NCDOT BRIDGE SUPERSTRUCTURE LEVEL III WAVE VULNERABILITY STUDY
Final Report

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16. Abstract

This report summarizes the work performed by Ocean Engineering International, PLLC for North Carolina Department of Transportation on the vulnerability of selected NCDOT coastal bridges to design storm surge and wave loads. In this study, the bridge is considered to be vulnerable if the surge/wave forces and moments (with the appropriate load factors) exceed the resistive forces and moments created by the dead weight of the superstructure for any of the spans. A Level III storm surge/wave analysis was performed to provide the design water level and wave parameters needed to compute the loads. This analysis entailed 1) the hindcasting of 62 of the most severe tropical storms and hurricanes that have impacted North Carolina coastal waters over the past 160 years, and 2) performing extreme value analyses on water elevation, wave heights, and depth averaged current velocities throughout the area covered by the model to obtain 100-year design conditions. To increase the data set for the extreme value analyses, the hindcasted storm paths were shifted to the right and left of the actual path and the modified-path storms hindcasted. This resulted in a total of 186 hindcasts being performed. The results from the extreme value analyses are presented in a GIS database for ease of access and use. The information in the GIS database has many uses beyond that of providing the conditions needed for computation of surge/wave loads on the bridge superstructures.

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Executive Summary

This report summarizes the work performed by Ocean Engineering International, PLLC for North Carolina Department of Transportation on the vulnerability of selected NCDOT coastal bridges to design storm surge and wave loads. In this study, the bridge is considered to be vulnerable if the surge/wave forces and moments (with the appropriate load factors) exceed the resistive forces and moments created by the dead weight of the superstructure for any of the spans. A Level III storm surge/wave analysis was performed to provide the design water level and wave parameters needed to compute the loads. This analysis entailed 1) the hindcasting of 62 of the most severe tropical storms and hurricanes that have impacted North Carolina coastal waters over the past 160 years, and 2) performing extreme value analyses on water elevation, wave heights, and depth averaged current velocities throughout the area covered by the model to obtain 100-year design conditions. To increase the data set for the extreme value analyses, the hindcasted storm paths were shifted to the right and left of the actual path and the modified-path storms hindcasted. This resulted in a total of 186 hindcasts being performed. The results from the extreme value analyses are presented in a GIS database for ease of access and use. The information in the GIS database has many uses beyond that of providing the conditions needed for computation of surge/wave loads on the bridge superstructures.

Computation of the surge/wave loads on bridge superstructures requires knowledge of the superstructure type (slab, girder, etc.), dimensions, and span low chord elevation, as well as the design water elevation and wave parameters. NCDOT engineers provided the structural information. The proprietary computer model, PBM, developed by OEA, Inc. produced the data for development of the parametric equations in the AASHTO code "*Guide Specifications for Bridges Vulnerable to Coastal Storms"* was used to compute the surge/wave loads on the bridge superstructures.

Selection of the bridges to be analyzed was a multi-step process. The initial list consisted of all of the coastal bridges exposed to open water under storm conditions. This was followed by a Level I screening analysis which employed existing information for design water surface elevations and empirical wave equations for computing design wave heights and periods. The screening reduced the number of bridges from 222 to 148. However, this study reexamined all of the bridges since the accuracy of some of the input data from the Level I analysis was not known. During the model grid generation, a review of aerial photographs showed that the fetch for 31 bridges was very limited and thus they were removed from the list. This resulted in a total of 191 bridges examined in this study.

1.0 Introduction

The infrastructure in low lying coastal areas subject to tropical storms and hurricanes is vulnerable to the elevated water levels, high velocity flows, and wave conditions that accompany these types of storms. It is imperative that those responsible for design and maintenance of this infrastructure have as much and as accurate information as practical about these conditions. These environmental parameters are referred to in this document as meteorological/oceanographic or met/ocean conditions. In particular, coastal roadways and bridges are potentially vulnerable to this type of loading. A number of large and expensive bridges in the Gulf Coast states were destroyed by storms during the past decade. Most of this destruction was attributed to hurricane storm surge and wave forces.

In order for the met/ocean information to be useful, its frequency of occurrence must also be known. That is, estimates of its probability of occurrence each year must be known. With this information and the desired structure life, acceptable level of risk, etc., design conditions can be established. Common design frequencies for coastal bridges are 1% and 2% chances of occurrence each year (referred to as 100-year and 50-year return intervals, respectively).

The objectives of this study were to: 1) establish 100-year design met/ocean conditions for North Carolina coastal waters and to present the results in a Surge/Wave GIS Database, and 2) from the Surge/Wave data and bridge information identify NCDOT bridges vulnerable to this type of loading. To achieve these objectives, the major tropical storms and hurricanes that have impacted the North Carolina coastal waters during the past 160 years were simulated (hindcasted) with calibrated computer models and the results analyzed using extreme value statistics to obtain design frequency met/ocean values for these locations. Surge/wave forces and moments on the superstructures of the coastal bridges specified by NCDOT were computed and the bridges analyzed for vulnerability to design surge/wave loads. In this study, a vulnerable bridge is one where the surge/wave forces or moments exceed the resistive forces and moments (based solely on the span dead weight) on one or more spans.

Selection of the bridges to be analyzed was a multi-step process. The initial list consisted of all of the coastal bridges exposed to open water under storm conditions. This was followed by a Level I screening analysis which used existing information for design water surface elevations and empirical wave equations for computing design wave heights and periods. The screening reduced the number of bridges from 222 to 148. That said, given the potential low accuracy of the Level I analysis, this study evaluates all of the bridges. During the model grid generation, a review of aerial photographs showed that the fetch for 31 bridges were limited and eliminated from the study. This left a total of 191 bridges for this analysis.

This report is organized as follows. Chapter 1 is an introduction and overview. The storm surge/wave modeling analyses is covered in Chapter 2. Chapter 3 summarizes the extreme value analyses used in this study. Chapter 4 describes the Surge/Wave database. Chapter 5 covers the surge/wave loading and bridge vulnerability assessment. Chapter 6

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summarizes the work and presents conclusions. More detail information and computations on many of the topics are presented in the appendices.

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2.0 Wind, Storm Surge and Wave Models

2.1 Wind and Atmospheric Pressure Fields

Both the storm surge and waves are generated by the wind and atmospheric pressure in the storm. For this study the wind and pressure fields for the hindcasted tropical storms and hurricanes were developed by Oceanweather, Inc., a meteorological firm located in Connecticut. The wind speed and direction and the atmospheric pressure is computed at the nodes of two rectangular grids — WNAT28km basin scale and the NC3Min fine scale grid— at each time step for about five days during the approach and landfall of the storm. The WNAT28km basin scale grid spacing is 15 Min (.25 degree, ~28 km) covering the domain 5-47.5N, 98-57.5W (Figure 2.1), the NC3Min fine scale grid spacing is 3 Min (.05 degree, ~5 km) covering a domain 33.5- 37N 79-75W (Figure 2.2).

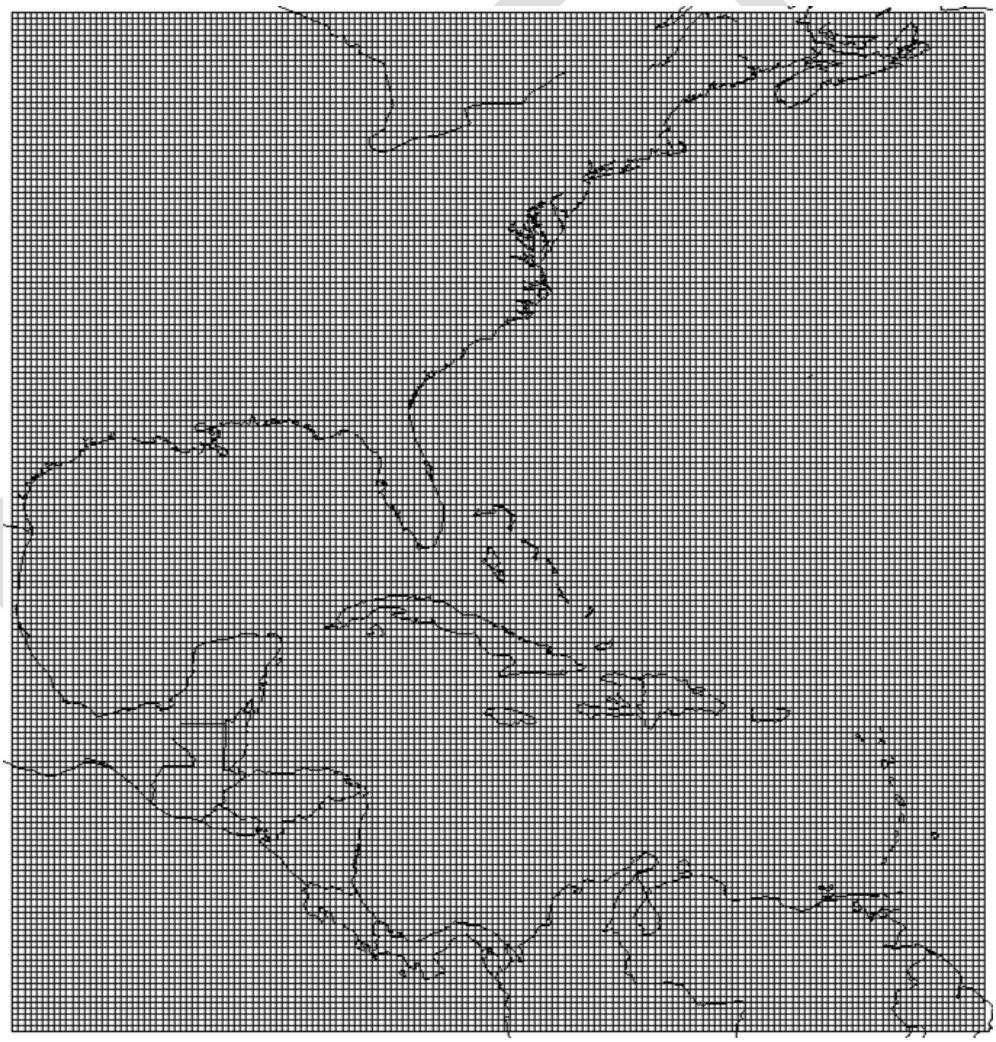

Figure 2.1 Coarse Scale Wind and Pressure Grid (WNAT28km).

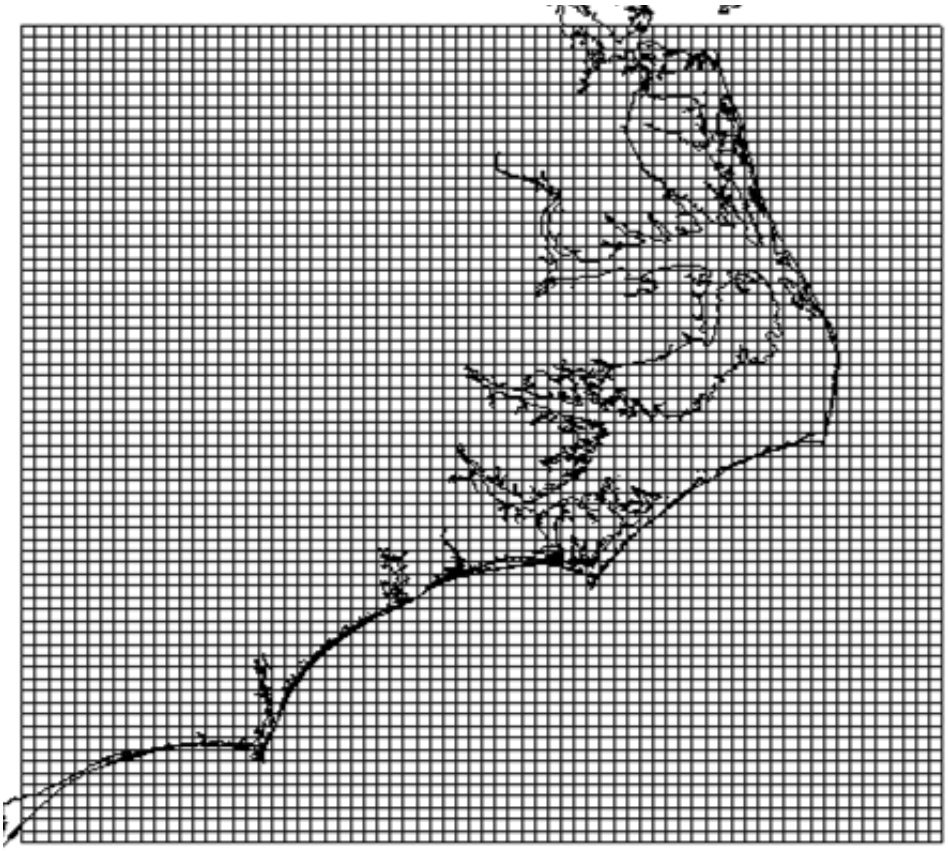

Figure 2.2 Fine Scale Wind and Pressure Grid (NC3Min).

