North Carolina International Terminal

PLANNING ASSUMPTIONS

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Prepared for

North Carolina State Ports Authority

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Acronyms and Abbreviations

AAPA	American Association of Port Authorities
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACS	Access Control System
ADA	Americans with Disabilities Act
ADM	Archer Daniels Midland
AGV	Automated Guided Vehicle
ARMG	Automated Rail-Mounted Gantry Crane
ASD	Allowable Stress Design
AWWA	American Water Works Association
BMP	Best Management Practice
CAGR	Compound Annual Growth Rate
CCTV	Closed Circuit Television
CO-HM	Commercial Heavy Manufacturing
CTP	Comprehensive Transportation Plan
CY	Container Yard
DA	Drivers Assistance
DL	Dead Load
DOT	Department of Transportation
DTM	Digital Terrain Model
DWT	Dead Weight Tonnage
E&D	Elderly and Disabled
EA	Environmental Assessment
EA	Each
E-IRR	Equity Internal Rate of Return
EIS	Environmental Impact Statement
EM	Engineering Manual (U.S. Army Corps of Engineers)
EMC	Electric Membership Corporation
FEU	Forty-foot Equivalent Unit
FGS	Forty-foot Ground Slot
fps	Foot per Second
GDP	Gross Domestic Product
GIS	Geographic Information System
gpd	Gallons per Day
gpm	Gallons per Minute
HCM	Highway Capacity Manual
HS20	Highway Specification 20
ICW	Inside Crane Width
IY	Intermodal Yard (also called Intermodal Rail Yard)
IRR	Internal Rate of Return

JOC	Journal of Commerce
KV	Kilovolt
LL	Live Load
LOA	Length Over All
LOS	Level of Service
LT	Long Ton
LS	Lump Sum
M&R	Maintenance and Repair
MHW	Mean High Water
MLW	Mean Low Water
MLLW	Mean Lower Low Water
MOTSU	Military Ocean Terminal, Sunny Point
mph	Miles per Hour
MSL	Mean Sea Level
NAVD	North American Vertical Datum
NC	North Carolina
NCAC	North Carolina Administrative Code
NC-CREWS	North Carolina Coastal Region Evaluation of Wetland Significance
NCDOT	North Carolina Department of Transportation
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NTP	Notice to Proceed
O&M	Operation and Maintenance
OCR	Optical Character Recognition
ODMDS	Ocean Dredged Material Disposal Site
OPEX	Operating Expenses
PF	Power Factor
PIANC	Permanent International Association of Navigation Congresses
PIDAS	Perimeter Intrusion, Detection, Assessment System
P-IRR	Project Internal Rate of Return
PPP	Public-Private Partnership, also referred to as a P3
psf	Pounds per Square Foot
psig	Pounds per Square Inch Gauge
PTZ	Pan Tilt Zoom
ROW	Right of Way
RMS	Root Mean Square
RPM	Radiation Portal Monitor
RPZ	Reduced Pressure Zone
RTG	Rubber-Tired Gantry
SF	Square feet

SMS	Security Management System
STS	Ship-to-Shore
TEU	Twenty–foot Equivalent Unit
TGS	Twenty-foot Ground Slot
TIP	Transportation Improvement Program
TL	Total Load
TOR	Top of Rail
TOS	Terminal Operating System
TSS	Total Suspended Solids
TWIC	Transportation Worker Identification Credential
UFC	Unified Facilities Criteria
ULCS	Ultra Large Container Ship
UNCTAD	United Nations Conference on Trade and Development
USACE	United States Army Corps of Engineers
WRDA96	Water Resources Development Act of 1996
yd^3	Cubic Yard

Planning Assumptions

1.0 Introduction

The North Carolina State Ports Authority (the Authority) is considering the development of a new container terminal on the Cape Fear River near the town of Southport in Brunswick County, NC. The Authority has initiated a phased process for studying and evaluating the economic viability of the new terminal. The first phase of this evaluation is designed to provide a conceptual-level business analysis.

Because the specific details of the facility have not been fully developed, this initial investigation created conceptual models solely for the purpose of creating a conceptual framework from which the Pro Forma Business Plan could be developed. The conceptual framework was used to identify infrastructure components, estimate size and quantity, and then estimate cost solely for the purpose of providing input to the Pro Forma Business Plan.

This document identifies the assumptions adopted to provide a conceptual framework needed for a business feasibility evaluation of a high-density, automated container terminal. Assumptions were made to conceptually illustrate the size and location of facilities and to define the interfaces between the ship and berth, the berth and storage yard, and domestic trucking and trains.

For purposes of creating the conceptual framework, the planning of the terminal concept is generally consistent with current industry standards. However, because of the limited information available, any analysis and cost estimate must be treated as resulting from the use of numerous assumptions and professional judgment and will be subject to change following further analysis in future phases of the project.

2.0 Development-Level Assumptions

The North Carolina International Terminal is generally described as follows:

1. A high-density, automated container terminal.
2. Capacity of 3.0 million twenty–foot equivalent units (TEUs) per annum.
3. Vessels up to 12,000-TEU capacity.
4. Planned to initiate operation and generate revenue at the earliest possible date.
5. Construction activities scheduled to allow terminal operations to begin prior to completion.
6. Terminal financing subject to private investment (Public-Private Partnership [PPP]).
7. Supporting access infrastructure funded by parties other than the Authority.

3.0 Pro Forma Business Plan Assumptions

3.1 Market Assessment Assumptions

3.1.1 Addressable market: U.S. East Coast & U.S. Gulf Coast.

3.1.2 Econometric forecast period: 2007 to 2030.

3.1.3 Base year (last year of actual reported volume data): 2006.

3.1.4 Base year container volume for addressable market: 19.62 million TEUs/year.

3.2 Addressable Market Growth Scenarios

3.2.1 Base Case Forecast Scenario.

3.2.1.1. Assumes East Coast and Gulf Coast container traffic grows at rates that are commensurate with historically observed growth rates for North America, as a whole.

3.2.1.2. Assumes some traffic is diverted from West Coast ports, resulting in consistent market share, going forward.

3.2.1.3. Growth rate: 6.3% compound annual growth rate (CAGR), years 2007 to 2030.

3.2.2 Low Case Forecast Scenario.

3.2.2.1. Assumes national growth rates are lower than historical averages, negatively impacting upside potential for East Coast and Gulf Coast ports.

3.2.2.2. Assumes tempered market response to macro events, such as the Panama Canal expansion project.

3.2.2.3. Growth rate: 4.3% CAGR, years 2007 to 2030.

3.2.3 High Case Forecast Scenario.

3.2.3.1. Assumes East Coast and Gulf Coast container traffic grows at rates that are above average for historically observed North American growth rates.

3.2.3.2. Assumes West Coast congestion and impact of Panama Canal expansion project drive further increases in traffic diversion over the Base Case.

3.2.3.3. Growth rate: 6.3% CAGR, years 2007 to 2014; 8.3% CAGR, years 2014 to 2020; 6.3% CAGR, years 2020 to 2030.

3.2.4 Completion date of Panama Canal expansion project: August 2014.

3.2.5 Ports serving addressable market.

3.2.5.1. North Atlantic Ports.

i. Massachusetts Port Authority (MassPort), MA.

ii. Port Authority of New York & New Jersey, NY.

iii. Philadelphia Regional Port Authority, PA.

iv. Maryland Port Administration, MD.

v. Virginia Port Authority, VA.

vi. APM Terminals,VA.

3.2.5.2. South Atlantic Ports.

vii. North Carolina State Ports Authority, NC.

viii. Port of Charleston, SC.

ix. Georgia Ports Authority, GA.

x. Jacksonville Port Authority, FL.

xi. Port of Palm Beach, FL.

xii. Port Everglades, FL.

xiii. Port of Miami, FL.

3.2.5.3. Gulf Coast Ports.

xiv. Port Manatee, FL.

xv. Port of Tampa, FL.

xvi. Port of Mobile, AL.

xvii. Gulfport, MS.

xviii. Port of New Orleans, LA.

xix. Port of Houston, TX.

3.2.6 North Carolina International Terminal's Primary Competitors.

3.2.6.1. Virginia Port Authority, VA.

3.2.6.2. APM Terminals, VA.

3.2.6.3. Port of Charleston, SC.

3.2.6.4. Georgia Ports Authority, GA.

3.2.6.5. Jacksonville Port Authority, FL.

3.2.7 Existing container throughput capacity for ports serving the addressable market—as reported through publicly available information such as port websites, annual reports, and various publications by the Journal of Commerce (JOC) and the American Association of Port Authorities (AAPA).

3.2.7.1. Base Year (2006): 21.61 million TEUs/year.

3.2.8 Future container throughput capacity for ports serving the addressable market—as reported through publicly available information such as port websites, annual reports, and various publications by the JOC and the AAPA.

3.2.8.1. Maximum reported future capacity (2030) to serve addressable market: 36.6 million TEUs/year.

3.2.8.2. Capacity added incrementally and assumed on-line according to reported capital improvement plans.

3.2.9 Estimated maximum productivity at primary competitors: 6,000 TEUs/acre.

3.2.10 Estimated container storage acreage at primary competitors: Estimated at 80% of reported container terminal acreage.

