NORTH CAROLINA
MARITIME Strategy

NC Maritime Strategy
Peer Ports Existing and Planned Port Infrastructure

Prepared for the
North Carolina Department of Transportation

by

AECOM
in association with URS

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DISCLAIMER

ACKNOWLEDGEMENTS

Initiated by the Governor's Logistics Task Force (GLTF), the *North Carolina Maritime Strategy* takes a fresh look at North Carolina's maritime assets and the needs for improvement to ensure that our State remains competitive in the future. A *Maritime Strategy* Executive Team has been formed to oversee this process, evaluate the results and provide an objective technical and economic analysis. The *Maritime Strategy* Executive Team includes: Lieutenant Governor Walter Dalton; the Governor's Senior Policy Advisor, Al Delia; Secretary of Transportation, Gene Conti; Secretary of Commerce, J. Keith Crisco; and Secretary of Environment and Natural Resources, Dee Freeman. The following North Carolina Department of Transportation (NCDOT) and North Carolina Department of Commerce (NCDOC) staff have provided day-to-day direction, guidance and support for study execution: NCDOT Director of Strategic Initiatives, Roberto Canales PE; NCDOT Project Manager, Virginia Mabry; NCDOT Liaison to the Lieutenant Governor, W. Seth Palmer; NCDOT/Commerce Liaison Joseph (Jed) McMillan; and Transportation Consultant to NCDOT and Global TransPark, Charles Diehl.

A Maritime Advisory Council, comprising State officials and staff, along with industry representatives from ocean shipping, trucking, rail and manufacturing interests, as well as community-at-large representatives, has provided further guidance and support to the study team. A roster of Advisory Council membership is included in the appendix of this report.

Finally, broad-based stakeholder outreach is key to successful development of the statewide *Maritime Strategy*. A comprehensive and ongoing public involvement program has provided additional input to the study by engaging the public, agencies and others through a series of informational meetings, public workshops and focused discussions with industry, as well as environmental and community groups.

EXECUTIVE SUMMARY

The *North Carolina Maritime Strategy* is being developed to connect maritime goods and economic development in North Carolina. This is accomplished through the following primary tasks:

- Facilitated collaboration of freight transportation, economic development and community interests as input to the statewide strategy,
- Definition of North Carolina's economic context and maritime market positioning strategies that would offer the greatest economic benefit to the State, and
- Identification of infrastructure investments and policies that would most significantly enhance North Carolina's economy through improved performance of the State's maritime gateways and related trade corridors.

The *North Carolina Maritime Strategy* will define maritime market scenarios in which the State could realize economic and public benefit. Opportunities to be explored will include those associated with import and export of containerized cargo, as well as the potential for expanded bulk, breakbulk, petrochemical and military cargos. Special emphasis will be made to link potential market positions with industry in the State. The range of market position alternatives to be investigated may include regional transshipment of goods, container-on-barge service and major international container terminal operations.

For each viable market scenario, the Strategy will define its infrastructure needs. Transportation investments to be examined may include reconfiguration or modernization of existing port facilities, new terminal developments, wharf and channel improvements, road and rail connections, and inland intermodal facilities. A comparative analysis of development alternatives will be conducted to measure the relative benefits, effectiveness and costs associated with various alternatives for market positions and associated infrastructure.

As input to the definition of infrastructure needs and opportunities, this *Peer Port Existing and Planned Port Infrastructure* technical memorandum provides an inventory of existing and currently-planned regional port facilities including water depth, rail access, and freeway access. Terminal size, shape and mode of operation are described to include cargo storage and handling equipment, methods, and productivity.

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LIST OF ABBREVIATIONS

APMT	A.P. Moller Maersk Group
ASC	Automated Stacking Cranes
BIT	Blount Island Terminal
CIDMMA	Craney Island Dredged Material Management Area
CIT	Colonel's Island Terminal
CST	Columbus Street Terminal
CY	Container Yard
DC	Dock Cranes
DPMT	Dames Point Marine Terminal
GCT	Garden City Terminal
GPA	Georgia Port Authority
I-26	Interstate 26
I-526	Interstate 526
MPT	Mayor's Point Terminal
MT	Marine Terminal
NCT	North Charleston Terminal
NIT	Norfolk International Terminal
NNMT	Newport News Marine Terminal
OCT	Ocean Terminal
PG	Port of Georgetown
PMT	Portsmouth Marine Terminal
PPX	Post Panamax
Ro/Ro	Roll on Roll off
RTG	Rubber Tired Gantry crane
SCSPA	South Carolina State Port Authority
Strad	Straddle Carrier
TEU	Twenty-Foot Equivalent Units
TP	Top Pick
TT	Talleyrand Terminal
USACE	U.S. Army Corps of Engineers
VIT	Virginia International Terminals
VT	Veterans Terminal
Whl	Wheeled Storage
WWT	Wando Welch Terminal

1 PEER PORTS SUMMARY

This chapter summarizes the capacity analysis of North Carolina's peers to benchmark and define the State's current competitive position in the regional and global marketplace. The Port of Wilmington competes for the container market with peer ports on the US East Coast, including Norfolk, VA; Charleston, SC; Savannah, GA; and to a lesser extent, Jacksonville, FL. For the non-container market, the extent of competition varies based on many parameters including the type of cargo being handled and proximity of ultimate importer/exporter of the cargo in relation to the port location.

An in-depth review of the existing and planned facilities at these peer ports was conducted based on the publicly available information, to determine the extent of potential capacity available in the study region for handling various types of cargo. Existing berth lengths, number of dock cranes, container yard (CY) size, mode of operation and railroad access for each of these ports' container terminals and relevant information for non-container handling terminals are summarized in this report.

For various market scenarios discussed in the North Carolina Maritime Strategy Study reports, the peer ports and regional capacity in addition to the market forecast was used to determine the extent of potential peer freight that is divertible to North Carolina for alternate infrastructure expansion scenarios.

1.1 Peer Ports Capacity Summary

Based on the publicly available information on existing and planned port infrastructure in Virginia, South Carolina, Georgia, and Florida, the annual terminal capacity was determined for containers, breakbulk, bulk, and Ro/Ro cargo handling operations.

Table 1: Peer Ports Capacity Utilization SummaryTable 1 summarizes peer ports capacity utilization calculated based on the independent evaluation of terminal capacity for each cargo type vs. actual amount of cargo handled in 2010. Peer ports capacity analysis is described in detail in this report.

It is concluded that North Carolina peer ports, as a total, are operating at approximately 50 percent of capacity for handling containers and Ro/Ro cargo. For breakbulk cargo, the peer ports are operating at less than 20 percent of the capacity and for bulk cargo, the peer ports are operating at 71 percent of the capacity.

For the containerized cargo, Georgia is operating with the highest capacity utilization of 63 percent and South Carolina is operating with the lowest capacity utilization of 40 percent.

For the breakbulk cargo, Port of Wilmington is operating with highest capacity utilization of 70 percent and Virginia is the lowest at 3 percent. And for bulk cargo, again Georgia is operating at the highest capacity utilization of 84 percent and Port of Morehead City is the lowest at 46 percent.

The Ro/Ro capacity utilization is highest at Jacksonville at 84 percent and lowest in Virginia – having no automobiles being handled despite having the capacity.

Table 1: Peer Ports Capacity Utilization Summary

	Containers TEU	**Breakbulk** Tons	**Bulk** Tons	**Ro/Ro** Units
Virginia				
Terminal Capacity	3,630,000	6,820,000		320,000
2010 Throughput	1,895,018	230,246		
% Utilization	52%	3%		0%
South Carolina				
Terminal Capacity	3,230,000	4,030,000	100,000	200,000
2010 Throughput	1,280,000	991,705	-	106,498
% Utilization	40%	25%	0%	53%
Georgia				
Terminal Capacity	4,500,000	7,440,000	2,110,000	1,070,000
2010 Throughput	2,825,178	1,239,091	1,772,897	477,851
% Utilization	63%	17%	84%	45%
Jacksonville				
Terminal Capacity	1,800,000	3,550,000	2,400,000	950,000
2010 Throughput	826,580	580,326	1,515,161	795,773
% Utilization	46%	16%	63%	84%
Peer Ports				
Regional Capacity	13,160,000	21,840,000	4,610,000	2,540,000
Regional Demand	6,826,776	3,041,368	3,288,058	1,380,122
% Utilization	52%	14%	71%	54%

Figure 1 shows a summary of container capacity at the peer ports vs. actual published 2010 TEU throughputs.

Figure 1: Peer Ports Container Capacity by Port

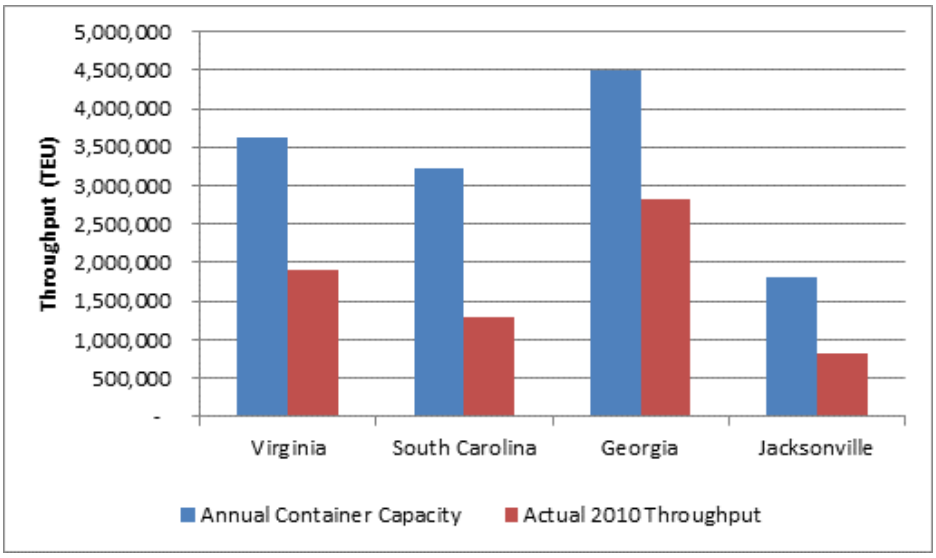
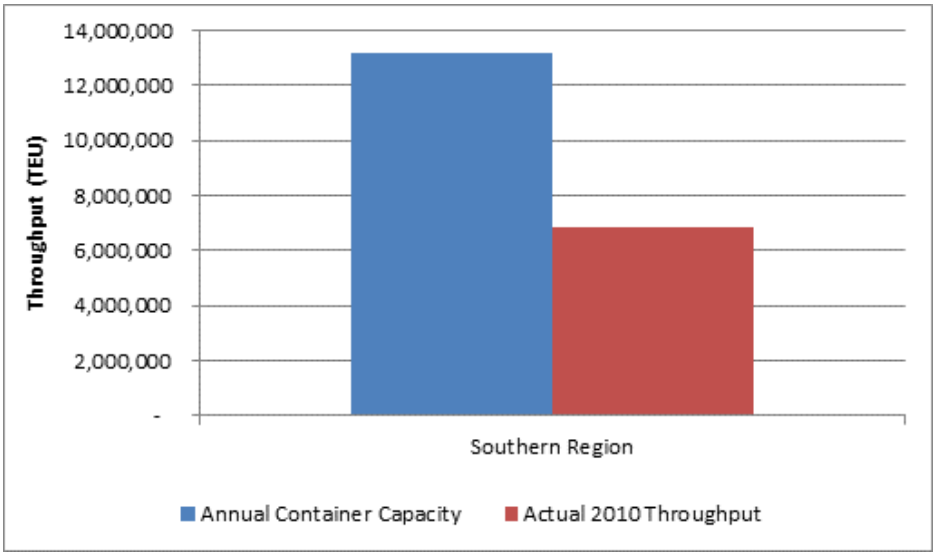


Figure 2 summarizes the container capacity vs. the actual throughput of the Southern Atlantic region characterized as a sum of all the Peer Ports.

Figure 2: Peer Ports Container Capacity Summary



The berth and storage capacities were calculated for individual terminals that makeup such ports as the: Port of Virginia, Port of Charleston, Port of Georgetown, Port of Savannah, Port of

Brunswick, and the Port of Jacksonville. Once the berth and storage capacities were calculated the smaller value of the two was selected to be that terminal's capacity. The terminal capacity is the maximum amount of tons handled at a terminal, due to berth and/or storage limitations.

Figure 3 sums up all the terminal capacities from ports in Virginia, South Carolina, Georgia, and Florida (Jacksonville only) with breakbulk operations. These values make up the annual breakbulk capacity, and they are then compared to the published 2009/2010 tonnage throughputs.

Figure 3: Peer Ports Breakbulk Capacity by Port

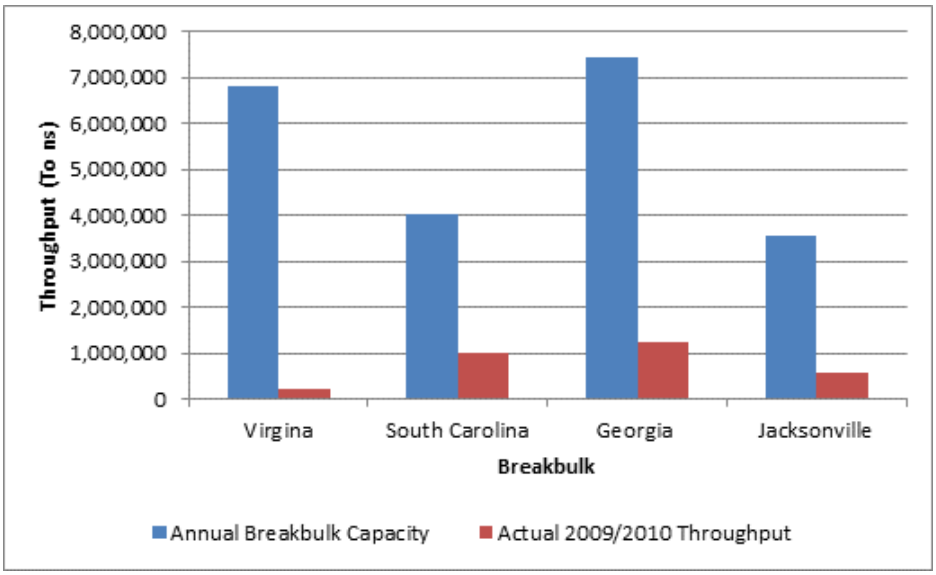


Figure 4 sums up the results determined in Figure 3, to show what the Southern Atlantic Region can handle versus what they actually handled in terms of breakbulk cargo.

Figure 4: Peer Ports Breakbulk Capacity Summary

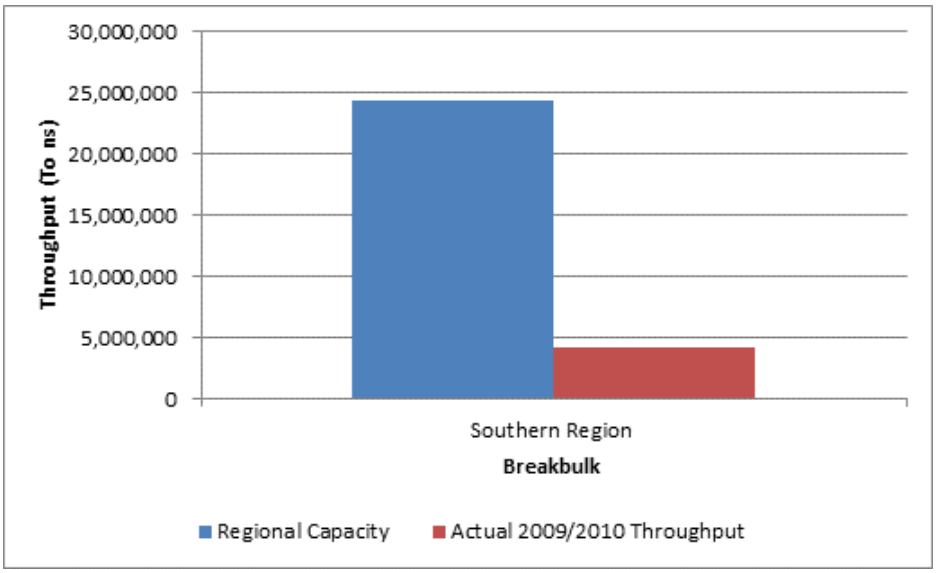


Figure 5 sums up all the terminal capacities from ports in Virginia, South Carolina, Georgia, and Florida (Jacksonville only) that handle bulk commodities. These values make up the annual bulk capacity, and they are then compared to the published 2009/2010 tonnage throughputs.

Figure 5: Peer Ports Bulk Capacity by Port

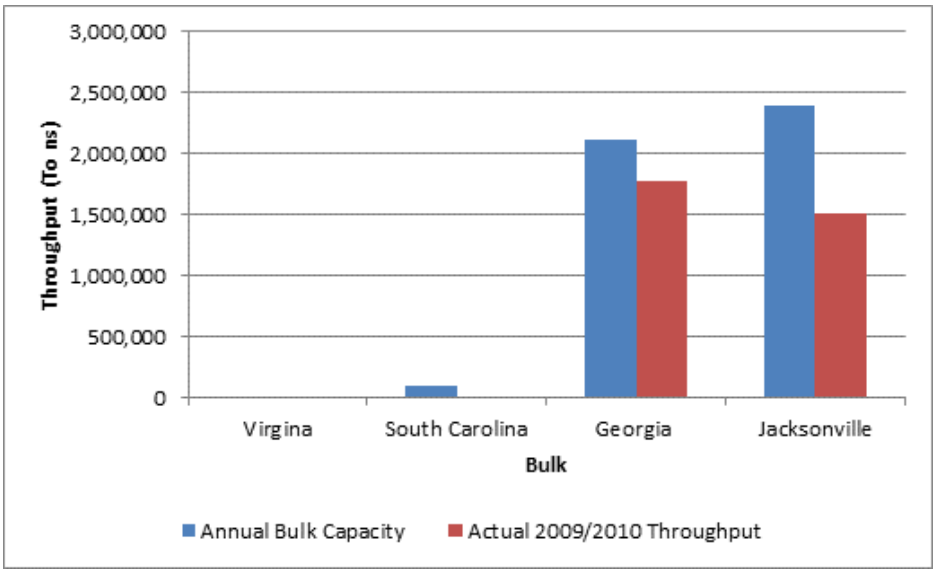


Figure 6 sums up the results determined in Figure 5, to show what the Southern Atlantic Region can handle versus what were the actually handled throughputs for bulk cargo.

Figure 6: Peer Ports Bulk Capacity Summary

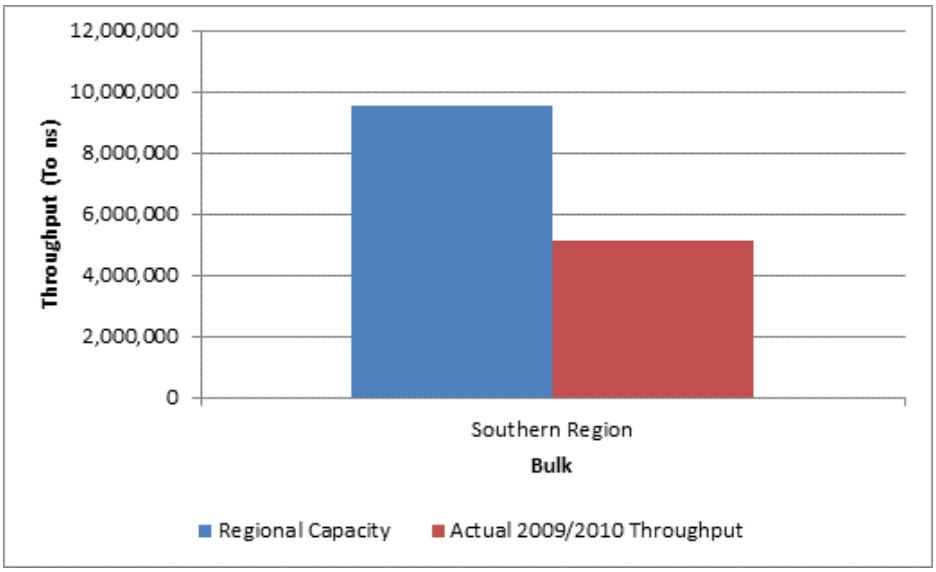


Figure 7 sums up all the terminal capacities from ports in Virginia, South Carolina, Georgia, and Florida (Jacksonville only) that handle Ro/Ro cargo, which mainly constitutes vehicles such as automobiles. These values make up the annual capacity, and they are then compared to the published 2009/2010 vehicle throughputs.

Figure 7: Peer Ports Ro/Ro Capacity by Port

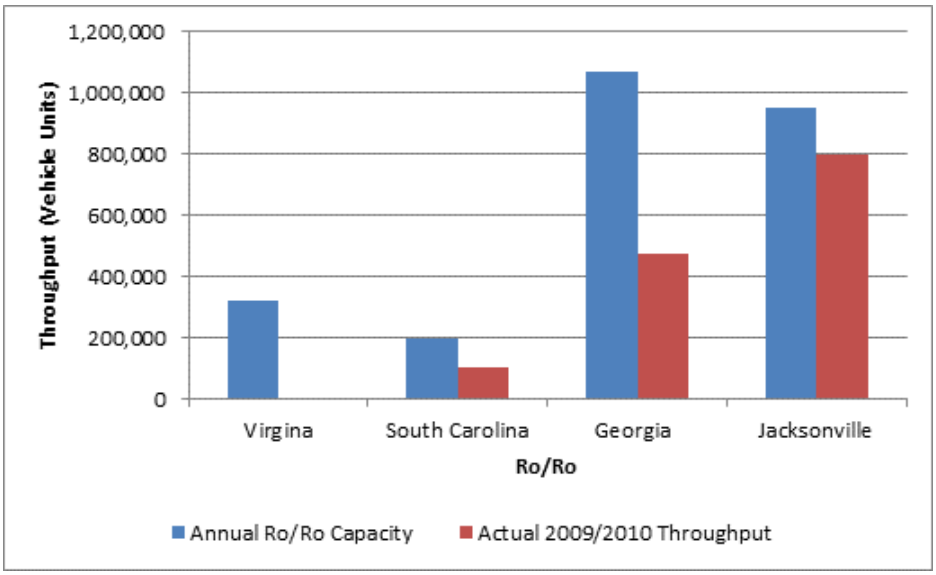


Figure 8 sums up the results determined in Figure 7, to show what the Southern Atlantic Region can handle versus current Ro/Ro handling throughputs.

Figure 8: Peer Ports Ro/Ro Capacity Summary

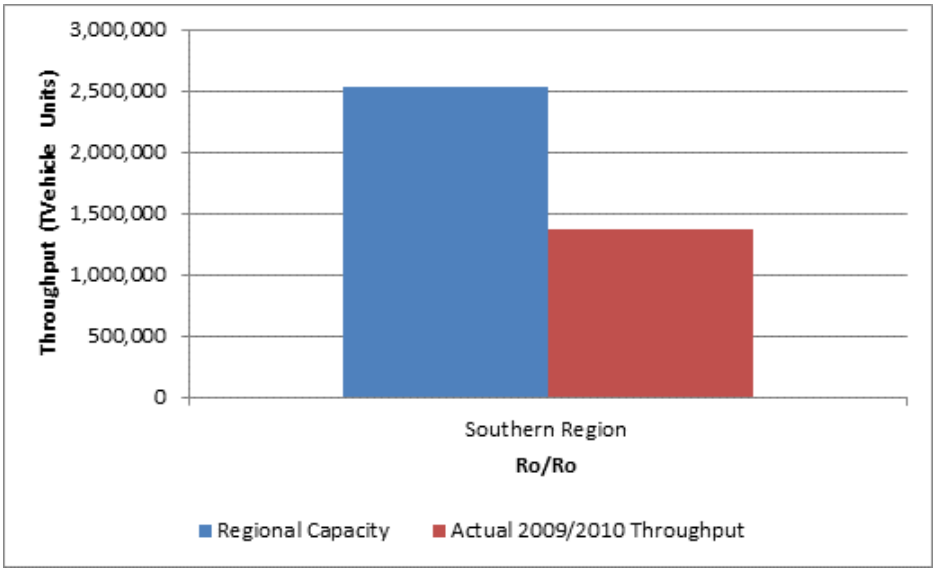


Table 2 summarizes the revenues, in millions, for the peer port authorities in the Southern Atlantic Region. Table 2 also summarizes the revenue per ton for the peer port authorities.

Table 2: Peer Ports Revenues

2010	Revenue (in millions)	Revenue (per ton)
Virginia Port Authority	$193.79	$12.44
South Carolina State Port Authority	$111.74	$10.80
Georgia Port Authority	$238.32	$11.11
Port of Jacksonville, FL	$50.60	$6.25

2 PEER PORTS CAPACITY ANALYSIS METHODOLOGY

As part of the Data Collection and Analysis task, the AECOM/URS team collected data on the existing port infrastructure at North Carolina's peers as a baseline for defining the State's current competitive position in the global marketplace for cargo handling capacity.

This section describes existing port infrastructure at following peer ports for comparison of existing and future planned capacity.

- Norfolk, Virginia
- Charleston, South Carolina
- Savannah, Georgia
- Jacksonville, Florida

For each peer port, the existing and future planned port infrastructure is described for container and non-container handling operations. The information was collected from various publicly-available data including port websites and studies conducted by other consulting firms. In cases where very limited data were available publicly, AECOM contacted peer ports to request the necessary information.

After an extensive data search for each peer port in the Southern Atlantic region, it was found that very limited data were available on the type of storage, the static storage capacity, mix of vessel sizes called at the port, amount of cargo handled per vessel call and the number of berths used for container, bulk, breakbulk and Roll on Roll off (Ro/Ro) commodities.

Most ports did provide however, general data on types of commodities they handled, and other general information including: terminal size, the number of berths or piers, berth or pier length, the available covered and open areas, the mode of operation for the terminal, the water depth, and annual throughput statistics for containerized, bulk, breakbulk, and Ro/Ro cargo.

For terminals with more than one mode of operation, the publicly available data included all facilities without providing a breakdown of facilities used by mode. When this occurred, AECOM used professional judgment based on industry knowledge and use of the Google Earth Professional program to separate out facilities used to handle the bulk (open and covered area), breakbulk (open and covered area), container and Ro/Ro cargo.

2.1 Container Terminal Capacity Analysis Assumptions

For each container terminal at a peer port, based on the limited operations data available, the existing container terminal capacity was determined, which is calculated as the minimum of two key capacity elements, berth capacity (capacity to handle containers over the berth) and Container Yard (CY) capacity (capacity to handle containers inside the yard). Landside access capacity was assumed to not limit the overall terminal capacity for this analysis.

Berth capacity – the potential maximum throughput of containers handled over the berth (measured in twenty-foot equivalent units or TEU), was calculated based on the following assumptions:

Number of Available Berths: The number of berths on the facility which are operational and provide access to 100' gauge cranes required to service typical-size container vessels. Since every terminal did not provide enough specific information, an assumption was made that one berth is equivalent to 1,200 feet.

Container Moves per Vessel Call: An average of 1,900 container moves per vessel call, also known as *lifts per vessel call* was used for every container terminal at peer ports.

Dock Cranes Assigned per Vessel: Depending on the terminal, three to four dock cranes was assumed to service a typical vessel. By taking an average, it was assumed that all container terminals at peer ports would assign 3.5 dock cranes per vessel call.

Productivity per Dock Crane: A net dock crane productivity of 30 moves per hour was used for all facilities except for APMT Virginia – which was set to 35 moves per hour.

Maximum Practical Berth Utilization: It is a key subjective variable in a berth capacity analysis. No berth can effectively run at 100 percent full. With a typical vessel schedule that includes a peak period and delays in vessel arrival/departure times, most facilities cannot operate much above 60 percent without vessel queuing. For this analysis, 60 percent is used for all facilities except 70 percent was used for the Garden City Terminal in Savannah (due to more than seven contiguous berths).

Unproductive Time at Berth: It accounts for ship tie-up and untie time, which represents time when the berth is physically occupied by a vessel (i.e. no other vessel can be in that berth position) but there is no crane activity, excluding breaks which are captured by the work hours per day input. This activity includes mooring, line fastening, unlashing prior to first container move, administrative clearance, and so forth. An average of 3 hours of unproductive time at berth per vessel call was assumed for all terminals.

Peak/mean Week Seasonal Demand: For all terminals, it is assumed that a peak week berth demand will be 20 percent higher than the average weekly demand to account for changes in seasonal demand.

TEU per Container: A factor of 1.75 was used to convert vessel moves to TEU.

CY Capacity - For the annual storage capacity of containerized cargo, the industry average container yard capacity per gross acre was determined by the type of equipment used at each specific terminal, which was then multiplied by the gross terminal acreage to determine the annual CY capacity.

- For terminals that use rubber tired gantry cranes and top picks (RTG/TP) inside the CY, static storage capacity of 7,500 TEU per gross acre was used in the analysis.
- For terminals with wheeled storage or top picks (Whl/TP) inside the CY, static storage capacity of 3,500 TEU per gross acre was used in the analysis.
- For terminals with straddle carrier (strad), static storage capacity of 4,500 TEU per gross acre was used in the analysis.
- For the APMT terminal in Virginia that uses Automated Stacking Cranes (ASC) inside the CY, a value of 10,000 TEU per gross acre was used in the analysis.