The wind and pressure fields are interpolated to the storm surge and wave mesh and provide the input to simulate surge, current and wave generation. The storm surge and wave computer models are discussed in the following sections.

2.2 Storm Surge and Wave Model Selection

This study employed the latest hindcast technology, which uses the tightly coupled ADCIRC+SWAN model and hindcasted tropical storm and hurricane wind and pressure fields provided by Oceanweather, Inc.

2.2.1 Selected Models

The program ADCIRC (ADvanced CIRCulation Model for Coastal Ocean Hydrodynamics) simulated both the tidal circulation and the hurricane storm surges in the project area. ADCIRC is a numerical model developed specifically for generating long duration hydrodynamic circulation along shelves, coasts, and within estuaries.

The program SWAN (Simulating WAves Nearshore) was used to simulate wave heights and periods. SWAN, developed at the Delft University of Technology in the Netherlands, is a one-, and two-dimensional numerical model for estimating wave parameters in coastal areas, lakes and estuaries from given wind, bathymetric, and current conditions.

Both models have been applied extensively by OEI as well as numerous governmental agencies including the US Army, Navy, and FEMA. Appendix B provides detailed information on both ADCIRC and SWAN.

Both models employ an unstructured model grid, or finite element mesh (mesh) to describe the area of interest. The spatially varying mesh defines the topography and bathymetry of the project area. The density of the nodes in the mesh in an area is dependent on the size of the topographic/bathymetric feature of that area. That said, model runtime is proportional to the number of nodes in the mesh. The number of nodes is governed by the required accuracy, the geometric features to be resolved and practical limits on model development and run times. The mesh configuration is generated through the application of an algorithm that relates mesh element size to both local bed elevation and local bed gradient. The mesh was then modified to increase the resolution in the regions within and surrounding the coast of North Carolina. Once generated, mesh nodes are assigned elevations using topography and bathymetry interpolated from NOAA datasets (coastal relief and ETOPO2 data sets and USACE surveys - Appendix A) for both the nearshore and the open ocean.

The mesh covers the western North Atlantic Ocean, the Gulf of Mexico, and the Caribbean Sea. Figure 2.3 through Figure 2.7 display the model mesh. Figure 2.3 presents the entire mesh with an inset showing the coastal North Carolina portion of the mesh. Figure 2.4 through Figure 2.7 display the details of the model mesh along the coastline of North Carolina from Currituck Sound to Cape Fear River. Figure 2.4 provides a key to the bounds for the detailed images of the mesh presented in Figure 2.5 through Figure 2.7. Figure 2.5 presents the mesh in the north coastal region, which includes; Currituck Sound, Albemarle Sound, and the north end of Pamlico Sound. Figure 2.6 presents the mesh in the central coastal region, which includes Pamlico Sound, Pamlico River, Neuse River, and the Outer Banks. Figure 2.7 presents the south coastal region of the model mesh illustrating the level of detail in Core Sound, Bogue Sound, New River, and Cape Fear River. The final mesh contains more than 207,000 nodes.

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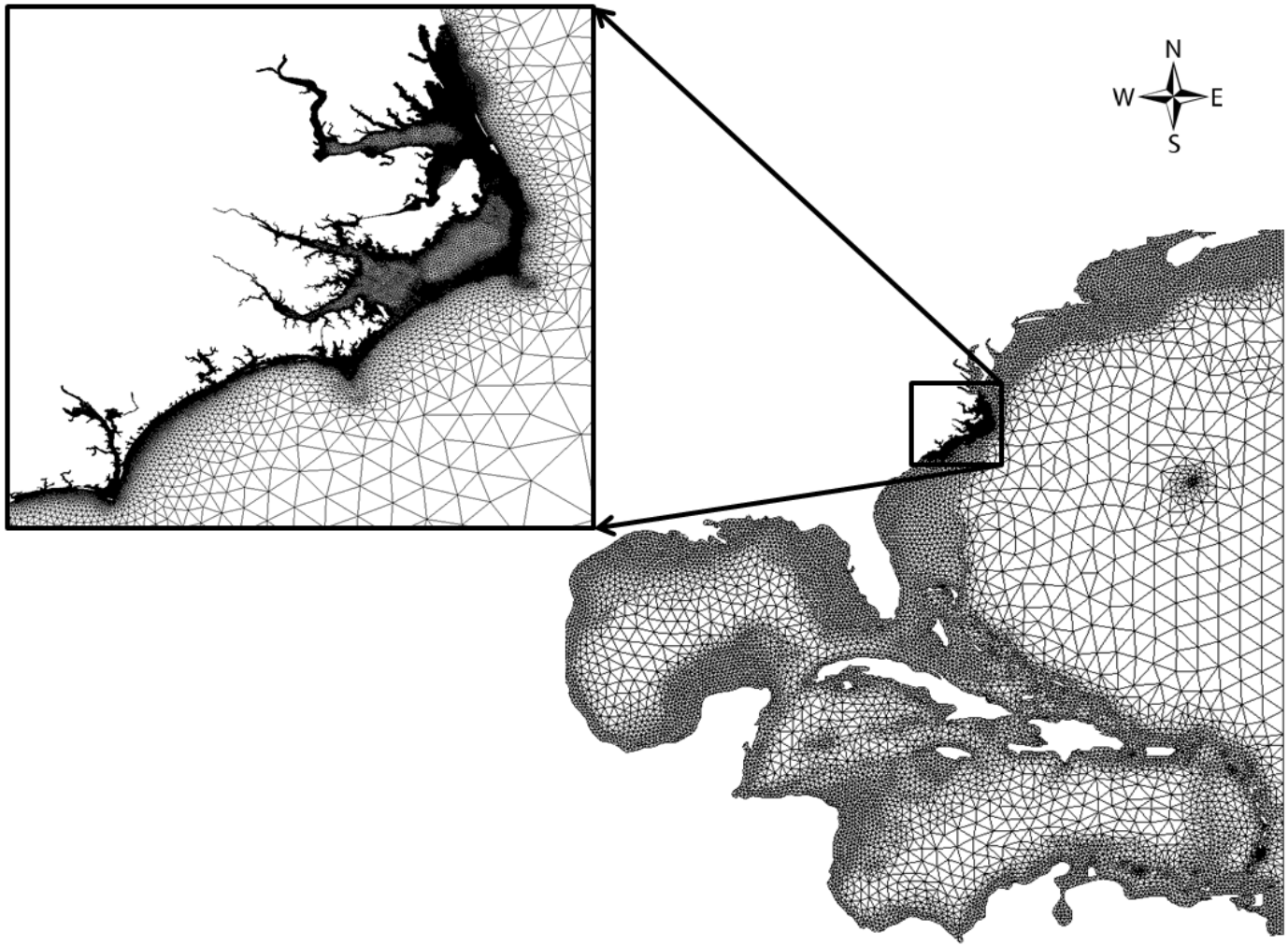

Figure 2.3 ADCIRC/SWAN Mesh Covering a Portion of the North Atlantic,the Caribbean Sea, and the Gulf of Mexico with Inset Showing Detail of Coastal North Carolina.

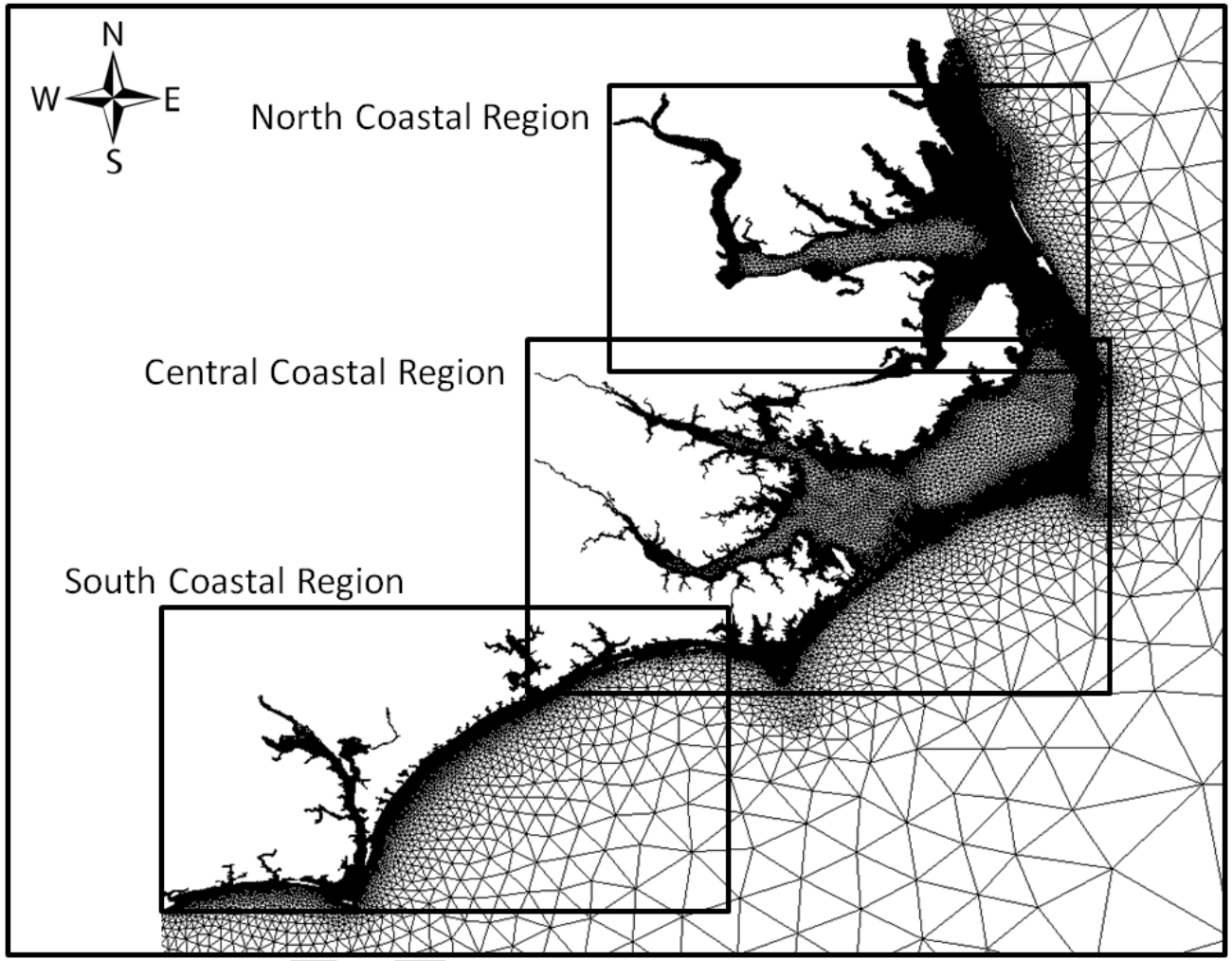

Figure 2.4 Location of the Detailed Regions of the Mesh.

