February
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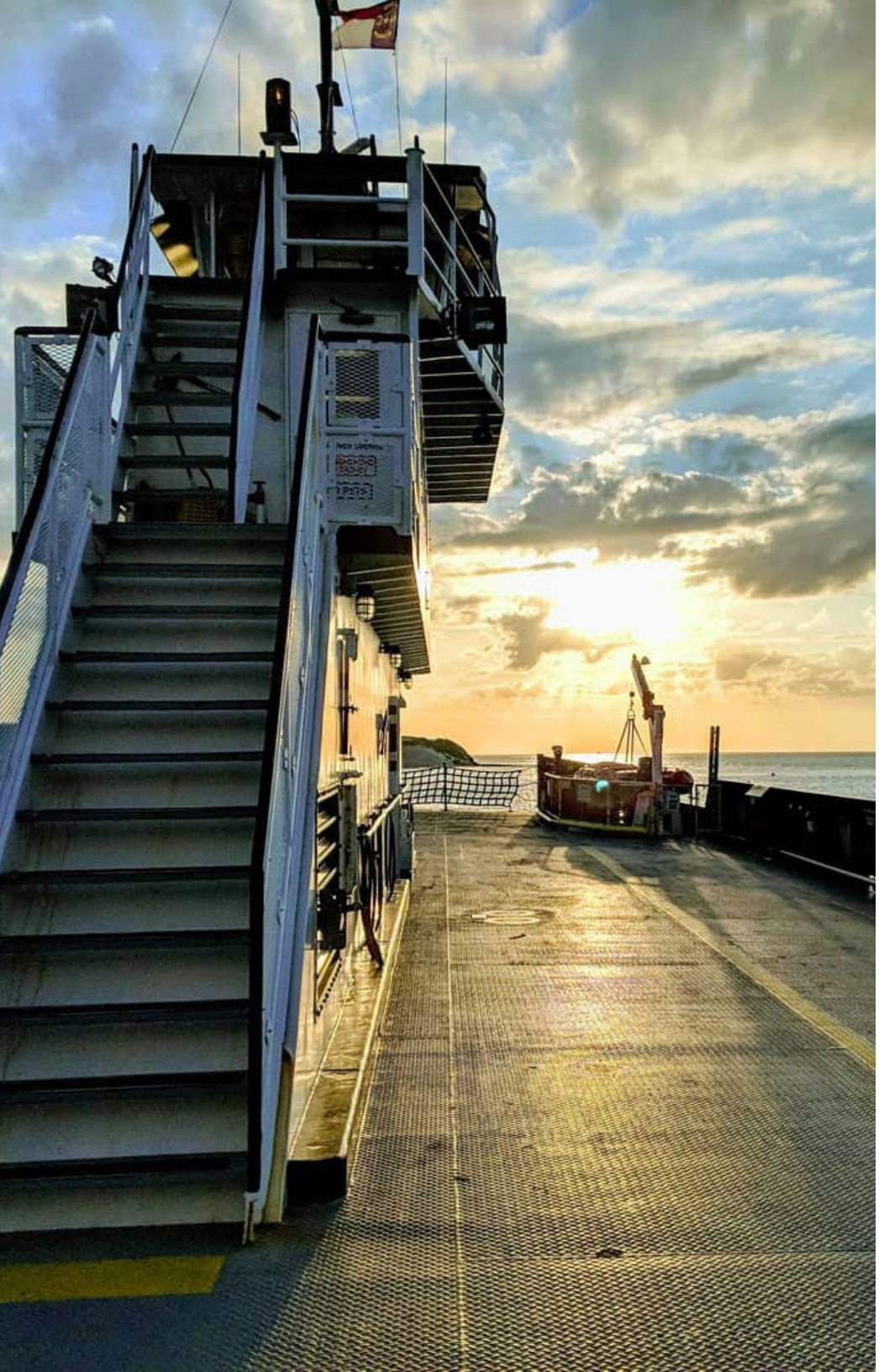
Study Report

Ferry Division Maintenance Capacity Study

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
Ferry Division
Manns Harbor, North Carolina



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Terminology Guide

HDR provides the following list of terms used throughout this report for the reader's benefit and reference.

General Terminology

PLATEN Platen describes a fixed location on land where vessels are stabilized and remain stationary while maintenance is performed.

EMERGENCY In this study, an emergency refers to when a vessel is damaged during service, for example, from running aground, and must undergo immediate repair before returning to service.

FD Ferry Division

NCDOT North Carolina Department of Transportation

TWICE-IN-FIVE POLICY According to USCG Office of Vessel Compliance Document CVC-WI-029(2), "most tank, passenger, cargo, and towing vessels operating in salt water and all offshore supply vessels" are subject to "two [work platen] exams within any five-year period with no more than three years between any two exams."

USCG United States Coast Guard

Capacity Modeling Terminology

AGENT A simulation modeling term used to define an object that can move through the simulation and interact with other objects such as resources, locations, other agents, etc. and has characteristics that can change over time. In this study, ferry vessels are considered "agents".

ATTRIBUTE A general simulation term to describe any characteristic of an agent or object. An attribute can take the form of a numerical value, alphanumeric "string", or a number of other data types. Attributes that can change over time are often referred to as "variables". Attributes that do not change are often referred to as "properties" or "constants".

KPI Key Performance Indicator. A metric which is used to measure the performance of a system and is particularly valuable for decision making and comparing alternatives.

Socio-Economics Terminology

ACS American Community Survey. An annual demographics estimate program conducted by the Census Bureau.

BLS Bureau of Labor Statistics. The principal labor economics and statistics research agency for the US government.

C2ER The Council for Community and Economic Research.

CATCHMENT AREA The area from which a governmental organization, private firm, or other institution attracts a population that uses its services and economic opportunities.

CCOLI County Cost of Living Index. Published by C2ER, the index is designed to assess the pricing differences for every county in the US during a single year. It compares the cost of maintaining a standard of living appropriate for moderately affluent professional and managerial households. The base of index 100 represents the US Average

SAIPE Small Area Income and Poverty Estimates. A program providing annual estimates of income and poverty statistics for all school districts, counties, and states.

GARM Geographic Areas Reference Manual. Published by the US Census Bureau and available to the public at https://www2.census.gov/geo/pdfs/reference/GARM/

IMPLAN An economic "input–output" model designed to represent the interdependencies between different sectors of a subnational/local economy. Key variables analyzed include employment, labor income, and output (the total value of business' production in a local economy).

LABORSHED An area or region from which an employment center draws its commuting workers.

LEHD Employer-Household Dynamics. A joint program between Labor Market Information (LMI) Divisions of states' Workforce Agencies and the Center for Economic Studies at the U.S. Census Bureau. Each LMI Division serves as the employment data collection service for the BLS.

MSA Metropolitan Statistical Area. US Census Bureau GARM defines MSA as "one or more counties that contain a city of 50,000 or more inhabitants, or contain a Census Bureau-defined urbanized area and have a total population of at least 100,000." Urbanized area (UA) is defined as "densely settled agglomerations around large cities."

NAICS North American Industry Classification System (NAICS); the system of classification for business establishments.

SOC Standard Occupational Classification. The system used to classify workers into occupational categories.

01 Executive Summary

Study Scope

The Ferry Division of the Department of Transportation for the State of North Carolina has been directed by the North Carolina House and Senate Transportation Appropriations Committee to study increasing the Capacity for Vessel Maintenance.

From the legislative Bill, the study shall include all the following:

1. An evaluation of all the following options for increasing in-house capacity for vessel maintenance:
   a. Expanding berths and staffing at Manns Harbor.
   b. Using existing State-owned properties for dry-dock availability.
   c. Purchasing or leasing additional property elsewhere along the North Carolina coast. The evaluation of this option shall include the identification of specific sites or regions where potential additional shipyard capacity may be found and whether the local population of that site or region possesses sufficient skilled labor to support vessel maintenance.
   d. Any other option that could potentially increase in-house capacity for vessel maintenance.
2. For each option evaluated pursuant to subdivision (1) of this subsection, the Division shall assess both of the following:
   a. The total costs the Division will incur for each option.
   b. The steps that would be necessary to implement each option and a proposed timeline for implementation.
3. An assessment of whether the presence of skilled employment in the local population is sufficient to support vessel maintenance.

The study analyzed the current state operations at existing maintenance facilities through a combination of first-hand observation by experienced operational planning professionals and discussions with key Ferry Division Subject Matter Experts (SMEs). Through this current state assessment, valuable understanding and insights were gained and potential facility and infrastructure improvements identified that can be enacted upon immediately. Areas reviewed include:

- Platens, piers, and berthing repairs and upgrades
- Major equipment availability and reliability
- Material storage capacity and inventory management
- Staffing numbers and capabilities
- Infrastructure capacity and conditions
- Alternate work locations
- Labor markets including rates and availability

Project Milestones

Milestone	Date
JLTOC and FRD Deadline	March 1, 2024

Approach

Capacity Modeling

A capacity projection was developed to forecast the demand for vessel maintenance over the next 50 years and recommend strategies to meet this demand through a combination of physical infrastructure (docks, platens, piers, and berthing locations) and staffing. The capacity model assumed a constant fleet of 23 ferries with newly commissioned vessels incorporated based on a specified (time-based) replacement plan.

The capacity analysis captured major maintenance activities, their locations, and durations. Each vessel followed a prescribed "Twice-In-Five" maintenance schedule. From this point, the key activities/work packages were defined in terms of major process flow through various berthing locations and maintenance activities, time to execute, and labor requirements for key steps. The impacts of unplanned repair activities were also considered.

This model became the basis for determining unmet capacity needs and deficiencies based on existing conditions. Following the capacity analysis, site assessment and socio-economic labor assessment tasks were completed to develop a set of options for addressing the unmet demand for vessel maintenance over the prescribed maintenance horizon.

Site Assessment

Site assessment, conceptual site designs and cost estimates were provided for three (3) candidate sites which may meet full capacity needs of the Ferry Division: Expansion of Manns Harbor; Expansion of state-owned site at Cherry Branch; Construction of a new shipyard at a state-owned site in Wilmington, North Carolina. All options assume the Manns Harbor facilities to be the basis of the estimated cost.

Labor Analysis

Labor market analysis focused on determining the availability of the types of labor required for vessel maintenance activities as outlined in the capacity model. The type of labor resources required was then focused around the sites selected to determine potential availability of those resources.

Factors such as cost of living, technical training resources, driving distance, and others were brought together in the analysis to further inform the potential labor market.

Findings

Results of the capacity model suggest that more staff and work platens will be needed beyond what is available in Manns Harbor today to meet the demand for maintenance over the next 50 years.

The capacity study assumed that one ferry vessel will be replaced every four years (12 new vessels over the next 50 years), which closely matches recent history for Ferry Division. While high operational performance can be achieved for any assumption of vessel replacement, more staff and work platens are needed as the average age of the fleet increases. In addition, a concurrent "Vessel Replacement Plan" study will provide additional recommendations for vessel replacement frequency.

Under the assumption of one replacement vessel every four years, the labor need was estimated to be **113 maintenance staff** across mechanical, welding, painting, and dock workers. **Six (6) total work platens** would also be needed (three more than are available currently at Manns Harbor) to keep up with maintenance demand, including one work platen designated specifically for emergency repairs.

Following capacity analysis, HDR analyzed and provided early conceptual site plans and construction cost estimates for four options considered for increasing in-house capacity for vessel maintenance. The estimates provided are considered Class 5 as defined by AACE, which assumes a margin of error of up to -50% on the low end to up to +100% on the high end.

The first alternative proposed to meet the capacity needs of Ferry Division, Site Option 1 was proposed as a full expansion of the existing Manns Harbor facility at an estimated cost of up to **$47.8MM**. While very attractive from an operational and infrastructure perspective, it is unlikely adequate staffing will be available from the area around Manns Harbor to support such a large facility.

Site Option 2, the expansion of a facility at Cherry Branch was estimated at a cost up to **$106.6MM** and proved to be a promising alternative, contingent upon a partial expansion of the Manns Harbor facility ("Option 1B" estimated at a cost up to **$20.0MM**) to complete the design and construction of "Platen 5". Site Option 3 at Wilmington, estimated at a cost of up to **$225.5MM**, benefits from the adjacent maritime industries. However, the distance from the majority of ferry routes and considerable cost made Option 3 the least desirable of the options considered.

Further development of the four site concepts will be required to establish complete engineering drawings, cost estimates and schedules suitable for funding requests to be made.

In coordination with site analysis, the labor analysis analyzed each site option from a socioeconomic perspective. In general, Manns Harbor performed unfavorable with respect to cost-of-living (higher than Cherry Branch and Wilmington) and wage indicators (lower than other areas) and was associated with the lowest employment for key maintenance occupations within a 50-mile radius of each respective site option. Cherry Branch and Wilmington, NC areas performed better with respect to these economic indicators and were associated with a larger workforce.

With respect to labor availability, Cherry Branch appears to be the most well positioned to meet the needs of a new facility. For Manns Harbor, a partial expansion would naturally be easier to accommodate than a full one, with both options accounting for a considerable portion of the staff employed in the area (around 20%). And while Wilmington, NC, generally showed the highest level of employment for key occupations, it also showed the highest wages and compensation, which would impact operational expenses for the Ferry Division if it relocated operations to that area.

Recommendations

HDR views Manns Harbor Ferry Maintenance Facility as a vital component in the future success of the Ferry Division. However, the current facility capacity cannot meet the full maintenance requirements of the existing fleet of 23 ferries. Furthermore, the current labor pool available to Manns Harbor is not adequate to support the future staffing needs of the facility.

Based on the totality of data gathered and analyzed during this study, HDR recommends the following site strategy to meet the long-term vessel maintenance needs of the Ferry Division:

1. Expand Manns Harbor with Platen #5 and dedicate one (1) work platen for emergency repairs
2. Expand Cherry Branch by adding two (2) work platens, a paint booth, machine shop, warehouse, and other ancillary buildings to supplement Manns Harbor in Cherry Branch.

Despite the disadvantages and potential inefficiencies related to a split operation, the combination of Cherry Branch and Manns Harbor would leverage the location and infrastructure of the existing Manns Harbor facility while also taking advantage of a lower cost of living and availability of labor in the areas surrounding Cherry Branch.

02

Introduction to Study and Existing Site

Introduction

Basis of Study

The Ferry Division of the Department of Transportation for the State of North Carolina has been directed by the North Carolina House and Senate Transportation Appropriations Committee to study increasing the capacity for vessel maintenance.

From the legislative Bill, the study was to include the following tasks:

1. An evaluation of all the following options for increasing in-house capacity for vessel maintenance:
   a. Expanding berths and staffing at Manns Harbor.
   b. Using existing State-owned properties for dry-dock availability.
   c. Purchasing or leasing additional property elsewhere along the North Carolina coast. The evaluation of this option shall include the identification of specific sites or regions where potential additional shipyard capacity may be found and whether the local population of that site or region possesses sufficient skilled labor to support vessel maintenance.
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   a. The total costs the Division will incur for each option.
   b. The steps that would be necessary to implement each option and a proposed timeline for implementation.
3. An assessment of whether the presence of skilled employment in the local population is sufficient to support vessel maintenance.

Approach

This report provides a detailed summary of three major tasks:

1. Develop a mathematical model to project out maintenance activity and determine staffing and work platen needs.
2. Site assessment and cost estimation to determine alternate site feasibility and capacity to support recommendations from the capacity model
3. Socio-economic labor assessment to determine the availability and potential recruitment of staff in and around the coastal areas of North Carolina

The three major tasks of this project will be analyzed through a combination of on-site observation of shipyard operations, data gathering, interviews and brainstorming with shipyard subject matter experts, and assumptions based on experience of the Ferry Division. These data points will be analyzed, combined with public information and the experience of HDR resources to bring better understanding of how NCDOT Ferry Division Maintenance Facilities can meet the capacity demands both near term and in the future.

Due to the broad reach of this study to include facilities, property/site assessment, labor markets, cost estimating, operational modeling and socio-economic analysis, the study has attempted to aggregate as much publicly and NCDOT Ferry Division available data to support the analysis and provide a holistic view of the Division maintenance challenges.

While these analysis are complex, there are strong indicators for much of the conclusions to be drawn. It is certain that once directions are recommended, any of the approaches to solve problems identified will require further study and concepts developed to solid, deliverable plans including scope, schedule and budget. In addition, funding sources or preparation of funding requests are not intended in the scope of this study, but will need to be developed with project plans.

Existing Facility at Manns Harbor

Facility Description

The primary Ferry Division facility responsible for maintaining the current fleet of ferries and other marine vessels is located at 8550 Shipyard Road, Manns Harbor, NC 27953. Manns Harbor is located in Dare County, the easternmost county in North Carolina (Figure 2.1).

The Manns Harbor facility spans approximately 17 developed acres with direct water access from the Croatoan Sound and vehicular access off US Highway 64. An additional 21 acres at the site are undeveloped.

The Manns Harbor maintenance facility normally operates Monday through Friday from 7:00 a.m. to 3:30 p.m. local time, with overtime extending days to 5:30 p.m. Maintenance operations occur year-round.

At the time of the study, there are a total of 50 maintenance personnel: 14 mechanics, 17 painters, 13 welders, and 6 dock workers. These crews are directly responsible for vessel maintenance and repair at the Manns Harbor site and occasionally in the field as well as a number of other related duties. Manns Harbor has hired additional maintenance staff on a temporary and/or seasonal basis in the past, however, as of December 2023 temporary staff constituted a very small percentage of the overall staff.

In addition to maintenance personnel, approximately 20 other staff members are either employed or stationed at the Manns Harbor facility, covering a range of positions including administration, engineering, logistics, facilities, and site security.

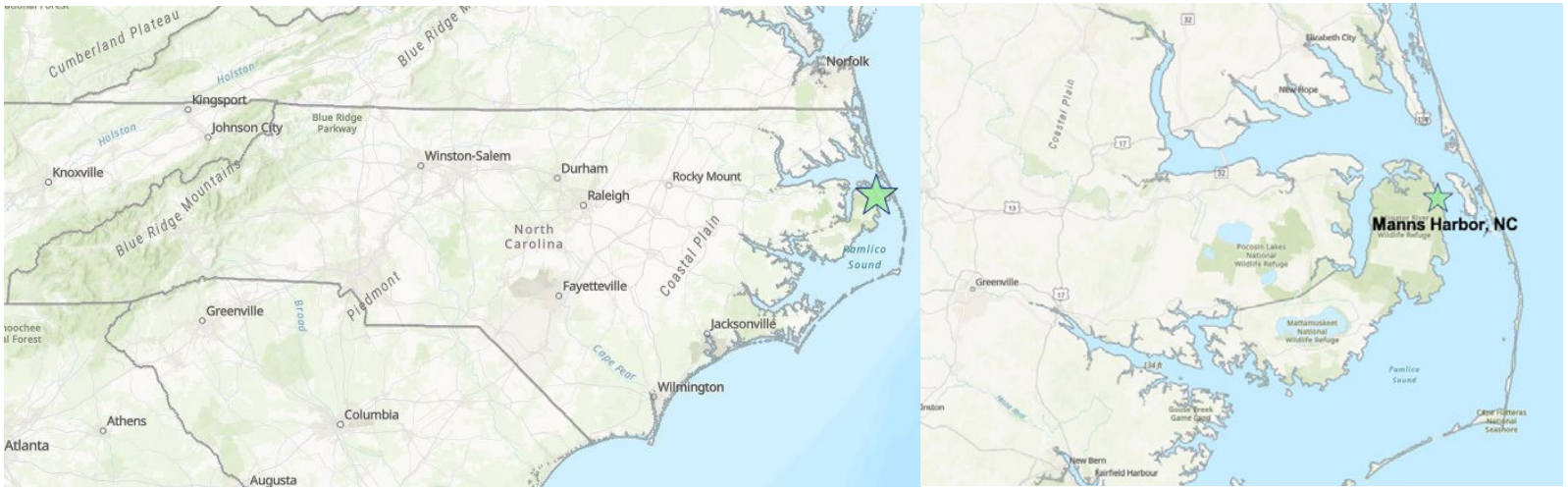


FIGURE 2.1 Geographic Location of Manns Harbor, North Carolina

Buildings and Infrastructure

The Manns Harbor facility includes several physical structures used for maintenance operations. Other buildings on the site house mechanical equipment, utilities, administrative offices, and storage of replacement parts and supplies. Figure 2.2 provides an aerial view of the site and location of the various structures, which are listed in Table 2.1 along with each building's gross square footage.

Vessels enter the maintenance facility via a Syncrolift (Bldg 10), which mechanically lift vessels out of the water. Vessels are then pulled onto a large transfer table using a motorized tug vehicle. This transfer table moves vessels horizontally across the facility via cables and electric wench. Once in the desired position, vessels are towed into work locations using the motorized tug.

FIGURE 2.2 Aerial View of Manns Harbor Maintenance Facility

There are three open-air work platens where vessels reside while undergoing maintenance and repair (Platens 1, 2, and 4). In recent years, plans have been developed for the construction of "Platen 5", which would serve as a fourth permanent work location.

Among the other prominent structures on site is a large paint booth (Bldg 15) where vessels can be removed from the elements and painted. There is also adjacent space to the south of the paint booth (Platen 4) where vessels can be staged prior to painting. While this location is not intended to be a long-term work location, it is routinely used for maintenance which creates logistical challenges for vessels moving in and out of the paint booth.

TABLE 2.1 Buildings at the Manns Harbor NCDOT FD Maintenance Facility

ID	Building No.	Name	SqFt
1	028-017-011	Ferry Marine Maintenance Office	43,972
2	028-017-012	Generator Building	2,528
3	028-017-013	Fire Pump Building	640
4	028-017-026	Oil Water Separator Building	404
5	028-017-040	Well Pump Storage Building	504
6	028-017-043	Maintenance Garage and Tool Storage Building	1152
7	028-017-046	Dyno Building	384
8	028-017-050	Maintenance Garage	2,204
9	028-017-051	Paint Building	836
10	028-017-052	Syncrolift Building	100
11	028-017-053	Marine Warehouse	42,000
12	028-017-054	Marine Security Booth	120
13	028-017-055	Maintenance Tool Room & Observatory	2,400
14	028-017-058	Ferry Headquarters	1,599
15	028-017-059	State Shipyard Paint Booth	31,337

Upon project award, the HDR team had the opportunity for a two-day site visit and operations tour of the Manns Harbor facility with Ferry Division Leadership. During this visit, HDR made the following high-level observations:

PLATENS, PIERS, AND BERTHING INFRASTRUCTURE

- Nothing currently in disrepair
- No known issues besides general capacity constraints related to number of work platens and lack of adequate staffing
- A condition assessment was previously performed on piers and berthing.

OTHER INFRASTRUCTURE

- A condition assessment was previously performed on facility buildings.
- Paint Booth currently appears to be a bottleneck, the result of inadequate staffing of qualified painters.
- HDR could not diagnose the root cause of congestion at the paint booth given other facility capacity constraints.
  - Paint booth may be utilized to make room for more vessels in work platen locations.
  - Vessels in the paint booth may be blocked from exiting by other vessels outside.

MACHINE SHOPS

- Maintenance garages, machine shops, while aging, no clear deficiencies outside typical opportunities for workplace organization and cleanliness ("5S").
- There may be room for improvement in management of critical spares.

EQUIPMENT AND SYSTEMS AVAILABILITY AND RELIABILITY

- No clear deficiencies in equipment availability or reliability causing major disruptions to operations were observed.
- It was noted that some utility systems require renovation to improve reliability. The disruptions of services of these utility systems have caused minor delays of vessel repair and maintenance. A full utility condition assessment should be done to determine scale and scope of the renovations needed.

Ferry Vessel Fleet and Operations

The fleet of vessels serving the North Carolina coast includes 23 ferries (Table 2.2). The age of the current fleet is just over 22 years old, the oldest vessel over 50 years old. Two vessels, the Avon and Salvo, are less than one year old.

Among the 23 ferries in the fleet, 22 are capable of carrying both passengers and vehicles and are classified into three main categories ("classes"): Sound, River, and Hatteras. As described in Figure 2.3, ferry classes vary with respect to functional capabilities, size and carrying capacity. The 23rd vessel, the Ocracoke Express, is a passenger-only ferry which serves the Ocracoke-Hatteras route.

Hatteras Class, the smallest ferries, carry 24 vehicles and 149 passengers and are specifically designed to ply the shallow waters of eastern North Carolina.

River Class ferries range between 129-180 feet in length and carry between 20-38 vehicles and as many as 300 passengers.

Sound Class, the largest ferries, are designed for the turbulent waters of the Pamlico Sound; these ferries can carry as many as 48 vehicles and 300 passengers.

FIGURE 2.3 Three Main Ferry Classes of the Ferry Division Fleet
(Source: NCDOT Ferry Division Long Range Plan 2050)

TABLE 2.2 Current Ferry Fleet Maintained by NCDOT Ferry Division

ID	Official Name	Off. No.	Delivered	Age	Type	Class
1	SILVERLAKE	299744	15-Dec-1968	55	FERRY	SOUND
2	CEDAR ISLAND	1023760	15-Dec-1994	29	FERRY	SOUND
3	CARTERET	928441	20-Jun-1988	35	FERRY	SOUND
4	SWAN QUARTER	1234389	17-Oct-2011	12	FERRY	SOUND
5	SEA LEVEL	1237503	14-Mar-2012	11	FERRY	SOUND
6	GOV DANIEL RUSSELL	978475	30-Apr-1992	31	FERRY	RIVER
7	SOUTHPORT	1043680	21-Nov-1996	27	FERRY	RIVER
8	NEUSE	1051627	10-Apr-1998	25	FERRY	RIVER
9	LUPTON	1090004	26-Mar-2000	23	FERRY	RIVER
10	FORT FISHER	1090005	15-May-2000	23	FERRY	RIVER
11	W STANFORD WHITE	1133333	26-May-2003	20	FERRY	RIVER
12	CROATOAN	1135643	8-Aug-2003	20	FERRY	RIVER
13	HATTERAS	1174277	25-May-2006	17	FERRY	RIVER
14	RODANTHE	1285078	24-May-2019	4	FERRY	RIVER
15	AVON	1333143	TBD	<1	FERRY	RIVER
16	SALVO	1316739	8-Jun-2023	<1	FERRY	RIVER
17	KINNAKEET	944638	5-May-1989	34	FERRY	HATTERAS
18	FRISCO	946908	16-Nov-1989	34	FERRY	HATTERAS
19	CHICAMOCOMICO	949252	28-Feb-1990	33	FERRY	HATTERAS
20	CAPE POINT	949251	28-Feb-1990	33	FERRY	HATTERAS
21	OCRACOKE	964046	9-Nov-1990	33	FERRY	HATTERAS
22	GOV JAMES B HUNT	665747	1-Jun-1984	39	FERRY	HATTERAS
23	OCRACOKE EXPRESS	1281353	28-Oct-2021	2	FERRY	ALUM FERRY

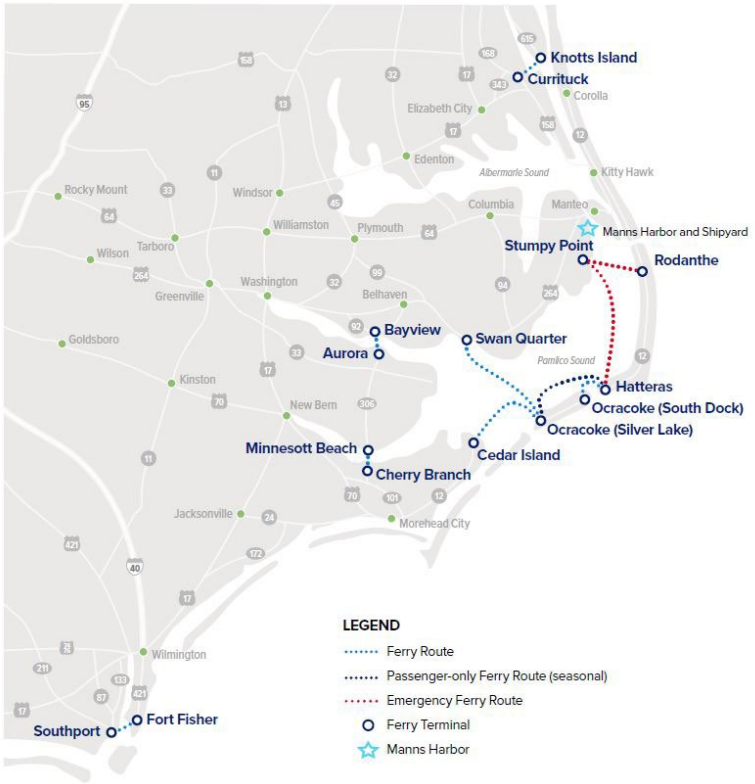
TABLE 2.3 Support Vessels Maintained by NCDOT Ferry Division

ID	Official Name	Off. No.	Delivered	Age	Type	Class
1	MANTEO	1259957	28-Apr-2016	7	DREDGE	14x16
2	OIL BARGE NC 2	515338	15-Dec-1968	55	FUEL BARGE	
3	SKYCO	1214725	23-Sep-2008	15	CRANE BARGE	100T
4	WANCHESE	1304616	2-Feb-2021	2	TUG	SOUND
5	MOREHEAD CITY	1296750	18-Sep-2020	3	TUG	
6	CAPE FEAR	1296755	18-Sep-2020	3	TUG	
7	HOBUCKEN	1296754	18-Sep-2020	3	TUG	
8	MANNS HARBOR	1296753	18-Sep-2020	3	TUG	HARBOR
9	NC-4	1296752	18-Sep-2020	3	DECK BARGE	
10	NC-5	1296751	18-Sep-2020	3	DECK BARGE	

The 23 ferries are supported by 10 other vessels, including 5 tugboats, one dredging vessel, one fuel barge, one crane barge, and two deck barges (Table 2.3).

As depicted in Figure 2.4, the fleet of ferry vessels services seven primary routes on the coast of North Carolina as far north as Knotts Island to as far south as Southport. As of 2017, total ridership was nearly 800,000 vehicles and 1.8 million passengers[1].

FIGURE 2.4 Ferry Service along the North Carolina Coast (*Source: NCDOT Ferry Division Long Range Plan 2050)*



[1]*Source: https://www.ncdot.gov/initiatives-policies/Transportation/nc-2050-plan/Documents/nc-moves-fact-sheet-ferry.pdf*

03

Maintenance Capacity Model

Introduction

In the first major task of this study, HDR set out to develop a mathematical model that estimates the labor hours spent performing maintenance and set up an analysis plan to test the operational impacts of increasing staffing and work platen capacity.

The scope of the model was limited exclusively to ferry vessels (excluding support vessels) which account for a vast majority of current maintenance activity. Particular emphasis was placed on NCDOT Ferry Division (FD) being able to maintain a "Twice-in-Five" planned maintenance and USCG inspection schedule.

The intent during this task was to be as data-driven as possible, leveraging all available data collected by the Ferry Division. As a result, NCDOT can be confident that capacity recommendations reflect the latest data and understanding of the system.

Objectives

The primary objectives of the capacity modeling task were as follows:

1. Develop a baseline model which reflects the most current data and understanding of labor hours expended due to planned maintenance and emergency repairs within a reasonable level of accuracy and confidence
2. Project the demand (labor hours required) for planned maintenance and emergency repairs for the current fleet of 23 ferry vessels over a long-term horizon, ideally up to 50 years
3. Determine through scenario analysis a set of solutions - consisting of the number of work platens, number of staff by discipline and other key decision variables - that will allow NCDOT FD to meet the needs for planned maintenance with minimal schedule delays and high operational success.

Modeling Approach

The modeling approach chosen by HDR fits within a discrete-event simulation (DES) paradigm which is time-tested and very well suited for this type of analysis.

In this paradigm, each vessel is modeled as an individual agent with its own attributes such as age, class, size, and maintenance due date which can vary over time. The maintenance facility is modeled as a set of locational resources (work platen, paint booth, lift, etc.) that are capacity-constrained.

Using a virtual clock, the model progresses calendar time one day at a time. As each new day begins, any vessel that becomes due for maintenance attempts to access the facility to begin its planned maintenance cycle. Vessels that are not yet due for maintenance simply age and continue to wait until their next respective maintenance due date.

The daily clock also triggers the allocation of available capacity for the various physical locations. For example, if two work platens are available, the two vessels which are next in line are chosen for maintenance. A first-come-first-serve policy is assumed. Vessels that are not chosen simply move up in the queue and continue waiting until they are chosen.

If a vessel is chosen to be dry-docked, it is taken out of service and begins a maintenance process based on a defined process flow involving various tasks, locations and staff crews. The vessel progresses through the process flow based on a model-generated number of labor hours required to complete each task. The calendar time required for each task is determined by the level of staffing available, which can vary day-to-day depending on the number of vessels each crew are working on at a time. Once the maintenance process is complete, the vessel returns to service and the next maintenance due date is set.

As the model progresses in time, statistics are collected to measure the amount of time vessels spend waiting for access to a work platen, how long maintenance cycles last, whether the Twice-in-Five policy can be achieved, and more.

Throughout the remainder of this section, HDR provides details regarding model structure, assumptions and input data. Finally, numerical results are provided which inform recommendations for staffing and work platen capacity.

Model Architecture

To find an appropriate mix of staffing and facility capacity (i.e. work platens) needed to respond to the Ferry Division's demand for planned maintenance and emergency repairs, HDR developed a numerical simulation model capable of projecting out maintenance and repair activity over a 50 year period. This model was built upon actual Ferry Division historical data and provides the ability to change a multitude of parameters from staffing to work platen capacity to vessel replacement strategy and report the estimated system performance over the entire time horizon.

The underlying model structure, input data, and assumptions are discussed in detail throughout this section.

Operational Process Flow

A key first step in building a simulation model is to understand the current state operational process flows related to how a vessel moves through the maintenance process during a maintenance or repair event. HDR reviewed and documented these process flows with Ferry Division subject matter experts during a site visit in November 2023.

As depicted in Figure 3.1, planned maintenance process flow begins with dry-docking the vessel and removing its fuel. Once that process is complete, the vessel is cleaned and prepared for US Coast Guard Inspection. Following inspection, the vessel can undergo the bulk of the maintenance activity involving Mechanical, Weld, and Paint crews. It was explained to HDR that there is some ability for these activities to be performed in parallel.

While preparation for painting (high-pressure washing, sand blasting, etc.) is typically performed in a work platen location, the actual process of painting the vessel is performed inside a dedicated Paint Booth building. Following the Paint process, the vessel is lowered back into the water and undergoes a quality control process before officially returning to service.

The mechanism to move each vessel around involves a large transfer table, rail cars, and a large tugging vehicle, which is not explicitly represented in the model as a separate step. As such, time and labor required for vessel movement is assumed to be included within the other defined steps.

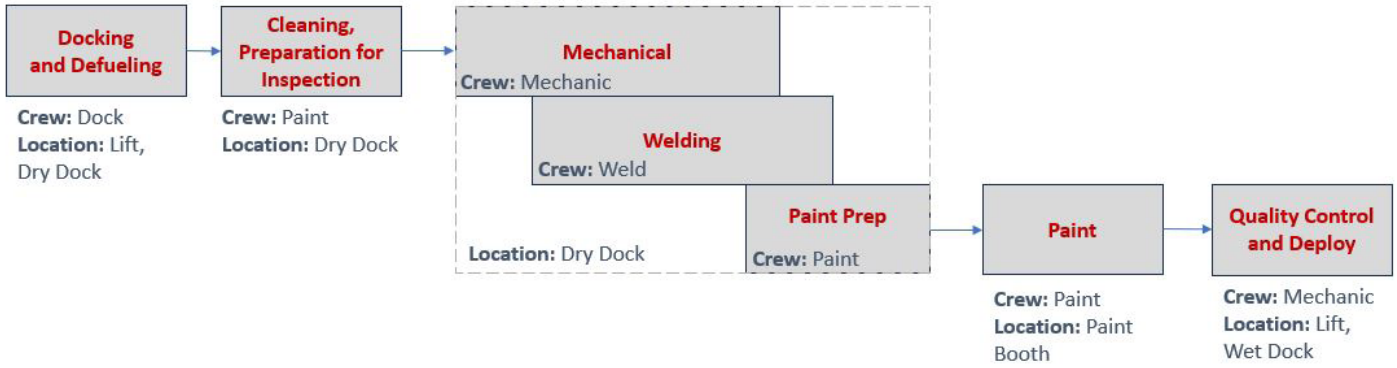


FIGURE 3.1 Planned Maintenance Process Flow

As depicted in Figure 3.2, the "emergency" repair process flow for when a vessel encounters a problem in the field requiring an immediate repair tends to be much simpler and can be summarized through four main processes: Docking, Mechanical, Welding, and Paint. Emergency repairs are often described as either "Grounding" or "Non-Grounding". Historical data suggests that the type of repair, staff disciplines involved, and labor hours required differs for Grounding and Non-Grounding repairs.

The model was limited to emergency repairs that require docking, and doesn't account for emergencies that don't need to be docked or are responded to in the field.

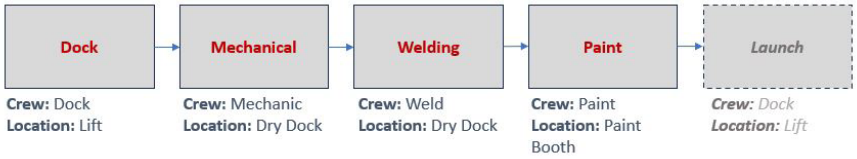


FIGURE 3.2 Emergency Repair Process Flow

Input Data and Model Parameters

Using the operational process flow as a template for how maintenance is performed in the Manns Harbor shipyard, there are many different types of data needed to build a simulation model that can inform future capacity decisions, for example, how long maintenance activities take to complete for all involved trades, how often vessels require maintenance, and others.

The model must be initialized with a fleet of vessels with their respective ages and maintenance schedules. The model also must be initialized with a specified number of staff, work platens, and other high-level assumptions.

In this section, each of the key data inputs and parameters HDR used to develop the capacity model will be described in detail.

Parallel Processing

Corresponding to the planned maintenance process flow described earlier in this section, the model defines parallel processing trigger points during the Mechanical process (triggering the begin of Weld process) and during the Weld process (triggering the beginning of Paint Prep).

- Mechanical Parallel Process Trigger point = 25% completion of activity
- Weld Parallel Process Trigger point = 66.67% (~2/3) completion of activity

Fleet Attributes and Model Initialization

The capacity model will be initialized with the current fleet of 23 ferries and populated with important details such as their age, class, and next maintenance cycle due date and type. Table 3.1 provides the full table used to populate the model.

TABLE 3.1 Vessel Information Used for Model Initialization

Vessel ID	Name	Age (Yrs)	Class	Location	Next maintenance type	Last maintenance date	Next maintenance due (Days) as of 12/1/23*
1	SILVER LAKE	54.9	SOUND	OCRACOKE_CEDAR_ISLAND	3-yr	8/15/2020	777.75
2	CEDAR ISLAND	28.9	SOUND	CEDAR ISLAND_OCRACOKE	3-yr	2/2/2021	829.75
3	CARTERET	35.4	SOUND	OCRACOKE_CEDAR_ISLAND	2-yr	10/18/2021	-43.50
4	SWAN QUARTER	12.1	SOUND	CEDAR ISLAND_OCRACOKE	3-yr	6/30/2022	576.75
5	SEA LEVEL	11.7	SOUND	CEDAR ISLAND_OCRACOKE	3-yr	5/18/2021	43.75
6	GOV DANIEL RUSSELL	31.6	RIVER	BAYVIEW_AURORA	3-yr	2/27/2021	998.75
7	SOUTHPORT	27.0	RIVER	SOUTHPORT_FORT_FISHER	3-yr	6/4/2020	674.75
8	NEUSE	25.6	RIVER	CHERRY_BRANCH	3-yr	1/19/2022	130.75
9	FLOYD J LUPTON	23.7	RIVER	CHERRY_BRANCH	2-yr	9/24/2021	-67.50
10	FORT FISHER	23.5	RIVER	SOUTHPORT_FORT_FISHER	2-yr	5/20/2022	-64.50
11	W STANFORD WHITE	20.5	RIVER	HATTERAS_OCRACOKE	2-yr	2/24/2023	450.50
12	CROATOAN	20.3	RIVER	HATTERAS_OCRACOKE	2-yr	10/4/2022	307.50
13	HATTERAS	17.5	RIVER	HATTERAS_OCRACOKE	2-yr	4/25/2022	145.50
14	RODANTHE	4.5	RIVER	HATTERAS	3-yr	6/10/2022	556.75
15	AVON	0.0	RIVER	CHERRY_BRANCH	3-yr	12/1/2023	1095.75
16	SALVO	0.5	RIVER	CHERRY_BRANCH	3-yr	6/8/2023	919.75
17	KINNAKEET	34.6	HATTERAS	HATTERAS_ OCRACOKE	3-yr	6/4/2021	955.75
18	FRISCO	34.0	HATTERAS	HATTERAS_ OCRACOKE	3-yr	4/11/2021	-143.25
19	CHICAMOCOMICO	33.7	HATTERAS	HATTERAS_ OCRACOKE	3-yr	7/30/2021	-159.25
20	CAPE POINT	33.7	HATTERAS	HATTERAS_ OCRACOKE	2-yr	10/22/2019	338.50
21	OCRACOKE	33.0	HATTERAS	HATTERAS_ OCRACOKE	3-yr	1/8/2020	552.75
22	GOV JAMES B HUNT	39.5	HATTERAS	CURRITUCK_KNOTS_ISLAND	5-yr	12/20/2018	19.25
23	OCRACOKE EXPRESS	2.1	ALUMFERRY	HATTERAS_OCRACOKE	3-yr	10/28/2021	331.75

Negative value denotes past due as of 12/1/2023.