3.3 Container Cargo Forecast for North Carolina International Terminal

3.3.1 Assumed six-point marketing strategy is deployed.

3.3.1.1. Deep water channel and berth facilities at -52.5 feet.

3.3.1.2. High rail volume with on-terminal rail capability: 50% of import traffic.

3.3.1.3. Availability of good highway access.

3.3.1.4. High productivity facility – Rail-Mounted Gantry Crane Facility.

3.3.1.5. State–of-the-art facility – Complies with long-term policy requirements.

3.3.1.6. Cost-competitive – Operating costs are within a competitive range.

3.3.2 Start of operations – Year 2017.

3.3.3 North Carolina International Terminal Container Forecast Growth Rates.

3.3.3.1. Year 2017 through year 2021: 17.0% CAGR.

3.3.3.2. Year 2021 through year 2030: 8.6% CAGR.

3.3.3.3. Year 2030 through year 2046: 4.0% CAGR.

3.3.3.4. Start of Operations to 3-million-TEU Capacity: 11.3% CAGR.

3.3.4 Total terminal throughput capacity: 3 million TEUs/Year.

3.4 Pro Forma Economic Model

3.4.1 Box Rate Competitive Range: $200 to $250 (2007 dollars).

3.4.2 Operating Expense Range.

3.4.2.1. 62% of revenue (Start of Operations), declining to

3.4.2.2. 50% of revenue (long-term).

3.4.3 Container Terminal Operating Condition–Private Sector Container Terminal Operating Company under a concession agreement.

3.4.3.1. Concession start: Year 2014 (3 years prior to start of operations for construction purposes).

3.4.3.2. Concession term: 35-year concession term for analytical and reporting purposes (a range of 25 to 50 years modeled for comparison purposes).

3.4.4 Total Capital Investment for Container Terminal – as determined by conceptual cost estimate.

3.4.5 Container Terminal construction phases.

3.4.5.1. Phase 1, 2 berths complete: (Years 2014 – 2017).

3.4.5.2. Phase 2, 3 berths complete: (Years 2018 – 2020).

3.4.5.3. Phase 3, 4 berths complete: (Years 2021 – 2025).

3.4.6 Time Value of Money Rates.

3.4.6.1. Revenue escalation rate: 2.5% per year.

3.4.6.2. Operating expense escalation rate: 2.5% per year.

3.4.6.3. Capital cost escalation rate: 2.5% per year.

3.4.6.4. Discount rate: 10%.

3.4.7 Financing.

3.4.7.1. Allowable debt to equity ratio range.

3.4.7.2. Minimum ratio 60% debt/40% equity.

3.4.7.3. Maximum ratio 70% debt/30% equity.

3.4.7.4. Bond Rate: 7%.

3.4.7.5. Bond Term: 25 years.

3.4.7.6. Minimum debt service coverage ratio: 1.2x.

3.4.7.7. Bond totals (terminal only): approximately $890 million (nominal dollars).

3.4.7.8. Equity Invested (terminal only): approximately $550 million (nominal dollars).

3.4.8 Target rates of return.

3.4.8.1. Project Internal Rate of Return (P-IRR): minimum 10%.

3.4.8.2. Equity Internal Rate of Return (E-IRR): minimum 15%.

4.0 Codes and Standards

It is assumed the terminal design and related infrastructure will utilize applicable design standards or codes, such as the following:

American Association of State Highway and Transportation Officials - Standard Specifications for Highway Bridges.
American Institute of Steel Construction – Manual of Steel Construction, Allowable Stress Design (ASD).
American National Standards Institute – Bolts & hardware standards.
American Petroleum Institute- Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms (RP2A).
American Society for Testing and Materials - Relevant Material Specifications Listed in the Project Design Specifications.
American Society of Civil Engineers. 2005 Minimum Design Loads for Building and Other Structures.
American Welding Society – Structural Welding Code - Steel (AWS D1.1), Structural Welding Code – Reinforcing Steel (AWS D1.4); Guide for Welding Mild Steel Pipe (AWS D10.12M) and Recommended Practice—Welding of Rails (AWS D15.2).
British Ports Association – The Structural Design of Heavy Duty Pavements for Port and other Industries – Third Edition – 1996.
British Standard 6349 Part 4, Maritime Structures Part 4. Code of Practice for Design of Fendering and Mooring Systems.
Building Code Requirements for Structural Concrete (American Concrete Institute [ACI] - 318-05).
Concrete Reinforcing Steel Institute.
Construction Specification Institute.
Department of the Navy, Military Handbooks Piers and Wharves: UFC 4-152-01. Mooring Design: UFC 4-159-03. Military Harbors and Coastal Facilities: UFC 4-150-06.
National Electrical Code.
National Fire Protection Association.
Permanent International Association of Navigation Congresses, Guidelines for the Design of Fenders Systems: 2002.
Transportation Research Board, Highway Capacity Manual.
U.S. Army Corps of Engineers, EM-1110-3-164 Coastal Engineering Manual and Design Document.
U.S. Army Corps of Engineers, EM 1110-2 1613 Hydraulic Design of Deep-Draft Navigation Projects, 31 May 2006.

5.0 Site Location

5.1 Site Boundary

5.1.1 The project site is bounded by the following Lambert Coordinates:

NE Corner – N77903.76
E2309936.97

NW Corner – N78688.19
E2304261.84

SW Corner – N74373.56
E2302371.18

NE Corner – N73312.55
E2308083.37

5.2 Site Size

5.2.1 The site proper is approximately 600 acres of available land.

5.2.2 Additional parcels of land needed for access or other terminal-related purposes will be made available.

5.3 Vertical Datum

Vertical datum used for defining dredge depths in ports is commonly Mean Low Water (MLW) or Mean Lower Low Water (MLLW); however, these levels vary with time and therefore must be referenced to a standard fixed datum such as National Geodetic Vertical Datum (NGVD) or North American Vertical Datum (NAVD). Typically, Authority engineering and construction projects use the 1929 version of the NGVD, and the NGVD reference will be used in studies of the North Carolina International Terminal development. The relationships among various vertical datums as defined by NOAA for the Yaupon Beach, NC gauge (Station 8659182) for the 1960-1978 epoch are shown in Table 1.

TABLE 1
Relationships Among Vertical Datums

Datum (ft)	Description
+4.67	July 19, 1978—Highest Observed Water Level.
+3.08	Mean Higher High Water.
+2.71	Mean High Water.
+1.02	North American Vertical Datum (NAVD) 1988[a].
+0.33	Mean Tide Level.
0.00	National Geodetic Vertical Datum (NGVD) 1929.
-2.06	Mean Low Water (MLW).
-2.25	Mean Lower Low Water (MLLW).
-4.74	December 5, 1978—Lowest Observed Water Level.

[a] To convert NAVD 1988 datum to NGVD 1929 datum, add 2.04 ft.
MLLW equals -3.27 ft in NAVD88 and -2.25 ft in NGVD29.

6.0 Assumed Vessel Characteristics

6.1 Design Vessel Selection Criteria

6.1.1 The vessel's port of departure.

6.1.2 The volume of cargo transported.

6.1.3 The route the vessel is expected to take.

6.1.4 The characteristics of the intended ports-of-call.

6.1.5 The compatibility of the vessel's maneuvering capabilities with the navigation conditions.

6.1.6 Provides flexibility to account for the next generation of vessels planned to transit the Panama Canal upon completion of its expansion in 2014.