2.2 Non-Container Terminal Capacity Assumptions

To determine the storage capacity for all the non-container terminals/ports in the Southern Atlantic region, the following assumptions were made:

- For terminals without a published static storage capacity, a relationship was developed between the storage area and the static storage capacity for specific commodities from the Port of Wilmington and the Port of Morehead City.
- For terminals that handle bulk and breakbulk, these commodities were given a dwell time of 30 days.
- For terminals that handle Ro/Ro, these commodities were given a dwell time of 15 days.
- For most terminals that handle bulk and breakbulk, a peak/mean inventory value of 150 percent was used.
- For terminals that handle Ro/Ro, a peak/mean inventory value of 110 percent was used.
- Only at the Port of Georgetown and Port of Brunswick, the 110 percent peak/mean inventory value was used for such products as metal, chemical, and wood pulp.

In contrast to container cargo, limited information is available in the public domain regarding non-containerized volumes at South Atlantic ports. The comparative share of imports versus exports, the amount of berths commodities used, the type of transfer system used, and the average vessel overall length are not known. For the ports in the Southern Atlantic region assumptions were made to calculate the annual berth capacity as follows:

- The number of berths available was determined by using aerial photographs and available port map layouts.
- The ship work day was assumed to be 21 hours.
- The maximum work days per week was assumed to be seven (7) days.
- The non-working hours at the berth were assumed to be four (4) hours.
- The weekly peaking factor was assumed to be 110 percent.
- The mean cargo handled for bulk was assumed to be 20,000 tons.
- The mean cargo handled for breakbulk was assumed to be 10,000 tons.
- The mean cargo handled for Ro/Ro was assumed to be 10,000 vehicles.
- The loading/ unloading rate for bulk was determined to be 800 tons per hour.

- The loading/ unloading rate for breakbulk was determined to be 300 tons per hour.
- The loading/ unloading rate for Ro/Ro was determined to be 100 units per hour.

3 NORFOLK, VIRGINIA

The Port of Virginia has the following four existing major cargo handling terminals:

- Norfolk International Terminal
- Portsmouth Marine Terminal
- APMT Virginia
- Newport News Marine Terminal

Figure 14 shows location of these four cargo handling facilities at the Port of Virginia.

Norfolk International Terminal (NIT) as shown in Figure 15 is the largest terminal in the Port of Virginia at 648 acres.[1]

Portsmouth Marine Terminal (PMT) is the second largest terminal in the Port of Virginia. On the east side of PMT the modes of operations include container, Ro/Ro, and breakbulk cargo as shown in Figure 16.[2]

The smallest of the terminals in the Port of Virginia is Newport News Marine Terminal (NNMT); an aerial view of the terminal can be seen in Figure 17. The northern end of the terminal is used for the breakbulk and Ro/Ro cargo operations.[3] The south end of the terminal has a coal loading system run by Dominion Terminal Associates. This report excludes the coal handling capacity and facility associated with it.

APMT Virginia is the newest terminal at the Port of Virginia as shown on Figure 18. APMT Virginia has a 291-acre terminal size, with 124 acres of existing wetlands, 17 acres of created wetlands, 7 acres of service yard, and 130 acres undeveloped, for a total of 576 acres[4]. All four of the terminals have railroad access on site.

Table 3 and Table 4 presents key attributes of container and non-container handling terminals in the Port of Virginia, respectively. The water depths presented in the tables were provided by the Virginia International Terminals (VIT).[5] As for the number of berths/piers, berth/pier length, covered area, and open areas, appropriate assumptions were made with the use of the Google Earth Professional program. These assumptions were checked with data provided by the VIT, where available.

Figure 9 and Figure 10 summarize the total berth length and the total area of terminals in Virginia.

[1] http://www.portofvirginia.com/facilities/norfolk-international-terminals.aspx
[2] http://www.portofvirginia.com/facilities/portsmouth-marine-terminal.aspx
[3] http://www.portofvirginia.com/facilities/newport-news-marine-terminal.aspx
[4] http://www.portofvirginia.com/facilities/apmt-virginia.aspx
[5] http://www.vit.org/CranesChannels.aspx

Figure 11 summarizes the annual berth and CY capacity for container terminals in Virginia. Figure 12 combines the bulk and breakbulk berth and storage capacities for the Port of Virginia. Figure 13 combines the Ro/Ro berth and storage capacities for the Port of Virginia. In the following sections, the calculations used to determine the berth, CY, and storage capacities are reviewed.

Table 3: Port of Virginia Container Handling Terminal Information

Norfolk, VA	Berth Len (ft)	Water Depth (ft)	# DC Total	# DC nPPX Outreach (20 wide)	Container Terminal Size (acres)	Mode of Operation	Railroad Access
Norfolk International Terminals	5,730	48	14	14	648	Strad	Yes
Portsmouth Marine Terminal	3,540	43	9	0	219	Strad	Yes
APMT Virginia	3,025	55	6	6	291	ASC	Yes

Table 4: Port of Virginia Non-Container Handling Terminal Information

Norfolk, VA	Number of Berths/ Piers (each)	Berth/Pier Length (ft)	Water Depth (ft)	Total Terminal Size (acres)	Covered Area (ft^2)	Open Area (acres)	Mode of Operation	Railroad Access
Norfolk International Terminal	6	9,000	37	120	1,700,000	85	Ro/Ro, Breakbulk	Yes
Portsmouth Marine Terminal	2	2,000	43	20	60,000	18	Ro/Ro, Breakbulk	Yes
Newport News Marine Terminal	4	4,000	39	140	400,000	50	Containerized, Breakbulk, Ro/Ro, LASH, Cargo	Yes

Figure 9: Berth Lengths - Port of Virginia

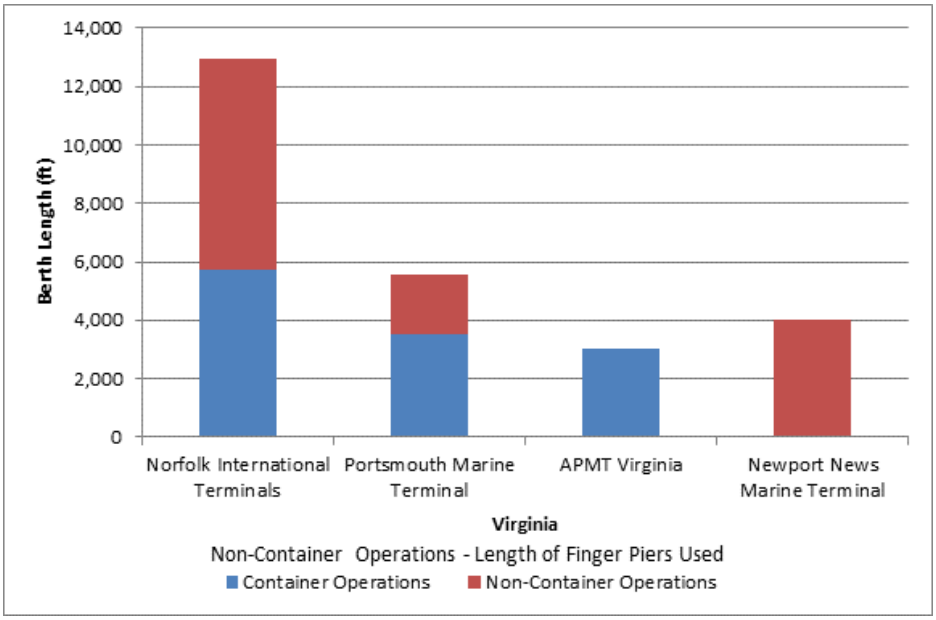


Figure 10: Terminal Sizes – Port of Virginia

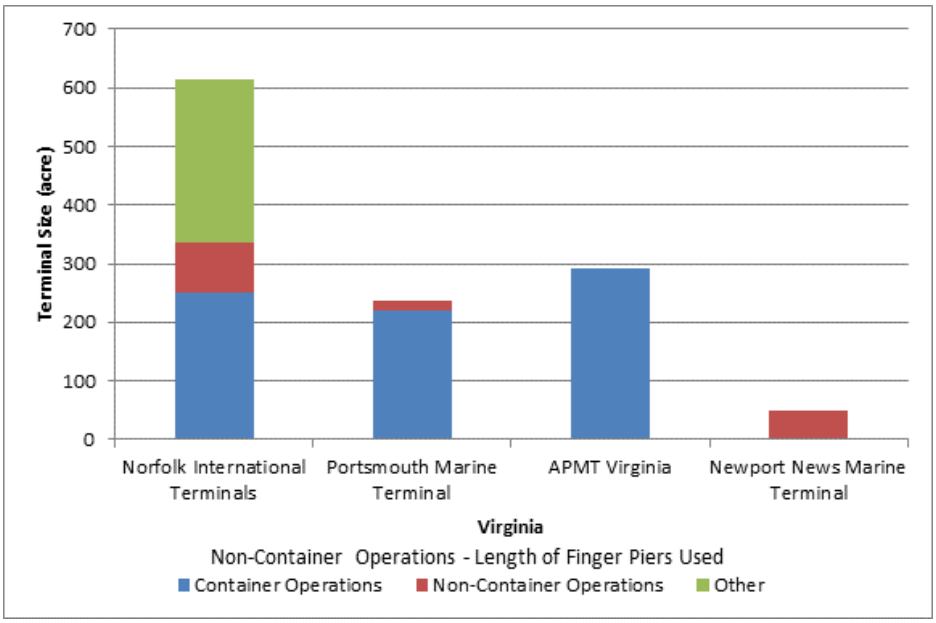


Figure 11: Container Capacity - Port of Virginia

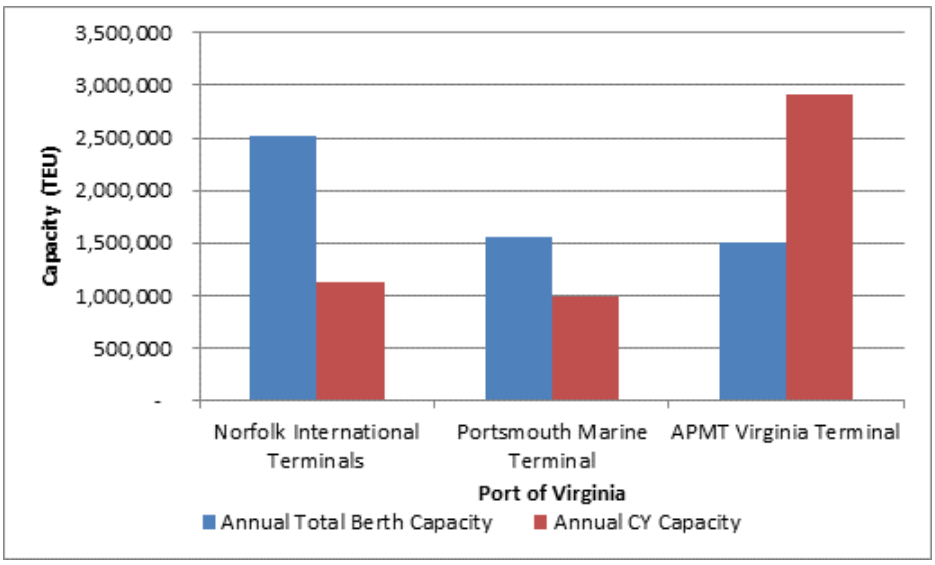


Figure 12: Port of Virginia Non-Container (Bulk/Breakbulk) Capacity

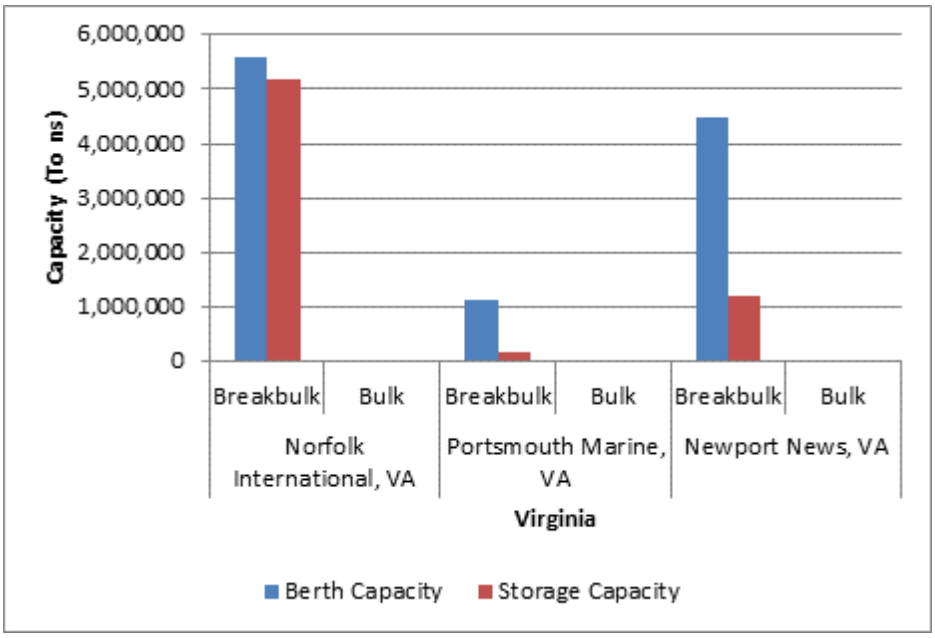


Figure 13: Port of Virginia Non-Container (Ro/Ro) Capacity

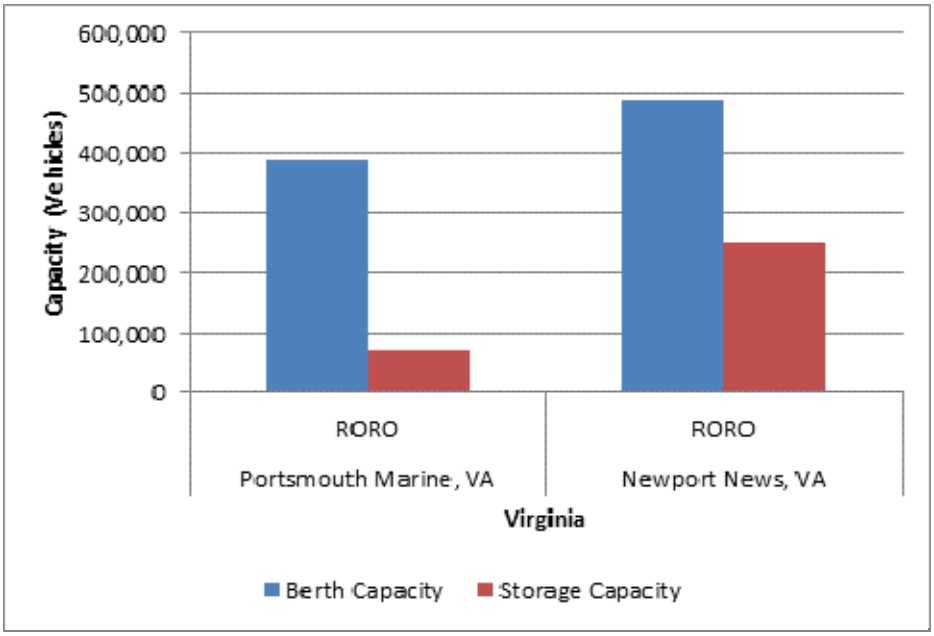


Figure 14: Port of Virginia

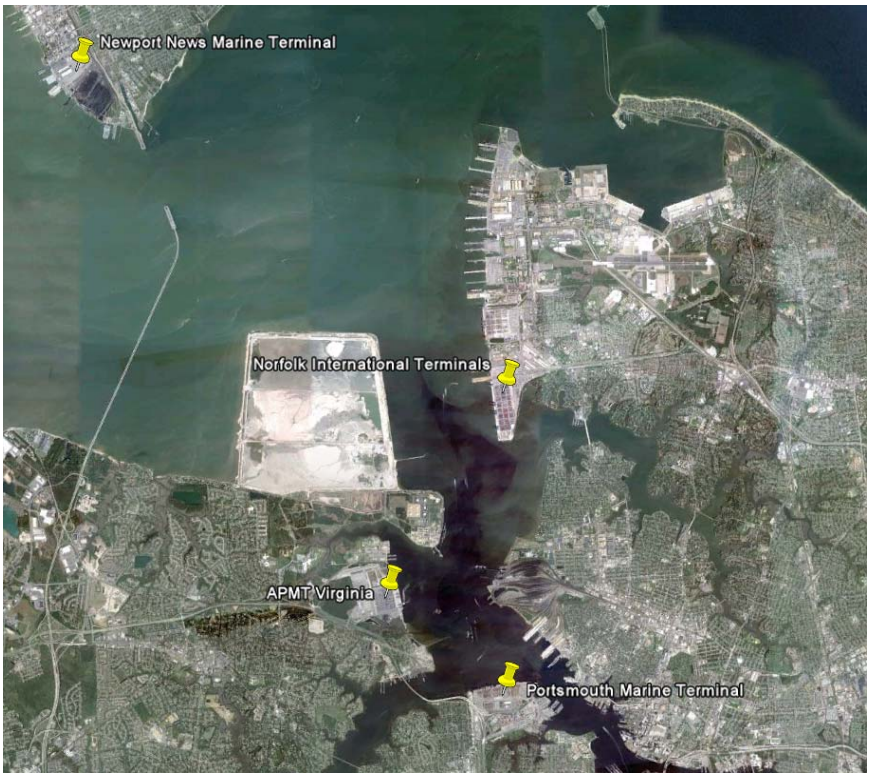


Figure 15: Port of Virginia - Norfolk International Terminal

Figure 16: Port of Virginia - Portsmouth Marine Terminal

Figure 17: Port of Virginia - Newport News Marine Terminal

Figure 18: Port of Virginia - APMT Virginia

3.1 Capacity Analysis of Container Terminals

3.1.1 Norfolk International Terminal

The Norfolk International Terminal (NIT) handles both containerized and non-containerized cargo. NIT is the largest terminal at the Port of Virginia, and is home to 14 of the world's biggest and most efficient dock cranes[6] (DC), which are all able to service Post-Panamax (PPX) vessels with a width up to 20 container stacks. Using available aerials of NIT, the available berths for container cargo handling operations were assumed to be on the north and south side of the breakbulk berths, with total length of approximately 5,730'.

For the capacity analysis, it was assumed that PMT has 4.4 berths with each berth of 1,200' length and it can service a typical maximum vessel size of 5,000 to 8,000 TEU. The productivity per dock crane was assumed to be 30 moves per hour with 60 percent maximum practical peak week berth utilization.

For NIT, the container terminal size was approximately measured using the Google Earth software, due to the mix of container and non-container handling facilities available at the

[6] http://www.portofvirginia.com/facilities/norfolk-international-terminals.aspx

terminal. The overall terminal is approximately 648 acres out of which net area of approximately 250 acres is used for container storage operations. For transfer of intermodal cargo, the terminal has access to a rail yard located in the middle of the terminal which is serviced by both CSX and NS rail carriers.

The terminal uses 1-over-3 straddle carriers (strads) to transfer containers from wharf to container yard and handle containers within the yard. Figure 19 shows a picture of an example strad working within a container terminal.

The storage capacity for the containerized cargo was determined based on the use of strads which provides an average static storage capacity of approximately 4,500 TEU per acre per year, which is then multiplied by the gross terminal acres to calculate the annual CY capacity for NIT.

Table 5 shows the calculations used to derive the annual berth capacity, CY capacity and terminal capacity for the NIT.

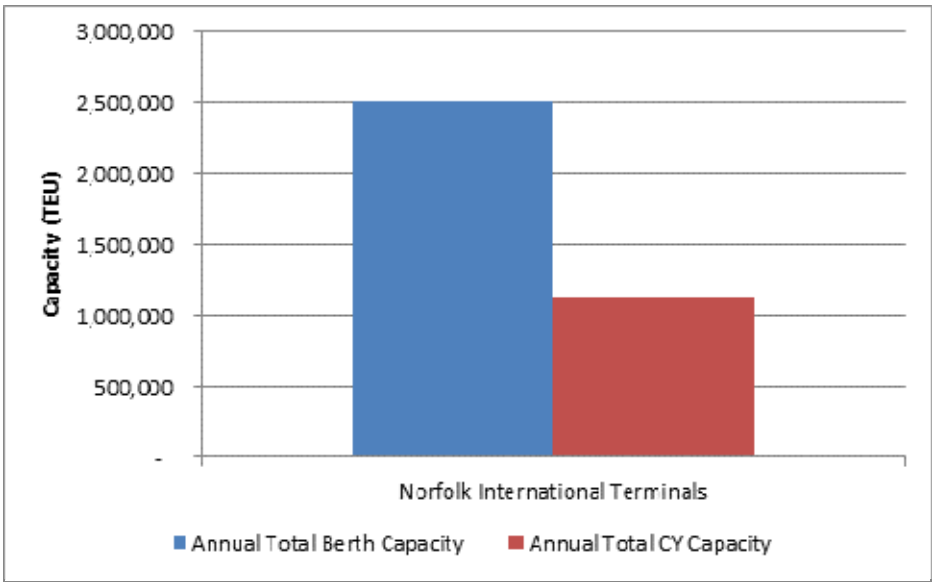
NIT's berth capacity is in the range of 2.5 million TEU whereas the terminal's CY capacity is in the range of 1.13 million TEU as shown on Figure 20. Overall, the terminal is limited by the CY capacity and low density strad-based operations with an overall capacity of 1.13 million TEU.

Figure 19: Picture of a Straddle Carrier Handling a Container within a Stack

Table 5: Container Terminal Capacity at Norfolk International Terminal

	Norfolk International Terminal
Container moves (lifts) per vessel call [a]	1,900
Dock cranes assigned per vessel [b]	3.5
Productivity per dock crane (mv/hr) [c]	30
Vessel productivity(mv/hr) [d=b*c]	105
Work hours per vessel call [e=a/d]	17.7
Unproductive time at berth (hrs) [f]	3
Total vessel time at berth (hrs) [g=e+f]	20.7
Work hours per day [h]	20
Calendar hrs/ work hour [i=24/h]	1.20
Total vessel hrs at berth [j=g*i]	24.8
Calendar hrs per week [k]	168
Vessel calls per week at 100% berth utilization [l=k/j]	6.78
Maximum practical peak week berth utilization [m]	60%
Maximum practical vessel calls per week [n=l*m]	4.07
Peak week berth capacity (moves) [o=n*a]	7,539
Peak/mean week seasonal demand factor [p]	1.2
Mean week throughput capacity (moves) [q=o/p]	6,283
Annual unit berth capacity (moves) [r=q*52]	327,000
TEU per container [s]	1.75
Annual unit berth capacity (TEU) [t=r*s]	570,000
Total berth length (feet)	5,730
Number of berths (100' gauge crane) [u]	4.4
Annual total berth capacity (TEU)	**2,510,000**
Annual CY capacity (TEU)	**1,130,000**
Terminal capacity (TEU)	**1,130,000**

Figure 20: NIT Container Capacity



3.1.2 Portsmouth Marine Terminal

At the Port of Virginia, Portsmouth Marine Terminal (PMT) handles multiple types of cargo including container, breakbulk, and Ro/Ro. The terminal has an approximately 3,540-foot long wharf with 9 dock cranes, none of which is able to service PPX vessels. The overall terminal area is approximately 219 acres. For transfer of intermodal cargo, the terminal has access to a near-terminal rail yard located on the south side of the terminal boundary with service provided by both CSX and NS.

The terminal uses straddle carrier equipment to transfer containers from wharf to container yard and handle containers within the yard.

Using the aerials available, the northern end of the terminal was assumed to be a dedicated berth for container cargo. It was assumed that at PMT the typical maximum vessel class size of 5,000 to 8,000 TEU can be handled with appropriate dock cranes and availability of 2.7 berths – each berth being 1,200'. The productivity per dock crane was assumed to be 30 moves per hour with 60 percent maximum practical peak week berth utilization.

The storage capacity for the containerized cargo was determined based on the use of strads which provides an average static storage capacity of approximately 4,500 TEU per acre per year, which is then multiplied by the gross terminal area of 219 acres, based on Google Earth, to calculate the annual CY capacity for NIT.

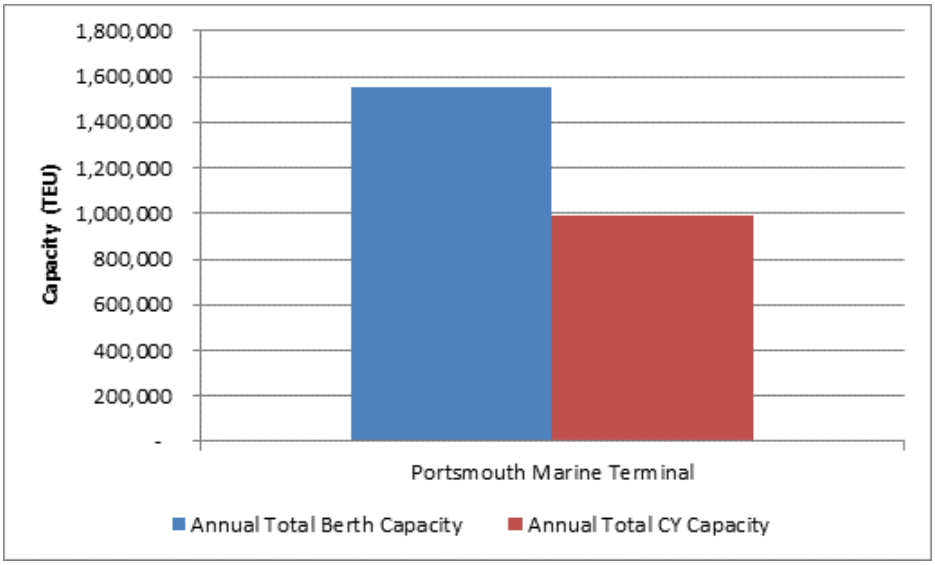
Table 6 shows the calculations used to derive the annual berth capacity, CY capacity and terminal capacity for the PMT.

PMT's berth capacity is in the range of 1.5 million TEU whereas the terminal's CY capacity is in the range of 1 million TEU as shown in Figure 21. Overall, the terminal is limited by the CY capacity and low density strad-based operations with an overall capacity of 990,000 TEU.

Table 6: Container Terminal Capacity at Portsmouth Marine Terminal

	Portsmouth Marine Terminal
Container moves (lifts) per vessel call [a]	1,900
Dock cranes assigned per vessel [b]	3.5
Productivity per dock crane (mv/hr) [c]	30
Vessel productivity(mv/hr) [d=b*c]	105
Work hours per vessel call [e=a/d]	17.7
Unproductive time at berth (hrs) [f]	3
Total vessel time at berth (hrs) [g=e+f]	20.7
Work hours per day [h]	20
Calendar hrs/ work hour [i=24/h]	1.20
Total vessel hrs at berth [j=g*i]	24.8
Calendar hrs per week [k]	168
Vessel calls per week at 100% berth utilization [l=k/j]	6.78
Maximum practical peak week berth utilization [m]	60%
Maximum practical vessel calls per week [n=l*m]	4.07
Peak week berth capacity (moves) [o=n*a]	7,539
Peak/mean week seasonal demand factor [p]	1.2
Mean week throughput capacity (moves) [q=o/p]	6,282.57
Annual unit berth capacity (moves) [r=q*52]	327,000
TEU per container [s]	1.75
Annual unit berth capacity (TEU) [t=r*s]	570,000
Total berth length (feet)	3,540
Number of berths (100' gauge crane) [u]	2.7
Annual total berth capacity (TEU)	**1,550,000**
Annual CY Capacity (TEU)	**990,000**
Terminal capacity (TEU)	**990,000**

Figure 21: PMT Container Capacity



3.1.3 APMT Virginia

APMT is the newest of all the terminals found at the Port of Virginia. This container cargo terminal is a highly automated facility. The 576-acre terminal is one of the most technologically advanced marine cargo facility in the Americas. APMT has 4,000 linear feet of berth and 3.3 miles of on-site rail.[7]

APMT Virginia can handle the 8,000 TEU vessel size. This highly-advanced facility achieves a dock crane productivity of 35 moves per hour. Since APMT Virginia uses automated stacking cranes, this allows for a higher number of TEU's per acre. Table 7 shows the calculations used to derive the annual berth capacity, CY capacity, and terminal capacity for the APMT Virginia.

APMT Virginia's berth capacity is in the range of 1.5 million TEU, whereas the terminal's CY capacity is in the range of 3 million TEU as shown on Figure 22. Overall, the terminal is limited by the berth capacity of 1,510,000 TEU.

