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# *Topsail Island Bridge Replacement Project*

STIP Project B-4929

Navigation Evaluation Report

December 2015



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**RS&H**

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## **EXECUTIVE SUMMARY**

The North Carolina Department of Transportation (NCDOT) proposes to replace the existing Topsail Island Bridge (NCDOT Bridge No. 16) along NC 50/NC 210 over the Intracoastal Waterway in Surf City, Pender County. Replacement of Topsail Island Bridge entails removal and replacement of an existing swing span bridge currently providing access to Topsail Island. This bridge is one of only two access points onto Topsail Island, the other bridge is located approximately seven miles north in the town of North Topsail Beach.

The purpose of this project is to replace the structurally deficient, functionally obsolete bridge to improve bridge safety and functionality. The project corridor is an important route for local and regional commuter and recreational travel. To meet the increasing traffic demand and to reduce travel delays, improvements are warranted for this corridor. The proposed bridge is designed to be a fixed span 3,773-foot long structure with a 65-foot vertical navigational clearance (VNC) and 120-foot horizontal navigational clearance (HNC).

NCDOT performed vessel height surveys for a total of 16 days in 2010 and analyzed historic vessel traffic data from 2008 through 2015 in order to more accurately determine the types and heights of vessels traveling through the Intracoastal Waterway and the frequency of these trips. The survey results, as well as other pertinent information and data regarding the Intracoastal Waterway, have been compiled into this Navigation Evaluation Report as part of the United States Coast Guard (USCG) permit application. This assessment details the following:

- » The proposed bridge is a high-level, fixed-span bridge located approximately 1,100 feet south of the existing bridge beginning on the mainland side just east of Atkinson Point Road and ending on the island side at Topsail Drive (NC 50). The new island tie-in is located approximately 300 feet south of Roland Avenue. The proposed bridge location would not impact access to any marinas.
- » The vessel height survey results concluded that the proposed bridge would not impact the safe and efficient navigation of 96.4% of the vessel traffic (up to 65-feet at mean high water (MHW)). Only 19 vessels observed, (3.6%) out of 528 vessels, were measured to be over 65-feet in height and would be unable to travel under the proposed bridge without adjustment.
- » The proposed bridge will not require the relocation of any businesses on the island. One business impact on the mainland side (currently a vacant building) is anticipated due to utility issues. NCDOT will offer relocation assistance to property owners that will be directly impacted by this project as part of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (1970, as amended in 1987).

- » NCDOT has determined that a separate fender system will not be required for the replacement structure. Any changes to the horizontal opening will need to be reevaluated by the USCG to determine if a fender system is required.

In conclusion, the data comparison from this Navigation Evaluation Report demonstrates that NCDOT's proposed bridge design and location, with a 65-foot VNC and 120-foot HNC, is an acceptable option for the replacement of the Topsail Island Bridge.

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## **1.0 INTRODUCTION**

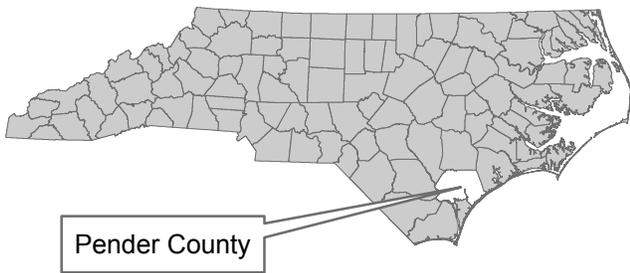
The North Carolina Department of Transportation (NCDOT) proposes to replace the existing Topsail Island Bridge (NCDOT Bridge No. 16) along NC 50/NC 210 over the Intracoastal Waterway in Surf City, Pender County. Replacement of Topsail Island Bridge entails removal and replacement of an existing swing span bridge currently providing access to Topsail Island. Figure 1-1 shows the study area.



**Looking south toward the Existing Topsail Island Bridge**

The purpose of this project is to replace the structurally deficient, functionally obsolete bridge to improve bridge safety and functionality. This bridge services two-lane traffic for state highway NC 50/210, a hurricane evacuation and bicycle route. This bridge is one of only two access points onto Topsail Island. The other bridge is located approximately seven miles north in the town of North Topsail Beach. Average annual daily traffic in 2013 was 15,000 vehicles per day with higher traffic peaks during the summer vacation months. Topsail Island's population is highly seasonal and includes the three towns of Topsail Beach, Surf City, and North Topsail Beach.

The United States Coast Guard (USCG) Bridge Program protects the freedom of navigation by requiring that bridges provide for the reasonable needs of navigation for boating traffic. Under this permit, USCG dictates the minimum horizontal and vertical navigational clearance of the proposed bridge. In order to fully comply with the terms of this permit application, NCDOT has prepared this Navigation Evaluation Report to clearly outline the characteristics of both the existing and proposed bridges, and provide greater detail regarding the maritime traffic and industry in the project area. This report is based on the elements outlined in USCG's White Paper, "Reasonable Needs of Navigation".



**Topsail Island  
Bridge Replacement Project**  
Bridge No. 16 over Intracoastal Waterway -  
NC 50/210

TIP No: B-4929  
WBS: 40233.1.1  
Division: 3

**Figure 1-1**  
Project Vicinity  
November 2015

## **2.0 EXISTING CONDITIONS**

### **2.1 Age and Type of Structure**

Topsail Island Bridge over the Intracoastal Waterway, also known as the Sears Landing Bridge, was completed in 1955 to replace a pontoon bridge previously utilized by the United States Navy during World War II. It remains in operable condition and retains circa 1930 gearing and mechanical systems. This bridge replacement project was first placed on the NCDOT Transportation Improvement Program (TIP) in 2005 after structural inspections indicated a very poor bridge sufficiency rating.

Topsail Island Bridge was most recently inspected in 2014, and the corresponding report indicates that the bridge is in fair condition with a sufficiency rating of 39 out of 100 possible points. The bridge, constructed of pre-stressed concrete open girders and a reinforced concrete deck, is classified as functionally obsolete and structurally deficient with load restrictions of 19 tons for single vehicles and 25 tons for truck tractors with semi-trailers. This bridge inspection report is included in Appendix A.

### **2.2 Location**

The existing Topsail Island Bridge along NC 50/NC 210 over the Intracoastal Waterway in Surf City, Pender County services two-lane traffic for state highway NC 50/210, a hurricane evacuation and bicycle route. This bridge is one of only two access points onto Topsail Island. The other bridge, North Topsail Island Bridge No. 28, is located approximately seven miles north in the town of North Topsail Beach. The existing bridge has two travel lanes and is 24 feet wide with 3-foot wide sidewalks on both sides. The existing roadway approaches along NC 50/210 are three-lane open shoulder sections with an opposing left-turn center lane and shoulder widths ranging from two to five feet wide. There are no sidewalks along the existing roadway approaches. The existing right-of-way along NC 50/210 varies from 80 to 100 feet, with no control of access. The posted speed limit on NC 50/210 west of Topsail Island Bridge is 45 miles per hour (mph). To the east of the bridge, the speed limit is 35 mph.

### **2.3 Navigational Clearances**

Topsail Island Bridge consists of a main channel swing span with concrete deck girder approach spans. The existing length of the bridge is 463 feet, with a main channel swing span length of 254 feet. In the closed position, the charted vertical clearance of the existing drawbridge is 13 feet above Mean High Water (MHW) and unlimited vertical clearance in the fully opened position, with 92 feet of horizontal clearance between fenders. The existing steel truss swing span bridge opens for commercial vessel traffic on demand and opens for daytime recreational vessels at the top of each hour.

### **2.4 Channel Characteristics**

Elevations used in the Bridge Survey and Hydraulic Report use the North American Vertical Datum of 1988 (NAVD 88), which is used throughout this report for consistency. Table 2-1 summarizes the water elevations and mean channel velocities. The elevation for mean high water was obtained from the Bridge

Survey and Hydraulic Report provided by NCDOT on May 19, 2015, included in Appendix B. The elevation and current speed for the 100 year flood event was obtained from NCDOT-provided calculations.

Average channel velocities were obtained from conversations with tug captains and data provided by NCDOT. According to the tug captains, the average current is 2.5 knots running south to north on a flood tide, or rising of the water level, and north to south on an ebb tide or period when tide level is falling. These velocities were conservatively adjusted to provide a worst case condition.

**Table 2-1 – Water Elevations and Velocities**

Reference	NAVD 88 Elevation (ft)	Average Channel Velocity (fps)	Average Overbank Velocity (fps)
Mean High Water (MHW)	1.45	4.25	1.69 (1 knot)
100-yr Flood Event	13.0	11.1	5.2

The channel bed of the Intracoastal Waterway ranges from 13 feet to 16 feet deep in the vicinity of the existing bridge according to the United States Army Corps of Engineers (USACE) Hydrographic Survey, Section 3 – Tangent 5, with sections through the navigational channel to the north that range from 10-feet to 14 feet in depth. The federally authorized channel, Atlantic Intracoastal Waterway, is 12 feet deep at mean low water (MLW) and 90 feet wide. The channel alignment is shown on the Hydrographic Survey, dated October 2013, from the USACE and is included in Appendix C. As shown on the USACE Hydrographic Survey, Section 3 – Tangent 6, the channel has a natural depth of at least 11 feet in the vicinity of the proposed bridge. According to the USACE Division of Contracting, the Intracoastal Waterway is part of an ongoing project to maintain the waterway.

The hydrology of the Intracoastal Waterway was recorded by the North Carolina Department of Environment and Natural Resources, Division of Environmental Health, Shellfish Sanitation and Recreational Water Quality Section from September 2010 to July 2015. The tidal stage, salinity and fecal coliform were measured and are included in Appendix D.

### **3.0 DESCRIPTION OF PROPOSED BRIDGE**

#### **3.1 Proposed Location**

The proposed bridge is a high-level, fixed-span bridge located approximately 1,100 feet south of the existing bridge beginning on the mainland side just west of Atkinson Point Road and ending on the island side at Topsail Drive (NC 50). The new island tie-in is located approximately 300 feet south of Roland Avenue. Figure 3-1 shows the location and alignment of the proposed bridge.