6.2 Design Vessel Parameters

6.2.1 Some design ship characteristics are represented graphically on Figure 1.

6.2.2 Container capacity of 12,000 TEUs.

6.2.3 Length over all (LOA) of 1,263 ft.

6.2.4 Beam of 185 ft (22 containers wide on deck).

6.2.5 Draft of -50.0 ft (-15.2 m).

6.2.6 Berthing velocity of 0.5 foot (ft) per second (FPS).

6.2.7 Approach angle of 5 degrees.

6.2.8 Allowable hull pressure of 5,000 pounds per square foot (psf).

6.2.9 Dead weight tonnage (DWT) is approximately 162,385 long tons (LT).

6.2.10 The 12,000-TEU ship is assumed to be the largest vessel expected to call at the port.

6.2.11 Due to the constraint of the berth length, four 12,000-TEU vessels would not be able to berth simultaneously.

6.2.12 Four 8,000-TEU vessels are assumed to be a more typical maximum berthing condition.

6.2.13 In actual operations, various combinations of ship classes are likely.

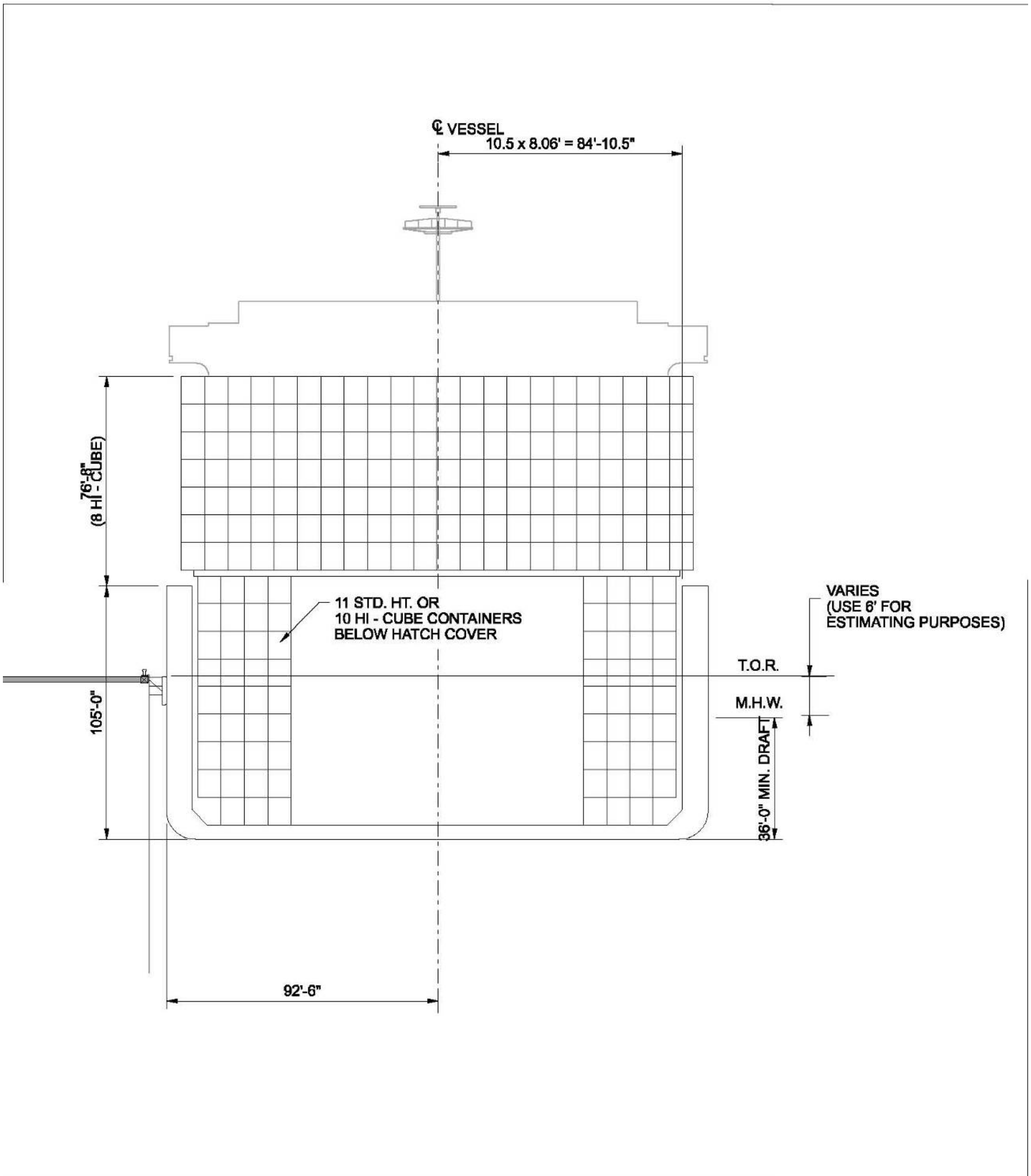

FIGURE 1
Assumed 22 Container-Wide Vessel Characteristics

7.0 Dredging Assumptions

7.1 General Assumptions

7.1.1 Examining all possible scenarios for dredging and disposal of material is beyond the scope of this study.

7.1.2 The alignment studied will be chosen only for the purpose of estimating cost and should not be considered the only possible alignment or a preferred alignment.

7.2 Channel Datum and Depth

7.2.1 For purposes of this study, the Yaupon Beach, NC, tidal datum for the 1960-1978 epoch is assumed as the tidal datum.

7.2.2 The datum separation of 3.27 ft between MLLW and NAVD88 is held throughout the length of the channel for this study.

7.2.3 Interior channel design depth is assumed to be -52.5 ft MLLW.

7.2.4 A 2-ft over-dredge allowance is required for maintenance.

7.3 Channel Layout

7.3.1 Cape Fear River reach designations are as shown on Figure 2 (NOAA Chart 11537, Cape Fear to Wilmington (36th edition, May 2005) or go to USACE website (http://www.saw.usace.army.mil/nav/Maps/nav_projects_nc_web.pdf).

7.3.2 Wilmington Harbor/Morehead City Harbor reach characteristics are as shown on Table 2.

7.3.3 An average additional depth for sea state in the offshore reaches of the Cape Fear River Entrance Channel and the channel extension is assumed to be 2.5 ft, making the offshore channel depth -55.0 plus 2 ft for over-dredge.

7.3.4 There are 0.5- to 1.5-knot currents in the interior channel.

7.3.5 There are less than 0.5-knot currents offshore.

7.4 Channel Alternatives

7.4.1 A realignment of the channel is a viable and conservative approach to defining the dredging cost for this project.

7.4.2 From the end of the existing channel seaward, none of the extension options would encounter rock.

7.5 Geotechnical Analysis

7.5.1 Dredged material is assumed to be categorized into one of three different types as follows:

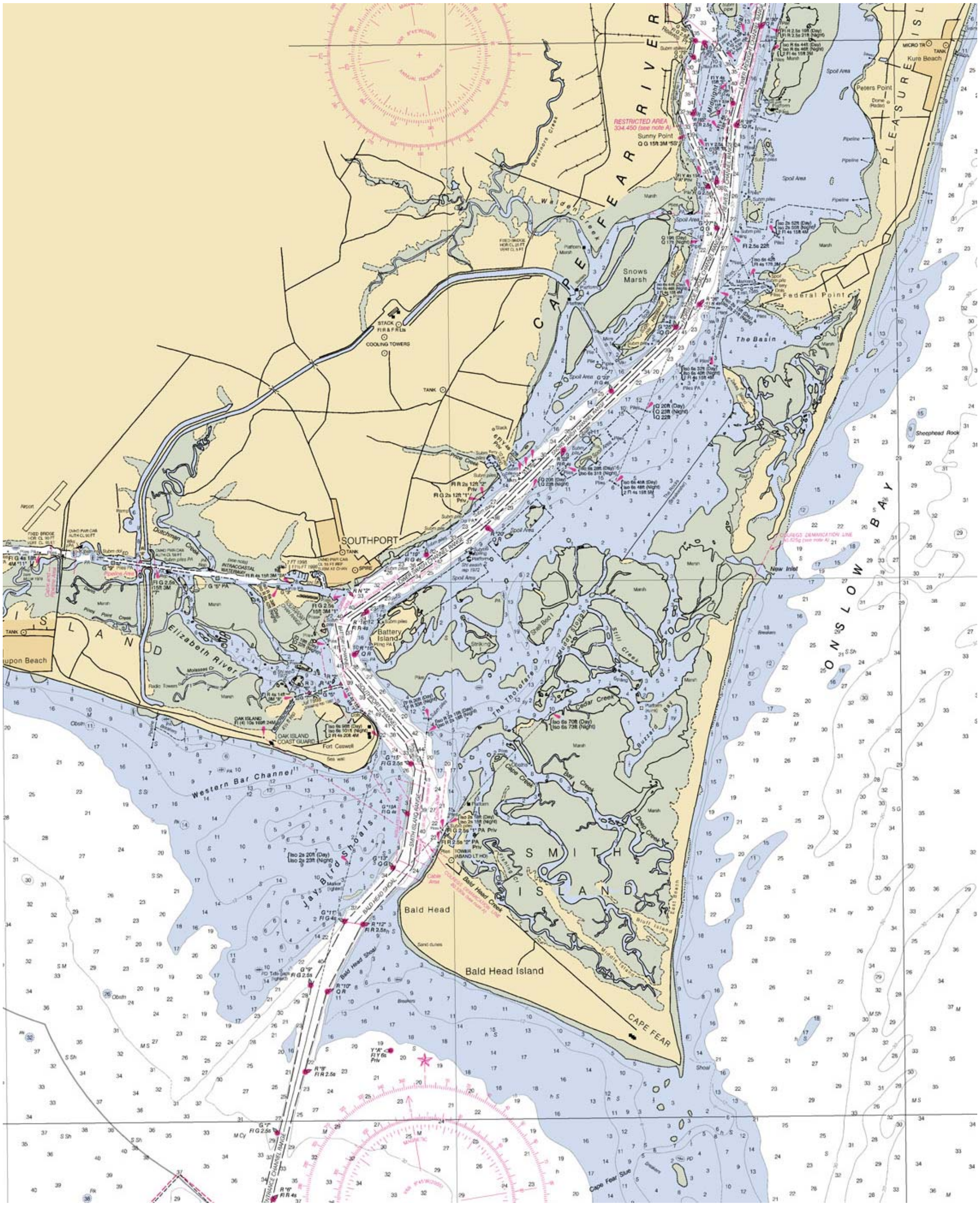

FIGURE 2
Cape Fear River Reach Designations

TABLE 2
Wilmington Harbor/Morehead City Harbor Reach Characteristics

(FOR CHANNELS 400 ft. WIDE OR GREATER) (ER 1130-2-316)						PAGE 1	OF 1	PAGES
TO:					FROM: USACE, Wilmington			
STATE: Wilmington Harbor / Morehead City Harbor					MINIMUM DEPTHS IN EACH 1/4 WIDTH OF CHANNEL ENTERING FROM SEAWARD			
		AUTHORIZED PROJECT				MID-CHANNEL		
NAME OF CHANNEL	DATE OF SURVEY	WIDTH (feet)	LENGTH (statute miles) approx.	DEPTH (feet)	LEFT OUTSIDE QUARTER (feet)	LEFT INSIDE QUARTER (feet)	RIGHT INSIDE QUARTER (feet)	RIGHT OUTSIDE QUARTER (feet)
Wilmington Harbor								
Anchorage Basin Station 0+00 to 39+70	10/12/2007	450 to 940	0.75	38	36.7	38.1	38.0	38.2
Anchorage Basin Station 39+70 to 84+81	12/18/2007	550 to 1200	0.75	42	15.6	40.5	40.0	23.1
Between Channel	6/19/2007	550	0.5	42	39.0	41.3	44.0	43.2
Fourth East Jetty	6/4/2007	500	1.7	42	2.2	37.1	40.2	13.0
Upper Brunswick	7/12/2007	400	0.8	42	6.5	32.8	40.6	12.5
Lower Brunswick	7/11/2007	400	1.6	42	6.7	25.6	31.1	13.9
Upper Big Island	9/6/2007	510 to 700	0.5	42	9.6	39.2	32.2	6.7
Lower Big Island	9/7/2007	400	0.8	42	3.6	42.1	44.0	6.5
Keg Island	2/8,11/2008	400	1.5	42	39.0	42.7	39.6	37.5
Upper Lilliput	2/22/2008	400	1.9	42	38.3	41.0	41.0	38.6
Lower Lilliput	10/16/2007	600	2.1	42	14.0	33.8	34.0	7.8
Upper Midnight	10/10,11/2007	600	2.6	42	13.4	38.7	38.4	15.4
Lower Midnight	10/17/2007	600	1.6	42	10.6	38.2	40.9	18.9
Reaves Point	10/18/2007	400	1.2	42	17.7	40.7	39.6	22.4
Horseshoe Shoal	10/19/2007	400	1.2	42	16.8	40.5	40.8	38.9
Snows Marsh	10/22-23/2007	400	2.9	42	11.9	39.8	39.2	14.7
Lower Swash	10/30/2007	400	1.8	42	25.2	40.6	38.8	23.4
Battery Island	11/8/2007	500	0.5	44	44.4	45.6	42.2	30.4
Southport	10/31/2007	500	1	44	36.5	43.6	37.4	32.7
Baldhead-Caswell	11/15/2007	500	0.4	44	27.6	39.3	45.7	42.8
Smith Island	2/20/2008	500 to 650	0.9	44	10.8	21.2	42.7	30.2
Baldhead Shoal Reach 1	2/14/2008	700	0.9	44	32.6	42.6	22.1	13.1
Baldhead Shoal Reach 2	2/12/2008	900	0.8	44	30.1	41.2	29.4	8.1
Baldhead Shoal Reach 3	1/4,5,6,8,16/2008	500 to 900	5.7	44	39.6	42.9	43.0	42.5
Morehead City Harbor								
Range A	9/12-14/2007	450 to 650	6.6	47	30.8	45.5	46.1	40.6
Cutoff	8/17,23,24/2007	600	0.7	45	45.4	44.9	44.1	30.9
Range B	8/14/2007	400	1.3	45	4.8	29.8	40.8	19.1
Range C	4/19,24,30/2007	1888	0.6	45	37.0	44.5	46.0	45.0
East Leg	9/5,6/2007	455 to 880	0.3	45	45.7	45.5	45.2	37.8
West Leg	9/11,20/2007	775	0.5	35	29.8	34.7	36.7	39.9
Northwest Leg	9/11,20/2007	120 to1200	0.5	35	15.3	31.9	25.8	25.2
EDITION OF JUL 59 IS OBSOLETE.	(Proponent:CECW-OM)							