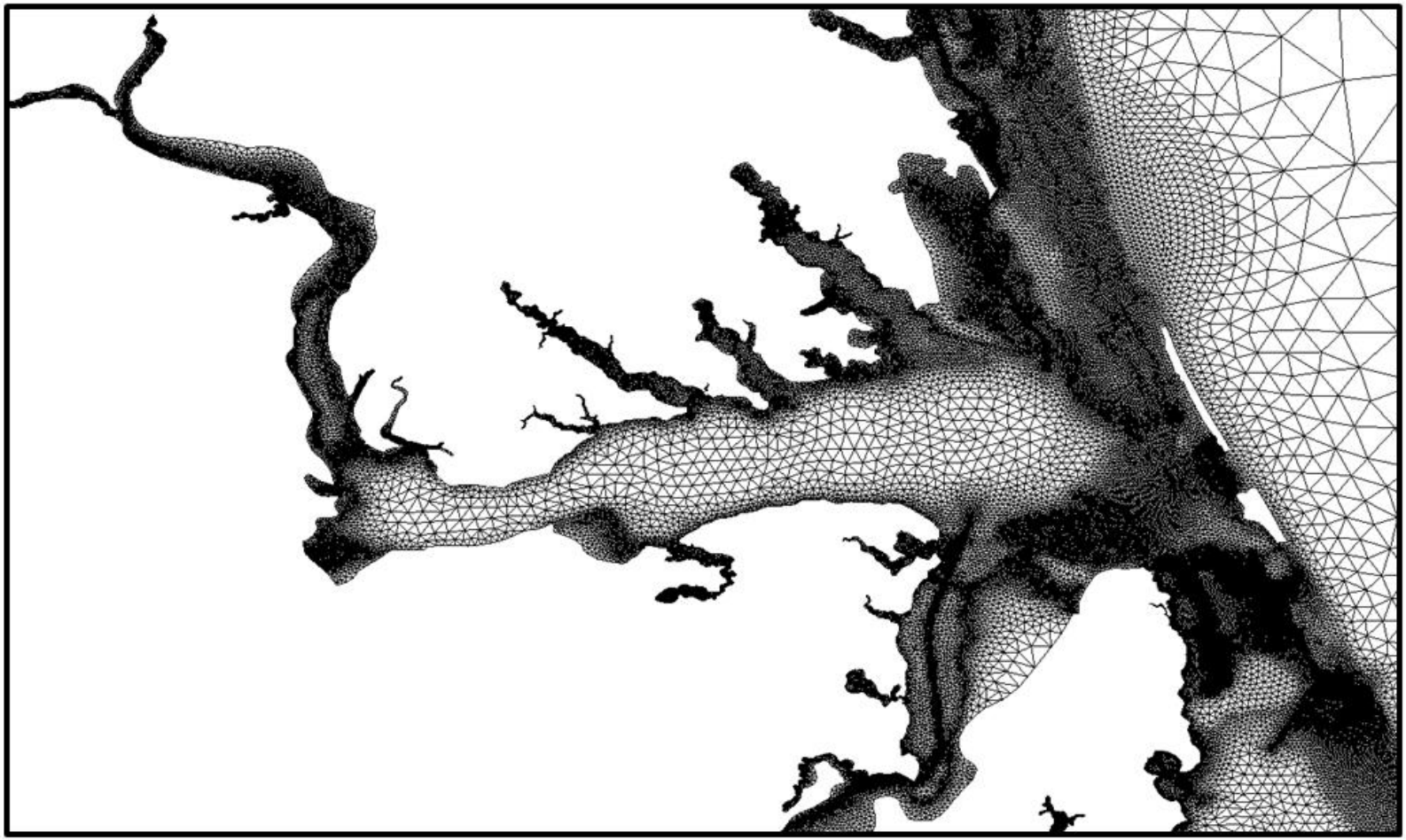

Figure 2.5 North Region of the Model Mesh Illustrating the Model Detail in the Currituck Sound and Albemarle Sound Areas.

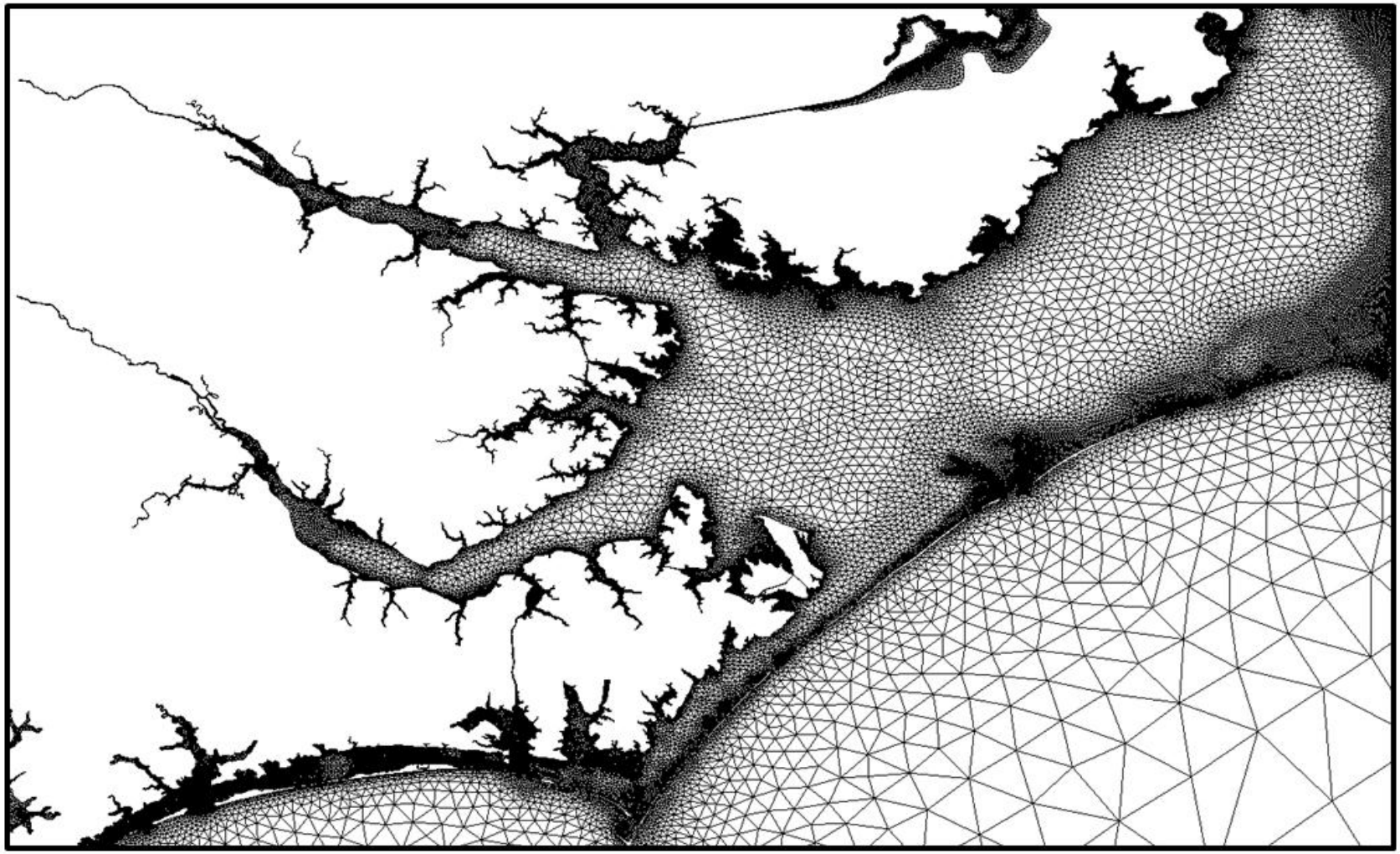

Figure 2.6 Central Region of the Model Mesh Illustrating the Model Detail in the Pamlico Sound and Neuse River Area.

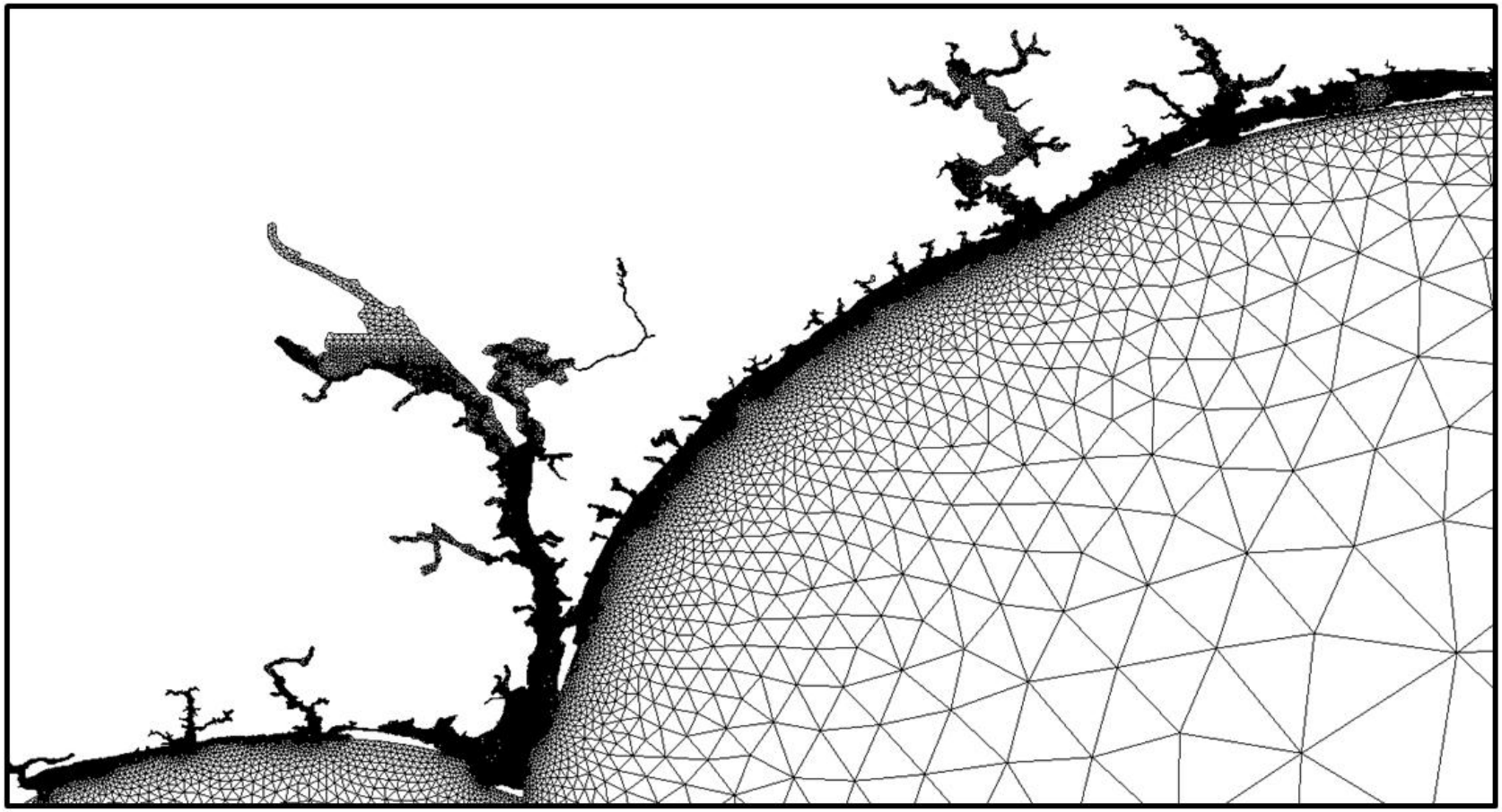

Figure 2.7 South Region of the Model Mesh Illustrating the Model Detail in the Core Sound, Bogue Sound, New River, and Cape Fear River Areas.

2.2.2 Model Calibration

This section presents an overview the ADCIRC and SWAN model calibration. Appendix C gives the details of the calibration.