### **3.2 Proposed Structure**

The proposed bridge is designed to be a fixed span, high-level structure with a 65-foot VNC above MWH and a proposed horizontal clearance of 120 feet. There is no fender system to be constructed. USCG regulations dictate that high-level fixed bridge types provide a minimum 65 feet of VNC spanning the Intracoastal Waterway. This bridge type eliminates bridge openings and thereby accommodates both vessel and vehicular traffic unimpeded.

The bridge is comprised of a prestressed concrete girder and concrete deck superstructure, and concrete post and beam substructure, supported on precast concrete piles. The main span over the Intracoastal Waterway is 150 feet in length and provides for horizontal clearance of 120 feet centered on the waterway.

The recommended bridge typical section includes a 10-foot multi-use path on the north side of the bridge, separated from the travel lanes by a concrete barrier, a 7.5-foot bicycle lane/shoulder in each direction, and a 12-foot travel lane in each direction. The 39-foot roadway width carrying the bicycle and travel lanes allows for an alternate evacuation configuration for emergencies/hurricanes (two lanes off of the island, one lane onto the island).

A detailed vessel collision study was conducted using the Method II analysis procedures in the 2014 AASHTO LRFD Bridge Design Specifications for a "Critical Bridge" operational classification. The objective of this study was to determine the vessel impact forces for the proposed structure. A database of vessels was constructed and the vessels that represented both the largest loads and most frequent traffic were determined. Ultimately this database was refined into several distinct design vessels. The resulting design vessels and their corresponding collision forces were developed for the relevant substructure units within the theoretical impact zone. All portions of the bridge pier or the substructure at risk of impact by the design vessel hull shall be designed to resist the applied loads. This information is included in the Vessel Impact Report in Appendix E.

### **3.3 Navigational Clearances**

A 65-foot VNC and 120-foot HNC will be provided beneath the proposed bridge for vessels travelling along the Intracoastal Waterway. This proposed VNC is higher than the 64-foot VNC provided at the North Topsail Island Bridge (Bridge No. 28) according to NOAA Nautical Chart 11541 in Appendix F. The North Topsail Island Bridge is located approximately seven miles north of the proposed bridge location, as shown in Figure 3-2. Figure 3-3 depicts the navigational clearances of the proposed bridge.

### **3.4 Clearances over Little Kinston Channel**

As part of the B-4929 project, USCG sent a public notice (Number 5-1302) dated June 12, 2014 to approximately 380 citizens and businesses that own property adjacent to the Intracoastal Waterway or have maritime businesses in the study area. This notice provided information on the proposed

replacement of the Topsail Island Bridge. USCG requested that navigational information such as the sizes and types of vessels presently owned and operated in the area be provided. In addition, USCG asked that mariners and adjacent property owners express their views in writing in favor of or opposition to the project, from a navigational standpoint. It was requested that comments be provided by July 11, 2014. The Project Team received eleven comments, three of which included a comment related to the small channel providing access to docks on Little Kinston Road, identified in this report as Little Kinston Channel. Table 3-1 provides a summary of the information received related to the vessels using Little Kinston Channel. The citizens reported a desire that access be maintained to Little Kinston Channel.

**Table 3-1 – Public Comments for Little Kinston Channel**

Citizen Name	Vessel Type	Use	Vessel Height	Draft	Length	Beam	Tonnage	Mooring Location
Chris Becherer	n/a	n/a	9'	1.2'	21'	8'	1.25 tons	232 Little Kinston Rd
Jay Maready	Shearwater – Outboard	Recreational	10'	3'	25'	8'	2,500 lb	216 Little Kinston Rd
Norwood West	Lowe Aluminum	Recreational	4'	0.5'	16'	5'	Less than 1 ton	356 Little Kinston Rd

Note: n/a indicates no response provided.

After the responses to the USCG Public Notice were received from the citizens, NCDOT completed a survey of Little Kinston Channel and determined it ranges from 23 feet to 33 feet wide in the vicinity of the proposed bridge. Currently, the proposed bridge design accommodates this channel, noted as “Boat Access Channel” on the structure design preliminary plans Sheet S-3 of 12, with a span of 94 feet, 4 inches above the center of Little Kinston Channel. In addition, the plans show a minimum vertical clearance of 32 feet, 5 inches above MHW. An excerpt of the plans are shown on Figure 3-4.

In addition, a visual survey by boat was completed on October 26, 2015. Based on this visual survey, approximately 36 vessels were observed to be moored in the Little Kinston Channel area. The maximum vessel height observed was 8 feet above MHW. The channel ranged from 3 feet to 5 feet in depth. There is another access point to Little Kinston Channel to the south of the proposed bridge, north of Becky’s Creek, however this is a shallower area and the depth was unable to be verified. This location is shown on Figure 1-1.

The USACE Hydrographic Survey does not include Little Kinston Channel. The nearest points on the survey to the channel show a range of 4 feet to 7 feet in depth as shown in Appendix C.

### **3.5 Other Alternatives Considered**

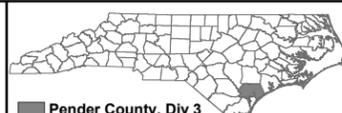
NCDOT evaluated numerous design alternatives for this project, including a No Build Alternative, several nontraditional alternatives, and 20 Build Alternatives, including construction of a new moveable or high-level fixed bridge either in the same location, to the north, or to the south of the existing bridge.

Initially, eighteen Build alternatives (described in detail in the EA approved in 2011) were developed. These Build alternatives included three types of bridge replacement: a low-level moveable, a mid-level moveable, and high-level fixed, with VNCs of 15, 30, and 65 feet, respectively. It should be noted that, under open condition, moveable bridges provide unlimited VNC (except vertical lift bridge). All bridge types considered in this project provide a minimum HNC of 90 feet. At the first Citizens Informational Workshop (CIW #1) held on June 25, 2009, attendees were asked to draw their alignment ideas on large study area aerial maps. Based on these ideas and input from other project stakeholders, 20 build alternative corridors were developed as shown on Figure 3-5.





**Proposed Bridge Alignment**



**Topsail Island Bridge Replacement Project**

**Figure 3-1**

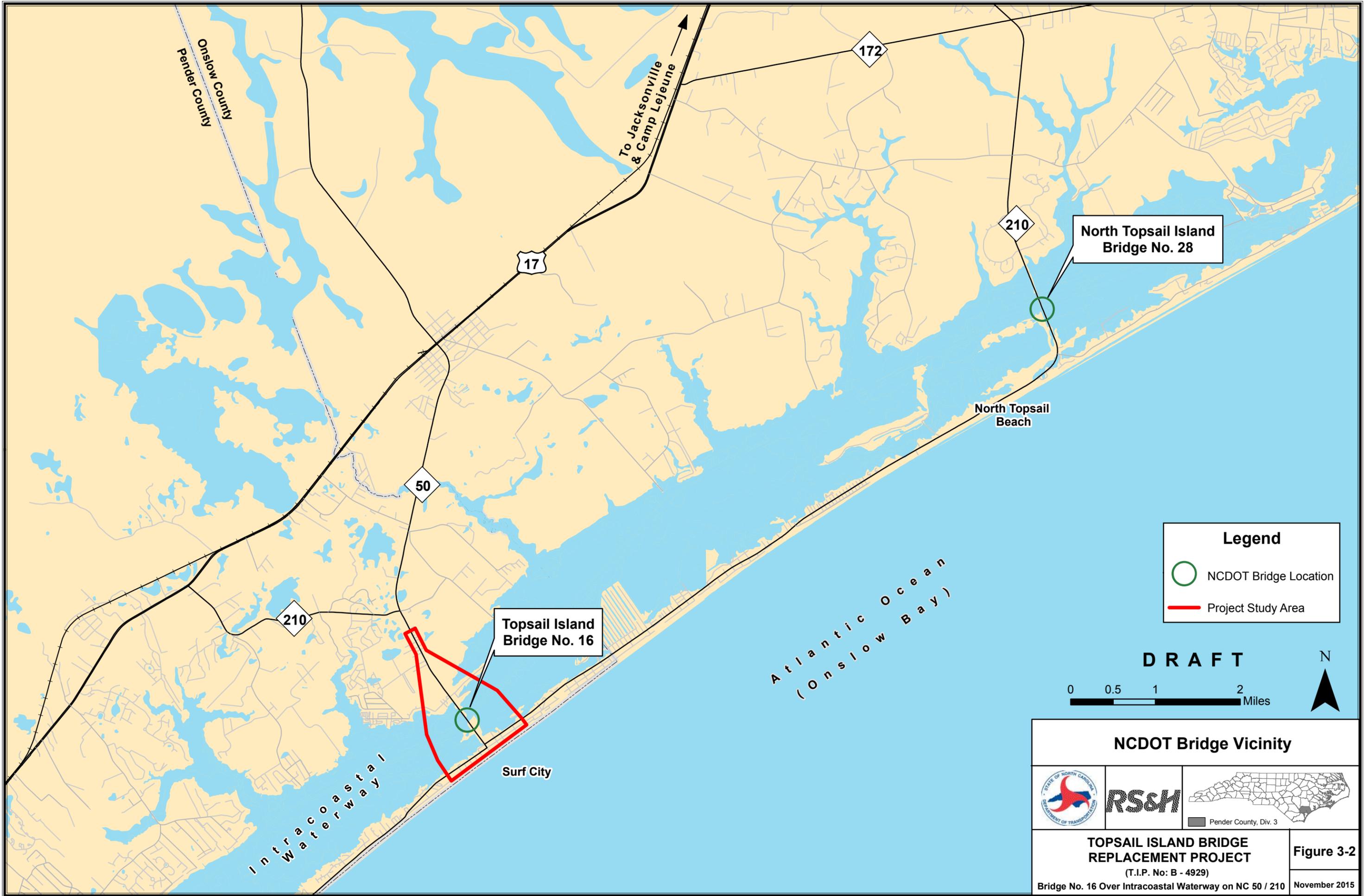
TIP No: B-4929

Bridge No. 16 over Intracoastal Waterway - NC 50/210

November 2015

Not To Scale

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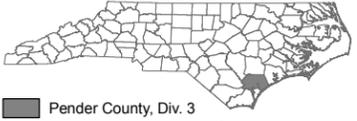
<b>NCDOT Bridge Vicinity</b>		
		