a. Material potentially suitable either for structural fill which may be needed for the terminal or for beach re-nourishment.

b. Unsuitable unconsolidated material (considered unsuitable for either structural use or beach replenishment and expected to be disposed of offshore).

c. Consolidated material (rock).

7.5.2 In the area east of Battery Island and in the turning basin area the upper layers are fine-grained sediments not suitable for beach disposal or structural uses.

7.5.3 The area east of Battery Island and in the turning basin would both have been about 20 ft deep prior to the 1800s and would have had higher velocity currents, resulting in coarser sediment deposits.

7.5.4 The material in the area east of Battery Island and in the turning basin are unsuitable to -20 MLLW, and then suitable structural fill sands would extend from 20 ft to the top of rock.

7.5.5 Top of rock elevation of -46.0 ft at South Battery Island can be extended north.

7.5.6 Top of rock elevation of -36.0 ft MLLW is assumed for the turning basin.

7.5.7 Putting a dog-leg turn in Baldhead Shoal Reach 3 will eliminate open ocean rock excavation, while keeping the overall dredging volumes to a minimum.

7.6 Volume Estimates

7.6.1 For the turning basin area, volumes were calculated assuming that all material between the survey data and -20 ft MLLW is unsuitable, material from -20 to -36 ft MLLW was structural quality fill sand, and material below -36.0 ft MLLW was rock.

7.6.2 For the area north of South Battery Island, volumes were calculated assuming that all material between the survey data and -20 ft MLLW is unsuitable, material from -20 to -46 ft MLLW was structural quality fill sand, and the sand–rock interface was at -46.0 ft MLLW.

7.6.3 For the channel from Snow's Marsh to Baldhead Shoal Reach 3, station 90+00, all material within the template above the rock layer is assumed as quality sand suitable for structural fill.

7.6.4 All material offshore of Baldhead Shoal Reach 3 station 90+00 is assumed as unconsolidated, unsuitable material.

7.7 Dredging Equipment Scenarios

7.7.1 For beach quality material, where there is less than 50,000 ft between the dredge and beach disposal site, hydraulic cutter suction dredges would be utilized.

7.7.2 For dredge areas where the probable disposal site is greater than 50,000 ft from the dredge area, hopper dredges with pipeline pump-out would be utilized.

7.7.3 For all unsuitable material excavated inshore of Baldhead Shoal Reach 2, clamshell and barge or similar techniques would be used and the material would be towed to the existing ODMDS southeast of the sea buoy.

7.7.4 For unsuitable unconsolidated material in Baldhead Shoal Reach 3 and the channel extension, it is assumed bottom dump hopper dredges would be used.

7.8 Dredged Material Disposal

7.8.1 Six dredged material disposal sites are assumed and separated by material type, as shown in Table 3.

TABLE 3
Assumed Dredged Material Classification and Potential Dredged Material Disposal Sites

Material	Disposal Site
Structural Fill or Beach Quality Material	1. Use by the project (undetermined amount). 2. Baldhead Island Beaches. 3. Oak Island Beaches (Caswell Beach/Long Beach).
Unconsolidated Unsuitable Material	4. Ocean Dredged Material Disposal Site (ODMDS).
Rock	5. Abandoned 38-ft channel (Baldhead Shoal Reach) 6. The 42-ft channel to be abandoned from the Lower Swash to the Caswell/Baldhead Range (current “S” curve).

Source: NOAA Chart 11537, Cape Fear to Wilmington.

7.8.2 Due to the anticipated current velocities in both the existing and previously abandoned channel, it is assumed the abandoned channels can be utilized for disposal of rock material only.

7.8.3 It is assumed disposal of rock from the turning basin could be used to create shallow (<20 ft MLLW) water habitat as a beneficial use/remediation component in the abandoned channels.

8.0 Conceptual Wharf Assumptions

8.1 General Assumptions

8.1.1 Landside vertical elevations are referenced to NGVD. A specific project datum will be identified in later phases of work.

8.1.2 Deck elevation is 18.0 feet NGVD.

8.1.3 Berth dredge depth is -52.5 ft MLLW plus an additional 2.0 ft over-dredge allowance.

8.1.4 Container crane gage is 100 ft-0 inch.

8.1.5 Fender and bollard spacing is 60 ft-0 inch.

8.1.6 Wharf length is 4,600 feet.

8.2 Wharf Configuration

8.2.1 The wharf consists of a pile-supported structure, with a sloping bottom from the berthing line up to a vertical bulkhead behind the land-side crane rail beam.

8.2.2 The slope of the mudline from the berthing line up to the wall is 5 to 1.

8.2.3 The wharf is also configured to have a travel or service lane outboard of the water-side crane rail beam.

8.3 Foundation

8.3.1 The foundation of the wharf is assumed to be an open pile system consisting of 24-inch-square pre-stressed concrete piles.

8.3.2 The capacity of these driven piles is estimated at approximately 250 tons each.

8.4 Substructure

8.4.1 The substructure of the wharf is assumed to be cast-in-place concrete.

8.5 Superstructure

8.5.1 The superstructure is assumed to be simply supported precast concrete slabs supported by the cast-in-place pile caps.

8.5.2 Gantry crane rails will be supported by cast-in-place concrete pile caps.

8.6 Wharf Loads

8.6.1 The wharf deck (between rails) is assumed to carry a 1,000-psf minimum uniform live load distributed to produce maximum stress.

8.6.2 Piles are assumed to be designed for 80 percent of uniform live load.[1]

8.6.3 The deck (outboard of water-side rail) is assumed to carry a 400-psf uniform live load distributed to produce maximum stress and/or HS25 truck loading.

8.6.4 The bollard load for a 22 wide vessel is assumed to carry 150 tons.

8.6.5 Water-side rail setback is assumed to result from superimposing a 2.5-degree list on the design vessel and determining necessary clearance dimensions.

8.7 Gantry Crane Loads

8.7.1 The following gantry crane characteristics are assumed:

a. 22 wide, 80 LT (tandem lift).

b. 135-ft under-spreader.

c. 60 miles per hour (mph) operating wind.

d. 130 mph non-operating wind.

8.7.2 Below are loadings for cranes currently in use at other facilities worldwide, and are the assumed loadings for this study ("machinery-on-trolley" cranes are not considered).

a. Assumed Vertical Loading.

- Loads are based on 10 wheels per corner.
  - Water-side Operating Equivalent Load: 72.0 ton/wheel.
  - Land-side Operating Equivalent Load: 60.3 ton/wheel.
  - Water-side Stowed Equivalent Load: 76 ton/wheel.
  - Land-side Stowed Equivalent Load: 73.2 ton/wheel.

b. Assumed Horizontal Loading (Perpendicular to Rail).

- Water-side Operating Equivalent Load = 1.6 kips/ft (Based on normal operating load) (Earthquake must be considered).
- Land-side Operating Equivalent Load = 1.6 kips/ft (Based on normal operating load)(Earthquake must be considered).
- Water-side Stowed Equivalent Load = 6.25 kips/ft.
- Land-side Stowed Equivalent Load = 6.25 kips/ft.

c. Assumed Horizontal Loading (Longitudinal).

- Water-side Operating Equivalent Load = 50% [0.10(TL + DL) + 0.05(LL)].
  Land-side Operating Equivalent Load = 50% [0.10(TL + DL) + 0.05(LL)].
  Vertical Jacking 1100 kips/Corner.

[1] Uniform load should not be considered within 5 ft of crane rails when combined with crane wheel loads. Uniform load should also not be considered when loadings such as truck loading, stacked containers, or other equipment are not considered.

- Crane beam design should allow an unloaded crane to pass over a broken pile with the crane boom in the most favorable position.

d. Assumed Equipment Loadings.

- Shuttle Carrier: (Inboard of Water-side Rail).
  - Capacity = 60 LT (New Machine/Loading to be obtained from Manufacturers).

- Reach Stacker.
  - Load Capacity: 45 LT.
  - Empty Drive Axle Load: 95 kips.
  - Empty Steering Axle Load: 85 kips.
  - Loaded Drive Axle Load: 230 kips.
  - Loaded Steering Axle Load: 65 kips.