Staffing

To populate the current state model, Ferry Division provided current staffing levels for Mechanical, Paint, Weld, and Dock staff. These staffing parameters are provided in Table 3.2. As of November, 2023, there were several vacant positions among three of the four staffing disciplines.

It was assumed that Manns Harbor shipyard operates one 8-hour shift per day, Monday through Friday for planned maintenance and emergency repairs. Staffing is assumed to stay constant throughout the entire year and over the full model time horizon.

Ferry Division also provided guidance as to how many staff members can work on the same vessel at the same time due to space constraints and other factors such as worker safety. Without such limits, the model would attempt to maximize productivity through excessive and unrealistic staffing levels which would not be attainable in reality. Table 3.3 provides these limits based on size/class of vessel.

TABLE 3.2 Current Permanent Staffing and Vacancies at Manns Harbor, By Discipline

Crew	Current Staffing (Nov 2023)	Vacancies
Mechanical	14	7
Dock	6	0
Welding	13	13
Painting	17	11

TABLE 3.3 Staff Limits per Vessel Undergoing Maintenance/Repair

Activity (Crew)	Small (Hatteras Class)	Medium (River Class)	Large (Sound Class)
Mechanical	4	5	6
Docking and Defueling (Dock)	4	5	6
Welding	12	15	20
Paint Prep	16	20	25
Painting	16	20	25
Quality Control (Mechanics)	3	3	3
Clean and Prep for Inspection (Paint)	4	5	6

Maintenance and Repair Labor Requirements

In order to build a capacity model for vessel maintenance, it was necessary to collect all available real-world data that reflects the labor hours required for maintenance activities. Fortunately, as of December 2023, NCDOT Ferry Division had been collecting this type of data for over eight years for four main trades/crews: Mechanic, Paint, Weld, and Dock.

Planned Maintenance

NCDOT Ferry Division provided HDR with historical data for more than 40 past planned maintenance cycles which typically occur at 2 and 3-year intervals.

Upon inspection of the available maintenance data, it appears that the labor required during routine maintenance of a vessel is related to the age of the vessel, particularly in the case of Mechanical, Weld and Paint labor, as depicted in Figure 3.3.

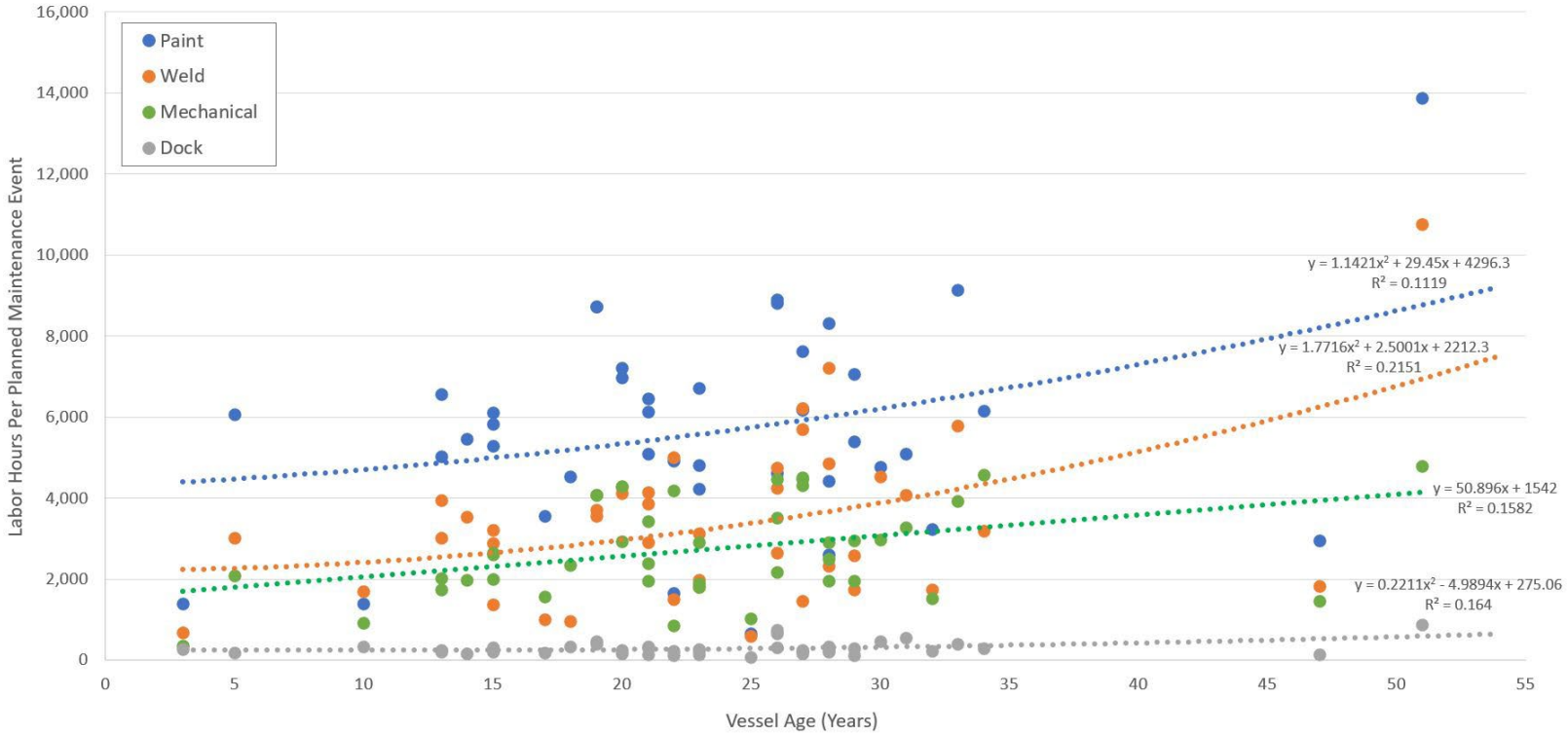


FIGURE 3.3 Historical Planned Maintenance Data - Labor Hours by Vessel Age

From the available historical data, Ferry Division was able to provide HDR with the best-fit relationship between age and maintenance labor requirements, as follows, to be used in the capacity model:

- Total Mechanical Labor Hours = -1.579*(Age^2) + 132.2*(Age) + 636.9
- Total Weld Labor Hours = 1.772*(Age^2) + 2.5*(Age) + 2212.3
- Total Paint Labor Hours = 1.142*(Age^2) + 29.45*(Age) + 4296.3
- **Total Dock Labor Hours = 0.221*(Age^2) - 4.98*(Age) + 275.1**

From these equations, the capacity model was programmed to generate labor requirements for each maintenance cycle and apply a random variation up to 10% from the best-fit equation to account for inherent variability.

Next, it was necessary for FD subject matter experts to provide a realistic distribution of the labor hours associated with some disciplines to align the data with activities in our process template. Specifically, mechanical and painting crews are responsible for multiple activities within the planned maintenance workflow, but the historical data does not track the time split between their responsibilities.

For the mechanical crew, which is responsible for "Mechanical" maintenance and the "Quality Control" task, the total time was distributed, as follows:

- Quality Control Labor = 240-360 hours
- Mechanical Task Labor = Total Mechanical Labor - Quality Control Labor

For the Paint crew, which is responsible for "Clean and Prep for Inspection", "Paint Prep", and "Painting" processes, the total time was distributed based on FD input, as follows:

- Cleaning and Prep For Inspection Labor = 20% of Total Paint Labor
- Paint Prep = 50 % of Total Paint Labor
- Paint = 30% of Total Paint Labor

Emergency Repairs

NCDOT Ferry Division recently started tracking "emergency" events where a vessel encounters damage during operation and must be repaired before being put back in service. In addition to the impact to the public, emergencies also cause significant disruptions to planned maintenance activities.

NCDOT data on emergencies, which classified events as whether or not they are due to running aground (also called "grounding"), allowed HDR to account for emergencies by modeling the frequency of an event (days between occurrence), likelihood of the event being due to running aground, and the labor required to make the repair. The model also applied a random deviation of up to 10% of the average value observed in the data. Tables 3.4 and 3.5 provide the average values used.

Missing data points for vessels which did not have any data for emergencies were populated with a conservative estimate.

TABLE 3.4 Average Labor Requirements for Emergency Repairs

Crew	Labor Hours - Grounding	Labor Hours - Non-Grounding
Mechanical	150	128
Welding	12	77
Painting	84	18
Dock	84	68

TABLE 3.5 Frequency of Emergency Events

Vessel	Frequency (Days)	% Grounding
SILVER LAKE	249	60%
CEDAR ISLAND	1246	0%
CARTERET	312	50%
SWAN QUARTER	208	83%
SEA LEVEL	178	71%
GOV. DANIEL RUSSELL	750	75%
SOUTHPORT	750	75%
NEUSE	750	75%
FLOYD J LUPTON	750	75%
FORT FISHER	750	75%
W. STANFORD WHITE	249	20%
CROATOAN	415	67%
HATTERAS	415	33%
RODANTHE	1246	0%
AVON	750	75%
SALVO	750	75%
KINNAKEET	1246	100%
FRISCO	623	100%
CHICAMOCOMICO	623	50%
CAPE POINT	415	100%
OCRACOKE	750	75%
GOV. JAMES B. HUNT	623	50%
OCRACOKE EXP.RESS	20000	75%

Red text denotes missing data points.

Other Modeling Assumptions and Simplifications

HDR made the following modeling assumptions and modeling simplifications which balance model realism with practical limitations of the project timeline:

1. Staff capacity is spread equally across all vessels undergoing maintenance and repair simultaneously, subject to staff limits per vessel. Therefore, as the number of vessels in the shipyard increases, the duration of the maintenance/repair may increase as the same staff is distributed across more vessels.
2. Once a vessel enters the shipyard it will complete all service before being re-deployed. There is no preempting, postponing, or disrupting the operational flow.
3. Priority for open work platen locations is given to emergency repairs over planned maintenance. In the case that both an emergency repair and planned maintenance need service, the first available work platen will be given to the vessel with the emergency. Emergency repair vessels are also given priority entering the Paint Booth.
4. The number of routes, ferry schedules, and total fleet size is assumed to be constant over the time horizon studied.
5. Newly purchased/deployed vessels are assigned the same route as the vessel being replaced/decommissioned. New vessels will also match the size/class of the vessel being replaced.
6. Delays in the normal operational process flow due to real world factors such as difficulties scheduling inspections, difficulties with the supply chain, and part shortages are not explicitly modeled.

7. The capacity model is built around a "Twice-in-Five" planned maintenance schedule for each vessel which consists of a 3-year planned maintenance event followed by a 2-year planned maintenance event. Time spent undergoing maintenance or emergency repair does not impact the vessel's planned schedule. New replacement vessels begin with a 3-year planned cycle.
8. Specialty repairs and maintenance which may occur at longer than typical maintenance cycles (e.g., every 5 or 10 years) are not explicitly modeled. Typical tasks include engine swaps, generator engine repair, Voith propulsion overhaul, etc. Such tasks are assumed to be accounted for within the labor hour variability of 2 and 3-year maintenance packages. If these activities need to be performed as a "one-off", it is assumed the event is not considered an emergency and can be performed relatively quickly, while not affecting normal maintenance schedule and operations.

Key Performance Indicators (KPIs)

To compare the performance of one model scenario to another, the following KPIs have been defined which address multiple facets of the decision being made from keeping on schedule for planned maintenance to maximizing the time the vessel spends in the field.

Many times, KPIs can conflict with one another (as one KPI increases, another decreases), and so the decision maker must look for solutions that perform well with respect to multiple KPIs but might not perform optimally with respect to any one KPI.

Planned Maintenance Performance

- Number of planned maintenance cycles completed
- Average number of days vessel are waiting for service (when due for maintenance)
- Total number of days vessels are waiting for service (across entire horizon)

Emergency Repair Performance

- Average number of days waiting for service (when needing a repair)
- Total number of days vessels are waiting for service (across entire horizon)

Service Level

- Percent of Time in Service

Labor Utilization

- Average Staff Utilization, by Discipline

Baseline Model

Based on the inputs presented earlier in this Section, HDR developed a computational simulation model using an industry-leading simulation software, AnyLogic. The simulation was designed to project out the maintenance activity of the NCDOT Ferry Division and gather statistics on how the system performs over time based on the number of resources (e.g., staff, work platens) available. AnyLogic also provides an animation window for developers and end users to visually track the location and attributes of "agents" (in this study, ferry vessels) as they change over time (Figure 3.4).

The initial "baseline" model was assigned all of the input parameters presented earlier in the report with respect to process flow, labor requirements, staffing, etc. The objective of this baseline was to paint a picture of what would happen if the status quo (current number of staff, facility size, etc.) is maintained and validate this baseline scenario against actual data collected by Ferry Division. This type of validation is essential before moving on to scenario analysis to ensure the model behaves as excepted and generates reasonable outputs. The baseline also establishes an initial set of results with which to compare other model configurations/scenarios.

The only parameters that were set specifically for the baseline scenario were the number of work platens (3, to match the Manns Harbor shipyard), a vessel replacement strategy of one new vessel every five years, and the ability to outsource one planned maintenance event every six months (which has been done in recent years). To reflect a faster turnaround time for outsourced vessels, it was assumed unlimited labor was available at the outsourcing facility subject to staff limits per vessel.

For the baseline scenario, HDR focused on the following KPIs:

1. Maintenance and repair cycle times (i.e. the calendar time required to perform service on the vessel)
2. Average number of days waiting for service (i.e. emergency repairs and planned maintenance)
3. Labor hours by discipline (total and %) and per vessel

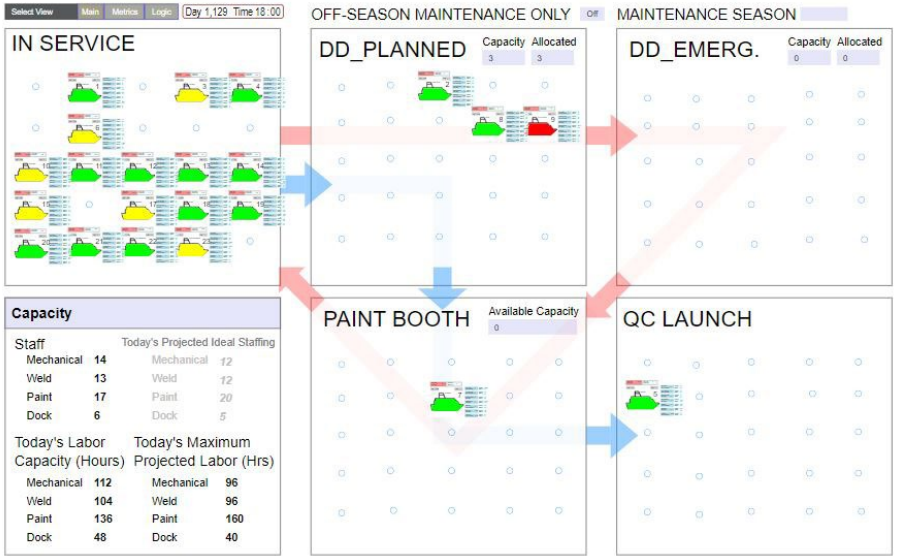


FIGURE 3.4 AnyLogic Simulation Model - Animation Snapshot

Results Validation

The base model used for validation purposes was assigned a 10-year time horizon to allow for a sufficient number of maintenance cycles to occur. While the desired time horizon is longer for a final recommendation, it is expected that past 10 years the system performance deteriorates to a point where KPIs cannot be validated.

Table 3.6 provides a summary of the simulation results and a comparison with actual NCDOT data. The key takeaways from the baseline simulation are as follows:

1. The labor hours consumed by discipline on a percentage basis matches real world data quite well, within about 5% variance across Mechanical, Weld, and Paint disciplines. Dock labor appears to be slightly overestimated in the simulation; However, dock labor accounts for only a small percentage of total labor.

2. Total labor hours per vessel is considerably lower than the actual data. A major contributing factor is having two almost brand new vessels (Avon and Salvo) upon starting the simulation as well as replacing two additional new vessels over the next 10 years. The average is expected to increase over time for the baseline scenario and align closer to the actual data.

3. The baseline simulation results for cycle time appear to be slightly conservative, that is, the simulated vessels spent more calendar time in the shipyard than actual vessels did. Given that the labor hours by discipline are so close between the simulation and actual and the total hours per vessel is low, this could mean that in reality, more of the maintenance activity is completed in parallel than what is reflected in the model's process flow logic.

TABLE 3.6 Baseline Simulation Validation Numerical Results

KPI	Simulated Result	Actual Data	% From Actual
Cycle Time (days)			
Emergency Repair	18.6 (7.0 -> 45.0)	14.7 (1.0 -> 136.0)	+26.5%
Planned Maint.	228.8 (112.0->319.0)	211.9 (81.1->309.1)	+8.0%
Outsourced Maint.	64.6	*insufficent data*	
Wait Time (days)			
Emergency Repair	49.8	*data not available*	
Planned Maint.	428.6	*data not available*	
Total Labor (hours)			
Mechanical	148,099 (23.1%)	22.5%	+2.7%
Weld	183,618 (28.7%)	27.9%	+2.8%
Paint	286,288 (44.7%)	47.1%	-5.1%
Dock	22,085 (3.5%)	2.5%	+40%
Total Labor Per Vessel	10,052.09	12,088.07	-20%

From this set of baseline results, which appear conservative in nature, Ferry Division leadership was comfortable moving forward into scenario analysis with the stated inputs and assumptions.

Maintenance Cycle Visualization

In addition to the AnyLogic animation and numerical results, HDR developed a tool using the Tableau data visualization software showing each vessel's maintenance and repair activity. This tool proved very useful for validation of the model behavior and also visualizing system performance over time.

Figure 3.5 shows the results of the baseline model configuration. Here, multi-colored bars depict maintenance activity with the time waiting to enter the shipyard shown as shaded red bars for planned and dark gray bars for emergencies. Outsourcing activity is shown as bright blue bars.

From this view of the baseline scenario, we can clearly see that the waiting time for planned maintenance is increasing over time. While the results appear to be quite bad at 10 years, they almost certainly would get worse as vessels continue to age. Also, the ability to respond to emergencies appears to be quite bad as the three available work platens are virtually always needed for planned maintenance.

From this view and the numerical results for wait times, it is apparent that more staff, more work platens, or both, are needed to keep up with demand for maintenance over the next 10 years and beyond.

It will be the objective of scenario analysis to determine what level of capacity is needed to have a well-balanced and well-performing maintenance facility over an extended time horizon.

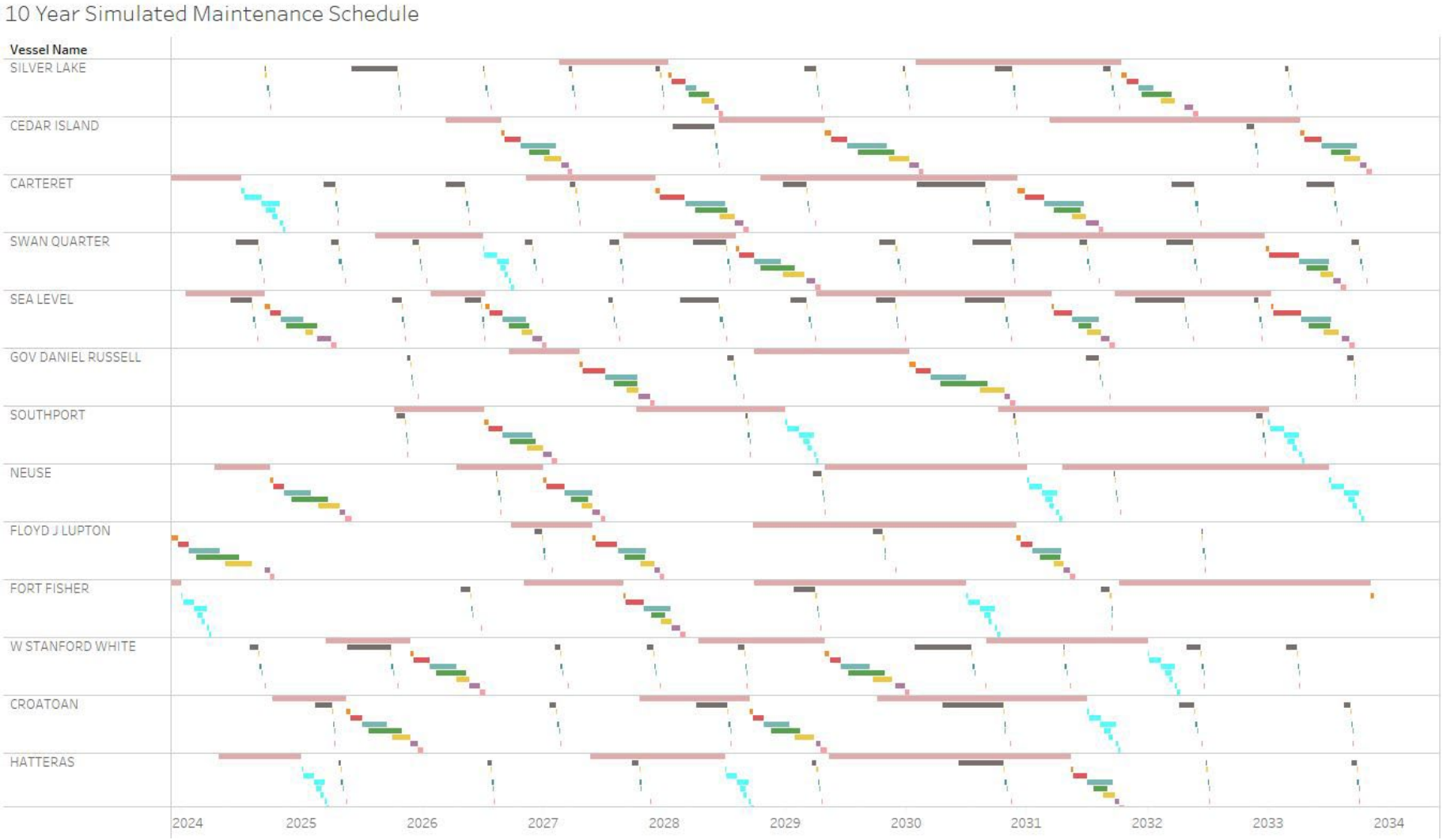
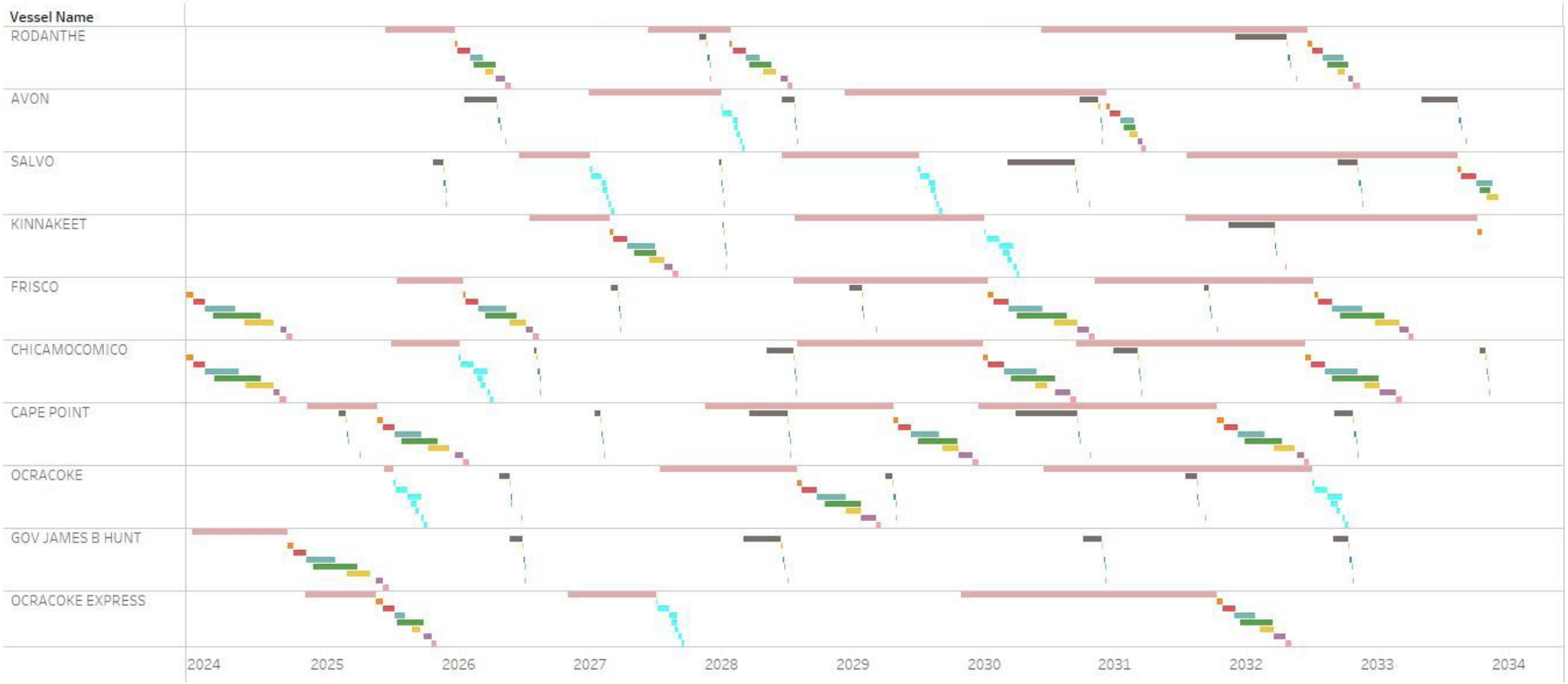


FIGURE 3.5 Maintenance Cycle Visualization for the Baseline, 10-year Scenario

Note: Diagram is model-generated. Does NOT reflect actual NCDOT FD performance or planning.

10 Year Simulated Maintenance Schedule *(Continued)*



Note: Diagram is model-generated. Does NOT reflect actual NCDOT FD performance or planning.

Staffing and Labor Balancing

Another benefit of the baseline scenario was being able to compare the current staff levels by discipline to the projected workload based on maintenance activity. Based on how long vessels wait for maintenance in this baseline scenario, it was suspected that the current staffing level played a large part.

The simulation model was configured to collect the projected daily workload (in hours) for Mechanical, Weld, Paint, and Dock staff and report out the average workload every 30 days. This projected workload is a theoretical maximum, but may not always be achieved based on the staffing level set.

Figures 3.6, 3.7, 3.8,and 3.9 illustrate how the daily workload varies significantly from month to month, with some months having very high workload and others having much lower workload.

Looking at each discipline independently, labor is not balanced in the right areas. While dock and mechanical staffing appears to be more than sufficient even during peak periods, weld and paint crews appear severely understaffed, as depicted by how often the workload curve exceeds available staff. When understaffed, maintenance and repair cycle times are extended and block other vessels from accessing the shipyard.

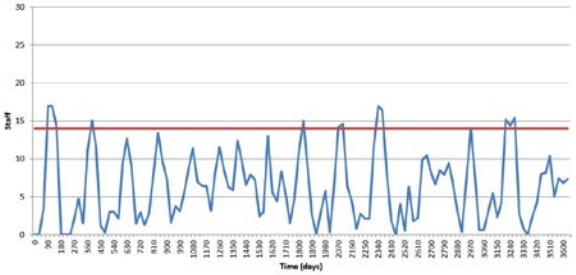


FIGURE 3.6 Baseline Scenario Mechanical Workload and Staffing

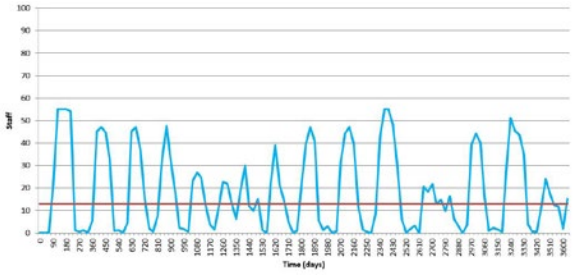


FIGURE 3.7 Baseline Scenario Weld Workload and Staffing

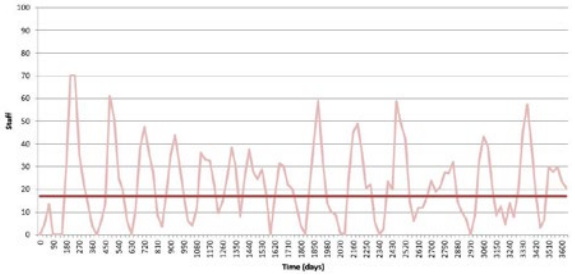


FIGURE 3.8 Baseline Scenario Paint Workload and Staffing

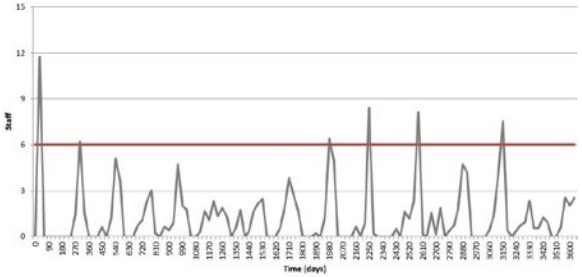


FIGURE 3.9 Baseline Scenario Dock Workload and Staffing

The "optimal" staffing will need to strike a balance between having enough staff to respond to peak periods of workload and maintain throughput while also considering the economics of staff that sit idle during slower periods.

In scenario analysis, staffing levels for each labor discipline will be set independently based on workload and target resource utilization, then adjusted as needed to achieve overall system performance.

It is also important to note there are other work responsibilities of staff outside of planned maintenance and emergency repairs that are not captured by the simulation. Therefore, staffing levels supported by the simulation model should be adjusted to ensure additional staff duties can be completed with the available staff.

Scenario Analysis

With a validated model, HDR set out to determine the recommended level of staffing and work platen infrastructure needed to meet the Ferry Division's operational needs in the future. This would require testing a multitude of model scenarios and evaluating their KPIs.

Unlike the baseline model, scenario analysis focused on determining the required "in-house" capacity such that all planned maintenance and emergency repair could be performed at an NCDOT facility.

Also, additional scenarios were tested over a 50-year horizon. While there is a lot of uncertainty looking out that far, HDR and FD agreed on 50 years in order to capture several planned maintenance cycles for each vessel, allow for the replacement of vessels as they reach a realistic useful life (typically 30 to 40 years), and account for age-related impacts to maintenance labor requirements. In addition, there are less concerns over model performance past 10 years when the set of inputs are designed to create a more sustainable and balanced system over time.

For scenario analysis, a full set of KPIs are analyzed:

1. Average number of days waiting for service, for emergency repairs and planned maintenance
2. Maintenance and repair cycle times (i.e. the calendar time required to perform service on the vessel)
3. Labor hours by discipline
4. **(Added for Scenarios)** Percentage of maintenance events completed
5. **(Added for Scenarios)** Percent of time in service
6. **(Added for Scenarios)** Staff utilization

Analysis 1. Increased Staffing and Work Platens

The first set of scenarios are designed to test the impacts of increasing staff and work platen capacity while holding other baseline assumptions constant. Most notably, these scenarios assumed the same vessel replacement plan used in the baseline of one new vessel every five years.

Results from the baseline model suggested at least one additional work platen is necessary as is additional staff. Therefore, work platen capacity was varied between four and six. Table 3.7 lists the 12 scenarios tested.

TABLE 3.7 Analysis 1 Scenarios Designed to Test Impact of Additional Staffing and Work Platens

Scenario	Total Staff (M, W, P, D)	No. Platens	Staff Per Platen
Scenario 1	104 (19, 36, 43, 6)	4	26.0
Scenario 2	113 (21, 39, 47, 6)	4	28.3
Scenario 3	121 (22, 42, 51, 6)	4	30.3
Scenario 4	131 (24, 45, 55, 7)	4	32.8
Scenario 5	96 (17, 33, 40, 6)	5	19.2
Scenario 6	106 (19, 36, 44, 7)	5	21.2
Scenario 7	116 (21, 40, 48, 7)	5	23.2
Scenario 8	127 (23, 44, 53, 7)	5	25.4
Scenario 9	95 (18, 30, 40, 7)	6	15.8
Scenario 10	107 (20, 35, 45, 7)	6	17.8
Scenario 11	119 (22, 40, 50, 7)	6	19.8
Scenario 12	131 (24, 45, 55, 7)	6	21.8

In terms of staffing, the number of staff for each of the four disciplines were rebalanced based on workload observed in the baseline model so that weld and paint staff were increased to better handle their peak workloads and dock and mechanic staff were reduced to improve their overall utilization.

Numerical results of the tested scenarios are provided in Table 3.8.

Utilization rates varies between 50-55% and 70-75% based on the level of staff within each set of work platen scenarios. Given the high variability in workload, it may be necessary to staff based on high peak workload periods of time at the expense of having staff sit idle during slower periods.

The numerical results clearly show a significant benefit going from four work platens to five in terms of time waiting for a work platen (Figure 3.10) and percentage of maintenance cycles completed (Figure 3.11). The difference between five and six platens is not quite as great. There is some additional improvement but the results also appear to plateau at six work platens.

TABLE 3.8 Numerical Results for Staffing and Work Platen Scenarios

	Waiting Time (days)		Cycle Time (days)		Total Labor (Hours) and Staff Utilization (%)								Maint. Cycles		Service Level		
Scenario	Emerg. Repair	Planned Maint.	Emerg. Repair	Planned Maint.	Mechanical		Weld		Paint		Dock		#	%	% Waiting	% Dry dock	% Operational
Scenario 1	34.7	401.2	15.8	191.7	1.24M	62.4%	2.00M	53.3%	2.78M	61.9%	195K	31.1%	382	86.8%	41.8%	19.7%	39%
Scenario 2	29.3	389.5	15.9	188.1	1.24M	56.7%	2.02M	49.6%	2.80M	57.2%	197K	31.5%	385	87.5%	40.4%	19.5%	40%
Scenario 3	33.3	361.8	15.5	188.0	1.24M	54.2%	2.03M	46.2%	2.82M	52.9%	198K	31.6%	388	88.2%	38.5%	19.6%	42%
Scenario 4	30.7	341.4	15.5	186.2	1.25M	49.9%	2.04M	43.4%	2.84M	49.4%	200K	27.3%	390	88.6%	36.4%	19.5%	44%
Scenario 5	20.2	109.4	16.7	202.9	1.34M	75.4%	2.24M	65.0%	3.08M	73.8%	212K	33.9%	418	95.0%	13.9%	22.6%	64%
Scenario 6	19.3	89.7	16.3	196.0	1.35M	68.1%	2.27M	60.5%	3.14M	68.4%	216K	29.5%	428	97.3%	12.0%	22.3%	66%
Scenario 7	16.0	84.5	15.4	192.9	1.34M	58.6%	2.28M	54.7%	3.14M	62.8%	218K	29.9%	428	97.3%	11.0%	21.9%	67%
Scenario 8	15.8	61.9	15.0	188.5	1.38M	57.4%	2.33M	50.7%	3.19M	57.7%	221K	30.3%	433	98.4%	8.7%	21.6%	70%
Scenario 9	16.3	54.7	16.4	219.3	1.36M	72.2%	2.29M	73.1%	3.15M	75.5%	219K	29.9%	429	97.5%	7.9%	24.7%	67%
Scenario 10	11.2	28.1	15.5	204.1	1.37M	65.9%	2.33M	63.9%	3.20M	68.2%	223K	30.5%	434	98.6%	4.6%	23.3%	72%
Scenario 11	8.8	36.9	14.7	200.1	1.37M	59.6%	2.36M	56.5%	3.22M	61.6%	225K	30.7%	434	98.6%	5.2%	22.8%	72%
Scenario 12	8.3	20.5	14.7	192.8	1.37M	54.7%	2.35M	50.1%	3.22M	56.2%	226K	31.0%	434	98.6%	3.4%	22.1%	75%

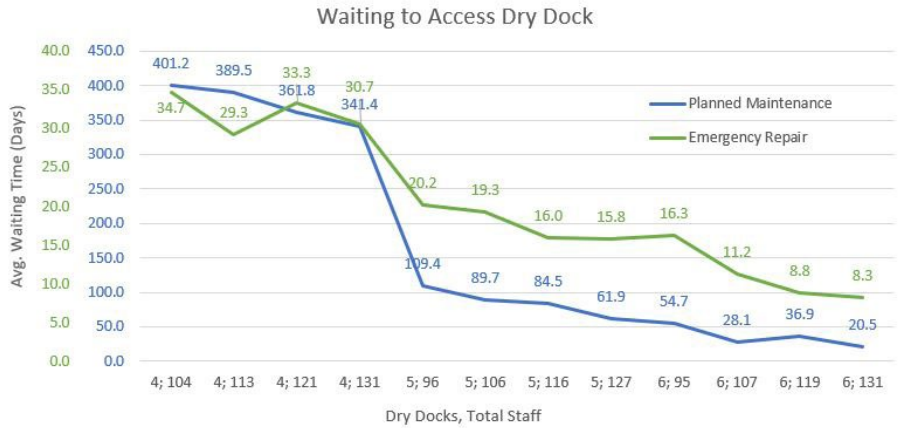


FIGURE 3.10 Analysis 1 Results for Vessel Waiting Time

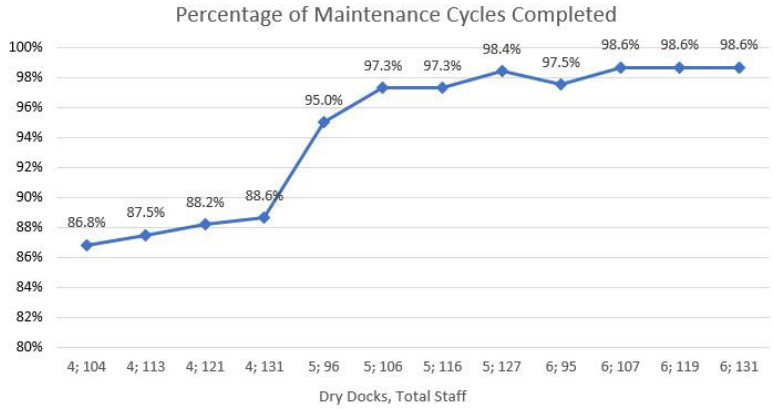


FIGURE 3.11 Analysis 1 Results for Maintenance Cycles Completed

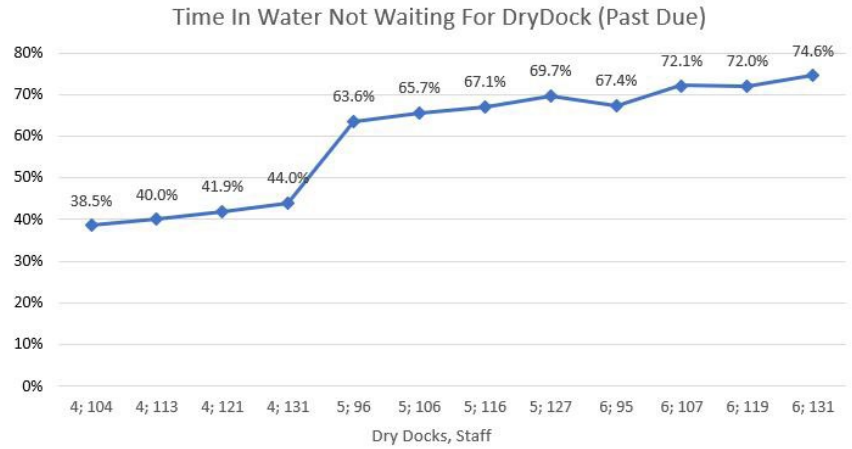


FIGURE 3.12 Analysis 1 Results for Time In Water Not Waiting for a Platen

As expected, performance also improves as staffing increases. It is also interesting that very high staffing for scenarios with four work platens does not perform as well as lower staffing with five work platens. For scenarios with six work platens, the improvements are relatively small going from 107 to 130 staff, with the exception of "time operational" (Figure 3.12) which captures a reduction in maintenance and repair cycle times.

From the results of Analysis 1, six work platens and at least 107 total staff **are recommended for the Ferry Division to meet maintenance needs over the next 50 years, when limited to one new vessel every five years. However, more analysis is necessary to find the optimal level of staffing.**

Analysis 2. Vessel Replacement Strategy

Analysis 1 was instrumental in understanding the impact of increased staff and work platens and narrow down the potential solutions. From the results, it was clear that four work platens would not be sufficient to meet the demand for maintenance over the next 50 years. To maximize performance, six work platens are recommended. In addition, the number of staff required will be more than double the current maintenance staffing at Manns Harbor.