<b>TOPSAIL ISLAND BRIDGE REPLACEMENT PROJECT</b> (T.I.P. No: B - 4929)		<b>Figure 3-2</b>
Bridge No. 16 Over Intracoastal Waterway on NC 50 / 210		November 2015

Figure 3-3 – Proposed Bridge Clearance

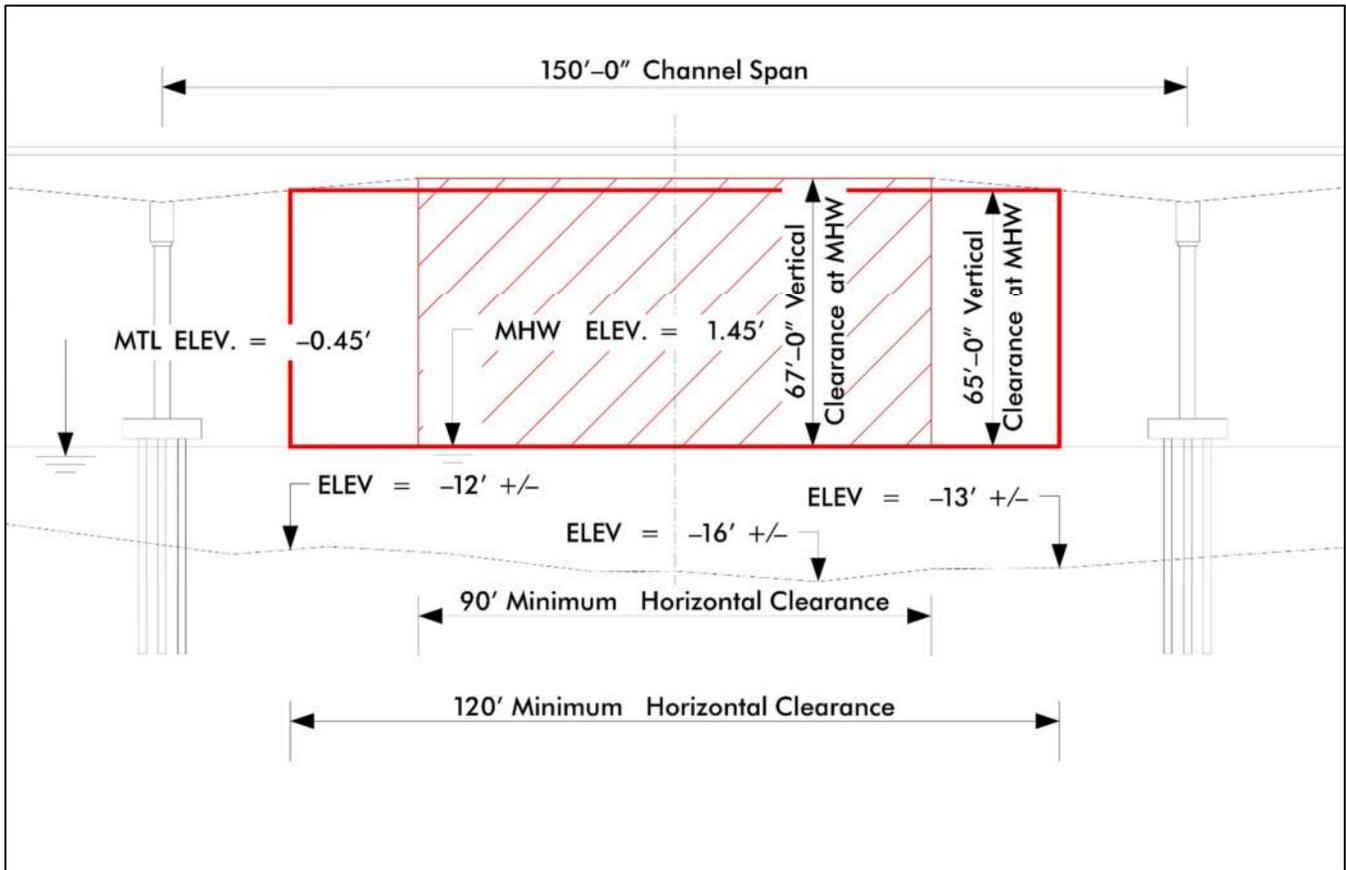
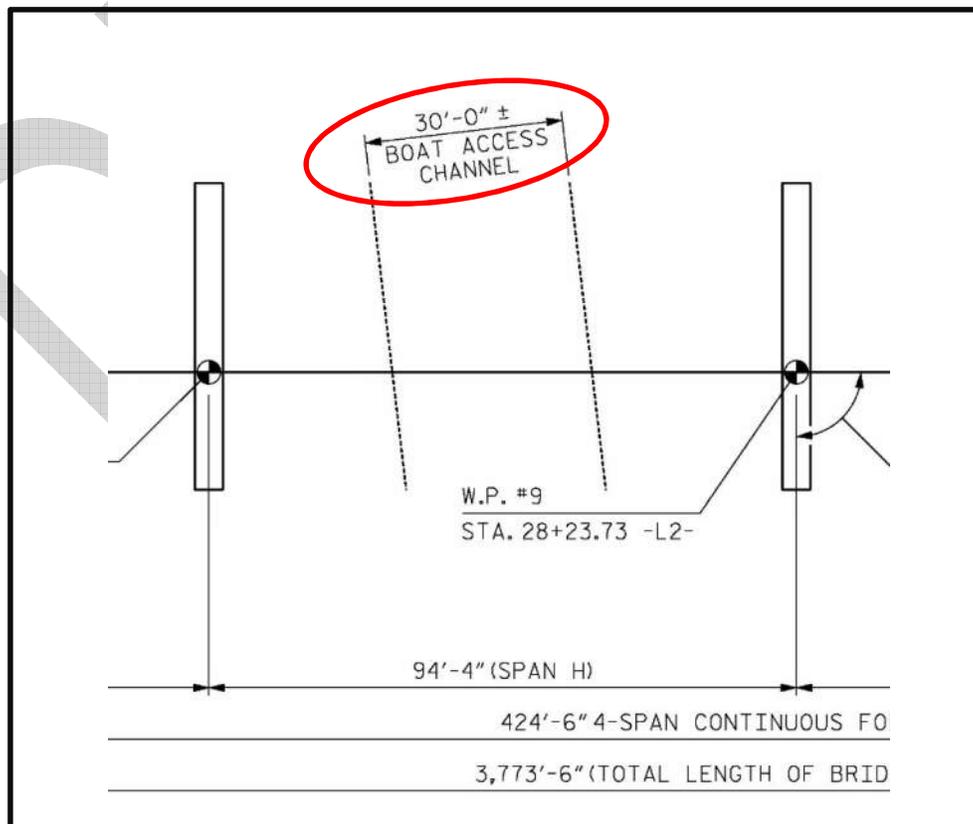
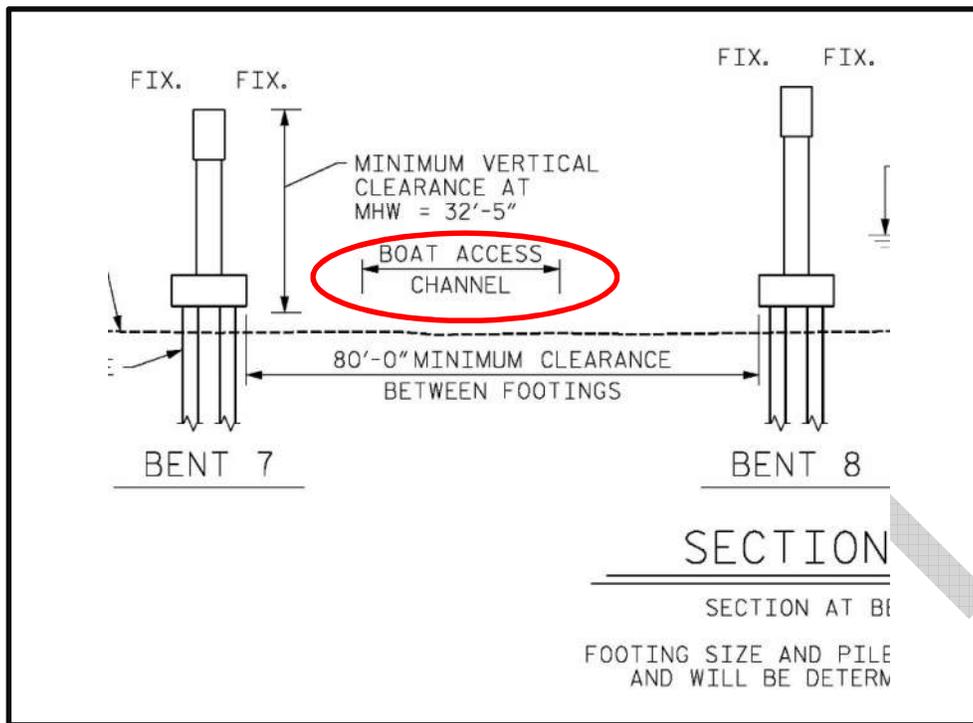
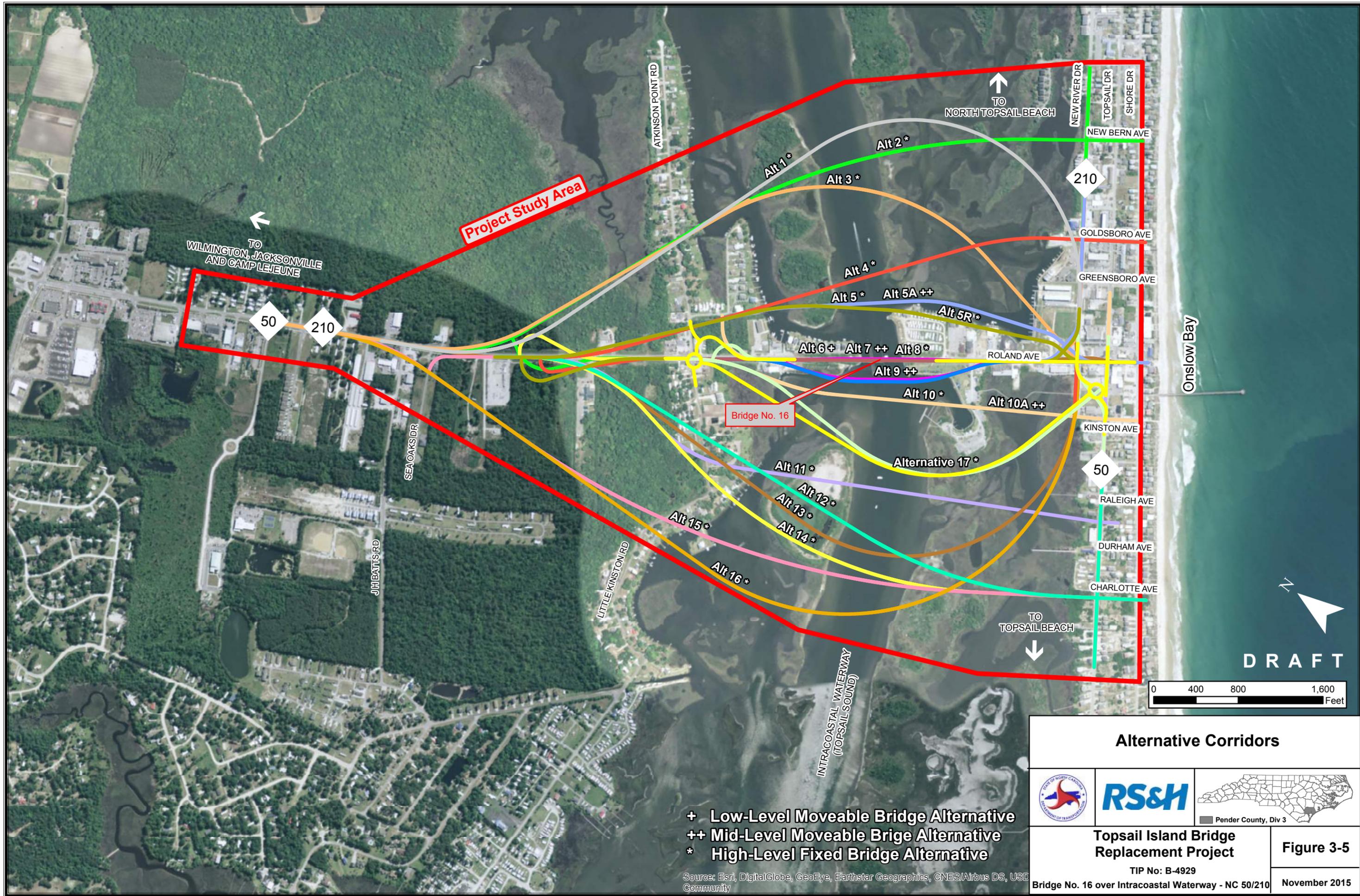