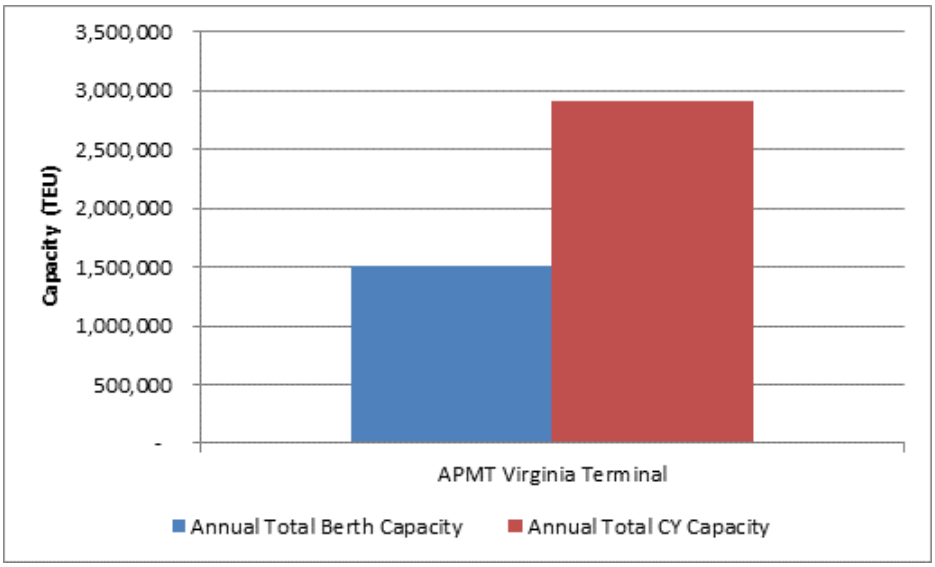
Table 7: Container Terminal Capacity at APMT Virginia

	APMT Virginia Terminal
Container moves (lifts) per vessel call [a]	1,900
Dock cranes assigned per vessel [b]	3.5
Productivity per dock crane (mv/hr) [c]	35
Vessel productivity(mv/hr) [d=b*c]	123
Work hours per vessel call [e=a/d]	15.1
Unproductive time at berth (hrs) [f]	3

[7] http://www.portofvirginia.com/facilities/apmt-virginia.aspx

Total vessel time at berth (hrs) [g=e+f]	18.1
Work hours per day [h]	20
Calendar hrs/ work hour [i=24/h]	1.20
Total vessel hrs at berth [j=g*i]	21.8
Calendar hrs per week [k]	168
Vessel calls per week at 100% berth utilization [l=k/j]	7.72
Maximum practical peak week berth utilization [m]	60%
Maximum practical vessel calls per week [n=l*m]	4.63
Peak week berth capacity (moves) [o=n*a]	8,588
Peak/mean week seasonal demand factor [p]	1.2
Mean week throughput capacity (moves) [q=o/p]	7,156
Annual unit berth capacity (moves) [r=q*52]	372,000
TEU per container [s]	1.75
Annual unit berth capacity (TEU) [t=r*s]	650,000
Total berth length (feet)	3,025
Number of berths (100' gauge crane) [u]	2.3
Annual total berth capacity (TEU)	**1,510,000**
Annual CY Capacity (TEU)	**2,910,000**
Terminal capacity (TEU)	**1,510,000**

Figure 22: APMT Virginia Container Capacity



3.2 Capacity Analysis of Non-Container Terminals

3.2.1 Norfolk International Terminal Capacity

At the Port of Virginia, the NIT has six available berths. NIT handles mostly containerized cargo, but it also handles breakbulk commodities. The breakbulk commodities were not specified so an average was calculated from the relationship between the storage areas and the static storage

capacities of the Ports of Wilmington and Morehead City. With this average value, the storage area from Norfolk International Terminal was then multiplied by that average to estimate the static storage capacity for the Norfolk International Terminal. Table 8 presents the berth capacity while Table 9 presents the storage capacity for the Norfolk International Terminal.

NIT's berth capacity is in the range of 5.6 million TEU, whereas the terminal's storage capacity is in the range of 5.1 million TEU as shown on Figure 23. Overall, the terminal is limited by its storage capacity to 5.1 million TEU.

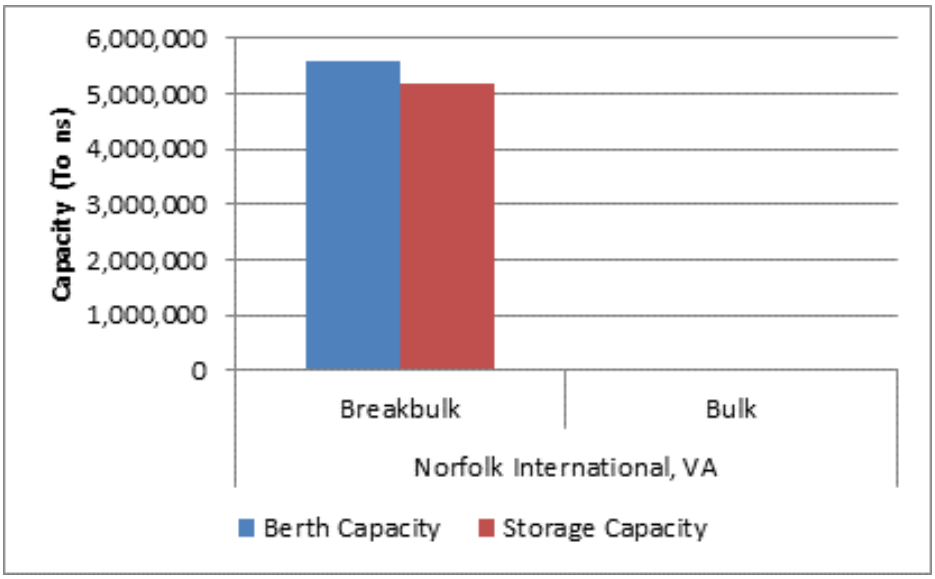
Table 8: Non-Container Berth Capacity for NIT

Norfolk International Terminal, VA Berth Capacity	Breakbulk Total (Covered Storage)
Number of Berths Available	6.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	50%
Effective Total Berth-Hours per Week	441.00
Mean Cargo Handled per Vessel Calls (Tons)	10,000
Mean Loading/ Unloading Rate (Tons per Hour)	300
Mean Ship Work Time (Hrs)	33.3
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	37.3
Potential Ship Calls per Week	11.8
Weekly Throughput Capacity (Tons)	118,125
Weekly Peaking Factor	110%
Annual Berth Capacity (Tons)	5,584,000

Table 9: Non-Container Storage Capacity for NIT

Norfolk International Terminal, VA Storage Capacity	Breakbulk Total (Covered Storage)
Storage Method	Covered
Static Storage Capacity (Tons)	638,684
Static Capacity / Mean Ship Capacity	63.9
Nominal Annual Throughput (Tons/Year)	100,000
Mean Week Vessel Volume (Tons)	1,923
Cargo Dwell Time (Days)	30.0
Average Volume of Cargo in Storage (Tons)	8,242
Peak/Mean Inventory	150%
Demand for Storage (Tons)	12,363
Total Storage Available (Tons)	638,684
Annual Storage Capacity (Tons)	5,166,000

Figure 23: NIT Non-Container Capacity



3.2.2 Portsmouth Marine Terminal Capacity

Portsmouth Marine Terminal is part of the Port of Virginia. While container cargo is the main commodity handled at Portsmouth Marine Terminal, breakbulk and Ro/Ro cargos are also handled at the port. By dividing the total berth length by 1,300', two available berths on the eastern end of the terminal are assumed to handle breakbulk and Ro/Ro commodities. Since this assumption was made, the maximum practical berth utilization has to be adjusted down to 30 percent. Table 10 and Table 11 show the berth capacity for breakbulk and Ro/Ro operations.

Since no commodities were specified at the terminal, an average was taken from the relationship between the storage areas and the static storage capacities from the Ports of Wilmington and Morehead City. With this average value, the storage area from Portsmouth Marine Terminal was then multiplied by that average to obtain the static storage capacity for the Portsmouth Marine Terminal.

Using the Google Earth program, it was determined that all breakbulk commodities were being stored inside warehouses and all Ro/Ro commodities were being stored in open areas. These areas were calculated to determine the static storage capacity in Table 12 and Table 13.

PMT's breakbulk berth capacity is in the range of 1.1 million tons whereas the terminal's storage capacity is in the range of 180,000 tons as shown on Figure 24. Overall, the terminal is limited by its storage capacity at 180,000 tons.

PMT's Ro/Ro berth capacity is in the range of 391,000 vehicle units whereas the terminal's storage capacity is in the range of 71,000 vehicle units as shown on Figure 25. Overall, the Ro/Ro terminal is limited by its storage capacity at 71,000 vehicle units.

Table 10: Non-Container Berth Capacity of Breakbulk for PMT

Portsmouth Marine Terminal, VA Berth Capacity	Breakbulk Total (Closed Storage)
Number of Berths Available	2.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	30%
Effective Total Berth-Hours per Week	88.20
Mean Cargo Handled per Vessel Calls (Tons)	10,000
Mean Loading/ Unloading Rate (Tons per Hour)	300
Mean Ship Work Time (Hrs)	33.3
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	37.3
Potential Ship Calls per Week	2.4
Weekly Throughput Capacity (Tons)	23,625
Weekly Peaking Factor	110%
Annual Berth Capacity (Tons)	1,117,000

Table 11: Non-Container Berth Capacity of Ro/Ro for PMT

Portsmouth Marine Terminal, VA Berth Capacity	Ro/Ro Total (Open Storage)
Number of Berths Available	2.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	30%
Effective Total Berth-Hours per Week	88.20
Mean Cargo Handled per Vessel Calls (Vehicle)	6,000
Mean Loading/ Unloading Rate (Vehicles per Hour)	100
Mean Ship Work Time (Hrs)	60.0
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	64.0
Potential Ship Calls per Week	1.4
Weekly Throughput Capacity (Vehicles)	8,269
Weekly Peaking Factor	110%
Annual Berth Capacity (Vehicles)	391,000

Table 12: Non-Container Storage Capacity of Breakbulk for PMT

Portsmouth Marine Terminal, VA Storage Capacity	Breakbulk Total (Closed Storage)
Storage Method	Closed
Static Storage Capacity (Tons)	22,542
Static Capacity / Mean Ship Capacity	2.3
Nominal Annual Throughput (Tons/Year)	100,000
Mean Week Vessel Volume (Tons)	1,923
Cargo Dwell Time (Days)	30.0
Average Volume of Cargo in Storage (Tons)	8,242
Peak/Mean Inventory	150%
Demand for Storage (Tons)	12,363
Total Storage Available (Tons)	22,542
Annual Storage Capacity (Tons)	182,000

Table 13: Non-Container Storage Capacity of Ro/Ro for PMT

Portsmouth Marine Terminal, VA Storage Capacity	Ro/Ro Total (Open Storage)
Storage Method	Open
Static Storage Capacity (Vehicles)	3,240
Static Capacity / Mean Ship Capacity	0.5
Nominal Annual Throughput (Vehicles/Year)	100,000
Mean Week Vessel Volume (Vehicles)	1,923
Cargo Dwell Time (Days)	15.0
Average Volume of Cargo in Storage (Vehicles)	4,121
Peak/Mean Inventory	110%
Demand for Storage (Vehicles)	4,533
Total Storage Available (Vehicles)	3,240
Annual Storage Capacity (Vehicles)	71,000

Figure 24: PMT Non-Container Capacity for Breakbulk/Bulk

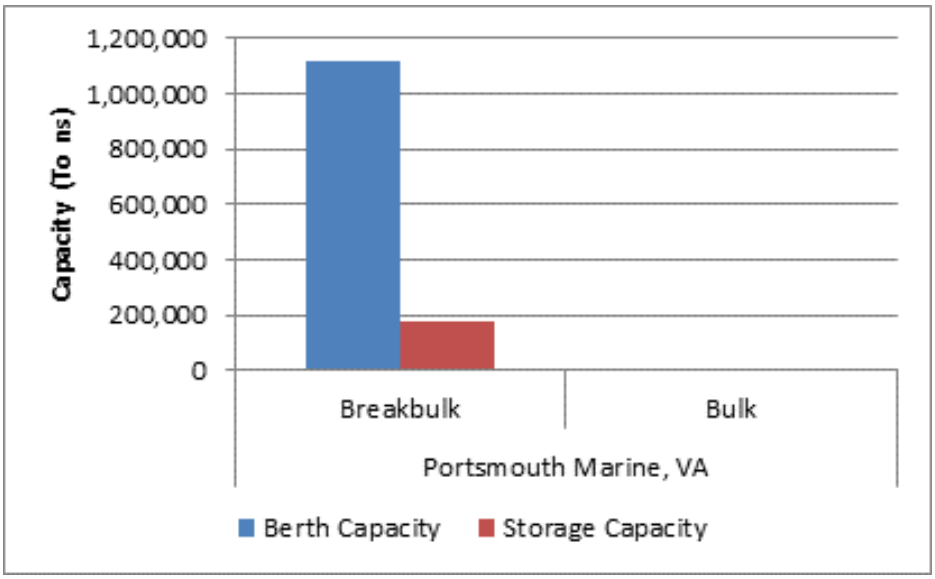
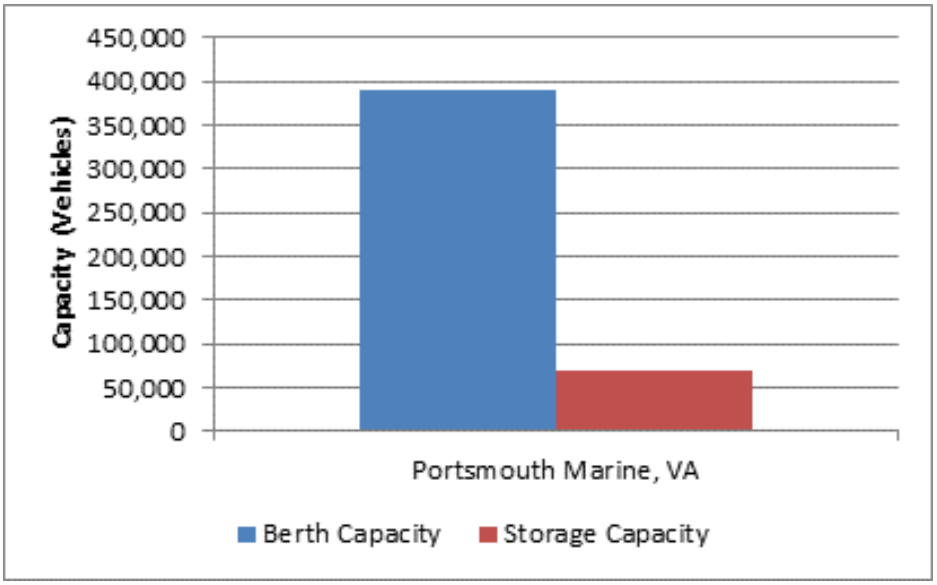


Figure 25: PMT Non-Container Capacity for Ro/Ro



3.2.3 Newport News Marine Terminal

Newport News Marine Terminal (NNMT) is the Port of Virginia's main breakbulk terminal. The terminal also handles Ro/Ro commodities. With four available berths, an assumption was made that all the berths can be used by breakbulk commodities, thus reducing the Maximum Practical Berth Utilization down to 40 percent. For Ro/Ro commodities, three of the berths can be used which causes the Maximum Practical Berth Utilization to be reduced to 25 percent. Table 14 and Table 15 calculate the berth capacities for breakbulk and Ro/Ro commodities at NNMT.

Since no commodities were specified at NNMT, the same assumption was used as at the above terminals of the Port of Virginia. Table 16 and Table 17 show the annual storage capacity for breakbulk and Ro/Ro commodities respectively.

NNMT's breakbulk berth capacity is in the range of 2.9 million tons whereas the terminal's storage capacity is in the range of 1.2 million tons as shown on Figure 26. Overall, the terminal is limited by its storage capacity at 1.2 million tons.

NNMT's Ro/Ro berth capacity is in the range of 500,000 vehicle units, whereas the terminal's storage capacity is in the range of 250,000 vehicle units as shown in Figure 27. Overall, the Ro/Ro terminal is limited by its storage capacity at 250,000 vehicle units.

Table 14: Non-Container Berth Capacity of Breakbulk for NNMT

Norfolk News Marine Terminal, VA Berth Capacity	**Breakbulk Total (Covered Storage)**
Number of Berths Available	4.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	40%
Effective Total Berth-Hours per Week	235.20
Mean Cargo Handled per Vessel Calls (Tons)	10,000
Mean Loading/ Unloading Rate (Tons per Hour)	300
Mean Ship Work Time (Hrs)	33.3
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	37.3
Potential Ship Calls per Week	6.3
Weekly Throughput Capacity (Tons)	63,000
Weekly Peaking Factor	110%
Annual Berth Capacity (Tons)	2,978,000

Table 15: Non-Container Berth Capacity of Ro/Ro for NNMT

Newport News Marine Terminal, VA Berth Capacity	Ro/Ro Total (Open Storage)
Number of Berths Available	3.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	25%
Effective Total Berth-Hours per Week	110.25
Mean Cargo Handled per Vessel Calls (Vehicle)	6,000
Mean Loading/ Unloading Rate (Vehicles per Hour)	100
Mean Ship Work Time (Hrs)	60.0
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	64.0
Potential Ship Calls per Week	1.7
Weekly Throughput Capacity (Vehicles)	10,336
Weekly Peaking Factor	110%
Annual Berth Capacity (Vehicles)	489,000

Table 16: Non-Container Storage Capacity of Breakbulk for NNMT

Newport News Marine Terminal, VA Storage Capacity	Breakbulk Total (Covered Storage)
Storage Method	Covered
Static Storage Capacity (Tons)	150,279
Static Capacity / Mean Ship Capacity	15.0
Nominal Annual Throughput (Tons/Year)	100,000
Mean Week Vessel Volume (Tons)	1,923
Cargo Dwell Time (Days)	30.0
Average Volume of Cargo in Storage (Tons)	8,242
Peak/Mean Inventory	150%
Demand for Storage (Tons)	12,363
Total Storage Available (Tons)	150,279
Annual Storage Capacity (Tons)	1,216,000

Table 17: Non-Container Storage Capacity of Ro/Ro for NNMT

Portsmouth Marine Terminal, VA Storage Capacity	Ro/Ro Total (Open Storage)
Storage Method	Open
Static Storage Capacity (Vehicles)	11,160
Static Capacity / Mean Ship Capacity	1.9
Nominal Annual Throughput (Vehicles/Year)	100,000
Mean Week Vessel Volume (Vehicles)	1,923
Cargo Dwell Time (Days)	15.0
Average Volume of Cargo in Storage (Vehicles)	4,121
Peak/Mean Inventory	110%
Demand for Storage (Vehicles)	4,533
Total Storage Available (Vehicles)	11,160
Annual Storage Capacity (Vehicles)	246,000

Figure 26: NNMT Non-Container Capacity for Breakbulk/Bulk

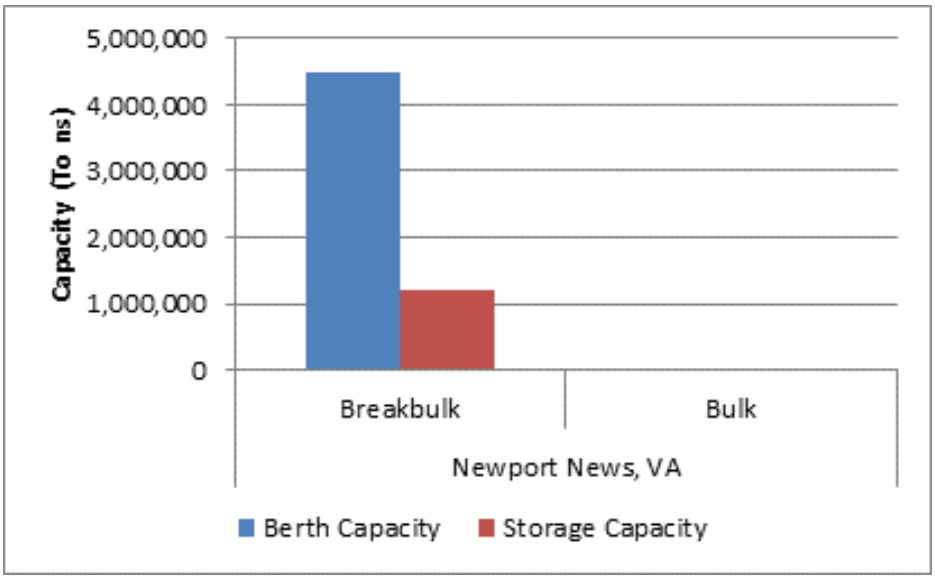
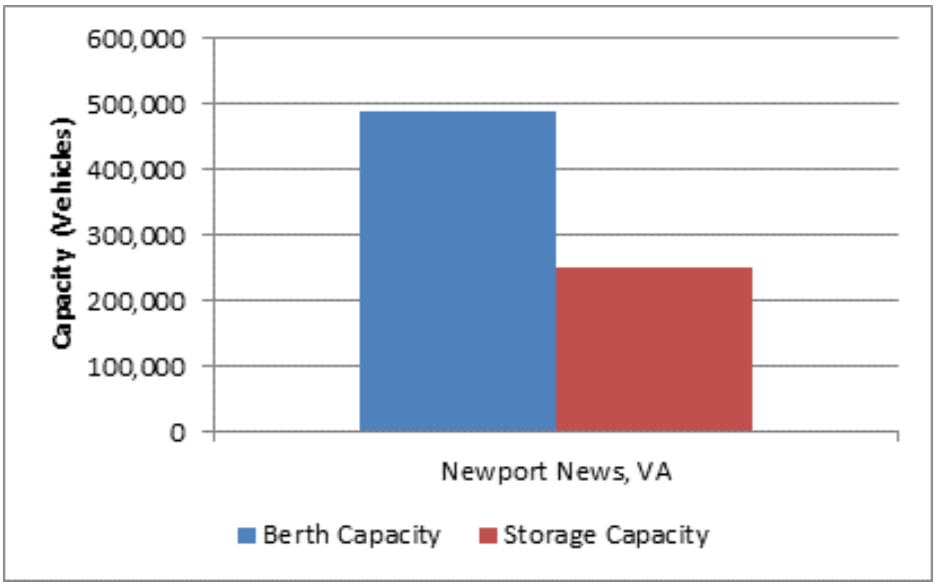


Figure 27: NNMT Non-Container Capacity for Ro/Ro



3.3 Port Revenue

From the Virginia Port Authority's 2010 financial year annual report, the port revenue is broken down in Table 18. The total tonnage was calculated by converting the container cargo from TEUs to tons. These container tons were then added to the total bulk and breakbulk tons. The revenue per ton was determined by dividing by the total revenue.

Table 18: Virginia Port Authority Revenue

Virginia Port Authority 2010 Financial Report	2010	2009
Revenue (in millions)	$193.79	$213.95
Total Tonnage (in millions)	15.6	14.9
Revenue per Ton	$12.44	$14.35

4 CHARLESTON, SOUTH CAROLINA

South Carolina is home to three container terminals and two non-container terminals:

- Wando Welch Terminal
- North Charleston Terminal
- Columbus Street Terminal
- Veterans Terminal
- Georgetown Terminal

Figure 33 shows the location of the Port of Charleston, while Figure 34 shows the location of the Port of Georgetown. For the 2011 fiscal year, both the Ports of Charleston and Georgetown reported that 991,705 pier-tons of breakbulk and 1.4 million TEU were moved.

Wando Welch Terminal (WWT) as shown on Figure 35, is the container terminal at the Port of Charleston; currently, WWT is the largest in volume and area as compared to the other terminals found at the Port of Charleston.

North Charleston Terminal (NCT) is another container cargo facility; approximately 130 acres are available for container cargo. The NCT layout is shown in Figure 36.

Columbus Street Terminal (CST) is also a dedicated container cargo terminal in South Carolina, see Figure 37.

Veterans Terminal (VT) in Figure 38 is the only terminal dedicated to bulk, breakbulk, and Ro/Ro at the Port of Charleston. The 110-acre terminal handles commodities such as paper products, lumber, and steel.[8]

The Port of Georgetown, as shown in Figure 39, is a breakbulk cargo facility. The Georgetown Terminal handles commodities that include metals, cement, chemicals, aggregates, forest products, and ore.[9]

Table 19 and Table 20 present key attributes of container and non-container handling terminals in the state of South Carolina, respectively, including: berth lengths, water depths, terminal sizes and other information. This information was gathered from sources including the Port of Charleston website and from the SSA Marine website. Data collected was checked via the Google Earth program. Figure 28 and Figure 29 summarize the berth length and terminal areas at the ports in South Carolina.

In Figure 30, the annual berth and CY capacity for container terminals in South Carolina is summarized. Figure 31 combines the bulk and breakbulk berth and storage capacities for the Ports of South Carolina. In Figure 32, the Ro/Ro berth and storage capacities for the Port of Charleston are determined. Tables 19 and 20 along with Figures 28 through 32 summarize the

[8] http://www.ssamarine.com/locations/atlantic/navy_base.asp
[9] http://www.port-of-charleston.com/georgetown/default.asp

results. Figures 33 through 39 show aerials and plans of the various terminals. Then in the following sections, the calculations and methods used to determine the berth, CY, and storage capacities are reviewed.