- Mobile Crane.
  - Not considered currently; to be determined at a future date.

- Stacked Container Loadings.
  - Height: 5 containers high.
  - Average Weight: TEU: 18-20 tons, Max: 24 tons; forty-foot equivalent unit (FEU): 30 tons.
- ARMG Crane Loadings assuming 65 LT Capacity and 111.5-ft gage.

  - Vertical.
    Starboard Operating Equivalent Load = 21 kips/ft.
    Port Operating Equivalent Load = 21 kips/ft.
    Starboard Stowed Equivalent Load = 21 kips/ft.
    Port Stowed Equivalent Load = 21 kips/ft.

  - Horizontal (Perpendicular).
    Starboard Operating Equivalent Load = 1.25 kips/ft (for 17-ft line load).
    Port Operating Equivalent Load = 1.25 kips/ft (for 17-ft line load).
    Starboard Stowed Equivalent Load = 6.25 kips/ft (for 17-ft line load).
    Port Stowed Equivalent Load = 6.25 kips/ft (for 17-ft line load).

  - Horizontal (Longitudinal).
    Starboard Operating Equivalent Load = 50% [0.10(TL+DL) + 0.05(LL)].
    Port Operating Equivalent Load = 50% [0.10(TL+DL) + 0.05(LL)].

  - Vertical Tie-Down: SB = 105 kips/ Port = 105 kips (W 1.2 Factor on Wind Load).

  - Longitudinal Stowage Pin: 300 kips/rail (W 1.0 Factor on Earthquake Load).

  - Vertical Jacking: 225 kips/corner.

9.0 Buildings and Facilities Assumptions

9.1 General Assumptions

9.1.1 The approximate floor areas of the buildings are assumed based on similar facilities for similarly sized container terminals as shown in Table 4 below:

TABLE 4
Approximate Building Areas by Type

Building	Maximum Build-out (square feet [SF])
Administration	33,600
Maintenance & Repair	34,400
Security Booth, 3 Locations	600
Drivers Assistance	200
Reefer Wash	16,000
Labor Check-In	2,400
Marine Operations	18,800
Roadability Facility	6,400
Gate Complex	3,200
Toilet Facilities (3 Locations)	9,600

10.0 Civil Works Assumptions

10.1 General Assumptions

10.1.1 The site covers approximately 600 acres and is divided approximately as shown in Table 5 below.

TABLE 5
Approximate Breakdown of Land-Use Development

	Area Description	Acres	Comments
1	Open on Terminal	34	Unused land between IY and Support area.
2	Container Yard	144	Stack area and surrounding paved area between IY and wharf.
3	Wharf	13	
4	Intermodal Yard	74	
5	Support Area	75	Admin Gate, empty storage and chassis storage, etc.
6	Total Terminal Area	340	Sum of lines 1, 2, 3, 4 & 5.
7	Open Off Terminal	163	Land available for future development and stormwater pond for Terminal.
8	Total Developable Area	503	Total area for development minus marsh.
9	Marsh/Unusable	97	Includes marsh and sliver of unused property on south side.
	Total	600	Total of all property in purchase.

10.1.2 The parcel is zoned as Commercial Heavy Manufacturing (CO-HM).

10.2 Terminal Surface Materials

10.2.1 Three pavement sections are assumed for designated operational areas as follows:

a. Entrance Road, Gate Area, and Parking and Maintenance Areas (68 acres). This section would consist of 7.5 inches of asphaltic concrete pavement on a 12-inch aggregate base.

b. Container Operations Area would consist of 12 inches of asphaltic concrete on a 12-inch aggregate base.

c. Container Stacking Area would be a 12-inch gravel/stone section (similar to railroad ballast-sized stone) on a prepared sub-base.

10.3 Site Grading

10.3.1 An average site elevation of 18 ft NGVD.

10.3.2 The grade was assumed to have a maximum of 1 percent slope extending from the land-side of the wharf towards the western boundary of the site.

10.4 Stormwater Management

10.4.1 Direct discharge into area waters is prevented.

10.4.2 Stormwater management processes are expected to be typical of high-density development but would depend on the final site configuration.

10.4.3 Control systems must be infiltration devices designed in accordance with 15A NCAC 02H .1008 to control runoff generated from 1½ inches of rainfall.

10.4.4 400 acres of the 600-acre site is covered with some form of paving.

10.4.5 Asphalt paving is approximately 98 percent impervious.

10.4.6 Gravel bedding is approximately 70 percent impervious.

10.4.7 The other 200 acres of developed area will initially remain pervious.

10.4.8 Three methods of treatment/storage will be used to store rainfall runoff volume, and excess storage volume would be made available through design:

a. A stormwater retention area (pond) could be constructed on the site.

b. The perimeter of the site could be used for stormwater treatment as an infiltration trench in conjunction with perimeter safety clear space requirements.

c. Some of the piping systems could be routed to underground exfiltration chambers to provide additional storage.

11.0 Mechanical Utilities Assumptions

11.1 Potable Water

11.1.1 Ample capacity is available through existing water lines.

11.1.2 Each employee at the terminal uses 39 gallons per day (gpd) of water.

11.1.3 Truckers using toilet facilities use 4 gpd of water each.

11.1.4 Container ships require 6.6 gallons of water per TEU.

11.2 Sanitary Sewer

11.2.1 Wastewater would be pumped to the existing wastewater collection system.

11.2.2 Ample sewage line capacity is available.

11.2.3 Ample wastewater treatment plant capacity is available.

11.2.4 The port would not receive sanitary discharge from the ships.

11.3 Fire Water

11.3.1 The maximum spacing between any two hydrants would be 300 ft.

11.3.2 Container storage pile height would exceed 15 ft.

11.3.3 Stored material class is "combustible."

11.3.4 Approximately 16,000,000 SF reserved for container storage.

11.3.5 Minimum distance to any "exposed facility" building is 150 ft.

11.3.6 A single fire event occurs at a time.

11.3.7 Based on other container terminals, an elevated water storage tank having a volume of approximately 830,000 gallons would be required.

12.0 Electrical Utilities Assumptions

12.1 General Assumptions

12.1.1 Local power suppliers can supply a 69-kilovolt (KV) transmission feed to the new port site.

12.1.2 Local power suppliers can own and operate a 69- to 13.2-KV substation (transformer included) and provide a point of connection outside the fence for the port's electrical service.

12.1.3 The Authority would provide the land for the substation (3 acres).

12.2 Electric System

12.2.1 Two independent 69-KV transmission lines would enter the terminal's main substation, where the voltage would be transformed to a common medium voltage for distribution inside the terminal.

12.2.2 Separate loop systems would be used to feed the wharf cranes, ARMGs, reefers, and buildings/lighting.

12.2.3 The wharf cranes and ARMGs would be fed directly with the medium distribution voltage.

12.2.4 Low voltage power for the reefers, buildings, and lighting would be obtained through unit substations strategically placed throughout the terminal area.

12.2.5 Buildings would be provided with emergency back-up power.

12.2.6 Emergency power for the yard lighting and equipment is not being considered.

12.2.7 Terminal lighting would be designed using a combination of high mast lighting (along the wharf and open stack areas) and roadway lighting (along traffic corridors in and around the ARMG areas).

12.2.8 Ductbanks, manholes, and handholds would be provided for all power and communication needs, including all special systems such as security, container management, reefer management, etc.

12.2.9 Provisions would be made for shore power to the container vessels (cold iron). This would include empty conduit and space allocation for substations.

12.2.10 Reefers would require 480 volt, 3 phase, 4 wire, rated 32 amps.

12.2.11 Lighting would consist of 1,000-watt illumination fixtures mounted on high mast poles.

12.2.12 Lighting intensity to be 5-ft-candles average, at eye height, maintained and 3-ft-candle minimum.

12.2.13 Lighting uniformity levels would be in the ratio of minimum to average of 1 to 2.5.

12.2.14 Security illumination levels would be as per Illuminating Engineering Society, United States Coast Guard, and Homeland Security requirements.

12.2.15 Wharf Cranes supply voltage would be 13.2 KV. Power demand would be considered with Peaking Factor for major equipment and without Power Factor (PF) correction equipment. Crane capacity, speeds, and system would be determined prior to power demand design.

12.2.16 Yard Crane supply voltage would be 13.2 KV. Power demand would be considered with Peaking Factor and without Peaking Factor correction equipment (Root Mean Square [RMS]/steady state/peak). Crane capacity, speeds, and system would be determined prior to power demand design.

13.0 Operations Assumptions

13.1 General Assumptions

13.1.1 There are four general components to the facility operations: the berth or ship operations; the container yard storage operations; the inbound and outbound gate operations; and the intermodal rail yard operations. Each of these component operations will have different characteristics, capacities, and operating hours.

13.1.2 Terminal characteristics and ship traffic characteristics are assumed to be as shown in Tables 6 and 7, respectively.

TABLE 6
Terminal Characteristics
(A Simplified Calculation)

Defining Condition	Number	Comment
Terminal Characteristics		
Terminal Capacity in TEUs	3,000,000	Estimated.
Average TEUs per Container	1.70	Calculated ratio of the number of TEUs and the number of containers.
Total Number of Containers	1,764,706	Without reference to container size.
Rail/Truck Split		
Percent of Trucks	50%	Basic assumption.
Percent of Rail	50%	Basic assumption.
Terminal Operating Hours/Day	16	Assumes gate is open for two shifts per day.

Represents a calculated value.

All calculations, estimates, and assumptions are for a Maximum Build-out

TABLE 7
Ship Traffic Characteristics
(A Simplified Calculation)

Defining Condition	Number	Comment
Calculated Ship Traffic		
Size of Ship	8,000	Average is smaller than design ship.
Percent of Cargo Discharged	50%	Assumed for import cargo.
Number of Imported TEUs	4,000	
Percent of Cargo Loaded	40%	Assumed for export cargo.
Number of Exported TEUs	3,200	
Total TEU Transactions per Ship	7,200	
Days per Week Berth in Operation	7	Estimated.