Figure 3-4 – Little Kinston Boat Access Channel

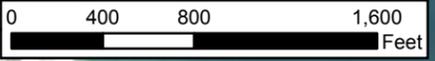




**Project Study Area**

Bridge No. 16

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- + Low-Level Moveable Bridge Alternative
- ++ Mid-Level Moveable Brige Alternative
- \* High-Level Fixed Bridge Alternative

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA Community

<b>Alternative Corridors</b>		
		<p>Pender County, Div 3</p>
<b>Topsail Island Bridge Replacement Project</b> TIP No: B-4929		
Bridge No. 16 over Intracoastal Waterway - NC 50/210		<b>Figure 3-5</b> November 2015

## 4.0 LIMITING FACTORS FOR NAVIGATION

### 4.1 Navigation in Project Area

The following is a list of potential impacts on navigation upstream and downstream of the proposed bridge location with their existing minimum HNC and VNC.

**Table 4-1 – Nearby Structural Clearances**

Structure	Location	Required to Travel through?	Vertical Navigational Clearance (VNC)	Horizontal Navigational Clearance (HNC)
Jones-Onslow Electric Membership Corporation Transmission Line	Just south of existing bridge over Intracoastal Waterway	Yes	81 feet MHW	N/A
Bridge No. 28 – North Topsail Island Bridge	Intracoastal Waterway	Yes	64 feet	90 feet

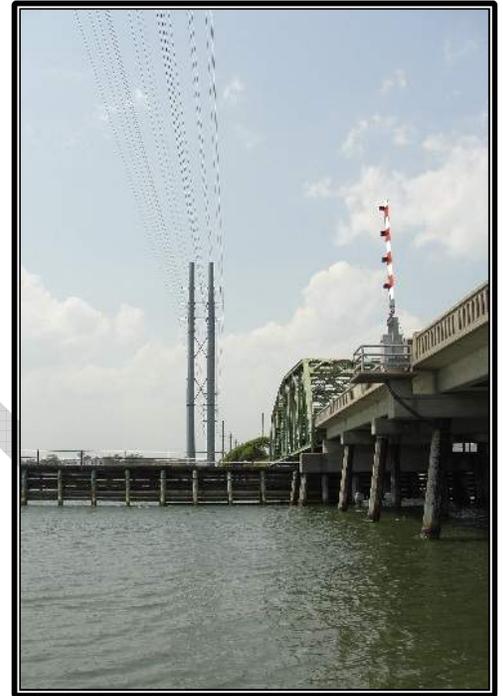
As shown in Table 4-1, the most restrictive vertical and horizontal clearances on the waterway occur at Bridge No. 28, North Topsail Island Bridge, also known as Trooper Larry Walton Memorial Bridge. This bridge is located south of Alligator Bay on NC 210 (Island Drive) with 64-feet VNC and 90-feet HNC according to NOAA Chart 11541 (Appendix F). The Jones-Onslow Electric Membership Corporation Transmission Line restricts the vertical clearance to 74-feet MHW. There are no additional known natural or man-made conditions that could affect navigation.

#### **4.2 Power Line Considerations**

Aerial electric transmission lines owned by Jones-Onslow Electric Membership Corporation (JOEMC) cross the Intracoastal Waterway just south of the existing bridge. Figure 3-1 shows the proximity of the power lines to the existing bridge and the proposed bridge alignment. According to NOAA Chart 11541, the transmission lines have a height of 81 feet above MHW. The line supplies power to Surf City and extends from the eastern coast to the utility station located on the mainland side (approximately 0.5 miles from the bridge). The full NOAA Chart is included in Appendix F.

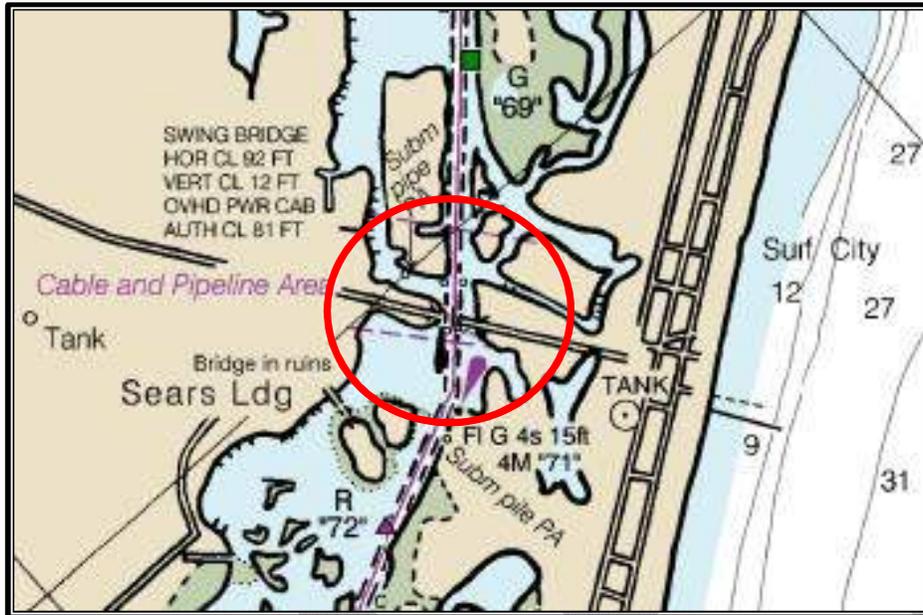
#### **4.3 Other Impacts on Navigation**

It is not anticipated that the proposed bridge would have any impacts to the bridge maintenance of other bridges along the waterway or channel maintenance. Nor is it anticipated that the proposed bridge would impact vessels that produce unique products for the region. There is also no anticipated impact to vessels that require helper boats or tugboats. The only known impacts on navigation are to the vessels exceeding 65 feet in height and are described in detail in Section 5.4.



**Existing JOEMC  
Transmission Lines**

Figure 4-1 – NOAA Chart 11541



Source: NOAA Chart 11541 – Intracoastal Waterway, February 2013, Revised October 2015.

## 5.0 VESSEL TRAFFIC

The existing swing span bridge opens for commercial vessel traffic on demand and opens for daytime recreational vessels on the hour from 7 AM to 7 PM. Currently, it takes approximately two minutes from the time the siren sounds to indicate the bridge is opening to the time where a vessel can pass through the channel. When the bridge is opened, vehicular traffic along NC 50/NC 210 is stopped for approximately ten minutes to allow a single vessel to pass through. Existing VNC from the waterway to low span is approximately 13 feet according to NCDOT, depending on the tide height and the level of flow in the Intracoastal Waterway.

### 5.1 Historic Vessel Traffic

Since 2000, logs have been kept of all vessel traffic requiring a bridge opening for Topsail Island Bridge. The bridge tender log catalogs the following items on a daily basis:

- » Date
- » Time of Vessel Signal
- » Time Gates Closed
- » Time Draw Fully Opens
- » Kind of Vessel
- » Name or Number of Vessel
- » Time Gates Open

- » Delay due to Bridge Opening
- » Number of Vehicles Delayed by Bridge Opening
- » Remarks
- » Weather at Time of Opening
- » Name of Operator

For the purposes of this report, the logs from 2008 through 2015 were cataloged and summarized. These logs are included in Appendix G. Table 5-1 shows a summary of the number of vessels per month requiring the bridge to open from January 2008 through September 2015, with the exception of May of 2010, which was not available. Chart 5-1 depicts the average number of vessels and number of openings for each month from January 2008 to September 2015. This data was used to determine the peak periods of vessel traffic for the channel in order to determine when the vessel survey should be completed. As shown in Chart 5-1, the summer peak period occurs in May with the winter peak occurring in November.