For the baseline model and Analysis 1, only one vessel is replaced every five years. As depicted in Figure 3.13 as the frequency of replacement and total number of vessels replaced increases, the fleet age begins to stabilize. At one vessel every two years, the fleet age appears to flatten out around the current age of just over 22 years old. As the fleet age decreases, labor requirements also decrease.

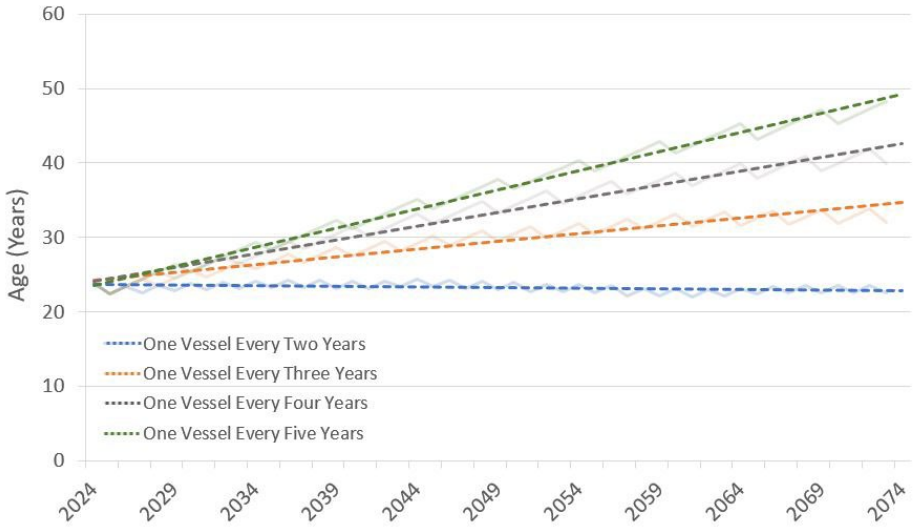


FIGURE 3.13 Average age of the fleet of 23 vessels over a 50-year time horizon for each of the tested vessel replacement plans

In Analysis 2, the focus shifted to understanding the implications and impact of vessel replacement. Therefore, Analysis 2 included nine total scenarios changing the vessel replacement assumption, as shown in Table 3.9. The number of staff and work platens is also varied within each replacement assumption to further focus in on a capacity recommendation.

In Scenarios 1 and 2, it was expected with a stable fleet age that significantly less staff would be required due to fewer labor hours required per vessel and therefore, only five work platens would also be needed. On the other end of the spectrum, Scenarios 8 and 9 were extensions of Analysis 1, assuming six work platens would be optimal while further refining the required staffing.

TABLE 3.9 Set of Scenarios to Test Impact of Vessel Replacement

Scenario	Total Staff (M, W, P, D)	No. Work Platens	Vessel Replacement Plan
Scenario 1	74 (16, 22, 32, 4)	5	1 vessel every 2 years
Scenario 2	82 (18, 24, 35, 5)	5	1 vessel every 2 years
Scenario 3	90 (20, 26,38, 6)	5	1 vessel every 3 years
Scenario 4	102 (20, 33, 42, 7)	5	1 vessel every 3 years
Scenario 5	113 (22, 36, 48, 7)	5	1 vessel every 4 years
Scenario 6	113 (22, 36, 48, 7)	6	1 vessel every 4 years
Scenario 7	107 (22, 33, 45, 7)	6	1 vessel every 4 years
Scenario 8	120 (22, 39, 52, 7)	6	1 vessel every 5 years
Scenario 9	108 (22, 34, 45, 7)	6	1 vessel every 5 years

TABLE 3.10 Numerical Results for Vessel Replacement Scenarios

	Waiting Time (days)		Cycle Time (days)		Total Labor (Hours) and Staff Utilization (%)								Maint. Cycles		Service Level		
Scenario	Emerg. Repair	Planned Maint.	Emerg. Repair	Planned Maint.	Mechanical		Weld		Paint		Dock		#	%	% Waiting	% Dry dock	% Operational
Scenario 1	16.1	39.3	16.7	189.1	1.21M	72.6%	1.54M	67.2%	2.49M	74.6%	162K	38.7%	421	99.1%	6.3%	21.4%	72.4%
Scenario 2	15.6	32.0	15.1	179.7	1.22M	65.0%	1.55M	61.8%	2.51M	68.7%	163K	31.2%	424	99.8%	5.5%	20.4%	74.1%
Scenario 3	16.3	44.5	16.0	191.4	1.33M	63.7%	1.91M	70.4%	2.84M	71.6%	188K	30.1%	431	99.5%	6.9%	21.9%	71.1%
Scenario 4	13.2	31.6	14.9	183.4	1.33M	63.9%	1.92M	55.6%	2.85M	64.9%	188K	25.8%	433	99.9%	5.2%	21.1%	73.7%
Scenario 5	13.8	38.0	15.0	189.4	1.36M	59.2%	2.12M	56.5%	3.01M	60.1%	205K	28.1%	429	98.1%	5.9%	21.5%	72.5%
Scenario 6	7.2	13.3	14.2	196.6	1.37M	59.6%	2.15M	57.2%	3.05M	60.9%	209K	28.6%	434	99.2%	2.4%	22.4%	75.1%
Scenario 7	9.3	16.4	14.6	200.2	1.36M	59.4%	2.14M	62.2%	3.04M	64.8%	208K	28.4%	432	98.7%	3.1%	22.7%	74.2%
Scenario 8	9.3	32.6	15.3	197.7	1.37M	59.7%	2.35M	57.8%	3.22M	59.3%	227K	31.0%	434	98.6%	4.8%	22.7%	72.5%
Scenario 9	11.8	40.6	15.9	206.8	1.36M	59.3%	2.34M	66.0%	3.20M	68.2%	223K	30.5%	433	98.4%	5.9%	23.6%	70.5%

Table 3.10 provides the full set of model results for Analysis 2.

For scenarios with more frequent vessel replacement, maintenance cycle times are reduced as a result of having a younger fleet. Likewise, with fewer vessels replaced, maintenance cycle times are higher. However, as was the case in Analysis 1, the addition of a sixth work platen appears to make up for the increased cycle time by reducing time waiting to get into the shipyard. The sixth work platen also appears to increase the ability to respond to emergencies even when multiple maintenance events are in-progress, as observed in emergency repair waiting time.

In terms of number of maintenance cycles achieved, all scenarios performed very high. The scenarios with more frequent replacement of vessels saw a very slight improvement over scenarios with fewer replacements. There are likely multiple factors accounting for this improvement, most notably that a vessel replacement effectively eliminates the need for one maintenance cycle.

In addition to operational performance, there will be economic implications of each replacement strategy. The strategy needed to maintain a relatively stable fleet age requires one replacement every two years (25 new vessels over 50 years) may prove cost prohibitive. On the other hand, while one vessel every five years may seem attractive from a financial perspective, it also requires maintaining a much older fleet as well as a larger maintenance operation physically.

There were two scenarios tested that balance time spent in the shipyard while also showing low waiting times getting into the shipyard: Scenarios 4 and 6. Scenario 6 assumes only one new vessel every 4 years (12-13 replacements over 50 years). In this scenario, six work platens and 113 total staff are recommended. Scenario 4 also performs well with six work platens and slightly lower staffing (102) but will require four additional new vessels (16-17 total) over the 50-year horizon.

Analysis 3. Impact of Emergency Repairs

The third and final analysis performed in this study evaluated the concept of a work platen reserved for emergency repairs only.

Here, the same scenarios from Analysis 2 were simulated but one work platen was allocated for emergency use only, as shown in Table 3.11. By replicating the same scenarios from Analysis 2, results for all vessel replacement plans could be analyzed.

In terms of model behavior, this policy meant that all but one work platen could be allocated to vessels requiring planned maintenance. The multiple work platens not reserved for emergency repair could still be allocated to emergencies which still had priority over planned maintenance. However, with one work platen dedicated to emergency, it is expected the other work platens will be used more exclusively for planned maintenance and situations where a vessel with an emergency must wait multiple days before beginning repair, for example, waiting for a planned maintenance event to complete, will be minimized.

Table 3.12 provides the numerical results of Analysis 3 and a summary comparison between Analyses 2 and 3 provided in Table 3.13, averaging across all vessel replacement plans.

TABLE 3.11 Set of Scenarios to Test Impact of Dedicated Emergency Platen

Scenario	Total Staff (M, W, P, D)	Total Work Platens	General Platens	Emergency Platens	Vessel Replacement Plan
Scenario 1b	74 (16, 22, 32, 4)	5	4	1	1 vessel every 2 years
Scenario 2b	82 (18, 24, 35, 5)	5	4	1	1 vessel every 2 years
Scenario 3b	90 (20, 26,38, 6)	5	4	1	1 vessel every 3 years
Scenario 4b	102 (20, 33, 42, 7)	5	4	1	1 vessel every 3 years
Scenario 5b	113 (22, 36, 48, 7)	5	4	1	1 vessel every 4 years
Scenario 6b	113 (22, 36, 48, 7)	6	5	1	1 vessel every 4 years
Scenario 7b	107 (22, 33, 45, 7)	6	5	1	1 vessel every 4 years
Scenario 8b	120 (22, 39, 52, 7)	6	5	1	1 vessel every 5 years
Scenario 9b	108 (22, 34, 45, 7)	6	5	1	1 vessel every 5 years

There is significant improvement in performance for the Emergency Platen scenarios, most notably for waiting time for vessels requiring emergency repair (average waiting time reduction of 80%). This translates also into a slight increase in "Time Operational". Interestingly, we also see modest cycle time reduction for both emergency repair and planned maintenance under the Emergency Platen scenario.

The only KPI that appears to be impacted is average waiting time for vessels requiring planned maintenance. However, the impact is not severe enough to compromise the number of maintenance cycles completed.

From these results, we would recommend that the Ferry Division consider reserving one work platen for emergency repairs only. This recommendation is contingent, however, on having at least five total work platens available due to the poor performance of scenarios tested with only four work platens.

TABLE 3.12 Comparison of Scenario Results for Analyses 2 and 3

	Waiting Time (days)		Cycle Time (days)		Total Labor (Hours) and Staff Utilization (%)								Maint. Cycles		Service Level		
Scenario	Emerg. Repair	Planned Maint.	Emerg. Repair	Planned Maint.	Mechanical		Weld		Paint		Dock		#	%	% Waiting	% Dry dock	% Operational
Scenario 1	16.1	39.3	16.7	189.1	1.21M	72.6%	1.54M	67.2%	2.49M	74.6%	162K	38.7%	421	99.1%	6.3%	21.4%	72.4%
Scenario 1b	3.1	53.4	15.4	181.0	1.22M	73.4%	1.55M	67.5%	2.5M	74.9%	164K	39.4%	422	99.3%	5.9%	20.5%	73.6%
Scenario 2	15.6	32.0	15.1	179.7	1.22M	65.0%	1.55M	61.8%	2.51M	68.7%	163K	31.2%	424	99.8%	5.5%	20.4%	74.1%
Scenario 2b	2.4	44.4	14.0	170.8	1.23M	65.3%	1.56M	62.3%	2.51M	68.8%	166K	31.8%	424	99.8%	4.9%	19.4%	75.7%
Scenario 3	16.3	44.5	16.0	191.4	1.33M	63.7%	1.91M	70.4%	2.84M	71.6%	188K	30.1%	431	99.5%	6.9%	21.9%	71.1%
Scenario 3b	3.0	63.6	14.4	183.3	1.33M	63.9%	1.91M	70.4%	2.84M	71.6%	190K	30.3%	429	99.0%	7.0%	20.9%	72.1%
Scenario 4	13.2	31.6	14.9	183.4	1.33M	63.9%	1.92M	55.6%	2.85M	64.9%	188K	25.8%	433	99.9%	5.2%	21.1%	73.7%
Scenario 4b	2.1	43.8	13.7	176.8	1.33M	64.0%	1.91M	55.4%	2.84M	64.9%	191K	26.1%	432	99.7%	4.8%	20.3%	74.9%
Scenario 5	13.8	38.0	15.0	189.4	1.36M	59.2%	2.12M	56.5%	3.01M	60.1%	205K	28.1%	429	98.1%	5.9%	21.5%	72.5%
Scenario 5b	2.4	69.3	13.8	181.7	1.36M	59.1%	2.13M	56.7%	3.01M	60.0%	206K	28.2%	428	97.8%	7.5%	20.6%	71.9%
Scenario 6	7.2	13.3	14.2	196.6	1.37M	59.6%	2.15M	57.2%	3.05M	60.9%	209K	28.6%	434	99.2%	2.4%	22.4%	75.1%
Scenario 6b	1.8	21.7	14.1	191.2	1.37M	59.7%	2.15M	57.1%	3.05M	60.9%	209K	28.6%	432	98.7%	2.5%	21.8%	75.7%
Scenario 7	9.3	16.4	14.6	200.2	1.36M	59.4%	2.14M	62.2%	3.04M	64.8%	208K	28.4%	432	98.7%	3.1%	22.7%	74.2%
Scenario 7b	1.5	24.9	14.1	194.5	1.36M	59.4%	2.14M	62.3%	3.04M	64.8%	208K	28.5%	432	98.7%	2.8%	22.1%	75.0%
Scenario 8	9.3	32.6	15.3	197.7	1.37M	59.7%	2.35M	57.8%	3.22M	59.3%	227K	31.0%	434	98.6%	4.8%	22.7%	72.5%
Scenario 8b	2.4	35.9	14.2	192.5	1.38M	60.0%	2.34M	57.5%	3.21M	59.2%	226K	30.9%	435	98.9%	4.1%	22.1%	73.8%
Scenario 9	11.8	40.6	15.9	206.8	1.36M	59.3%	2.34M	66.0%	3.20M	68.2%	223K	30.5%	433	98.4%	5.9%	23.6%	70.5%
Scenario 9b	2.3	41.0	15.1	200.1	1.36M	59.4%	2.34M	67.9%	3.21M	73.2%	225K	30.8%	433	98.4%	4.6%	22.9%	72.5%

TABLE 3.13 Impact of Dedicated Emergency Platen on KPIs

Waiting Time		Cycle Time		Maint. Cycles Completed		Service Level		
Emerg. Repair	Planned Maint.	Emerg. Repair	Planned Maint.	#	%	Waiting	Dry dock	Operational
-81%	40%	-6%	-4%	0%	0%	-4%	-4%	1.4%

Recommendations and Conclusions

In this section, HDR presented a detailed summary of the capacity model used to project the Ferry Division's maintenance activity over a 50-year time horizon. Scenario analysis was then conducted to find effective combinations of staffing and work platen capacity which meet the projected demand while ensuring a high level of operational success.

Upon review of these findings, **HDR recommends a total staff of approximately 113 across four key maintenance disciplines and 6 total work platens, one designated specifically for emergency repairs.** This recommendation assumes a vessel replacement plan of **one vessel every four years (a total of 12 new vessels)** over the full time horizon. This capacity recommendation provides a benchmark for further analysis of alternate site locations and labor availability.

From scenario analysis, it was determined that high operational performance can be achieved regardless of vessel replacement plan chosen. However, for scenarios with only 10-12 total replacements (one vessel replaced every 4-5 years), additional staff and work platens are necessary to compensate for the increased labor associated with maintaining older vessels. Additional guidance on vessel replacement strategy can be found in a study being completed concurrent with this maintenance capacity study.

Through another set of scenarios, it was also shown that there is benefit to reserving one work platen strictly for emergencies. The benefit of being able to respond quickly to emergencies seems to outweigh the impact to planned maintenance and maximizes the time ferries are operational and serving the public.

Figure 3.14 illustrates the model scenario associated with the recommended capacity and highlights how a Twice-in-Five schedule can be achieved with minimal delay over the next 50 years when there is sufficient staffing and work platen capacity.

There are opportunities to enhance and extend the model to account for other variables. For example, the model can be expanded to represent how vessels work their respective routes and how taking vessels out of the water for maintenance affects which vessels serve which routes. The model could also be leveraged to generate long-range maintenance schedules for the Ferry Division. Finally, HDR recommends updating the model as more maintenance data becomes available to project changes in capacity requirements.

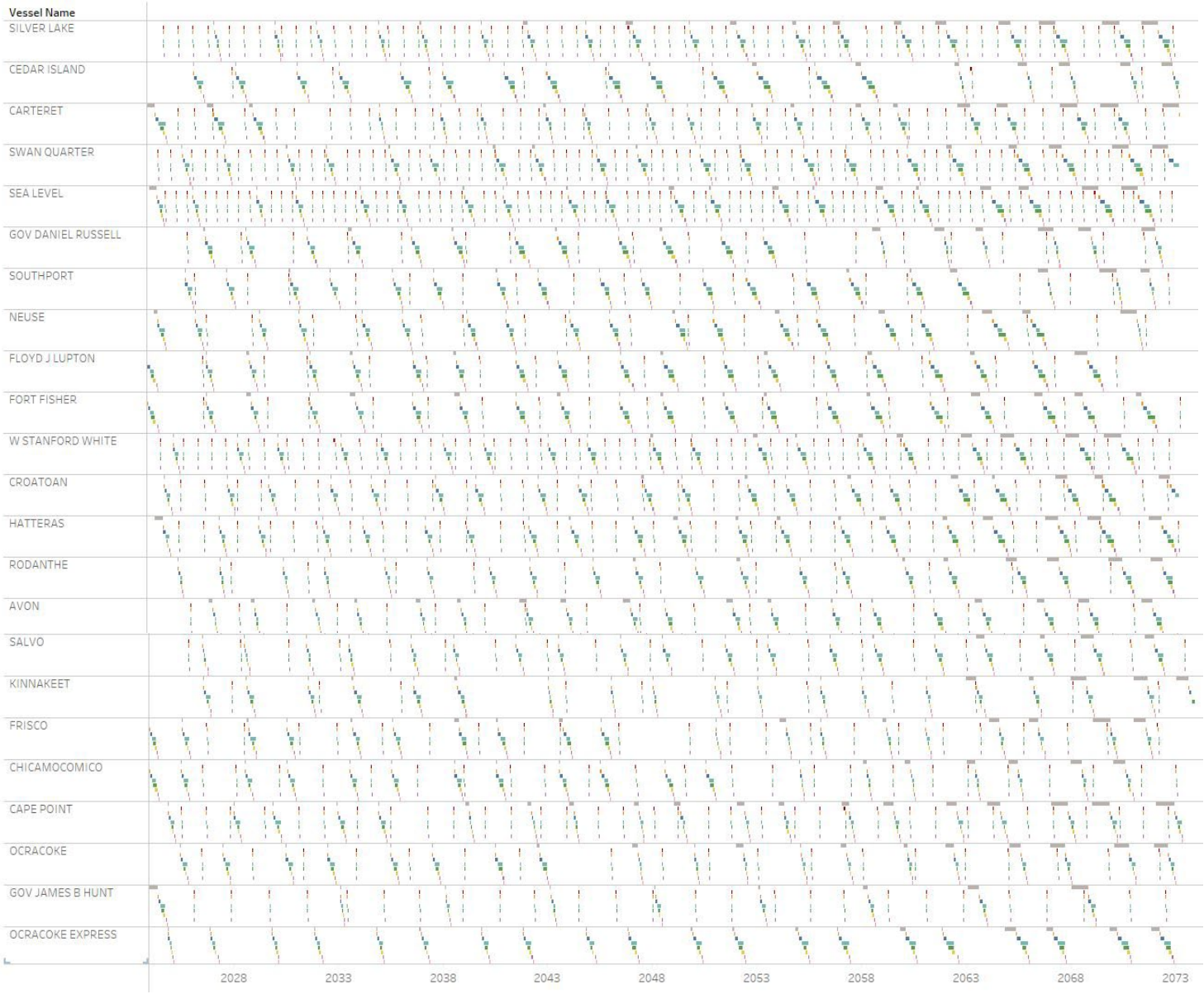


FIGURE 3.14 Maintenance Cycle Visualization for the Recommended Capacity Scenario

Other Considerations

Staff Utilization and Other Duties Besides Maintenance Work Orders

While 80% utilization is often seen in other industries, rates of 50 to 60% were observed In the scenarios tested. Lower average utilization may be appropriate in this maintenance setting to respond better to peak demand periods and unpredictable surges in demand.

Lower average utilization related to maintenance would also mean more time will be available for additional duties during low periods of demand. Maintenance personnel are responsible for a variety of other tasks, such as:

- Prep work
- Overhauls/rebuilds of vessel components
- Maintain/clean/repair their tools and equipment
- Cleaning and organizing workspace
- Unplanned runs to local stores for supplies
- Maintain the storm water management systems
- Maintaining the Syncrolift, transfer table, and rail cars
- Vehicle maintenance for Club Cars, man lifts, cranes and forklifts
- Severe weather preparations
- Off-site emergency repairs

Ferry Division leadership indicated that the level of utilization observed during modeling would leave sufficient time to accommodate these other work responsibilities without requiring additional staff.

Off-Peak-Season Maintenance

The model presented, which is based on current state operations, assumed year-round maintenance. A strategy where all planned maintenance occurs outside of peak season, from around Memorial Day through Labor Day, will require additional staffing and work platens above what was recommended. Other strategies which may provide for the ability to reduce maintenance during the peak tourism season include outsourcing or increasing the frequency of vessel replacement as a way of reducing maintenance associated with aging vessels.

Shift Schedule

One of the important assumptions made up front is that staff will follow a 8-hour shift Monday through Friday. If significantly more staff become available, it may be possible to move to a 12-hour shift or even two-shift operation. This might have the potential to reduce the number of work platens needed. The capacity model developed could be used to test alternate shift schedules.

Construction Limitations

Given typical design and construction timelines, it is not realistic to expect additional work platens will be available immediately. Model performance in the near term (within 5 years) suggests there might be time to ramp up operations before the effects of an aging fleet become more pronounced, especially if outsourcing maintenance to other shipyards continues to be a viable option.

Maintenance Labor Requirements

Age was the primary factor used to generate labor hours for each planned maintenance event primarily because age is easy to track and because historical data suggests that labor does increase with vessel age. However, there remains a lot to be learned about other factors that impact the maintenance requirements of vessels.

Vessel Replacement

Ultimately, given funding limitations, Ferry Division leadership felt most comfortable assuming one vessel could be replaced every four years. As depicted earlier in this Section, any replacement plan less frequent than one new vessel every two years on average will result in the fleet as a whole getting older over time. The consequences of an aging fleet were felt in terms of projecting staffing and work platen needs.

It may be possible through investment in process improvement and analytics to better understand and improve maintenance practices, reduce the deterioration of vessels over time, and even reduce the need to replace vessels. As a result, by improving maintenance processes, vessel replacement could become less influential on the staffing and infrastructure needs of the facility.

04

Site Options and Cost Estimation

Introduction

Following capacity analysis, which identified the need for additional work platen work locations for vessel maintenance and repair not currently available at Manns Harbor, the site assessment task was completed to identify expansion and/or development opportunities at properties owned by the State of North Carolina.

The expansion of Manns Harbor was first identified as a viable candidate to meet the projected demand for maintenance. The construction of "Platen 5" would accommodate one additional long-term maintenance work position, resulting in a total of four "work platens". HDR also investigated the potential for a full expansion of Manns Harbor to achieve a total of six maintenance work positions.

As part of this assessment, alternative locations for expansion or development were identified from NCDOT's repository of state-owned properties. Figure 4.1 shows the general regions which were considered.

Unfortunately, no viable options were identified on the Albemarle Sound. Similarly, there were no viable options on the Pamlico Sound or further up the Pamlico River due in large part to site conditions. However, there were sites available further south, first on the Neuse River and second in Wilmington, NC.

Ultimately, two sites were selected for conceptual development: an existing ferry terminal site at Cherry Branch and a state-owned property near downtown Wilmington, NC, and the Port of Wilmington.

Another possibility for a new shipyard location near New Bern was discussed but not detailed in this study. The New Bern area brings additional advantages from a labor pool, cost of living and proximity to technical trade schools, as well as ferry routes, that should be considered if full shipyard replacement is pursued in the future.

Finally, additional analysis was done to define the criteria by which another site might be purchased for a new replacement shipyard. The cost of this option is assumed to be the cost of the Wilmington option plus the cost acquisition of the property.

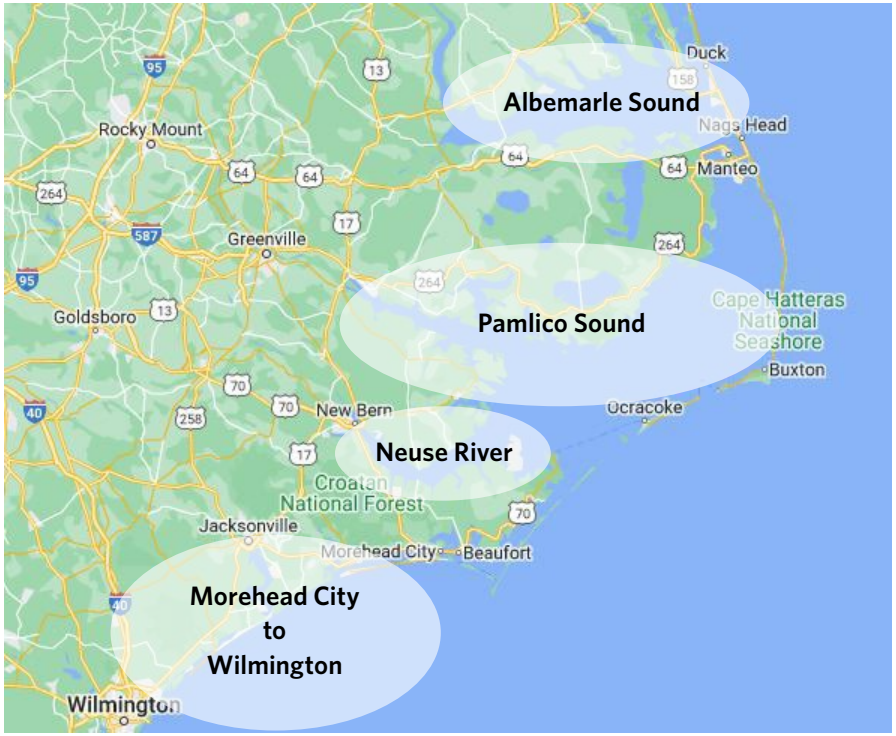


FIGURE 4.1 Key Areas of North Carolina Explored for Alternate Sites

Site Options

Following the exploration of state-owned properties, the following major site options were analyzed as potentially viable alternatives to achieve full capacity:

OPTION 1: Manns Harbor expansion to six (6) platens/work platens

OPTION 1B: Manns Harbor partial expansion to four (4) platens/work platens per design specifications of "Platen 5".

OPTION 2: Cherry Branch expansion to add two (2) platens/work platens, paint building, Syncrolift, and support buildings supplemented by "Platen 5" partial expansion of Manns Harbor (OPTION 1B)

OPTION 3: New, full replacement shipyard at Wilmington, NC, based on full expansion of Manns Harbor shipyard (OPTION 1)

Basis of Site Assessment

Preliminary site assessments were completed for each site considering physical features, site vehicular access, limitations to development, availability of utilities, site zoning and surrounding property use, and anticipated site development permits. These assessments were completed using available publicly assessable information only including online mapping and zoning codes.

Other Key Assumptions

Due to the nature of the analysis and study limitations, the following assumptions were made to conceptualize potential shipyard expansion possibilities:

1. Manns Harbor full site expansion for six (6) work platens is possible without consideration of wetlands impact or permitting regulations for the site and area.
2. Cherry Branch has no development regulations that would restrict the additional facilities, operations, and personal proposed for the site.
3. The Wilmington site does not have other development plans and can be used by Ferry Division for a replacement shipyard.
4. Site surveys of site locations have not been prepared and the information herein does not constitute a detailed design assessment.
5. A detailed cost analysis of site options will not be possible until a site is selected where acquisition cost, wetlands, dredging, and site conditions could be known and site access roads, facilities and other costs could be determined.

Site Options 1 & 1B:
Expansion of Existing Maintenance Facility at Manns Harbor

The first alternative identified to achieve full operational capacity involves expansion of the current maintenance facility at Manns Harbor (Figure 4.2). This facility benefits from an experienced labor pool, close proximity to ferry routes, and full complement of facilities, equipment, and utilities required to perform vessel maintenance.

Partial expansion would involve the construction of "Platen 5". It is assumed partial expansion would be used as part of a split facility strategy with the remainder of capacity fulfilled at another site.

Proposed full expansion of the site includes the construction of two (2) additional work platens (in addition to "Platen 5") and expansion of the existing transfer table to support all new work platens.

Zoning and Property Use

The existing ferry maintenance facility in Manns Harbor, North Carolina, is zoned MH-A per the Dare County Zoning Ordinance. Within MH-A zoning, all existing uses are "grandfathered" in perpetuity.

The site is bordered by residential properties to the north. To the south and west are private vacant land.

Site Conditions

The site topography is generally flat with marshland on the south side of the site. The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) identifies the following soil types on site:

FIGURE 4.2 Aerial View of Manns Harbor Maintenance Facility

Hobonny muck (HoA), Psannebts (PsB), Baymeade fine sand (BaC), Currituck mucky peat (CuA), and Leon fine sand (LEA). In the area of proposed facility expansion, the US Fish and Wildlife Service identifies the following wetlands: estuarine and marine wetland, freshwater emergent wetland, and freshwater forested /shrub wetland.

Construction of the additional work platens will require reconstruction of the existing berm dividing the site from marshland on the southeast corner.

Site Access

The site can be accessed from the existing driveway to the north off Shipyard Rd.

Utilities

The current site has access to water, electric, gas, and sewer; and the existing utilities can be extended as necessary for development.

Site Development Permits

A Floodplain Development Permit is required for any development activities in any AE, AO, VE, Shaded X or X Flood Zone. This site expansion will infringe on Zone X and Zone AE flood hazard areas, based on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs), requiring a Floodplain Development Permit.

Additionally, development in wetlands in North Carolina requires a permit from either the U.S. Army Corps of Engineers or the N.C. Division of Coastal Management. The site is not located in a Phase II stormwater area and is, therefore, subject to the state Coastal State SW Permitting Program. All disturbance of over 1 acre in North Carolina requires an NCDEQ Erosion Control Permit.

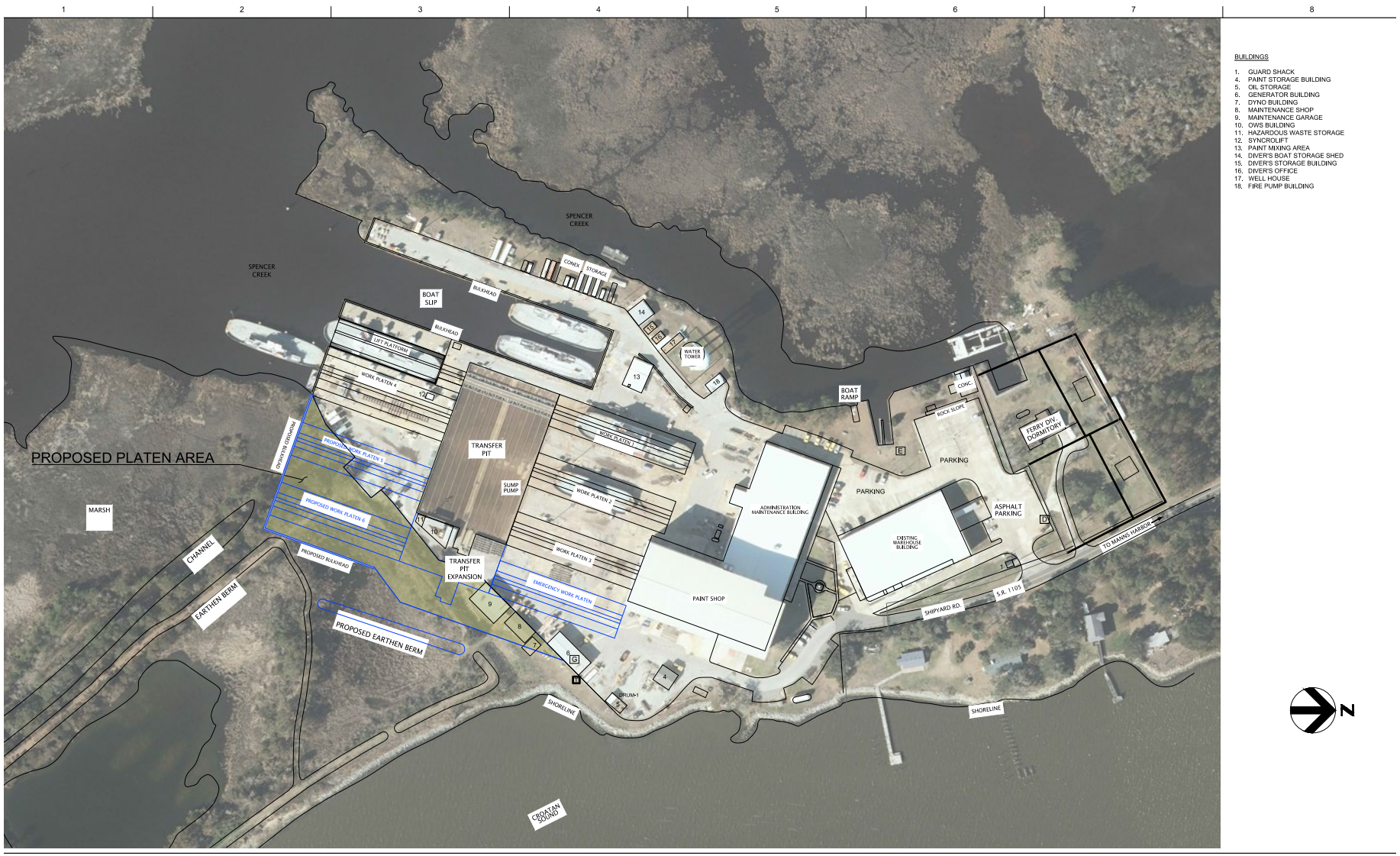
Option 1 (Full Expansion) Design Concept

As depicted in Figure 4.3, the Option 1 Concept would add three platens, extend the transfer pit/table, expand into the wetlands, build an earthen berm, and relocate several maintenance shops/space on the east side of the site. This option would allow for 5 planned maintenance work platen, 1 emergency work platen, and use of the platen that is in front of the Paint Booth for staging into and out of the Paint Booth only.

This expansion would also create more logistics challenges and crowding on the site. With the additional personnel required for this complete build-out may require additional parking and/or support space (break rooms, admin space, or restrooms) to accommodate the staff. It is assumed that sufficient utilities are available to support this expansion and encroachment into the wetlands south east of the site is allowed.

Option 1B (Partial Expansion) Design Concept

As depicted in Figure 4.4, the Option 1B concept includes the construction of the Platen #5 project as designed/completed in 2018. This option would also require development of another site to meet the complete work platen capacity recommendations.



ISSUE	DATE	DESCRIPTION
	1/11/2024	SCHEMATIC DESIGN

PROJECT MANAGER XXX X. XXXXXX
PROJECT NUMBER 10386767

NCDOT FERRY DIVISION

MANNS HARBOR SITE
SCHEMATIC DESIGN
OPTION 1

0 1" 2"
FILENAME
SCALE 1" = 80'
SHEET

FIGURE 4.3 Conceptual Expansion of Manns Harbor Maintenance Facility

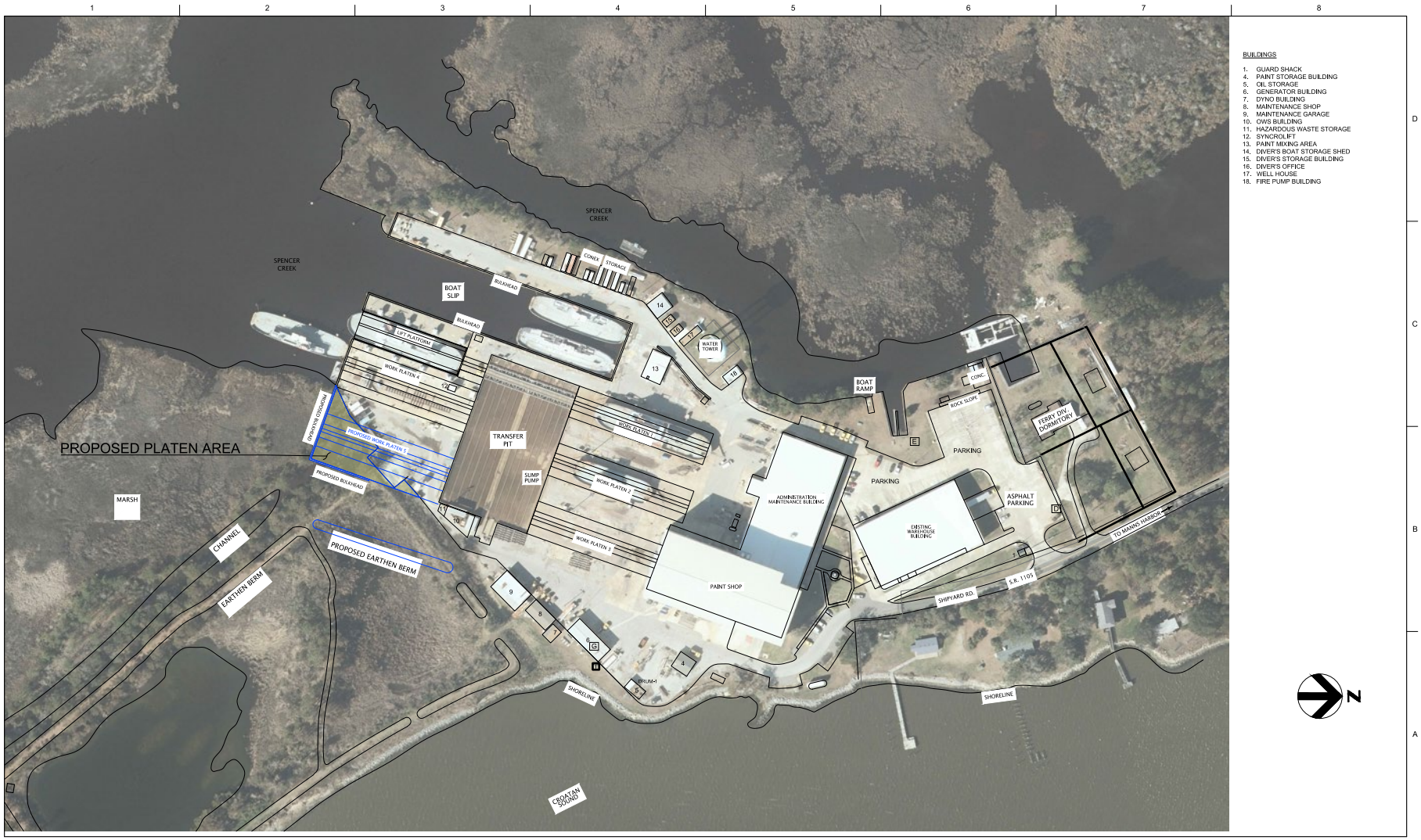


FIGURE 4.4 Conceptual Partial Expansion of Manns Harbor Maintenance Facility

Site Option 2:
Cherry Branch, North Carolina

A potential site for expansion of Ferry Division operations away from Manns Harbor, "Cherry Branch" is located on a 45-acre parcel at 2300 Ferry Road, Havelock, NC 28532. This location sits well south of Manns Harbor on the Neuse River, as shown in Figure 4.5. Proposed development of the site, which includes a working ferry terminal facility, involves the construction of two (2) work platens, Syncrolift, transfer table, maintenance garage, warehouse/ machine shop, and a paint building for Ferry Division maintenance.

Zoning and Property Use

A portion of the site is being used as a NCDOT ferry terminal for the Cherry Branch-Minnesott Beach Ferry. The property is surrounded by residential properties to the east, south, and west. No Craven County zoning overlays apply to this property.

Site Conditions

The site topography is generally flat. The USDA NRCS identifies the following soil types on site: Bragg soil (BrB), Masontown mucky fine sandy loam and Muckalee sandy loan (MM), Norfolk loamy fine sand 0 to 2 percent slopes (NoA), and Norfolk loamy fine sand 2 to 6 percent slopes. On the property, the US Fish and Wildlife Service has identified freshwater emergent wetland and freshwater forested/shrub wetlands. However, the currently proposed facility layout is not anticipated to disturb these wetlands.

An existing spoil pit on site will need to be relocated to allow for development.

Site Access

The site can be accessed from an extension of the existing driveway from Ferry Road. The current site has access to water, electric, and sewer; and the existing utilities can be extended as necessary for development. Construction of a Syncrolift will require modifications to the existing sea wall.