TABLE 7
Ship Traffic Characteristics
(A Simplified Calculation)

Defining Condition	Number	Comment
Days per Year Berth in Operation	364	
Number of Ships per Year	417	
Number of Ships per Week	8.0	

Represents a calculated value.

All calculations, estimates, and assumptions are for a Maximum Build-out

13.2 Equipment Assumptions

13.2.1 Use automated rail-mounted gantry cranes (ARMG) in the container stacking yard.

13.2.2 Provide intermodal yard (IY) operated by gantry cranes or top pick operation.

13.2.3 The water-side ends of the ARMG stacks would be serviced by shuttle carriers or mini-straddle carriers.

13.2.4 The shuttle carriers are assumed to be manually operated.

13.3 Facility Layout

13.3.1 The gross stack dimensions are 10 containers wide and up to 5 containers high in 400-TEU ground slot segments.

13.3.2 The ARMG stacks would be oriented perpendicular to the berth.

13.3.3 Approximately 10 percent of the ARMG stacking blocks would be dedicated to reefers.

13.3.4 The land-side operation of the ARMG stacks is a dual-purpose operation to serve both the IY and conventional trucks in and out of the gate.

13.3.5 The logistics of moving boxes from the land-side end of ARMG stacks to the IY are assumed to be by a land-side fleet of AGVs or shuttle carriers to transfer boxes back and forth from the ARMG stacks to the IY.

13.3.6 The actual operations scenario to be implemented will be chosen by a future operator and is unknown at this time.

13.3.7 The IY contains 10 tracks.

13.4 Gate Operations

13.4.1 Optical Character Recognition (OCR) technology would be used.

13.4.2 Approximately 15 in-gates and 15 out-gates would be sufficient for handling approximately 1.5 million TEUs of truck traffic.

13.4.3 The following inbound gate facilities are utilized:

a. One security booth.

b. One OCR portal for data collection at each lane.

c. One communications pedestal at each lane.

d. Weigh-in-motion scale for five inbound lanes.

e. One emergency/bypass/oversize lane.

f. Transportation Worker Identification Credential (TWIC) reader for each lane.

13.4.4 The outbound gate complex would feature the following as a minimum:

a. One communication pedestal at each lane.

b. One OCR portal.

c. One radiation portal monitor (RPM).

d. One over-wide lane.

e. TWIC reader at each lane.

f. One security guard booth.

14.0 Berth Capacity Assumptions

14.1 Capacity Calculations

14.1.1 The following operations parameters will be used to model capacity:

a. Terminal berth operates 24 hours a day.

b. The average ship length is 1,100 feet.

c. 10 percent ship waiting time assumed.

d. 250 feet of wharf per crane.

e. 30 crane moves per hour.

f. 85 percent berth working time.

g. Crane availability is assumed at 95 percent.

h. United Nations Conference on Trade and Development (UNCTAD) crane effectiveness factor of 85 percent.

15.0 Container Yard Capacity Assumptions

15.1 General Assumptions

15.1.1 Terminal container stacking area operates 24 hours per day.

15.1.2 Each ARMG's stack is assumed to have 400-TEU ground slots (10 x 40).

15.1.3 The ARMG stacks are assumed to have a maximum stack height of 5 and an average height of 3.5 containers is assumed to allow for re-moves and reshuffling.

16.0 Security Assumptions

16.1 General Assumptions

16.1.1 Primary security features and criteria include:

a. ID validation.

b. Monitoring and control of vehicle and pedestrian gates.

c. Intrusion detection and video assessment.

d. Video surveillance and monitoring of port operations and the waterfront.

16.1.2 The Conceptual Security Plan for the terminal security posture of the North Carolina International Terminal includes electronic security equipment, hardware, and software.

16.1.3 Excluded from the security evaluation were items with multiple uses and items already specified by other processes or facilities, including fencing, gates, gate controls, perimeter lighting, area lighting, telecommunications cable, power distribution, monitoring and control center, radios, dispatching equipment, guard booths, and physical barriers.

16.1.4 The perimeter intrusion detection and assessment system (PIDAS) assumes one PIDAS zone for every 300 ft of fence line.

16.1.5 Each PIDAS zone would include exterior fence-mounted or ground-based intrusion detect sensor(s), alarm processing equipment, assessment camera, camera pole/or tower, and fiber optic transmission equipment.

16.1.6 Security Management System (SMS) would be housed in a security control center and would include the following:

a. One alarm processing server, two workstations, and required software.

b. One video processing and recording server, two workstations, and required software.

c. Eight video monitors and two control keyboards.

d. Two security equipment consoles.

16.1.7 Access Control System (ACS) equipment would include card readers, electric locks, door status switches, interface equipment for gate controls and guard booths, badges, and a badge printer.

16.1.8 Waterfront and surface protection can be based on the application of fixed video cameras and video analytic software that would be integrated with the SMS.

16.1.9 It is assumed general surveillance of the dock area, CY, and IY can be accomplished with approximately 12 pole- or tower-mounted Pan Tilt Zoom (PTZ) cameras interfaced with the SMS.

17.0 Rail Assumptions

17.1 General Assumptions

17.1.1 Rail components will be created and/or upgraded to provide rail access to the North Carolina International Terminal.

Rail traffic characteristics are assumed to be as shown in Table 8.

TABLE 8
Rail Traffic Characteristics
(A Simplified Calculation)

Defining Condition	Number	Comment
Calculated Rail Traffic		
Number of Containers by Rail	882,353	Based on rail/truck split.
Length of Train (feet)	9,000	Estimated.
Length of Rail Car (feet)	305	Assumed average length.
Number of Rail Cars/Train	30	
Number of Containers/Rail Car	8	Based on industry statistics.
Total Containers per Train	240	
Number of Trains per Year	3,676	
Days per Week IY in Operation	7	Assumed.
Total Days per Year in Operation	364	
Average Trains per Day	10.1	
Peaking Factor	1.45	Based on modeling studies.
Peak Trains per Day	14.6	A maximum expectation.

Represents a calculated value.

All calculations, estimates, and assumptions are for a Maximum Build-out

17.2 Intermodal Rail

17.2.1 Track-side staging and IY ground space for container management is assumed to provide operational separation between rail lift operations and track-side delivery and take-away operations.

17.2.2 A back-to-back rubber-tired gantry (RTG) operation between pairs of tracks is assumed to increase IY density.

17.2.3 The IY layout provides for the loading of multiple rail destinations or blocks within each pair of tracks without compromising the order of loading or the order of container delivery to the IY.

18.0 Traffic Assumptions

18.1 General Assumptions

18.1.1 Two separate roadway systems will be developed: a port connector to connect the port terminal to the larger public transportation system; and a transportation corridor, as part of the public transportation system, to connect the port connector to the interstate highway system.

18.1.2 Gate operations will be conducted 16 hours per day.

18.1.3 Traffic characteristics are assumed to be as shown in Table 9.

TABLE 9
Traffic Characteristics
(A Simplified Calculation)

Defining Condition	Number	Comment
Calculated Truck Traffic		
Number of Containers by Truck	882,353	Based on assumed rail/truck split.
Days per Week Gate in Operation	5.5	Assumed.
Total Days per Year in Operation	286	
Number of Containers per Truck	1	Conservative assumption.
Number of Trucked Containers per Day	3,085	
Percent Loaded Trucks	70%	As projected in Pro Forma Business Plan for 2030.
Average Annual Daily Traffic (AADT)	4,407	Includes both in-bound and out-bound trucks.
Average Number of Trucks per Hour	275	
Peaking Factor	1.30	Estimated value.
Peak Trucks per Day	5,730	A maximum expectation.
Maximum Peak Hour Volume	441	Based on 10% of Average Annual Daily Traffic.

Represents a calculated value.

All calculations, estimates, and assumptions are for a Maximum Build-out

18.2 Routing Assumptions

18.2.1 For purposes of this initial evaluation only, NC-87 is assumed to represent the end point of the terminal connector accessing the public road system.

18.2.2 One of the alternative routes investigated will become the North Carolina International Terminal transportation corridor and allow traffic to travel between the terminal and the interstate highway system.

18.3 Current Conditions

18.3.1 Due to the heavy volume of projected truck traffic and the existing pavement condition of most of the existing roadways, new full-depth pavement would be needed throughout the length of the corridors studied.

18.3.2 Removal of the existing pavement and/or tie-ins with the terminal connector roads would be required.

18.3.3 Grade-separated, or "fly-over," bridges/overpasses are needed to provide unimpeded left-turn movements.

18.3.4 Bridges would be needed to span over existing rail lines that are currently at-grade rail/highway crossings. The locations for these structures are assumed to be:

a. NC-133 near MOTSU entrance.

b. Entrance to MOTSU.

c. Entrance to Progress Energy property.

d. Two additional locations to be determined as to best benefit community traffic.

18.4 Capacity Analysis

18.4.1 Free-flow speed on the transportation corridor is estimated at between 45 and 60 mph depending on the alignment and surrounding land use.

18.5 Other Assumptions

18.5.1 A conservative mitigation cost is used for roadway improvements.

18.5.2 The cost of required right of ways (ROWs), both residential and commercial, and the additional costs of displacements are not known.

18.5.3 Existing utilities run parallel to the existing roadways and are non-reimbursable costs (costs borne by the utilities).

19.0 Cost Estimate Assumptions

19.1 General Assumptions

19.1.1 The cost estimate is a general approximation of cost and is subject to change following further analysis in future phases of the project.

19.1.2 The Authority would be responsible for the environmental and permitting cost.

19.1.3 The State of North Carolina would be responsible for 50 percent of the channel deepening cost.

19.1.4 The Authority would be responsible for the terminal design and construction cost. This element would be the subject of a future PPP developed by the Authority to bring private investment into the terminal facilities.