Also documented in the bridge tender logs are delays due to maintenance, inspections, construction, and bridge repairs and malfunctions for the existing bridge. This is not an all-inclusive list but only what the bridge tenders documented from January 2008 through September 2015. A table detailing these activities can be found in Appendix G with the bridge tender log data. The following activities were documented in the bridge tender logs:

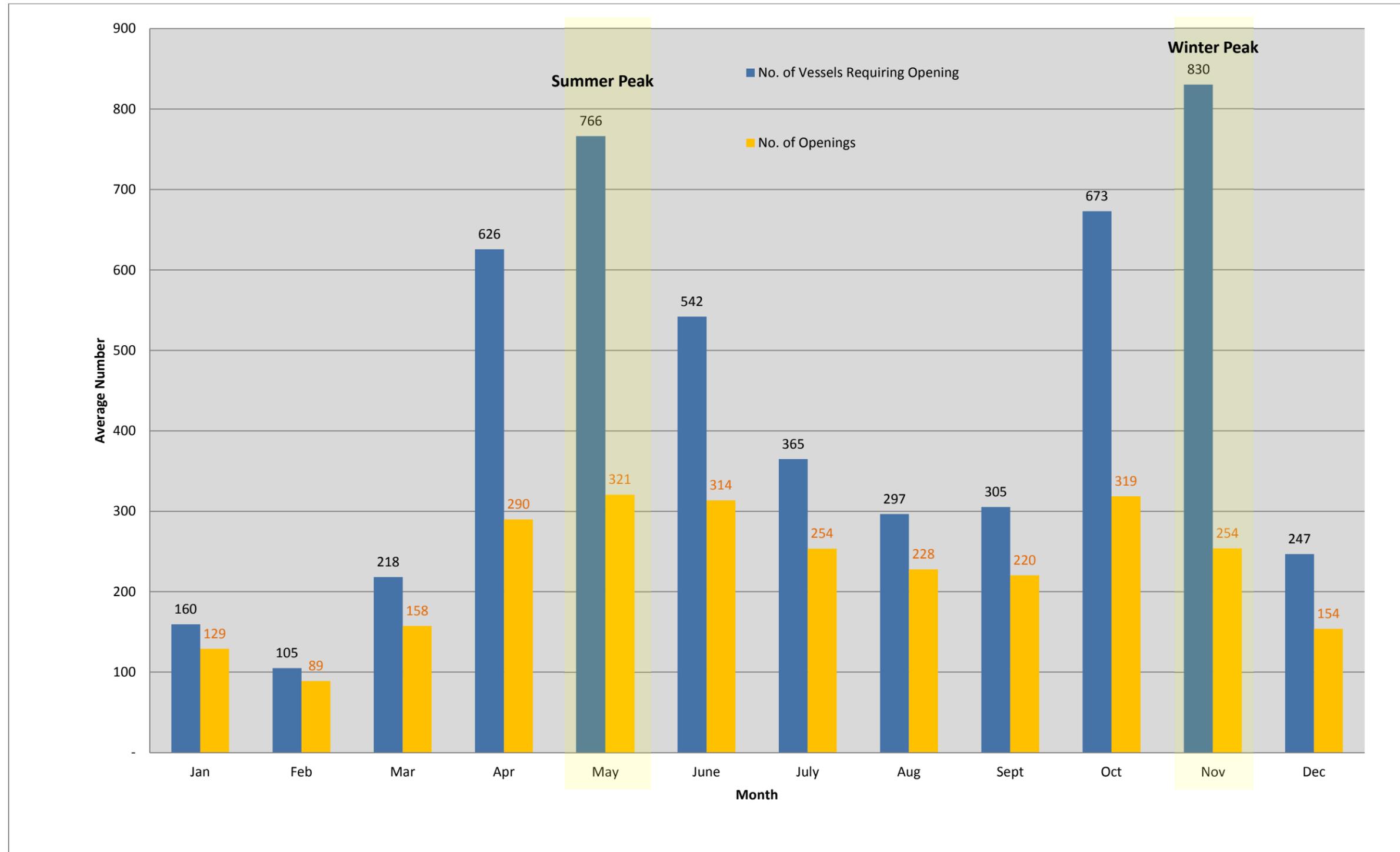
- » Maintenance (greasing the bridge, testing the bridge, etc.) – 120 instances documented; bridge closed to vehicular traffic for over 18.5 hours.
- » Training – 201 instances documented; bridge closed to vehicular traffic for over 23 hours.
- » Bridge Repair/Malfunction – 11 instances documented; bridge closed to vehicular traffic for more than one hour.
- » Additional delays include high winds, inclement weather, vessel collisions and medical responses – 29 instances; bridge closed for approximately 3.5 hours.

**Table 5-1 – Historic Vessel Traffic Monthly Summary from 2008 to 2015**

Month	2008		2009		2010		2011		2012		2013		2014		2015		Average	
	No. of Vessels Requiring Opening	No. of Openings	No. of Vessels Requiring Opening	No. of Openings	No. of Vessels Requiring Opening	No. of Openings	No. of Vessels Requiring Opening	No. of Openings	No. of Vessels Requiring Opening	No. of Openings	No. of Vessels Requiring Opening	No. of Openings	No. of Vessels Requiring Opening	No. of Openings	No. of Vessels Requiring Opening	No. of Openings	No. of Vessels Requiring Opening	No. of Openings
January	176	140	146	124	190	143	196	156	157	130	135	107	127	103	149	129	160	129
February	136	105	125	102	93	77	106	100	95	85	105	89	114	93	65	60	105	89
March	299	198	226	156	216	168	241	177	233	157	204	152	167	128	160	124	218	158
April	785	304	619	300	604	286	664	311	648	301	580	264	521	265	584	287	626	290
May	1075	378	953	371	-	-	870	361	861	380	776	363	791	362	803	351	766	321
June	529	299	491	275	589	325	505	303	569	325	618	343	556	339	479	300	542	314
July	382	259	370	251	409	292	342	229	324	243	324	235	364	250	404	269	365	254
August	259	208	325	240	326	249	264	195	250	196	349	276	301	230	298	228	297	228
September	281	206	315	223	333	226	279	200	333	262	267	190	335	241	299	215	305	220
October	749	319	892	295	840	305	861	861	593	233	715	257	734	279	-	-	673	319
November	1071	309	976	285	1087	310	1003	301	908	289	786	267	808	270	-	-	830	254
December	299	178	317	183	289	178	258	170	236	162	286	182	289	178	-	-	247	154
<b>Total</b>	<b>6,041</b>	<b>2,903</b>	<b>5,755</b>	<b>2,805</b>	<b>4,976</b>	<b>2,559</b>	<b>5,589</b>	<b>3,364</b>	<b>5,207</b>	<b>2,763</b>	<b>5,145</b>	<b>2,725</b>	<b>5,107</b>	<b>2,738</b>	<b>3,241</b>	<b>1,963</b>	<b>5,133</b>	<b>2,728</b>
<b>Annual Average</b>	<b>503</b>	<b>242</b>	<b>480</b>	<b>234</b>	<b>415</b>	<b>213</b>	<b>466</b>	<b>280</b>	<b>434</b>	<b>230</b>	<b>429</b>	<b>227</b>	<b>426</b>	<b>228</b>	<b>270</b>	<b>164</b>	<b>428</b>	<b>227</b>

Note: Data not available for May 2010 and October through December 2015

Chart 5-1 – Historic Vessel Traffic, Monthly Averages from 2008 to 2015



### **Historic Log of Vessel Allusions/Collisions, Rammings, and Groundings**

The historic bridge tender logs provide a record of vessel allusions (a moving vessel running into stationary vessel), vessel collisions (moving vessels running into one another), rammings, and groundings for the existing Topsail Island Bridge from 2008 to September 2015. This is not an all-inclusive list, only what bridge tenders have documented. Four instances were logged. Below is a summary of this data:

- » November 2, 2011 – A yacht named “Satisfaction” struck the bridge at approximately 10:00 AM.
- » December 17, 2013 – At approximately 4:30 AM, a barge escorted by the tug “Island Pilot” hit the bridge fender system.
- » June 13, 2014 – Around 10:00 PM, a yacht named “The Day After” struck the bridge.
- » July 19, 2015 – A barge being pulled by a tug struck the bridge causing damage to the fender system.

### **5.2 Observed Vessel Traffic**

Vessel height surveys were performed in May 2010 and October 2010 in order to more accurately determine the types and heights of vessels traveling through the Intracoastal Waterway and the frequency of these trips (the full report is available upon request). The vessel height surveys were conducted in three phases between 6 AM and 10 PM, daily:

- » May 8 to May 15, 2010;
- » October 16 to October 23, 2010.