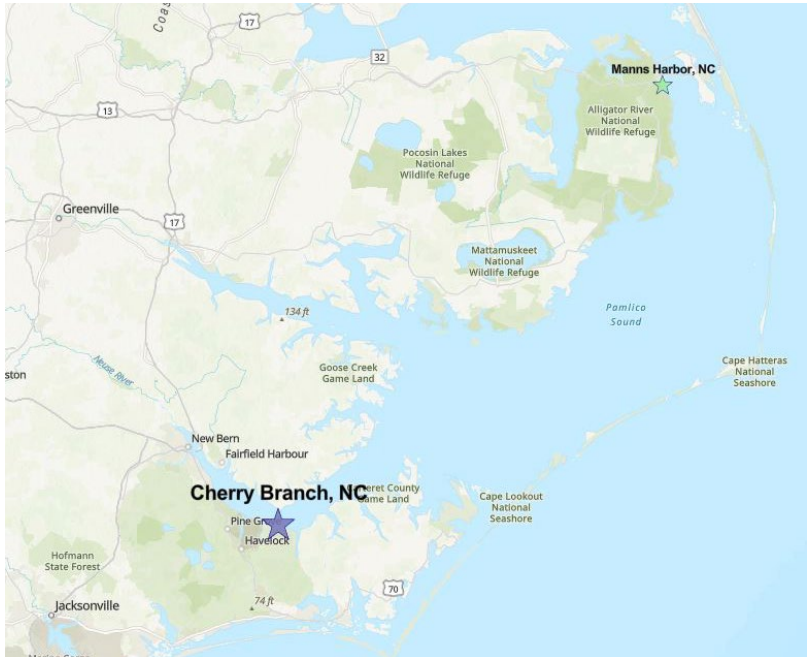


FIGURE 4.5 Geographic Location of Cherry Branch, North Carolina

Site Development Permit

A Floodplain Development Permit is required for any development activities in any AE, AO, VE, Shaded X or X Zone. This site improvements will infringe on Zone X and Zone AE flood hazard areas, based on FEMA FIRM, requiring a Floodplain Development Permit. Additionally, development in wetlands in North Carolina requires a permit from either the U.S. Army Corps of Engineers or the N.C. Division of Coastal Management. The site is not located in a Phase II stormwater area and is, therefore, subject to the state Coastal State SW Permitting Program. All disturbance of over 1 acre in North Carolina requires an NCDEQ erosion control permit.

Option 2 Design Concept

The Cherry Branch site has potential for expansion of facilities to help meet the capacity needs of the Ferry Division. While not used for planned maintenance at this time, this location currently supports ferry maintenance through repairs that do not require the vessel to be removed from the water.

The intent of the expansion concept is to provide two (2) work platen platens, paint booth, Syncrolift, transfer table, and support buildings to allow for the complete planned maintenance cycle for vessels. Then, to reach full capacity, the facility at Cherry Branch would be supplemented by the addition of Platen 5 at the Manns Harbor facility.

A conceptual plan for this Option is provided in Figure 4.6.

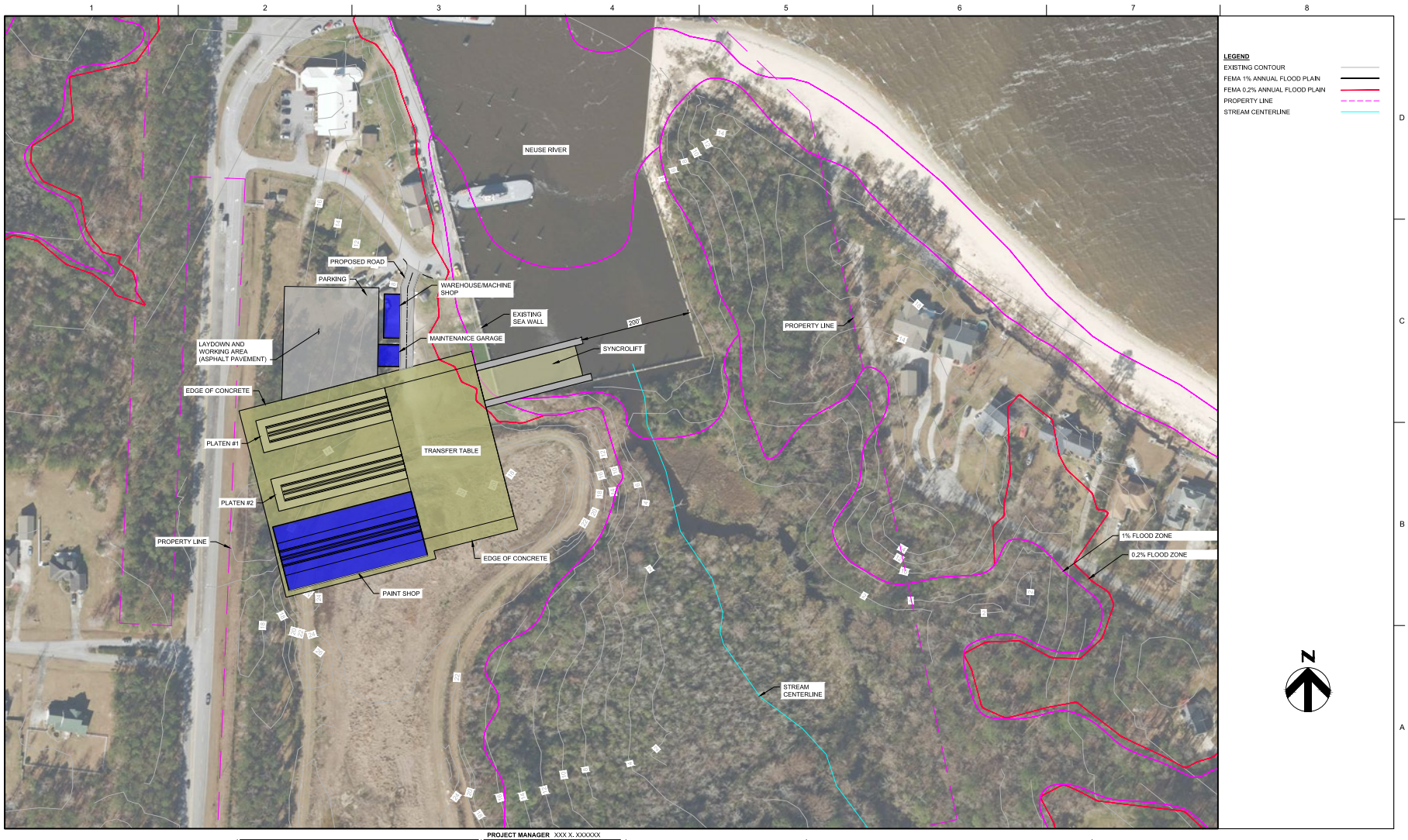


FIGURE 4.6 Conceptual Plan for New Maintenance Facility at Cherry Branch Site

Site Option 3:
Wilmington, North Carolina

The proposed site development in downtown Wilmington, NC, is located on an 89-acre parcel owned by the State Port Authority at the west end of Greenfield Street. Wilmington, NC, is located in New Hanover County in Southeastern North Carolina (Figure 4.7).

Proposed development of the site includes the construction of a full maintenance facility: six (6) work platens, Syncrolift, transfer table, maintenance garage, warehouse/machine shop, paint building, guard shack, and other associated structures.

Zoning and Property Use

The site was previously used for industrial applications. To the north of the site is an industrial oil storage facility. A railway borders the east side of the site. To the south is state owned land that is currently vacant. The Cape Fear River borders the west side of the site. The site is zoned IND for general industrial zoning in the City of Wilmington; boat building and repair is a permitted use in this district.

Site Conditions

The site topography is generally flat. The USDA NRCS identifies the soil on site as Dorovan soil (DO) and Urban land (UR). On the property, the US Fish and Wildlife Service has identified freshwater emergent wetland and freshwater forested/shrub wetlands. The currently proposed facility will encroach within the freshwater emergent wetland boundary.

Site Access

An approximately 24' wide asphalt road is proposed to access the site from the east, at the intersection of S Front St. and Greenfield St.

Utilities

The site has close proximity to water, electric, and sewer.

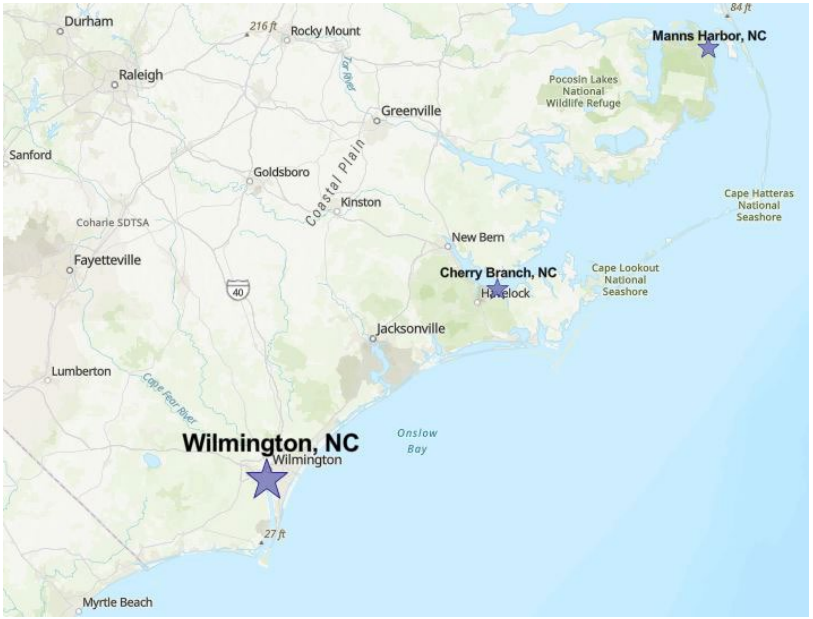


FIGURE 4.7 Geographic Location of Wilmington, North Carolina, in Relation to Other Potential Sites

Site Development Permits

A Floodplain Development Permit is required for any development activities in any AE, AO, VE, Shaded X or X Zone. The entire site sits within Zone X and Zone AE flood hazard areas, based on FEMA FIRM, requiring a Floodplain Development Permit. Additionally, development in wetlands in North Carolina requires a permit from either the U.S. Army Corps of Engineers or the N.C. Division of Coastal Management. Land development permits, including a stormwater permit, must be obtained from the City of Wilmington and New Hanover County. New Hanover County issues all building permits in the city of Wilmington, but the Zoning Section must approve building permit applications within city limits prior to their issuance. The site is within a Phase II stormwater area, but local regulations satisfy requirements of the Phase II permit. All disturbance of over 1 acre in North Carolina requires an NCDEQ erosion control permit.

Option 3 Design Concept

The Wilmington site concept has been developed as a full replacement of Manns Harbor to meet the complete requirements of the capacity model for Ferry Maintenance. This site has the available land and water access with some dredging to support this construction. The site would include six (6) work platens, Syncrolift, transfer table, dock and mooring space, paint building, warehouse, machine shop, administrative building, and ancillary shops/building to support complete vessel maintenance.

The intent of this option is to represent a full replacement of the Manns Harbor facility. It is possible to take the cost associated with this option and apply it to another site that could be purchased in closer proximity to the ferry routes. The costs of acquisition, permitting, and development of another site are not known at this time.

A conceptual plan is provided for the Wilmington site in Figure 4.8.

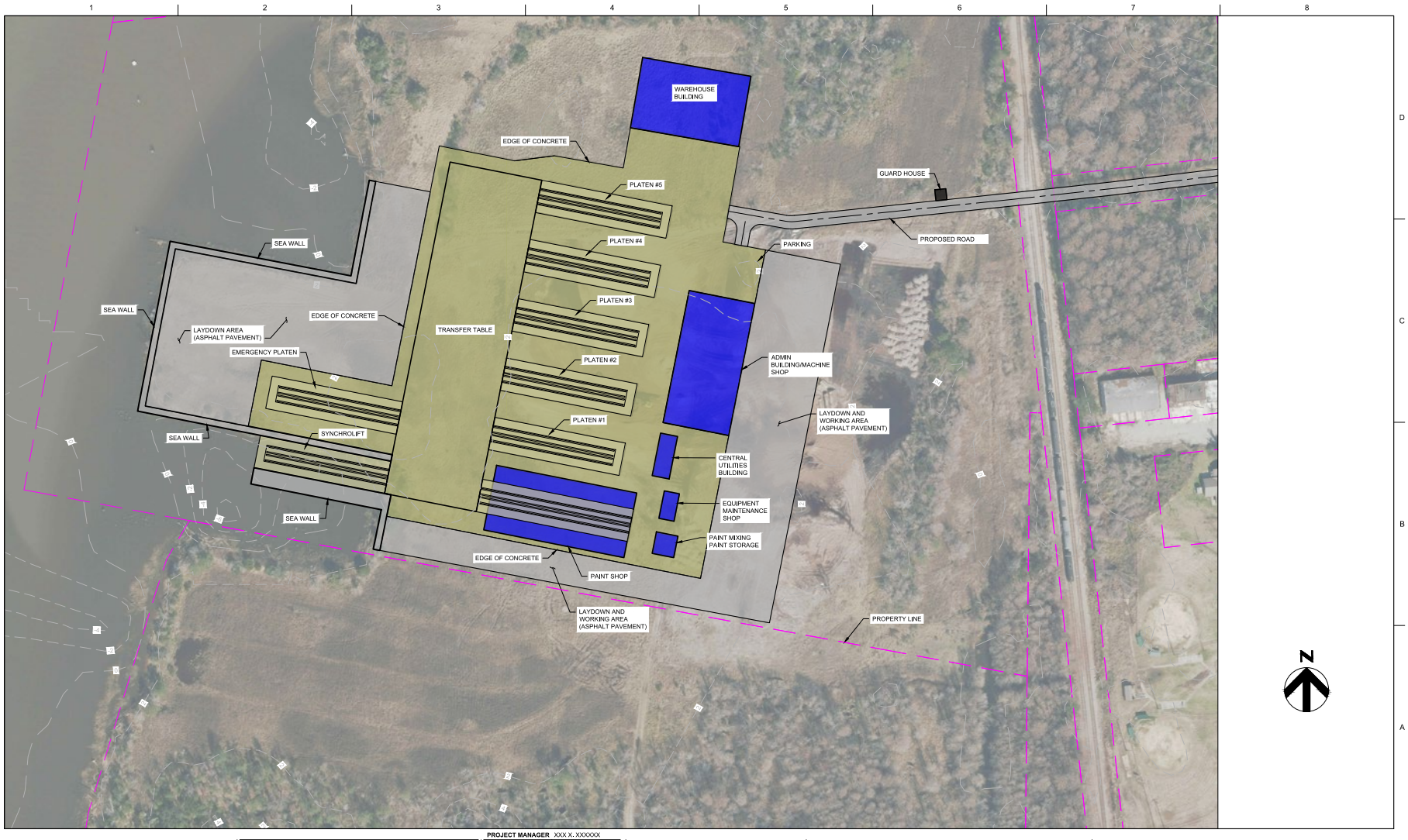


FIGURE 4.8 Conceptual Plan for New Maintenance Facility at Wilmington, NC Site

Site Options Comparison

Table 4.1 provides a side-by-side comparison of the characteristics of each of the three sites considered for potential development.

Manns Harbor appears to have the least restrictions or unknowns related to development. However, if Option 1 is chosen, Manns Harbor may have permitting concerns due to the encroachment on the wetland/dredge spoils area. There are other concerns of creating a crowded or congested site, which may have an impact on personnel, vehicle and material flows around the site. For a partial expansion (Option 1B), there is minimal impact expected to site flows.

Option 2, Cherry Branch has available land for expansion, but zoning and permitting requirements will create additional effort during engineering development. Proximity to ferry routes is not as favorable as Manns Harbor but not as unfavorable as Wilmington. Cherry Branch currently serves ferries from the terminal but may require additional dredging to allow for all vessels to access the new Syncrolift.

The Wilmington site option, Option 3, is the least favorable from a proximity to ferry routes and will require some development of new roadway to reach the site. Other factors, such as site conditions, channel depth, and permitting are positive for this site, based on preliminary analysis.

TABLE 4.1 Comparison of Three Sites Considered

Manns Harbor	Cherry Branch	Wilmington	Criterion
🟢	🟡	🟢	Channel Depth
🟢	🟢	🟢	Site Conditions
🟢	🟢	🟡	Vehicular Road Access
🟢	🟡	🟢	Zoning
🟢	🟡	🔴	Proximity to Ferry Routes
🟢	🟢	🟢	Availability of Utilities
🟡	🟡	🟢	Site Development Permit

🟢 **Good/Favorable**
🟡 **Fair/Neutral**
🔴 **Poor/Unfavorable**

Cost Estimation

The current Manns Harbor facilities and the additions suggested through the capacity modeling task were used as a basis for cost estimation of a full replacement facility. With respect to a partial expansion of Manns Harbor, cost estimates were based primarily on the plans for construction of Platen 5.

Docking Infrastructure and Vessel Maintenance Work Positions

With regard to a full replacement facility, HDR cost estimators referenced major infrastructure at the current Manns Harbor facility, as well as projected addition of three work platen locations.

- Syncrolift Shiplift system
- Transfer Table
- Six (6) total work platens
- Approximately 1,000 ft of dock space

Building Structures and Infrastructure

HDR cost estimators referenced the buildings on the Manns Harbor site for use in estimation of a replacement facility. The major buildings considered include:

- Paint Booth
- Administrative Building
- Machine and Welding Shops
- Warehouse
- Ancillary support buildings
  - Paint storage
  - Paint mixing
  - Syncrolift house
  - Equipment repair garages
- Central Utilities Building

Equipment

A list of major equipment assets at the Manns Harbor Site was compiled and current market replacement values determined to allow for placeholders to be included in the estimate shipyard replacement cost. The list included the following major types of maintenance-related equipment:

- Large Industrial Tooling (e.g., lathe, drill press)
- Large Equipment (e.g., cranes, hoists, and wenches)
- Utility Production Equipment (e.g., air compressors, generators, fire pumps)
- Other necessary equipment (e.g., diesel pressure washer, paint sprayers)

The following mobile equipment were not able to be estimated during the study and, therefore, were excluded from the total site cost estimates:

- Scissor Lift(s)
- Forklift(s)
- Crane truck(s)
- Motorized Tugger Vehicle(s)
- Rail Car(s)

Some equipment values are based on new purchase costs and much of the costs are based on used market costs for the purposes of this study. Many of the existing equipment have been in service for more than 20 years and replacement with new equipment will need to be analyzed to establish a complete cost picture for the shipyard replacement option.

The full list of estimated equipment is provided in **Appendix A** including manufacturer, model, and other key characteristics used to determine pricing.

Cost Basis

Direct costs and indirect cost percentages are based on experience, current market conditions, and historical data. The document set referenced as the basis for this estimate included the following:

- Discipline reports including descriptions, photos and quantities regarding anticipated scope
- Construction drawings from previous ferry facility construction projects:
  - Mott McDonald – New Platen #5 April 2018
  - CH2MHill – Phase VII Paint Building February 2011

Direct Cost Methodology

A combination of HDR database pricing, similar project costs, and historical data were used to establish direct costs.

All labor is done on normal 8-hour days, Monday through Friday. No overtime allowance is included. Per Diem costs of $150 per day were included for Cherry Branch and Manns Harbor.

Subcontractor pricing includes mark-ups of 10% Field Overhead and General Conditions, and 5% Profit.

Indirect Cost Methodology

General Contractor Mobilization & Demobilization – (3%)

- Set up and removal of all temporary facilities, including contractor field office
- Equipment necessary for self-performed scopes of work

General Contractor Field Overhead – (8-10%)

- Field project staff and standard burden
- Procurement
- Project controls/scheduling
- QA/QC manager
- Safety Manager

General Contractor Field General Conditions – (4%)

- Site office facilities adequate for staff required to manage project site
- Field office staff vehicles and equipment
- SWPPP and minor maintenance of SWPPP measures
- Project consumables
- Temporary utilities
- Temporary facilities

Sales Tax (**Excluded*)

General Contractor Fee – (7%)

- Local market conditions
- Size and scope of project

Estimate contingency – (30%)

General Contractor Bonds & Insurance – (2%)

- Bonds & Insurance includes the following (under normal conditions)

Escalation – (5%)

- A factor used to account for commodity and labor price volatility

Dollar Cost Basis

Cost estimates are represented in 2024 US Dollars, without escalation for future years, except as required for project durations that may extend beyond 2024.

Assumptions/Exclusions

Assumptions:

- Platen and Seawall construction costs are based on the Mott McDonald, Manns Harbor drawing set dated April 2018
- Dewatering allowances were included on a per site basis for each of the three sites
- This work will be completed uninterrupted, only one mobilization and demobilization per construction stage for the Prime Contractor and sub-contractor
- This project will be worked on a standard work week
- Project to be competitively bid with a minimum of 3 bidders
- All regulatory approvals will be obtained by others prior to mobilization
- See direct cost for application of per diem fee
- Location provides for sufficient lay-down and staging area
- All procurements by the general contractor and its subcontractor's
- Any/all environmental impact studies and associated permitting will be completed by others prior to mobilization
- Landfill for disposal of non-contaminated construction debris is within 15 mile round trip of the project site
- Excavated spoils shall be disposed of within a 10 mile radius at no cost to contractor

Exclusions

- Cost associated with accelerated schedules
- Deep foundations were not anticipated for the buildings
- All permits, regulatory fees, environmental fees or requirements and acquisition of such
- Off-site storage facilities
- Site Security measures
- Rock excavation or excavation of unforeseen underground obstacles
- Extended warranty costs
- Extreme weather conditions that would affect working days/ lost productivity
- Cost increases related to recently imposed tariffs
- Cost/work associated with hazardous and/or contaminated materials
- Costs associated with endangered species mitigation
- Snow melt and or radiant heat boiler

Level of Confidence

This is a Class 5 estimate as defined by AACE. The margin of error for this estimate classification is L: -50%/H: +100%. According to these guidelines and the stated classifications, construction contingency would be between 30% or greater.

This estimate is based on assessment reports generated by design discipline. The estimate does not utilize a bottoms up approach but is based on parametric values and or crew based duration costing. The estimate incorporates a 30% construction contingency to account for the evolution of the specifications, drawings, omissions and the final coordination of scopes and or design disciplines.

Any opinions of probable construction cost or cost estimates provided by HDR, Inc. are made on the basis of information available to HDR, Inc. and on the basis of the estimator's experience and qualifications and represents its judgment as an experienced and qualified professional engineer. However, since HDR, Inc. has no control over the cost of labor, materials, equipment or services furnished by others, or over the contractor(s') methods of determining prices, or over competitive bidding or market conditions, HDR, Inc. does not guarantee that proposals, bids or actual project or construction cost will not vary from opinions of probable cost or cost estimates prepared by HDR, Inc.

Site Option Cost Summary

Table 4.2 provides the total construction cost estimates for the four site options considered. The lowest cost option is the addition of "Platen 5" (Option 1B) at Manns Harbor while the full site development at Wilmington, NC, is the most costly option.

Based on a Class 5 estimate classification, the margin of error around the provided estimates range from -50% of the total cost on the low end to +100% on the high end. Cost estimation worksheets, which provide line-item detail of direct and indirect cost components, are provided for each option in **Appendix B**.

TABLE 4.2 Total Cost Comparison of Site Options

	Option 1: Manns Harbor Expansion		Option 1B: Manns Platen #5		Option 2: Cherry Branch Expansion		Option 3: Wilmington Full Site	
Description	**Amount**	**Totals**	**Amount**	**Totals**	**Amount**	**Totals**	**Amount**	**Totals**
Labor	1,994,732		787,550		4,440,802		9,925,290	
Labor Burden	797,893		315,020		1,776,321		3,970,116	
Material	9,672,063		4,062,405		15,543,340		37,787,643	
Equipment	516,155		268,815		2,133,360		4,960,152	
Discount RS Means Equip (-25%)	-		-		-		-	
Subcontract	37,000		37,000		1,760,080		3,409,980	
Per Diem	669,041		236,878		856,966		-	
Other	37,000		37,000		1,760,080		3,409,980	
Subtotal Direct Project Costs		**13,723,884**		**5,744,668**		**28,270,949**		**63,463,161**
Contractor's Mob	411,716		172,340		848,128		1,903,895	
Contractor's Field Overhead	1,372,388		574,467		2,827,095		5,077,053	
Contractor's General Condition	548,955		229,787		1,130,838		2,538,526	
Subtotal Field Const Costs	**2,333,059**	**16,056,943**	**976,594**	**6,721,262**	**4,806,061**	**33,077,010**	**9,519,474**	**72,982,635**
Sales Tax Estimate (Mat & Eq)	-		-		-		-	
Subtotal Field Const Costs	**-**	**16,056,943**	**-**	**6,721,262**	**-**	**33,077,010**	**-**	**72,982,635**
Contractor's Fee	1,123,986		470,488		2,315,391		5,108,784	
Subtotal Field Const Costs	**1,123,986**	**17,180,929**	**470,488**	**7,191,750**	**2,315,391**	**35,392,401**	**5,108,784**	**78,091,419**
Construction Contingency	5,154,279		2,157,525		10,617,720		23,427,426	
Subtotal Field Const Costs	**5,154,279**	**22,335,208**	**2,157,525**	**9,349,275**	**10,617,720**	**46,010,121**	**23,427,426**	**101,518,845**
Escalation Project (2025)	1,116,760		467,464		2,300,506		5,075,942	
Subtotal	**1,116,760**	**23,451,968**	**467,464**	**9,816,739**	**2,300,506**	**48,310,627**	**5,075,942**	**106,594,787**
Contractor's Bonds & Insurance	469,039		196,335		966,213		2,131,896	
Subtotal	**469,039**	**23,921,007**	**196,335**	**10,013,074**	**966,213**	**49,276,840**	**2,131,896**	**108,726,683**
Syncrolift (owner purchased)					4,000,000		4,000,000	
Total		***23,921,007***		***10,013,074***		***53,276,840***		***112,726,683***
AACE Class 5 Range Low (-50%)		**11,960,504**		**5,006,537**		**26,638,420**		**56,363,342**
AACE Class 5 Range High (+100%)		**47,842,014**		**20,026,148**		**106,553,680**		**225,453,366**

Alternate Site Considerations

The evaluation of additional sites for increasing in-house capacity for vessel maintenance on the coast of North Carolina was conducted to provide suitable alternatives not presented through the evaluations of expanding berths and staffing at Manns Harbor or using state-owned properties for dry-dock availability. Specific criteria HDR utilized for determining viability of properties are as follows:

- Property Acreage (15-25+ acres)
- Depth of navigational channels
- Proximity to residential properties
- Ability to develop outside of floodplain and wetlands
- Zoning
- Current and neighboring land use
- Restrictive Municipal Overlay zones

HDR conducted a Geographic Information System (GIS)-based site assessment across the coast of North Carolina utilizing public databases and records to identify suitable areas for developing vessel maintenance facilities. Criteria for evaluation were sorted into three categories determined by characteristics limiting development potential. An initial evaluation using the most restrictive criteria for development was utilized to identify high constraint areas along the coast of North Carolina. Once the highest constraint areas were identified, secondary evaluations were focused on available Areas of Interest (AOI). The remaining criteria were then reviewed to identify suitable land area for developing a new maintenance facility.

Data Collection

A team of experienced GIS and siting specialists collected publicly available data from a variety of coastal and nautical sources to create a criteria system to support the vessel maintenance facility site selection. Table 4.3 categorizes the datasets from the criteria system as Round 1 (R1) and Round 2 (R2).

A full list of references is also available in **Appendix C.**

TABLE 4.3 Data layers used for analysis are categorized as R1 (most detrimental to development) and R2 (least detrimental to development).

Criteria Categorization	Datasets
Base Data	• North Carolina Department of Transportation (NCDOT) Ferry Division - Ferry Terminals & Routes • North Carolina Division of Coastal Management (NCDCM). Coastal Area Management Act (CAMA) - Municipalities and Counties • Bing Hybrid Aerial Imagery
Round 1	• National Oceanic and Atmospheric Administration (NOAA) - Aquaculture and Electronic Navigational Charts • Navigation Data Center - Principal Port, Dock, and Waterway Network • U.S. Geological Survey (USGS) Protected Areas Database of the United States • North Carolina Department of Environmental Quality-Division of Coastal Management (NCDEQ-DCM) - DCM Coastal Reserve Boundary • North Carolina Division of Marine Fisheries – Artificial Reefs and Oyster Sanctuaries
Round 2	• North Carolina Historic Preservation Office. Survey and National Register – Designated Historic Districts and Local District Boundaries • County Parcel Data (filtered by 10 acres and greater) • County Zoning Data • U.S. Fish and Wildlife Service (USFWS) – Critical Species Habitat • USGS. National Hydrography Dataset • U.S. Fish and Wildlife Service. National Wetlands Inventory

R1 criteria was utilized as a comprehensive data set to broadly review the coast of North Carolina, allowing for identification of opportunity areas and constraint areas. The criteria utilized in R1 of the analysis includes data for conservation/ protection limitations, environmental regulations, and potentially restrictive areas. The R2 Criteria is composed of more localized datasets that allow parcel specific diligence to determine suitability.

All GIS layers listed in Table 1 were managed in ArcGIS Pro and staged by downloads or Representational State Transfer (REST) Application Programming Interface (API) links. Not all the data layers appear in the AOI Figures to allow for visual clarity, however all the data layers presented in Table 1, were reviewed during analysis. In particular, the USGS National Hydrography Dataset and USFWS National Wetlands Inventory are not on the figure to better show the aerial imagery around the sites.

Site Selection Methodology

HDR conducted a GIS-based dual-phased approach to determine areas suitable for vessel maintenance facilities on the North Carolina coastline.

The first round focused on the whole North Carolina coast and the R1 criteria. A visual analysis and review of the compiled data revealed broad areas along the coast that contained minimal areas considered detrimental to development. These broad areas were analyzed further in R2 with the additional criteria.

The second round focused on the broad areas identified in round one. While evaluating the selected areas, R2 criteria was considered on a case-by-case basis to determine how favorable to development the area would be.

HDR utilized the judgment of the team of specialists to make data driven decisions in cases where more nuanced development risks may arise. All AOIs and parcels identified in the site assessment portion of this report have been evaluated using all criteria stated above.

Site Assessment

As discussed in the methodology, site evaluations were conducted along the entirety of the North Carolina coast. The initial round identified eight potential AOIs depicted in Figure 4.9. A secondary analysis, in round 2, narrowed down the initial eight areas to four AOIs (AOI 2, 3, 5, 6).

Areas of Interest Less Favorable for Development

In the second round, four of the original identified AOIS AOIs were deemed Least Favorable for Development. AOI'ss: 1,4,7,8 shared similar characteristics between the four of them, that were considered less favorable.

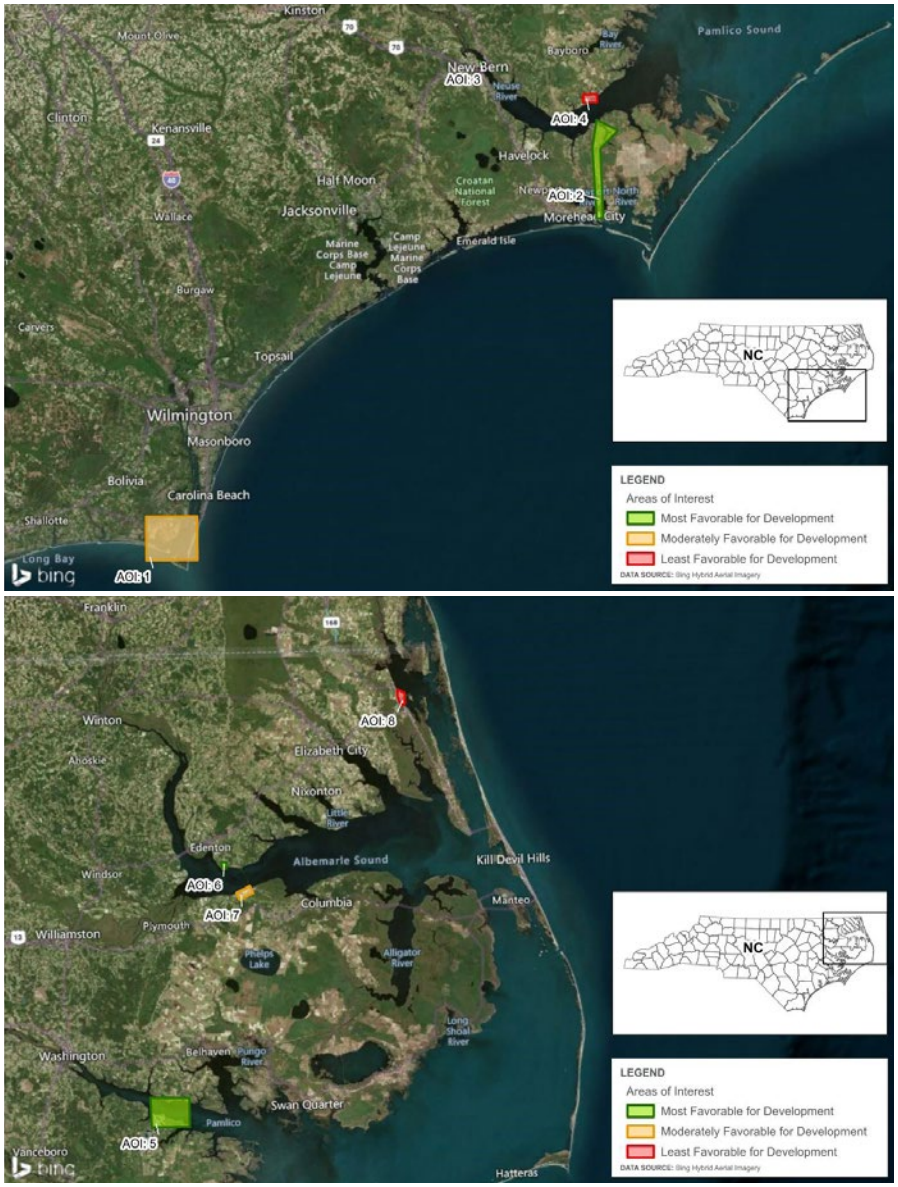
AOI 1 is considered Moderately Favorable because a parcel owned by the North Carolina Ports Authority was identified due to its size and proximity to industrial uses. It was not included in the four Most Favorable areas because much of the waterfront area has limited access due to an outcropping of land in the Cape Fear River.

AOI 4 was initially identified because of the amount of 10+ acre parcels on the coast and the lack of R1 criteria. It was ultimately categorized as Least Favorable due to the number and proximity of residential uses in the area.

AOI 7 was categorized as Moderately Favorable because of the large parcels currently used for agriculture purposes. It was not considered Most Favorable because of the lack of open land to be developed residential presence without the purchase and redevelopment of a residential parcel. Purchasing a residential parcel may be feasible, but for the purposes of this analysis, purchasing of residential properties was considered a high constraint. Other areas of interest offer more opportunity for development at this time.

Similar to AOI 7, AOI 8 had several large waterfront parcels with no limiting R1 criteria, however, further analysis showed the large parcels were owned by estates that may be unlikely to sell.

FIGURE 4.9 Eight Initial Areas of Interest (AOI) Considered for Additional Evaluation



AOI 2

AOI 2 includes Newport River from Morehead City and Beaufort, Adams Creek from its mouth in the Neuse River, and Core Creek at its mouth in the Newport River. Due to the large size of this AOI (17,900 acres), HDR has broken the area into three subsets.

SUBSET AREA 1

Subset area 1 focuses mainly on the section of the Newport River where it discharges to the Ocean at Morehead City and Beaufort (Figure 4.10).

HDR has identified a parcel on Radio Island adjacent to the Newport River Pier and Ramp and Arendell Street (Parcel No. 639619529265000), which may be suitable for development. The parcel is currently owned by the North Carolina Port Authority. The parcel is 23-acres with 20 plus of the acres identified as being potentially developable. There is no identified zoning on the parcel. Adjacent land uses in the surrounding area appear to be compatible from a land use perspective with a vessel maintenance facility.

SUBSET AREA 2

The second portion of AOI 2 is focused on the portions of Adams Creek and Core Creek between the Newport River and the Neuse River (Figure 4.11). Multiple suitable parcels are located on both the east and west banks of Adams and Core Creeks. The most suitable areas surround the Highway 101 bridge in the central portion of the subset area where Adams and Core Creeks meet. There are multiple marinas, work platens, and maintenance facilities along the banks in this portion of the creeks.

SUBSET AREA 3

Subset area 3 focuses on the section of Adams Creek that connects to the Neuse River (Figure 4.12). This area is composed of forested, vacant land with pockets of residential along either side of Adams Creek. There are multiple parcels that meet criteria for developing a vessel maintenance facility in the agricultural sections of the creek bank.

The mouth of Adams Creek is located approximately 7.5 miles east of the existing Cherry Branch Ferry Terminal evaluated in previous HDR site evaluations. Further site assessment will be required to identify suitable parcels incorporating access data and channel depth studies.

FIGURE 4.10 Subset Area 1 Site on Radio Island near Morehead City, NC

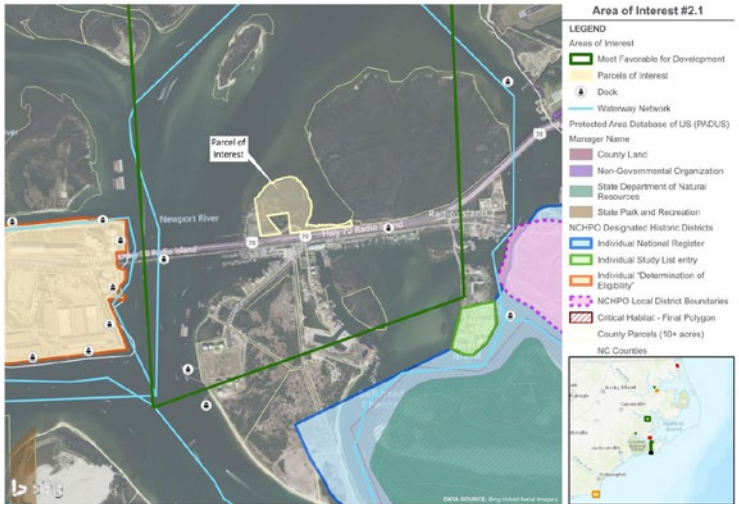


FIGURE 4.11 Subset Area 2 Site near where Adams and Core Creeks Meet

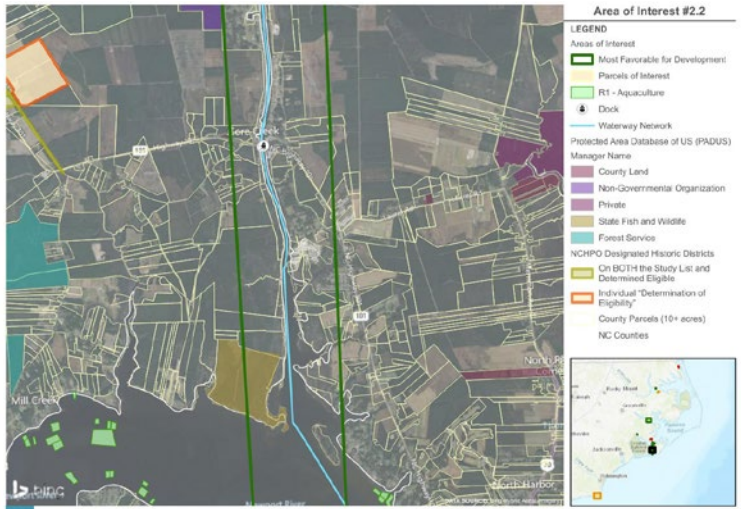


FIGURE 4.12 Subset Area 3 Site on Adams Creek

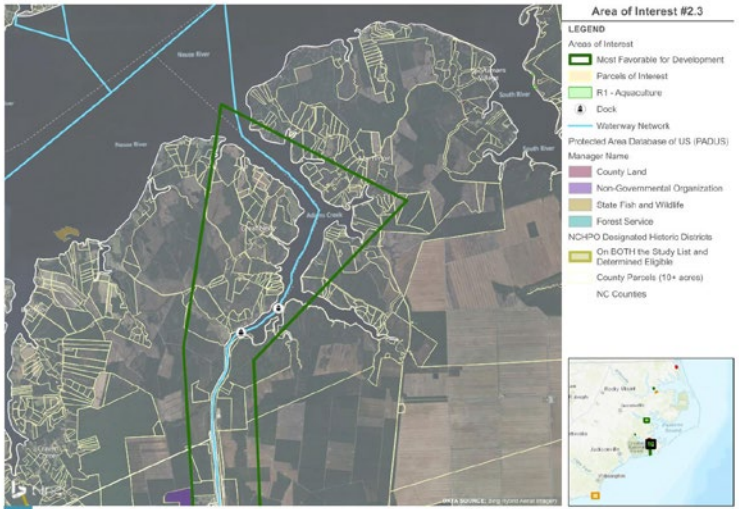
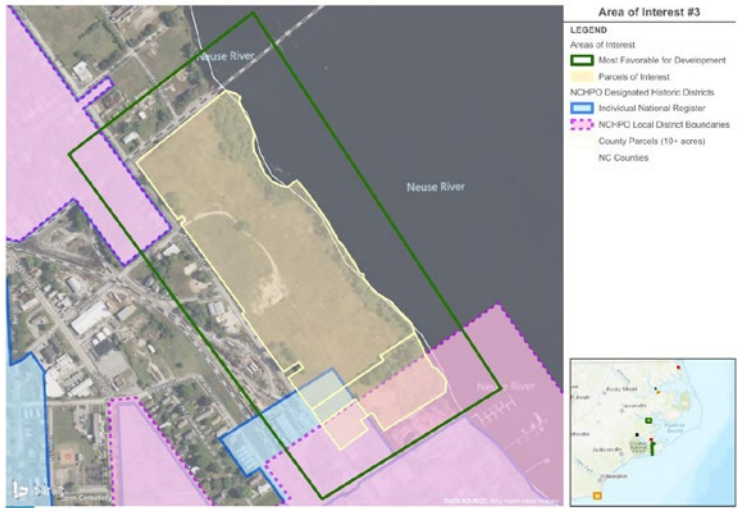


FIGURE 4.13 Area of Interest (AOI) 3 Site near New Bern, NC



AOI 2 was sited due to the multiple access areas for both on shore transportation and ferry vessel transportation for the fleet to get to the vessel maintenance facility. Further evaluation of the subsets of AOI 2 will be required to narrow down a specific development opportunity. In both Subset area 2 and 3, proximity to the road network must be considered when identifying specific parcels. AOI 2 sites were also selected under the following assumptions:

- Based on publicly available information obtained through NOAA, Adams and Core Creeks have enough depth to accommodate the fleet. Additional analysis of channel depth will be needed prior to site acquisition for verification. Clearance under the Highway 101 bridge is adequate for ferry vessel transportation.
- The North Carolina Port Authority will work with NCDOT in land acquisition.