19.1.5 NCDOT would be responsible for the road system improvements.

19.1.6 The Federal government would be responsible for 50 percent of the channel deepening cost.

19.1.7 Other parties, depending on ownership and operational agreements, would be responsible for the costs for rail system improvements.

19.1.8 Cost is based on October 2007 market conditions.

19.2 Contingencies

19.2.1 Contingency costs will allow for additional uncertainty and risk, including:

a. Additional costs due to design development.

b. Estimating error and uncertainty.

c. Price inflation.

d. Unforeseen conditions such as soil anomalies and meteorological conditions.

e. Risks, whether allocated to the construction contractor or owner.

19.2.2 An allowance of 25 percent is assumed as a contingency for construction.

19.2.3 An allowance of 10 percent is assumed for equipment cost changes.

19.2.4 An allowance of 20 percent is assumed for contractor’s preliminaries.

19.2.5 An allowance of 10 percent is assumed for engineering and construction management.

20.0 Schedule Assumptions

20.1 General Assumptions

20.1.1 Assume initiation of operation and generation of revenue at the earliest possible date.

20.1.2 Develop construction schedule to allow operation prior to completion.

20.1.3 An interagency process facilitates, within 3 years, the Environmental Assessment (EA) for all infrastructure and facilities so that the EA is completed, an Environmental Impact Statement (EIS) written and approved by USACE.

20.1.4 There is no litigation.

20.1.5 An investor provides funds for the project in a timely manner.

20.1.6 The Federal government funds the channel deepening project in a timely manner.

20.1.7 The NCDOT develops the roadway system needed for Brunswick County in a timely manner.

20.1.8 A rail infrastructure agreement is approved to benefit all parties.

20.1.9 Rail infrastructure improvements are made in a timely manner.

Appendix A

Glossary

Appendix A
Glossary

Addressable Market – As used in this analysis, the container market demand served by container ports along the U.S. East Coast and Gulf Coast. The forecast container volume at the North Carolina International Terminal was calculated as a market share percentage of the addressable market.

Authority – North Carolina State Ports Authority.

Automated Rail-Mounted Gantry (ARMG) Crane – An unmanned rail-mounted gantry crane, used for the purpose of transporting, stacking, loading, or unloading containers. The ARMG is linked to the terminal operating system and operated by computer sensing devices.

Automated Guided Vehicle (AGV) – Vehicles designed to carry cargo (containers) and to perform their operations from computer-generated commands and without direct human guidance. An automatic guided vehicle system (AGVS) consists of one or more computer-controlled, wheel-based load carriers running without the need for an onboard operator or driver. AGVs have defined paths or areas where they navigate. Navigation is achieved by any one of several means, including following a path defined by buried inductive wires, surface-mounted magnetic or optical strips, or inertial, satellite, or laser guidance.

Average Annual Daily Traffic (AADT) – The traffic (both directions) experienced through the roadway section for a 24-hour period averaged over a 1-year period.

Beam – The overall width of the ship, measured at its widest point (outside of bulkhead to outside of bulkhead); also known as breadth.

Berth – The designated place where a ship lies when secured to a wharf or pier.

Bollard – A short steel column with a base plate used to secure ship mooring lines, thus holding the ship to the wharf while at berth. Bollards are available in various shapes and load capacities.

Box Rate – The conglomerated cost to transport a container from a ship berthed at the port to the conveyance used to transport the container out of the port facilities. The cost also applies to containers coming into the port for loading aboard ship.

Capacity – The number of TEUs or containers handled by the facility at an acceptable level of service, performance, and unit cost.

Capital Cost – The amount of money needed to acquire or improve capital assets (sometimes called “fixed assets”) such as land, buildings, equipment, and machinery.

Capital Assets – The tools of the business and the means of being in business rather than the products or services of the business.

Channel Alignment – The primary path of the channel is defined by its alignment. Often the centerline of the channel is depicted on charts to define the channel’s navigation geometry or alignment.

Chassis – Over-the-road trailer used for transporting containers; usually owned and maintained by the shipping line or terminal operator in the U.S. market.

Competitive Position Assessment – Provides an understanding of the competitive environment within which the port must market, determines a marketing strategy that will create sustainable competitive advantage, and provides a future container demand projection for the port.

Compound Annual Growth Rate (CAGR) – Rate of growth of a number when compounded year after year. Compounding means the growth rate applies to each increase in the base number.

Concession – The granting of the use of property, and the right to undertake and profit from activities conducted by the grantee (or concessionaire), by a government entity in return for specific services, revenue, and/or activities conducted to achieve a specific purpose through the use of such concession by the grantee.

Crane Availability – The amount of the total available time when a crane is available for use. In general, the non-available time would be related to equipment failure or maintenance activities requiring the crane to sit idle until fully re-instated to working status.

Crane Beam – A structural steel member, typically used as a bridge girder to allow the crane's load carrying device to reach out to the object to be secured.

Crane Boom – A mechanism mounted horizontally on the frame of an overhead crane to which the crane rails and trolley bridge are attached. On a ship-to-shore crane, the crane boom is located transverse to the wharf, extending over the ship's hatch and extending back to the shoreward side of the wharf. The water-side portion of the crane boom can be raised by means of a hinged connection to allow ships to pass along the wharf face.

Crane Utilization – The portion of the time when the crane is actually in use as compared to the total time the crane is available for use.

Deployed Technology – Technology which is already in use by the subject industry, or by other industries.

Depth (ft) – Vertical measurement of the internal size of the cargo hold.

Development Costs – Up-front costs associated with planning and permitting.

Diversity Factor – A multiplication factor used to reduce the demand of for power which was determined by simply adding up the maximum demand for each source in a system. The diversity factor is used to recognized that each piece of equipment will not be utilizing a full demand at the same time.

Draft – Vertical measurement from the ship's waterline to the bottom of the keel.

Dredge Depth – Normal operating water depth plus 2 ft of over-dredge allowance, i.e., -52.5 ft plus 2 ft of over-dredge equals a -54.5-ft dredge depth.

Dwell Time – The average time (in days) a container is in the container yard, the amount of time a container resides within the port terminal area.

Econometric Evaluation – The use of computer analysis and modeling techniques to describe in mathematical terms the relationship between key economic forces such as labor, capital, interest rates, and government policies; then test the effects of changes in economic scenarios. For example, an econometric model might show the relationship between housing starts and interest rates.

Fenders – Fenders are flexible, structural components of the wharf which are intended to prevent the ship from coming into direct contact with the wharf and are used to absorb or dissipate the kinetic energy of the berthing ship by converting it into potential energy in the fender materials. The fender is similar to a bumper and is generally constructed in the form of a fender pile, a column of rubber, a foam-filled cylinder, or pneumatic device. Other energy conversion processes are also possible.

Forty-foot Ground Slot (FGS) – The ground area required for a single stack of forty-foot containers.

Forty-Foot Equivalent Unit (FEUs) – Containers with a length of 40 feet (12.19 meters). One FEU is equal to two TEUs.

Gantry Crane – A classification which refers to an overhead crane used for picking up and moving cargo by means of a horizontal rail system and a form of movable bridge spanning between the rails. The bridge is supported on the rails by wheels called “trolleys.” Movable gantry cranes are generally supported either by rubber tires or steel wheels. Several forms of gantry cranes are used in port facilities, including ship-to-shore container gantry cranes for loading and unloading the ship, and rubber-tired or rail-mounted gantry cranes used for moving cargo or loading and unloading cargo onto trucks and trains.

Height from Keel to Antenna Mast – Total height (in ft) of vessel from keel (bottom-most part of the ship) to top of antenna mast (highest component of ship).

Height from Keel to Top Tier on Deck – Total height (in ft) from the bottom of the keel to the top of the highest container stacked on the deck of the ship.

High-Peaking Operation – Operation characterized by cargo arriving at the port in large quantities over a very short period of time and then dropping to a much lower, perhaps idle, operation at other times.

Highway Access Improvement Costs – Costs associated with construction of highway access to the site.

HS20-44 – A designation established by AASHTO. “HS” refers to the type of vehicles a bridge or highway can accommodate. AASHTO also identifies the conventional semi- or tractor-trailer vehicle as an HS truck configuration; “20” refers to the loading specification of the bridge, in tons; “44” indicates the year the specification was adopted. HS20-44 capacity means that the bridge or highway is able to safely accommodate 3- or 4-axle vehicles, such as a large semi-tractor-trailer.

HS25-44 – A scaled-up version of the HS20 vehicle.

Intermodal Yard (IY) – An area where an interchange of people or cargo occurs among various modes of transportation, such as ships, trucks, buses, or trains. Typically, in a port environment, the IY is a rail yard where container cargo from the ship is loaded onto freight trains. The equipment in an IY is often compatible with multiple transport systems.

Internal Rate of Return (IRR) – The discount rate at which the present value of the future cash flow of an investment equals the cost of the investment. When the net present values of cash outflows (the cost of the investment) and the cash inflows (returns on investment) equal zero, the rate of discount being used is the IRR. When the IRR is greater than the required return (called the “hurdle rate” in capital budgeting), the investment would generally be considered acceptable.

Kips – A 1,000-pound load (5 kips = 5,000 pounds).

Live Load – The weight or forces applied to the structure by any object or material exclusive of the actual construction materials used to create the subject structure. Live loads may be static (not moving) like stacked containers, dynamic (moving) as by a vehicle, repetitive, or impact (generally a sudden event).

Low-Peaking Operation – Operation characterized by cargo arriving at the port in a more steady volume throughout the working hours of the terminal, creating a steady flow of equipment operation with less, or no, idle time.

Market Entry Strategy—A plan describing the timing and process to be used to introduce a new or improved product into the marketplace in a manner best suited to achieving the objectives of the stakeholders.