The Project Team measured the heights of only those vessels which required a bridge opening during the vessel height surveys. The Project Team collected and/or calculated the following information as part of these vessel surveys:

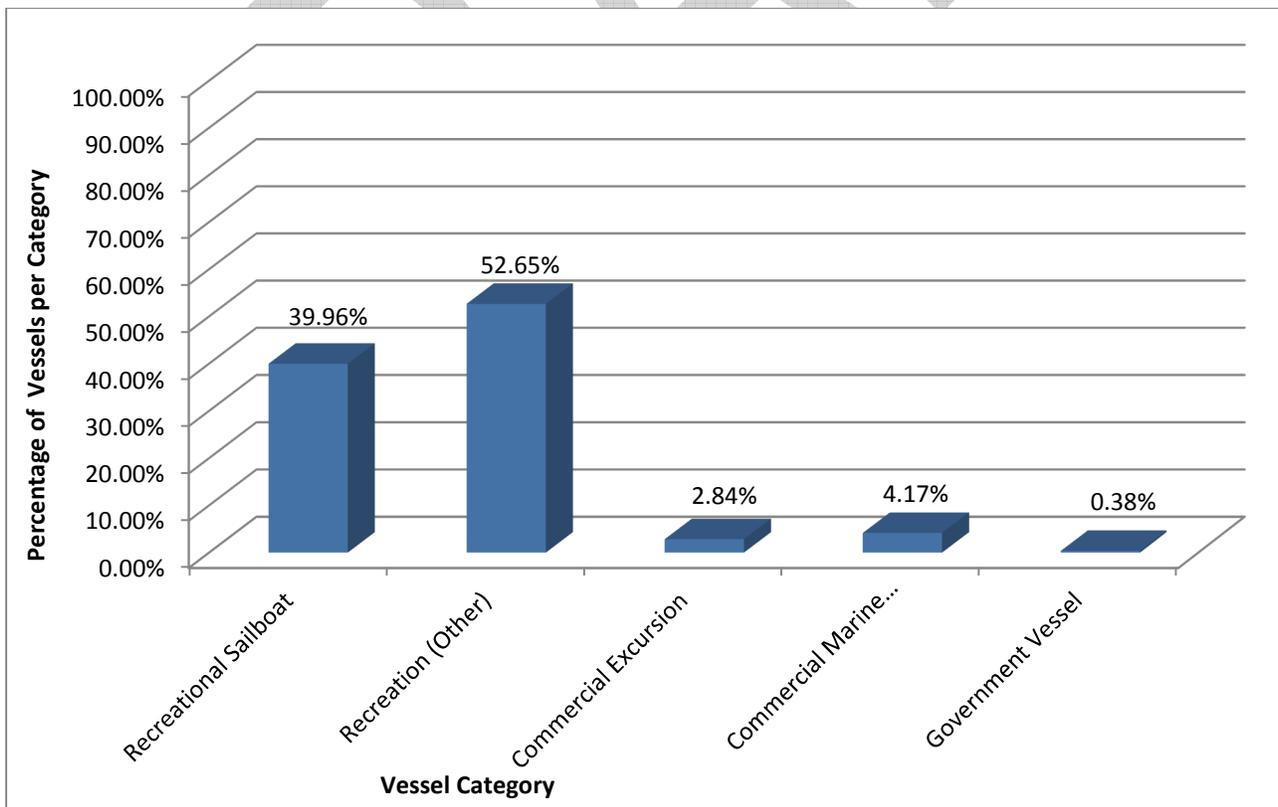
- » Date & Time
- » Vessel Type
- » Direction of Travel
- » Horizontal Angle
- » Zenith Angle
- » Horizontal Distance
- » Vertical Distance
- » Vessel Elevation
- » Elevation of Water
- » Vessel Height above Water
- » Vessel Name (if available)

The horizontal angle, zenith angle, vertical distance, vessel elevation, and elevation of water were collected and/or calculated only for vessels requiring the bridge to open. The daily survey data is provided in Appendix H. Table 5-2 and Chart 5-2 depict the number of vessels observed during the vessel surveys for the following vessel categories: recreational sailboats, other recreational vessels, commercial excursion vessels, commercial marine industrial vessels, and government vessels. Table 5-3 provides a listing of the vessel types included in each category. The majority of the "other recreational vessels" are recreational boats that were unable to be identified more specifically.

**Table 5-2 – Number and Percentage of Vessels per Category**

Vessel Category	No. of Vessels	Percentage of Vessels
Recreational Sailboat	211	39.96%
Recreation (Other)	278	52.65%
Commercial Excursion	15	2.84%
Commercial Marine Industrial	22	4.17%
Government Vessel	2	0.38%
<b>Total</b>	<b>528</b>	<b>100.00%</b>

**Chart 5-2 – Percentage of Vessels per Category**



**Table 5-3 – Vessel Types per Category**

Vessel Category	Type of Vessel
Recreational Sailboats	Rec. Sailboat
Recreational Fishing Boats	Rec. Fishing Boat
Recreational (Other)	Rec. Boat, Rec. Rowboat, Rec. Motorboat, Rec. Kayak, Rec. Jetski, Rec. Yacht
Commercial Marine Industrial	Comm. Barge w/ Backhoe, Comm. Barge w/ Crane, Comm. Fishing Vessel, Comm. Fishing Boat, Comm. Barge
Commercial Excursion	Comm. Dive Boat, Comm. Tour Boat, Comm. Tour Sailboat, Comm. Pirate Ship Replica, Comm. Water Taxi, Comm. Ferry, Comm. Rowboat
Government Vessel	NC Marine Patrol Boat, USCG Boat, DOT Boat, DOT Boat Towing Barge
On-Water Service	Comm. Towboat, Comm. Tugboat, Comm. Tugboat w/ Barge
Educational	Comm. Research Boat
Other Commercial	Comm. Boat

### 5.3 Vessel Height and Measurement

#### Survey Control

In order to properly measure the height of the vessels, it was important to establish a control. While NCDOT Photogrammetry Unit provides aerial panel points, the panels were no longer in the field. One such panel, p6, was previously located on a private campground. The owner of the campground, Blackbeard’s Treasure Campground, showed the survey team the former location of p6 and the survey team set up the equipment on a #5 rebar set within 60-ft horizontal of the p6 location and within 0.15-ft vertical. This vertical variation was not significant to the p6 elevation of 3.14-ft due to the accuracies of measuring moving vessels is no better than 1-ft. Therefore 3.14-ft was the assumed elevation of the instrument location.

For a baseline, a South bearing was assumed between the set #5 rebar and the easterly edge of the bridge operators’ house. Angles were based from this baseline. Reference angles were turned to the city water tower southeasterly of the instrument and a church cross northeasterly from the instrument point.



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### **Survey Procedure**

Each day the instrument was set on the #5 rebar and the video camera on the 8" nail. The height of the instrument was recorded and a back sight was taken at zero degrees on the east edge of the bridge operators' house (the baseline).

For each vessel that required a bridge opening the following was measured:

- » Horizontal Angle
- » Zenith Angle
- » Horizontal Distance
- » Elevation of Water

Due to the movement of the vessels through the channel during the survey, state-of-the-art surveying methods, such as using electronic data collection and reflectorless distance measurements, were not effective. The challenge of measuring a moving target occurs when a vessel is directly in front of the instrument (perpendicular). It is possible to accurately measure the horizontal distance to the side of the boat using reflectorless measurement; however it is impossible to get a matching zenith angle to the top of the vessel before the vessel has moved and the horizontal distance has then changed. When the vessel is approaching or moving away from the instrument, the zenith angle is easier to obtain but the horizontal distance cannot be obtained with reflectorless measurement.

As a solution to this challenge, the survey team used a marked, constant distance to the center of the channel at the end of the channel fenders. Every vessel must cross this point; therefore, the zenith angle can be recorded and a reliable elevation calculated. The marked location yields a horizontal angle of 30°09'02" with the horizontal distance of 270.74 feet. Naturally, it is difficult to consistently measure the zenith angle at this exact horizontal angle every time. Therefore, the differing horizontal angle can be used to determine the horizontal distance in order to remove errors. This was verified by calculating the angles and distances to each vessel based on the surveyed horizontal and zenith angle and the location of the channel, the instrument, and the bridge. This theory is sound within the horizontal tolerance (+/- 1-foot) assuming the vessel is in the center of the channel. Near the existing bridge, the channel itself is narrow, which increases the likelihood that the vessel remains in the channel's center through and past the marked line. Since the conditions require measurement of the vessel while buoyant and in motion, at rapid speeds on occasion, this method has been determined as the most accurate. Finally, the distance to the top of the water was measured to adjust for the tide and the height of vessel above water was achieved through the calculations outlined in the next section.

### **Survey Calculations**

Based on these recorded measurements, the height of the vessel above the water was calculated in three steps:

Step 1: Calculate Vertical Distance

$$VD = \tan(90^\circ - A) \times D$$

where VD = Vertical Distance,  
A = Zenith Angle,  
D = Horizontal Distance.

Step 2: Calculate Vessel Elevation

$$VE = VD + E + Hi$$

where VE = Vertical Elevation,  
VD = Vertical Distance,  
E = Elevation of Observation Point,  
Hi = Height of Instrument.

Step 3: Calculate Vessel Height above Water

$$H = VE - EW$$

where H = Vessel Height above Water,  
VE = Vertical Elevation,  
EW = Elevation of Water.

The majority of the vessels that were measured multiple times had calculated Vessel Heights above Water within a reasonable tolerance (+/- 1-foot). However, the Vessel Height above Water for vessels that were measured multiple times throughout the survey could vary outside of this tolerance due to a number of factors:

- » Raising/lowering of outriggers
- » Raising/lowering of antenna
- » Displacement (weight) of the vessel varying due to load, fuel level, etc.
- » Tilt of a masted vessel due to wind

#### 5.4 Vessel Survey Results

During the 16-day survey period, a total of 528 vessels were measured, averaging 33 vessels per day. This vessel activity corresponded with 186 bridge openings, averaging 12 openings per day.

**Surveyed Vessels over 65-feet**

For any vessels over 65-feet, there is a limited length of waterway they are able to travel along the Intracoastal Waterway until they are inhibited by the North Topsail Island Bridge. Table 5-4 provides a listing of the vessels over 65-feet that were measured during the survey. There were 19 vessels measuring over 65-feet. Of these 19 vessels, 18 of these vessels are Recreational Sailboats that are able to step down their masts or use counterweights to tip the mast in order to pass beneath a fixed-span bridge with a VNC of 65-feet. The remaining vessel measured over 65-feet is a Commercial Fishing Vessel that is able to lower the outriggers in order to pass beneath a fixed-span bridge with a VNC of 65-feet. The vessel height as well as the vessel type is shown in Table 5-4.

As the 65-foot VNC is measured based on the MHW elevation (during high tide), and there can be fluctuations of approximately 2 feet in the elevation of the water in the Intracoastal Waterway at the proposed bridge location throughout the day, vessels ranging in height from 65-feet to 67-feet could reasonably pass beneath the proposed Topsail Island Bridge during low tide without adjustment.