Model calibration involves an iterative process of adjusting model parameters until the model results at set locations match measured values within acceptable limits. Once calibrated, the model is verified by comparing model results to measured data for additional events to verify they meet established criteria. Three types of measured data were collected for the calibration: water surface elevation (WSE) data, hurricane high water marks, and wave data. The following paragraphs provide an overview of the calibration.

The ADCIRC calibration includes the adjustment of model friction and lateral eddy viscosity until modeled water surface elevations match measured values within acceptable limits. FEMA (2007) defines this limit as 10% or less for tidal calibrations. For storm surge verifications, FEMA acknowledges the complexity associated with measurements during storms. Based on the complexity, FEMA notes that the acceptable error range exceeds that under normal tidal calibrations.

The ADCIRC calibration employed two types of observed data at four NOAA gages distributed along the coast. The first, used in the calibration, are time series of water surface elevations (WSE) recorded during a normal month of tides both with and without meteorological influences. The second, used in the verification, are four different time series of WSE recorded during the passing of four different hurricanes. Appendix C provides details of the gage locations, the time series observations from the gages, and comparisons of the observed and simulated WSE.

Table 2.1 summarizes results from the ADCIRC model calibration, which uses the month long NOAA predicted tidal record without meteorological influences. Positive values indicate over prediction and negative values under prediction. In the table, the average percent error for all gages is within the acceptable limits. Again, refer to Appendix C for the details of the calibration.

Table 2.1 ADCIRC Calibration Results.

Gage	Mean Error (ft)	RMSE (ft)	Average % Error
8652587	-0.01	0.11	7%
8651370	0.03	0.39	8%
8658120	-0.24	0.49	9%
8656483	0.05	0.39	8%

Table 2.2 summarizes results from the ADCIRC model verification. The table consists of four sub-tables one for each hurricane event with results at each gage location. Positive values indicate over prediction and negative values under prediction. As the average percent errors demonstrate, the model is within acceptable error limits. Appendix C provides the details of the verification.

Table 2.2 ADCIRC Verification Results.

Hurricane Isabel			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
8652587	0.31	0.55	10%
8651370	0.27	0.66	10%
8658120	-0.06	0.55	12%
8656483	0.15	0.43	9%

Hurricane Floyd			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
8652587	0.56	0.71	14%
8651370	0.10	0.58	12%
8658120	0.29	0.92	13%
8656483	0.30	0.69	11%

Hurricane Fran			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
8652587	0.13	0.36	12%
8651370	0.17	0.51	10%
8658120	-0.51	1.29	17%
8656483	0.04	0.55	8%

Hurricane Bonnie			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
8652587	-0.25	0.49	9%
8651370	0.15	0.53	11%
8658120	-0.42	1.11	22%
8656483	-0.20	0.65	11%

Calibration of the SWAN model involved the four National Data Buoy Center (NDBC) wave stations presented in Appendix C. Table 2.3 presents a summary of the results. Positive values indicate over prediction of wave height and negative values under prediction. The average percent error ranged from a low of +5% to a high of +23% and an average of +10%. Given the low errors and the slight tendency to over predict,, the calibration was deemed within acceptable bounds and as such, the wave model was considered calibrated. Appendix C provides additional details of the SWAN calibration.

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Table 2.3 SWAN Calibration Summary.

Hurricane Isabel			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
FPSN7	0.2	2.9	13%
41001	2.0	7.5	23%
41002	1.4	4.0	10%
44014	No Data Were Available		

Hurricane Floyd			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
FPSN7	0.01	1.50	5%
41001	0.91	1.57	7%
41002	0.64	1.72	6%
44014	1.61	2.66	9%

Hurricane Fran			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
FPSN7	0.96	2.30	8%
41001	2.29	3.72	13%
41002	3.94	4.87	6%
44014	1.97	2.93	9%

Hurricane Bonnie			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
FPSN7	0.50	1.72	6%
41001	0.75	1.32	9%
41002	2.32	3.30	8%
44014	1.09	3.03	12%

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2.3 Storm Surge and Wave Hindcast Procedure

As previously noted, the hindcast procedure employs the tightly coupled ADCIRC+SWAN model. As the name implies, the model is composed of the circulation model ADIRC and the wave model SWAN. Since the models share an identical mesh, they pass wind speeds water levels, currents and radiation stresses efficiently allowing them to run sequentially in time. The procedure begins with the application of the storm surge/circulation model (ADCIRC). Inputs to this model include tidal potential boundary conditions and the pressure and wind fields. ADCIRC simulates the conditions for a set time then passes the WSE and currents to SWAN. SWAN then simulates wave generation, transformation and breaking for a set amount of time. Inputs to this model include WSE and currents from ADCIRC and wind fields. SWAN then passes radiation stresses to ADCIRC. ADCIRC then calculates WSE and currents with the radiation stresses as additional input. This process continues for the duration of the hindcast simulation. Figure 2.8 shows a diagram of the hindcast procedure including inputs, outputs, and interaction between the model applications.

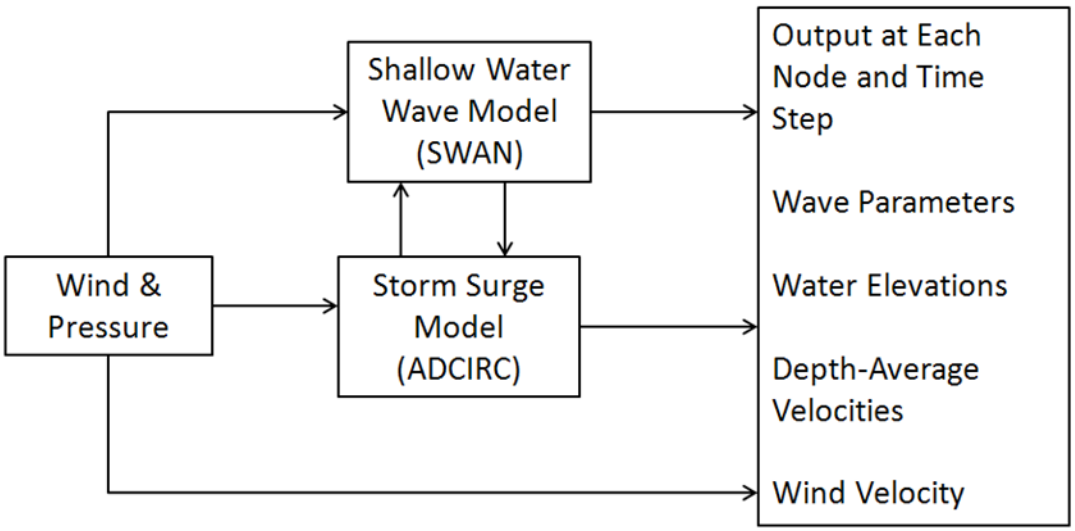

Figure 2.8 Model Application Procedure Diagram.

2.4 Selection of Hindcast Storms

The storm selection process involved the application of a simplistic hurricane wind model that examines all historical tropical storms and hurricanes whose paths came within 100 miles of the North Carolina Coastline. The computed wind fields were used to identify hurricanes that had the potential for creating significant storm surge and wave heights in the areas of interest. Additionally, wave, wind, and water elevation measurements from a variety of sources were analyzed to identify additional hurricanes and storms that affected North Carolina Coastal waters. This process produced the tropical storms and hurricanes listed inTable 2.4. Their paths are shown in Figure 2.9 and Figure 2.10. As Table 2.4 illustrates, these storms occurred between 1857 and 2007. The steering currents for hurricanes are such that the path could have been easily altered resulting in a point of landfall either to the right or left of the actual landfall. For this

reason, the path of each hindcasted storm was shifted ½ degree (approximately 30 nautical miles) in either direction from the original path to increase the amount of data used in the extreme value analyses. Notably, the probability of taking those different paths is not necessarily equal. The difference in probabilities was taken into account in the extreme value analyses. Appendix D details the procedure for shifting the hurricanes and the methodology for calculating the associated probabilities.

Table 2.4 Storms Identified for Hindcasting.

Date	**Name**
06-Sep-1857	NOT
27-Sep-1861	NOT
01-Nov-1861	NOT
22-Oct-1872	NOT
25-Sep-1874	NOT
12-Sep-1876	NOT
18-Oct-1878	NOT
13-Aug-1879	NOT
06-Sep-1880	NOT
07-Sep-1881	NOT
04-Sep-1883	NOT
21-Aug-1885	NOT
14-Aug-1887	NOT
25-Sep-1893	NOT
18-Sep-1894	NOT
01-Oct-1894	NOT
03-Aug-1899	NOT
15-Oct-1899	NOT
04-Jul-1901	NOT
24-May-1908	NOT
24-Jul-1908	NOT
30-Aug-1913	NOT
23-Aug-1918	NOT
27-Sep-1924	NOT
17-Aug-1933	NOT
08-Sep-1933	NOT
29-Aug-1935	NOT
08-Sep-1936	NOT
30-Jul-1944	NOT
09-Sep-1944	NOT
21-Aug-1949	NOT
11-Aug-1953	BARBARA
25-Aug-1954	CAROL
02-Sep-1954	EDNA
05-Oct-1954	HAZEL

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Date	Name
03-Aug-1955	CONNIE
07-Aug-1955	DIANE
10-Sep-1955	IONE
21-Sep-1958	HELENE
29-Aug-1960	DONNA
26-Aug-1962	ALMA
20-Aug-1971	DORIA
06-Sep-1971	GINGER
08-Sep-1984	DIANA
16-Sep-1985	GLORIA
13-Aug-1986	CHARLEY
10-Sep-1989	HUGO
16-Aug-1991	BOB
22-Sep-1992	DANIELLE
22-Aug-1993	EMILY
08-Nov-1994	GORDON
05-Jul-1996	BERTHA
23-Aug-1996	FRAN
04-Oct-1996	JOSEPHINE
19-Aug-1998	BONNIE
24-Aug-1999	DENNIS
07-Sep-1999	FLOYD
06-Sep-2003	ISABEL
31-Jul-2004	ALEX
09-Aug-2004	CHARLEY
06-Sep-2005	OPHELIA
06-May-2007	ANDREA

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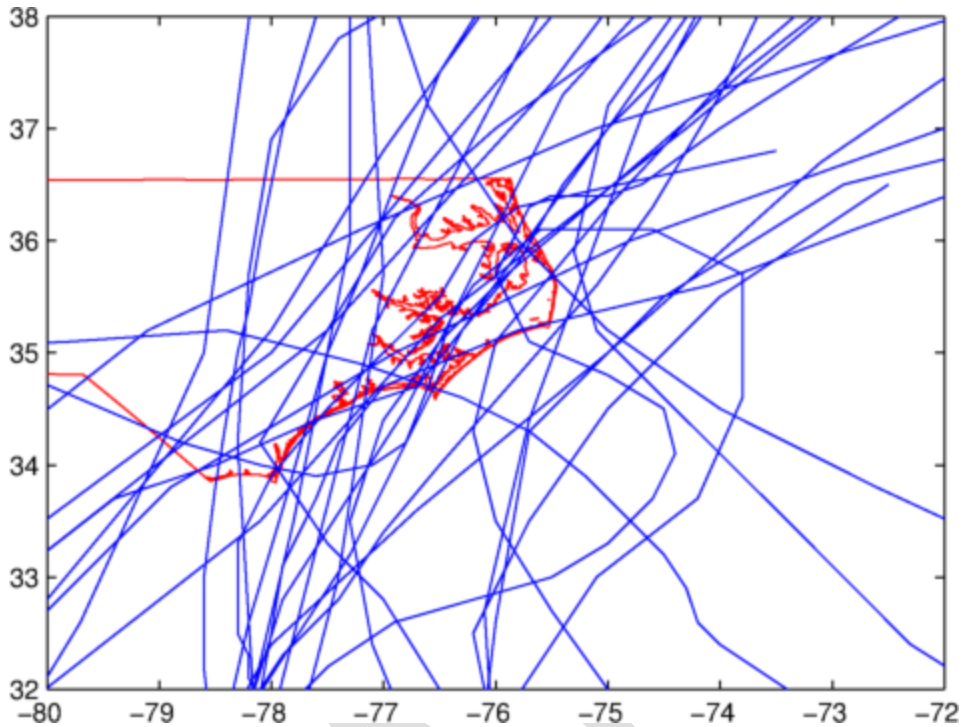

Figure 2.9 Paths of Storms that Occurred before 1950.

