emissions policy due to regulatory impacts on the level and cost of domestic production.

Under the with-current emissions policy condition, the most likely condition for USACE planning purposes, U.S. cement consumption is projected to increase from observed 2010 levels (68.9 million tons) to 170.8 million tons in 2025, an annual growth rate of 6.2%. Cement imports under the with-current emissions policy condition are projected to increase from observed 2010 levels (5.9 million tons) to 82.0 million tons in 2025, an annual growth rate of 19.2%. This reflects an increasing share of imports versus domestic production over this period.

Even under the without-current emissions policy condition, which favors domestic production over imports, cement imports are still projected to grow at an annual rate of 15.0%, achieving 48.0 million tons in 2025. Under the without-current emissions policy condition cement imports at the national level are projected to more than double between 2010 and 2015. Note again that the Economics Appendix very conservatively assumes no resumption of cement imports at Port Canaveral until 2015 with a subsequent growth rate of 2.8% thereafter.

One important contributing factor to the PCA import projections under both policy conditions is that domestic production is expected to level off beginning in 2015. Under the without-current emissions policy condition, domestic production levels off at a greater tonnage than under the with-current emissions policy condition.

Three sensitivity analyses were conducted using information contained in the PCA report:

- PCA 1 - On average, from 2000 through 2007, Port Canaveral cement imports were equivalent to 3.7% of all US cement imports. Starting in 2015, this sensitivity analysis calculates that Port Canaveral imports will resume and will equal 3.7% of the PCA without-current emissions policy condition cement import projection. After 2025, an annual growth rate of 2.81% (the base case cement imports growth rate) is used to forecast years 2026 – 2063.
- PCA 2 - Starting in 2015, this sensitivity analysis calculates Port Canaveral imports will resume and will equal 3.7% of the PCA with-current emissions policy condition cement import projection. After 2025, an annual growth rate of 2.81% (the base case cement imports growth rate) is used to forecast years 2026 – 2063.
- PCA 3 – In 2007, Port Canaveral cement imports were only 2.5% of all US cement imports, which is the lowest percentage of imports at Port Canaveral from 2000 through

2007. This sensitivity analysis calculates Port Canaveral imports as 2.5% of the PCA without-current emissions policy condition cement import projection (the lower of the two PCA import projection conditions). This analysis projects no Port Canaveral cement imports will resume until 2.5% of US imports is equivalent to the observed 2007 Port Canaveral cement import level. Under this scenario, imports are projected to begin in 2018 (539,450 tons) and continue to grow at PCA without-condition levels through 2025. After 2025, an annual growth rate of 2.81% (the base case cement imports growth rate) is used to forecast years 2026 – 2063.

Table 5-38 presents the base-case channel deepening benefits and deepening benefits under the four sensitivity analyses: 2007 Port Canaveral cement import levels not achieved until 2020 with a 2.81% growth rate thereafter and the three PCA-based scenarios. Note that cement vessels benefit from channel deepening and are not expected to contribute to channel widening benefits. The most restrictive 2020 commencement of cement benefits scenario produces fewer transportation cost savings than the base-case, as anticipated. Each of the three sensitivity analyses based on the PCA projections actually generated greater benefits that the base-case used for the calculation of benefits in the Economics Appendix. Sensitivity Analysis PCA 2, which estimates transportation cost savings using PCA import projections based on current emissions policies, and based on Port Canaveral's historical share of US cement imports, may be a more reasonable base case scenario than is currently identified in the Economics Appendix and would generate greater benefits for the project.

Table 5-38
Port Canaveral Cement Import Projection Sensitivity Analyses (Transportation Cost Savings)

Deepening Plan	Base Case		2020 Start with 2.81%		PCA 1		PCA 2		PCA 3	
	Total	Incremental	Total	Incremental	Total	Incremental	Total	Incremental	Total	Incremental
-42 feet	$1,475,165	$1,475,165	$1,325,531	$1,325,531	$2,389,712	$2,389,712	$3,433,052	$3,433,052	$1,831,940	$1,831,940
-43 feet	$1,966,660	$491,494	$1,763,284	$437,753	$3,148,064	$758,352	$4,641,872	$1,208,821	$2,399,917	$567,977
-44 feet	$2,273,075	$306,415	$2,024,649	$261,364	$3,593,670	$445,606	$5,401,929	$760,057	$2,776,762	$376,845

5.6.7 Alternative Slag Forecasts

The impact of the new EPA regulations on fly ash use and the limits on domestic production of slag are both strong indicators that slag imports will likely increase substantially in the near future, even in the absence of a robustly rebounding construction industry. As an example, if only half of projected fly ash use is replaced by slag (even though it is less expensive than Portland cement), then domestic slag consumption would increase to 30 million tons by 2025. Also, if net import reliance increases from 10% to 15% (which is highly likely given domestic production regulatory changes), then total imports would be 4.5 million tons. Under this scenario, the projected 2025 import tonnage (4.5 million tons) would be three times the 2010 level of imports (1.5 million tons), which implies an average annual growth rate of 7.6%. The base case scenario for the Port Canaveral Section 203 Study uses a growth rate of less than half of this: 2.81%. This growth rate is based on projected population growth, to project future slag and cement import tonnages and does not account for the competitive advantages cited previously.

Table 5-39 presents slag projections using:

- the base case growth rate (2.81%),
- one-half the base case growth rate (1.4%) and
- the growth rate based on the fly ash replacement and import versus domestic production assumptions presented above (7.6%).

Note that plant annual capacity is approximately 600,000 tons and is used as a cap on all projections, and also that the starting point for all scenario projections are based on the observed 2010 tonnage.