**Table 5-4 – Surveyed Vessels over 65-feet in Height**

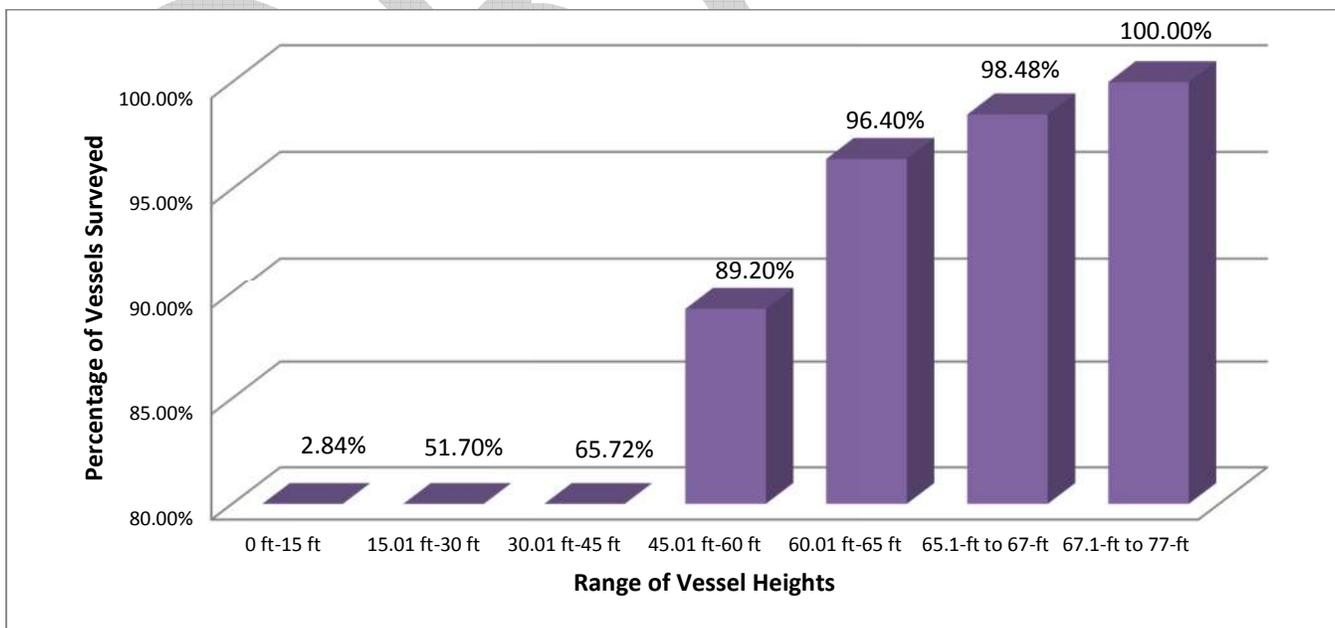
No.	Vessel Type	Height (ft)
1	Rec. Sailboat	67
2	Rec. Sailboat	73
3	Rec. Sailboat	70
4	Rec. Sailboat	66
5	Rec. Sailboat	74
6	Rec. Sailboat	67
7	Rec. Sailboat	65
8	Rec. Sailboat	65
9	Comm. Fishing	69
10	Rec. Sailboat	66
11	Rec. Sailboat	66
12	Rec. Sailboat	67
13	Rec. Sailboat	68
14	Rec. Sailboat	68
15	Rec. Sailboat	66
16	Rec. Sailboat	69
17	Rec. Sailboat	66
18	Rec. Sailboat	66
19	Rec. Sailboat	71

Based on the data obtained in the survey, a high-level fixed span bridge with a 65-foot VNC at MHW would accommodate 96.4% of the vessels recorded (509 out of 528 vessels). At MLW, the proposed bridge would accommodate 98.5% of the vessels recorded (520 out of 528 vessels), as vessels up to 67 feet would be able to travel beneath the bridge during low tide. Eight vessels were measured to be over 67 feet in height and would be unable to travel beneath the proposed bridge without adjustment (step down mast). Table 5-5 and Chart 5-3 provide a summary of this data.

**Table 5-5 – Number and Percentage of Vessels within Vessel Height Ranges**

Vessel Height Range	No. of Vessels Surveyed within Height Range	Percentage of Vessels Surveyed within Height Range	Cumulative Vessel Tally	Cumulative Vessel Percentage Tally
0 ft-15 ft	15	2.84%	15	2.84%
15.01 ft-30 ft	258	48.86%	273	51.70%
30.01 ft-45 ft	74	14.02%	347	65.72%
45.01 ft-60 ft	124	23.48%	471	89.20%
60.01 ft-65 ft	38	7.20%	509	96.40%
65.1-ft to 67-ft	11	2.08%	520	98.48%
67.1-ft to 77-ft	8	1.52%	528	100.00%
Total	528	100.00%	528	100.00%

**Chart 5-3 – Percentage of Vessels per Category**



### 5.5 Marina Industry Interviews

Six marinas were identified by the Project Team in the vicinity of the Topsail Island Bridge. In order to determine more information on the maritime activity in the area, interviews were conducted with five of the marinas. The remaining marina, Hampstead Marker 90 Boat Storage and Launch, was unmanned and a visual survey was performed at that location. Figure 5-1 shows these marina locations in relation to the existing Topsail Island Bridge. The interviews were completed on October 26-27, 2015. The marinas provided estimates for each of the percentages reported as they do not document this data specifically for each vessel they service. Typically, marinas do not record the height of the vessel but rather the length. Table 5-5 provides a summary of the information recorded during the interviews and visual surveys.

**Table 5-6 – Marina Interview Data**

Marina Name	No. of Vessels Currently Stored*	Percentage of Annual Vessel Usage Leisure (Commercial)	Percentage of Vessels using Topsail Island Bridge	Percentage of Vessels above 65-feet
Marinas Located North of the Proposed Bridge				
New River Marina	65	50% (50%)	60%	0%
Topsail Island Yacht Club	164	98% (2%)	100%	0%
Swan Point Marina	32	90% (10%)	100%	<1%
Marinas Located South of the Proposed Bridge				
Anchor's Away Boatyard	90	100%	50%	<1%
Harbour Village Marina	200	100%	100%	0%
Hampstead Marker 90 Boat Storage and Launch	25	80%	-	0%

\*It should be noted that the number of vessels stored was the amount reported for October 2015. Annually, each marina is reported to service a significantly higher number of vessels.



**Legend**

- Project Study Area
- Marine Facilities

**DRAFT**

0 0.75 1.5 3 Miles

**Area Marine Facilities**

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**TOPSAIL ISLAND BRIDGE REPLACEMENT PROJECT**  
 (T.I.P. No: B - 4929)

Bridge No. 16 Over Intracoastal Waterway on NC 50 / 210

**Figure 5-1**  
November 2015

## 6.0 OTHER REQUIRED ELEMENTS FOR PERMIT

The USCG Bridge Permit Application Guide lists a number of issues to be addressed in the application. Several issues not previously addressed in the permit application and a brief statement of their applicability to the marine traffic assessment for the Topsail Island Bridge are outlined herein, although certain issues are discussed in more detail in other sections of this report.

1. *The name and contact information for marine facilities within a 3-mile radius of the project: public boat ramps, marina, major docking facilities, boat repair facilities, etc.*

Table 6-1 presents the type, name, and contact information for marine facilities within the project area of influence.

**Table 6-1 – Area Marine Facilities**

Facility Name	Facility Type	Address	Phone number
Marine Facilities within a 3-mile Radius			
Soundside Park Boat Ramp	Public Boat Ramp	517 Roland Ave, Surf City, NC 28445	-
Topsail Island Yacht Club	Marina	412 Roland Avenue, Surf City, NC 28445	910.328.2628
Marine Facilities outside of a 3-mile Radius (within area of influence)			
Anchors Away Boatyard	Marina, Boat Repair Facility	585 Lewis Rd, Hampstead, NC 28443	910.270.4741
Bush Marina	Public Boat Ramp	820 S Anderson Blvd, Topsail Beach, NC 28445	910.328.5841
Hampstead Boating Access Area	Public Boat Ramp	613 Lewis Rd, Hampstead, NC 28443	-
Hampstead Marina Inc	Marina	128 Broadview Ln, Hampstead, NC 28443	910.270.0505
Hampstead Marker 90 Marina	Marina	579 Lewis Rd, Hampstead, NC 28443	910.821.1024
Harbour Village Marina	Marina	101 Harbor Village Dr, Hampstead, NC 28443	910.270.2994
New River Marina	Marina, Boat Repair Facility	104 James Rd, Sneads Ferry, NC 28460	910.327.2106
Sneads Ferry Boat Ramp	Public Boat Ramp	302 Fulcher Landing Loop, Sneads Ferry, NC	-
Swan Point Marina	Marina, Boat Repair Facility	123 Page St, Sneads Ferry, NC 28460	910.327.1081
West Onslow Beach Boat Ramp	Public Boat Ramp	656 NC Hwy 210, North Topsail Beach, NC 28460	-

- 2. The approximate width of the waterway at the proposed bridge location (bank to bank, shoreline to shoreline, etc.).*

The federally authorized channel is 90 feet wide at the proposed bridge location. The bank to bank distance is approximately 1,460 feet wide. The 150-ft span of the proposed bridge provides a minimum HNC of 120-feet.

- 3. The depths of the waterway at the proposed bridge location in and around the navigation channel.*

The channel bed of the Intracoastal Waterway ranges from 13 feet to 16 feet deep in the vicinity of the proposed bridge.

- 4. A description of vessels on the waterway that are engaged in emergency operations, national defense activities, or channel maintenance, and any potential impacts to their operations.*

The Intracoastal Waterway is utilized by USCG Vessels and NC Marine Patrol Vessels. There are no anticipated impacts to their operations by the proposed Topsail Island Bridge.

- 5. Information regarding whether the Corps of Engineers has completed plans to complete a federal navigation project on this waterway.*

The Intracoastal Waterway is a federal navigation project for maintenance. In addition, the New Topsail Inlet is a project connecting the channel to the Intracoastal. The Coastal Storm Damage Reduction construction project in the towns of Surf City and North Topsail Beach are federally authorized as a result of Hurricanes Fran and Floyd.