AOI 3

AOI 3 is located on the eastern portion of New Bern on the bank of the Neuse River (Figure 4.13). HDR reviewed the New Bern area specifically as a preferred location for the development of a new vessel maintenance facility due to the high numbers of skilled workers, adequate infrastructure, and proximity to the existing ferry fleet.

A 25-acre parcel has been identified as potentially suitable (Parcel No. 8-004-042 and 8-003-241-A). The parcel is currently owned by Craven Street Partners, LLC. The current land use is vacant land with an additional designation from the City of New Bern as a parcel ready for commercial development. Surrounding land use observations have noted vacant lots on either side of the property and a railway switching yard buffering the project parcel from the residential portions of the City of New Bern. NOAA Electronic Navigation Charts indicated an existing maintained dredged channel, potentially 60 feet deep, approximately 350 feet from the shoreline. AOI 3 was selected under the following assumptions:

- Current land use of vacant land ready for commercial development will allow for a ferry vessel maintenance facility.
- The current depth of the Neuse River will be adequate for vessel maintenance.
- Clearance under Highway 51 is adequate for vessel transportation.
- The New Bern Historic District will not impact the project parcel.

AOI 5

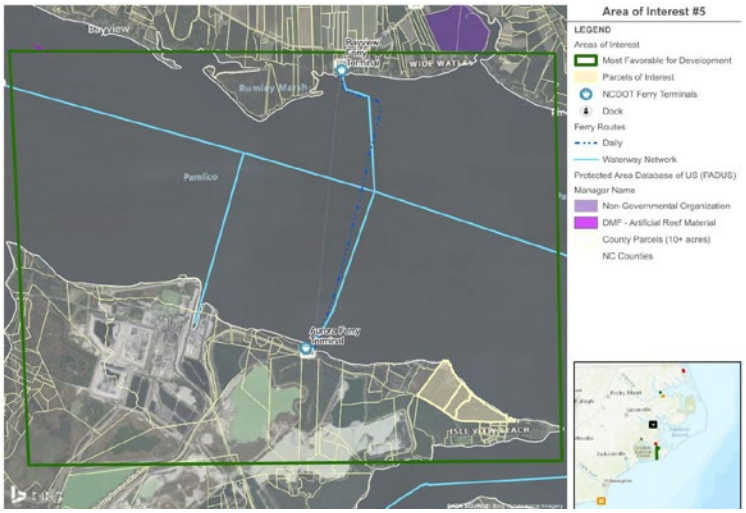
AOI 5 is located north of Aurora, North Carolina (Figure 4.14). The project parcels identified are located on the southern side of the Pamlico River east of the Aurora Ferry Terminal.

The parcels are owned by the nearby nutrient facility, PCS Phosphate Company, Inc. Current land use of the properties shows forested land with no signs of future development. The residential development to the east and the south of the parcels does not show signs of future development onto the properties.

AOI 5 is located near the majority of the NCDOT ferry vessel fleet and the routes associated with them. Nearby ferry vessel facilities indicate adequate depths for ferry vessels.

When selecting AOI 5, HDR is assuming that PCS Phosphate Company, Inc. will not expand its operations north of Hickory Point Road into the parcels identified.

FIGURE 4.14 Area of Interest (AOI) 5 Site North of Aurora, NC



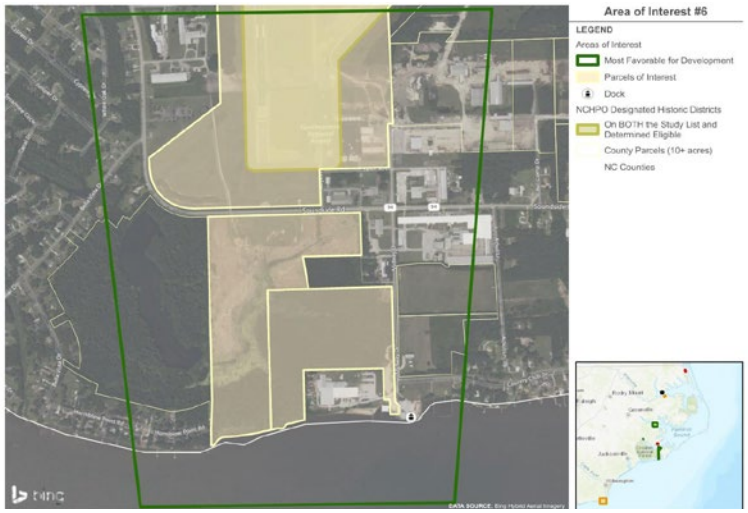
AOI 6

AOI 6 is located on the north bank of the Albemarle Sound south of the city of Edenton (Figure 4.15). AOI 6 is in a portion of Albemarle Sound that is advantageous for skilled labor and accessibility of the labor to the site.

The parcels identified as potentially suitable for development are owned by the Town of Edenton and the Edenton-Chowan Partnership, Inc. The area is zoned industrial. The current land use of the parcels is vacant forested land. The neighboring parcel on the bank of the Sound is currently a boat maintenance facility and a boat ramp. There is evidence of barge loading activities occurring at the property as well. Based on available information, HDR assumes development of a ferry maintenance facility in these parcels will occur north of the existing maintenance facility. Access to the proposed facility would be located off of Midway Drive. Dredging will be required to connect the dry docks to Albemarle Sound. AOI 6 was selected under the following assumptions:

- HDR is assuming that ferry access to the Sound can be made through dredging west of the Albemarle Boats Facility with the dry docks located inland.
- The pocket of residential to the west of the identified parcels will retain the forested buffer and will not be impacted by a vessel maintenance facility.

FIGURE 4.15 Area of Interest (AOI) 6 Site South of Edenton, NC



Conclusion and Recommendations

The analysis of site options and the cost for each option has shown that there are options, including state-owned, that can achieve the ferry maintenance capacity recommendations. However, this analysis has also highlighted within each option varying degrees of limitations that will require further engineering, financial, and logistical development to reach a final design solution.

The estimates provided are considered Class 5 as defined by AACE, subject to a margin of error of Low: -50%/High: +100%. According to these guidelines and the stated classifications, construction contingency would be between 30% or greater. As a result, a range of likely costs were presented for each option. Cost estimates are represented in 2024 US Dollars.

Site Option 1 (Up to $47.8MM): Not Recommended

The full expansion of Manns Harbor creates a very congested site and may not be able to support the safe movements of people and equipment to be a viable alternative. Given current conditions, the ability to recruit and retain adequate staffing is expected to be a significant hurdle towards achieving the necessary staffing capacity at Manns Harbor.

Site Option 1B (Up to $20.0MM): Recommended

The expansion of Manns Harbor by constructing the Platen #5 provides short term relief to the work platen limitations of the site. Long term this option will need to be paired with an expansion of another site, Option 2 suggests Cherry Branch, to meet the full maintenance requirements outlined in the capacity model.

Site Option 2 (Up to $106.6MM): Recommended

Expansion of Cherry Branch by creating the capability of maintenance activity requiring vessels to be work platened provides a supplement to the existing and partial expansion of Manns Harbor facility. This expansion would include 2 work platens, Syncrolift, transfer table, paint shop, and ancillary support facilities. The further development of this site has the advantage of being a currently owned NCDOT Ferry Division property with some infrastructure in place and there is available land that does not require acquisition. The study does briefly consider other properties for this option to be developed but acquisition of land would add to the cost of an alternate site.

Site Option 3 (Up to $225.5MM): Not Recommended

The complete replacement of the Manns Harbor shipyard by construction a facility in Wilmington is certainly possible given the state-owned land, the adjacent maritime industries, and the space available. However, the distance from the majority of ferry routes makes this option the least desirable of the options considered.

05

Labor Market Socio-Economic Assessment

Introduction

The final task within the Maintenance Capacity study consists of a labor and socioeconomic analysis to inform North Carolina legislators and NCDOT leadership of the availability of labor in the coastal and coastal-adjacent areas of North Carolina. Based on the earlier analyses, it was critical to determine whether sufficient labor exists to meet the future needs of Ferry Division maintenance operations, particularly in relation to the candidate site options presented in Section 4.

The assessment begins with NCDOT FD targeting specific occupations for its industry. Based on the combination of occupational set and assessment areas, an understanding of workforce (place of work) employment, wage and salary income, supplemental, and full compensation levels are developed. Competitive wage-salary income and compensation values are crucial for attracting and retaining talent, reducing turnover, and maintaining employee motivation.

Final comparisons of relative labor force (place of residence) conditions within the assessment areas are presented using cost of living and household statistics. This "residential" respective of the analysis is important in understanding the various factors that a potential employee must weigh in accepting employment.

Occupations within the Maritime Industry

Ferry maintenance facilities are part of the Ship Building and Repairing industry, NAICS code 336611. This manufacturing sector industry includes establishments that operate fixed facilities with work platens and fabrication equipment that can build, repair, convert, or alter watercraft intended for other than personal or recreational use. Ferry Division leadership designated 23 positions as contributing to maintenance operations. The positions translate to the 19 Standard Occupational Category (SOC) codes listed in Table 5.1.

Currently, there are 50 maintenance employees at the Manns Harbor maintenance facility across the major technical areas of mechanics, welders, painters, and dock workers. These maintenance staff relate primarily to the following SOC occupation codes:

- SOC 51-9124: Coating, Painting, and Spraying Machine Setters, Operators, and Tenders ("Painters")
- SOC 47-2141: Painters, Construction and Maintenance ("Painters")
- SOC 49-9041: Industrial Machinery Mechanics ("Mechanics")
- SOC 51-4121: Welders, Cutters, Solderers, and Brazers ("Welders")
- SOC 51-9198: Helpers--Production Workers ("Dock Workers")

TABLE 5.1 Standard Occupational Categories (SOC) Relevant to this Economic Study.

SOC Code	Soc Title
11-3013	Facilities Managers
11-3071	Transportation, Storage, and Distribution Managers (Superintendent, Marine)
17-2121	Mechanical Engineers
17-3023	Electrical and Electronic Engineering Technologists and Technicians
47-2111	Electricians
47-2141	Painters, Construction and Maintenance
47-2152	Plumbers, Pipefitters, and Steamfitters
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers
49-3051; 49-3053	Motorboat Mechanics and Service Technicians
49-9041	Industrial Machinery Mechanics
49-9071; 49-9072	Maintenance and Repair Workers, General
51-4041	Machinists
51-4121	Welders, Cutters, Solderers, and Brazers
51-4192	Layout Workers, Metal and Plastic
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers / Marine Engineers and Naval Architects
51-9124	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders
51-9198	Helpers--Production Workers

Identification of Assessment Areas

As previously mentioned the current ferry maintenance facility location, Manns Harbor, is assessed in comparison with potential sites at Cherry Branch and Wilmington, North Carolina. To account for employee mobility, a catchment area of 50 miles was developed for each site, as depicted in Figure 5.1, and is supported by publicly available data and current Ferry Division trends.

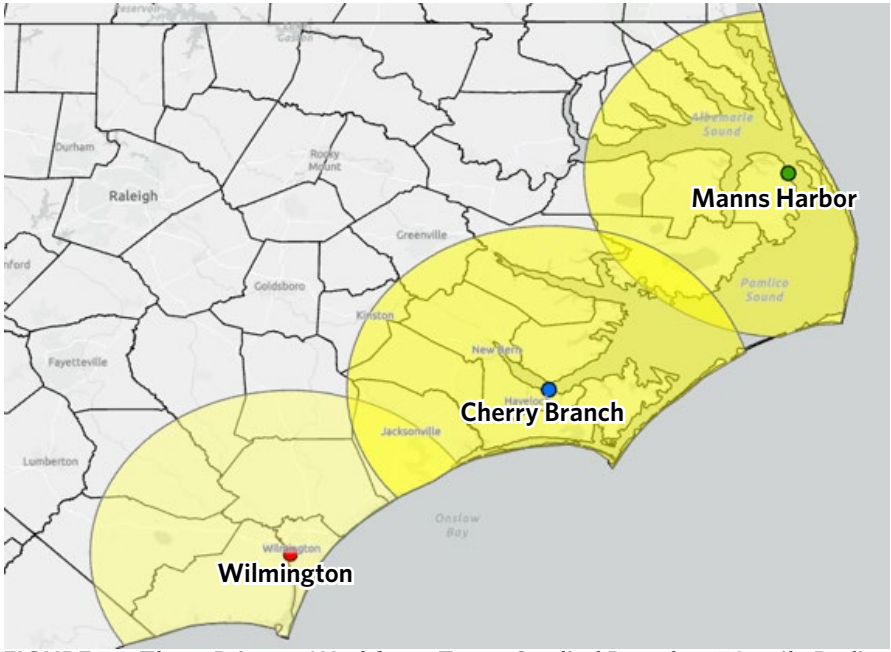


FIGURE 5.1 Three Primary Workforce Zones Studied Based on 50-mile Radius From Candidate Maintenance Facility Sites

Comparative Location Analysis

Concentrating on the occupations identified which correspond to the key Manns Harbor positions of welders, painters, and mechanics, workforce comparisons are conducted between Manns Harbor, Cherry Branch, and Wilmington designated sites.

The key workforce comparison metrics presented in this comparative analysis are 1) total employment, 2) annual wage and salary income, and 3) annual compensation levels. This set of values serves to define the set of potential workers that can be recruited and the competitive benefits to offer for optimal site operations.

The analysis is based on IMPLAN's 2023 County Level Occupational Employment data developed from the BLS. The values presented represent the entire occupational category regardless of a specific industry.

Employer-Household Dynamics (LEHD) employment origin-destination statistics available from the "Census OnTheMap" web application from 2021 presents that over 80 percent of the entire workforce in Manns Harbor, NC travel 50 miles or less to their place of work.

LEHD data is reinforced by NCDOT data for current employees at the Manns Harbor maintenance facility location, which shows over 90 percent of the workforce within a 50-mile radius based on zip code of residence. The extent of the additional workforce live within 75 miles of the facility. A map of the facility's laborshed, the area or region where an employment center draws its commuting workers, is presented in Figure 5.2.

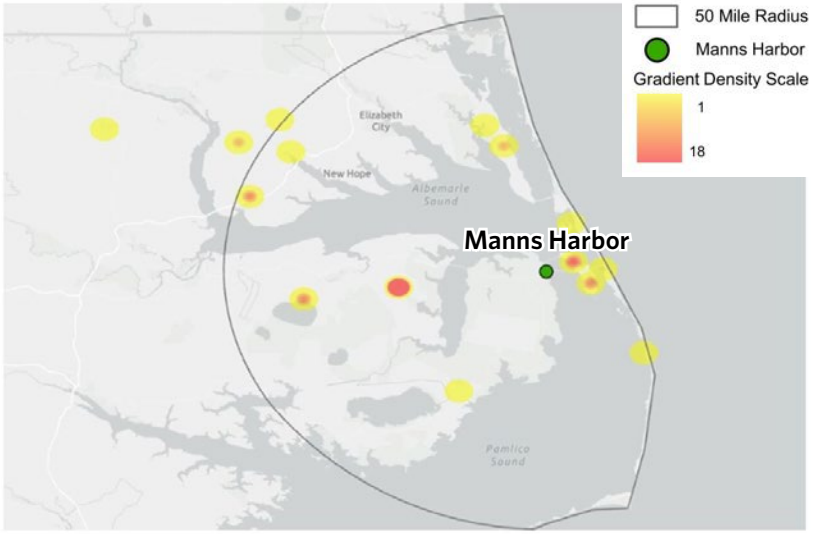


FIGURE 5.2 Location of Residence by Zip Code for Current Manns Harbor Facility Maintenance Employees

KEY TERMINOLOGY

The term "workforce" refers to the employees or jobs of a particular organization or industry sector by a geographic area. It is focused on the place of work irrespective of place of residence.

Employment

Analysis of employment levels across the designated sites generally reflects that the Wilmington site area contains the greatest level of the desired key occupations within its 50-mile radius (Figure 5.3).

Total employment in the area surrounding Cherry Branch is similar to Wilmington for Welders, Cutters, Solderers, and Brazers (SOC 51-4121) but is slightly lower in all other categories. The 50-mile area around Manns Harbor is significantly lower across all occupations.

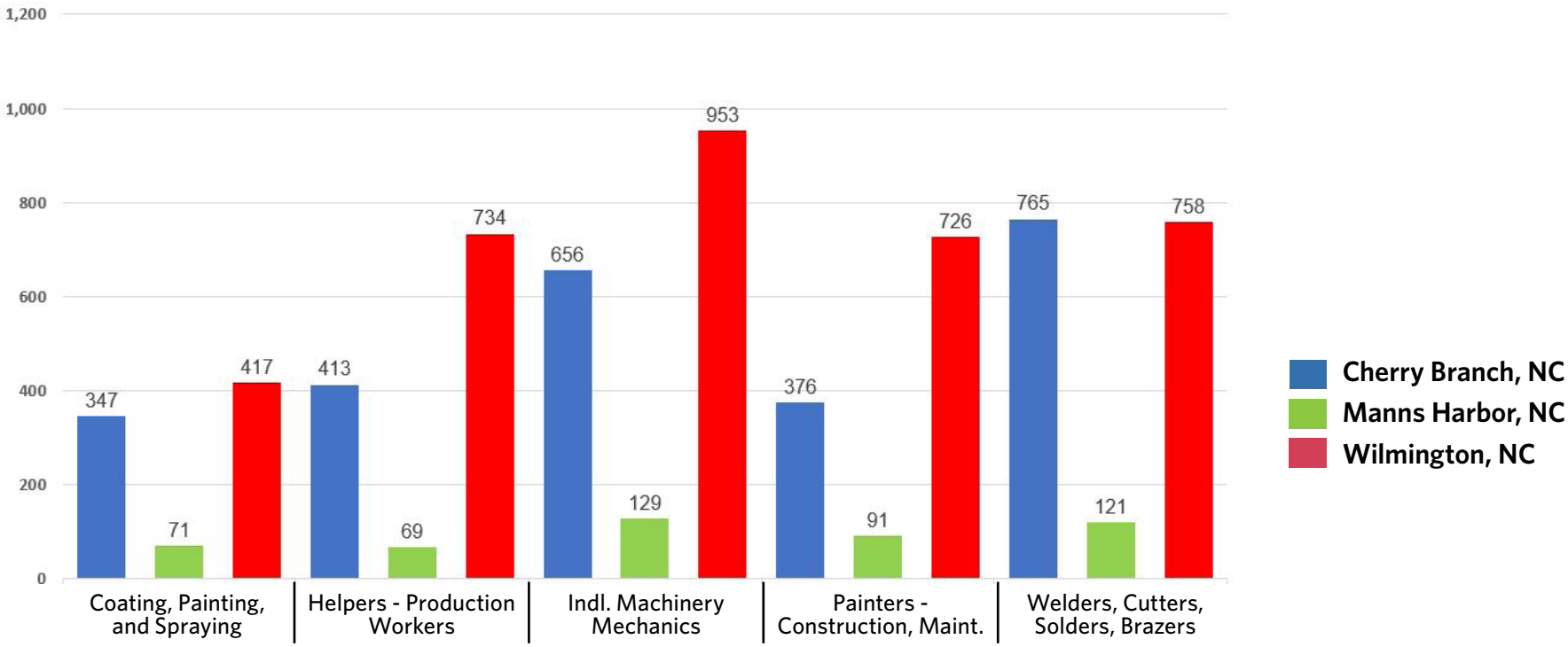


FIGURE 5.3 Total Employment for Key Occupations in the Three Zones Studied

Wages

An occupational comparison of wage and salary incomes between the designated sites is presented in Figure 5.4 below. The data generally reflects that wages in the Wilmington site area are higher for the desired key occupations within its 50-mile radius as compared to the other sites. The Cherry Branch area showed the lowest annual wages of the three sites studied.

The "income spread" for each occupation varies with the average amount of income differential being $5,857. The largest differential is for the Coating, Painting, and Spraying Machine Setters, Operators, and Tenders occupation at $9,376.

As a point of reference, the 2022 Census SAIPE estimated median household income for the US was $74,755.

FIGURE 5.4 Estimated Yearly Wages for the Three Zones Studied

Supplemental Benefits

Compensation also includes supplemental payments and benefits like health insurance, retirement contributions, and paid time off which contribute towards an employee's total compensation. A comparison of supplemental benefits between the designated sites is presented in Figure 5.5 below.

The "benefit spread" for each occupation is minimally different with the average difference being $898. The site with the largest value of compensation also varies depending upon occupation.

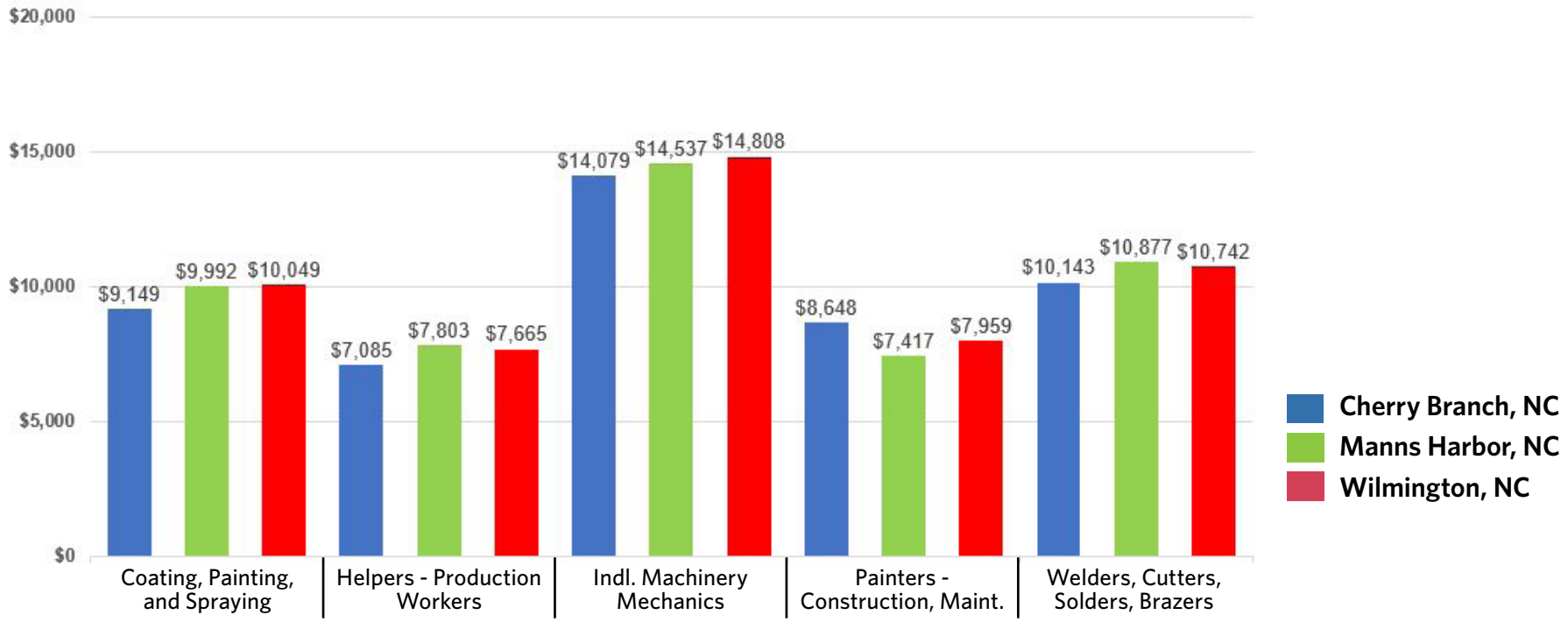


FIGURE 5.5 Estimated Supplemental Benefits for the Three Zones Studied

Total Compensation

As with the wage analysis, average annual total compensation (wages plus other compensation) across the designated sites generally reflects that the Wilmington site values area are higher for the desired key occupations within its 50-mile radius as compared to the other sites (Figure 5.6).

The "compensation spread" for each occupation varies with the average amount of income differential being $6,626. The largest differential is for the Coating, Painting, and Spraying Machine Setters, Operators, and Tenders occupation at $10,276.

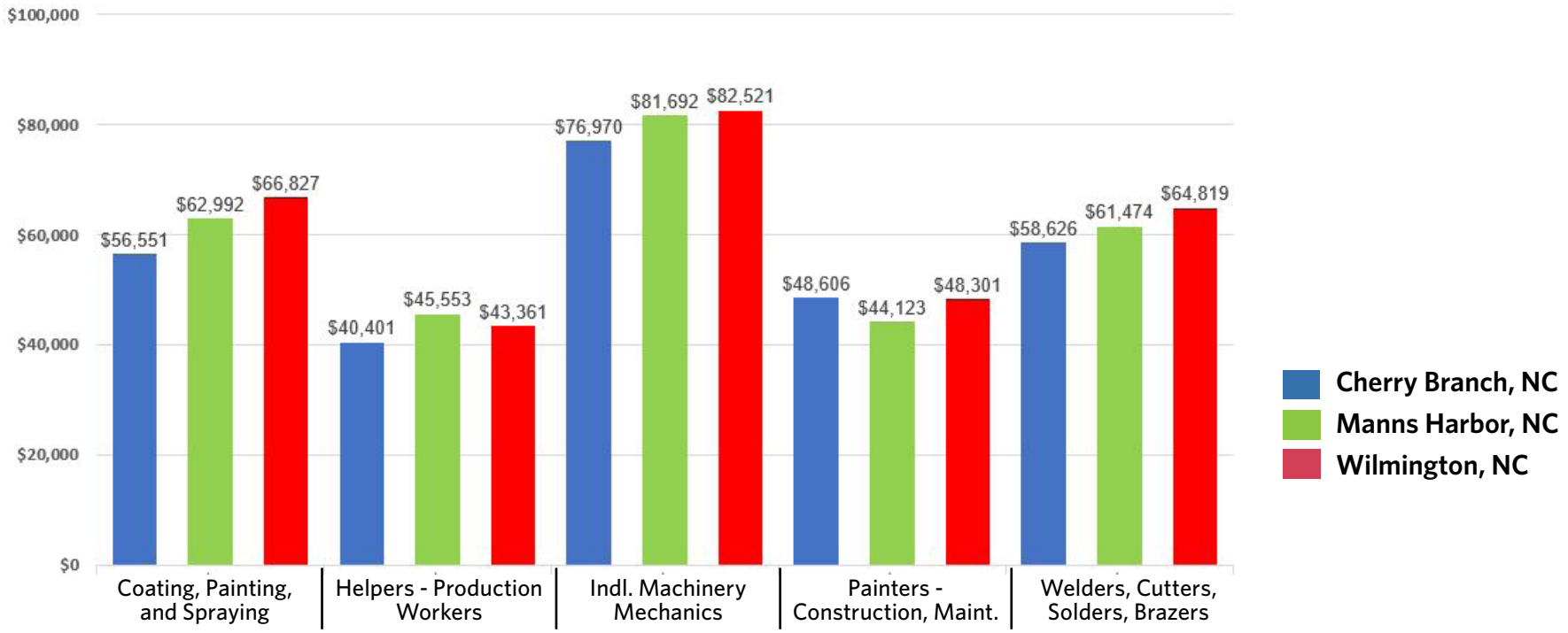


FIGURE 5.6 Estimated Yearly Compensation for the Three Zones Studied

Comparison to Norfolk, VA

An additional comparison of employment, wage and salary income, benefits, and compensation levels is conducted between the Manns Harbor maintenance facility and the closest municipality - Norfolk, VA. Table 5.2 summarizes the findings for the key occupations considered.

A 40-mile radius is established with notable overlap in four North Carolina counties: Pasquotank, Currituck, Camden, and Perquimans, as illustrated in Figure 5.7.

Across all of the comparison categories, the Norfolk analysis area has the greater values. The most prominent reason for this is that Norfolk sits within a metropolitan statistical area (MSA) with relatively high population density and close economic integration. The four overlapping counties, when evaluated as a separate group, are substantially below both Manns Harbor and Norfolk.

FIGURE 5.7 40-mile Catchment Areas of Norfolk, VA, and Manns Harbor, NC, Overlap in Four North Carolina Counties

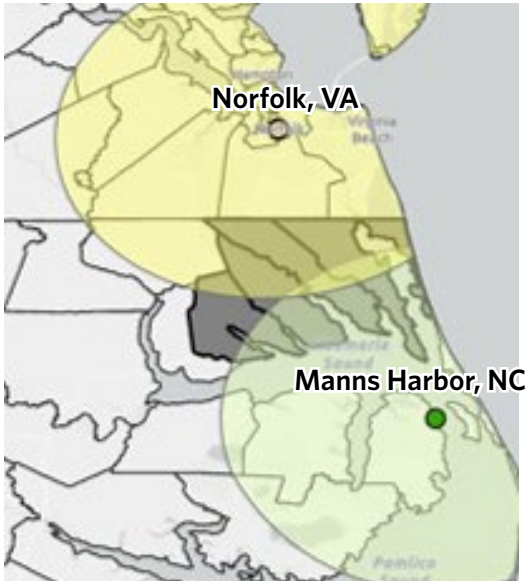


TABLE 5.2 Comparison of Manns Harbor to Norfolk, VA for Key Maintenance Occupations

Occupation	Analysis Area	Total Employment	Average Income	Average Supplements	Average Compensation
49-9041 Industrial Machinery Mechanics	**Manns Harbor**	129	$67,155	$14,537	$81,692
	Norfolk	1,020	$70,434	$15,217	$85,651
	Overlap	49	$51,182	$10,978	$62,160
51-9124 Coating, Painting Spraying	**Manns Harbor**	71	$53,000	$9,992	$62,992
	Norfolk	708	$58,417	$11,344	$69,761
	Overlap	24	$50,408	$8,573	$58,981
51-4121 Welders, Cutters, Solderers, and Brazers	**Manns Harbor**	121	$50,596	$10,877	$61,474
	Norfolk	1,740	$61,489	$13,251	$74,740
	Overlap	36	$45,869	$9,429	$55,298
47-2141 Painters-Construction and Maintenance	**Manns Harbor**	91	$36,706	$7,417	$44,123
	Norfolk	900	$47,720	$10,358	$58,078
	Overlap	40	$36,281	$7,644	$43,925
All 19 Studied SOC Occupations	**Manns Harbor**	2,767	$48,021	$9,835	$57,856
	Norfolk	22,607	$61,702	$13,375	$75,077
	Overlap	1,097	$45,913	$9,765	$55,669

Labor Force Site Analysis

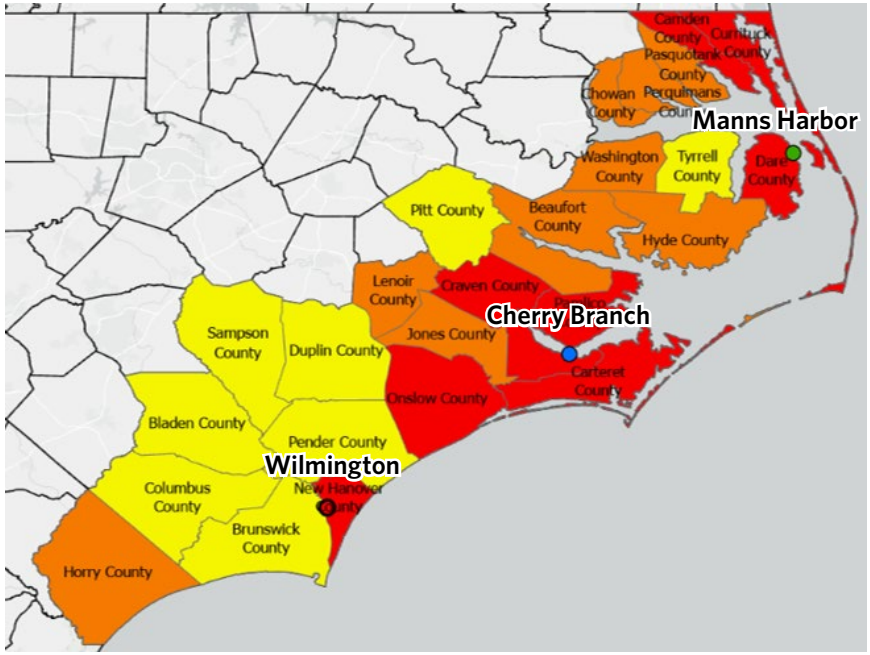
Cost-Of-Living

One key measure for the labor force is a cost-of-living index. Among the various types of this index is the Council for Community and Economic Research's (C2ER) County Cost of Living Index (CCOLI). The index is designed to assess the pricing differences for every county in the US during a single year. It compares the cost of maintaining a standard of living appropriate for moderately affluent professional and managerial households. The base of index 100 represents the US Average.

The indices for 25 contiguous counties from the Manns Harbor, Cherry Branch, and Wilmington analysis areas are presented in Figure 5.8. While being careful not to overemphasize small differences in cost of living indexes between places, the Cherry Branch location has larger county groups with higher index values (97.1 -102.0). The Manns Harbor consists more of a mix of mid to high-value index counties in its proximity with one low-index outlier. Wilmington's home county (New Hanover) also has a higher index value but is surrounded by counties on the lower end of the study range (90.1-93.0).

A full list of county cost-of-living index is presented in Table 5.3, showing the cost equivalent to $50,000 in Dare County, NC, where Manns Harbor is located.

FIGURE 5.8 Cost-of-Living-Index Heatmap by County



Color Legend

- **90.1 - 93.0**
- **93.1 - 97.0**
- **97.1 - 102.0**

KEY TERMINOLOGY

The term "labor force" refers to the employed residents of a particular geographic area. Unlike "workforce", labor force is focused on the various demographic and economic aspects of where they live irrespective of where they work.

TABLE 5.3 Cost of Living Indices By County (100 = National Average)

North Carolina County	Cost-of-Living Index (COLI)	Equivalent to $50K in Dare County
Beaufort	95.1	$46,801
Bladen	93.9	$46,211
Brunswick	93.0	$45,768
Camden	100.1	$49,262
Carteret	99.6	$49,016
Chowan	96.5	$47,490
Columbus	90.7	$44,636
Craven (Cherry Branch)	97.2	$47,835
Currituck	98.7	$48,573
Dare (Manns Harbor)	101.6	$50,000
Duplin	92.6	$45,571
Horry	95.3	$46,900
Hyde	96.3	$47,392
Jones	96.9	$47,687
Lenoir	94.9	$46,703
New Hanover (Wilmington)	98.8	$48,622
Onslow	97.1	$47,785
Pamlico	98.8	$48,622
Pasquotank	94.4	$46,457
Pender	93.0	$45,768
Perquimans	96.8	$47,638
Pitt	93.7	$46,112
Sampson	93.3	$45,915
Tyrrell	93.5	$46,014
Washington	94.3	$46,407

A weighted-average COLI using C2ER's CCOLI data and the Census' ACS household data based on the 50-mile zones surrounding each potential site location was also developed, and is presented in Figure 5.9.

This analysis shows the relatively similar index levels between Manns Harbor, Cherry Branch, and Wilmington. Again being careful not to overstate small differences between the indices, the data presents a higher cost-of-living around Manns Harbor compared to the potential Cherry Branch and Wilmington laborsheds.

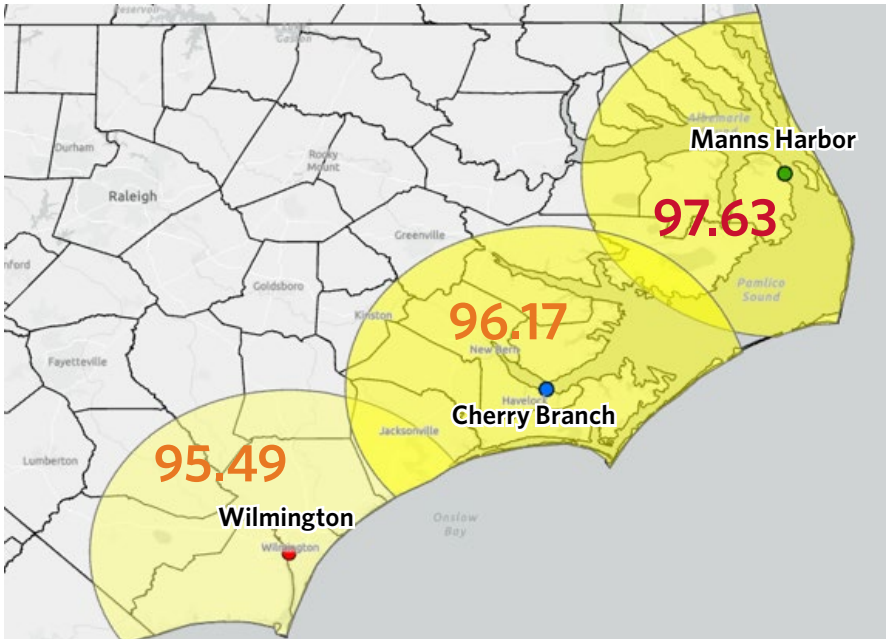


FIGURE 5.9 Weighted-Average Cost-of-Living Index Around Potential Maintenance Facility Site Locations

Conclusion and Recommendations

In this phase of the study HDR looked at several economic factors that impact employment in coastal region of North Carolina for a subset of occupations that will be critical for growth of Ferry Division maintenance operations.

In summary, Manns Harbor performed unfavorable with respect to cost-of-living (perceived as related to the tourism industry) and wage indicators and was associated with the lowest employment levels within a 50-mile radius of each respective site option. Cherry Branch and Wilmington, NC areas, when including both the MSA and surrounding areas, performed better with respect to these economic indicators as well as total workforce size. Economic data also highlighted the competition that Norfolk, VA, presents to Manns Harbor.

In Table 5.4, the estimated staff need associated with a full build-out of maintenance operations is compared to the estimated workforce within a 50-mile radius of each site. The ratio of staff needed to staff currently employed implies the share of the workforce that would be needed at each site. For Cherry Branch and partial Manns Harbor expansion, a 10% redundancy was added for inefficiencies of a split operation.

From this comparison, Cherry Branch appears to be the most well positioned to meet the needs of a new facility. For Manns Harbor, a partial expansion would naturally be easier to accommodate than a full one, with both options accounting for a considerable portion of the staff employed in the area (around 20%). The Wilmington option also appears suitable for finding staff. It is uncertain, however, the level of investment in wages, benefits, training, and other compensation needed to pull the necessary staff away from other positions and employers in these areas.

TABLE 5.4 Staffing Availability for Ferry Division Maintenance Operations

Occupation	Location	Site Staff Needed	Staff Available in Area Workforce	Implied Share of Workforce
Painters (Currently **17** at Manns Harbor)	Manns Harbor (Full)	48	162 (71+91)	29.6%
	Cherry Branch	18	723 (347+376)	2.6%
	Manns Harbor (Partial)	35	162 (71+91)	23.5%
	Wilmington	48	1,143 (417+726)	4.2%
Mechanics (Currently **14** at Manns Harbor)	Manns Harbor (Full)	22	129	17.1%
	Cherry Branch	8	656	1.5%
	Manns Harbor (Partial)	15	129	13.2%
	Wilmington	48	953	5.0%
Welders (Currently **13** at Manns Harbor)	Manns Harbor (Full)	36	121	29.8%
	Cherry Branch	13	765	1.8%
	Manns Harbor (Partial)	26	121	24.0%
	Wilmington	48	758	6.3%
Dock Workers (Currently **6** at Manns Harbor)	Manns Harbor (Full)	7	69	10.1%
	Cherry Branch	4	413	1.5%
	Manns Harbor (Partial)	6	69	8.7%
	Wilmington	48	734	6.5%
Total	**Manns Harbor (Full)**	**113**	**481**	**23.5%**
	Cherry Branch	**43**	**2,557**	**1.9%**
	Manns Harbor (Partial)	**82**	**481**	**18.7%**
	Wilmington	**113**	**3,588**	**3.1%**

06

Conclusion

Study Findings

The service provided by the NCDOT Ferry Division is vital to movement of goods, services, and people around the Outer Banks of the North Carolina. To safely operate the ferries in the region, routine, emergency, and USCG required maintenance, repair, and upgrades to systems and components must be performed. The Manns Harbor facility has been providing these services for more than 40 years. Throughout this time many new technical advancements, new vessels, new facilities, and new regulations have been added that both improve and create additional burdens on the Manns Harbor facility. This study, through the tools, techniques, and data analyses described herein, have attempted to bring together the requirements for continued support of the Ferry System for the next 50 years, and beyond.