Table 19: South Carolina Container Handling Terminal Information

Charleston, SC	Berth Length (ft)	Water Depth (ft)	# DC Total	# DC nPPX Outreach (20 wide)	Container Terminal Size (acres)	Mode of Operation	Railroad Access
Wando Welch Terminal	3,800	45	10	6	242	RTG/TP	Offsite
North Charleston Terminal	2,500	40	6	2	130	RTG/TP	Yes
Columbus Street Terminal	2,500	45	5	2	78	RTG/TP	Yes

Table 20: South Carolina Non-Container Handling Terminal Information

	Location	Number of Berths/Piers (each)	Berth/Pier Length (ft)	Water Depth (ft)	Total Terminal Size (ac.)	Covered Area (ft^2)	Open Area (ac.)	Mode of Operation	Railroad Access
Veterans Terminal	Charleston, SC	5	4,000	35	110	90,000	100	Bulk, Breakbulk, Ro/Ro, Project Cargo	Yes
Georgetown Terminal	Georgetown, SC	1	2,000	27	30	140,000	30	Breakbulk	Yes

Figure 28: Berth Length for Port Terminals at South Carolina

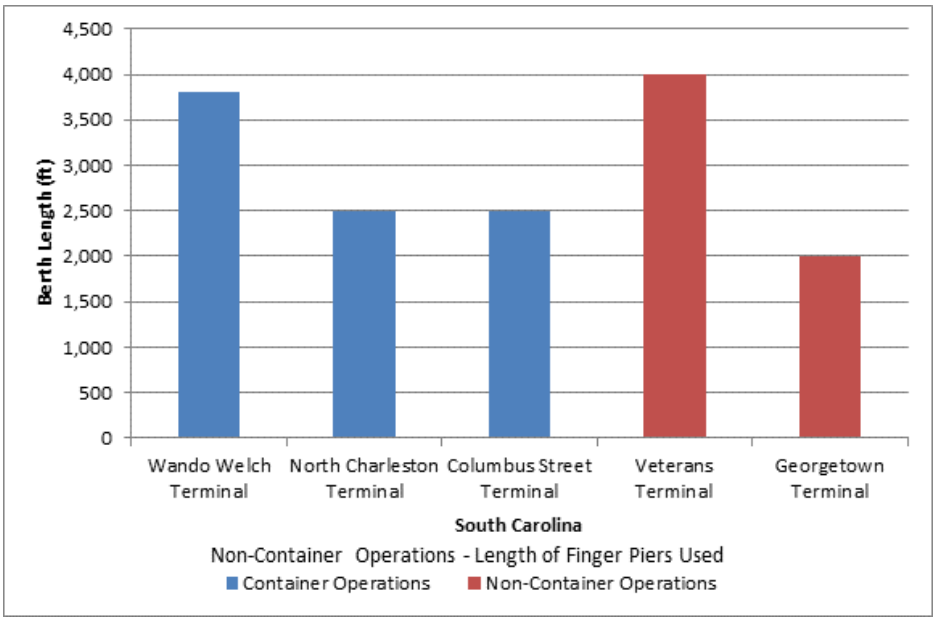


Figure 29: Terminal Sizes for Port Terminals at South Carolina

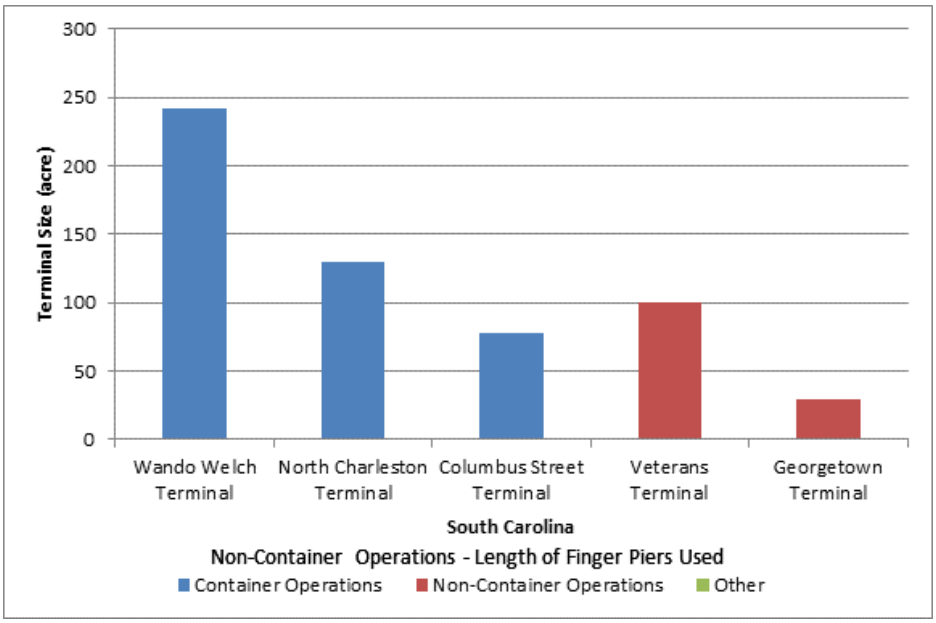


Figure 30: Port of Charleston Container Capacity

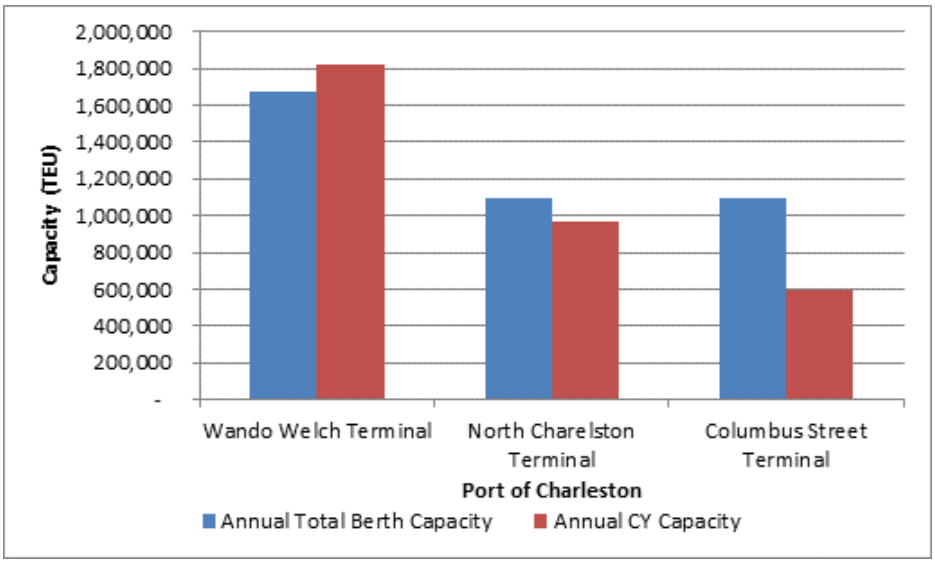


Figure 31: Ports of South Carolina Non-Container (Bulk/Breakbulk) Capacity

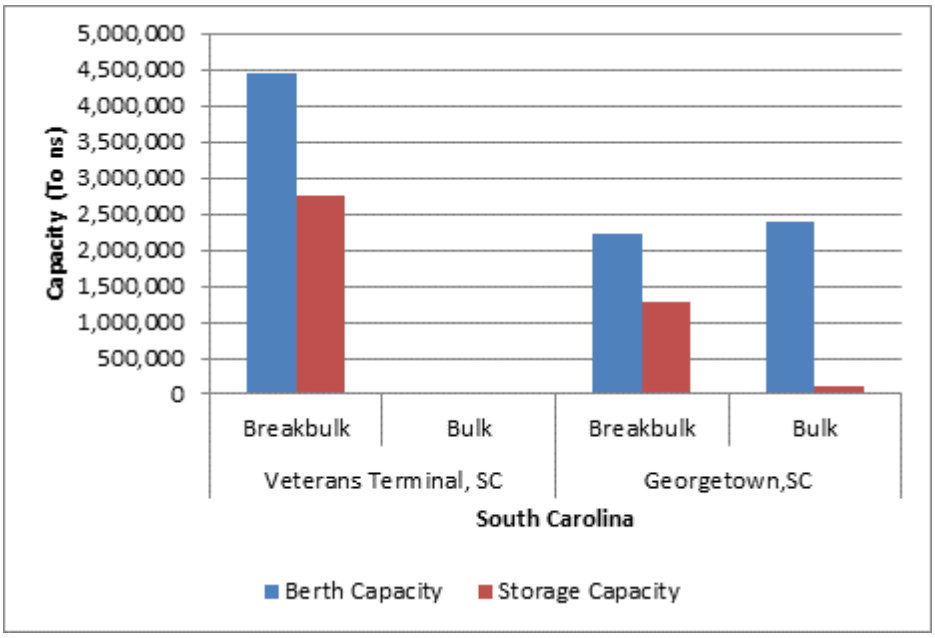


Figure 32: Port of Charleston Non-Container (Ro/Ro) Capacity

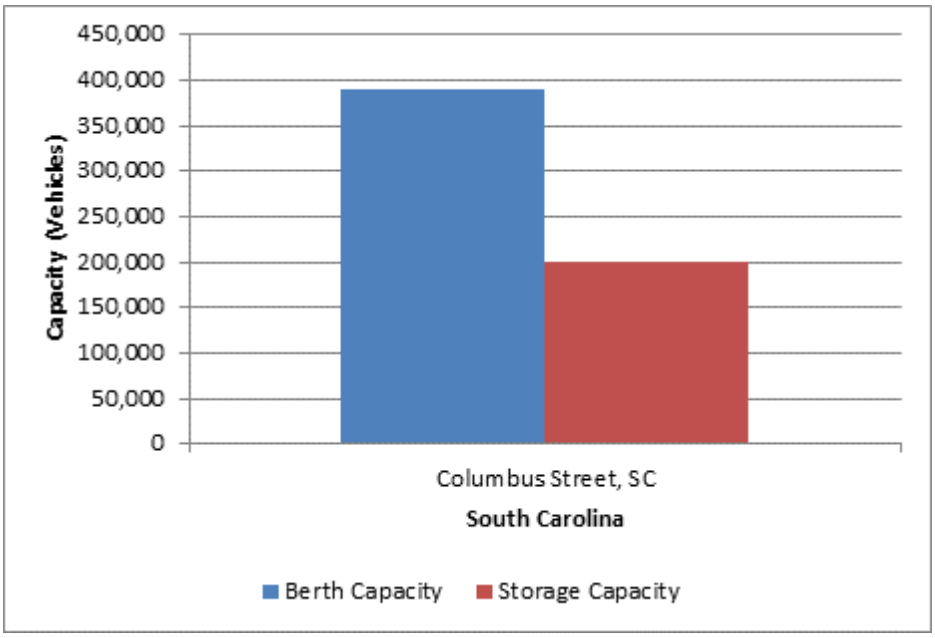


Figure 33: Port of Charleston

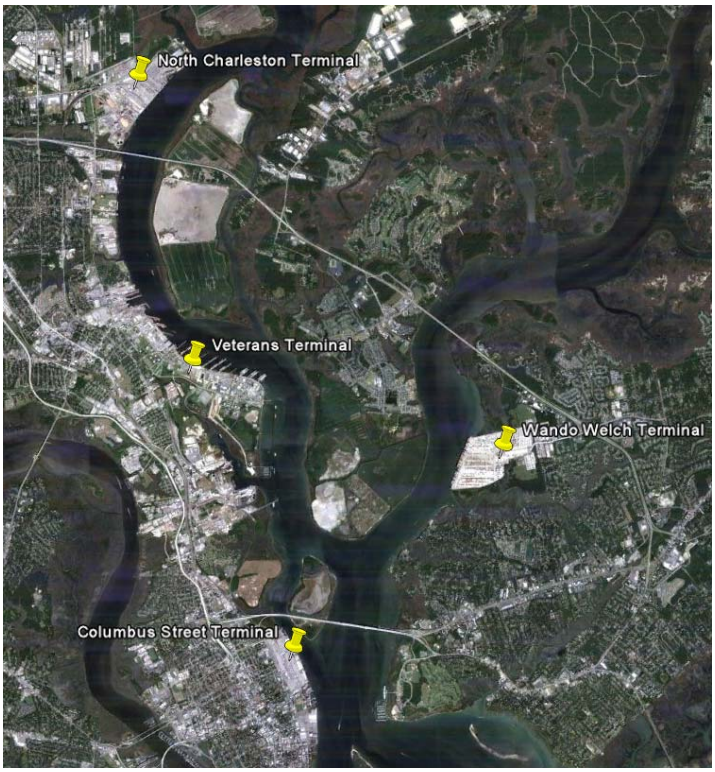


Figure 34: Port of Georgetown

Figure 35: Port of Charleston - Wando Welch Terminal

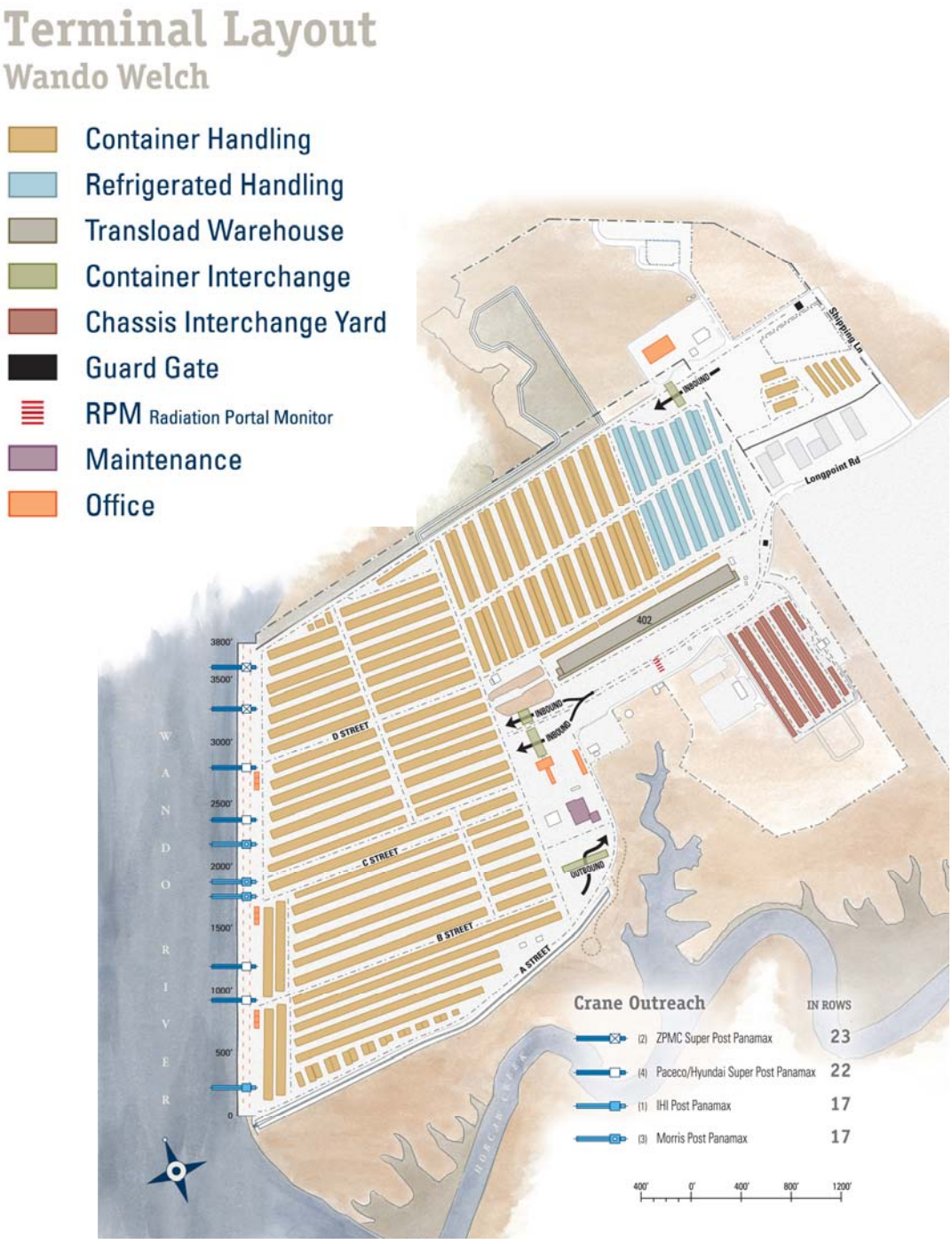


Figure 36: Port of Charleston - North Charleston Terminal

Figure 37: Port of Charleston - Columbus Terminal

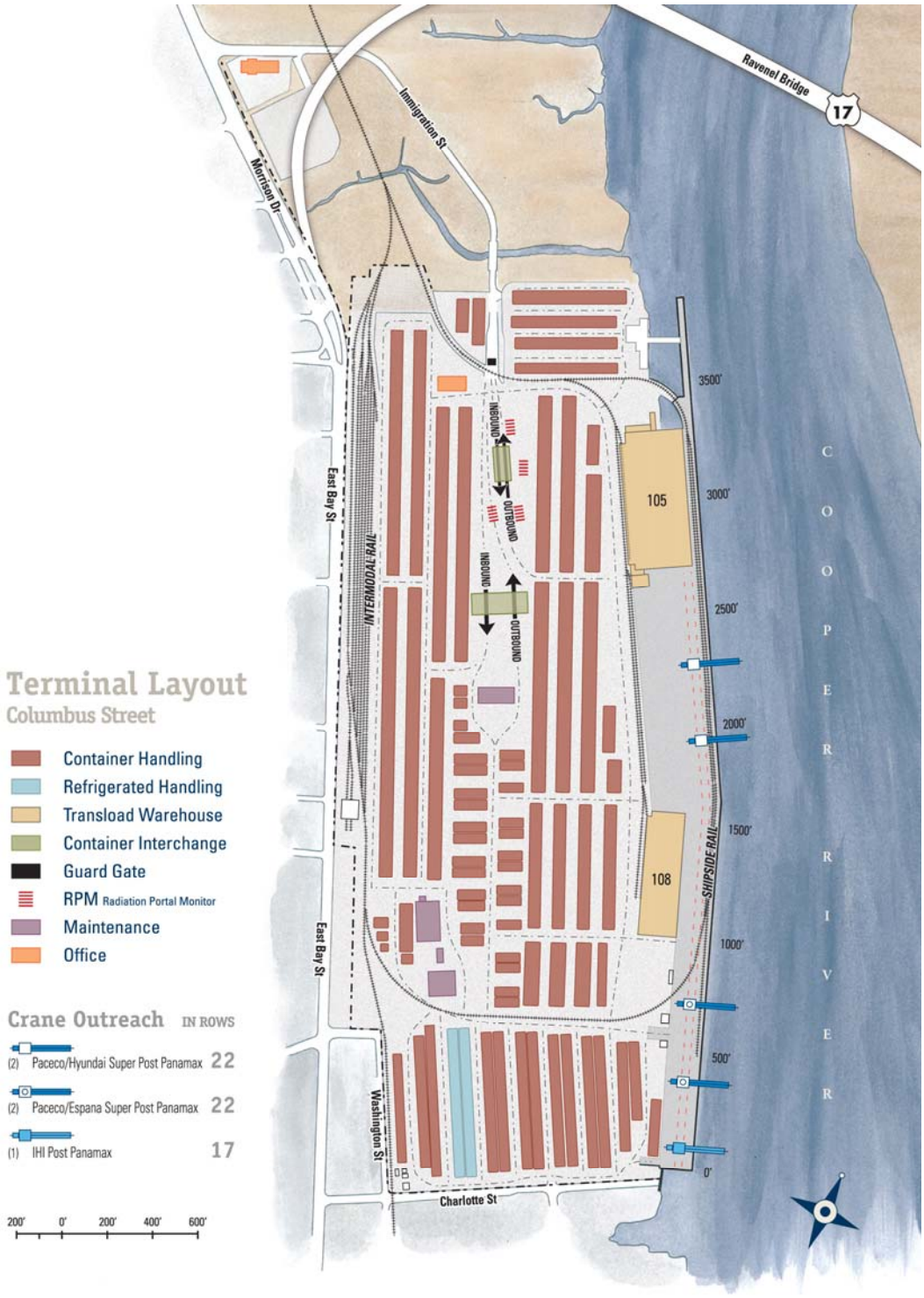
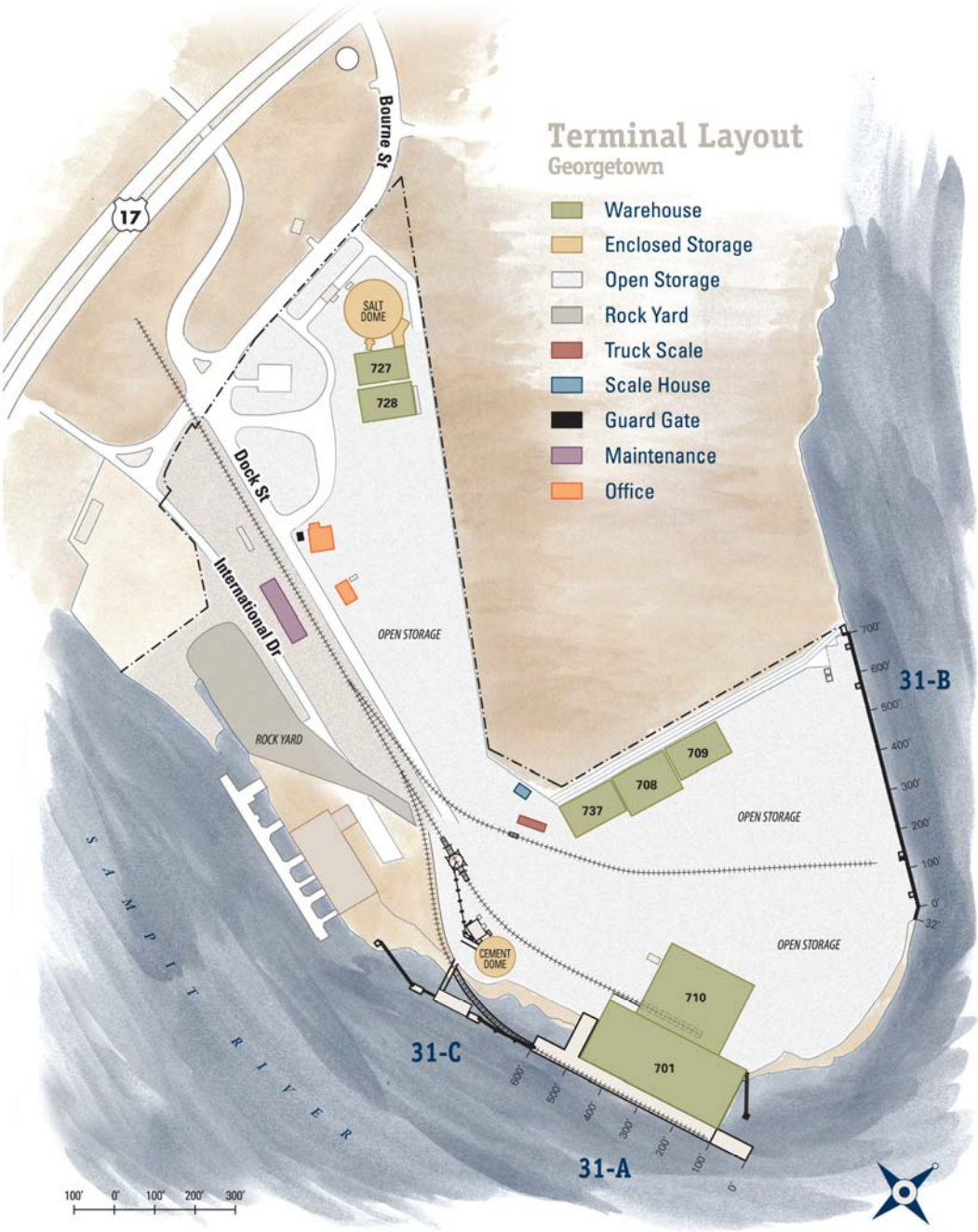


Figure 38: Port of Charleston - Veterans Terminal

Figure 39: Port of Georgetown



4.1 Capacity Analysis of Container Terminals

4.1.1 Wando Welch Terminal

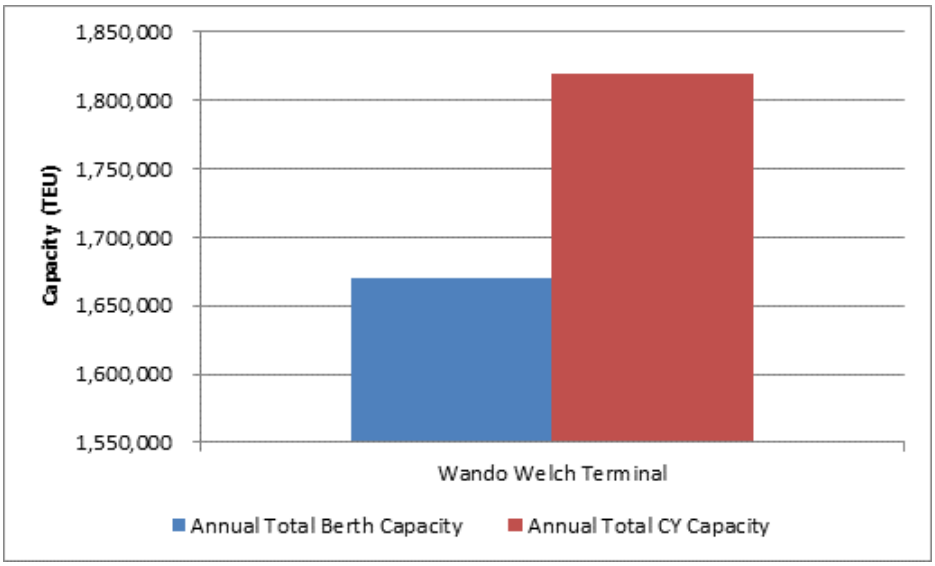
Wando Welch Terminal (WWT) is part of the Port of Charleston in South Carolina. WWT can handle vessel sizes of 5,000 to 7,000 TEU. Recall the layout of WWT on Figure 35, the entire facility is for containerized cargo, and all the available berths are on the eastern side of the terminal. With this layout, the maximum practical berth utilization is kept at 60 percent. WWT has approximately 3 berths.

To determine the annual storage capacity of WWT, again the type of equipment used has to be taken into account to determine the average container yard (CY) capacity in TEU per acre. At WWT, container cargo is handled by Rubber Tire Gantries or by Top Picks (RTG/TP). With this equipment we follow the set standards from the Ports of Wilmington and Morehead City. Table 21 shows the calculations used to derive the annual berth capacity, CY capacity and terminal capacity for the WWT. WWT's berth capacity is in the range of 1.7 million, TEU whereas the terminal's CY capacity is in the range of 1.8 million TEU as shown in Figure 20. Overall, the terminal is limited by the berth capacity of 1.7 million TEU.

Table 21: Container Terminal Capacity at Wando Welch Terminal

	Wando Welch Terminal
Container moves (lifts) per vessel call [a]	1,900
Dock cranes assigned per vessel [b]	3.5
Productivity per dock crane (mv/hr) [c]	30
Vessel productivity(mv/hr) [d=b*c]	105
Work hours per vessel call [e=a/d]	17.7
Unproductive time at berth (hrs) [f]	3
Total vessel time at berth (hrs) [g=e+f]	20.7
Work hours per day [h]	20
Calendar hrs/ work hour [i=24/h]	1.20
Total vessel hrs at berth [j=g*i]	24.8
Calendar hrs per week [k]	168
Vessel calls per week at 100% berth utilization [l=k/j]	6.78
Maximum practical peak week berth utilization [m]	60%
Maximum practical vessel calls per week [n=l*m]	4.07
Peak week berth capacity (moves) [o=n*a]	7,539
Peak/mean week seasonal demand factor [p]	1.2
Mean week throughput capacity (moves) [q=o/p]	6,283
Annual unit berth capacity (moves) [r=q*52]	327,000
TEU per container [s]	1.75
Annual unit berth capacity (TEU) [t=r*s]	570,000
Total berth length (feet)	3,800
Number of berths (100' gauge crane) [u]	2.9
Annual total berth capacity (TEU)	**1,670,000**
Annual CY capacity (TEU)	**1,820,000**
Terminal capacity (TEU)	**1,670,000**

Figure 40: WWT Container Capacity



4.1.2 North Charleston Terminal

North Charleston Terminal (NCT) is about 15 miles from the Atlantic Ocean, making it the furthest terminal from the Atlantic Ocean at the Port of Charleston. Like other terminals at the Port of Charleston, I-26 and I-526 are relatively close by. NCT is another dedicated container cargo facility. According to our calculations, NCT has 2 berths. With a maximum of 5,000 TEU vessel class ships, NCT follows the same established assumptions as in WWT. NCT handles container cargo with RTG/TP.

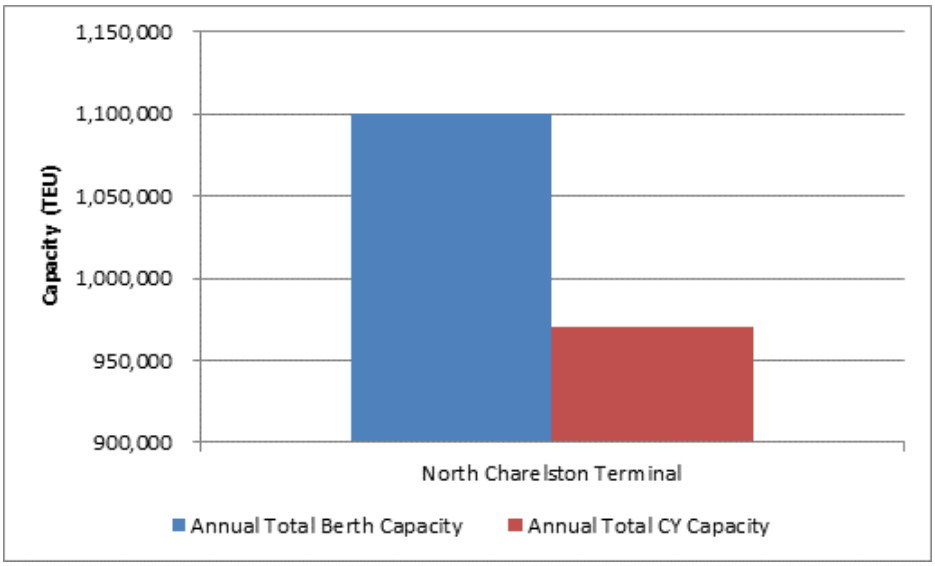
Table 22 shows the calculations used to derive the annual berth capacity, CY capacity and terminal capacity for the NCT.

NCT's berth capacity is in the range of 1.1 million TEU; whereas the terminal's CY capacity is in the range of 970,000 TEU as shown on Figure 20. Overall the terminal is limited by the CY capacity of 970,000 TEU.

Table 22: Container Terminal Capacity at North Charleston Terminal

	North Charleston Terminal
Container moves (lifts) per vessel call [a]	1,900
Dock cranes assigned per vessel [b]	3.5
Productivity per dock crane (mv/hr) [c]	30
Vessel productivity(mv/hr) [d=b*c]	105
Work hours per vessel call [e=a/d]	17.7
Unproductive time at berth (hrs) [f]	3
Total vessel time at berth (hrs) [g=e+f]	20.7
Work hours per day [h]	20
Calendar hrs/ work hour [i=24/h]	1.20
Total vessel hrs at berth [j=g*i]	24.8
Calendar hrs per week [k]	168
Vessel calls per week at 100% berth utilization [l=k/j]	6.78
Maximum practical peak week berth utilization [m]	60%
Maximum practical vessel calls per week [n=l*m]	4.07
Peak week berth capacity (moves) [o=n*a]	7,539
Peak/mean week seasonal demand factor [p]	1.2
Mean week throughput capacity (moves) [q=o/p]	6,283
Annual unit berth capacity (moves) [r=q*52]	327,000
TEU per container [s]	1.75
Annual unit berth capacity (TEU) [t=r*s]	570,000
Total berth length (feet)	2,500
Number of berths (100' gauge crane) [u]	1.9
Annual total berth capacity (TEU)	**1,100,000**
Annual CY capacity (TEU)	**970,000**
Terminal capacity (TEU)	**970,000**

Figure 41: NCT Container Capacity



4.1.3 Columbus Street Terminal

Columbus Street Terminal (CST) can handle vessels in the range of 5,000 to 7,000 TEU. For the berth capacity, and CY; all assumptions made for CST followed the same assumptions made at the other container cargo terminals in South Carolina.