Table 5-39
Sensitivity Analysis: Alternative Slag Import Forecasts

	2011*	2020	2030	2040	2050	2060
Base case (2.81%)	235,856	302,646	399,260	526,715	604,973	604,973
Low estimate (1.4%)	235,856	267,294	307,162	352,378	405,627	466,130
Fly Ash Replacement (7.6%)	235,856	455,992	611,233	611,233	611,233	611,233

*Actual observed data

Lowering the slag import growth rate by 50% (Projection #2) pushes the year at which the Hanson plant capacity is achieved to beyond the end of the study period (2064). Alternatively, the forecast based on the impact of the new fly ash regulations (Projection #3) causes the Hanson plant capacity to be achieved 20 years earlier than the base case.

The impact of alternative growth rate projections on project benefits (Table 5-40) is less substantial for the low projections than for the higher projection. As shown in Table 5-39, a reduction of 50% in the projected growth rate only reduces slag benefits by 10-16% (depending on the channel deepening scenario analyzed); whereas the higher Projection 3 results in a doubling of benefits under all channel deepening scenarios. The cargo forecast presenting the effects of the new fly ash regulations (Projection #3) is considered to be a better indication of future growth than the base-case forecast, since it is based on industry-specific competitive conditions rather than a general trend among the observed relationship between cement import growth and population growth. Certainly it is a more likely scenario than Projection #1, since there is no independent analysis which plausibly suggests that currently published population projections for Florida are likely to be 100% too high.

Table 5-40
Port Canaveral Slag Import Projection Sensitivity Analyses

Deepening Plan	Base Case (2.81% annual growth rate)		Low Forecast (one-half base-case projection = 1.4% annual growth rate)		Fly Ash Regulation & Domestic Slag Production Impact (7.6% annual growth rate)	
	Total Benefits	**% Change from Base Case**	**Total Benefits**	**% Change from Base Case**	**Total Benefits**	**% Change from Base Case**
-42 feet	$ 1,475,165	n/a	$1,381,352	-6.36%	$1,565,566	6.13%
-43 feet	$ 1,966,660	n/a	$1,889,091	-3.94%	$2,032,853	3.37%
-44 feet	$ 2,273,075	n/a	$2,116,430	-6.89%	$2,454,136	7.97%

5.6.8 Alternative Aggregate Materials Forecast

Rock (aggregate, limestone, and granite) forecasts were provided by the CPA based on term sheets for the two major bulk handling firms operating at the port. The term sheet is a planning document used by the operator and the CPA to allocate resources and terminal area. The term sheet provides a revenue stream estimate for the CPA and is used to establish minimum guarantee fees. The term sheets for both firms provide commodity projections from 2011 through 2035. In this analysis, there is no further growth projected for these commodities beyond growth identified in the term sheets, due to forecast uncertainty.

Port Canaveral is uniquely situated as the only deep water port on Florida's central east coast with the ability to handle and store the amount of rock products identified in the term sheets. The importance of Port Canaveral's location, as explained by the operators, is that continued infrastructure development along the Orlando/Interstate 4 corridor requires more rock products than can be supplied through existing and historical local sources. The fixed location of rail infrastructure and the inability to develop potential sources within the Everglades due to land use constraints increase the need for imported rock products. At the same time, vessels carrying international rock products are increasing in size, lowering per unit transportation costs and increasing their cost competitiveness in the central Florida market. For example CSL, one of the world's major bulk carriers which also calls regularly at Port Canaveral, will have a new fleet of Panamax bulk vessels in service by 2012 with draft capabilities of 44 feet.

An update on the status of the two new bulk terminal operators at Port Canaveral indicates that both facilities are currently under construction and are approximately one year behind schedule due to permitting issues. The permitting issues have been resolved, terminal construction is underway, and both facilities will be in operation in 2012. In addition, a third bulk terminal operator is investigating a long-term lease at Port Canaveral, which would include new bulk terminal facility on the north side of the port complex. This potential third bulk operation would be similar in capacity and handle similar commodity types as the two facilities currently under construction.

Three sensitivity analyses were developed to assess the impact of changes in the aggregate materials forecast on project benefits. The first sensitivity analysis identifies the impacts of a two year delay in commencing operations at the port for both facilities. The second sensitivity analysis includes a two year delay for both facilities but also includes a new third facility entering operations in the same year as the existing facilities. The third sensitivity analysis presents the impact of cutting the forecast for each of the two facilities by 50%.

These bulk vessels are not projected to benefit from a wider channel; therefore, the transportation cost savings presented in Table 5-41 are channel deepening benefits only. The sensitivity analysis changes in bulk commodity forecasts generate relatively small changes in overall deepening benefits largely because the these bulk commodities generally have lower transportation costs than cement or slag due to import origins in the Caribbean and Canada.

Table 5-41
Port Canaveral Aggregate Import Projection Sensitivity Analyses

Deepening Plan	Base Case		Two Year Delay		Two Year Delay with Third Facility		Commodity Forecast at 50% of Base-case	
	Total	Incremental	Total	Incremental	Total	Incremental	Total	Incremental
-42 feet	$1,475,165	$1,475,165	$1,462,600	$1,462,600	$1,540,218	$1,540,218	$1,471,272	$1,471,272
-43 feet	$1,966,660	$491,494	$1,946,977	$484,377	$2,018,915	$478,697	$1,873,276	$402,004
-44 feet	$2,273,075	$306,415	$2,255,070	$308,093	$2,320,876	$301,961	$2,187,651	$314,375