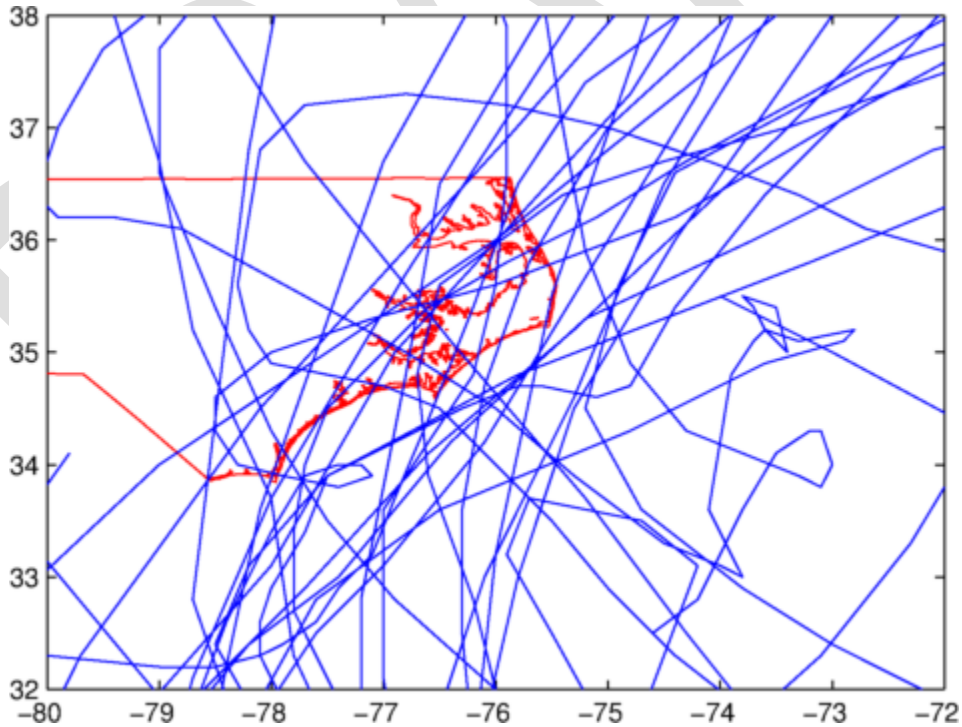

Figure 2.10 Paths of Storms that Occurred after 1950.

2.5 Model Runs/Example Results

Once developed and calibrated the model hindcasts the hurricanes and tropical storms. Sixty-two simulations (hindcasts) were performed using the wind and pressure fields provided by Oceanweather, Inc. for the storms listed in Table 2.4. This was followed by 124 simulations of the same storms but with paths shifted to the right and left as described in Appendix D. This resulted in 186 sets of data for the extreme value analyses.

The hindcasts produce wind speed and direction, water elevation, depth average current speed and direction, significant wave height, and wave peak period at each grid node for each time step throughout the storm. The significant wave height is the average height of the one-third highest waves in a 20 minute wave record. The peak period is the period of the waves with the greatest energy.

2.5.1 Example Hindcast Results

Figure 2.11 through Figure 2.14 present model results from the Hurricane Ione (1955) hindcast. Hurricane Ione approached the coast of North Coast as a Category 3 hurricane. Weakening as it reached the coast, Hurricane Ione made landfall near Morehead City, North Carolina as a Category 1 hurricane on September 19, 1955. Figure 2.11 presents contours of the peak WSE (ft-MSL) that occurred during the storm. This figure illustrates the importance of the role of local wind setup/set down on WSE in Pamlico Sound. For example, at this point in the simulation wind direction is predominately from the east, which lowers the water surface (-4 ft-MSL) in the eastern portion of the bay and super elevates the water surface (+8 ft-MSL) in the western portions of the bay. Figure 2.12 presents contours of the peak significant wave height (ft) that occurred during the storm. As the figure illustrates, waves within the interior waters peaked at approximately 8 ft. Figure 2.13 combines the WSE and the wave heights to present the maximum wave crest elevation (ft-MSL). As the figure demonstrates, during this particular storm wave crest elevations in the southern end of Pamlico Sound and in the Neuse River reached +18 ft-MSL. As such, any bridge crossing these waterways with low chord elevations below +18 ft-MSL would have experienced wave forces during Hurricane Ione. Figure 2.14 presents contours of depth-averaged current speeds (ft/sec) during Hurricane Ione. As the figure illustrates, the highest current speeds occurred in the inlets that connect Pamlico Sound to the Atlantic Ocean.

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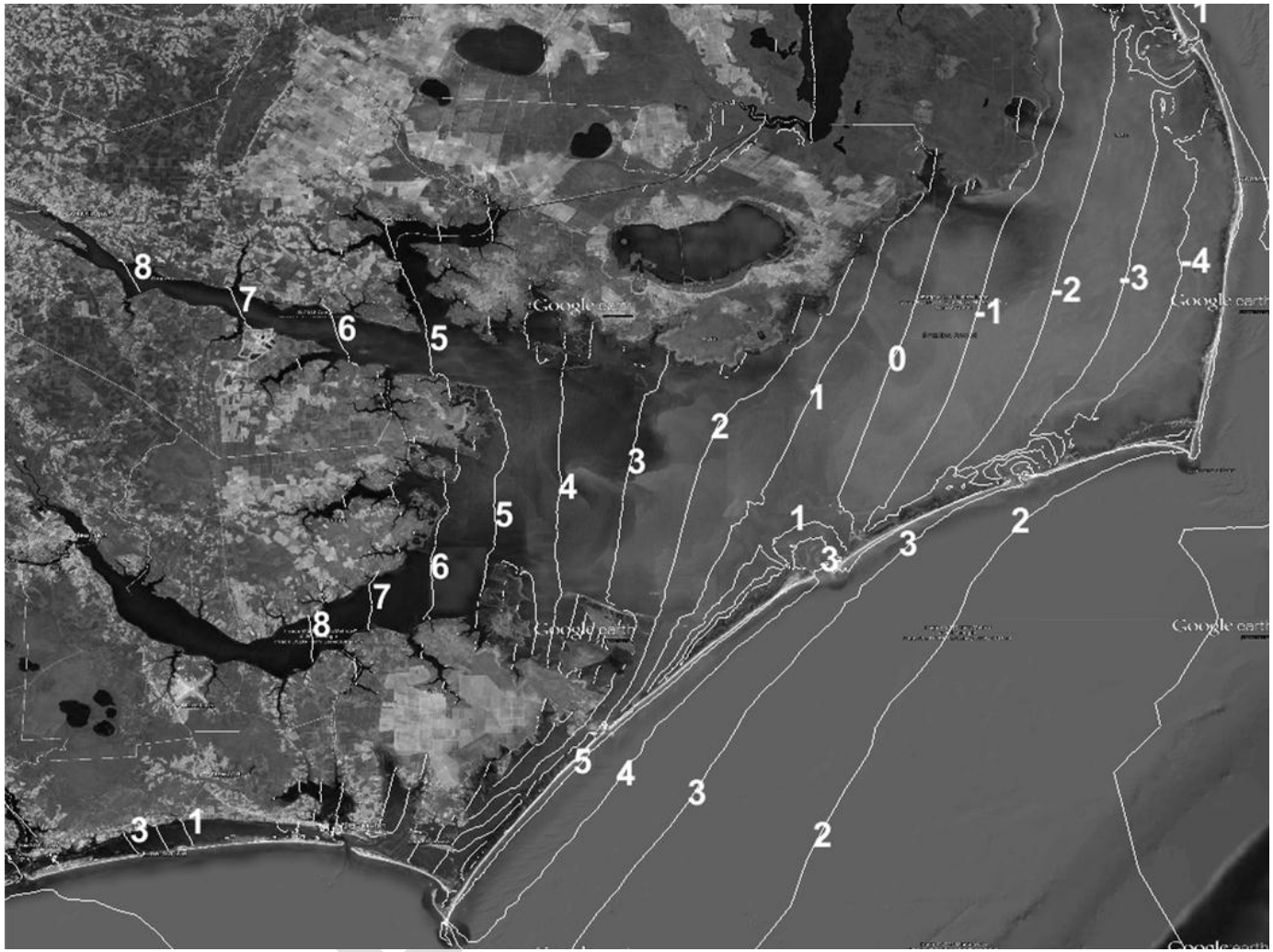

Figure 2.11 Contours of Water Surface Elevation (ft-MSL) during Hurricane Ione.

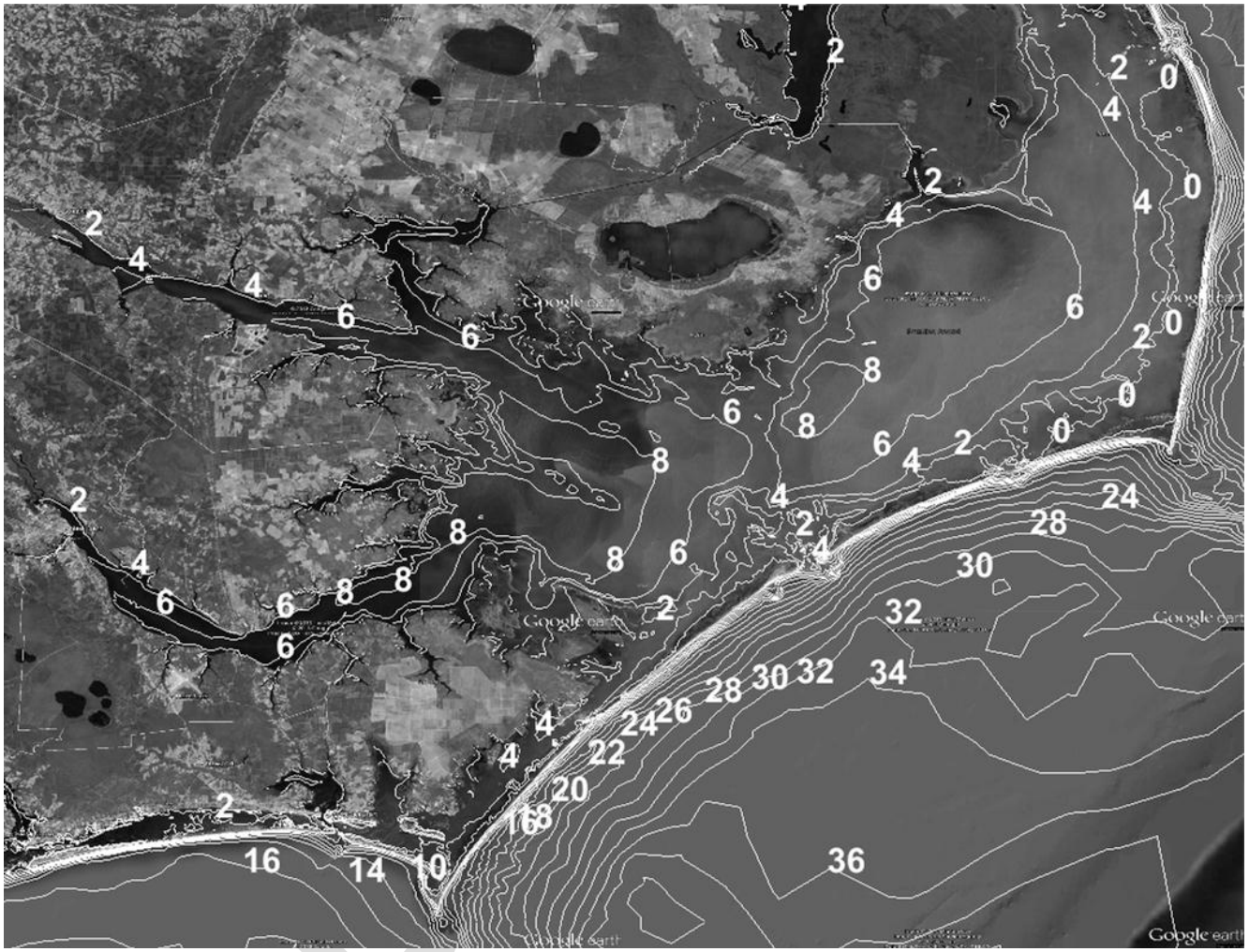

Figure 2.12 Contours of Significant Wave Height (ft) during Hurricane Ione.