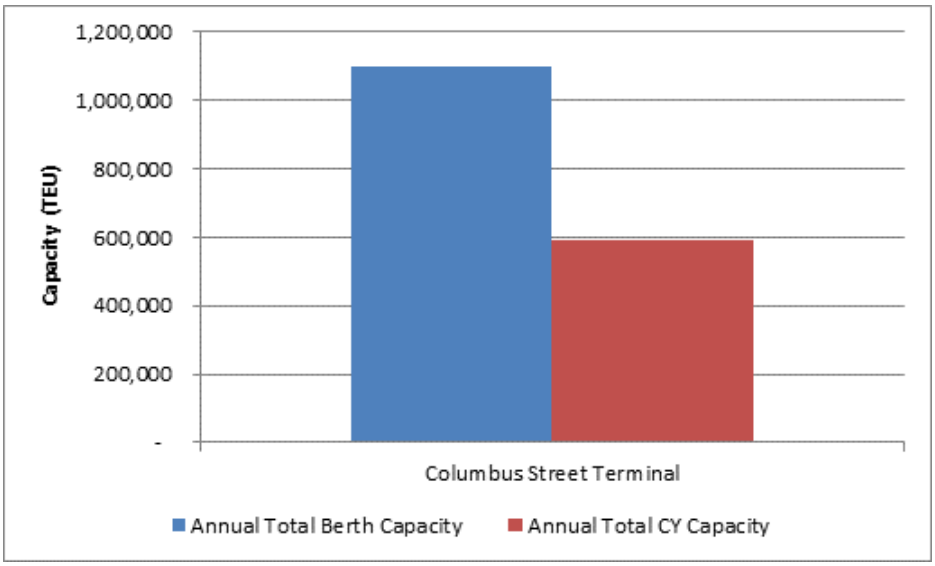
Table 23 shows the calculations used to derive the annual berth capacity, CY capacity and terminal capacity for the CST.

CST's berth capacity is in the range of 1.1 million TEU whereas the terminal's CY capacity is in the range of 600,000 TEU as shown in Figure 42. Overall, the terminal is limited by the CY capacity of 600,000 TEU.

Table 23: Container Terminal Capacity at Columbus Street Terminal

	Columbus Street Terminal
Container moves (lifts) per vessel call [a]	1,900
Dock cranes assigned per vessel [b]	3.5
Productivity per dock crane (mv/hr) [c]	30
Vessel productivity(mv/hr) [d=b*c]	105
Work hours per vessel call [e=a/d]	17.7
Unproductive time at berth (hrs) [f]	3
Total vessel time at berth (hrs) [g=e+f]	20.7
Work hours per day [h]	20
Calendar hrs/ work hour [i=24/h]	1.20
Total vessel hrs at berth [j=g*i]	24.8
Calendar hrs per week [k]	168
Vessel calls per week at 100% berth utilization [l=k/j]	6.78
Maximum practical peak week berth utilization [m]	60%
Maximum practical vessel calls per week [n=l*m]	4.07
Peak week berth capacity (moves) [o=n*a]	7,539.09
Peak/mean week seasonal demand factor [p]	1.2
Mean week throughput capacity (moves) [q=o/p]	6,282.57
Annual unit berth capacity (moves) [r=q*52]	327,000
TEU per container [s]	1.75
Annual unit berth capacity (TEU) [t=r*s]	570,000
Total berth length (feet)	2,500
Number of berths (100' gauge crane) [u]	1.9
Annual total berth capacity (TEU)	**1,100,000**
Annual CY capacity (TEU)	**590,000**
Terminal capacity (TEU)	**590,000**

Figure 42: CST Container Capacity



4.2 Capacity Analysis of Non-Container Terminals

4.2.1 Veterans Terminal

Veterans Terminal (VT) is part of the Port of Charleston with five finger piers. It was determined that Veterans Terminal handles only breakbulk commodities; forest, metal, and paper products. The layout of the terminal is setup in a way to allow open and closed storage for the breakbulk commodities. Table 24 shows the berth capacity for VT. An assumption was made that at any given time 4 berths will be available for open and closed storage breakbulk, with a maximum practical berth utilization of 60 percent each.

At Veterans Terminal, the areas of covered storage were used to calculate the static storage capacity. For the open storage, the paved areas A, B, C, D, E were the determined using the Google Earth program; these areas were then used to determine the static storage capacity. The unimproved open storage areas were ignored due to the fact that on the Google Earth aerial, no type of commodity was being stored at any of those locations. Table 25 shows the storage capacity for VT.

VT's berth capacity is in the range of 4.5 million tons, whereas the terminal's storage capacity is in the range of 2.8 million tons as shown in Figure 43. Overall, the terminal is limited by the storage capacity of 2.8 million tons.

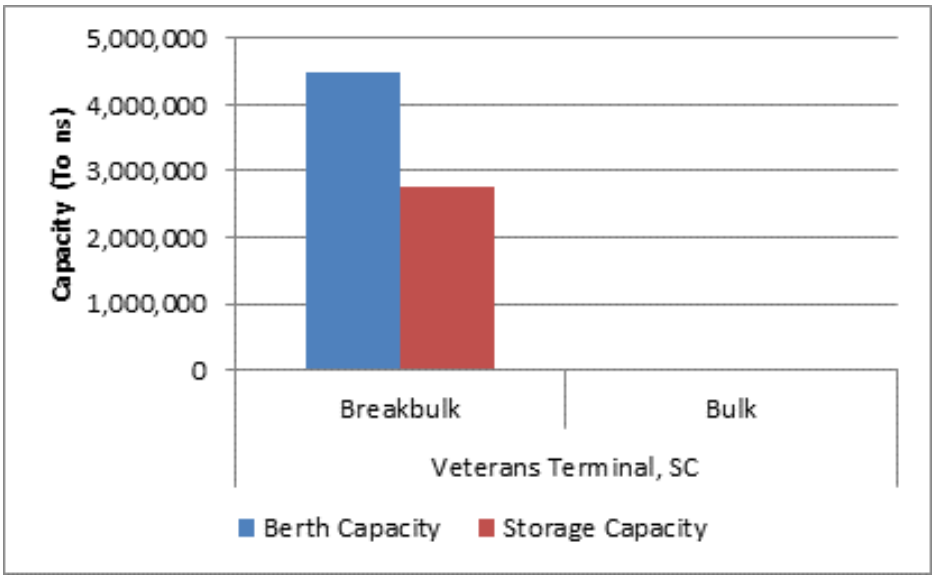
Table 24: Non-Container Storage Capacity of Breakbulk for VT

Veterans Terminal, SC Berth Capacity	Breakbulk (Closed Storage)	Breakbulk (Open Storage)	Breakbulk Total
Number of Berths Available	4.0	4.0	4.0
Ship Work Rate (Hours per Day)	21	21	21
Max Work Days per Week	7	7	7
Max Practical Berth Utilization	60%	60%	60%
Effective Total Berth-Hours per Week	352.80	352.80	352.80
Mean Cargo Handled per Vessel Calls (Tons)	10,000	10,000	10,000
Mean Loading/ Unloading Rate (Tons per Hour)	300	300	300
Mean Ship Work Time (Hrs)	33.3	33.3	33.3
Non-Work Hours at Berth	4.0	4.0	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	37.3	37.3	37.3
Potential Ship Calls per Week	9.5	9.5	9.5
Weekly Throughput Capacity (Tons)	94,500	94,500	94,500
Weekly Peaking Factor	110%	110%	110%
Annual Berth Capacity (Tons)	4,467,000	4,467,000	4,467,000

Table 25: Non-Container Storage Capacity of Breakbulk for VT

Norfolk International Terminal, VA Storage Capacity	Breakbulk (Closed Storage)	Breakbulk (Open Storage)	Breakbulk Total
Storage Method	Closed	Open	Closed & Open
Static Storage Capacity (Tons)	40,375	300,000	340,375
Static Capacity / Mean Ship Capacity	4.0	3.0	34.0
Nominal Annual Throughput (Tons/Year)	100,000	100,000	100,000
Mean Week Vessel Volume (Tons)	1,923	1,923	1,923
Cargo Dwell Time (Days)	30.0	30.0	30.0
Average Volume of Cargo in Storage (Tons)	8,242	8,242	8,242
Peak/Mean Inventory	150%	150%	150%
Demand for Storage (Tons)	12,363	12,363	12,363
Total Storage Available (Tons)	40,375	300,000	340,375
Annual Storage Capacity (Tons)	327,000	2,427,000	2,753,000

Figure 43: VT Non-Container Capacity



4.2.2 Port of Georgetown

At the Port of Georgetown (PG), bulk commodities were assumed to be stored in covered storage, inside the cement and salt domes. With the Google Earth program, the total area of both domes was determined to obtain the static storage capacity for bulk products. To determine the total breakbulk static storage capacity, an average was taken of all the specific breakbulk commodities found at the port of Georgetown. Table 26 and Table 27 show calculations for the PG berth and storage capacities.

PG's berth capacity for bulk is in the range of 2.4 million tons, whereas breakbulk is in the range of 2.2 million tons. The terminal's storage capacity for bulk is in the range of 99,000 tons and for breakbulk 1.3 million tons as shown on Figure 44. Overall, the terminal is limited by the storage capacity for both bulk, and breakbulk.

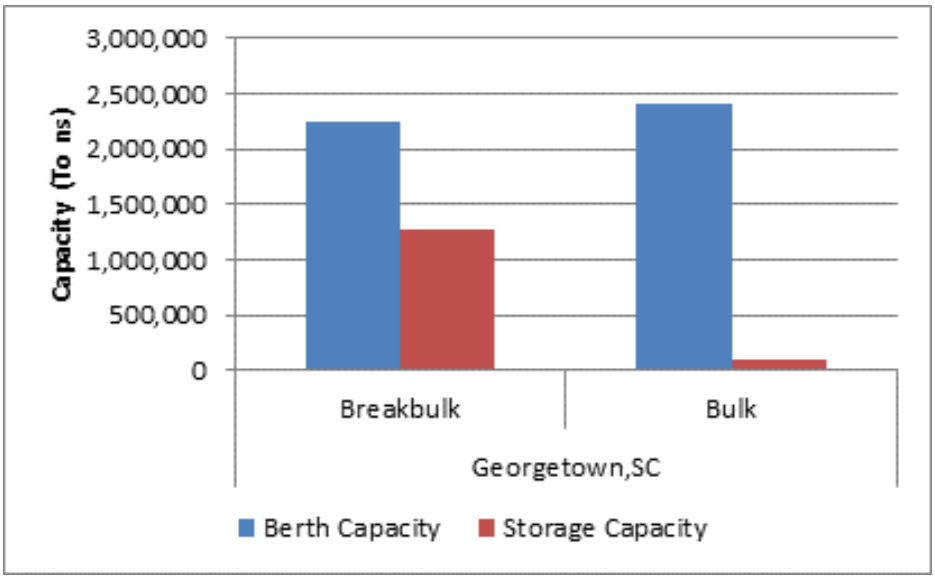
Table 26: Non-Container Berth Capacity of Bulk and Breakbulk for PG

Georgetown Terminal, SC Berth Capacity	Bulk Total (Covered Storage)	Breakbulk Total (Covered Storage)
Number of Berths Available	1.0	2.0
Ship Work Rate (Hours per Day)	21	21
Max Work Days per Week	7	7
Max Practical Berth Utilization	25%	30%
Effective Total Berth-Hours per Week	36.75	88.20
Mean Cargo Handled per Vessel Calls (Tons)	20,000	10,000
Mean Loading/ Unloading Rate (Tons per Hour)	800	300
Mean Ship Work Time (Hrs)	25.0	33.3
Non-Work Hours at Berth	4.0	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	29.0	37.3
Potential Ship Calls per Week	1.3	2.4
Weekly Throughput Capacity (Tons)	25,345	23,625
Weekly Peaking Factor	110%	110%
Annual Berth Capacity (Tons)	2,396,000	2,234,000

Table 27: Non-Container Storage Capacity of Bulk and Breakbulk for PG

Georgetown Terminal, SC Storage Capacity	Breakbulk Total (Covered Storage)	Breakbulk Total (Covered Storage)
Storage Method	Covered	Covered
Static Storage Capacity (Tons)	8,341	79,970
Nominal Annual Throughput (Tons/Year)	100,000	100,000
Mean Week Vessel Volume (Tons)	1,923	1,923
Cargo Dwell Time (Days)	30.0	15.0
Average Volume of Cargo in Storage (Tons)	8,242	4,121
Peak/Mean Inventory	150%	150%
Demand for Storage (Tons)	12,363	6,181
Total Storage Available (Tons)	8,341	79,970
Annual Storage Capacity (Tons)	67,000	1,294,000

Figure 44: PG Non-Container Capacity



4.3 Port Revenue

From the SC State Port Authority, 2009 and 2010 financial year annual report, the ports revenue is shown in Table 28. The container cargo which is in TEU was converted into tons. These container tons were then added to the total bulk and breakbulk tons, which makes up the total tonnage. The revenue per ton was determined by dividing the total revenue.

Table 28: SC State Port Authority Revenue

SC State Port Authority 2010 & 2009 Financial Report	2010	2009
Revenue (in millions)	$111.74	$136.20
Total Tonnage (in millions)	10.3	11.1
Revenue per Ton	$10.80	$12.26

5 SAVANNAH, GEORGIA

Georgia has following four existing major cargo handling terminals:

- Garden City Terminal
- Ocean Terminal
- Mayor's Terminal
- Marine Terminal
- Colonel's Island Terminal

Figure 50 shows the Port of Savannah while Figure 51 shows the Port of Brunswick.

At the Port of Savannah, there are two different terminals. Garden City Terminal (GCT) is a dedicated container cargo facility as shown in Figure 52. Ocean Terminal (OCT) is a dedicated breakbulk and Ro/Ro facility as shown in Figure 53. GCT is the fourth largest container terminal in the United States of America; GCT is also the largest single-terminal operation in North America.[10] Ocean Terminal (OCT) has a diverse mode of operations which allows commodities including forest products, steel, industrial equipment, farm equipment, automobiles, and heavy-lift cargoes. The Georgia Ports Authority (GPA) has reported 2,927,338 TEUs and 1,107,870 tons of breakbulk cargo were handled at the Port of Savannah.[11]

The GPA has plans for a future expansion to both GCT and OCT. Over the next 10 years the GPA is scheduled to buy 25 new cranes and 86 RTGs. By 2014 the GPA expects the OCT to have expanded the terminal size into surrounding land to open up additional storage for the Ro/Ro cargo. The GPA is also planning on deepening the Savannah channel up to 48 feet at mean low water to accommodate for the deep-draft vessels.[12]

The Port of Brunswick offers three different terminals for non-container handling, all of which are within five miles east of Interstate 95. The GPA reports that 170,309 tons of breakbulk were moved between the three terminals.[13]

Mayor's Point Terminal (MPT), shown in Figure 54, is a dedicated breakbulk facility. Mayor's Point Terminal distributes commodities such as wood pulp, linerboard, plywood and paper products. Because of the berth size and the available open and covered areas, Mayor's Point Terminal has the capacity to handle the largest cargo shipments quickly and efficiently.

The Marine Terminal (MT), as seen in Figure 55, is leased to Logistec U.S.A. Marine Terminal handles various breakbulk, and bulk commodities including renewable fuels in the form of wood and peanut hull pellets. Since 2006 Marine Terminal has exported approximately 500,000 tons

[10] http://www.gaports.com/Default.aspx?tabid=122
[11] http://savannah.gatech.edu/people/psiplon/snapshot/snapshots/LogisticsMarketSnapshot-AUGUST2011.pdf
[12] http://www.gaports.com/Facilities/OceanTerminal/FutureExpansion.aspx
[13] http://savannah.gatech.edu/people/psiplon/snapshot/snapshots/LogisticsMarketSnapshot-AUGUST2011.pdf

of pellets. In recent developments, the Georgia Port Authority and Logistec U.S.A. came to an agreement to expand the market for wood pellets in the Marine Terminal. By January 2012 the terminal will be upgraded by deepening three berths to 36 feet at mean low water; as well as other upgrades to the docks and facilities for the terminal to handle up to 1 million tons of wood pellets.[14] Biomass is the world's largest wood pellet plant which can produce approximately 750,000 tons per year. The manufacture expands over 300 acres and is about 60 miles away from Brunswick, Georgia.[15]

Colonel's Island Terminal (CIT) as shown in Figure 56, has two distinct terminals; RoRo, and Agri-bulk. The Ro/Ro terminal at Colonel's Island is one of the largest auto facilities in the nation. Car manufactures like Glovis, Porsche, BWM, Jaguar, SAAB, Volvo, Land Rover, and Volkswagen imported 465,342 automobile and machinery units in the 2011 fiscal year, an increase by 40.1 percent from the previous fiscal year.[16] The Agri-bulk terminal at Colonel's Island is among the largest deep-water agri-bulk operations in the United States. The facility features a dedicated agri-bulk berth that is capable of accommodating a diverse group of agricultural products such as soybean meal, barley malt, and wheat in flat or vertical storage.[17] In the 2010 fiscal year the GPA reported 1.7 million tons of agri-bulk.[18]

Both Table 29 and Table 30 provide an overview of container and non-container handling terminals at the Port of Savannah. This information was gathered from the Georgia Ports Authority website. Figure 45 and Figure 46 summarize the total berth lengths and terminal areas for the ports in the state of Georgia.

In Figure 47, the annual berth and CY capacity for container terminals in Savannah is summarized. Figure 48 combines the bulk and breakbulk berth and storage capacities for the Ports of Georgia. In Figure 49, the Ro/Ro berth and storage capacities for the Ports of Georgia are determined. In the following sections, calculations and methods used to determine the berth, CY, and storage capacities are explained.

Table 29: Georgia Container Handling Terminal Information

Savannah, GA	Berth Length (ft)	Water Depth (ft)	# DC total	# DC nPPX Outreach (20 wide)	Container Terminal Size (acres)	Mode of Operation	Railroad Access
Garden City Terminal	9,693	48	23	12	600	RTG/TP	Yes

[14] http://www.forestbusinessnetwork.com/6588/brunswick-partnership-to-expand-wood-pellet-market/
[15] http://www.gabiomass.com/projects
[16] http://savannah.gatech.edu/people/psiplon/snapshot/snapshots/LogisticsMarketSnapshot-AUGUST2011.pdf
[17] http://www.gaports.com/Default.aspx?tabid=356
[18] http://www.buygeorgia.com/communitymagazines/communities/141/2011/pdfs/Port.pdf

Table 30: Non-Container Handling Terminal Information

	Location	Number of Berth/Pier (each)	Berth/Pier Length (ft)	Water Depth (ft)	Total Terminal Size (acres)	Covered Area (ft^2)	Open Area (acres)	Mode of Operation	Railroad Access
Ocean Terminal	Savannah, GA	9	6,000	42	200	11,000	70	Breakbulk, Ro/Ro, Containers, Heavy-lift Cargo	Yes
Mayor's Point Terminal	Brunswick, GA	2	2,000	36	20	400,000	10	Breakbulk	Yes
Marine Terminal	Brunswick, GA	5	2,500	36	70	500,000	15	Liquid Bulk, Breakbulk, and Dry Bulk	Yes
Colonel's Terminal	Brunswick, GA	5	4,000	36	2,000	3,000,000	1,600	Ro/Ro, Agribulk, & Cargo	Yes

Figure 45: Berth Length for Port Terminals at Georgia

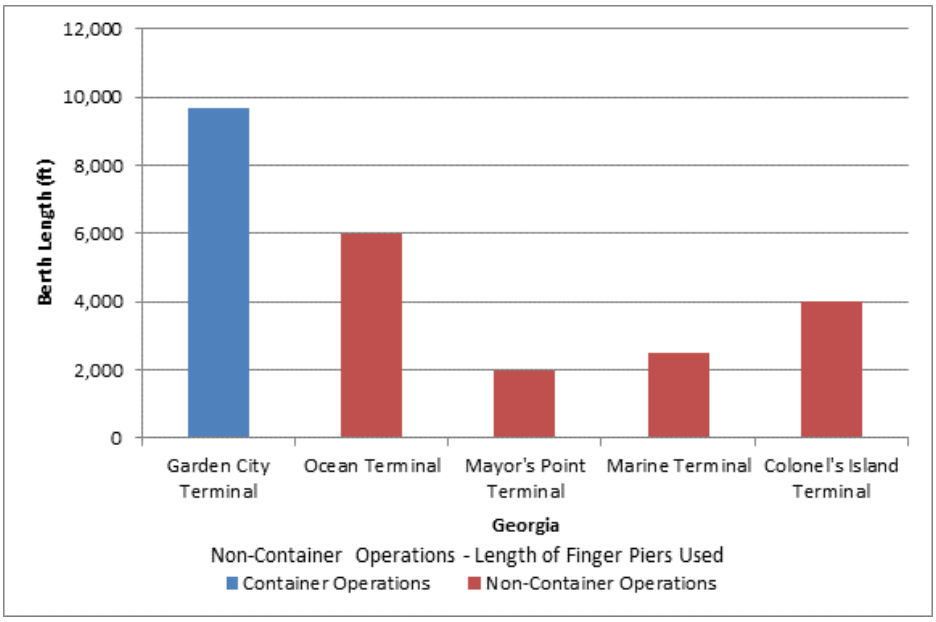


Figure 46: Terminal Sizes for Port Terminals at Georgia

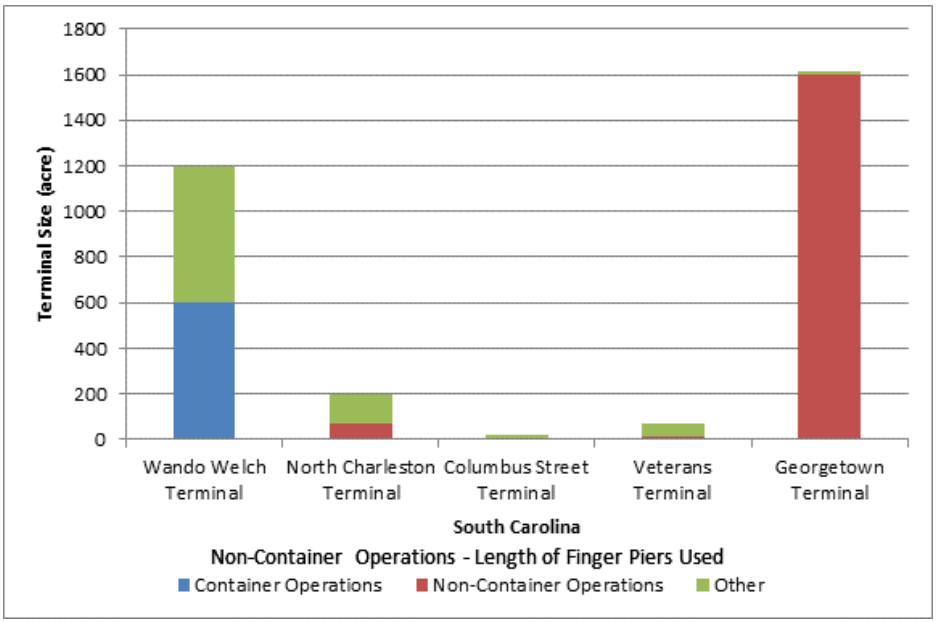


Figure 47: Port of Savannah Container Capacity

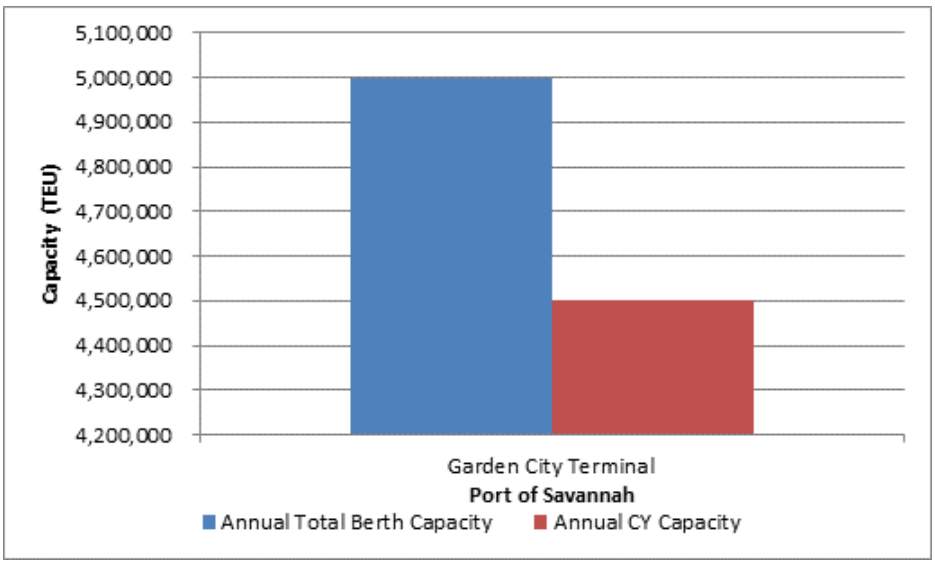


Figure 48: Ports of Georgia Non-Container (Bulk/Breakbulk) Capacity

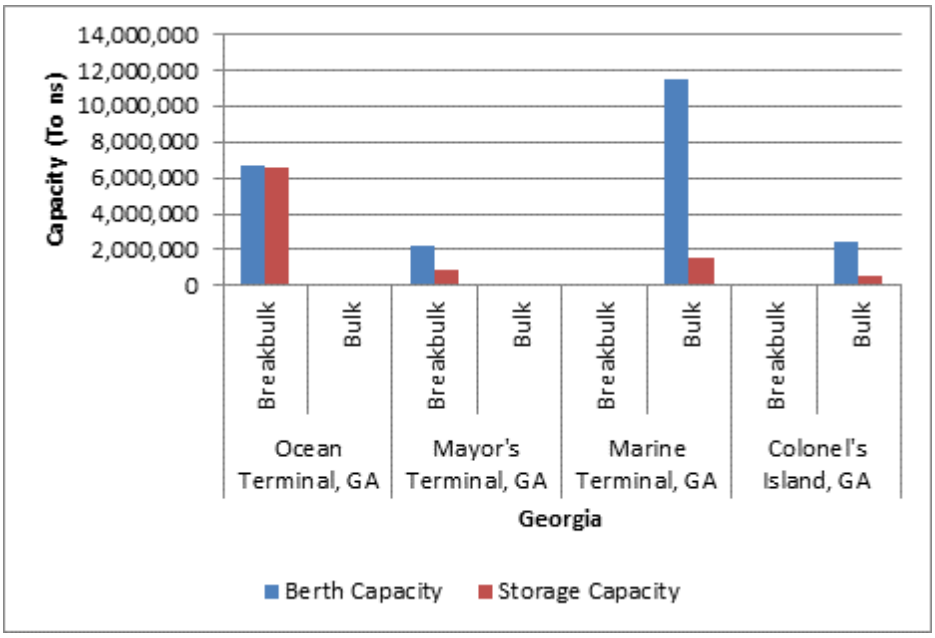


Figure 49: Ports of Georgia Non-Container (Ro/Ro) Capacity

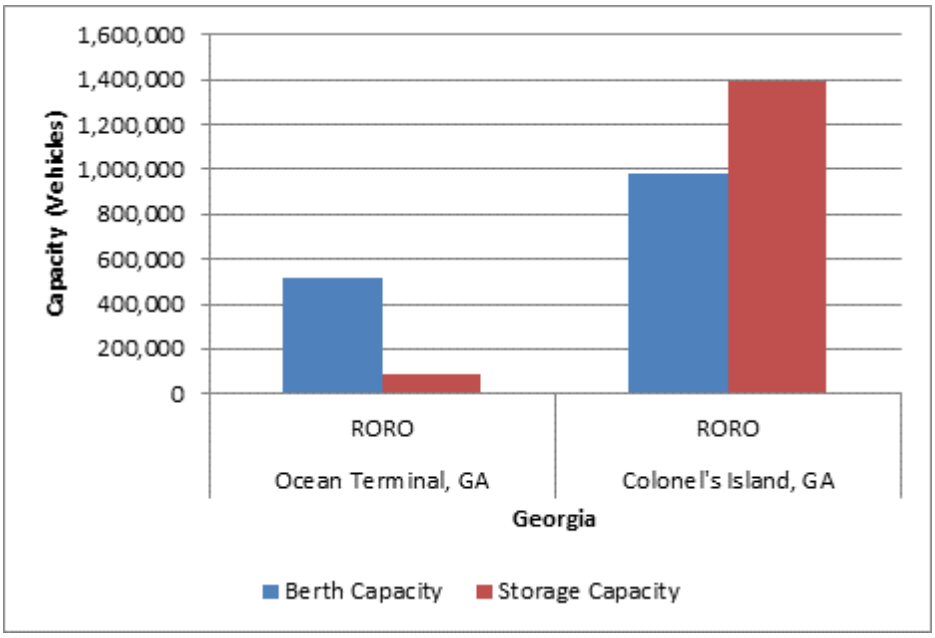


Figure 50: Port of Savannah

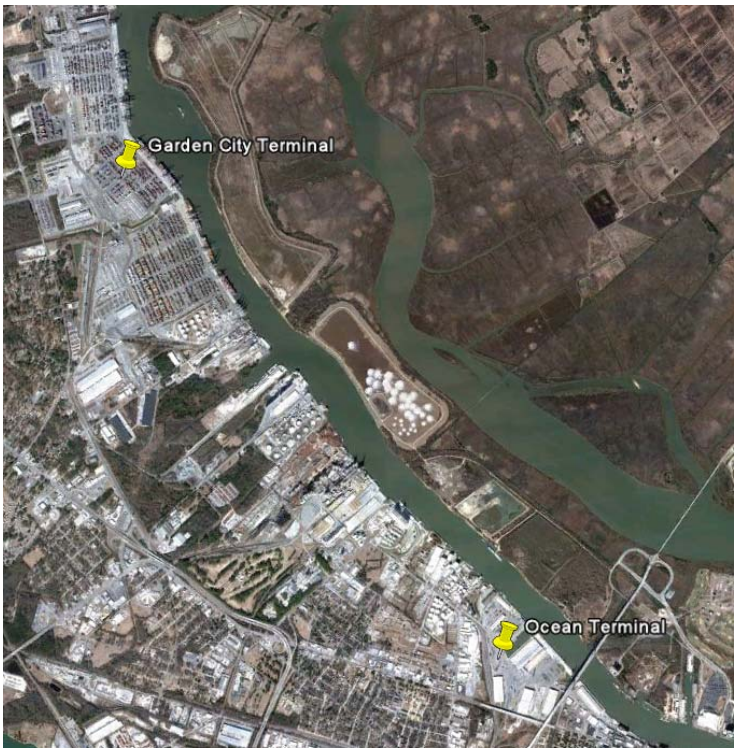


Figure 51: Port of Brunswick

Figure 52: Port of Savannah - Ocean Terminal

Figure 53: Port of Savannah - Ocean Terminal

Figure 54: Port of Brunswick - Mayor's Point Terminal

Figure 55: Port of Brunswick - Marine Terminal

Figure 56: Port of Brunswick - Colonel's Island Terminal

5.1 Capacity Analysis of Container Terminals

5.1.1 Garden City Terminal

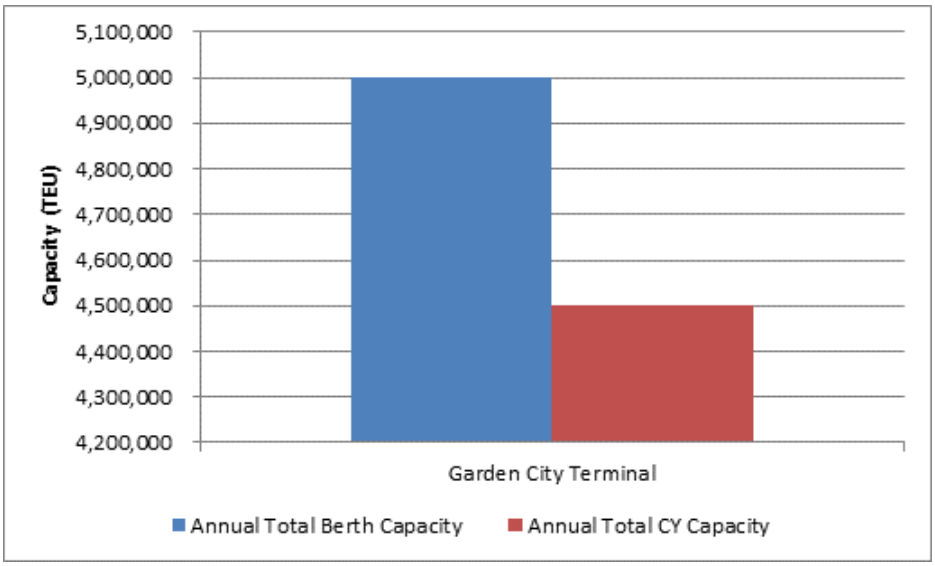
Garden City Terminal (GCT) is a container handling facility located in the Port of Savannah. GCT can handle vessel sizes of 5,000 to 7,000 TEU. GCT was determined to have 7.5 berths, and a maximum practical peak week berth utilization of 70 percent.