Maximum Build-out – The peak level of container throughput obtained after all facilities in the conceptual plan are built and operating, producing a four-berth (8,000-TEU ship) container terminal with an estimated throughput of 3,000,000 TEUs per year.

Mean Low Water (MLW) – See definition of "Mean Lower Low Water."

Mean Lower Low Water (MLLW) – There are two low tides in each tidal cycle (so usually two low tides in each day). These two low tides are not quite the same height because one tide is generated by the relatively small gravitational interaction with the sun, and the other is generated by the larger gravitational interaction with the moon. Since the two low tides (or water levels) are different levels of low, one is naturally the higher low water (higher low tide) and the other is the *lower* low water (lower low tide). So MLLW is the average of the lower low water height of each tidal day (i.e., average of the lowest low tide from each day). The averages are taken over a period called the National Tidal Datum Epoch (a 19-year epoch).

Minimum Build-out – When two of the four berths planned for the North Carolina International Terminal are available for use and the terminal goes into operation while remaining elements of terminal facilities are still under construction.

Mini-Straddle Carrier – A small straddle carrier or small piece of mobile truck equipment capable of straddling and lifting one container within its own framework.

Navigation Channel Improvement Costs – Costs associated with dredging the existing Federal Navigation Channel from -42 feet to the planned depth for the new container terminal.

Operating Equivalent Load – The sum of the wheel loads produced (by the ship-to-shore gantry crane) while operating on the supporting structure (wharf).

Operation and Maintenance (O&M) Cost – Those ongoing costs of doing business related to the operation of the business and the maintenance of capital assets such as roads, buildings, infrastructure, equipment, and services such as water and power.

Operation and Maintenance Cost Projection – A method used to identify and quantify representative O&M cost parameters; in this context, the O&M cost projection describes a conceptual operating model for the North Carolina International Terminal.

Opportunity Assessment – A method used to identify and quantify the future addressable market for waterborne container traffic which may be captured by the port; determines the need for additional system capacity to address the needs of a particular market.

Panamax – A term meaning the maximum size vessel which can utilize the existing Panama Canal. The maximum size ship allowed to transit the canal is defined by the following dimensions:

> **Width** – 106 feet (32.3 meters)
> **Length** – 965 feet (294.3 meters)

Draft – 39.5 feet (12 meters)
Dead Weight Tons – Approximately 69,000

Panzer Belt – A proprietary system used to protect the electric cable which supplies power from the wharf to the ship-to-shore container crane. A continuous semi-flexible belt, fabricated from rubber with inlaid steel reinforcement, which lies over a cable storage trench cast in the wharf, thus covering the cable trench.

Peaking Factor – The ratio of the maximum usage of some system or element of a system to the average usage of the system or element in the system. Often used to express the relationship between peak use and average use of systems, such as electrical systems and water systems, where the peak can be much higher than the average usage. The Peaking Factor for a number of such systems is an empirically derived value of common usage in engineering calculations.

Pedestal Canopy – A canopy is a building structure with a roof but without walls. The pedestal canopy is a roof supported by vertical columns covering the pedestal for the purpose of providing shade and shelter from the elements.

Pile – A long, slender pole which can be used for many purposes and may be in many shapes including round, square, or multi-faceted. A pile is often used as the structural component of a wharf which holds up the deck. As a support structure, a pile is typically driven (or placed) vertically (plumb) or at an angle (batter). Piles may be made of steel, precast concrete, precast prestressed concrete, timber, steel/concrete composite, or, depending on use, other materials such as plastic or rubber.

Port – In this report, the North Carolina International Terminal.

Post-Panamax – The class of ships constructed in excess of the size permitted through the Panama Canal. In general, these ships are in the 5,000-TEU to 8,000-TEU class.

Power Factor (PF)– A measurement of electrical efficiency denoted by PF or the mathematical symbol φ (Cosine of Phi or Cos. Phi). It is the ratio of productive power (kW) to total power (kVA) and is measured as a number between 0 and 1 or as a percentage. Consider the following: Imagine driving your car down the highway, you're using gasoline to power the engine (total power) and the engine is generating 200 horsepower (productive power) to move. If all the gasoline you're using is going towards moving the car, you are said to have a power factor of 1. Now in contrast, you turn your car on but let it sit in the driveway. You are still using gas (total power), but the engine is generating 0 horsepower (productive power), and you are said to have a power factor of 0. Recent studies have shown that the average power factor of a house is approximately 0.8. This means that you're using about 80 percent of the power that's given to you and therefore wasting the other 20 percent. This 20 percent is lost due to heat generated by friction inside the electrical lines.

Power Factor Correction – The means of increasing the power factor within an electrical system and therefore its efficiency.

Power Factor Correction Capacitors – Specially designed capacitors used specifically for power factor correction. The primary function of a capacitor is to store electricity using an electric field. Due to its physical nature, the capacitor has a tendency to maintain a constant voltage. When the voltage drops on an electrical system, the capacitor will release some of the electricity stored within itself to correct this drop. Power capacitors are measured in kVAR, which signifies their reactive power or their ability to react to changes in voltage.

PPP – Public-Private Partnership; also referred to as a P3.

Pro Forma Business Plan – The term “pro forma” means “as a matter of form” in Latin. It refers to a presentation of data, such as a balance statement or income statement, where certain amounts are hypothetical. For example, a pro forma business plan might show revenues or costs which are proposed, or assumed or approximated, but which are conceptual because they have not yet been consummated.

Pro Forma Economic Model – Provides a computational assessment of the economic viability of a given project, in this case the North Carolina International Terminal enterprise, identifies any major gaps or economic barriers to project success, and identifies those elements that would most improve the economic fundamentals of the project.

Rail Access Improvement Costs – Costs associated with improvement of existing rail infrastructure that is located outside the boundaries of the planned terminal.

Reefer – A refrigerated container.

Reefer Plug – The plug used to provide power to a refrigerated container. Reefer plugs are generally grouped together to allow the temporary storage of refrigerated containers while maintaining the temperature integrity of the cargo.

Re-handling, Re-moves and Re-shuffling – Container movements from one point in the container yard to another point in the yard. Re-shuffling can be either for the convenience of the yard operator, in which case they do not generate revenue for the yard operator, or by direction of the shipping line, in which case they may generate revenue.

Revenue Projection – Identifies, evaluates, and quantifies the key revenue opportunities for a project, such as a port, as an ongoing enterprise.

Roadability – The condition of a vehicle for purposes of travel by public roads. An inspection to determine if a vehicle cargo and chassis is "roadworthy," especially after repair or servicing A roadability building is a facility which supports roadability inspections.

Scantling Draught – Depth (in ft) from the ship’s waterline to its keel, also called “draft.”

Slip – See definition for “Berth.”

Stowed Equivalent Load – The sum of the loads produced (by the crane) on the wharf in a non-operating or "stowed” condition. In the stowed position, the ship-to-shore gantry crane boom is up, the trolley and lifting system are in the stowed position, and tiedowns, if any, are in place.

Straddle Carrier – A manually operated, movable, drivable rubber-tired gantry crane capable of carrying one FEU. In general, the use of a straddle carrier is to pick up a box, either from the ground or from a single-line stack of up to 3 or 4 containers, and move the container either to a different ground location or a different stack as a step in the processing of the container through the port facility.

Super Post-Panamax – A class of newer, larger ships created through advances in engine technology which began appearing in about 1997. These ships generally range from 8,000 TEUs to 10,000 TEUs.

Terminal – The location where cargo is handled and generally consisting all operations between the ship and the inbound and outbound gates. The area where cargo is handled between transportation modes, such as between rail or highway and ship transport.

TGS – Twenty-foot Ground Slot. The ground area required for a single stack of twenty-foot containers.

Tiers on Deck – The number of containers stacked on the ship deck, as measured by containers.

Transshipment – The term used to describe cargo coming into a port facility by ship and subsequently departing the same port facility by a different ship, all without leaving the port facilities.

Turning Basin – An area for turning a vessel around to change the direction it is facing. This activity is generally accomplished either before docking the vessel or prior to departure. Often, a terminal operator and/or the vessel's pilot will have a preference for berthing vessels either "starboard side-to" or "port-side-to," which will define when, in the course of a vessel call, the vessel is turned.

Twenty–Foot Equivalent Unit (TEU) – The expression most commonly used in the container shipping business as a measurement or quantity of containers. The TEU refers to containers measuring 20 feet (6.1 meters) in length and which are generally 8 feet wide and 8.5 feet in height. Two TEUs are equal to one FEU.

Twenty-Foot Ground Slot – The area representing the footprint of one TEU.

Unconstrained Economic Forecast – An economic forecast which assumes an "normal" economic environment. A normal economic environment would not include the effect of catastrophic events such as war, extreme effects of major weather events (draughts, famine), severe global recession, or similar occurrences.

Ultra Large Container Ship (ULCS) – The newest class of ships which began design in approximately 2001 and began construction in approximately 2006 and which are thought to be in the 12,000-TEU to 15,000-TEU range. These ships (or a sub-class of these ships) may also be called NPX Class, which would refer to ships capable of transiting the anticipated Panama Canal expansion. The exact size of the NPX ships is unknown at this time.

Wave Period – The time, generally expressed in seconds, it takes for a complete wave to pass a fixed point. Generally, the wave period measurement would be taken from the crest (highest point) of the first passing wave to the crest of the second passing wave.

Wharf – The wharf is the structure to which the ship is attached when at berth. It is designed specifically to accept the load created by a berthing vessel. When the wharf is aligned with the shore and connected to the shore along its full length, it is called a marginal wharf or perimeter wharf. A wharf can have more than one berth, allowing it to accommodate more than one ship at a time.

Wind Loading – The force of the wind on an object as the result of wind-induced pressure or suction. Wind loading is dependent upon the interrelationship of: wind velocity; air mass density; structural geometry including dimensions, stiffness, orientation, and location; and the surrounding ground surface conditions.