- 6. A description of the present and prospective recreational navigation on the waterway, indicating whether the proposed project will have an impact on the safe, efficient movement of any segment of the present or prospective recreational fleet.*

Approximately 92% of the existing vessel traffic traveling through Topsail Island Bridge in 2010 was recreational. The proposed bridge would not impact the safe and efficient movement of 96.4% of the vessel traffic. From the survey, 3.6% of the existing vessel traffic would be unable to travel beneath the proposed bridge at MHW. In order to travel north of the proposed bridge, these vessels can either have their masts stepped down or travel at lower tides in order to travel beneath the proposed bridge.

For more information, refer to Section 5.2 of this report.

7. *A description of the present and prospective commercial navigation and the cargoes moved on the waterway, indicating whether the proposed project will have an impact on the safe, efficient movement of any segment of the present or prospective commercial fleet operating on the waterway.*

As this bridge is located on the Intracoastal Waterway, commercial fishing vessels, cargo vessels, and oceangoing vessels travel the area. Approximately 8% of the existing vessel traffic traveling beneath the Topsail Island Bridge is commercial. The proposed bridge would not impact the safe and efficient movement of the vessel traffic.

For more information, refer to Section 5.4 of this report.

8. *Whether the proposed bridge will block access of any vessel presently using local service facilities.*

While three marinas are located north of the existing bridge, only one is south of the North Topsail Island Bridge. Access would be limited for vessels over 65 feet in height, however, no vessels over 65 feet in height are served at the Topsail Island Yacht Club.

9. *Whether alternate routes bypassing the proposed bridge are available for use by vessels unable to pass the proposed bridge.*

For any vessels over 65 feet, there is a limited length of waterway they are able to travel along the Intracoastal Waterway until they are inhibited by the North Topsail Island Bridge approximately seven miles north of the existing Topsail Island Bridge. To access facilities north of the proposed bridge and south of the North Topsail Island Bridge, these vessels can either have their masts stepped down or travel at lower tides.

10. *A description of any local harbor, indicating whether the bridge will prohibit the entry of any vessels to the local harbor of refuge.*

According to US Harbors listing, the Beach House Marina Harbor is the only harbor in the area that would be impacted by the proposed bridge. However, this harbor has been closed since 2012 due to bankruptcy.

11. *Whether the proposed bridge will be located within one-half mile of a bend in the waterway.*

The proposed bridge is located within one-half mile of a bend in the waterway as Waypoint 2 near light 71 according to the USACE Hydrographic Survey, included in Appendix C.

12. *Whether there are factors located within one-half mile of the proposed bridge which would create hazardous passage through the proposed structure and a description of each factor.*

The existing Jones-Onslow Electric Membership Corporation (JOEMC) transmission lines are located north of the proposed bridge. It is currently unsafe for vessels exceeding 81 feet in height to traverse the channel and would remain a hazard in the channel.

13. *Whether local hydraulic conditions increase the hazard of passage through the proposed bridge and a description of these conditions.*

There are no known hydraulic conditions that would create hazardous passage through the proposed bridge.

14. *Whether atmospheric conditions increase the hazard of passage through the proposed bridge and a description of these conditions.*

There are no known atmospheric conditions that would create hazardous passage through the proposed bridge.

15. *A description of guide clearances established for the waterway, if applicable. If not, indicate whether clearance gauges are needed and why.*

It is anticipated with the proposed bridge, that a guide clearance of 65-feet VNC and 120-feet HNC could be posted. The District Commander will determine whether a clearance gauge is needed for the proposed bridge. The existing Topsail Island Bridge has clearance gauges for mariners. In order to be consistent with the existing provisions, a clearance gauge could be provided.

16. *A description of any other factors considered necessary for the safe, efficient passage of vessels through the proposed bridge.*

There are no known other factors that would be considered necessary for the safe, efficient passage of vessels through the proposed bridge.

17. *A description of the impacts to navigation caused or which could be reasonably caused by the proposed bridge, including, but not limited to, proposed construction methodology and any proposed mitigation to all unavoidable impacts to navigation.*

Vehicular traffic is proposed to remain on the existing bridge during the construction of the proposed bridge and associated roadway improvements. The existing bascule bridge would continue to operate as it currently does during construction, opening for vessels exceeding 13 feet in height. The construction of the proposed bridge will be conducted so as to minimize interference with the operation and maintenance of Intracoastal Waterway. Construction of the new bridge will likely require a combination of temporary work bridges and the use of a barge.

## 7.0 LETTERS AND RESOLUTIONS

The following is a list of documents in support of the proposed 65-foot fixed bridge design by the stakeholders in the study area. These documents are included in Appendix I.

- » Town of Surf City – resolution dated October 5, 2010
- » Town of Surf City – resolution dated February 5, 2014

## 8.0 CONCLUSIONS

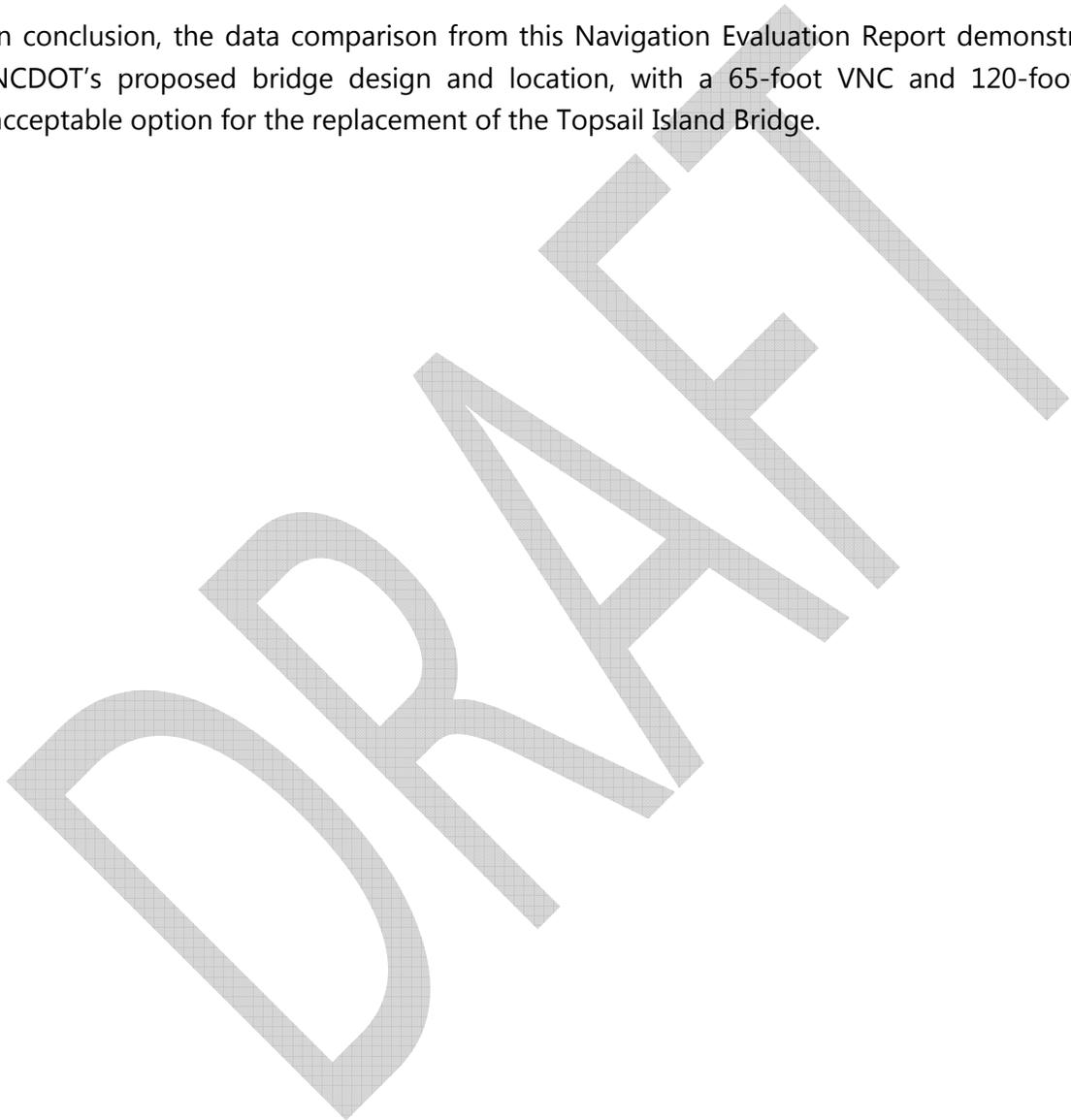
NCDOT performed vessel height surveys for a total of 16 days in 2010 in order to more accurately determine the types and heights of vessels traveling through the Intracoastal Waterway and the frequency of these trips. The survey results, as well as other pertinent information and data regarding Topsail Island Bridge over the Intracoastal Waterway, were compiled into this Navigation Evaluation Report as part of the USCG permit application. This assessment detailed the following:

- » The proposed bridge is a high-level, fixed-span bridge located approximately 1,100 feet south of the existing bridge beginning on the mainland side just east of Atkinson Point Road and ending on the island side at Topsail Drive (NC 50). The new island tie-in is located approximately 300 feet south of Roland Avenue. The proposed bridge location would not impact access to any marinas.
- » The vessel height survey results concluded that the proposed bridge would not impact the safe and efficient navigation of 96.4% of the vessel traffic (up to 65 feet at mean high water (MHW)). Only 19 vessels observed, (3.6%) out of 528 vessels, were measured to be over 65 feet in height and would be unable to travel under the proposed bridge without adjustment.
- » The proposed bridge will not require the relocation of any businesses on the island. One business impact on the mainland side (currently a vacant building) is anticipated due to utility issues. NCDOT will offer relocation assistance to the property owner that will be directly impacted by this

project as part of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (1970, as amended in 1987).

- » NCDOT has determined that a separate fender system will not be required for the replacement structure. Any changes to the horizontal opening will need to be reevaluated by USCG to determine if a fender system is required.

In conclusion, the data comparison from this Navigation Evaluation Report demonstrates that the NCDOT's proposed bridge design and location, with a 65-foot VNC and 120-foot HNC, is an acceptable option for the replacement of the Topsail Island Bridge.





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