At GCT, the container cargo is handled by RTG/TP. By following the industry average of container yard capacity for RTG/TP per acre, 7,500 TEU per acre per year was multiplied by the available acreage to determine the annual storage capacity of the container yard. Table 31 shows the calculations used to derive the annual berth capacity, CY capacity and terminal capacity for the GCT. GCT's berth capacity is in the range of 5 million TEU whereas the terminal's CY capacity is in the range of 4.5 million TEU as shown on Figure 57. Overall, the terminal is limited by the CY capacity of 4.5 million TEU.

Table 31: Container Terminal Capacity at Garden City Terminal

	Garden City Terminal
Container moves (lifts) per vessel call [a]	1,900
Dock cranes assigned per vessel [b]	3.5
Productivity per dock crane (mv/hr) [c]	30
Vessel productivity(mv/hr) [d=b*c]	105
Work hours per vessel call [e=a/d]	17.7
Unproductive time at berth (hrs) [f]	3
Total vessel time at berth (hrs) [g=e+f]	20.7
Work hours per day [h]	20
Calendar hrs/ work hour [i=24/h]	1.20
Total vessel hrs at berth [j=g*i]	24.8
Calendar hrs per week [k]	168
Vessel calls per week at 100% berth utilization [l=k/j]	6.78
Maximum practical peak week berth utilization [m]	70%
Maximum practical vessel calls per week [n=l*m]	4.74
Peak week berth capacity (moves) [o=n*a]	8,796
Peak/mean week seasonal demand factor [p]	1.2
Mean week throughput capacity (moves) [q=o/p]	7,330
Annual unit berth capacity (moves) [r=q*52]	381,000
TEU per container [s]	1.75
Annual unit berth capacity (TEU) [t=r*s]	670,000
Total berth length (feet)	9,693
Number of berths (100' gauge crane) [u]	7.5
Annual total berth capacity (TEU)	**5,000,000**
Annual CY capacity (TEU)	**4,500,000**
Terminal capacity (TEU)	**4,500,000**

Figure 57: GCT Container Capacity



5.2 Capacity Analysis of Non- Container Terminals

5.2.1 Ocean Terminal

Ocean Terminal which is part of the Port of Savannah has 11 berths, nine of which are assumed to be used for breakbulk commodities while two are assumed to be used for Ro/Ro cargo. Table 32 shows the total breakbulk berth capacity at Ocean Terminal, with 40 percent maximum practical berth utilization. Table 33 gives us the total Ro/Ro berth capacity, also with 40 percent maximum practical berth utilization. For the Berth capacity calculation, it was determined that Ro/Ro will have 6,000 mean vehicles per ship call, with an average ramp productivity of 100 vehicles per hour being unloaded.

At the Port of Savannah, in OCT, breakbulk commodities are handled in covered storage while Ro/Ro commodities are handled in open storage. For the total breakbulk static storage capacity, again an average of the storage capacities for the available commodities handled at the terminal was used. The static storage capacity for Ro/Ro was found by first determining the area of open space in acres and then multiplying the area by 180 vehicles per acre. Table 34 shows the total storage capacity for breakbulk commodities at the Ocean Terminal. Table 35 shows the total storage capacity for Ro/Ro commodities at the Ocean Terminal.

OCT's berth capacity for breakbulk is in the range of 6.7 million tons whereas Ro/Ro is in the range of 500,000 vehicle units. As for the terminal's storage capacity for breakbulk the range is of 6.6 million tons and for Ro/Ro 87,000 million tons. The capacities are shown on Figure 58 and Figure 59. Overall, the terminal is limited by the storage capacity for both bulk, and breakbulk.

Table 32: Non-Container Berth Capacity of Breakbulk for OCT

Ocean Terminal, GA Berth Capacity	Breakbulk Total (Covered Storage)
Number of Berths Available	9.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	40%
Effective Total Berth-Hours per Week	529.20
Mean Cargo Handled per Vessel Calls (Tons)	10,000
Mean Loading/ Unloading Rate (Tons per Hour)	300
Mean Ship Work Time (Hrs)	33.3
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	37.3
Potential Ship Calls per Week	14.2
Weekly Throughput Capacity (Tons)	141,750
Weekly Peaking Factor	110%
Annual Berth Capacity (Tons)	6,701,000

Table 33: Non-Container Berth Capacity of Ro/Ro for OCT

Ocean Terminal, GA Berth Capacity	Ro/Ro (Open Storage)
Number of Berths Available	2
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	20%
Effective Total Berth-Hours per Week	58.8
Mean Cargo Handled per Vessel Calls (Tons)	6,000
Mean Loading/ Unloading Rate (Tons per Hour)	100
Mean Ship Work Time (Hrs)	60
Non-Work Hours at Berth	4
Mean Berth Occupancy Time per Ship (Hrs/Call)	64
Potential Ship Calls per Week	0.9
Weekly Throughput Capacity (Tons)	5,513
Weekly Peaking Factor	110%
Annual Berth Capacity (Tons)	260,000

Table 34: Non-Container Storage Capacity of Breakbulk for OCT

Ocean Terminal, GA Storage Capacity	Breakbulk Total (Covered Storage)
Storage Method	Covered
Static Storage Capacity (Tons)	815,260
Static Capacity / Mean Ship Capacity	81.5
Nominal Annual Throughput (Tons/Year)	100,000
Mean Week Vessel Volume (Tons)	1,923
Cargo Dwell Time (Days)	30.0
Average Volume of Cargo in Storage (Tons)	8,242
Peak/Mean Inventory	150%
Demand for Storage (Tons)	12,363
Total Storage Available (Tons)	815,260
Annual Storage Capacity (Tons)	6,595,000

Table 35: Non-Container Storage Capacity of Ro/Ro for OCT

Ocean Terminal, GA Storage Capacity	Ro/Ro (Open Storage)
Storage Method	Open
Static Storage Capacity (Vehicle)	3,960
Static Capacity / Mean Ship Capacity	0.7
Nominal Annual Throughput (Vehicle/Year)	100,000
Mean Week Vessel Volume (Vehicle)	1,923
Cargo Dwell Time (Days)	15.0
Average Volume of Cargo in Storage (Vehicle)	4,121
Peak/Mean Inventory	110%
Demand for Storage (Vehicle)	4,533
Total Storage Available (Vehicle)	3,960
Annual Storage Capacity (Vehicle)	87,000

Figure 58: OCT Non-Container of Breakbulk Capacity

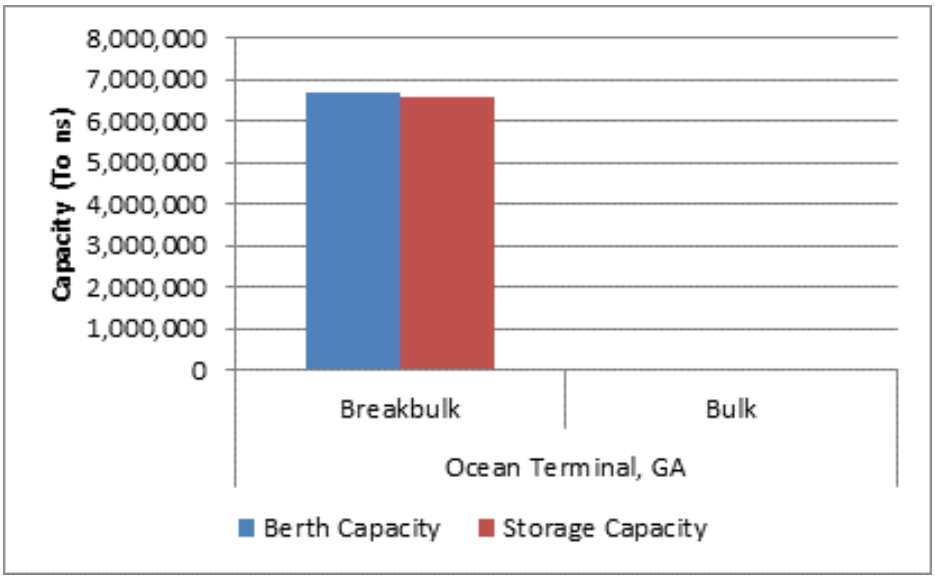
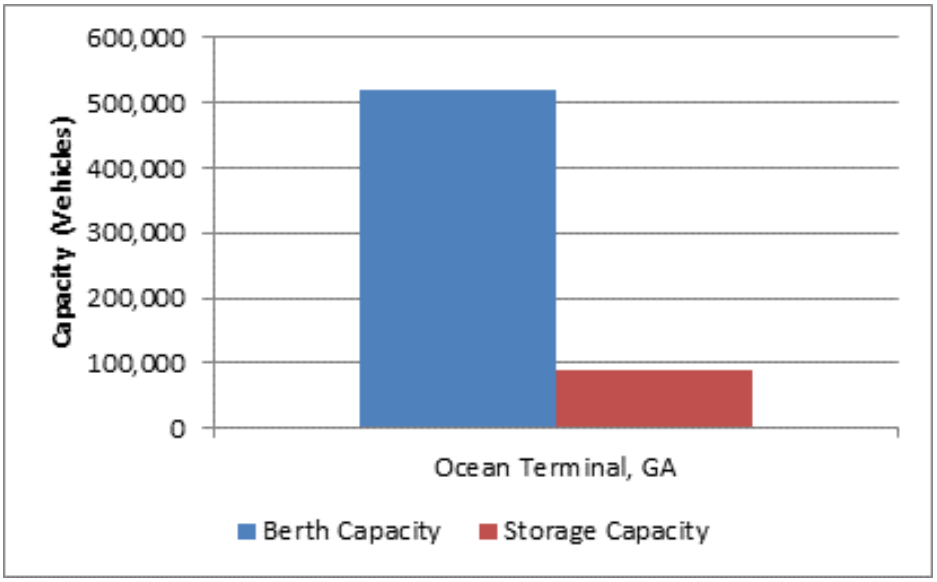


Figure 59: OCT Non-Container of Ro/Ro Capacity



5.2.2 Mayor's Point Terminal

At the Port of Brunswick, Mayor's Point Terminal (MPT) is a dedicated breakbulk handling facility with a total of two berths. Table 36 has Mayor's Point Terminal's berth capacity.

The annual storage capacity for MPT at the Port of Brunswick in Georgia is shown in Table 37. The static storage capacity values follow the average of the specific breakbulk commodities from MPT.

MPT's berth capacity for breakbulk is in the range of 2.2 million tons, whereas the storage capacity is in the range of 800,000 tons. Overall, the terminal is limited by the storage capacity as shown on Figure 60.

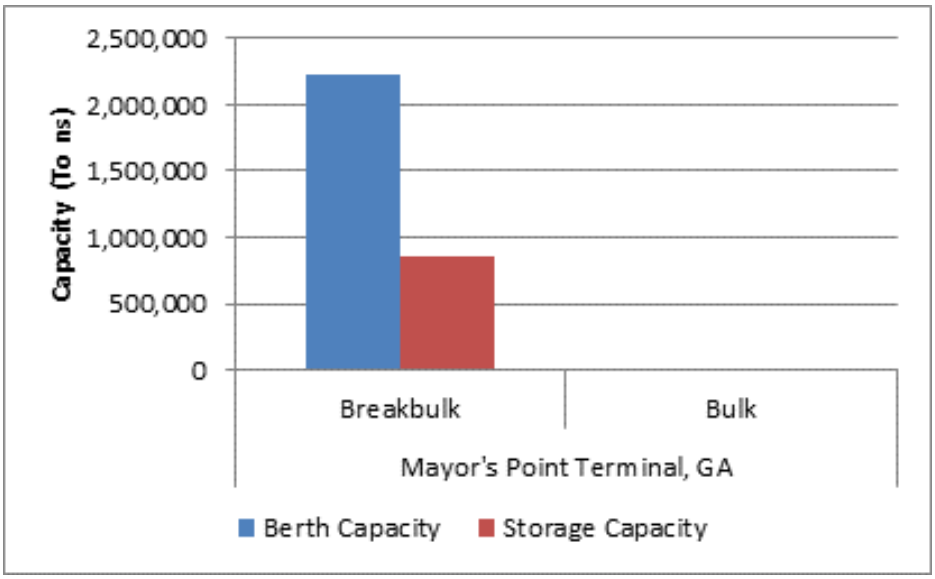
Table 36: Non-Container Berth Capacity of Breakbulk for MPT

Mayor's Point Breakbulk Terminal, GA Berth Capacity	Breakbulk Total (Covered Storage)
Number of Berths Available	2.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	60%
Effective Total Berth-Hours per Week	176.40
Mean Cargo Handled per Vessel Calls (Tons)	10,000
Mean Loading/ Unloading Rate (Tons per Hour)	300
Mean Ship Work Time (Hrs)	33.3
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	37.3
Potential Ship Calls per Week	4.7
Weekly Throughput Capacity (Tons)	47,250
Weekly Peaking Factor	110%
Annual Berth Capacity (Tons)	2,234,000

Table 37: Non-Container Storage Capacity of Breakbulk for MPT

Mayor's Point Breakbulk Terminal, GA Storage Capacity	Breakbulk Total (Covered Storage)
Storage Method	Covered
Static Storage Capacity (Tons)	87,350
Static Capacity / Mean Ship Capacity	8.7
Nominal Annual Throughput (Tons/Year)	100,000
Mean Week Vessel Volume (Tons)	1,923
Cargo Dwell Time (Days)	30.0
Average Volume of Cargo in Storage (Tons)	8,242
Peak/Mean Inventory	125%
Demand for Storage (Tons)	10,302
Total Storage Available (Tons)	87,350
Annual Storage Capacity (Tons)	848,000

Figure 60: MPT Non-Container Capacity



5.2.3 Marine Terminal

Marine Terminal (MT) has a total of four berths; Table 38 show the estimated annual berth capacity for the MT. MT exports the bulk commodity of wood pellets. The annual storage capacity for Marine Terminal is show in Table 39.

To calculate the annual storage capacity, we used values from the Port of Wilmington. The annual storage capacity was determined to be 1,530,000 tons; this number is validated by Logistec USA and from an article from the Forest Business Network. It is stated on the Logistec USA website that in 2006 they have, "…exported close to 500,000 tons of pellets through our facility, and this number is expected to more than triple in the next few years," which 500,000 tons times three is 1,500,000 tons.[19] In the Forest Business Network article it states, the terminal will be significantly upgraded in the first phase of the expanded partnership to handle up to one million tons of wood pellets and chips annually.[20] These two sources confirm the calculations preformed to determine what the annual storage capacity is at each port terminal.

MT's berth capacity for breakbulk is in the range of 11.5 million tons, whereas the storage capacity is in the range of 1.5 million tons. Overall, the terminal is limited by the storage capacity as shown in Figure 61.

[19] http://www.logistec.com/web/PRODWEB/sites/logistec/page/achievements/wood_pellets.php
[20] http://www.forestbusinessnetwork.com/6588/brunswick-partnership-to-expand-wood-pellet-market/

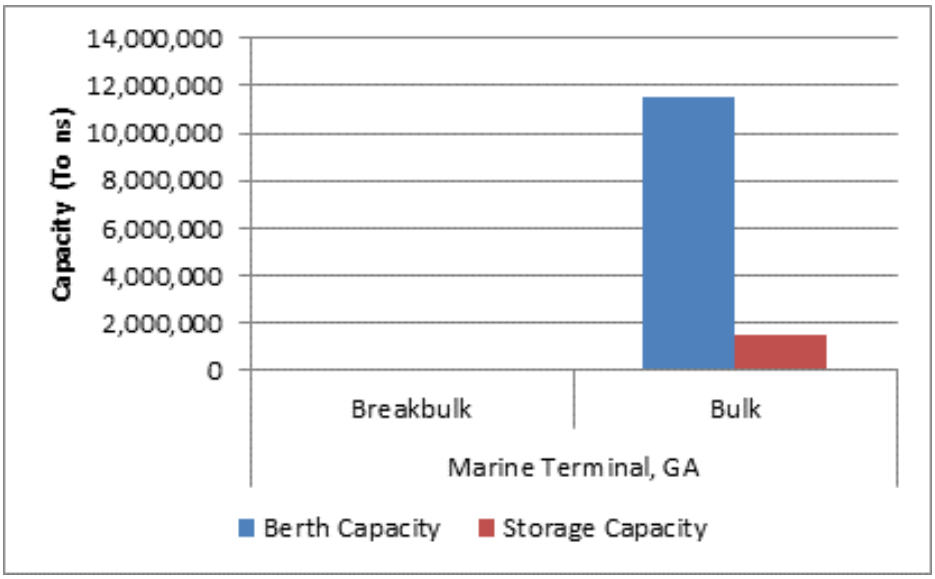
Table 38: Non-Container Berth Capacity of Bulk for MT

Marine Terminal, GA Berth Capacity	Breakbulk Total (Covered Storage)
Number of Berths Available	4.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	60%
Effective Total Berth-Hours per Week	352.80
Mean Cargo Handled per Vessel Calls (Tons)	20,000
Mean Loading/ Unloading Rate (Tons per Hour)	800
Mean Ship Work Time (Hrs)	25.0
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	29.0
Potential Ship Calls per Week	12.2
Weekly Throughput Capacity (Tons)	243,310
Weekly Peaking Factor	110%
Annual Berth Capacity (Tons)	11,502,000

Table 39: Non-Container Storage Capacity of Bulk for MT

Marine Terminal, GA Storage Capacity	Breakbulk Total (Covered Storage)
Storage Method	Covered
Static Storage Capacity (Tons)	189,189
Static Capacity / Mean Ship Capacity	9.5
Nominal Annual Throughput (Tons/Year)	100,000
Mean Week Vessel Volume (Tons)	1,923
Cargo Dwell Time (Days)	30.0
Average Volume of Cargo in Storage (Tons)	8,242
Peak/Mean Inventory	150%
Demand for Storage (Tons)	12,363
Total Storage Available (Tons)	189,189
Annual Storage Capacity (Tons)	1,530,000

Figure 61: MT Non-Container Capacity



5.2.4 Colonel's Island Terminal

At the Port of Brunswick, Colonel's Island Terminal (CIT) handles both bulk and Ro/Ro commodities. The bulk facility which handles grain products has a dedicated berth with mechanical loading and unloading equipment. The Ro/Ro facility is one of the largest in the United States of America. At CIT, all bulk commodities are stored inside covered storage; while Ro/Ro commodities are stored outside in open paved storage. Table 40 and Table 41 are the annual berth capacities for the bulk and Ro/Ro commodities respectfully.

Through the Georgia Ports Authority website, the actual static storage capacity for the bulk facility was found to be approximately 60,000 metric tons. For the Ro/Ro commodities the static storage capacity was determined by taking the paved areas, approximately 350 acres and multiplying it by 180 units per area to get the approximate static storage capacity for Colonel's Island Terminal in vehicle units. On Table 42 and Table 43 the storage capacity for bulk and Ro/Ro commodities respectively are presented.

For the bulk operation, the limiting factor is the storage capacity, as shown in Figure 62. Unlike most non-container terminals in the Southern Atlantic Region, the berth capacity is the limiting factor here at CIT for the Ro/Ro operation, as shown in Figure 63. With the ability to store an annual capacity of approximately 1.4 million vehicle units, only about 1 million vehicle units per year can be handled at CIT because of the berth capacity.

Table 40: Non-Container Berth Capacity of Bulk for CIT

Colonel's Island Terminal, GA Berth Capacity	Bulk Total (Covered Storage)
Number of Berths Available	1.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	50%
Effective Total Berth-Hours per Week	73.50
Mean Cargo Handled per Vessel Calls (Tons)	20,000
Mean Loading/ Unloading Rate (Tons per Hour)	800
Mean Ship Work Time (Hrs)	25.0
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	29.0
Potential Ship Calls per Week	2.5
Weekly Throughput Capacity (Tons)	50,690
Weekly Peaking Factor	110%
Annual Berth Capacity (Tons)	2,396,000

Table 41: Non-Container Berth Capacity of Ro/Ro for CIT

Colonel's Island Terminal, GA Berth Capacity	Ro/Ro Total (Open Storage)
Number of Berths Available	3.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	50%
Effective Total Berth-Hours per Week	220.50
Mean Cargo Handled per Vessel Calls (Vehicle)	6,000
Mean Loading/ Unloading Rate (Vehicle per Hour)	100
Mean Ship Work Time (Hrs)	60
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	64.0
Potential Ship Calls per Week	3.4
Weekly Throughput Capacity (Vehicle)	20,672
Weekly Peaking Factor	110%
Annual Berth Capacity (Vehicle)	977,000

Table 42: Non-Container Storage Capacity of Bulk for CIT

Colonel's Island Terminal, GA Storage Capacity	Bulk Total (Covered Storage)
Storage Method	Covered
Static Storage Capacity (Tons)	60,000
Static Capacity / Mean Ship Capacity	3.0
Nominal Annual Throughput (Tons/Year)	100,000
Mean Week Vessel Volume (Tons)	1,923
Cargo Dwell Time (Days)	30.0
Average Volume of Cargo in Storage (Tons)	8,242
Peak/Mean Inventory	150%
Demand for Storage (Tons)	12,363
Total Storage Available (Tons)	60,000
Annual Storage Capacity (Tons)	485,000

Table 43: Non-Container Storage Capacity of Ro/Ro for CIT

Colonel's Island Terminal, GA Storage Capacity	Ro/Ro (Open Storage)
Storage Method	Open
Static Storage Capacity (Vehicle)	63,000
Static Capacity / Mean Ship Capacity	10.5
Nominal Annual Throughput (Vehicle/Year)	100,000
Mean Week Vessel Volume (Vehicle)	1,923
Cargo Dwell Time (Days)	15.0
Average Volume of Cargo in Storage (Vehicle)	4,121
Peak/Mean Inventory	110%
Demand for Storage (Vehicle)	4,533
Total Storage Available (Vehicle)	63,000
Annual Storage Capacity (Vehicle)	1,390,000

Figure 62: CIT Non-Container Capacity for Bulk

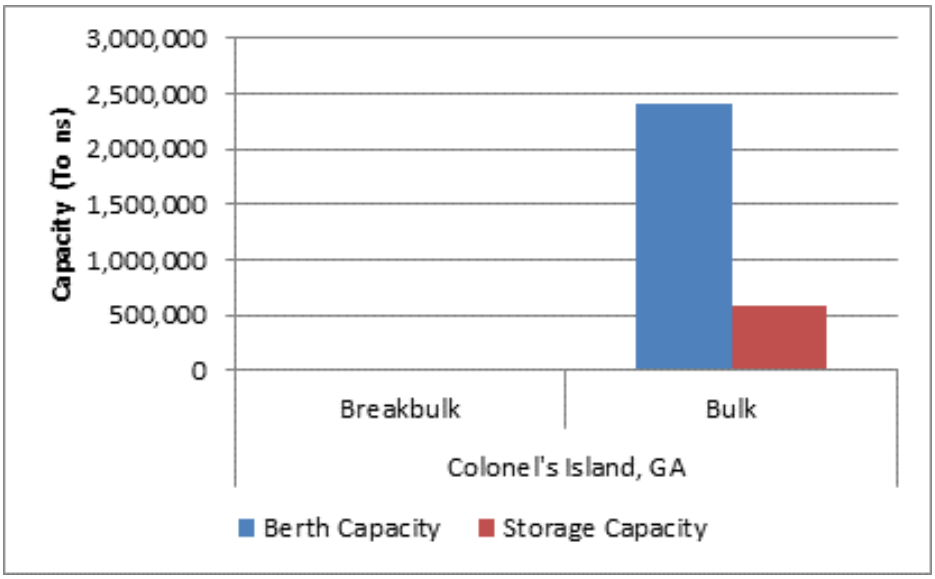
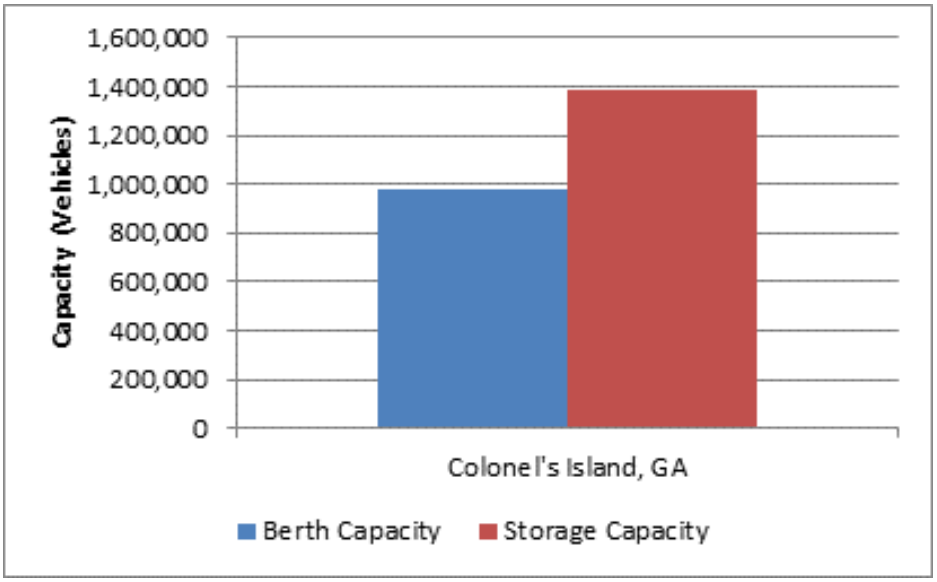


Figure 63: CIT Non-Container Capacity for Ro/Ro



5.3 Port Revenue

From the Georgia Port Authority's, 2010 financial year annual report, the port revenue is shown in Table 44. The container cargo which is in TEU was converted into tons. These container tons were then added to the total bulk and breakbulk tons, which makes up the total tonnage. The revenue per ton was determined by dividing the total revenue.