First and foremost, HDR views Manns Harbor Ferry Maintenance Facility as a vital component in the future success of the Ferry Division. However, the current facility capacity cannot meet the full maintenance requirements of the existing fleet of 23 ferries. This study has determined that to meet the maintenance needs of the Ferry Division, more work platen space is required.

The study has also determined that to meet the maintenance needs of the Ferry Division, more skilled labor is required. Current staff needs are not being met due to many factors including cost of living, state approved wage rates, skilled labor availability, and relative proximity to the Hampton Roads marine maintenance facilities north of Manns Harbor. The Hampton Roads area provides better wages, lower cost of living, better trades training programs, and more maritime job opportunities in the region.

The study has also determined that to meet the needs of the Ferry Division, vessel age and condition are important factors that add significant stress to the ferry maintenance facility. As the vessels age, the maintenance requirements of the vessels increase. The design of the vessels and the routes the vessels travel also contribute to increase maintenance requirements. These issues are being analyzed in the parallel study, Ferry Vessel Replacement Plan, currently underway.

There are several optional solutions to address current capacity needs that should be considered. Firstly, expansion of the Manns Harbor shipyard can be made to address the facility needs to meet the capacity. Secondly, expansion of Manns Harbor and Cherry Branch can be made to meet total maintenance facility capacity requirements. Thirdly, a new replacement shipyard can be built to address the maintenance facility capacity requirements. One potential location is state-owned property in Wilmington, adjacent to the Port of Wilmington. In addition, the New Bern area could have sites to be purchased and developed as replacement or supplement to Manns Harbor.

As detailed throughout this report, each option has its advantages and disadvantages, for example:

- Labor force and cost of living make Manns Harbor less than the ideal location for a shipyard to meet the current and future maintenance demands of the Ferry Division. The Manns Harbor site is somewhat land-locked, and expansion could be accomplished but would create a very crowded site.
- Cherry Branch and New Bern areas are more ideally situated in proximity to ferry routes, trade schools, labor markets, and have similar cost of living indexes to Manns Harbor.
- Wilmington has the labor market, cost of living and trade school advantages over Manns Harbor. However, Wilmington would add significantly to the annual operating expense of the Ferry Division due to increase fuel and transportation expense to transport vessels to and from the Wilmington area for repair and maintenance. While good for staff, increased wages would also mean an increased labor expense for the Ferry Division.

Figure 6.1 summarizes the holistic analysis of these options.

Option 1. Full Expansion of Manns Harbor Maintenance Facility

PROS	CONS
• Existing Infrastructure and Equipment • Experienced Labor Pool • Established Processes • Maintain Centralized Operation • Proximity to Ferry Routes • Spencer Creek Channel Depth	• Space Needs for Expanding Site and Buildings • Aging Equipment and Utilities Systems • Potential Difficulty Finding Sufficient Staff, Additional investment for Recruiting and Training • High Cost of Living for Staff

Option 2. Partial Expansion at Manns Harbor (Option 1B) and Expansion of Cherry Branch

PROS	CONS
• Leverage Existing Manns Harbor Facilities • Maintain Proximity to Routes • Neuse River Conditions • (Cherry Branch) Proximity to Labor Pool, Schools and Military Installation • (Cherry Branch) Adjacent to Minnesott Beach Ferry Operation • (Cherry Branch) Lower Cost-of-Living	• (Cherry Branch) Dredging Requirements • (Cherry Branch) New Facility and Operations, Training of New Staff • (Cherry Branch) Proximity to Residential Areas • (Manns Harbor) Potential Difficulty Finding Staff • (Cherry Branch) Duplication of Facilities, Supply Chain, Admin

Option 3. Full Replacement Facility at State-Owned Wilmington, NC Site

PROS	CONS
• Proximity to Port of Wilmington Resources • Labor Pool in the Area around Wilmington • Proximity to Schools • Channel Depth of Cape Fear River • Favorable Cost of Living in Adjacent Counties • Centralized Facility and Operation	• Significant Distance from Ferry Routes Resulting in Operational Expense and Excessive Vessel Transport • Potential Conflicts/ Congestion with Port of Wilmington Activity • Potential Other Plans for Development of Site • New Facility, Operations, Staff • Increased Operational Expense related to High Labor Wages • Significant Cost of Construction (Estimated up to $225.5 MM)

FIGURE 6.1 Pros and Cons of the Analyzed Site Options for Achieving the Recommended Increase in Maintenance Capacity

Recommended Site Options

Based on the totality of data gathered and analyzed during this study, HDR provides the following site strategy NCDOT could implement in order to meet the long-term vessel maintenance needs of the Ferry Division:

1. Expand Manns Harbor with Platen #5 and dedicate one (1) work platen for emergency repairs
2. Expand Cherry Branch by adding two (2) work platens, a paint booth, machine shop, warehouse, and other ancillary buildings to supplement Manns Harbor in Cherry Branch.

Level of Investment

Construction

The recommendations of this study for partial expansion of Manns Harbor Platen 5 and expansion of Cherry Branch to add two work platens and additional infrastructure for full-service, out of water maintenance, would required a level of investment for construction of up to **$126.6MM**.

Labor

Based on current average annual labor expense of $96,544, $122,535, $74,695, and $104,929 for Mechanics, Painters, Welders, and Dock workers, respectively, the additional annual labor expense for a partial expansion of Manns Harbor and expansion of Cherry Branch facility would be approximately **$7.64MM** across 75 additional maintenance staff. Additional investment in recruiting and training of new staff may also be needed.

Vessel Replacement

The investment related to vessel replacement is detailed in the Vessel Replacement Plan Study being prepared in parallel with this study. Please reference that study for cost associate with vessel replacement.

Implementation Timeline

The exact timelines for implementation will be developed through the project planning process. However, given the myriad of options and parameters described and discussed, the construction of the facilities in Manns Harbor and Cherry Branch could easily stretch to between three and seven years. The timing will also be impacted by funding availability, permitting processes, and construction market conditions.

Future Study Opportunities

Throughout the course of this study, HDR identified opportunities for further study which it believes would provide benefit to NCDOT and the Ferry Division with respect to increasing capacity.

1. FERRY EMERGENCIES

HDR recommends that increased attention be paid to the root causes of "emergencies" that ferry vessels experience while in the field. It was noted anecdotally as well as through modeling that these emergencies impact operational performance and capacity, operating expense, and potentially useful life of the vessels. Channel depth appears to be a clear culprit in key routes. An impact analysis could shed light on the effects of these emergencies and potentially provide additional value back to the State of North Carolina.

2. MAINTENANCE OUTSOURCING

HDR built its analysis on the assumption that outsourcing of maintenance to external shipyards is not preferred and, therefore, Ferry Division facilities should be configured with all the necessary capacity to perform all maintenance and repair in-house. However, HDR notes that outsourcing can be an effective "pressure-release valve" in some situations. Further study should be undertaken to assess the costs and benefits of outsourcing as a potential supplement to in-house maintenance. Such a study may yield additional solutions beyond those presented in this report.

3. PROCESS IMPROVEMENT

While there were no clear operational deficiencies noted during HDR's site visit, this study focused primarily on high-level capacity issues related to facilities and staffing. Additional opportunities at the Manns Harbor maintenance facility to increase "wrench time" and reduce maintenance and repair cycle times could be identified by looking more closely at the various maintenance processes.

Additionally, a closer look at the supply chain could identify opportunities to optimize inventory management and reduce operational delays caused by supply issues.

4. DATA MANAGEMENT AND COLLECTION

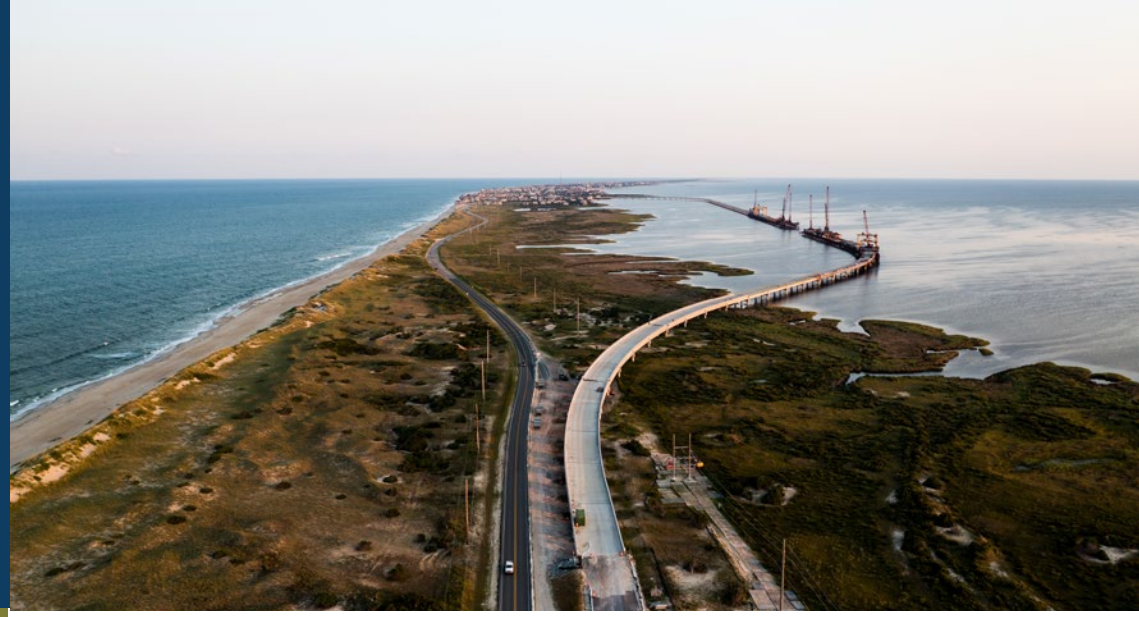
Maintenance data was integral in this study towards building a credible capacity model. HDR noted opportunities to dive deeper into the existing data management system to see what types of job codes are used within each maintenance event. However, this level of analysis was not possible given the project timeline. With access to more data, it may be easier to understand and analyze the work being done on each vessel which may lead to other operational improvements.

5. DETERMINANTS OF MAINTENANCE AND VESSEL HEALTH

There is a lot to be learned about what actual determines the maintenance requirements of vessels besides simply how old they are. As a follow on from this study and the "Vessel Replacement Plan Study", more effort could be spent on determining the optimal maintenance plan for each vessel to maximize useful life and minimize maintenance and repair costs.

6. STAFF RECRUITING AND RETENTION

Further efforts will be needed to develop a strategy to attract and retain qualified staff in Manns Harbor as well as other sites chosen for development. A comprehensive strategy for growth of Ferry Division operations may require collaborating with local colleges and trade schools, developing a more robust training/apprenticeship program, increase employee benefits and compensation to include (or subsidize) room and board, transportation services, and other incentives.



07

Appendices

A. Manns Harbor Equipment List

B. Cost Estimates By Site Option

C. Alternate Site Selection References

A. Manns Harbor Equipment List

ITEM NO.	ITEM TYPE	MANUFACTURER	MODEL	DESCRIPTION	LOCATION	Estimated Cost of Replacement
1	Radial Drill	LeBlond INC.	Fosdick - 3 FOOT SENSITIVE	3' Radial Drill Press	Machine Shop - Large Room	$10,000
2	Mill	JET Equipment and Tools	JTM-1254VS	Varaible Speed Vertical Milling Machine	Machine Shop - Large Room	$25,000
3	Mill	JET Equipment and Tools	JTM-1054	Turret Milling Machine	Machine Shop - Large Room	$15,000
4	Mill	Cincinnati	-	Turret Milling Machine	Machine Shop - Large Room	$15,000
5	Lathe	JET Equipment and Tools	GH-1880ZX	Geared Head Precision Lathe - 8.5' Length	Machine Shop - Large Room	$45,000
6	Lathe	The Monarch machine Tool CO.	-	4.5' Lathe	Machine Shop - Large Room	$15,000
7	Lathe	Cincinnati	-	14.4' Lathe	Machine Shop - Large Room	$50,000
8	Lathe	Acra	-	19' Lathe	Machine Shop - Large Room	$60,000
9	Lathe	-	-	30' Lathe	Machine Shop - Large Room	$70,000
10	Crane	Deshazo	3-TON	3 Ton Single Girder Indoor Crane	Machine Shop - Large Room	$20,000
11	AC/DC TIG Weld	Miller Welds	Dynasty 400	400 amp AC/DC TIG Welder Package	Machine Shop - Smaller Room	$20,000
12	Lathe	RIGID	535 SERIES	535 SERIES Auto Chucking Machine (Lathe)	Machine Shop - Smaller Room	$10,000
13	Crane	Deshazo	3-TON	3 Ton Single Girder Indoor Crane	Machine Shop - Large Room	$20,000
14	Mill	Greaves Cincinnati	-	Milling Machine	Machine Shop - Smaller Room	$5,000
15	Shear	AccurShear	637510	10' X 3/8" Hydraulic Shear	Machine Shop - Smaller Room	$40,000
16	Punching Machine	Sunrise	IW-95KD	Dual cylindar ironworker, puncher, shear	Machine Shop - Smaller Room	$25,000
17	Engine	Cummins	V-504-FI	Fire Pump Engine	Fire Pump Building	$25,000
18	Syncrolift			See drawings	Syncrolift	$4,000,000
19	Crane	-	SWL 4000	4000# Single Girder Indoor Crane	Building - East of Transfer Table	$20,000

ITEM NO.	ITEM TYPE	MANUFACTURER	MODEL	DESCRIPTION	LOCATION	Estimated Cost of Replacement
20	Air Dryer	Kaeser	KADPS-3000	"Pressure swing regenerative Desiccant Compressed Air Dryer MAWP 185 at 450°F"	Compressor/Generator Building	$44,000
21	Air Dryer	Kaeser	KADPS-3000	"Pressure swing regenerative Desiccant Compressed Air Dryer MAWP 185 at 450°F"	Compressor/Generator Building	
22	Air Filter	Kaeser	KFS-3125-P	Compressed Air Filter - Max working pressure 225 PSI	Compressor/Generator Building	$12,000
23	Air Filter	Kaeser	KFS-3125-P	Compressed Air Filter - Max working pressure 225 PSI	Compressor/Generator Building	$12,000
24	Air Filter	Kaeser	KPF-RF-3125-P	Compressed Air Filter - Max working pressure 225 PSI	Compressor/Generator Building	$12,000
25	Compressor	AtlasCopco	GA180W VSD-FF	Variable Speed Drive Air Compressor - 183 kW - 245 hp	Compressor/Generator Building	$230,000
26	Compressor	AtlasCopco	GA250W	Air compressor - 238 kW - 319 hp	Compressor/Generator Building	$180,000
27	Generator	McGraw-Edison - Onan Gen Set	400.0DFN-4XR/1C	400 kW Generator - 60 Hz - 1800 rpm	Compressor/Generator Building	$50,000
28	Generator	Electric Machine MFG Company	E-M BEMAC III	"1050/900 kW Brushless Syncronous Generator CAT D399 Diesel Engine"	Compressor/Generator Building	$100,000
29	Generator	Electric Machine MFG Company	E-M BEMAC III	"1050/900 kW Brushless Syncronous Generator CAT D399 Diesel Engine"	Compressor/Generator Building	$100,000
30	Potable Water Tank	-	-	Volume not provided - about 12' tall x 6' diameter tank	Outside Machine Shop	$3,000
31	Diesel Tank	-	-	10000 Gallon Diesel Tank	Adj to work platens	$30,000
32	Used Oil Tank	-	-	Volumen not provided - About 6 ft in height and 8 ft in diameter	Northeast of transfer table	$20,000

ITEM NO.	ITEM TYPE	MANUFACTURER	MODEL	DESCRIPTION	LOCATION	Estimated Cost of Replacement
33	Used Oil Tank	-	-	Volume not provided - About 6 ft in height and 8 ft in diameter	Northeast of transfer table	$20,000
34	Water Pump	Thompson	6HT993	Trailer mounted water pump	Transfer Table	$35,000
35	Water Pump	Thompson	4DDL-805	Trailer mounted water pump	Transfer Table	$25,000
36	Heat Exchanger	Hiross	-	4 Fan Heat exchanger	Behind Compressor Room	$20,000
37	Heat Exchanger	Hiross	-	6 Fan Heat Exchanger	Behind Compressor Room	$30,000
38	Diesel Tank	-	-	10,000 Gallon Diesel Tank	Adj to Compressor Room	$30,000
39	Gas Tank	-	-	300 Gallon Gasoline Tank	Adj to Compressor Room	$1,000
40	Propane Tank	-	-	15,000 Gallon Propane Tank	North of Paint Building	$40,000
41	Ultra High Pressure Sprayers	Flow International Corporation	C-9 Diesel Husky 40K	40000 PSI - Caterpillar C-9 Engine - 6.5 GPM - 205 HP	Paint Building	$35,000
42	Ultra High Pressure Sprayers	Flow International Corporation	HUSKY S-200	40000 PSI pump	Paint Building	$35,000
43	Ultra High Pressure Sprayers	Flow International Corporation	HUSKY S-200	40000 PSI pump	Paint Building	$35,000
44	Slurry Blaster Hoppers	EcoQuip	EQs elite	Vapor Abrasive Blast Equipment - Max pressure 175 psi	Paint Building	$50,000
45	Crane		2-TON	2 Ton Single Girder Indoor Crane	Engine Shop - E113	$20,000
	TOTAL					**$5,659,000**

B. Cost Estimates By Option

Option 1 - Manns Harbor Full Expansion

North Carolina DOT

Ferry Division Maintenance

Detail Report - Direct Costs

1/29/2024 9:42 AM

Design Stage: Concept

Estimate Version:

Project name	**Manns Harbor**
Document	Concept
Estimator	KJA
Labor rate table	HDR_2023_Union
Equipment rate table	HDR_EQ_2023
Project	Capacity Study
Report format	Sorted by 'WBS_MAIN/MF04_DIV/HDR04SPEC' 'Detail' summary
Factor table	Virginia-Norfolk

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - Direct Costs

1/29/2024 9:42 AM
Design Stage: Concept
Estimate Version:

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
		01 Sitework										
DIVISION 01		**GENERAL REQUIREMENTS**										
01 21 00.000		*Allowances*										
n	0900	Utilities	1,000.00	lnft	30,000	30,000	30,000		30,000	30,000	150.00 /lnft	150,000
n	0900	Dewatering	1.00	ls	7,000	7,000	7,000		7,000	7,000	35,000.00 /ls	35,000
		01 21 00.000 Allowances			*37,000*	*37,000*	*37,000*		*37,000*	*37,000*	*185,000.00 /LS*	*185,000*
		1.00 LS										
		DIVISION 01 GENERAL REQUIREMENTS			**37,000**	**37,000**	**37,000**		**37,000**	**37,000**	**185,000.00 /LS**	**185,000**
		1.00 LS										
DIVISION 02		**EXISTING CONDITIONS**										
02 41 10.000		*Selective Demolition*										
n	0500	(Bldgs 6, 7, 8, 9, 10, 11) Building demolition, small buildings or single buildings, steel str only	6.00	cf	45,882	-	-		44,118	-	14,999.998 /cf	90,000
n	0500	(Bldgs 6, 7, 8, 9, 10, 11) Relocate, Erect, Skin	6.00	cf	45,882	-	-		44,118	-	14,999.998 /cf	90,000
n	0500	Mechanical, Plumbing Relocation to existing / tie-in utilities	200.00	lnft	11,216	-	-		10,784	-	110.000 /lnft	22,000
		02 41 10.000 Selective Demolition			*102,980*				*99,020*		*201,999.99 /LS*	*202,000*
		1.00 LS										
		1,932.707 Labor hours										
		965.019 Equipment hours										
		DIVISION 02 EXISTING CONDITIONS			**102,980**	**0**	**0**		**99,020**	**0**	**201,999.99 /LS**	**202,000**
		1.00 LS										
		1,932.707 Labor hours										
		965.019 Equipment hours										
DIVISION 26		**ELECTRICAL**										
26 05 00.000		*Electrical: Sitework*										
	900	Friction tape	7.00	ea	31	4	-		-	-	4.946 /ea	35
	1000	Phase tape	4.00	ea	18	30	-		-	-	11.945 /ea	48
n	0800	Electrcl manholes,hand holes,precast concrete,with concrete cover,3'x3'x3'deep,remove and replace	2.00	ea	936	1,410	-		199	-	1,272.50 /ea	2,545
	0200	Wiremarkers	192.00	ea	513	9	-		-	-	2.723 /ea	523

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - Direct Costs

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
26 05 00.000		*Electrical: Sitework*										
	0300	Scotchloks	93.00	ea	290	13	-		-	-	3.257 /ea	303
	1780	Crimp 1 hole lugs, copper, #8	1.00	ea	10	2	-		-	-	11.64 /ea	12
	1780	Crimp 1 hole lugs, copper, #8	1.00	ea	10	2	-		-	-	11.64 /ea	12
	1800	Crimp 1 hole lugs, copper, #6	3.00	ea	36	6	-		-	-	13.837 /ea	42
	2400	Crimp 1 hole lugs, copper, #2	4.00	ea	71	18	-		-	-	22.303 /ea	89
	2600	Crimp 1 hole lugs, copper, 3/0	12.00	ea	285	72	-		-	-	29.738 /ea	357
	1200	Wire, copper, #12	25.00	lf	8	5	-		-	-	0.498 /lf	12
	1250	Wire, copper, #10	850.00	lf	302	247	-		-	-	0.646 /lf	549
	1300	Wire, copper, #8	3,195.00	lf	1,421	1,534	-		-	-	0.925 /lf	2,954
	1350	Wire, copper, #6	45.00	lf	24	32	-		-	-	1.234 /lf	56
	1400	Wire, copper, #4	420.00	lf	280	445	-		-	-	1.727 /lf	725
	1500	Wire, copper, #2	100.00	lf	80	164	-		-	-	2.440 /lf	244
	1700	Wire, copper, 3/0	220.00	lf	313	825	-		-	-	5.173 /lf	1,138
	2200	Wire, copper, 250 kcmil	1,680.00	lf	2,988	8,770	-		-	-	6.998 /lf	11,757
	0100	Pull string	1,275.00	lf	351	62	-		-	-	0.325 /lf	414
	0100	Grounding rod, copper clad, 10' long, 3/4" diameter	5.00	ea	404	189	-		-	-	118.566 /ea	593
	0220	Grounding drive studs, 3/4" diameter	5.00	ea		89	-		-	-	17.788 /ea	89
	0250	Ground clamp	5.00	ea	56	29	-		-	-	16.898 /ea	84
	0340	Ground wire, copper wire, bare #10	200.00	lf	62	47	-		-	-	0.546 /lf	109
	0390	Ground wire, copper wire, bare #8	15.00	lf	5	6	-		-	-	0.691 /lf	10
	2730	Exothermic weld, wire to ground rod	5.00	ea	254	51	-		-	-	60.956 /ea	305
	0100	Post base	2.00	ea	22	35	-		-	-	28.755 /ea	58
	0150	3/8" expansion anchors	20.00	ea	116	18	-		-	-	6.682 /ea	134
	0200	3/8" bolts	40.00	ea	53	18	-		-	-	1.775 /ea	71
	0300	3/8" nuts	36.00	ea	32	2	-		-	-	0.938 /ea	34
	0350	3/8" washers	80.00	ea	71	2	-		-	-	0.919 /ea	73
	0400	1 1/2" x 1 1/2" unistrut	20.00	ea	27	38	-		-	-	3.216 /ea	64
	0500	1 1/2" unistrut cover	20.00	ea	18	19	-		-	-	1.850 /ea	37
	0550	45 degree elbow	4.00	ea	34	17	-		-	-	12.78 /ea	51
	0600	90 degree elbow	2.00	ea	17	9	-		-	-	12.775 /ea	26
	0650	Tee	2.00	ea	17	7	-		-	-	11.785 /ea	24
	0850	PVC cement	3.00	ea	133	37	-		-	-	56.71 /ea	170
	0900	Nameplates	3.00	ea	33	15	-		-	-	16.017 /ea	48
	0950	Tyraps	50.00	ea	67	7	-		-	-	1.481 /ea	74
	1000	Wire lube	2.00	ea	89	49	-		-	-	68.96 /ea	138
	1800	Rigid galvanized steel conduit, 1" diameter	325.00	lf	1,778	1,430	-		-	-	9.872 /lf	3,208
	1830	Rigid galvanized steel conduit, 1-1/4" diameter	5.00	lf	30	32	-		-	-	12.398 /lf	62
	1870	Rigid galvanized steel conduit, 2" diameter	25.00	lf	198	221	-		-	-	16.754 /lf	419
	1900	Rigid galvanized steel conduit, 2-1/2" diameter	20.00	lf	203	336	-		-	-	26.982 /lf	540
	2920	Rigid galvanized steel conduit nipples, 1" diameter, 6" long, incl locknuts and bushings	3.00	ea	46	21	-		-	-	22.323 /ea	67
	3120	Rigid galvanized steel conduit nipples, 1-1/4" diameter, 6" long, incl locknuts and bushings	2.00	ea	36	19	-		-	-	27.145 /ea	54
	3540	Rigid galvanized steel conduit nipples, 2" diameter, 6" long, incl locknuts and bushings	2.00	ea	44	35	-		-	-	39.625 /ea	79
	1410	Outlet boxes, cast, 1 gang, FS, 3/4" hub, 2" deep	1.00	ea	30	28	-		-	-	58.06 /ea	58
	1600	Outlet boxes, cast, weatherproof receptacle cover, 1 gang	1.00	ea	6	4	-		-	-	9.58 /ea	10
	2200	Pull boxes, steel, type SC, raintight & weatherproof, 8" L x 8" W x 6" D, NEMA 3R	4.00	ea	178	92	-		-	-	67.49 /ea	270

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - Direct Costs

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
26 05 00.000		*Electrical: Sitework*										
	6500	Wiring boxes, dust tight & drip tight, 72" L x 72" W x 12" D, NEMA 12, J.I.C.	1.00	ea	534	4,734	-		-	-	5,267.96 /ea	5,268
	0300	Conduit fittings for rigid galvanized steel, standard, locknuts, 1" diameter	12.00	ea	-	7	-		-	-	0.608 /ea	7
	0500	Conduit fittings for rigid galvanized steel, standard, locknuts, 1-1/4" diameter	8.00	ea	-	6	-		-	-	0.774 /ea	6
	1000	Conduit fittings for rigid galvanized steel, standard, locknuts, 2" diameter	8.00	ea	-	15	-		-	-	1.813 /ea	15
	1170	Conduit fittings for rigid galvanized steel, bushings, plastic, 1" diameter	6.00	ea	76	1	-		-	-	12.90 /ea	77
	1200	Conduit fittings for rigid galvanized steel, bushings, plastic, 1-1/4" diameter	4.00	ea	59	1	-		-	-	15.065 /ea	60
	1250	Conduit fittings for rigid galvanized steel, bushings, plastic, 2" diameter	4.00	ea	95	2	-		-	-	24.32 /ea	97
	2180	Conduit fittings for rigid galvanized steel, boxes connector, 1" diameter	20.00	ea	142	101	-		-	-	12.161 /ea	243
	2190	Conduit fittings for rigid galvanized steel, boxes connector, 1-1/4" diameter	4.00	ea	36	53	-		-	-	22.173 /ea	89
	2210	Conduit fittings for rigid galvanized steel, boxes connector, 2" diameter	16.00	ea	285	635	-		-	-	57.474 /ea	920
	2220	Conduit fittings for rigid galvanized steel, boxes connector, 2-1/2" diameter	8.00	ea	158	839	-		-	-	124.62 /ea	997
	1090	Flexible metallic conduit, sealtite, 3/4" diameter	24.00	lf	85	35	-		-	-	4.998 /lf	120
	1200	Flexible metallic conduit, sealtite, 1-1/4" diameter	3.00	lf	21	10	-		-	-	10.29 /lf	31
	1400	Flexible metallic conduit, sealtite, 2" diameter	9.00	lf	107	39	-		-	-	16.189 /lf	146
	1700	Flexible metallic conduit, sealtite, connectors, straight, 3/4" diameter	8.00	ea	57	37	-		-	-	11.749 /ea	94
	2000	Flexible metallic conduit, sealtite, connectors, straight, 1-1/4" diameter	1.00	ea	11	16	-		-	-	27.19 /ea	27
	2200	Flexible metallic conduit, sealtite, connectors, straight, 2" diameter	3.00	ea	53	113	-		-	-	55.513 /ea	167
	2400	Flexible metallic conduit, sealtite, connectors, 90 Deg., 3/4" diameter	8.00	ea	57	53	-		-	-	13.68 /ea	109
	2800	Flexible metallic conduit, sealtite, connectors, 90 Deg., 1-1/4" diameter	1.00	ea	11	30	-		-	-	41.01 /ea	41
	3100	Flexible metallic conduit, sealtite, connectors, 90 Deg., 2" diameter	3.00	ea	53	153	-		-	-	68.743 /ea	206
	4500	Flexible metallic conduit, coupling sealtite to rigid, 3/4" diameter	8.00	ea	158	42	-		-	-	25.053 /ea	200
	4900	Flexible metallic conduit, coupling sealtite to rigid, 1-1/4" diameter	1.00	ea	30	10	-		-	-	39.24 /ea	39
	5100	Flexible metallic conduit, coupling sealtite to rigid, 2" diameter	3.00	ea	107	90	-		-	-	65.457 /ea	196
	3270	PVC conduit, schedule 40, 1" diameter, in concrete slab, incl terminations, fittings and supports	840.00	lf	1,494	823	-		-	-	2.758 /lf	2,317
	3300	PVC conduit, schedule 40, 1-1/4" diameter, in concrete slab, incl terminations, fittings and supports	5.00	lf	10	7	-		-	-	3.542 /lf	18

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - Direct Costs

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
26 05 00.000		*Electrical: Sitework*										
	3350	PVC conduit, schedule 40, 2" diameter, in concrete slab, incl terminations, fittings and supports	465.00	lf	1,378	963	-		-	-	5.034 /lf	2,341
	3370	PVC conduit, schedule 40, 2-1/2" diameter, in concrete slab, incl terminations, fittings and supports	820.00	lf	3,241	2,722	-		-	-	7.272 /lf	5,963
	3530	PVC conduit, schedule 40, 90 elbow, 1" diameter, in concrete slab	15.00	ea	167	603	-		-	-	51.295 /ea	769
	3550	PVC conduit, schedule 40, sweep, 30" radius, 1-1/4" diameter, in concrete slab	2.00	ea	30	17	-		-	-	23.20 /ea	46
	3600	PVC conduit, schedule 40, 90 elbow, 2" diameter, in concrete slab	17.00	ea	336	866	-		-	-	70.72 /ea	1,202
	3630	PVC conduit, schedule 40, sweep, 30" radius, 2-1/2" diameter, in concrete slab	6.00	ea	152	470	-		-	-	103.805 /ea	623
	3770	PVC conduit, schedule 40, adapter / coupling, 1" diameter, in concrete slab	15.00	ea		4	-		-	-	0.294 /ea	4
	3800	PVC conduit, schedule 40, couplings, 1-1/4" diameter, in concrete slab	2.00	ea		1	-		-	-	0.37 /ea	1
	3850	PVC conduit, schedule 40, adapter, 2" diameter, in concrete slab	17.00	ea		12	-		-	-	0.725 /ea	12
	3870	PVC conduit, schedule 40, couplings, 2-1/2" diameter, in concrete slab	6.00	ea		7	-		-	-	1.088 /ea	7
	4030	PVC conduit, schedule 40, end bells, 1" diameter, in concrete slab	6.00	ea	36	19	-		-	-	9.172 /ea	55
	4150	PVC conduit, schedule 40, end bells, 2" diameter, in concrete slab	8.00	ea	84	47	-		-	-	16.39 /ea	131
	4350	Underground marking tape	865.00	lf	308	246	-		-	-	0.640 /lf	553
	0400	Trench No 2 (backhoe with operator)	865.00	lf	1,538	56,225	-		-	-	66.778 /lf	57,763
	0600	Concrete encasement	22.777	cys	4,052	8,323	-		-	-	543.277 /cys	12,374
	0800	Dirt removal	96.116	cys	962	23,548	-		-	-	255.004 /cys	24,510
	1000	Backfill	78.335	cys	1,741	806	-		-	-	32.520 /cys	2,547
	1200	Sand backfill	6.529	cys	290	224	-		-	-	78.76 /cys	514
	1400	Compaction	865.00	lf	1,038	2,119	-		-	-	3.650 /lf	3,158
	0100	Vibration isolation	1.00	ea	44	25	-		-	-	68.96 /ea	69
	3700	Transformer, dry-type, ventilated, 3 phase 480 V primary 120/208 V secondary, 75 kVA	1.00	ea	1,016	3,250	-		-	-	4,266.230 /ea	4,266
	1000	Panelboards, 120/208 V, 225 amp, 42 circuits	1.00	ea	1,046	4,250	-		-	-	5,296.12 /ea	5,296
	1500	Panelboards, 277/480 V, 225 amp, 42 circuits	1.00	ea	1,186	5,500	-		-	-	6,685.60 /ea	6,686
	3600	Receptacle, 20 amp, single	1.00	ea	13	21	-		-	-	34.24 /ea	34
	4870	Receptacle box assembly, 50A, welding receptacle	2.00	ea	89	411	-		-	-	249.78 /ea	500
	4875	Receptacle box assembly, 100A, welding receptacle	2.00	ea	121	1,278	-		-	-	699.865 /ea	1,400
	4880	Receptacle box assembly, 200A, welding receptacle	2.00	ea	210	4,413	-		-	-	2,311.565 /ea	4,623
	0200	Lighting contactors, 3 pole, electrically held, 600 volt, 30 amp, NEMA 1	1.00	ea	99	294	-		-	-	392.80 /ea	393
	0420	Mounting bracket	8.00	ea	356	400	-		-	-	94.46 /ea	756
	0120	Lighting fixture	8.00	ea	1,423	3,400	-		-	-	602.84 /ea	4,823

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - Direct Costs

	Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
26 05 00.000		*Electrical: Sitework*										
	3005	Electrical utility pole, wood pole yellow pine, CCA-treated, 50', class 3, excludes excavation, backfill and cast in place concrete	4.00	ea	2,032	4,500	-		249	-	1,695.403 /ea	6,782
n	0140	Foreman at 15% of 869	130.35	hour	1,890	-	-		-	-	14.50 /hour	1,890
n	0160	Journeyman at 10% of 869	86.90	hour	652	-	-		-	-	7.50 /hour	652
n	0180	Cleanup and delivery at 5% of 869	43.45	hour	1,086	-	-		-	-	25.00 /hour	1,086
		26 05 00.000 Electrical: Sitework			*42,279*	*149,366*			*448*		*192,093.05 /ls*	*192,093*
		1.00 ls										
		1,130.049 Labor hours										
		11.830 Equipment hours										
		DIVISION 26 ELECTRICAL			**42,279**	**149,366**	**0**		**448**	**0**	**192,093.05 /LS**	**192,093**
		1.00 LS										
		1,130.049 Labor hours										
		11.830 Equipment hours										
DIVISION 31		**EARTHWORK**										
31 23 00.001		*Structural Excavation*										
	0100	No. 3 Aggregate for earthwork, bank run gravel, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction	3,810.00	lcy	9,337	37,910	-		16,826	-	16.817 /lcy	64,073
	1000	Topsoil spreading from stockpile, topsoil, clay, medium hard, ideal conditions, 300 H.P. dozer	350.00	cy	81	-	-		263	-	0.984 /cy	344
	1000	Topsoil stripping and stockpiling, topsoil, clay, medium hard, ideal conditions, 300 H.P. dozer	1,146.00	cy	267	-	-		861	-	0.984 /cy	1,128
n	5100	Excavating,bulk bank measure,sandy clay/loam,open site,1 cy capacity = 120 cy/hour,excavator,hydraulic,crawler mounted,excluding truck loading	8,631.00	bcy	19,613	-	-		23,542	-	5.00 /bcy	43,155
n	5100	xfer Table Excavating,bulk bank measure,sandy clay/loam,open site,1 cy capacity = 120 cy/hour,excavator,hydraulic,crawler mounted,excluding truck loading	2,845.00	bcy	6,465	-	-		7,760	-	5.000 /bcy	14,225
	1700	Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	3,810.00	ecy	3,239	-	-		10,096	-	3.50 /ecy	13,335
n	1240	Various Structures Spoils Hauling, excavated or borrow material, loose cubic yards, 4 mile round trip, 1.5 loads/hour, 20 C.Y. dump trailer, highway haulers, excludes loading	1,000.00	lcy	1,766	-	-		3,404	-	5.170 /lcy	5,170
n	0560	Hauling, No. 3,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	3,810.00	lcy	27,033	-	-		37,737	-	17.000 /lcy	64,770

North Carolina DOT
Ferry Division Maintenance
Detail Report - Direct Costs

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
		31 23 00.001 Structural Excavation			*67,802*	*37,910*			*100,488*		*17.968/bcy*	*206,200*
		11,476.00 bcy										
		1,338.035 Labor hours										
		1,172.025 Equipment hours										
31 30 00.000		*Earthwork Methods*										
n	1100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	2,000.00	lf	3,372	1,628	-		-	-	2.500 /lf	5,000
n	0100	Laydown Area - Base course drainage layers, aggregate base course for roadways and large paved areas, stone base, compacted, 3/4" stone base, to 6" deep	8,000.00	sy	2,475	43,200	-		6,791	-	6.558 /sy	52,466
	0200	Synthetic erosion control, polypropylene mesh, stapled, 6.5 oz./ S.Y.	2,500.00	sy	717	3,673	-		-	-	1.756 /sy	4,389
n	9100	Stabilized Construction Entrance	1.00	ea	1,772	1,228	-		-	-	2,999.99 /ea	3,000
n	9900	25-ft x 9-in Straw Natural Biodegradable Wattle	500.00	lf	333	2,730	-		65	-	6.255 /lf	3,127
		31 30 00.000 Earthwork Methods			*8,669*	*52,458*			*6,856*		*67,982.95 /ls*	*67,983*
		1.00 ls										
		249.123 Labor hours										
		67.077 Equipment hours										
		DIVISION 31 EARTHWORK			**76,472**	**90,368**	**0**		**107,343**	**0**	**274,182.470/LS**	**274,182**
		1.00 LS										
		1,587.158 Labor hours										
		1,239.102 Equipment hours										
		01 Sitework			***258,731***	***276,733***	***37,000***		***243,811***	***37,000***	***101,580.418/AC***	***853,276***
		8.40 AC										
		4,649.914 Labor hours										
		2,215.950 Equipment hours										

20 Platens

DIVISION 35 — **WATERWAY & MARINE CONSTRUCTION**

35 20 00.200		*Platens*										
n	0900	45,000 sqft of Platens (3 ea)	45,000.00	sf								
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	6.00	day	5,268	-	-		185	-	908.80 /day	5,453
n	4900	Platen Concrete - 285x62 Structural concrete,place,slab grade (4000 psi),	3,900.00	cy	1,064,188	4,777,826	-		7,986	-	1,500.00 /cy	5,850,000
	1000	Railroad track, rail, 100 lb. prime grade (includes bolts, plates etc.)	3,192.00	lf	-	159,600	-		-	-	50.00 /lf	159,600

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - Direct Costs

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
35 20 00.200		*Platens*										
n	0250	Structural steel building framing (Mooring, Misc. Steel)	30,000.00	lb	7,827	48,767	-		3,406	-	2.000 /lb	60,000
		35 20 00.200 Platens			*1,077,283*	*4,986,194*			*11,576*		*9,000.079/LNFT*	*6,075,053*
		675.00 LNFT										
		20,385.762 Labor hours										
		2,316.616 Equipment hours										
		DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**1,077,283**	**4,986,194**	**0**		**11,576**	**0**	**6,075,053.16 /LS**	**6,075,053**
		1.00 LS										
		20,385.762 Labor hours										
		2,316.616 Equipment hours										
		20 Platens			***1,077,283***	***4,986,194***	***0***		***11,576***	***0***	***25,851.290/LNFT***	***6,075,053***
		235.00 LNFT										
		20,385.762 Labor hours										
		2,316.616 Equipment hours										

21 Equipment

DIVISION 35 **WATERWAY & MARINE CONSTRUCTION**

35 20 00.000		*Waterway & Marine Construction & Equipment*										
n	0900	Equipment installation and infrastructure	1.00	ls	75,000	275,000					350,000.00 /ls	350,000
		35 20 00.000 Waterway & Marine Construction & Equipment			*75,000*	*275,000*					*350,000.00 /LS*	*350,000*
		1.00 LS										
		DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**75,000**	**275,000**	**0**		**0**	**0**	**350,000.00 /LS**	**350,000**
		1.00 LS										
		21 Equipment			***75,000***	***275,000***	***0***		***0***	***0***	***350,000.00 /LS***	***350,000***
		1.00 LS										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - Direct Costs