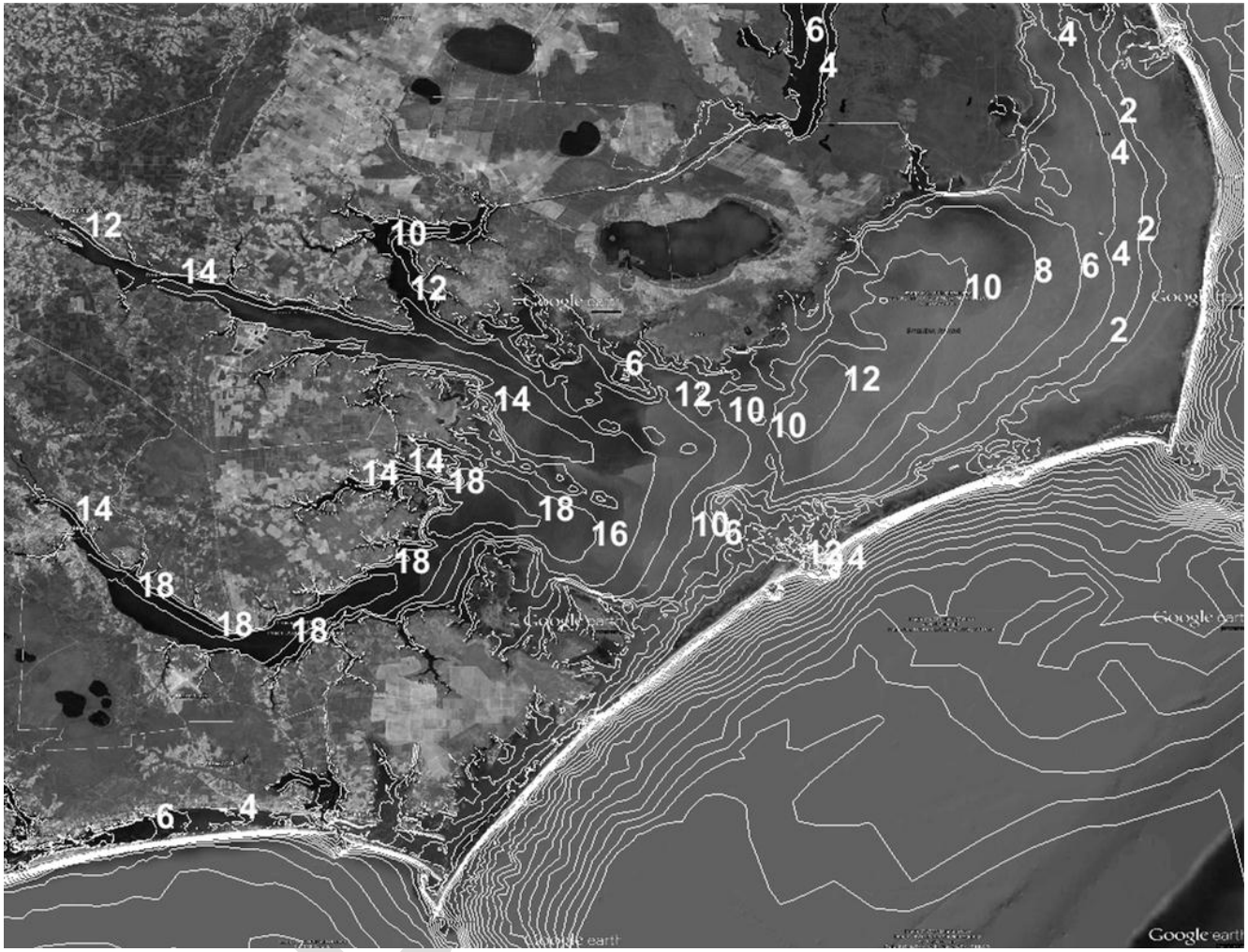

Figure 2.13 Wave Crest Elevation Contours (ft-MSL), Pamlico Sound Region.

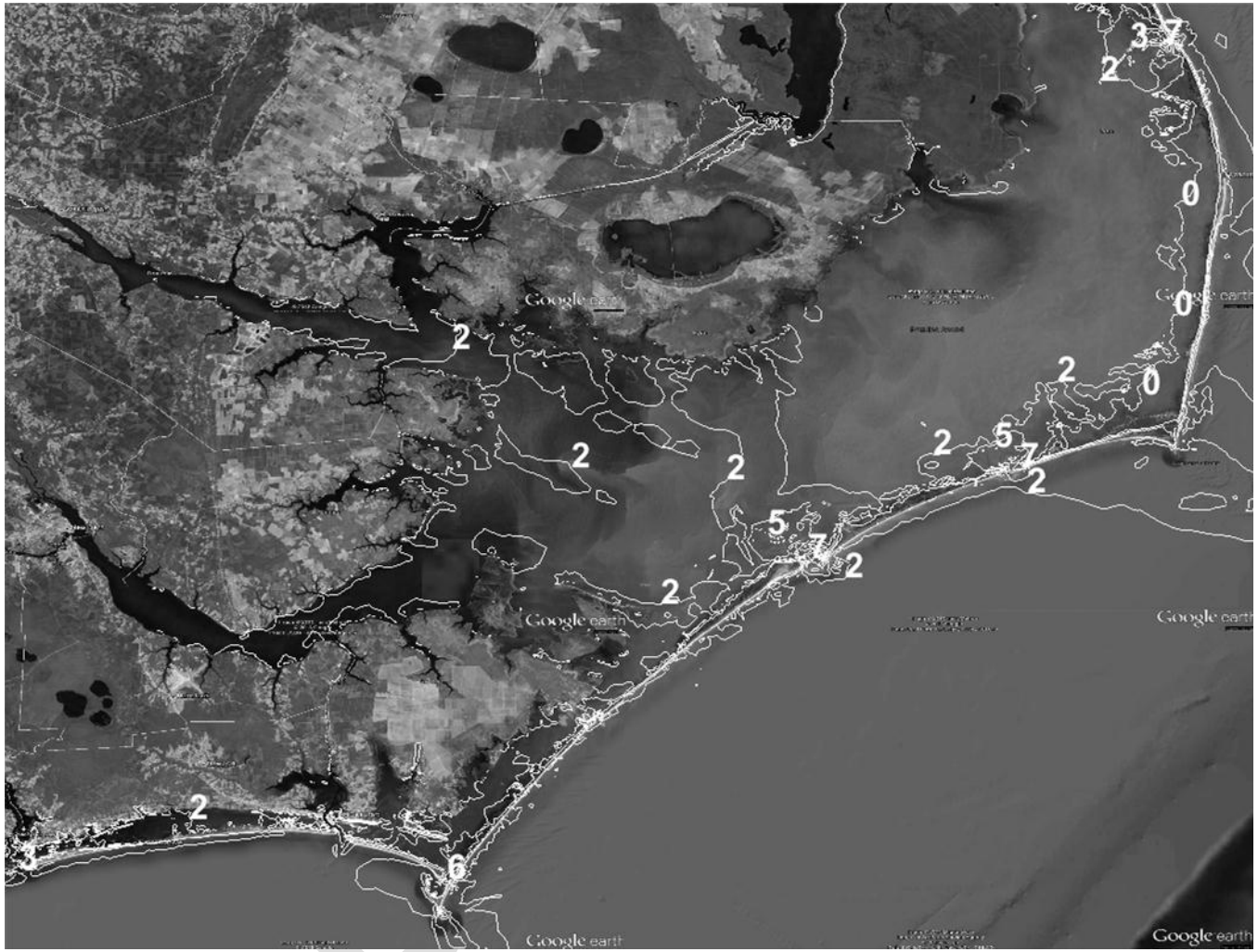

Figure 2.14 Contours of Depth-Averaged Current Speed (ft/sec) during Hurricane Ione.

3.0 Extreme Value Analyses

Design loads for structures are typically based on their probability of exceedance; the value of which depends on the level of risk acceptable by the owner. In the case of storm surge and wave loads on bridge superstructures, the AASHTO codes recommend using met/ocean conditions with a 1% chance of being exceeded each year for the computation of these loads. This is commonly referred to as the 100-year return interval conditions. When sufficient data/information is available, extreme value statistics can be applied to estimate probability of exceedance.

Extreme value analysis provides a method to estimate different return interval values for the quantities produced by tropical storm and hurricane hindcasts. For example, the 100-year return interval value water surface elevation, WSE, at a particular bridge location can be estimated from the results of simulations of past hurricane that have impacted that location. In this study, 62 of the most severe tropical storms and hurricanes that have impacted North Carolina coastal waters between 1850 and 2010 were hindcasted. Note, however, that even though this is a large number of storms, not all of the storms impacted the entire region of interest. In order to capture more of the natural variability of the storms and to improve the robustness of the extreme value analyses, the historical hurricane paths were shifted 0.5 degrees in both directions from their actual path at landfall and the modified path storms hindcasted. A relative probability of occurrence was calculated for each storm path as detailed in Appendix D. This increased the total number of simulations to 186 and the effective record length to 480 years. Notably, this procedure is not the same as having an actual historical record of 480 years, because the shift process is capturing only some of the natural variation. For example, there is always the possibility of having a hurricane with wind speeds higher than any previously observed value, but this is not possible with the path-shifted hindcasts. As such, the accuracy of predictions extrapolated for periods greater than 480 years are questionable. However, this methodology greatly improves the 100-year return interval predictions.

As discussed in Appendix E, the empirical cumulative distribution functions or CDF method for estimating 100-year return interval values was determined to be the most appropriate for use here. A bootstrapping method was employed to examine the impact of astronomical tide phase. Both methods are described in detail in Appendix E.

3.1 Design Conditions for Wave Loading

One of the objectives of this study is to determine the vulnerability of NCDOT coastal bridges to storm surge and wave loading. Since these forces and moments depend on the combination of water elevation and wave parameters (height and length), two sets of conditions need to be examined at each bridge; 1) the maximum 100-year water elevation and associated wave height and 2) the maximum wave height and associated water elevation. This is necessary since the maximum wave height does not necessarily occur at the same time as the maximum water elevation during the storm.

The hindcast simulations provided values of water elevation, depth-averaged current and wave parameters at each of the 191 bridge locations throughout the passage of each of the 186 storms. The maximum values of water surface elevation (and the wave heights at that point in time) and the maximum wave heights (and the water surface elevation at that point in time) at each bridge location were extracted from the hindcast results. Each of these maximum values is treated as an independent variable in the extreme value statistical analysis. These simulation results are treated as "observations" and identified as such to distinguish them from probability model results.

3.2 Extreme Value Analysis Results

The extreme value analyses produced two sets of data, the maximum water surface elevation and associated wave height and the maximum wave height and associated water surface elevation, for 100-year return interval met/ocean conditions. Table 3.1 and Table 3.2 present the met/ocean results for the 100-year design conditions at each of the bridges. These data provide the met/ocean input information needed to compute design wave forces and moments for the subject bridges. Notably, as stated in the introduction, these results do not include the effects of predicted sea level rise. At this time, the NCDOT is not recommending sea level rise be considered in these and related analyses.

Table 3.1 100-Year Extreme Value Analyses Results for Maximum Water Surface Elevation and Associated Wave Height.