Table 44: Georgia Ports Authority Revenue

Georgia Port Authority 2010 Financial Report	2010	2009
Revenue (in millions)	$238.32	$227.80
Total Tonnage (in millions)	21.5	18.6
Revenue per Ton	$11.11	$12.27

6 JACKSONVILLE, FLORIDA

Jacksonville, Florida has following three existing major container and non-container handling terminals:

- Dames Point (TraPac) Terminal
- Talleyrand Terminal
- Blount Island Terminal

Figure 69 shows the location of these three cargo handling facilities in the Port of Jacksonville.

The Port of Jacksonville has three terminals with container handling operations: TraPac Terminal as shown on Figure 70; Blount Island Terminal as shown on Figure 71; and Talleyrand Terminal as shown on Figure 72. Two of the terminals at the Port of Jacksonville also have non-container handling areas, Blount Island Terminal and Talleyrand Terminal. During the 2010 fiscal year, the Port of Jacksonville handled approximately 4,419,331 TEU's, 990,353 tons of breakbulk, 1,515,161 tons of bulk, and 518,880 automobile units.[21] Currently, the Port of Jacksonville has plans to refurbish the rail infrastructure, and wharf rehabilitation at both Blount Island and Talleyrand Terminals.[22] Both Blount Island and Talleyrand Terminals are easily accessible from major Interstates 95 and 10.

Blount Island Terminal is the largest facility in the Port of Jacksonville, at 754 acres. Using the Google Earth program, it was determined that the non-container facilities comprise about 240 acres. Blount Island Terminal handles commodities that include container cargo, Ro/Ro, heavy lift, breakbulk, and liquid bulk cargoes.

The Talleyrand Terminal is approximately 173 acres, 90 of which are used for non-container commodities such as breakbulk (steel, lumber, paper, and frozen goods), imported automobiles, and liquid bulk (turpentine and vegetable oil).[23]

Table 45 and Table 46 shows an overview of container and non-container handling terminals in the Port of Jacksonville. This information was gathered from the Jacksonville Ports Authority website and was adjusted to meet with our Google Earth aerials. Figure 64 and Figure 65 shows the summary of the total berth length and the areas for the port terminals found in Jacksonville, Florida.

In Figure 66, the annual berth and CY capacity for container terminals in Jacksonville is determined. Figure 67 combines the bulk and breakbulk berth and storage capacities for the Port of Jacksonville. In Figure 68, the Ro/Ro berth and storage capacities for the Port of Jacksonville are calculated. In the following sections, calculations and methods used to determine the berth, CY, and storage capacities are explained in further detail.

[21] http://www.jaxport.com/cargo/maritime-resources/marine-statistics
[22] http://www.jaxport.com/cargo/facilities/expansion-plans
[23] http://www.jaxport.com/cargo/facilities/talleyrand

Table 45: Port of Jacksonville Container Handling Terminal Information

Jacksonville, FL	Berth Length (ft)	Water Depth (ft)	# DC Total	# DC nPPX Outreach (20 wide)	Container Terminal Size (acres)	Mode of Operation	Railroad Access
TraPac Terminal at Dames Point	2,400	40	6	6	158	RTG/TP	Yes
Blount Island	3,500	40	6	-	129	Whl/TP	Yes
Talleyrand	2,250	40	4	-	59	Whl/TP	Yes

Table 46: Port of Jacksonville Non-Container Handling Terminal Information

Jacksonville, FL	Number of Berths/Piers (each)	Berth/Pier Length (ft)	Water Depth (ft)	Total Terminal Size (acres)	Covered Area (ft^2)	Open Area (acres)	Mode of Operation	Railroad Access
Dames Point Terminal	6	700	40	50	0	50	Container, Bulk	Yes
Blount Terminal	7	2,000	39	240	600,000	210	Container, Ro/Ro, Breakbulk & Cargo	Yes
Talleyrand Terminal	6	5,000	40	90	553,000	70	Container, Ro/Ro, Breakbulk, Liquid Bulk & Cargo	Yes

Figure 64: Berth Length for Port Terminals at Jacksonville, FL

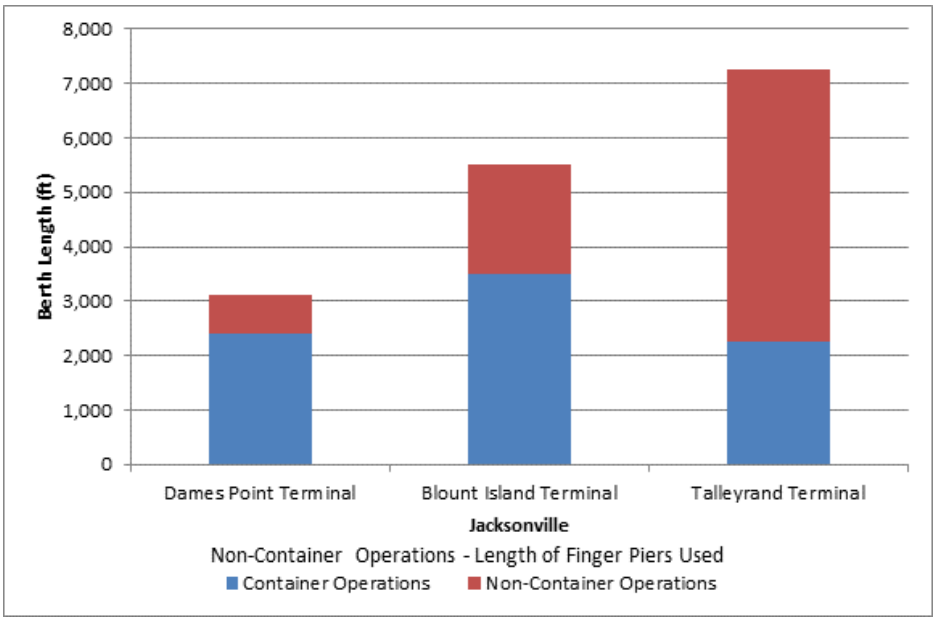


Figure 65: Terminal Sizes for Port Terminals at Jacksonville, FL

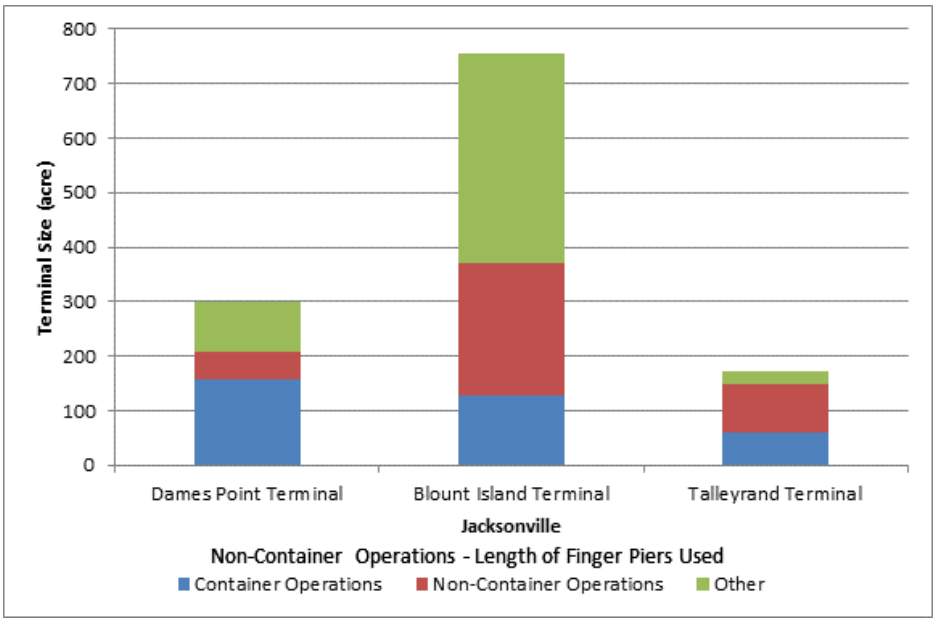


Figure 66: Port of Jacksonville Container Capacity

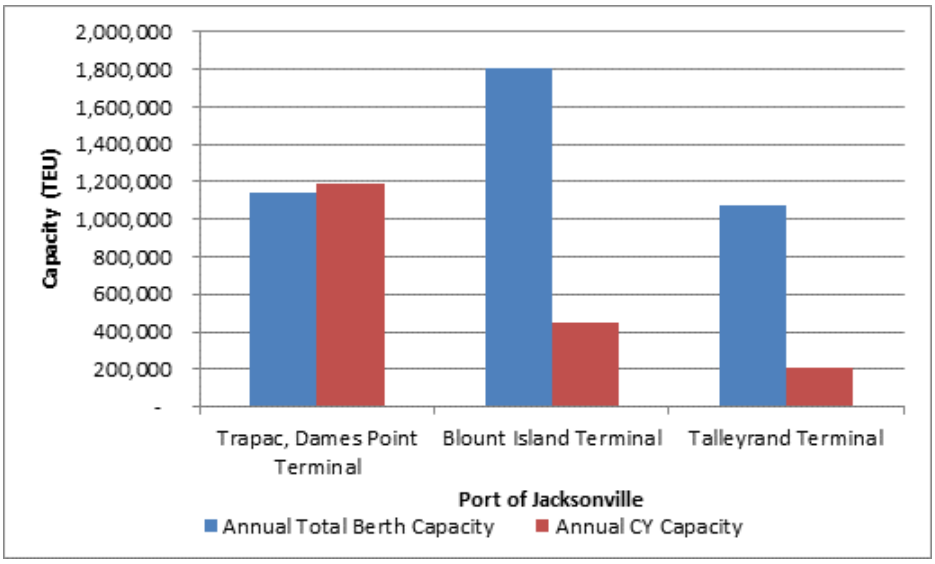


Figure 67: Port of Jacksonville Non-Container (Bulk/Breakbulk) Capacity

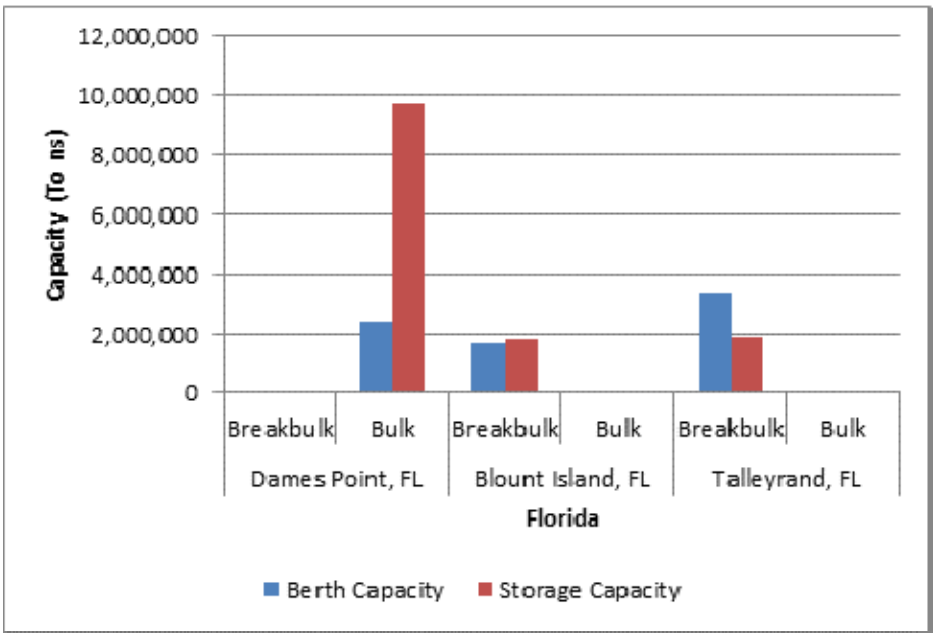


Figure 68: Port of Jacksonville Non-Container (Ro/Ro) Capacity

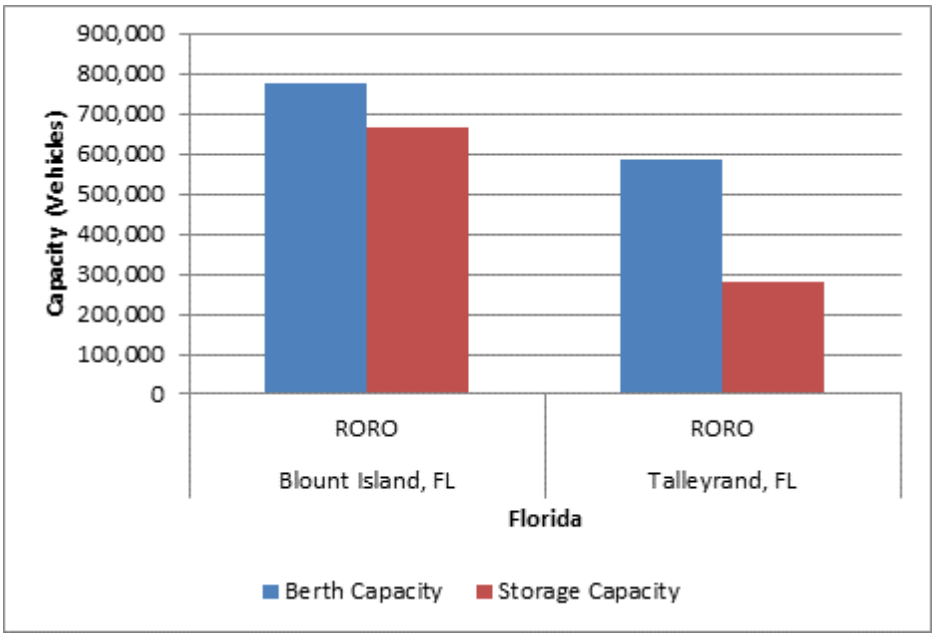


Figure 69: Port of Jacksonville

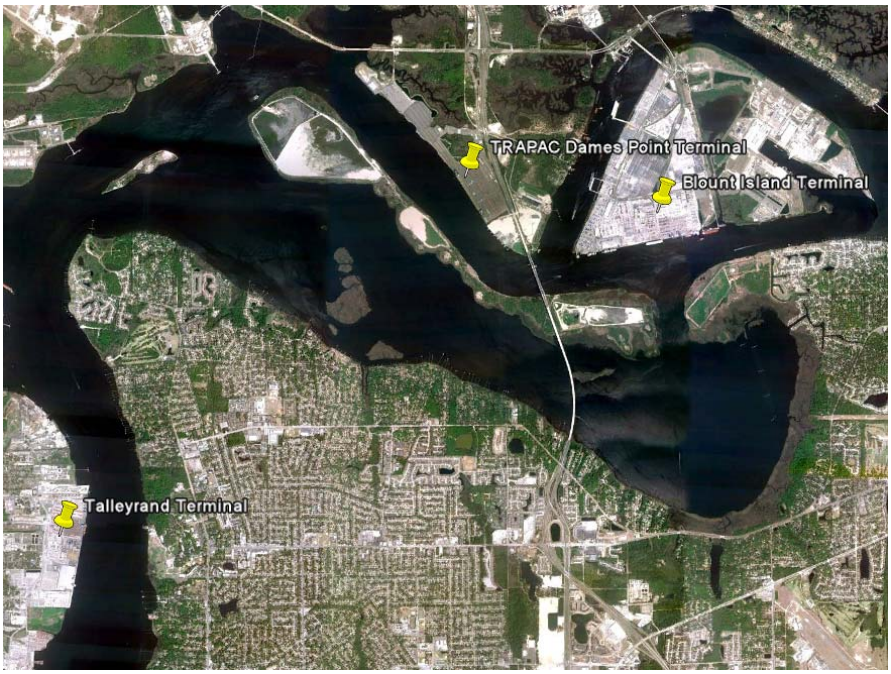


Figure 70: Port of Jacksonville - Dames Point Terminal

Figure 71: Port of Jacksonville - Blount Island Terminal

Figure 72: Port of Jacksonville - Talleyrand Terminal

6.1 Capacity Analysis of Container Terminals

6.1.1 TRAPAC Dames Point Terminal

Dames Point Marine Terminal (DPMT) is the newest marine facility at the Port of Jacksonville. Located approximately 10 miles from the Atlantic Ocean, the terminal is alongside the main shipping channel of the port. It was determined that DPMT has two berths and can handle 5,000 to 7,000 TEU vessel class sizes.

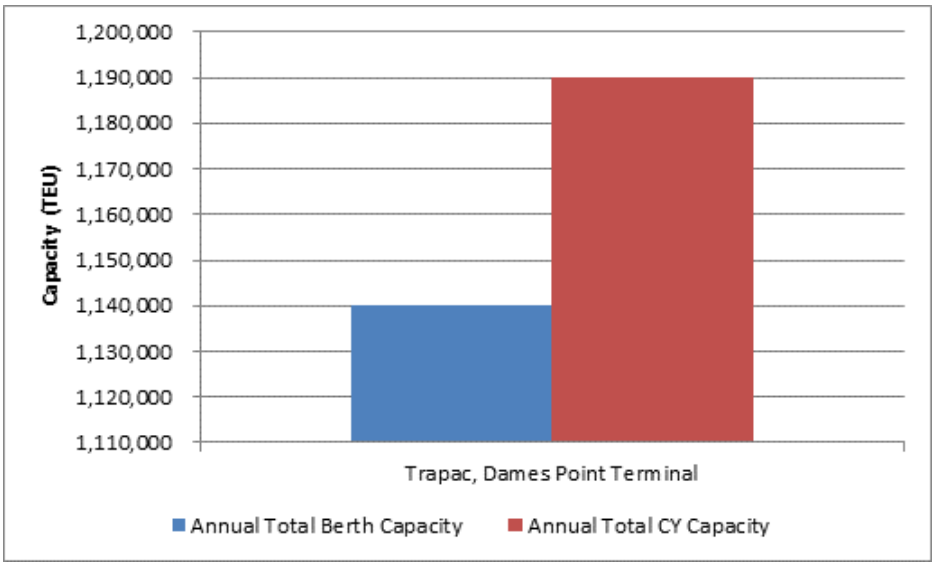
Since DPMT handles its container cargo with RTG/TP, we follow earlier assumptions made; DPMT storage capacity is determined by the same industry average CY capacity from North Carolina ports. With an available container yard of 158 acres, Table 47 presents the berth and CY capacity of container cargo at DPMT.

DPMT's berth capacity is in the range of 1.1 million TEU; whereas the terminal's CY capacity is in the range of 1.2 million TEU as shown on Figure 73. Overall, the terminal is limited by the berth capacity of 1.1 million TEU.

Table 47: Container Terminal Capacity at DPMT

	Trapac, Dames Point Terminal
Container moves (lifts) per vessel call [a]	1,900
Dock cranes assigned per vessel [b]	3.5
Productivity per dock crane (mv/hr) [c]	30
Vessel productivity(mv/hr) [d=b*c]	105
Work hours per vessel call [e=a/d]	17.7
Unproductive time at berth (hrs) [f]	3
Total vessel time at berth (hrs) [g=e+f]	20.7
Work hours per day [h]	20
Calendar hrs/ work hour [i=24/h]	1.20
Total vessel hrs at berth [j=g*i]	24.8
Calendar hrs per week [k]	168
Vessel calls per week at 100% berth utilization [l=k/j]	6.78
Maximum practical peak week berth utilization [m]	60%
Maximum practical vessel calls per week [n=l*m]	4.07
Peak week berth capacity (moves) [o=n*a]	7,539
Peak/mean week seasonal demand factor [p]	1.2
Mean week throughput capacity (moves) [q=o/p]	6,283
Annual unit berth capacity (moves) [r=q*52]	327,000
TEU per container [s]	1.75
Annual unit berth capacity (TEU) [t=r*s]	570,000
Total berth length (feet)	2,400
Number of berths (100' gauge crane) [u]	2.0
Annual total berth capacity (TEU)	**1,140,000**
Annual CY capacity (TEU)	**1,190,000**
Terminal capacity (TEU)	**1,140,000**

Figure 73: DPMT Container Capacity



6.1.2 Blount Island Terminal

Blount Island Terminal (BIT) handles multiple commodities. There is a of total eight berths found at BIT, but by taking a look at available aerials, one can see that the three northernmost berths are dedicated to container cargo.

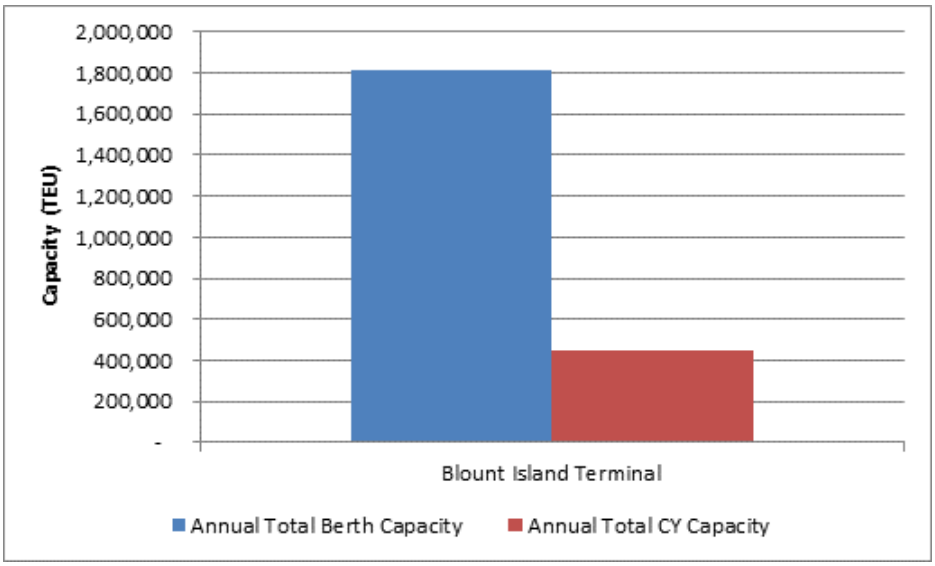
At Blount Island Terminal, the equipment used to handle container cargo includes Whl/TP. Following the industry average capacity of TEUs per acre handled by wheeled or top picks, the berth and CY capacities are shown in Figure 73.

BIT's berth capacity is in the range of 1.8 million TEU; whereas the terminal's CY capacity is in the range of 450,000 TEU as shown on Figure 73. Overall, the terminal is limited by the CY capacity of 450,000 TEU.

Table 48: Container Terminal Capacity at BIT

	Blount Island Terminal
Container moves (lifts) per vessel call [a]	1,900
Dock cranes assigned per vessel [b]	3.5
Productivity per dock crane (mv/hr) [c]	30
Vessel productivity(mv/hr) [d=b*c]	105
Work hours per vessel call [e=a/d]	17.7
Unproductive time at berth (hrs) [f]	3
Total vessel time at berth (hrs) [g=e+f]	20.7
Work hours per day [h]	20
Calendar hrs/ work hour [i=24/h]	1.20
Total vessel hrs at berth [j=g*i]	24.8
Calendar hrs per week [k]	168
Vessel calls per week at 100% berth utilization [l=k/j]	6.78
Maximum practical peak week berth utilization [m]	65%
Maximum practical vessel calls per week [n=l*m]	4.41
Peak week berth capacity (moves) [o=n*a]	8,167
Peak/mean week seasonal demand factor [p]	1.2
Mean week throughput capacity (moves) [q=o/p]	6,806
Annual unit berth capacity (moves) [r=q*52]	354,000
TEU per container [s]	1.75
Annual unit berth capacity (TEU) [t=r*s]	620,000
Total berth length (feet)	3,500
Number of berths (100' gauge crane) [u]	2.9
Annual total berth capacity (TEU)	**1,810,000**
Annual CY capacity (TEU)	**450,000**
Terminal capacity (TEU)	**450,000**

Figure 74: BIT Container Capacity



6.1.3 Talleyrand Terminal

Talleyrand Terminal (TT) follows the same assumptions made at the other terminals found at the Port of Jacksonville.

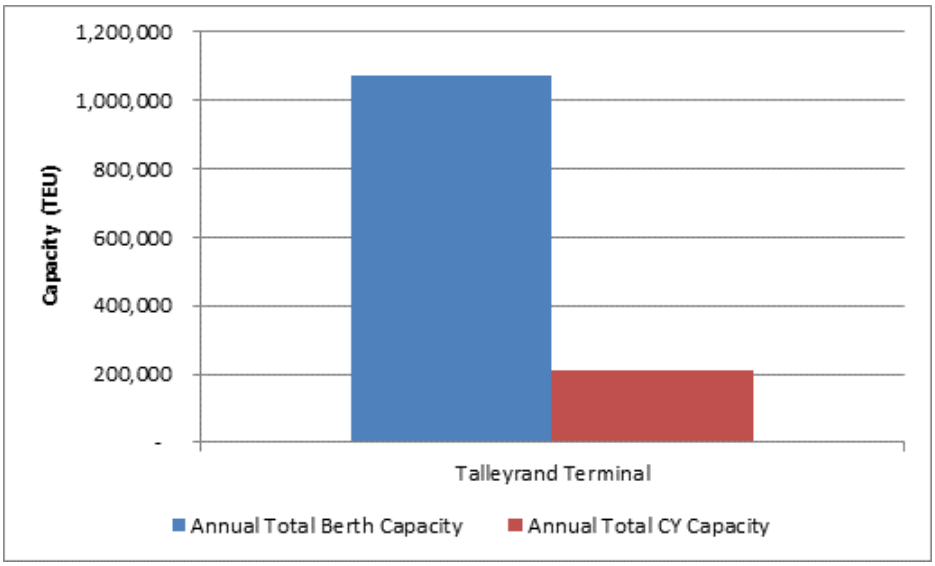
Table 49 presents the calculations for the storage and CY capacity at TT.

TT's berth capacity is in the range of 1 million TEU; whereas the terminal's CY capacity is in the range of 200,000 TEU as shown on Figure 73. Overall, the terminal is limited by the CY capacity of 200,000 TEU.

Table 49: Container Terminal Capacity at TT

	Talleyrand Terminal
Container moves (lifts) per vessel call [a]	1,900
Dock cranes assigned per vessel [b]	3.5
Productivity per dock crane (mv/hr) [c]	30
Vessel productivity(mv/hr) [d=b*c]	105
Work hours per vessel call [e=a/d]	17.7
Unproductive time at berth (hrs) [f]	3
Total vessel time at berth (hrs) [g=e+f]	20.7
Work hours per day [h]	20
Calendar hrs/ work hour [i=24/h]	1.20
Total vessel hrs at berth [j=g*i]	24.8
Calendar hrs per week [k]	168
Vessel calls per week at 100% berth utilization [l=k/j]	6.78
Maximum practical peak week berth utilization [m]	60%
Maximum practical vessel calls per week [n=l*m]	4.07
Peak week berth capacity (moves) [o=n*a]	7,539
Peak/mean week seasonal demand factor [p]	1.2
Mean week throughput capacity (moves) [q=o/p]	6,283
Annual unit berth capacity (moves) [r=q*52]	327,000
TEU per container [s]	1.75
Annual unit berth capacity (TEU) [t=r*s]	570,000
Total berth length (feet)	2,250
Number of berths (100' gauge crane) [u]	1.9
Annual total berth capacity (TEU)	**1,070,000**
Annual CY capacity (TEU)	**210,000**
Terminal capacity (TEU)	**210,000**

Figure 75: TT Container Capacity



6.2 Capacity Analysis of Non-Container Terminals

6.2.1 Dames Point Marine Terminal

Dames Point Marine Terminal (DPMT) also handles bulk commodities on the southern part of the peninsula.

Table 50 and Table 51 calculate the berth and the storage capacities for DPT.

DPT's berth capacity is in the range of 2.4 million tons whereas the terminal's storage capacity is in the range of 9.7 million tons as shown on Figure 76. Overall, the terminal is limited by the berth capacity of 2.4 million tons.