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
		22 Seawall										
DIVISION 35		**WATERWAY & MARINE CONSTRUCTION**										
35 20 00.100		*Seawall*										
n	0900	465 LNFT@ 45' depth @ 35psf (20,925 sqft)										
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	2.00	day	1,756	-	-		62	-	908.80 /day	1,818
n	5300	(47 EA @ 50') Piles, steel, pipe piles, points, heavy duty, 36" diameter @.75"wall	2,350.00	vlf	41,395	1,163,250	-		47,793	-	532.953 /vlf	1,252,439
	0900	Sheet piling, steel, 38 psf, 40' excavation, per ton, left in place, excludes wales	366.50	ton	61,334	789,927	-		57,233	-	2,478.837 /ton	908,494
	2500	Sheet piling, wales, connections and struts, 2/3 salvage (150#/lnft of wall)	35.00	ton	-	21,081	-		-	-	602.310 /ton	21,081
	3000	Sheet piling, steel, tie rod, not upset, with turnbuckle, 1-1/2" to 4", excludes wales	46.50	ton	-	124,935	-		-	-	2,686.775 /ton	124,935
	1000	Corrostion mitigation (galvanized dip) 46#/ft	1,559,000.00	lb	83,043	396,610	-		65,150	-	0.349 /lb	544,803
		35 20 00.100 Seawall			*187,528*	*2,495,802*			*170,239*		*136.371/SF*	*2,853,568*
		20,925.00 SF										
		3,120.447 Labor hours										
		887.071 Equipment hours										
		DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**187,528**	**2,495,802**	**0**		**170,239**	**0**	**2,853,568.49 /LS**	**2,853,568**
		1.00 LS										
		3,120.447 Labor hours										
		887.071 Equipment hours										
		22 Seawall			***187,528***	***2,495,802***	***0***		***170,239***	***0***	***6,136.706/LNFT***	***2,853,568***
		465.00 LNFT										
		3,120.447 Labor hours										
		887.071 Equipment hours										
		23 Transfer Table										
DIVISION 35		**WATERWAY & MARINE CONSTRUCTION**										
32 12 16.000		*Transfer Table - Asphaltic Concrete Vehicular Paving*										
n	0900	7,000 sy, 1,270 cy ag @ 6", 1,712 tn mix										
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	1.76	day	1,545	-	-		54	-	908.80 /day	1,599

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - Direct Costs

	Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
32 12 16.000		*Transfer Table - Asphaltic Concrete Vehicular Paving*										
	0100	No. 3 Aggregate for earthwork, bank run gravel, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction	1,270.72	lcy	3,114	12,644	-		5,612	-	16.817 /lcy	21,370
	0012	Fine grading, finish grading, small area, to be paved with grader	7,626.08	sy	15,771	-	-		20,247	-	4.723 /sy	36,018
	0012	Fine grading, finish grading, small area, to be paved with grader	7,626.08	sy	15,771	-	-		20,247	-	4.723 /sy	36,018
	5020	Compaction, riding, vibrating roller, 3 passes, 6" lifts	1,270.72	ecy	359	-	-		320	-	0.534 /ecy	679
	5020	Compaction, riding, vibrating roller, 3 passes, 6" lifts	953.04	ecy	269	-	-		240	-	0.534 /ecy	509
	0160	Plant-mix asphalt paving, for highways and large paved areas, binder course, 3" thick, no hauling included	7,626.08	sy	7,083	73,820	-		4,466	-	11.194 /sy	85,369
	0340	Plant-mix asphalt paving, for highways and large paved areas, wearing course, 1-1/2" thick, no hauling included	7,626.08	SY	4,993	41,082	-		3,084	-	6.446 /SY	49,159
n	0560	Hauling, asphalt material,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	1,270.72	lcy	13,370	-	-		18,664	-	25.210 /lcy	32,035
n	0560	Hauling, asphalt material,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	953.04	lcy	10,029	-	-		14,000	-	25.213 /lcy	24,029
		32 12 16.000 Transfer Table - Asphaltic Concrete Vehicular Paving			*72,304*	*127,546*			*86,934*		*40.969/sy*	*286,784*
		7,000.00 sy										
		1,396.868 Labor hours										
		902.721 Equipment hours										
35 20 00.300		*Transfer Table*										
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	2.00	day	1,756	-	-		62	-	908.80 /day	1,818
n	4900	Table Concrete - Structural concrete,place,slab grade (4000 psi),	1,111.00	cy	303,157	1,361,068	-		2,275	-	1,500.00 /cy	1,666,500
n	4900	Concrete Wall - Structural concrete,place,slab grade (4000 psi) (514*5)	2,570.00	sf	16,363	73,464	-		123	-	35.00 /sf	89,950
	1000	Railroad track, rail, 100 lb. prime grade (includes bolts, plates etc.)	1,200.00	lf	-	60,000	-		-	-	50.00 /lf	60,000
n	0250	Structural steel building framing (Mooring, Misc. Steel)	10,000.00	lb	2,609	16,256	-		1,135	-	2.000 /lb	20,000
		35 20 00.300 Transfer Table			*323,885*	*1,510,788*			*3,595*		*122.551/sf*	*1,838,268*
		15,000.00 sf										
		6,129.183 Labor hours										
		698.199 Equipment hours										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - Direct Costs

Item	Description	Takeoff Qty	Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	DIVISION 35 WATERWAY & MARINE CONSTRUCTION		**396,190**	**1,638,334**	**0**		**90,529**	**0**	**2,125,052.14 /LS**	**2,125,052**
	1.00 LS									
	7,526.051 Labor hours 1,600.920 Equipment hours									
	23 Transfer Table		***396,190***	***1,638,334***	***0***		***90,529***	***0***	***278.656/SY***	***2,125,052***
	7,626.08 SY									
	7,526.051 Labor hours 1,600.920 Equipment hours									

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - Direct Costs

Estimate Totals

Description	Amount	Totals	Rate			
Labor	1,994,732					
Labor Burden	797,893		40.000	%		
Material	9,672,063					
Equipment	516,155					
Discount RS Means Equip (-25%)						
Subcontract	37,000					
Per Diem	669,041		18.750	$/hr	H	2.80%
Other	37,000					
Subtotal Direct Project Costs		**13,723,884**				
Contractor's Mob	411,716		3.000	%		
Contractor's Field Overhead	1,372,388		10.000	%		
Contractor's General Condition	548,955		4.000	%		
Subtotal Field Const Costs	**2,333,059**	**16,056,943**				
Sales Tax Estimate (Mat & Eq)						
Subtotal Field Const Costs		**16,056,943**				
Contractor's Fee	1,123,986		7.000	%		
Subtotal Field Const Costs	**1,123,986**	**17,180,929**				
Construction Contingency	5,154,279		30.000	%		
Subtotal Field Const Costs	**5,154,279**	**22,335,208**				
Escalation Project (2025)	1,116,760		5.000	%		
Subtotal	**1,116,760**	**23,451,968**				
Contractor's Bonds & Insurance	469,039		2.000	%		
Subtotal	**469,039**	**23,921,007**				
Total		***23,921,007***				

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

Option 1B - Manns Harbor Partial Expansion (Platen 5)

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Project name	**Manns Harbor**
Document	Concept
Estimator	KJA
Labor rate table	HDR_2023_Union
Equipment rate table	HDR_EQ_2023
Project	Capacity Study
Report format	Sorted by 'WBS_MAIN/MF04_DIV/HDR04SPEC' 'Detail' summary
Factor table	Virginia-Norfolk

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
		01 Sitework										
DIVISION 01		**GENERAL REQUIREMENTS**										
01 21 00.000		*Allowances*										
n	0900	Utilities	1,000.00	lnft	30,000	30,000	30,000		30,000	30,000	150.00 /lnft	150,000
n	0900	Dewatering	1.00	ls	7,000	7,000	7,000		7,000	7,000	35,000.00 /ls	35,000
		01 21 00.000 Allowances			*37,000*	*37,000*	*37,000*		*37,000*	*37,000*	*185,000.00 /LS*	*185,000*
		1.00 LS										
		DIVISION 01 GENERAL REQUIREMENTS			**37,000**	**37,000**	**37,000**		**37,000**	**37,000**	**185,000.00 /LS**	**185,000**
		1.00 LS										
DIVISION 02		**EXISTING CONDITIONS**										
02 41 10.000		*Selective Demolition*										
n	0500	Mechanical, Plumbing Relocation to existing / tie-in utilities	200.00	lnft	11,216	-	-		10,784	-	110.000 /lnft	22,000
		02 41 10.000 Selective Demolition			*11,216*				*10,784*		*22,000.01 /LS*	*22,000*
		1.00 LS										
		210.493 Labor hours										
		105.101 Equipment hours										
		DIVISION 02 EXISTING CONDITIONS			**11,216**	**0**	**0**		**10,784**	**0**	**22,000.01 /LS**	**22,000**
		1.00 LS										
		210.493 Labor hours										
		105.101 Equipment hours										
DIVISION 04		**MASONRY**										
04 22 00.080		*Concrete Masonry Unit (8")*										
n	0200	CMU Sandblasting Area	2,600.00	sf	74,068	16,931	-		-	-	35.000 /sf	90,999
		04 22 00.080 Concrete Masonry Unit (8")			*74,068*	*16,931*					*35.000/sf*	*90,999*
		2,600.00 sf										
		1,342.055 Labor hours										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	DIVISION 04 MASONRY			**74,068**	**16,931**	**0**		**0**	**0**	**90,999.22 /LS**	**90,999**
	1.00 LS										
	1,342.055 Labor hours										
DIVISION 26	**ELECTRICAL**										
26 05 00.000	*Electrical: Sitework*										
900	Friction tape	2.66	ea	12	1	-		-	-	4.947 /ea	13
1000	Phase tape	1.52	ea	7	11	-		-	-	11.95 /ea	18
n 0800	Electrcl manholes,hand holes,precast concrete,with concrete cover,3'x3'x3'deep,remove and replace	0.76	ea	356	536	-		76	-	1,272.50 /ea	967
0200	Wiremarkers	72.96	ea	195	4	-		-	-	2.723 /ea	199
0300	Scotchloks	35.34	ea	110	5	-		-	-	3.258 /ea	115
1780	Crimp 1 hole lugs, copper, #8	0.38	ea	4	1	-		-	-	11.63 /ea	4
1780	Crimp 1 hole lugs, copper, #8	0.38	ea	4	1	-		-	-	11.63 /ea	4
1800	Crimp 1 hole lugs, copper, #6	1.14	ea	14	2	-		-	-	13.84 /ea	16
2400	Crimp 1 hole lugs, copper, #2	1.52	ea	27	7	-		-	-	22.30 /ea	34
2600	Crimp 1 hole lugs, copper, 3/0	4.56	ea	108	27	-		-	-	29.739 /ea	136
1200	Wire, copper, #12	9.50	lf	3	2	-		-	-	0.498 /lf	5
1250	Wire, copper, #10	323.00	lf	115	94	-		-	-	0.646 /lf	209
1300	Wire, copper, #8	1,214.100	lf	540	583	-		-	-	0.925 /lf	1,123
1350	Wire, copper, #6	17.10	lf	9	12	-		-	-	1.233 /lf	21
1400	Wire, copper, #4	159.60	lf	106	169	-		-	-	1.727 /lf	276
1500	Wire, copper, #2	38.00	lf	30	62	-		-	-	2.440 /lf	93
1700	Wire, copper, 3/0	83.60	lf	119	314	-		-	-	5.173 /lf	432
2200	Wire, copper, 250 kcmil	638.40	lf	1,135	3,332	-		-	-	6.998 /lf	4,468
0100	Pull string	484.50	lf	134	24	-		-	-	0.325 /lf	157
0100	Grounding rod, copper clad, 10' long, 3/4" diameter	1.90	ea	154	72	-		-	-	118.57 /ea	225
0220	Grounding drive studs, 3/4" diameter	1.90	ea		34	-		-	-	17.79 /ea	34
0250	Ground clamp	1.90	ea	21	11	-		-	-	16.90 /ea	32
0340	Ground wire, copper wire, bare #10	76.00	lf	24	18	-		-	-	0.547 /lf	42
0390	Ground wire, copper wire, bare #8	5.70	lf	2	2	-		-	-	0.691 /lf	4
2730	Exothermic weld, wire to ground rod	1.90	ea	97	19	-		-	-	60.95 /ea	116
0100	Post base	0.76	ea	8	13	-		-	-	28.76 /ea	22
0150	3/8" expansion anchors	7.60	ea	44	7	-		-	-	6.682 /ea	51
0200	3/8" bolts	15.20	ea	20	7	-		-	-	1.774 /ea	27
0300	3/8" nuts	13.68	ea	12	1	-		-	-	0.938 /ea	13
0350	3/8" washers	30.40	ea	27	1	-		-	-	0.918 /ea	28
0400	1 1/2" x 1 1/2" unistrut	7.60	ea	10	14	-		-	-	3.216 /ea	24
0500	1 1/2" unistrut cover	7.60	ea	7	7	-		-	-	1.85 /ea	14
0550	45 degree elbow	1.52	ea	13	7	-		-	-	12.776 /ea	19
0600	90 degree elbow	0.76	ea	6	3	-		-	-	12.78 /ea	10
0650	Tee	0.76	ea	6	3	-		-	-	11.79 /ea	9

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
26 05 00.000	*Electrical: Sitework*										
0850	PVC cement	1.14	ea	51	14	-		-	-	56.71 /ea	65
0900	Nameplates	1.14	ea	13	6	-		-	-	16.018 /ea	18
0950	Tyraps	19.00	ea	25	3	-		-	-	1.481 /ea	28
1000	Wire lube	0.76	ea	34	19	-		-	-	68.96 /ea	52
1800	Rigid galvanized steel conduit, 1" diameter	123.50	lf	676	543	-		-	-	9.872 /lf	1,219
1830	Rigid galvanized steel conduit, 1-1/4" diameter	1.90	lf	11	12	-		-	-	12.395 /lf	24
1870	Rigid galvanized steel conduit, 2" diameter	9.50	lf	75	84	-		-	-	16.755 /lf	159
1900	Rigid galvanized steel conduit, 2-1/2" diameter	7.60	lf	77	128	-		-	-	26.982 /lf	205
2920	Rigid galvanized steel conduit nipples, 1" diameter, 6" long, incl locknuts and bushings	1.14	ea	18	8	-		-	-	22.325 /ea	25
3120	Rigid galvanized steel conduit nipples, 1-1/4" diameter, 6" long, incl locknuts and bushings	0.76	ea	14	7	-		-	-	27.14 /ea	21
3540	Rigid galvanized steel conduit nipples, 2" diameter, 6" long, incl locknuts and bushings	0.76	ea	17	13	-		-	-	39.62 /ea	30
1410	Outlet boxes, cast, 1 gang, FS, 3/4" hub, 2" deep	0.38	ea	11	11	-		-	-	58.053 /ea	22
1600	Outlet boxes, cast, weatherproof receptacle cover, 1 gang	0.38	ea	2	2	-		-	-	9.579 /ea	4
2200	Pull boxes, steel, type SC, raintight & weatherproof, 8" L x 8" W x 6" D, NEMA 3R	1.52	ea	68	35	-		-	-	67.493 /ea	103
6500	Wiring boxes, dust tight & drip tight, 72" L x 72" W x 12" D, NEMA 12, J.I.C.	0.38	ea	203	1,799	-		-	-	5,267.97 /ea	2,002
0300	Conduit fittings for rigid galvanized steel, standard, locknuts, 1" diameter	4.56	ea	-	3	-		-	-	0.607 /ea	3
0500	Conduit fittings for rigid galvanized steel, standard, locknuts, 1-1/4" diameter	3.04	ea	-	2	-		-	-	0.773 /ea	2
1000	Conduit fittings for rigid galvanized steel, standard, locknuts, 2" diameter	3.04	ea	-	6	-		-	-	1.813 /ea	6
1170	Conduit fittings for rigid galvanized steel, bushings, plastic, 1" diameter	2.28	ea	29	0	-		-	-	12.90 /ea	29
1200	Conduit fittings for rigid galvanized steel, bushings, plastic, 1-1/4" diameter	1.52	ea	23	0	-		-	-	15.066 /ea	23
1250	Conduit fittings for rigid galvanized steel, bushings, plastic, 2" diameter	1.52	ea	36	1	-		-	-	24.316 /ea	37
2180	Conduit fittings for rigid galvanized steel, boxes connector, 1" diameter	7.60	ea	54	38	-		-	-	12.16 /ea	92
2190	Conduit fittings for rigid galvanized steel, boxes connector, 1-1/4" diameter	1.52	ea	14	20	-		-	-	22.17 /ea	34
2210	Conduit fittings for rigid galvanized steel, boxes connector, 2" diameter	6.08	ea	108	241	-		-	-	57.475 /ea	349
2220	Conduit fittings for rigid galvanized steel, boxes connector, 2-1/2" diameter	3.04	ea	60	319	-		-	-	124.62 /ea	379
1090	Flexible metallic conduit, sealtite, 3/4" diameter	9.12	lf	32	13	-		-	-	4.998 /lf	46
1200	Flexible metallic conduit, sealtite, 1-1/4" diameter	1.14	lf	8	4	-		-	-	10.29 /lf	12
1400	Flexible metallic conduit, sealtite, 2" diameter	3.42	lf	41	15	-		-	-	16.19 /lf	55
1700	Flexible metallic conduit, sealtite, connectors, straight, 3/4" diameter	3.04	ea	22	14	-		-	-	11.75 /ea	36
2000	Flexible metallic conduit, sealtite, connectors, straight, 1-1/4" diameter	0.38	ea	4	6	-		-	-	27.18 /ea	10

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
26 05 00.000	*Electrical: Sitework*										
2200	Flexible metallic conduit, sealtite, connectors, straight, 2" diameter	1.14	ea	20	43	-		-	-	55.51 /ea	63
2400	Flexible metallic conduit, sealtite, connectors, 90 Deg., 3/4" diameter	3.04	ea	22	20	-		-	-	13.68 /ea	42
2800	Flexible metallic conduit, sealtite, connectors, 90 Deg., 1-1/4" diameter	0.38	ea	4	11	-		-	-	41.00 /ea	16
3100	Flexible metallic conduit, sealtite, connectors, 90 Deg., 2" diameter	1.14	ea	20	58	-		-	-	68.74 /ea	78
4500	Flexible metallic conduit, coupling sealtite to rigid, 3/4" diameter	3.04	ea	60	16	-		-	-	25.053 /ea	76
4900	Flexible metallic conduit, coupling sealtite to rigid, 1-1/4" diameter	0.38	ea	11	4	-		-	-	39.24 /ea	15
5100	Flexible metallic conduit, coupling sealtite to rigid, 2" diameter	1.14	ea	41	34	-		-	-	65.46 /ea	75
3270	PVC conduit, schedule 40, 1" diameter, in concrete slab, incl terminations, fittings and supports	319.20	lf	568	313	-		-	-	2.758 /lf	880
3300	PVC conduit, schedule 40, 1-1/4" diameter, in concrete slab, incl terminations, fittings and supports	1.90	lf	4	3	-		-	-	3.547 /lf	7
3350	PVC conduit, schedule 40, 2" diameter, in concrete slab, incl terminations, fittings and supports	176.70	lf	524	366	-		-	-	5.034 /lf	890
3370	PVC conduit, schedule 40, 2-1/2" diameter, in concrete slab, incl terminations, fittings and supports	311.600	lf	1,231	1,035	-		-	-	7.272 /lf	2,266
3530	PVC conduit, schedule 40, 90 elbow, 1" diameter, in concrete slab	5.70	ea	63	229	-		-	-	51.296 /ea	292
3550	PVC conduit, schedule 40, sweep, 30" radius, 1-1/4" diameter, in concrete slab	0.76	ea	11	6	-		-	-	23.20 /ea	18
3600	PVC conduit, schedule 40, 90 elbow, 2" diameter, in concrete slab	6.46	ea	128	329	-		-	-	70.72 /ea	457
3630	PVC conduit, schedule 40, sweep, 30" radius, 2-1/2" diameter, in concrete slab	2.28	ea	58	179	-		-	-	103.807 /ea	237
3770	PVC conduit, schedule 40, adapter / coupling, 1" diameter, in concrete slab	5.70	ea		2	-		-	-	0.295 /ea	2
3800	PVC conduit, schedule 40, couplings, 1-1/4" diameter, in concrete slab	0.76	ea		0	-		-	-	0.37 /ea	0
3850	PVC conduit, schedule 40, adapter, 2" diameter, in concrete slab	6.46	ea		5	-		-	-	0.724 /ea	5
3870	PVC conduit, schedule 40, couplings, 2-1/2" diameter, in concrete slab	2.28	ea		2	-		-	-	1.088 /ea	2
4030	PVC conduit, schedule 40, end bells, 1" diameter, in concrete slab	2.28	ea	14	7	-		-	-	9.175 /ea	21
4150	PVC conduit, schedule 40, end bells, 2" diameter, in concrete slab	3.04	ea	32	18	-		-	-	16.388 /ea	50
4350	Underground marking tape	328.70	lf	117	93	-		-	-	0.640 /lf	210
0400	Trench No 2 (backhoe with operator)	328.70	lf	585	21,366	-		-	-	66.778 /lf	21,950

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

	Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
26 05 00.000		*Electrical: Sitework*										
	0600	Concrete encasement	8.655	cys	1,540	3,162	-		-	-	543.278 /cys	4,702
	0800	Dirt removal	36.524	cys	365	8,948	-		-	-	255.004 /cys	9,314
	1000	Backfill	29.767	cys	662	306	-		-	-	32.52 /cys	968
	1200	Sand backfill	2.481	cys	110	85	-		-	-	78.763 /cys	195
	1400	Compaction	328.70	lf	395	805	-		-	-	3.650 /lf	1,200
	0100	Vibration isolation	0.38	ea	17	9	-		-	-	68.947 /ea	26
	3700	Transformer, dry-type, ventilated, 3 phase 480 V primary 120/208 V secondary, 75 kVA	0.38	ea	386	1,235	-		-	-	4,266.24 /ea	1,621
	1000	Panelboards, 120/208 V, 225 amp, 42 circuits	0.38	ea	398	1,615	-		-	-	5,296.10 /ea	2,013
	1500	Panelboards, 277/480 V, 225 amp, 42 circuits	0.38	ea	451	2,090	-		-	-	6,685.605 /ea	2,541
	3600	Receptacle, 20 amp, single	0.38	ea	5	8	-		-	-	34.26 /ea	13
	4870	Receptacle box assembly, 50A, welding receptacle	0.76	ea	34	156	-		-	-	249.776 /ea	190
	4875	Receptacle box assembly, 100A, welding receptacle	0.76	ea	46	486	-		-	-	699.87 /ea	532
	4880	Receptacle box assembly, 200A, welding receptacle	0.76	ea	80	1,677	-		-	-	2,311.570 /ea	1,757
	0200	Lighting contactors, 3 pole, electrically held, 600 volt, 30 amp, NEMA 1	0.38	ea	38	112	-		-	-	392.80 /ea	149
	0420	Mounting bracket	3.04	ea	135	152	-		-	-	94.461 /ea	287
	0120	Lighting fixture	3.04	ea	541	1,292	-		-	-	602.84 /ea	1,833
	3005	Electrical utility pole, wood pole yellow pine, CCA-treated, 50', class 3, excludes excavation, backfill and cast in place concrete	1.52	ea	772	1,710	-		95	-	1,695.401 /ea	2,577
n	0140	Foreman at 15% of 869	49.533	hour	718	-	-		-	-	14.50 /hour	718
n	0160	Journeyman at 10% of 869	33.022	hour	248	-	-		-	-	7.50 /hour	248
n	0180	Cleanup and delivery at 5% of 869	16.511	hour	413	-	-		-	-	25.00 /hour	413
		26 05 00.000 Electrical: Sitework			*16,066*	*56,759*			*170*		*72,995.22 /ls*	*72,995*
		1.00 ls										
		429.418 Labor hours										
		4.495 Equipment hours										
		DIVISION 26 ELECTRICAL			**16,066**	**56,759**	**0**		**170**	**0**	**72,995.22 /LS**	**72,995**
		1.00 LS										
		429.418 Labor hours										
		4.495 Equipment hours										
DIVISION 31		**EARTHWORK**										
31 23 00.001		*Structural Excavation*										
	0100	No. 3 Aggregate for earthwork, bank run gravel, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction	1,268.73	lcy	3,109	12,624	-		5,603	-	16.817 /lcy	21,336

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

	Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
31 23 00.001		*Structural Excavation*										
	1000	Topsoil spreading from stockpile, topsoil, clay, medium hard, ideal conditions, 300 H.P. dozer	116.55	cy	27	-	-		88	-	0.984 /cy	115
	1000	Topsoil stripping and stockpiling, topsoil, clay, medium hard, ideal conditions, 300 H.P. dozer	381.618	cy	89	-	-		287	-	0.984 /cy	375
n	5100	Excavating,bulk bank measure,sandy clay/loam,open site,1 cy capacity = 120 cy/hour,excavator,hydraulic,crawler mounted,excluding truck loading	2,874.123	bcy	6,531	-	-		7,839	-	5.000 /bcy	14,371
n	5100	xfer Table Excavating,bulk bank measure,sandy clay/loam,open site,1 cy capacity = 120 cy/hour,excavator,hydraulic,crawler mounted,excluding truck loading	947.385	bcy	2,153	-	-		2,584	-	5.000 /bcy	4,737
	1700	Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	1,268.73	ecy	1,079	-	-		3,362	-	3.50 /ecy	4,441
n	1240	Various Structures Spoils Hauling, excavated or borrow material, loose cubic yards, 4 mile round trip, 1.5 loads/hour, 20 C.Y. dump trailer, highway haulers, excludes loading	333.00	lcy	588	-	-		1,133	-	5.17 /lcy	1,722
n	0560	Hauling, No. 3,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	1,268.73	lcy	9,002	-	-		12,566	-	17.000 /lcy	21,568
		31 23 00.001 Structural Excavation			*22,578*	*12,624*			*33,462*		*17.968/bcy*	*68,664*
		3,821.508 bcy										
		445.566 Labor hours										
		390.284 Equipment hours										
31 30 00.000		*Earthwork Methods*										
n	1100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	2,000.00	lf	3,372	1,628	-		-	-	2.500 /lf	5,000
n	0100	Laydown Area - Base course drainage layers, aggregate base course for roadways and large paved areas, stone base, compacted, 3/4" stone base, to 6" deep	4,000.00	sy	1,238	21,600	-		3,395	-	6.558 /sy	26,233
	0200	Synthetic erosion control, polypropylene mesh, stapled, 6.5 oz./ S.Y.	2,500.00	sy	717	3,673	-		-	-	1.756 /sy	4,389
n	9100	Stabilized Construction Entrance	1.00	ea	1,772	1,228	-		-	-	2,999.99 /ea	3,000
n	9900	25-ft x 9-in Straw Natural Biodegradable Wattle	500.00	lf	333	2,730	-		65	-	6.255 /lf	3,127
		31 30 00.000 Earthwork Methods			*7,432*	*30,858*			*3,460*		*41,749.770/ls*	*41,750*
		1.00 ls										
		217.123 Labor hours										
		35.077 Equipment hours										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Item	Description	Takeoff Qty	Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	DIVISION 31 EARTHWORK		**30,010**	**43,482**	**0**		**36,922**	**0**	**110,414.19 /LS**	**110,414**
	1.00 LS									
	662.688 Labor hours									
	425.361 Equipment hours									
	01 Sitework		***168,360***	***154,172***	***37,000***		***84,877***	***37,000***	***320,939.093/AC***	***481,409***
	1.50 AC									
	2,644.654 Labor hours									
	534.957 Equipment hours									

20 Platens

DIVISION 35 — **WATERWAY & MARINE CONSTRUCTION**

32 12 16.000		*Transfer Table - Asphaltic Concrete Vehicular Paving*										
n	0900	7,000 sy, 1,270 cy ag @ 6", 1,712 tn mix										
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	1.026	day	901	-	-	32	-	908.801 /day	932
	0100	No. 3 Aggregate for earthwork, bank run gravel, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction	740.83	lcy	1,816	7,371	-	3,272	-	16.817 /lcy	12,459
	0012	Fine grading, finish grading, small area, to be paved with grader	4,446.005	sy	9,194	-	-	11,804	-	4.723 /sy	20,998
	0012	Fine grading, finish grading, small area, to be paved with grader	4,446.005	sy	9,194	-	-	11,804	-	4.723 /sy	20,998
	5020	Compaction, riding, vibrating roller, 3 passes, 6" lifts	740.83	ecy	209	-	-	186	-	0.534 /ecy	396
	5020	Compaction, riding, vibrating roller, 3 passes, 6" lifts	555.622	ecy	157	-	-	140	-	0.534 /ecy	297
	0160	Plant-mix asphalt paving, for highways and large paved areas, binder course, 3" thick, no hauling included	4,446.005	sy	4,129	43,037	-	2,604	-	11.194 /sy	49,770
	0340	Plant-mix asphalt paving, for highways and large paved areas, wearing course, 1-1/2" thick, no hauling included	4,446.005	SY	2,911	23,951	-	1,798	-	6.446 /SY	28,660
n	0560	Hauling, asphalt material,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	740.83	lcy	7,795	-	-	10,881	-	25.21 /lcy	18,676
n	0560	Hauling, asphalt material,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	555.622	lcy	5,847	-	-	8,162	-	25.213 /lcy	14,009

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
		32 12 16.000 Transfer Table - Asphaltic Concrete Vehicular Paving			*42,153*	*74,359*			*50,683*		*37.606/SY*	*167,195*
		4,446.005 SY										
		814.373 Labor hours										
		526.286 Equipment hours										
35 20 00.200		*Platens*										
n	0900	15,000 sqft of Platens (1 ea)	15,000.00	sf								
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	2.00	day	1,756	-	-		62	-	908.80 /day	1,818
n	4900	Platen Concrete - 285x62 Structural concrete,place,slab grade (4000 psi),	1,300.00	cy	354,729	1,592,609	-		2,662	-	1,500.00 /cy	1,950,000
	1000	Railroad track, rail, 100 lb. prime grade (includes bolts, plates etc.)	1,064.00	lf	-	53,200	-		-	-	50.00 /lf	53,200
n	0250	Structural steel building framing (Mooring, Misc. Steel)	10,000.00	lb	2,609	16,256	-		1,135	-	2.000 /lb	20,000
		35 20 00.200 Platens			*359,094*	*1,662,065*			*3,859*		*3,000.026/LNFT*	*2,025,018*
		675.00 LNFT										
		6,795.254 Labor hours										
		772.205 Equipment hours										
		DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**401,248**	**1,736,424**	**0**		**54,541**	**0**	**2,192,213.010/LS**	**2,192,213**
		1.00 LS										
		7,609.627 Labor hours										
		1,298.491 Equipment hours										
		20 Platens			***401,248***	***1,736,424***	***0***		***54,541***	***0***	***9,328.566/LNFT***	***2,192,213***
		235.00 LNFT										
		7,609.627 Labor hours										
		1,298.491 Equipment hours										

21 Equipment

DIVISION 35 **WATERWAY & MARINE CONSTRUCTION**

35 20 00.000		*Waterway & Marine Construction & Equipment*										
n	0900	Equipment installation and infrastructure	1.00	ls	75,000	275,000					350,000.00 /ls	350,000
		35 20 00.000 Waterway & Marine Construction & Equipment			*75,000*	*275,000*					*350,000.00 /LS*	*350,000*
		1.00 LS										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	35 20 00.000 Waterway & Marine Construction & Equipment			*75,000*	*275,000*					*350,000.00 /LS*	*350,000*
	1.00 LS										
	DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**75,000**	**275,000**	**0**		**0**	**0**	**350,000.00 /LS**	**350,000**
	1.00 LS										
	21 Equipment			***75,000***	***275,000***	***0***		***0***	***0***	***350,000.00 /LS***	***350,000***
	1.00 LS										

22 Seawall

DIVISION 35 **WATERWAY & MARINE CONSTRUCTION**

35 20 00.100		*Seawall*										
n	0900	465 LNFT@ 45' depth @ 35psf (20,925 sqft)										
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	2.00	day	1,756	-	-	62	-	908.80 /day	1,818
n	5300	(47 EA @ 50') Piles, steel, pipe piles, points, heavy duty, 36" diameter @.75"wall	1,786.00	vlf	31,460	884,070	-	36,323	-	532.953 /vlf	951,853
	0900	Sheet piling, steel, 38 psf, 40' excavation, per ton, left in place, excludes wales	278.540	ton	46,614	600,344	-	43,497	-	2,478.837 /ton	690,455
	2500	Sheet piling, wales, connections and struts, 2/3 salvage (150#/lnft of wall)	26.60	ton	-	16,021	-	-	-	602.310 /ton	16,021
	3000	Sheet piling, steel, tie rod, not upset, with turnbuckle, 1-1/2" to 4", excludes wales	35.34	ton	-	94,951	-	-	-	2,686.775 /ton	94,951
	1000	Corrostion mitigation (galvanized dip) 46#/ft	1,184,840.00	lb	63,112	301,423	-	49,514	-	0.349 /lb	414,050
	35 20 00.100 Seawall				*142,942*	*1,896,810*		*129,396*		*136.545/SF*	*2,169,148*
	15,886.00 SF										
	2,379.219 Labor hours										
	678.014 Equipment hours										
	DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**142,942**	**1,896,810**	**0**		**129,396**	**0**	**2,169,148.280/LS**	**2,169,148**
	1.00 LS										
	2,379.219 Labor hours										
	678.014 Equipment hours										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Item	Description	Takeoff Qty	Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
22 Seawall			***142,942***	***1,896,810***	***0***		***129,396***	***0***	***6,144.896/LNFT***	***2,169,148***
	353.00 LNFT									
	2,379.219 Labor hours									
	678.014 Equipment hours									

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Estimate Totals

Description	Amount	Totals	Rate
Labor	787,550		
Labor Burden	315,020		40.000 %
Material	4,062,405		
Equipment	268,815		
Discount RS Means Equip (-25%)			
Subcontract	37,000		
Per Diem	236,878		18.750 $/hr
Other	37,000		
Subtotal Direct Project Costs		**5,744,668**	
Contractor's Mob	172,340		3.000 %
Contractor's Field Overhead	574,467		10.000 %
Contractor's General Condition	229,787		4.000 %
Subtotal Field Const Costs	**976,594**	**6,721,262**	
Sales Tax Estimate (Mat & Eq)			
Subtotal Field Const Costs		**6,721,262**	
Contractor's Fee	470,488		7.000 %
Subtotal Field Const Costs	**470,488**	**7,191,750**	
Construction Contingency	2,157,525		30.000 %
Subtotal Field Const Costs	**2,157,525**	**9,349,275**	
Escalation Project (2025)	467,464		5.000 %
Subtotal	**467,464**	**9,816,739**	
Contractor's Bonds & Insurance	196,335		2.000 %
Subtotal	**196,335**	**10,013,074**	
Total		***10,013,074***	

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

Option 2 - Cherry Branch

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

Project name	**Cherry Branch**
Document	Concept
Estimator	KJA
Labor rate table	HDR_2023_Union
Equipment rate table	HDR_EQ_2023
Project	Capacity Study
Report format	Sorted by 'WBS_MAIN/MF04_DIV/HDR04SPEC' 'Detail' summary
Factor table	North Carolina-Kinston

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Design Stage: Concept

Estimate Version:

2/13/2024 12:24 PM

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
		01 Sitework										
DIVISION 01		**GENERAL REQUIREMENTS**										
01 21 00.000		*Allowances*										
n	0900	Utilities	2,000.00	lnft	60,000	60,000	60,000		60,000	60,000	150.00 /lnft	300,000
n	0900	Dewatering	1.00	ls	30,000	30,000	30,000		30,000	30,000	150,000.00 /ls	150,000
n	0900	Electrical - Sitework	1.00	ls	2,000	2,000	2,000		2,000	2,000	10,000.00 /ls	10,000
		01 21 00.000 Allowances			*92,000*	*92,000*	*92,000*		*92,000*	*92,000*	*460,000.00 /LS*	*460,000*
		1.00 LS										
		DIVISION 01 GENERAL REQUIREMENTS			**92,000**	**92,000**	**92,000**		**92,000**	**92,000**	**460,000.00 /LS**	**460,000**
		1.00 LS										
DIVISION 31		**EARTHWORK**										
31 23 00.001		*Structural Excavation*										
n	0500	Clearing & Grubbing	1.00	ls	7,647	-	-		7,353	-	15,000.00 /ls	15,000
	0100	No. 3 Aggregate for earthwork, bank run gravel, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction	1,500.00	lcy	3,676	14,925	-		6,624	-	16.817 /lcy	25,225
	1000	Topsoil spreading from stockpile, topsoil, clay, medium hard, ideal conditions, 300 H.P. dozer	500.00	cy	116	-	-		376	-	0.984 /cy	492
	1000	Topsoil stripping and stockpiling, topsoil, clay, medium hard, ideal conditions, 300 H.P. dozer	3,528.00	cy	821	-	-		2,650	-	0.984 /cy	3,471
n	5100	Excavating,bulk bank measure,sandy clay/loam,open site,1 cy capacity = 120 cy/hour,excavator,hydraulic,crawler mounted,excluding truck loading	14,590.00	bcy	33,155	-	-		39,795	-	5.00 /bcy	72,950
	1700	Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	3,810.00	ecy	3,239	-	-		10,096	-	3.50 /ecy	13,335
n	1240	Various Structures Spoils Hauling, excavated or borrow material, loose cubic yards, 4 mile round trip, 1.5 loads/hour, 20 C.Y. dump trailer, highway haulers, excludes loading	1,000.00	lcy	1,766	-	-		3,404	-	5.170 /lcy	5,170
n	0560	Hauling, No. 3,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	1,500.00	lcy	10,643	-	-		14,857	-	17.000 /lcy	25,500
		31 23 00.001 Structural Excavation			*61,064*	*14,925*			*85,154*		*11.045/cy*	*161,143*
		14,590.00 cy										
		1,208.638 Labor hours										
		926.273 Equipment hours										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
31 30 00.000		*Earthwork Methods*										
n	1100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	3,000.00	lf	5,058	2,442	-		-	-	2.50 /lf	7,500
n	0100	Laydown Area - Base course drainage layers, aggregate base course for roadways and large paved areas, stone base, compacted, 3/4" stone base, to 6" deep	8,000.00	sy	2,475	43,200	-		6,791	-	6.558 /sy	52,466
	0200	Synthetic erosion control, polypropylene mesh, stapled, 6.5 oz./ S.Y.	2,500.00	sy	717	3,673	-		-	-	1.756 /sy	4,389
n	9100	Stabilized Construction Entrance	2.00	ea	3,545	2,455	-		-	-	2,999.985 /ea	6,000
n	9900	25-ft x 9-in Straw Natural Biodegradable Wattle	1,000.00	lf	666	5,460	-		129	-	6.255 /lf	6,255
		31 30 00.000 Earthwork Methods			*12,461*	*57,230*			*6,920*		*76,610.41 /ls*	*76,610*
		1.00 ls										
		355.416 Labor hours										
		70.154 Equipment hours										
		DIVISION 31 EARTHWORK			**73,525**	**72,155**	**0**		**92,074**	**0**	**237,753.79 /LS**	**237,754**
		1.00 LS										
		1,564.054 Labor hours										
		996.427 Equipment hours										
		01 Sitework			***165,525***	***164,155***	***92,000***		***184,074***	***92,000***	***69,775.379/AC***	***697,754***
		10.00 AC										
		1,564.054 Labor hours										
		996.427 Equipment hours										

03 Warehouse / Machine Shop

DIVISION 01 **GENERAL REQUIREMENTS**

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
01 21 00.000		*Allowances*										
n	0900	Square Foot Allowance - Building Only	2,800.00	SF	123,200	123,200	123,200		123,200	123,200	220.00 /SF	616,000
		01 21 00.000 Allowances			*123,200*	*123,200*	*123,200*		*123,200*	*123,200*	*616,000.00 /LS*	*616,000*
		1.00 LS										
		DIVISION 01 GENERAL REQUIREMENTS			**123,200**	**123,200**	**123,200**		**123,200**	**123,200**	**616,000.00 /LS**	**616,000**
		1.00 LS										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
03 Warehouse / Machine Shop					***123,200***	***123,200***	***123,200***		***123,200***	***123,200***	***220.00 /SF***	***616,000***
		2,800.00 SF										
05 Maintenance Garage												
DIVISION 01		**GENERAL REQUIREMENTS**										
01 21 00.000		*Allowances*										
n	0900	Square Foot Allowance - Building Only	1,420.00	SF	62,480	62,480	62,480		62,480	62,480	220.00 /SF	312,400
		01 21 00.000 Allowances			*62,480*	*62,480*	*62,480*		*62,480*	*62,480*	*312,400.00 /LS*	*312,400*
		1.00 LS										
DIVISION 01 GENERAL REQUIREMENTS					**62,480**	**62,480**	**62,480**		**62,480**	**62,480**	**312,400.00 /LS**	**312,400**
		1.00 LS										
05 Maintenance Garage					***62,480***	***62,480***	***62,480***		***62,480***	***62,480***	***220.00 /SF***	***312,400***
		1,420.00 SF										
06 Paint Shop												
DIVISION 01		**GENERAL REQUIREMENTS**										
01 21 00.000		*Allowances*										
n	0900	Square Foot Allowance - Building Only	31,200.00	SF	1,372,800	1,372,800	1,372,800		1,372,800	1,372,800	220.00 /SF	6,864,000
n	0900	Ductwork / HVAC premium Square Foot Allowance - Building Only	31,200.00	ls	93,600	93,600	93,600		93,600	93,600	15.00 /ls	468,000
		01 21 00.000 Allowances			*1,466,400*	*1,466,400*	*1,466,400*		*1,466,400*	*1,466,400*	*7,332,000.00 /LS*	*7,332,000*
		1.00 LS										
DIVISION 01 GENERAL REQUIREMENTS					**1,466,400**	**1,466,400**	**1,466,400**		**1,466,400**	**1,466,400**	**7,332,000.00 /LS**	**7,332,000**
		1.00 LS										
06 Paint Shop					***1,466,400***	***1,466,400***	***1,466,400***		***1,466,400***	***1,466,400***	***235.00 /SF***	***7,332,000***
		31,200.00 SF										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