Bridge Number	Maximum Water Surface Elevation (ft-MSL)	Associated Wave Height (ft)	Associated Wave Period (sec)
60009	12.8	2.0	2.9
60025	13.8	3.9	4.0
60028	11.1	2.5	3.2
60045	10.9	1.5	2.5
60048	10.8	0.0	0.0
60063	10.3	0.0	0.0
60064	9.6	2.1	3.0
60066	10.5	0.9	1.9
60070	9.7	2.3	3.1
60077	9.6	4.2	4.2
60103	13.6	0.9	1.9
60174	10.5	0.0	0.0
60249	11.4	0.0	0.0
70038	7.9	6.7	5.3
90013	14.4	2.9	3.5

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Bridge Number	Maximum Water Surface Elevation (ft-MSL)	Associated Wave Height (ft)	Associated Wave Period (sec)
90015	16.1	2.3	3.1
90022	14.1	2.3	3.1
90055	7.4	0.0	0.0
90056	0.0	0.0	0.0
90061	9.1	2.8	3.4
90071	13.3	1.8	2.8
90103	8.7	1.8	2.8
90105	8.8	1.9	2.8
90107	8.7	1.3	2.3
90108	8.2	1.1	2.1
90190	13.5	0.0	0.0
90198	14.6	3.0	3.6
90207	16.1	2.1	2.9
150003	11.3	0.8	1.9
150004	10.7	0.3	1.1
150006	8.6	3.8	4.0
150011	6.5	3.2	3.7
150012	9.5	1.3	2.3
150016	9.4	0.9	1.9
150018	7.4	0.6	1.6
150023	6.4	2.4	3.1
150029	6.8	1.7	2.6
150031	8.5	0.9	2.0
150032	8.5	0.8	1.8
150033	8.3	4.2	4.2
150035	8.0	2.3	3.1
150037	5.6	1.9	2.9
150039	6.1	2.7	3.4
150068	6.1	3.3	3.7
150073	4.6	2.9	3.5
150096	4.6	2.9	3.5
150101	8.0	1.0	2.0
200002	7.7	3.2	3.7

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Bridge Number	Maximum Water Surface Elevation (ft-MSL)	Associated Wave Height (ft)	Associated Wave Period (sec)
240060	13.1	5.3	4.7
240235	12.9	5.5	4.8
240236	12.9	5.6	4.8
240237	13.0	4.6	4.4
260007	4.3	2.1	2.9
260008	4.3	2.1	3.0
260016	5.4	4.0	4.1
260035	5.3	4.1	4.1
270003	8.8	1.0	2.1
270006	6.6	2.7	3.4
270008	4.4	0.8	1.9
270009	5.2	4.5	4.3
270011	5.0	4.5	4.3
270012	6.7	3.3	3.7
270013	6.2	2.2	3.0
270014	6.9	2.8	3.4
270038	6.9	2.5	3.3
270042	5.6	2.6	3.3
270043	6.3	1.7	2.6
270054	5.4	5.2	4.7
470008	10.3	0.3	1.1
470029	9.3	0.3	1.1
470032	9.3	0.9	1.9
470039	1.3	0.0	0.0
470042	1.1	0.0	0.0
470044	8.4	0.3	1.0
470046	2.0	0.5	1.5
470050	6.2	0.8	1.8
470052	6.3	1.2	2.2
470055	6.5	1.1	2.2
470056	9.6	2.5	3.2
470118	4.7	2.1	3.0
470119	4.7	2.9	3.5

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Bridge Number	Maximum Water Surface Elevation (ft-MSL)	Associated Wave Height (ft)	Associated Wave Period (sec)
640010	12.9	3.1	3.6
640012	11.8	3.1	3.6
640014	12.5	2.8	3.4
640015	9.1	2.5	3.2
640017	9.1	2.0	2.9
640019	8.6	2.8	3.4
640021	11.1	2.0	2.9
640022	11.0	3.0	3.5
640024	11.4	2.4	3.2
660025	10.0	3.8	4.0
660030	10.2	4.1	4.1
660077	11.8	3.6	3.9
660230	9.5	2.6	3.3
660231	0.5	0.0	0.0
660232	0.0	0.0	0.0
660233	3.5	0.0	0.0
660234	7.7	0.5	1.4
660235	5.4	0.0	0.0
660236	7.1	0.0	0.0
660237	7.2	0.0	0.0
660240	8.6	1.3	2.3
680009	12.8	0.0	0.0
680024	12.8	0.0	0.0
680036	12.8	0.0	0.0
680042	10.3	0.6	1.6
680057	10.6	3.8	4.0
680065	11.0	3.9	4.0
690018	6.1	1.3	2.3
690019	6.3	3.1	3.6
690027	6.3	3.1	3.6
690087	5.0	1.9	2.8
690092	6.2	2.0	2.9
700016	9.0	9.0	6.1

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Bridge Number	Maximum Water Surface Elevation (ft-MSL)	Associated Wave Height (ft)	Associated Wave Period (sec)
710008	7.3	2.6	3.3
710011	7.3	1.2	2.2
710014	7.1	4.4	4.3
710019	7.3	1.8	2.7
710031	7.0	2.4	3.2
710080	7.1	4.4	4.3
880002	5.8	1.8	2.7
880007	3.6	4.3	4.2
880089	6.6	0.0	0.0
930009	9.6	3.1	3.6
930015	6.5	8.4	5.9

Table 3.2 100-Year Extreme Value Analyses Results for Maximum Wave Height and Associated Water Surface Elevation.

Bridge Number	Associated Water Surface Elevation (ft-MSL)	Maximum Wave Height (ft)	Wave Period (sec)
60009	12.8	2.0	2.9
60025	13.8	3.9	4.0
60028	11.1	2.6	3.3
60045	10.9	1.7	2.6
60048	10.8	0.4	1.3
60063	10.3	0.0	0.0
60064	9.6	2.1	3.0
60066	10.5	1.1	2.1
60070	9.7	2.3	3.1
60077	9.6	4.2	4.2
60103	13.6	1.6	2.6
60174	10.5	0.0	0.0
60249	11.4	0.0	0.0
70038	7.9	6.8	5.3

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Bridge Number	Associated Water Surface Elevation (ft-MSL)	Maximum Wave Height (ft)	Wave Period (sec)
90013	14.4	3.0	3.5
90015	16.1	2.5	3.2
90022	14.1	2.3	3.1
90055	7.4	0.0	0.0
90056	0.0	0.0	0.0
90061	9.1	3.0	3.6
90071	13.2	1.8	2.8
90103	8.7	2.2	3.0
90105	8.7	2.3	3.1
90107	8.6	1.4	2.4
90108	8.2	1.3	2.4
90190	13.5	0.0	0.0
90198	14.6	3.3	3.7
90207	15.9	2.1	2.9
150003	11.3	1.0	2.0
150004	10.7	0.4	1.3
150006	8.6	3.8	4.0
150011	6.5	3.2	3.7
150012	9.5	1.4	2.4
150016	9.4	1.4	2.4
150018	7.4	0.9	1.9
150023	6.3	2.7	3.4
150029	6.8	1.9	2.8
150031	8.5	1.1	2.1
150032	8.4	0.9	1.9
150033	8.3	4.5	4.3
150035	7.9	2.3	3.1
150037	5.6	2.0	2.9
150039	6.1	2.7	3.4
150068	6.1	3.4	3.8
150073	4.6	3.2	3.7
150096	4.6	3.1	3.6
150101	8.0	1.0	2.0

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Bridge Number	Associated Water Surface Elevation (ft-MSL)	Maximum Wave Height (ft)	Wave Period (sec)
200002	7.7	3.4	3.8
240060	13.1	5.4	4.7
240235	12.9	5.7	4.9
240236	12.9	5.8	4.9
240237	13.0	4.7	4.4
260007	4.3	2.1	3.0
260008	4.3	2.3	3.1
260016	5.4	4.0	4.1
260035	5.3	4.3	4.2
270003	8.8	1.2	2.2
270006	6.6	2.8	3.4
270008	4.4	0.8	1.9
270009	5.2	5.0	4.6
270011	5.0	4.6	4.4
270012	6.7	3.4	3.7
270013	6.2	2.2	3.1
270014	6.9	2.9	3.5
270038	6.9	2.6	3.3
270042	5.6	2.6	3.3
270043	6.3	1.7	2.6
270054	5.4	5.5	4.8
470008	10.3	0.4	1.2
470029	9.3	0.5	1.5
470032	9.3	1.0	2.0
470039	1.3	0.0	0.0
470042	1.1	0.0	0.0
470044	8.3	0.5	1.4
470046	2.0	0.5	1.5
470050	6.2	0.8	1.8
470052	6.3	1.2	2.2
470055	6.5	1.2	2.2
470056	9.6	2.6	3.3
470118	4.6	2.1	3.0

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Bridge Number	Associated Water Surface Elevation (ft-MSL)	Maximum Wave Height (ft)	Wave Period (sec)
470119	4.7	2.9	3.5
640010	12.9	3.1	3.6
640012	11.8	3.1	3.6
640014	12.5	2.9	3.5
640015	9.1	2.7	3.3
640017	9.1	2.2	3.1
640019	8.6	3.3	3.7
640021	11.1	2.2	3.0
640022	11.0	3.0	3.5
640024	11.4	2.4	3.2
660025	9.9	4.1	4.1
660030	10.1	4.2	4.2
660077	11.7	3.7	3.9
660230	9.5	2.6	3.3
660231	0.5	0.0	0.0
660232	0.0	0.0	0.0
660233	3.4	0.0	0.0
660234	7.7	0.5	1.4
660235	5.4	0.0	0.0
660236	7.1	0.1	0.5
660237	7.2	0.0	0.0
660240	8.6	1.3	2.3
680009	12.8	0.1	0.7
680024	12.8	0.2	0.8
680036	12.8	0.2	0.8
680042	10.3	0.7	1.7
680057	10.6	3.9	4.1
680065	11.0	4.0	4.1
690018	6.1	1.4	2.4
690019	6.3	3.3	3.7
690027	6.3	3.3	3.7
690087	5.0	2.0	2.9
690092	6.2	2.1	3.0

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Bridge Number	Associated Water Surface Elevation (ft-MSL)	Maximum Wave Height (ft)	Wave Period (sec)
700016	9.0	9.0	6.1
710008	7.3	2.6	3.3
710011	7.3	1.3	2.3
710014	7.1	4.5	4.3
710019	7.3	2.0	2.9
710031	7.0	2.4	3.2
710080	7.1	4.5	4.4
880002	5.8	1.8	2.8
880007	3.6	5.0	4.5
880089	6.6	0.0	0.0
930009	9.6	3.1	3.6
930015	6.5	8.7	6.0

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4.0 Storm Surge and Wave GIS Database

The magnitude of the met/ocean information produced by this study is extremely large, and, therefore its presentation does not lend itself to the usual tables and graphs. For this reason this information, which has uses far beyond the computation of wave loads on bridge superstructures, is presented in a GIS database. The database was constructed using ESRI ArcInfo and ArcReader GIS mapping software. This software allows greater flexibility in graphical representation of large datasets with seamless flow between various types of information.

The Storm Surge and Wave GIS Database presents the user with an interactive map that contains 100-year hydraulic design data for North Carolina's coastal waters. Hydraulic data contained within the database include the following: 100-year maximum water surface elevation (and associated wave height), 100-year maximum wave height (and associated water elevation), and 100-year current speed (and most likely 100-year current direction). Thematic groups include roadways, county boundaries, and city and town locations. Base maps in the database include land boundaries, aerial imagery and topographic maps.

Accessibility of the hydraulic information is by mouse click at the desired point on the map at the desired location. This information can also be obtained by typing in the x-y coordinates (lat-long, state-plane, etc.) or bridge number. The search results are presented in tabular format with the coordinates and hydraulic values displayed in a window on the map.

The GIS database also contains bridge information data for each of the bridges analyzed by clicking on the bridge symbol at the bridge location. Bridge data is also accessible through a method similar to that used to access the hydraulic data. The bridge data, bridge name and number, state plane coordinates, structural information as well as the hydraulic data at the site, are displayed in tabular format in a window within the program.