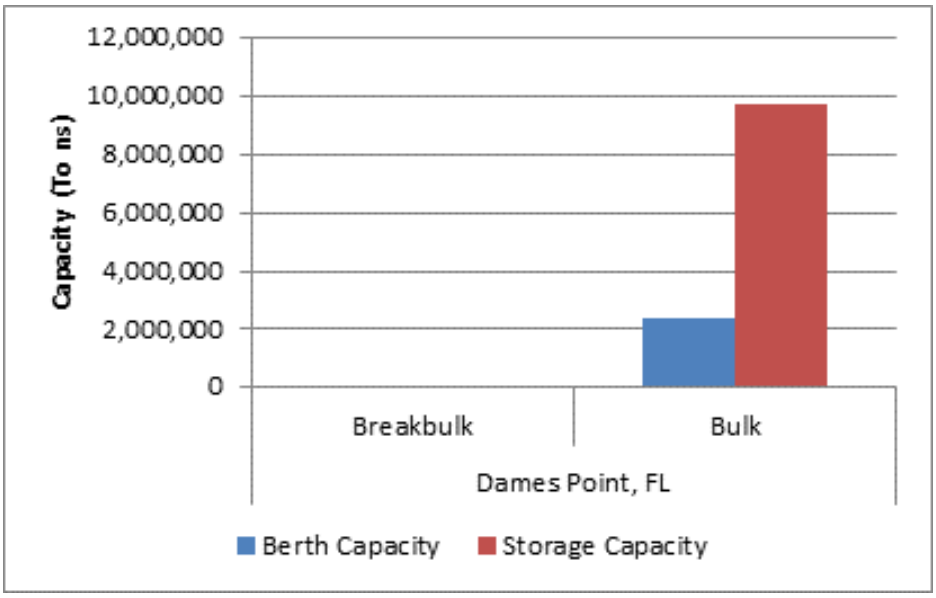
Table 50: Non-Container Berth Capacity of Bulk for DPT

Dames Point, FL Berth Capacity	**Bulk Total (Covered Storage)**
Number of Berths Available	1.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	50%
Effective Total Berth-Hours per Week	73.50
Mean Cargo Handled per Vessel Calls (Tons)	20,000
Mean Loading/ Unloading Rate (Tons per Hour)	800
Mean Ship Work Time (Hrs)	25.0
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	29.0
Potential Ship Calls per Week	2.5
Weekly Throughput Capacity (Tons)	50,690
Weekly Peaking Factor	110%
Annual Berth Capacity (Tons)	2,400,000

Table 51: Non-Container Storage Capacity of Bulk for DPT

Dame's Point, FL Storage Capacity	**Bulk Total (Open Storage)**
Storage Method	Open
Static Storage Capacity (Tons)	1,000,000
Static Capacity / Mean Ship Capacity	50.0
Nominal Annual Throughput (Tons/Year)	100,000
Mean Week Vessel Volume (Tons)	1,923
Cargo Dwell Time (Days)	30.0
Average Volume of Cargo in Storage (Tons)	8,242
Peak/Mean Inventory	125%
Demand for Storage (Tons)	10,302
Total Storage Available (Tons)	1,000,000
Annual Storage Capacity (Tons)	9,710,000

Figure 76: DPT Non-Container Capacity for Bulk



6.2.2 Blount Island Terminal

Blount Island Terminal is a 750-acre facility, making it the largest terminal at the Port of Jacksonville, and one of the largest vehicle import/export facilities in the United States. At Blount Island Terminal, containerized cargo, breakbulk and Ro/Ro commodities are handled. Using the Google Earth program, the available berths for breakbulk commodities were assumed to be three, these available berths are on the southern side of the terminal and can be shared with container cargo, and thus the maximum practical berth utilization is at 30 percent. It was determined that the Ro/Ro commodities would use two available berths on the western side of the terminal. Table 52 and Table 53 present the annual berth capacity for breakbulk and Ro/Ro.

Unfortunately no specific breakbulk and Ro/Ro commodities data were available on the Port of Jacksonville website. The open and covered areas of the Port of Jacksonville were determined from the Google Earth program. To calculate the annual storage capacity for the breakbulk, an average of 0.4 tons per square foot, was taken from the covered areas and then divided by the static storage capacity for the available commodities at both the Port of Morehead City and the Port of Wilmington to determine the static storage capacities at Blount Island Terminal for breakbulk. The same was done for Ro/Ro only an average of 180 vehicles per acre was used for the open areas. The results are shown on Table 54 and Table 55.

BIT's berth capacity for breakbulk is in the range of 1.6 million tons; whereas the storage capacity is in the range of 1.8 million tons. BIT's berth capacity for Ro/Ro is in the range of 800,000 vehicle units while the storage capacity is in the range of 700,000 vehicle units. Overall, the terminal is limited by the berth capacity for breakbulk operation as shown on Figure 77 and storage capacity for Ro/Ro operations as shown on Figure 78.

Table 52: Non-Container Berth Capacity of Breakbulk for BIT

Blount Island Terminal, FL Berth Capacity	Breakbulk Total (Covered Storage)
Number of Berths Available	3.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	30%
Effective Total Berth-Hours per Week	132.30
Mean Cargo Handled per Vessel Calls (Tons)	10,000
Mean Loading/ Unloading Rate (Tons per Hour)	300
Mean Ship Work Time (Hrs)	33.3
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	37.3
Potential Ship Calls per Week	3.5
Weekly Throughput Capacity (Tons)	35,438
Weekly Peaking Factor	110%
Annual Berth Capacity (Tons)	1,675,000

Table 53: Non-Container Berth Capacity of Ro/Ro for BIT

Blount Island Terminal, FL Berth Capacity	Ro/Ro Total (Open Storage)
Number of Berths Available	2.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	60%
Effective Total Berth-Hours per Week	176.40
Mean Cargo Handled per Vessel Calls (Vehicle)	6,000
Mean Loading/ Unloading Rate (Vehicle per Hour)	100
Mean Ship Work Time (Hrs)	60
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	64.0
Potential Ship Calls per Week	2.8
Weekly Throughput Capacity (Vehicle)	16,538
Weekly Peaking Factor	110%
Annual Berth Capacity (Vehicle)	782,000

Table 54: Non-Container Storage Capacity of Breakbulk for BIT

Blount Island Terminal, FL Storage Capacity	Breakbulk Total (Covered Storage)
Storage Method	Covered
Static Storage Capacity (Tons)	225,418
Static Capacity / Mean Ship Capacity	22.5
Nominal Annual Throughput (Tons/Year)	100,000
Mean Week Vessel Volume (Tons)	1,923
Cargo Dwell Time (Days)	30.0
Average Volume of Cargo in Storage (Tons)	8,242
Peak/Mean Inventory	150%
Demand for Storage (Tons)	12,363
Total Storage Available (Tons)	225,418
Annual Storage Capacity (Tons)	1,823,000

Table 55: Non-Container Storage Capacity of Ro/Ro for BIT

Blount Island Terminal, FL Storage Capacity	Ro/Ro (Open Storage)
Storage Method	Open
Static Storage Capacity (Vehicle)	30,240
Static Capacity / Mean Ship Capacity	5.0
Nominal Annual Throughput (Vehicle/Year)	100,000
Mean Week Vessel Volume (Vehicle)	1,923
Cargo Dwell Time (Days)	15.0
Average Volume of Cargo in Storage (Vehicle)	4,121
Peak/Mean Inventory	110%
Demand for Storage (Vehicle)	4,533
Total Storage Available (Vehicle)	30,240
Annual Storage Capacity (Vehicle)	667,000

Figure 77: BIT Non-Container Capacity for Breakbulk

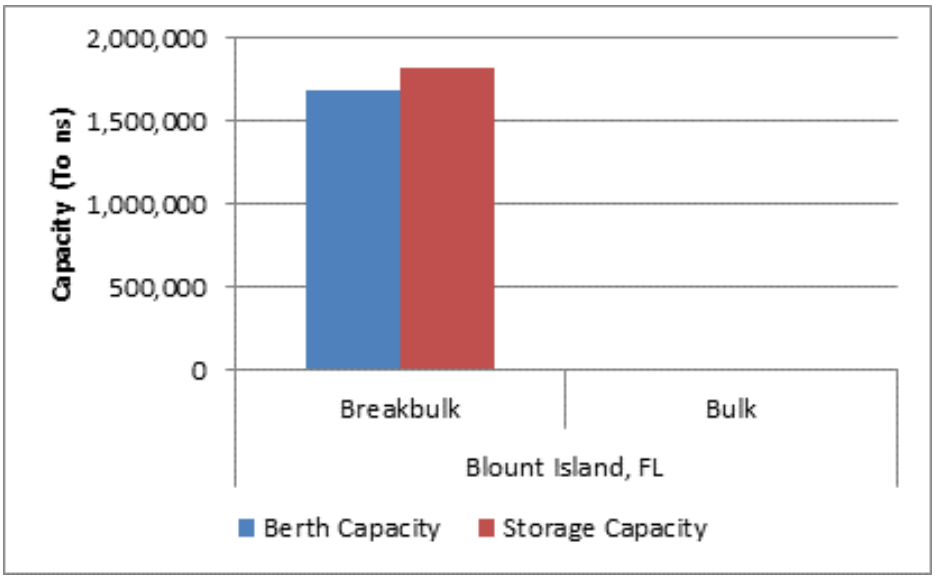
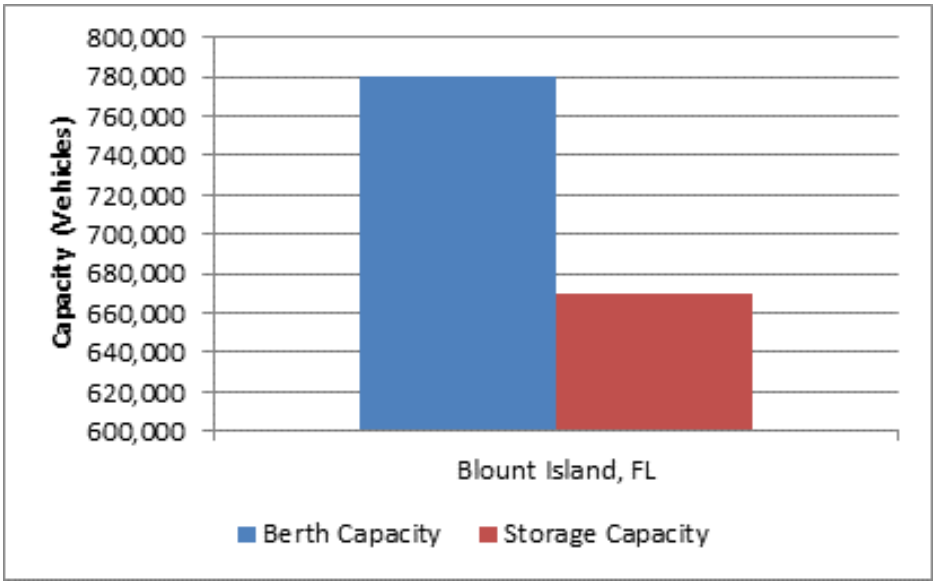


Figure 78: BIT Non-Container Capacity for Ro/Ro



6.2.3 Talleyrand Terminal

At Talleyrand Terminal, a 4,800 linear foot berth is located on the east side of the terminal. With a total of six available berths, an assumption was made for the number of available berths for breakbulk and Ro/Ro commodities. Since no terminal layout was available, the Google Earth program was used once again. With breakbulk commodities located in the middle of the terminal, it was safe to assume that breakbulk commodities can be loaded/ unloaded from any one of the six berths. Because all the berths are then available for breakbulk the practical berth utilization is reduced to 30 percent.

The Ro/Ro commodities are located on the southernmost end of the terminal, so it is assumed that the lower three berths can be used to load/ unload Ro/Ro commodities. In Table 56 and Table 57 the berth capacities for breakbulk and Ro/Ro are shown, respectively.

At Talleyrand Terminal, an average of the static storage capacity was taken to determine the total breakbulk static storage capacity. As for the Ro/Ro, again the Google Earth program was used to determine the areas of the Ro/Ro commodities in acres. This value was then multiplied with 180 vehicle units per acre to get the total static storage capacity in units of vehicles. The annual storage capacity for breakbulk is shown on Table 58 and for Ro/Ro is shown on Table 59.

BIT's berth capacity for breakbulk is in the range of 3.4 million tons whereas the storage capacity is in the range of 100,000. BIT's berth capacity for Ro/Ro is in the range of 600,000 vehicle units while the storage capacity is in the range of 300,000 vehicle units. Overall, the terminal is limited by the storage capacity for breakbulk operation as shown on Figure 79 and storage capacity for Ro/Ro operations as shown on Figure 80.

Table 56: Non-Container Berth Capacity of Breakbulk for TT

Talleyrand Terminal, FL Berth Capacity	Breakbulk Total (Covered Storage)
Number of Berths Available	6.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	30%
Effective Total Berth-Hours per Week	264.60
Mean Cargo Handled per Vessel Calls (Tons)	10,000
Mean Loading/ Unloading Rate (Tons per Hour)	300
Mean Ship Work Time (Hrs)	33.3
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	37.3
Potential Ship Calls per Week	7.1
Weekly Throughput Capacity (Tons)	70,875
Weekly Peaking Factor	110%
Annual Berth Capacity (Tons)	3,350,000

Table 57: Non-Container Berth Capacity of Ro/Ro for TT

Talleyrand Terminal, FL Berth Capacity	Ro/Ro Total (Open Storage)
Number of Berths Available	3.0
Ship Work Rate (Hours per Day)	21
Max Work Days per Week	7
Max Practical Berth Utilization	30%
Effective Total Berth-Hours per Week	132.30
Mean Cargo Handled per Vessel Calls (Vehicle)	6,000
Mean Loading/ Unloading Rate (Vehicle per Hour)	100
Mean Ship Work Time (Hrs)	60.0
Non-Work Hours at Berth	4.0
Mean Berth Occupancy Time per Ship (Hrs/Call)	64.0
Potential Ship Calls per Week	2.1
Weekly Throughput Capacity (Vehicle)	12,403
Weekly Peaking Factor	110%
Annual Berth Capacity (Vehicle)	586,000

Table 58: Non-Container Storage Capacity of Breakbulk for TT

Talleyrand Terminal, FL Storage Capacity	**Breakbulk Total (Covered Storage)**
Storage Method	Warehouse
Static Storage Capacity (Tons)	231,062
Nominal Annual Throughput (Tons/Year)	100,000
Mean Week Vessel Volume (Tons)	1,923
Cargo Dwell Time (Days)	30.0
Average Volume of Cargo in Storage (Tons)	8,242
Peak/Mean Inventory	150%
Demand for Storage (Tons)	12,363
Total Storage Available (Tons)	231,062
Annual Storage Capacity (Tons)	**1,870,000**

Table 59: Non-Container Storage Capacity of Ro/Ro for TT

Talleyrand Terminal, FL Storage Capacity	**Ro/Ro Total (Open Storage)**
Storage Method	Open
Static Storage Capacity (Vehicle)	12,600
Static Capacity / Mean Ship Capacity	2.1
Nominal Annual Throughput (Vehicle/Year)	100,000
Mean Week Vessel Volume (Vehicle)	1,923
Cargo Dwell Time (Days)	15.0
Average Volume of Cargo in Storage (Vehicle)	4,121
Peak/Mean Inventory	110%
Demand for Storage (Vehicle)	4,533
Total Storage Available (Vehicle)	12,600
Annual Storage Capacity (Vehicle)	278,000

Figure 79: TT Non-Container Capacity for Breakbulk

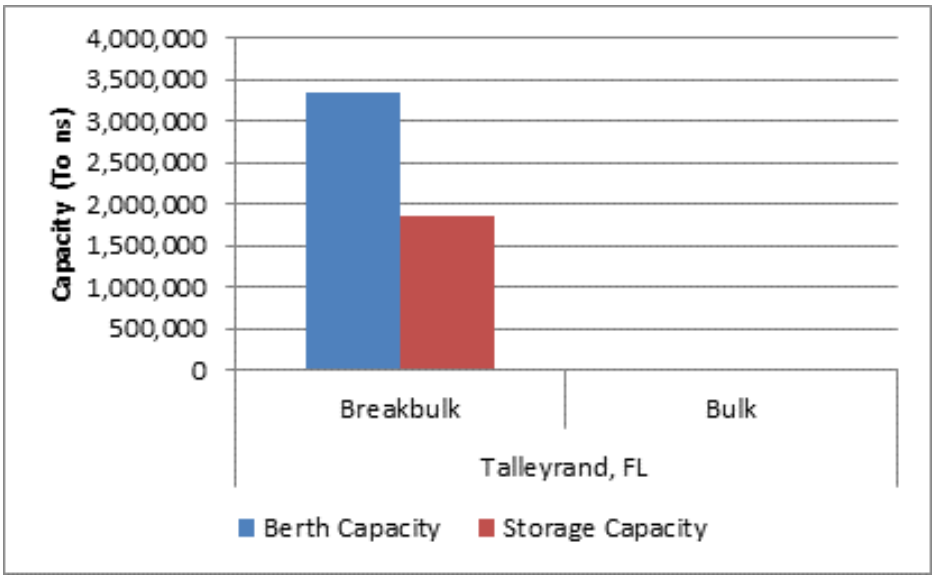
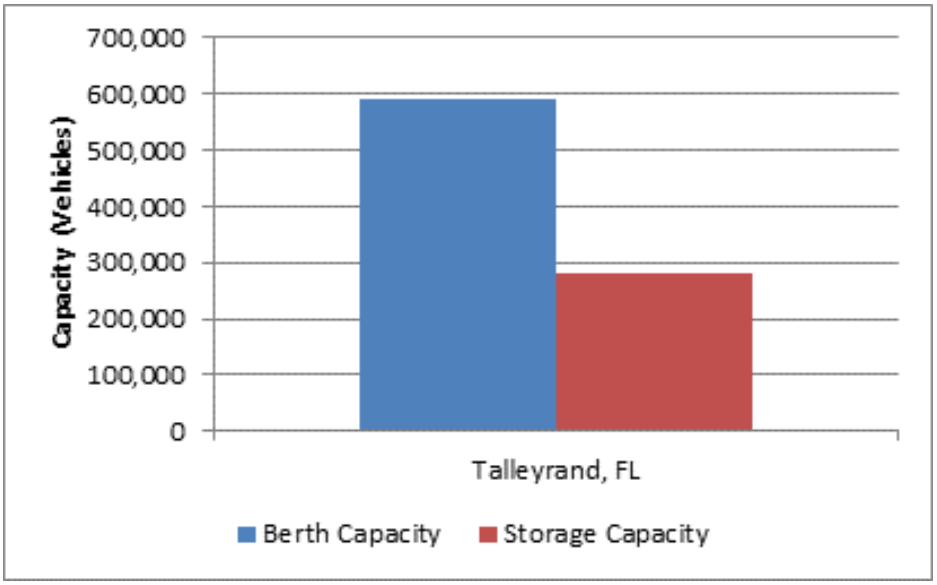


Figure 80: TT Non-Container Capacity for Ro/Ro



6.3 Port Revenue

From the Georgia Port Authority's, 2010 financial year annual report, the port revenue is shown in Table 60. The container cargo which is in TEU was converted into tons. These container tons were then added to the total bulk and breakbulk tons, which makes up the total tonnage. The revenue per ton was determined by dividing the total revenue.

Table 60: Port of Jacksonville Revenue

Port of Jacksonville 2010 Financial Report	2010	2009
Revenue (in millions)	$50.60	$47.34
Total Tonnage (in millions)	8.1	7.3
Revenue per Ton	$6.25	$6.49

7 PLANNED TERMINALS

In addition to the peer port facilities already developed in the North Carolina region, there are several significant container terminal projects already planned or under consideration in the region. AECOM analyzed the potential capacity of three planned terminals with the ability to increase regional container throughput capacity significantly if constructed.

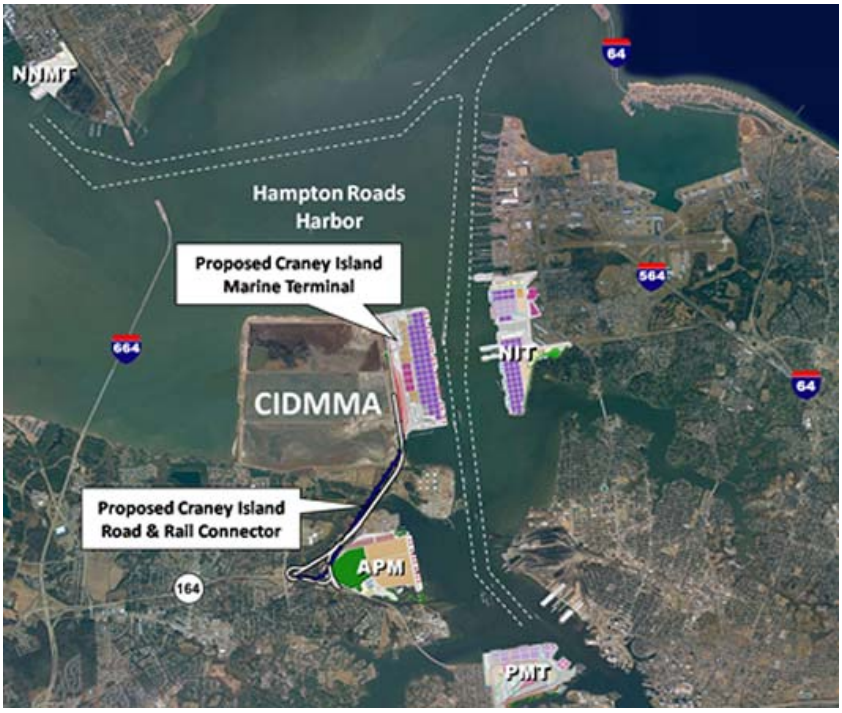
7.1 Planned Terminal Overviews

7.1.1 Craney Island Marine Terminal, Virginia

Craney Island Marine Terminal is a new facility planned by the Virginia Port Authority (VPA) in conjunction with the US Army Corps of Engineers (USACE). The facility will be located next to the USACE-operated Craney Island Dredged Material Management Area (CIDMMA) as shown in Figure 81 to efficiently use dredge materials stored there for the new terminal.

The planned terminal will be 522 acres with an 8,400-foot berth and 50 feet of water depth. Both Norfolk Southern (NS) and CSX rail lines will have direct access to the terminal.[24]

Figure 81: Proposed site for the Craney Island Marine Terminal[25]



[24] http://www.craneyisland.info/about.html
[25] http://www.craneyisland.info/overview.html

7.1.2 New Charleston Naval Base Terminal

The South Carolina State Port Authority (SCSPA) has planned a new terminal on property formerly used as the Charleston Naval Base. The three-berth facility would cover approximately 288 acres.[26]

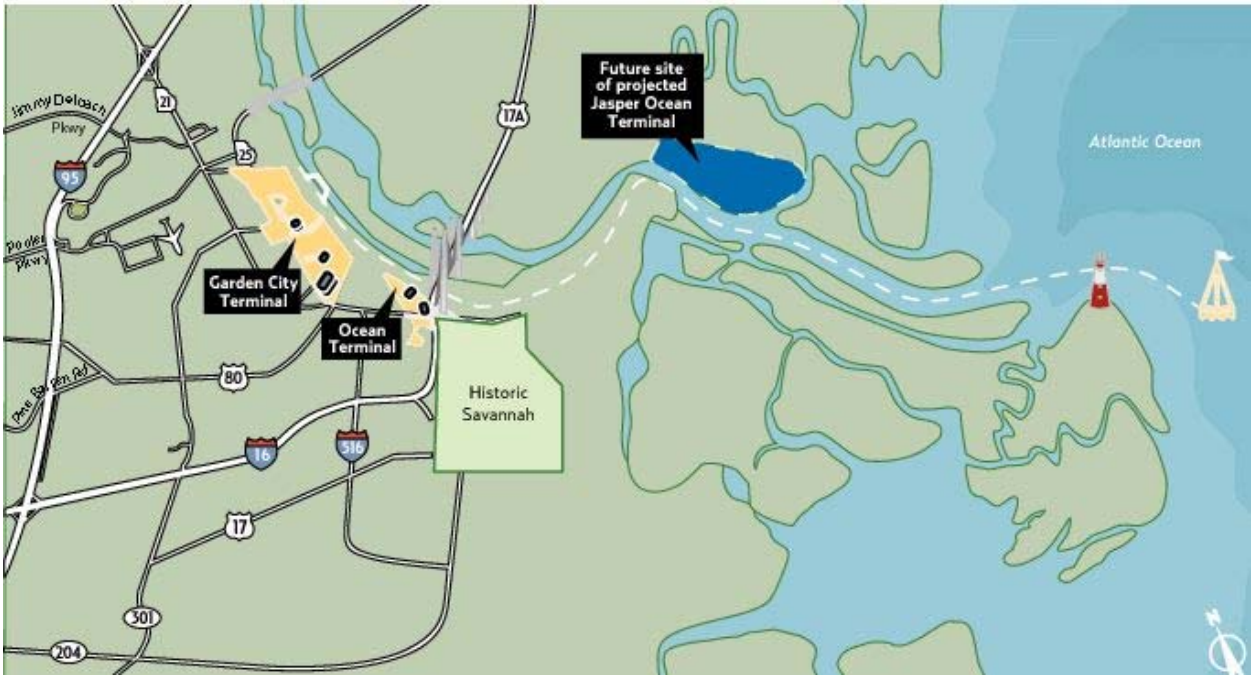
Figure 82: New Charleston Navy Base Terminal[27]

7.1.3 Jasper Ocean Terminal

Jasper Ocean Terminal is a new container terminal to be located on the Savannah River in Jasper County, SC, as shown in Figure 83. Both the SCSPA and Georgia Port Authority (GPA) are involved in the planning of the facility, which will span approximately 1,500 acres and have about 10 berths if constructed.[28]

[26]http://www.pbworld.com/capabilities_projects/charleston_naval_base_container_terminal.aspx
[27]http://www.pbworld.com/capabilities_projects/charleston_naval_base_container_terminal.aspx
[28]http://www.gaports.com/Portals/5/SHEP/Jasper%20Ocean%20Terminal%20white%20paper.pdf

Figure 83: Proposed Site for the Jasper Ocean Terminal



7.2 Planned Terminal Capacities

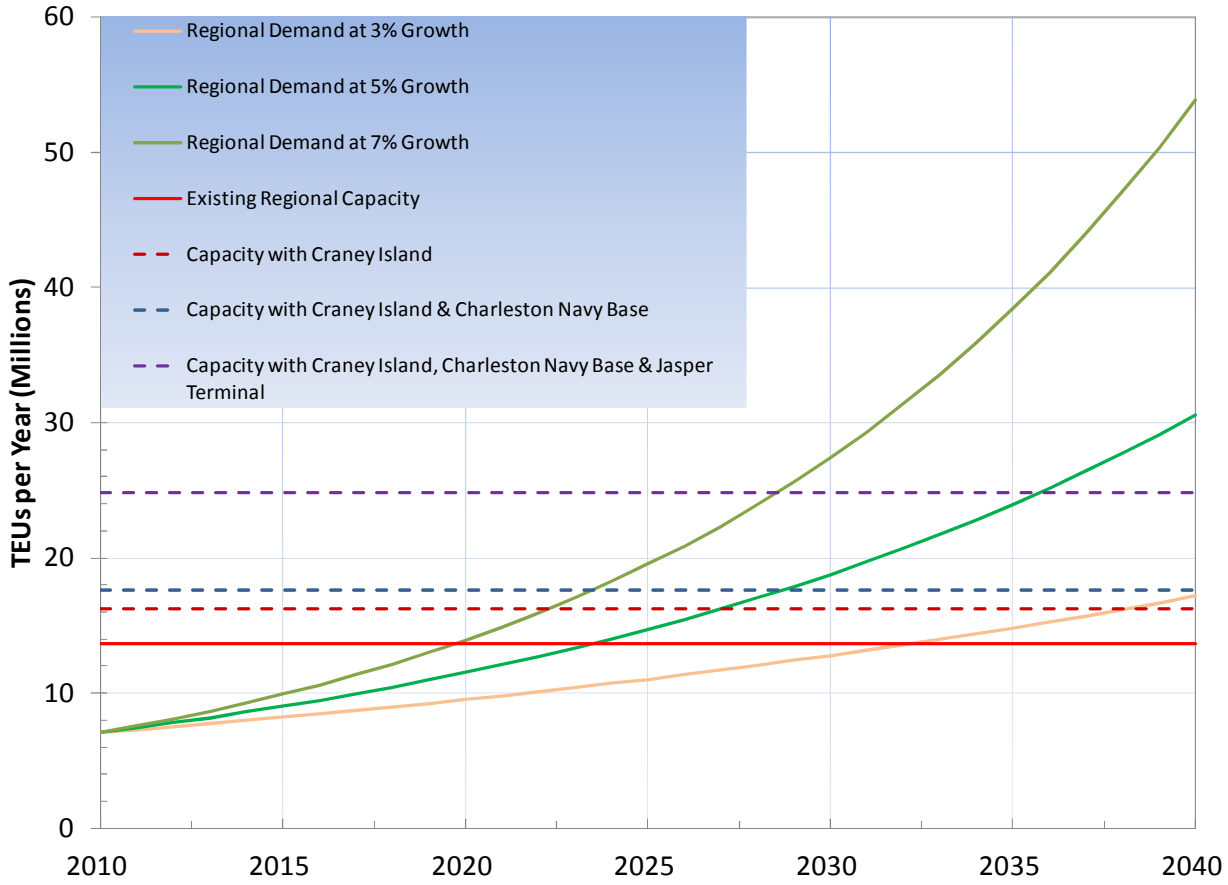
AECOM estimated the capacities of the three planned terminals based on the densest port in North America, Port Metro Vancouver (PMV). In 2011, PMV handled 2.5M TEU at its three primary container terminals, which have a combined area of about 364 acres. This is a capacity density of about 6,900 TEU/acre. A new modern terminal should be able to achieve a similar density; to be conservative, AECOM estimated that new facilities can handle 70 percent of the density that PMV did in 2011; for a future target density of just under 5,000 TEU per acre. Estimated capacities are shown in Table 61.

Table 61: Planned Terminal Capacity Estimates

Planned Terminal	Terminal Size (acres)	Est. Capacity (annual TEU)
Craney Island	522	2,520,000
Charleston Navy Base	288	1,390,000
Jasper	1,500	7,250,000
Total	**2,310**	**11,160,000**

These three planned terminals would add over 11 million TEU of annual capacity to North Carolina peer port facilities. Figure 84 shows when the region may run out of capacity with or without these facilities based on different potential growth rates.

Figure 84: Regional Capacity



Based on existing facility capacities, the region will run out of capacity between about 2020 and 2030, depending on throughput growth rates. With all three new terminals in place, the region may have excess capacity well into the future.