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Design Stage: Concept
Estimate Version:

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
		06 Paint Shop			***1,466,400***	***1,466,400***	***1,466,400***		***1,466,400***	***1,466,400***	***235.00 /SF***	***7,332,000***
		31,200.00 SF										

08 Guard House

DIVISION 13 SPECIAL CONSTRUCTION

13 34 19.000 Metal Building Systems

n	0900	Prefabricated Guard House	1.00	ls	3,000	3,000	3,000		3,000	3,000	15,000.00 /ls	15,000
n	0900	Electrical - Guard House	1.00	ls	13,000	13,000	13,000		13,000	13,000	65,000.00 /ls	65,000
		13 34 19.000 Metal Building Systems			*16,000*	*16,000*	*16,000*		*16,000*	*16,000*	*80,000.00 /LS*	*80,000*
		1.00 LS										
		DIVISION 13 SPECIAL CONSTRUCTION			**16,000**	**16,000**	**16,000**		**16,000**	**16,000**	**80,000.00 /LS**	**80,000**
		1.00 LS										
		08 Guard House			***16,000***	***16,000***	***16,000***		***16,000***	***16,000***	***80,000.00 /LS***	***80,000***
		1.00 LS										

20 Platens

DIVISION 35 WATERWAY & MARINE CONSTRUCTION

35 20 00.200 Platens

n	0900	45,000 sqft of Platens (3 ea)	45,000.00	sf								
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	6.00	day	5,268	-	-		185	-	908.80 /day	5,453
n	4900	Platen Concrete - 285x62 Structural concrete,place,slab grade (4000 psi),	3,900.00	cy	1,064,188	4,777,826	-		7,986	-	1,500.00 /cy	5,850,000
	1000	Railroad track, rail, 100 lb. prime grade (includes bolts, plates etc.)	3,192.00	lf	-	159,600	-		-	-	50.00 /lf	159,600
n	0250	Structural steel building framing (Mooring, Misc. Steel)	30,000.00	lb	7,827	48,767	-		3,406	-	2.000 /lb	60,000
		35 20 00.200 Platens			*1,077,283*	*4,986,194*			*11,576*		*9,000.079/LNFT*	*6,075,053*
		675.00 LNFT										

20,385.762 Labor hours
2,316.616 Equipment hours

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

Item	Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**1,077,283**	**4,986,194**	**0**		**11,576**	**0**	**6,075,053.16 /LS**	**6,075,053**
	1.00 LS										
	20,385.762 Labor hours										
	2,316.616 Equipment hours										
	20 Platens			***1,077,283***	***4,986,194***	***0***		***11,576***	***0***	***331.066/SF***	***6,075,053***
	18,350.00 SF										
	20,385.762 Labor hours										
	2,316.616 Equipment hours										

21 Equipment

DIVISION 35 **WATERWAY & MARINE CONSTRUCTION**

35 20 00.000		*Waterway & Marine Construction & Equipment*									
n	0900	Equipment installation and infrastructure	1.00	ls	256,800	1,659,000				1,915,800.00 /ls	1,915,800
		35 20 00.000 Waterway & Marine Construction & Equipment			*256,800*	*1,659,000*				*1,915,800.00 /LS*	*1,915,800*
		1.00 LS									
		DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**256,800**	**1,659,000**	**0**	**0**	**0**	**1,915,800.00 /LS**	**1,915,800**
		1.00 LS									
		21 Equipment			***256,800***	***1,659,000***	***0***	***0***	***0***	***1,915,800.00 /LS***	***1,915,800***
		1.00 LS									

22 Seawall

DIVISION 35 **WATERWAY & MARINE CONSTRUCTION**

35 20 00.100		*Seawall*									
n	0900	400 LNFT@ 45' depth @ 35psf (18,000 sqft)									
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	2.00	day	1,756	-	-	62	-	908.80 /day	1,818

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
35 20 00.100		*Seawall*										
n	5300	(47 EA @ 50') Piles, steel, pipe piles, points, heavy duty, 36" diameter @.75"wall	2,025.70	vlf	35,683	1,002,722	-		41,198	-	532.953 /vlf	1,079,602
	0900	Sheet piling, steel, 38 psf, 40' excavation, per ton, left in place, excludes wales	315.923	ton	52,870	680,917	-		49,335	-	2,478.837 /ton	783,122
	2500	Sheet piling, wales, connections and struts, 2/3 salvage (150#/lnft of wall)	30.17	ton	-	18,172	-		-	-	602.310 /ton	18,172
	3000	Sheet piling, steel, tie rod, not upset, with turnbuckle, 1-1/2" to 4", excludes wales	40.083	ton	-	107,694	-		-	-	2,686.775 /ton	107,694
	1000	Corrostion mitigation (galvanized dip) 46#/ft	1,343,858.00	lb	71,583	341,877	-		56,160	-	0.349 /lb	469,620
		35 20 00.100 Seawall			*161,891*	*2,151,381*			*146,754*		*136.668/SF*	*2,460,027*
		18,000.00 SF										
		2,694.241 Labor hours										
		766.863 Equipment hours										
		DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**161,891**	**2,151,381**	**0**		**146,754**	**0**	**2,460,026.85 /LS**	**2,460,027**
		1.00 LS										
		2,694.241 Labor hours										
		766.863 Equipment hours										
		22 Seawall			***161,891***	***2,151,381***	***0***		***146,754***	***0***	***6,150.067/LNFT***	***2,460,027***
		400.00 LNFT										
		2,694.241 Labor hours										
		766.863 Equipment hours										

23 Transfer Table

DIVISION 35 **WATERWAY & MARINE CONSTRUCTION**

32 12 16.000		*Asphaltic Concrete Vehicular Paving*										
n	0900	9,977 sy, 1,658 cy ag @ 6", 1,900 tn mix										
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	2.296	day	2,016	-	-		71	-	908.802 /day	2,087
	0100	No. 3 Aggregate for earthwork, bank run gravel, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction	1,657.943	lcy	4,063	16,497	-		7,322	-	16.817 /lcy	27,882
	0012	Fine grading, finish grading, small area, to be paved with grader	9,949.955	sy	20,577	-	-		26,417	-	4.723 /sy	46,994
	0012	Fine grading, finish grading, small area, to be paved with grader	9,949.955	sy	20,577	-	-		26,417	-	4.723 /sy	46,994
	5020	Compaction, riding, vibrating roller, 3 passes, 6" lifts	1,657.943	ecy	468	-	-		417	-	0.534 /ecy	885

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

	Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
32 12 16.000			*Asphaltic Concrete Vehicular Paving*										
		5020	Compaction, riding, vibrating roller, 3 passes, 6" lifts	1,243.457	ecy	351	-	-		313	-	0.534 /ecy	664
		0160	Plant-mix asphalt paving, for highways and large paved areas, binder course, 3" thick, no hauling included	9,949.955	sy	9,241	96,316	-		5,827	-	11.194 /sy	111,383
		0340	Plant-mix asphalt paving, for highways and large paved areas, wearing course, 1-1/2" thick, no hauling included	9,949.955	SY	6,515	53,600	-		4,024	-	6.446 /SY	64,139
n		0560	Hauling, asphalt material,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	1,657.943	lcy	17,445	-	-		24,352	-	25.210 /lcy	41,797
n		0560	Hauling, asphalt material,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	1,243.457	lcy	13,085	-	-		18,266	-	25.213 /lcy	31,351
			32 12 16.000 Asphaltic Concrete Vehicular Paving			*94,337*	*166,413*			*113,425*		*37.504/sy*	*374,175*
			9,977.00 sy										
			1,822.527 Labor hours										
			1,177.802 Equipment hours										
35 20 00.300			*Transfer Table*										
n		1100	Boundary & survey markers, crew for building layout, 2 person crew	6.00	day	5,268	-	-		185	-	908.80 /day	5,453
n		4900	Table Concrete - Structural concrete,place,slab grade (4000 psi),	3,588.00	cy	979,053	4,395,600	-		7,347	-	1,500.00 /cy	5,382,000
n		4900	Concrete Wall - Structural concrete,place,slab grade (4000 psi) (900*5)	4,500.00	sf	28,651	128,634	-		215	-	35.00 /sf	157,500
		1000	Railroad track, rail, 100 lb. prime grade (includes bolts, plates etc.) (14*285)	3,990.00	lf	-	199,500	-		-	-	50.00 /lf	199,500
n		0250	Structural steel building framing (Mooring, Misc. Steel)	15,000.00	lb	3,913	24,384	-		1,703	-	2.000 /lb	30,000
			35 20 00.300 Transfer Table			*1,016,886*	*4,748,118*			*9,450*		*119.184/sf*	*5,774,453*
			48,450.00 sf										
			19,238.255 Labor hours										
			2,182.014 Equipment hours										
			DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**1,111,223**	**4,914,530**	**0**		**122,875**	**0**	**6,148,628.19 /LS**	**6,148,628**
			1.00 LS										
			21,060.781 Labor hours										
			3,359.816 Equipment hours										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Item	Description	Takeoff Qty	Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
23 Transfer Table			***1,111,223***	***4,914,530***	***0***		***122,875***	***0***	***617.953/SQYD***	***6,148,628***
	9,950.00 SQYD									
	21,060.781 Labor hours									
	3,359.816 Equipment hours									

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Estimate Totals

Description	Amount	Totals	Rate			
Labor	4,440,802					
Labor Burden	1,776,321		40.000	%		
Material	15,543,340					
Equipment	2,133,360					
Discount RS Means Equip (-25%)						
Subcontract	1,760,080					
Per Diem	856,966		18.750	$/hr		
Other	1,760,080					
Subtotal Direct Project Costs		**28,270,949**				
Contractor's Mob	848,128		3.000	%		
Contractor's Field Overhead	2,827,095		10.000	%		
Contractor's General Condition	1,130,838		4.000	%		
Subtotal Field Const Costs	**4,806,061**	**33,077,010**				
Sales Tax Estimate (Mat & Eq)						
Subtotal Field Const Costs		**33,077,010**				
Contractor's Fee	2,315,391		7.000	%		
Subtotal Field Const Costs	**2,315,391**	**35,392,401**				
Construction Contingency	10,617,720		30.000	%		
Subtotal Field Const Costs	**10,617,720**	**46,010,121**				
Escalation Project (2025)	2,300,506		5.000	%		
Subtotal	**2,300,506**	**48,310,627**				
Contractor's Bonds & Insurance	966,213		2.000	%		
Subtotal	**966,213**	**49,276,840**				
Synchrolift	4,000,000				L	7.51%
Total		***53,276,840***				

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

Option 3 - Wilmington, NC

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Project name	**Wilmington**
Document	Concept
Estimator	KJA
Labor rate table	HDR_2023_Union
Equipment rate table	HDR_EQ_2023
Project	Capacity Study
Report format	Sorted by 'WBS_MAIN/MF04_DIV/HDR04SPEC' 'Detail' summary
Factor table	North Carolina-Wilmington

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

2/13/2024 12:23 PM
Design Stage: Concept
Estimate Version:

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
		01 Sitework										
DIVISION 01		**GENERAL REQUIREMENTS**										
01 21 00.000		*Allowances*										
n	0900	Utilities	3,500.00	lnft	105,000	105,000	105,000		105,000	105,000	150.00 /lnft	525,000
n	0900	Dewatering	1.00	ls	35,000	35,000	35,000		35,000	35,000	175,000.00 /ls	175,000
n	0900	Electrical - Sitework	1.00	ls	2,000	2,000	2,000		2,000	2,000	10,000.00 /ls	10,000
		01 21 00.000 Allowances			*142,000*	*142,000*	*142,000*		*142,000*	*142,000*	*710,000.00 /LS*	*710,000*
		1.00 LS										
		DIVISION 01 GENERAL REQUIREMENTS			**142,000**	**142,000**	**142,000**		**142,000**	**142,000**	**710,000.00 /LS**	**710,000**
		1.00 LS										
DIVISION 02		**EXISTING CONDITIONS**										
02 41 10.000		*Selective Demolition*										
n	0500	Misc. Cleanup	1.00	ls	7,647	-	-		7,353	-	15,000.00 /ls	15,000
		02 41 10.000 Selective Demolition			*7,647*				*7,353*			*15,000*
		143.518 Labor hours										
		71.660 Equipment hours										
		DIVISION 02 EXISTING CONDITIONS			**7,647**	**0**	**0**		**7,353**	**0**	**15,000.00 /LS**	**15,000**
		1.00 LS										
		143.518 Labor hours										
		71.660 Equipment hours										
DIVISION 31		**EARTHWORK**										
31 23 00.001		*Structural Excavation*										
	0400	Mechanical dredging, dumped 20 miles at sea, barge mounted clamshell excavation into scows, maximum	28,936.00	bcy	332,182	-	-		246,408	-	19.995 /bcy	578,590
	0100	No. 3 Aggregate for earthwork, bank run gravel, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction	3,810.00	lcy	9,337	37,910	-		16,826	-	16.817 /lcy	64,073
	1000	Topsoil spreading from stockpile, topsoil, clay, medium hard, ideal conditions, 300 H.P. dozer	2,000.00	cy	466	-	-		1,502	-	0.984 /cy	1,968
	1000	Topsoil stripping and stockpiling, topsoil, clay, medium hard, ideal conditions, 300 H.P. dozer	13,754.00	cy	3,202	-	-		10,330	-	0.984 /cy	13,532

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
31 23 00.001		*Structural Excavation*										
n	5100	Excavating,bulk bank measure,sandy clay/loam,open site,1 cy capacity = 120 cy/hour,excavator,hydraulic,crawler mounted,excluding truck loading	35,614.00	bcy	80,931	-	-		97,139	-	5.00 /bcy	178,070
	1700	Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	3,810.00	ecy	3,239	-	-		10,096	-	3.50 /ecy	13,335
n	1240	Various Structures Spoils Hauling, excavated or borrow material, loose cubic yards, 4 mile round trip, 1.5 loads/hour, 20 C.Y. dump trailer, highway haulers, excludes loading	1,000.00	lcy	1,766	-	-		3,404	-	5.170 /lcy	5,170
n	0560	Hauling, No. 3,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	3,810.00	lcy	27,033	-	-		37,737	-	17.000 /lcy	64,770
		31 23 00.001 Structural Excavation			*458,156*	*37,910*			*423,441*		*58.367/cy*	*919,507*
		15,754.00 cy										
		9,023.299 Labor hours										
		27,966.106 Equipment hours										
31 30 00.000		*Earthwork Methods*										
n	1100	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	5,000.00	lf	8,430	4,070	-		-	-	2.50 /lf	12,500
n	0100	Laydown Area - Base course drainage layers, aggregate base course for roadways and large paved areas, stone base, compacted, 3/4" stone base, to 6" deep	8,000.00	sy	2,475	43,200	-		6,791	-	6.558 /sy	52,466
	0200	Synthetic erosion control, polypropylene mesh, stapled, 6.5 oz./ S.Y.	2,500.00	sy	717	3,673	-		-	-	1.756 /sy	4,389
n	9100	Stabilized Construction Entrance	2.00	ea	3,545	2,455	-		-	-	2,999.985 /ea	6,000
n	9900	25-ft x 9-in Straw Natural Biodegradable Wattle	1,000.00	lf	666	5,460	-		129	-	6.255 /lf	6,255
		31 30 00.000 Earthwork Methods			*15,833*	*58,858*			*6,920*		*81,610.41 /ls*	*81,610*
		1.00 ls										
		465.076 Labor hours										
		70.154 Equipment hours										
		DIVISION 31 EARTHWORK			**473,989**	**96,767**	**0**		**430,361**	**0**	**1,001,117.16 /LS**	**1,001,117**
		1.00 LS										
		9,488.374 Labor hours										
		28,036.260 Equipment hours										
		01 Sitework			***623,636***	***238,767***	***142,000***		***579,714***	***142,000***	***54,936.892/AC***	***1,726,117***
		31.42 AC										
		9,631.892 Labor hours										
		28,107.920 Equipment hours										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
02 Admin Building / Machine Shop												
DIVISION 01		**GENERAL REQUIREMENTS**										
01 21 00.000		*Allowances*										
n	0900	Square Foot Allowance - Building Only	30,000.00	sf	1,320,000	1,320,000	1,320,000		1,320,000	1,320,000	220.00 /sf	6,600,000
n	0900	Square Foot Allowance - TI Admin area	5,000.00	sf	65,000	65,000	65,000		65,000	65,000	65.00 /sf	325,000
		01 21 00.000 Allowances			*1,385,000*	*1,385,000*	*1,385,000*		*1,385,000*	*1,385,000*	*6,925,000.00 /LS*	*6,925,000*
		1.00 LS										
		DIVISION 01 GENERAL REQUIREMENTS			**1,385,000**	**1,385,000**	**1,385,000**		**1,385,000**	**1,385,000**	**6,925,000.00 /LS**	**6,925,000**
		1.00 LS										
		02 Admin Building / Machine Shop			***1,385,000***	***1,385,000***	***1,385,000***		***1,385,000***	***1,385,000***	***230.833/SF***	***6,925,000***
		30,000.00 SF										
03 Warehouse												
DIVISION 01		**GENERAL REQUIREMENTS**										
01 21 00.000		*Allowances*										
n	0900	Square Foot Allowance - Building Only	2,800.00	ls	123,200	123,200	123,200		123,200	123,200	220.00 /ls	616,000
		01 21 00.000 Allowances			*123,200*	*123,200*	*123,200*		*123,200*	*123,200*	*616,000.00 /LS*	*616,000*
		1.00 LS										
		DIVISION 01 GENERAL REQUIREMENTS			**123,200**	**123,200**	**123,200**		**123,200**	**123,200**	**616,000.00 /LS**	**616,000**
		1.00 LS										
		03 Warehouse			***123,200***	***123,200***	***123,200***		***123,200***	***123,200***	***220.00 /SF***	***616,000***
		2,800.00 SF										
05 Maintenance Garage												

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
DIVISION 01		**GENERAL REQUIREMENTS**										
01 21 00.000		*Allowances*										
n	0900	Square Foot Allowance - Building Only	1,420.00	sf	62,480	62,480	62,480		62,480	62,480	220.00 /sf	312,400
		01 21 00.000 Allowances			*62,480*	*62,480*	*62,480*		*62,480*	*62,480*	*312,400.00 /LS*	*312,400*
		1.00 LS										
		DIVISION 01 GENERAL REQUIREMENTS			**62,480**	**62,480**	**62,480**		**62,480**	**62,480**	**312,400.00 /LS**	**312,400**
		1.00 LS										
		05 Maintenance Garage			***62,480***	***62,480***	***62,480***		***62,480***	***62,480***	***220.00 /SF***	***312,400***
		1,420.00 SF										

06 Paint Shop

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
DIVISION 01		**GENERAL REQUIREMENTS**										
01 21 00.000		*Allowances*										
n	0900	Square Foot Allowance - Building Only	31,200.00	ls	1,372,800	1,372,800	1,372,800		1,372,800	1,372,800	220.00 /ls	6,864,000
n	0900	Ductwork / HVAC premium Square Foot Allowance - Building Only	31,200.00	ls	93,600	93,600	93,600		93,600	93,600	15.00 /ls	468,000
		01 21 00.000 Allowances			*1,466,400*	*1,466,400*	*1,466,400*		*1,466,400*	*1,466,400*	*7,332,000.00 /LS*	*7,332,000*
		1.00 LS										
		DIVISION 01 GENERAL REQUIREMENTS			**1,466,400**	**1,466,400**	**1,466,400**		**1,466,400**	**1,466,400**	**7,332,000.00 /LS**	**7,332,000**
		1.00 LS										
		06 Paint Shop			***1,466,400***	***1,466,400***	***1,466,400***		***1,466,400***	***1,466,400***	***235.00 /SF***	***7,332,000***
		31,200.00 SF										

07 Paint Mixing

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
DIVISION 01		**GENERAL REQUIREMENTS**										
01 21 00.000		*Allowances*										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

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Design Stage: Concept
Estimate Version:

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
01 21 00.000		*Allowances*										
n	0900	Square Foot Allowance - Building Only	1,600.00	ls	70,400	70,400	70,400		70,400	70,400	220.00 /ls	352,000
		01 21 00.000 Allowances			*70,400*	*70,400*	*70,400*		*70,400*	*70,400*		*352,000*
		DIVISION 01 GENERAL REQUIREMENTS			**70,400**	**70,400**	**70,400**		**70,400**	**70,400**	**352,000.00 /LS**	**352,000**
		1.00 LS										
		07 Paint Mixing			***70,400***	***70,400***	***70,400***		***70,400***	***70,400***	***220.00 /SF***	***352,000***
		1,600.00 SF										

08 Guard House

DIVISION 13 — **SPECIAL CONSTRUCTION**

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
13 34 19.000		*Metal Building Systems*										
n	0900	Prefabricated Guard House	1.00	ls	3,000	3,000	3,000		3,000	3,000	15,000.00 /ls	15,000
n	0900	Electrical - Guard House	1.00	ls	13,000	13,000	13,000		13,000	13,000	65,000.00 /ls	65,000
		13 34 19.000 Metal Building Systems			*16,000*	*16,000*	*16,000*		*16,000*	*16,000*	*1,600.00 /SF*	*80,000*
		50.00 SF										
		DIVISION 13 SPECIAL CONSTRUCTION			**16,000**	**16,000**	**16,000**		**16,000**	**16,000**	**1,600.00 /SF**	**80,000**
		50.00 SF										
		08 Guard House			***16,000***	***16,000***	***16,000***		***16,000***	***16,000***	***80,000.00 /SF***	***80,000***
		1.00 SF										

09 Central Utility

DIVISION 01 — **GENERAL REQUIREMENTS**

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
01 21 00.000		*Allowances*										
n	0900	Electrical	2,500.00	sf	34,500	34,500	34,500		34,500	34,500	69.00 /sf	172,500
n	0900	Square Foot Allowance - Building Only	2,500.00	sf	110,000	110,000	110,000		110,000	110,000	220.00 /sf	550,000
		01 21 00.000 Allowances			*144,500*	*144,500*	*144,500*		*144,500*	*144,500*		*722,500*

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
DIVISION 01 GENERAL REQUIREMENTS					**144,500**	**144,500**	**144,500**		**144,500**	**144,500**	**722,500.00 /LS**	**722,500**
		1.00 LS										
09 Central Utility					***144,500***	***144,500***	***144,500***		***144,500***	***144,500***	***289.00 /SF***	***722,500***
		2,500.00 SF										

20 Platens

DIVISION 35 — **WATERWAY & MARINE CONSTRUCTION**

35 20 00.200		*Platens*										
n	0900	105,000 sqft of Platen (7 ea.)	105,000.00	sf								
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	14.00	day	12,292	-	-		431	-	908.80 /day	12,723
n	4900	Platen Concrete - 285x62 Structural concrete,place,slab grade (4000 psi),	9,100.00	cy	2,483,105	11,148,262	-		18,633	-	1,500.00 /cy	13,650,000
	1000	Railroad track, rail, 100 lb. prime grade (includes bolts, plates etc.)	6,300.00	lf	-	315,000	-		-	-	50.00 /lf	315,000
n	0250	Structural steel building framing (Mooring, Misc. Steel)	70,000.00	lb	18,263	113,790	-		7,947	-	2.000 /lb	140,001
		35 20 00.200 Platens			*2,513,660*	*11,577,052*			*27,012*		*8,963.634/LNFT*	*14,117,724*
		1,575.00 LNFT										
		47,566.778 Labor hours										
		5,405.436 Equipment hours										
		DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**2,513,660**	**11,577,052**	**0**		**27,012**	**0**	**14,117,724.03 /LS**	**14,117,724**
		1.00 LS										
		47,566.778 Labor hours										
		5,405.436 Equipment hours										
		20 Platens			***2,513,660***	***11,577,052***	***0***		***27,012***	***0***	***769.358/LNFT***	***14,117,724***
		18,350.00 LNFT										
		47,566.778 Labor hours										
		5,405.436 Equipment hours										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

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Design Stage: Concept
Estimate Version:

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
		21 Equipment										
DIVISION 35		**WATERWAY & MARINE CONSTRUCTION**										
35 20 00.000		*Waterway & Marine Construction & Equipment*										
n	0900	Equipment installation and infrastructure	1.00	ls	256,800	1,659,000					1,915,800.00 /ls	1,915,800
		35 20 00.000 Waterway & Marine Construction & Equipment			*256,800*	*1,659,000*						*1,915,800*
		DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**256,800**	**1,659,000**	**0**		**0**	**0**	**1,915,800.00 /LS**	**1,915,800**
		1.00 LS										
		21 Equipment			***256,800***	***1,659,000***	***0***		***0***	***0***	***1,915,800.00 /LS***	***1,915,800***
		1.00 LS										
		22 Seawall										
DIVISION 35		**WATERWAY & MARINE CONSTRUCTION**										
35 20 00.100		*Seawall*										
n	0900	1915 LNFT@ 45' depth @ 35psf (86,175 sqft)										
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	8.24	day	7,235	-	-		254	-	908.80 /day	7,489
n	5300	(47 EA @ 50') Piles, steel, pipe piles, points, heavy duty, 36" diameter @.75"wall	9,682.00	vlf	170,549	4,792,590	-		196,909	-	532.953 /vlf	5,160,048
	0900	Sheet piling, steel, 38 psf, 40' excavation, per ton, left in place, excludes wales	1,509.98	ton	252,694	3,254,498	-		235,802	-	2,478.837 /ton	3,742,994
	2500	Sheet piling, wales, connections and struts, 2/3 salvage (150#/lnft of wall)	144.200	ton	-	86,853	-		-	-	602.310 /ton	86,853
	3000	Sheet piling, steel, tie rod, not upset, with turnbuckle, 1-1/2" to 4", excludes wales	191.58	ton	-	514,732	-		-	-	2,686.775 /ton	514,732
	1000	Corrostion mitigation (galvanized dip) 46#/ft	6,423,080.00	lb	342,136	1,634,032	-		268,419	-	0.349 /lb	2,244,587
		35 20 00.100 Seawall			*772,614*	*10,282,705*			*701,383*		*136.428/SF*	*11,756,702*
		86,175.00 SF										
		12,856.240 Labor hours										
		3,654.730 Equipment hours										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

Item	Description	Takeoff Qty	Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
	DIVISION 35 WATERWAY & MARINE CONSTRUCTION		**772,614**	**10,282,705**	**0**		**701,383**	**0**	**11,756,702.12 /LS**	**11,756,702**
	1.00 LS									
	12,856.240 Labor hours									
	3,654.730 Equipment hours									
	22 Seawall		***772,614***	***10,282,705***	***0***		***701,383***	***0***	***6,139.270/LNFT***	***11,756,702***
	1,915.00 LNFT									
	12,856.240 Labor hours									
	3,654.730 Equipment hours									

23 Transfer Table

DIVISION 35 **WATERWAY & MARINE CONSTRUCTION**

32 12 16.000		*Asphaltic Concrete Vehicular Paving*									
n	0900	31,923 sy, 5,314 cy ag @ 6", 6,075 tn mix									
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	7.36	day	6,462	-	-	227	-	908.800 /day	6,689
	0100	No. 3 Aggregate for earthwork, bank run gravel, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction	5,313.92	lcy	13,023	52,874	-	23,468	-	16.817 /lcy	89,364
	0012	Fine grading, finish grading, small area, to be paved with grader	31,890.88	sy	65,950	-	-	84,670	-	4.723 /sy	150,621
	0012	Fine grading, finish grading, small area, to be paved with grader	31,890.88	sy	65,950	-	-	84,670	-	4.723 /sy	150,621
	5020	Compaction, riding, vibrating roller, 3 passes, 6" lifts	5,313.92	ecy	1,501	-	-	1,337	-	0.534 /ecy	2,838
	5020	Compaction, riding, vibrating roller, 3 passes, 6" lifts	3,985.44	ecy	1,126	-	-	1,003	-	0.534 /ecy	2,128
	0160	Plant-mix asphalt paving, for highways and large paved areas, binder course, 3" thick, no hauling included	31,890.88	sy	29,620	308,704	-	18,675	-	11.194 /sy	356,998
	0340	Plant-mix asphalt paving, for highways and large paved areas, wearing course, 1-1/2" thick, no hauling included	31,890.88	SY	20,880	171,796	-	12,897	-	6.446 /SY	205,574
n	0560	Hauling, asphalt material,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	5,313.92	lcy	55,913	-	-	78,051	-	25.210 /lcy	133,964
n	0560	Hauling, asphalt material,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	3,985.44	lcy	41,939	-	-	58,545	-	25.213 /lcy	100,485

North Carolina DOT
Ferry Division Maintenance
Detail Report - With Contractor Markups

Item		Description	Takeoff Qty		Labor Amount	Material Amount	Subcontract Amount	Subcontract Name	Equipment Amount	Other Amount	Total Unit Cost	Total Amount
		32 12 16.000 Asphaltic Concrete Vehicular Paving			*302,364*	*533,373*			*363,543*		*12.535/sy*	*1,199,280*
		95,672.64 sy										
		5,841.448 Labor hours										
		3,775.015 Equipment hours										
35 20 00.300		*Transfer Table*										
n	1100	Boundary & survey markers, crew for building layout, 2 person crew	8.00	day	7,024	-	-		246	-	908.80 /day	7,270
n	4900	Table Concrete - Structural concrete,place,slab grade (4000 psi),	7,777.00	cy	2,122,100	9,527,476	-		15,924	-	1,500.00 /cy	11,665,500
n	4900	Concrete Wall - Structural concrete,place,slab grade (4000 psi) (1570*5)	7,850.00	sf	49,980	224,394	-		375	-	35.000 /sf	274,750
	1000	Railroad track, rail, 100 lb. prime grade (includes bolts, plates etc.) (600*14)	8,400.00	lf	-	420,000	-		-	-	50.00 /lf	420,000
n	0250	Structural steel building framing (Mooring, Misc. Steel)	35,000.00	lb	9,131	56,895	-		3,974	-	2.000 /lb	70,000
		35 20 00.300 Transfer Table			*2,188,236*	*10,228,766*			*20,519*		*118.877/sf*	*12,437,521*
		104,625.00 sf										
		41,402.684 Labor hours										
		4,666.636 Equipment hours										
		DIVISION 35 WATERWAY & MARINE CONSTRUCTION			**2,490,600**	**10,762,139**	**0**		**384,062**	**0**	**13,636,801.27 /LS**	**13,636,801**
		1.00 LS										
		47,244.132 Labor hours										
		8,441.651 Equipment hours										
		23 Transfer Table			***2,490,600***	***10,762,139***	***0***		***384,062***	***0***	***427.620/SQYD***	***13,636,801***
		31,890.00 SQYD										
		47,244.132 Labor hours										
		8,441.651 Equipment hours										

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

North Carolina DOT

Ferry Division Maintenance

Detail Report - With Contractor Markups

Estimate Totals

Description	Amount	Totals	Rate		
Labor	9,925,290				
Labor Burden	3,970,116		40.000 %		
Material	37,787,643				
Equipment	4,960,152				
Discount RS Means Equip (-25%)					
Subcontract	3,409,980				
Other	3,409,980				
Subtotal Direct Project Costs		**63,463,161**			
Contractor's Mob	1,903,895		3.000 %		
Contractor's Field Overhead	5,077,053		8.000 %		
Contractor's General Condition	2,538,526		4.000 %		
Subtotal Field Const Costs	**9,519,474**	**72,982,635**			
Sales Tax Estimate (Mat & Eq)					
Subtotal Field Const Costs		**72,982,635**			
Contractor's Fee	5,108,784		7.000 %		
Subtotal Field Const Costs	**5,108,784**	**78,091,419**			
Construction Contingency	23,427,426		30.000 %		
Subtotal Field Const Costs	**23,427,426**	**101,518,845**			
Escalation Project (2025)	5,075,942		5.000 %		
Subtotal	**5,075,942**	**106,594,787**			
Contractor's Bonds & Insurance	2,131,896		2.000 %		
Subtotal	**2,131,896**	**108,726,683**			
Synchrolift	4,000,000			L	3.55%
Total		***112,726,683***			

AACE Classification Accuracy Range

Upper Range +100% **Lower Range -50%**

C. Alternate Site Selection References

1. National Oceanic and Atmospheric Administration (NOAA). Aquaculture. Accessed 2/2/2024. https://coast.noaa.gov/arcgis/rest/services/Hosted/Aquaculture/FeatureServer/0
2. National Oceanic and Atmospheric Administration (NOAA). Electronic Navigational Charts. Accessed 2/2/2024. https://gis.charttools.noaa.gov/arcgis/rest/services/MCS/ENCOnline/MapServer/exts/MaritimeChartService/WMSServer
3. Navigation Data Center. Waterway Mile Marker. Accessed 2/2/2024. https://services7.arcgis.com/n1YM8pTrFmm7L4hs/arcgis/rest/services/ndc/FeatureServer/0
4. Navigation Data Center. Principal Port. Accessed 2/2/2024. https://services7.arcgis.com/n1YM8pTrFmm7L4hs/arcgis/rest/services/ndc/FeatureServer/1
5. Navigation Data Center. Dock. Accessed 2/2/2024. https://services7.arcgis.com/n1YM8pTrFmm7L4hs/arcgis/rest/services/ndc/FeatureServer/2
6. Navigation Data Center. Lock. Accessed 2/2/2024. https://services7.arcgis.com/n1YM8pTrFmm7L4hs/arcgis/rest/services/ndc/FeatureServer/3
7. Navigation Data Center. Waterway Network Node. Accessed 2/2/2024. https://services7.arcgis.com/n1YM8pTrFmm7L4hs/arcgis/rest/services/ndc/FeatureServer/6
8. Navigation Data Center. Waterway Network. Accessed 2/2/2024. https://services7.arcgis.com/n1YM8pTrFmm7L4hs/arcgis/rest/services/ndc/FeatureServer/7
9. Navigation Data Center. Link Tonnages (historic). Accessed 2/2/2024. https://services7.arcgis.com/n1YM8pTrFmm7L4hs/arcgis/rest/services/ndc/FeatureServer/8
10. NC OneMap. 2023. Washington County Parcels. Accessed 2/5/2024. https://www.nconemap.gov/
11. NC OneMap. 2023. Pamlico County Parcels. Accessed 2/5/2024. https://www.nconemap.gov/
12. NC OneMap. 2024. Dare County Parcels. Accessed 2/5/2024. https://www.nconemap.gov/
13. NC OneMap. 2023. Currituck County Parcels. Accessed 2/5/2024. https://www.nconemap.gov/
14. NC OneMap. 2023. Carteret County Parcels. Accessed 2/5/2024. https://www.nconemap.gov/
15. NC OneMap. 2023. Craven County Parcels. Accessed 2/5/2024. https://www.nconemap.gov/
16. NC OneMap. 2023. Chowan County Parcels. Accessed 2/5/2024. https://www.nconemap.gov/
17. NC OneMap. 2024. Brunswick County Parcels. Accessed 2/5/2024. https://www.nconemap.gov/
18. NC OneMap. 2023. Beaufort County Parcels. Accessed 2/5/2024. https://www.nconemap.gov/
19. North Carolina Department of Environmental Quality-Division of Coastal Management (NCDEQ-DCM). DCM Coastal Reserve Boundary. Accessed 2/2/2024. https://services.arcgis.com/NuWFvHYDMVmmxMeM/ArcGIS/rest/services/NCDOT_FerryTerminals/FeatureServer/0
20. North Carolina Department of Transportation Ferry Division. Ferry Terminals. Accessed 2/2/2024. https://services.arcgis.com/NuWFvHYDMVmmxMeM/ArcGIS/rest/services/NCDOT_FerryTerminals/FeatureServer/0

21. North Carolina Department of Transportation Ferry Division. Ferry Routes. Accessed 2/2/2024. https://services.arcgis.com/NuWFvHYDMVmmxMeM/ArcGIS/rest/services/NCDOT_FerryRoutes/FeatureServer/0

22. North Carolina Division of Coastal Management (NCDCM) Coastal Area Management Act (CAMA). Municipalities. Accessed 2/2/2024. https://services2.arcgis.com/kCu40SDxsCGcuUWO/ArcGIS/rest/services/DCM_CAMA_LUP/FeatureServer/1

23. North Carolina Division of Coastal Management (NCDCM) Coastal Area Management Act (CAMA). Counties. Accessed 2/2/2024. https://services2.arcgis.com/kCu40SDxsCGcuUWO/ArcGIS/rest/services/DCM_CAMA_LUP/FeatureServer/0

24. North Carolina Division of Marine Fisheries. 2015. Artificial Reefs. Accessed 2/2/2024. https://services2.arcgis.com/kCu40SDxsCGcuUWO/ArcGIS/rest/services/DMF_ReefGuide/FeatureServer/0

25. North Carolina Division of Marine Fisheries. 2015. Oyster Sanctuaries. Accessed 2/2/2024. https://services2.arcgis.com/kCu40SDxsCGcuUWO/ArcGIS/rest/services/DMF_ReefGuide/FeatureServer/1

26. North Carolina Division of Marine Fisheries. 2015. Artificial Reef Material. Accessed 2/2/2024. https://services2.arcgis.com/kCu40SDxsCGcuUWO/ArcGIS/rest/services/DMF_ReefGuide/FeatureServer/2

27. North Carolina Division of Marine Fisheries. 2015. Oyster Sanctuaries Material. Accessed 2/2/2024. https://services2.arcgis.com/kCu40SDxsCGcuUWO/ArcGIS/rest/services/DMF_ReefGuide/FeatureServer/3

28. North Carolina Division of Marine Fisheries. 2015. NC WRC Boating Locations. Accessed 2/2/2024. https://services2.arcgis.com/kCu40SDxsCGcuUWO/ArcGIS/rest/services/DMF_ReefGuide/FeatureServer/4

29. North Carolina Historic Preservation Office. Survey and National Register. 2024. NCHPO_NR_SL_DOE_Boundaries. Accessed 2/8/2024. GIS Maps and Data | NC HPO

30. North Carolina Historic Preservation Office. Survey and National Register. 2024. Local_District_Boundaries. Accessed 2/8/2024. GIS Maps and Data | NC HPO

31. U.S. Fish and Wildlife Service. National Wetlands Inventory. 2023. North Carolina. Accessed 2/2/2024. https://www.fws.gov/program/national-wetlands-inventory/download-state-wetlands-data

32. U.S. Fish and Wildlife Service. USFWS Threatened & Endangered Species Active Critical Habitat Report. 2024. Critical Habitat - Final Polygon. Accessed 2/2/2024. https://services.arcgis.com/QVENGdaPbd4LUkLV/ArcGIS/rest/services/USFWS_Critical_Habitat/FeatureServer/0

33. U.S. Fish and Wildlife Service. USFWS Threatened & Endangered Species Active Critical Habitat Report. 2024. Critical Habitat - Final Linear. Accessed 2/2/2024. https://services.arcgis.com/QVENGdaPbd4LUkLV/ArcGIS/rest/services/USFWS_Critical_Habitat/FeatureServer/1

34. U.S. Fish and Wildlife Service. USFWS Threatened & Endangered Species Active Critical Habitat Report. 2024. Critical Habitat – Proposed Polygon. Accessed 2/2/2024. https://services.arcgis.com/QVENGdaPbd4LUkLV/ArcGIS/rest/services/USFWS_Critical_Habitat/FeatureServer/2

35. U.S. Fish and Wildlife Service. USFWS Threatened & Endangered Species Active Critical Habitat Report. 2024. Critical Habitat – Proposed Linear. Accessed 2/2/2024. https://services.arcgis.com/QVENGdaPbd4LUkLV/ArcGIS/rest/services/USFWS_Critical_Habitat/FeatureServer/3

36. USGS. National Hydrography Dataset. 2023. NHD Flowline. Accessed 2/2/2024. https://www.usgs.gov/national-hydrography/access-national-hydrography-products

37. U.S. Geological Survey (USGS) Gap Analysis Project (GAP), 2022, Protected Areas Database of the United States (PAD-US) 3.0: U.S. Geological Survey data release, https://doi.org/10.5066/P9Q9LQ4B

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