The information in the Storm Surge and Wave GIS Database will have numerous uses for both existing and future water related projects. Figure 4.1 displays a screen shot of the Storm Surge and Wave GIS base map. A detailed description of the database and its use is presented in Appendix G.

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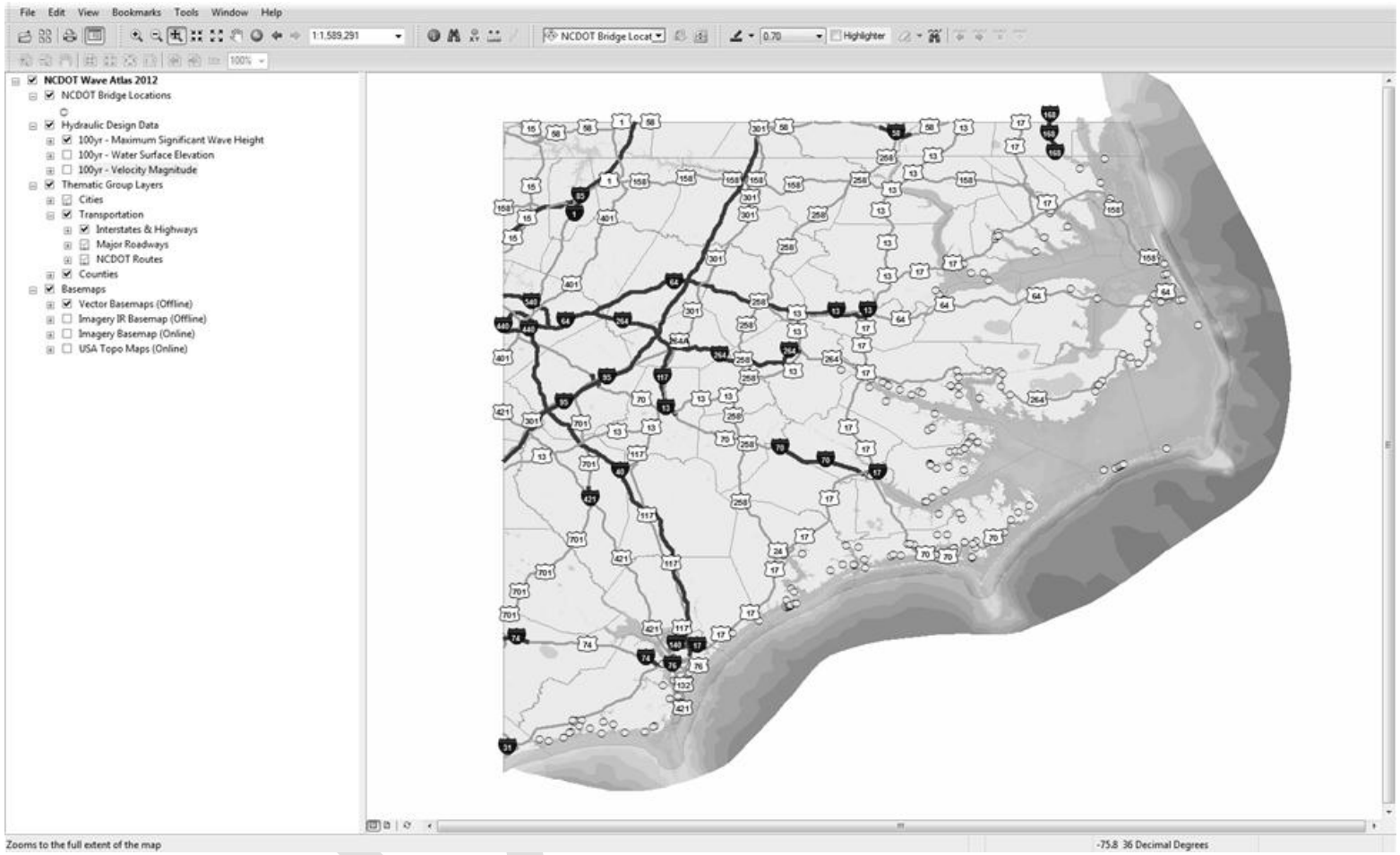

Figure 4.1 Screen Shot of Storm Surge and Wave GIS Geo-Database.

5.0 Coastal Bridge Vulnerability to Surge/Wave Forces

This Section details 1) the process for selection of the bridges analyzed, 2) the computer model (PBM) that computed the vertical and horizontal forces and the moments on the bridge superstructures, 3) the wave force methodology, 4) the application of the PBM to 191 bridges, 5) presentation of the design surge/wave forces and moments on the spans on the 191 bridges, and 6) the computation and presentation of the bridge vulnerability.

5.1 Selection of Bridges to Analyze

The selection of bridges to analyze was an iterative process. An initial survey of NCDOT coastal bridges, based solely on bridge location, identified 233 bridges with potentially vulnerable spans. Additional information regarding span elevation, water depths at the bridge, bridge criticality, etc. reduced this number to 222 bridges. OEA analyzed these 222 bridges from the results of a simplified Level I met/ocean analysis. This analysis reduced the number by 74 bridges leaving 148 bridges requiring further analyses. During the model grid generation a review of aerial photographs, showed that 31 more bridges should be removed based on limited fetch. Table 5.1 lists the bridges removed and the reason for their removal. As noted in the introduction, the Level I analysis is dependent on existing data and simple empirical equations, which is much less accurate than the Level III. As such, this study evaluated all of the bridges not eliminated during the mesh generation — for a total of 191 bridges. Table 5.2 lists the 191 bridges along with the waterway, roadway, county, and the bridges criticality assigned by NCDOT. Table 5.3 provides descriptions for the Criticality Index. A value of 1 to 4 was assigned to all bridges considered in this study by NCDOT engineers.

Table 5.1 Bridges Removed from Consideration.

Bridge Number	Reason for Removal
60019	Narrow waterway and dense vegetation on floodplain restrict fetch
60104	Narrow waterway and dense vegetation on floodplain restrict fetch
60105	Narrow waterway and dense vegetation on floodplain restrict fetch
60113	Narrow waterway and dense vegetation on floodplain restrict fetch
60115	Narrow waterway and dense vegetation on floodplain restrict fetch
60126	Waterway geometry and heavy vegetation restrict fetch
60314	Waterway geometry and heavy vegetation restrict fetch
90045	Small meandering waterway and vegetation on banks restrict fetch
90048	Small meandering waterway and vegetation on banks restrict fetch
90053	Small meandering waterway and vegetation near abutments restrict fetch
90058	Small waterway and dense vegetation restrict fetch
150007	Narrow waterway and dense vegetation on floodplain restrict fetch

Bridge	Reason for Removal
150008	Narrow waterway and dense vegetation on floodplain restrict fetch
150015	Narrow waterway and dense vegetation on floodplain restrict fetch
150026	Narrow waterway and dense vegetation on floodplain restrict fetch
150095	Dense vegetation on flood plain and waterway geometry restrict fetch
200029	Narrow waterway and dense vegetation on floodplain restrict fetch
240005	Waterway geometry restricts fetch
270007	Narrow waterway restricts fetch
270010	Narrow waterway and dense vegetation on floodplain restrict fetch
270016	Narrow waterway and dense vegetation on floodplain restrict fetch
270040	Narrow waterway and dense vegetation on floodplain restrict fetch
470079	Waterway geometry restricts fetch
660182	Waterway geometry restricts fetch
680010	Narrow waterway restricts fetch
680017	Narrow waterway and dense vegetation on floodplain restrict fetch
680031	Waterway geometry and heavy vegetation restrict fetch
680040	Waterway geometry and heavy vegetation restrict fetch
680044	Waterway geometry and heavy vegetation restrict fetch
680058	Narrow waterway restricts fetch
680064	Waterway geometry restricts fetch

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Table 5.2 Bridges Analyzed.

Bridge Number	Waterway	Roadway	County	Criticality
60009	BLOUNTS CREEK	SR1112	BEAUFORT	2
60025	PAMLICO RIVER	US17	BEAUFORT	4
60028	BATH CREEK	NC92	BEAUFORT	4
60045	BACK CREEK	NC92	BEAUFORT	4
60048	SOUTH CREEK	NC33	BEAUFORT	4
60063	CUCKOLD'S CREEK	US264	BEAUFORT	4
60064	PUNGO CREEK	NC99	BEAUFORT	4
60066	PUNGO RIVER	US264	BEAUFORT	4
60070	BR OF PUNGO CREEK	NC99	BEAUFORT	4
60077	PANTEGO CREEK	NC99	BEAUFORT	4
60103	RUNYON CREEK	NC32	BEAUFORT	4
60174	FORK OF SOUTH CREEK	SR1919	BEAUFORT	3
60249	DUCK CREEK	SR1336	BEAUFORT	3
60330	SILAS CR.	SR1199	BEAUFORT	1
70007	ROAN.MID.&CASHIKE RIVERS	NC45&NC308	BERTIE	4
70038	CHOWAN RIVER	US17	BERTIE	4
70058	CASHOKE CREEK	NC45	BERTIE	4
90002	CANAL DISCHARGE(CP&L)	NC87	BRUNSWICK	4
90013	INTRACOASTAL WATERWAY	NC904	BRUNSWICK	4
90014	INTRACOASTAL WATERWAY	NC133	BRUNSWICK	4
90015	CALABASH RIVER	NC179 BUS	BRUNSWICK	4
90022	MERCERS MILL POND	SR1112	BRUNSWICK	3

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Bridge Number	Waterway	Roadway	County	Criticality
90055	BR.LITTLE SHALLOTTE RVR.	SR1140	BRUNSWICK	1
90056	ALLEN'S CREEK	NC133	BRUNSWICK	4
90061	TOWN CREEK	NC133	BRUNSWICK	4
90071	INTRACOASTAL WATERWAY	NC130	BRUNSWICK	4
90072	SAUCE PAN CREEK	NC179	BRUNSWICK	4
90093	CP&L DISCHARGE CANAL	NC211	BRUNSWICK	4
90103	BRUNSWICK RIVER	US17	BRUNSWICK	4
90105	BRUNSWICK RIVER	US17 SBL	BRUNSWICK	4
90107	ALLIGATOR CREEK	US17,74,76	BRUNSWICK	4
90108	ALLIGATOR CREEK	US17,74,76(SBL)	BRUNSWICK	4
90163	MULBERRY SWAMP	SR1349	BRUNSWICK	1
90190	SAUCE PAN CREEK	SR1155	BRUNSWICK	1
90198	INTRACOASTAL WATERWAY	SR1172	BRUNSWICK	4
90206	DAVIS CREEK	SR1105	BRUNSWICK	2
90207	BR.SHALLOTTE RIVER	SR1191	BRUNSWICK	1
150003	BACK CREEK	SR1300	CARTERET	4
150004	BRANCH OF ADAMS CREEK	SR1300	CARTERET	4
150006	INTRACOASTAL WATERWAY	NC58	CARTERET	4
150009	PETTIFORD CREEK	NC58	CARTERET	4
150010	HARLOWE CREEK	NC101	CARTERET	4
150011	BROAD CREEK	NC24	CARTERET	4
150012	THOROFARE BAY CHANNEL	NC12	CARTERET	4
150013	NEWPORT RIVER	US70	CARTERET	4

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Bridge Number	Waterway	Roadway	County	Criticality
150014	INTRACOASTAL WATERWAY	NC101	CARTERET	4
150016	WEST BAY CHANNEL	NC12	CARTERET	4
150018	BRANCH NORTH RIVER	SR1333	CARTERET	1
150020	BRANCH OF BAND CRK	SR1124	CARTERET	2
150023	GALES CREEK	NC24	CARTERET	4
150024	HADNOT CREEK	NC58	CARTERET	4
150029	BEAUFORT CHANNEL	US70	CARTERET	4
150031	BRANCH NEWPORT RIVER	NC101	CARTERET	4
150032	RUSSELL CREEK	SR1165	CARTERET	1
150033	NORTH RIVER	US70	CARTERET	4
150034	CALICO CREEK	SR1176	CARTERET	2
150035	WARD CREEK	US70	CARTERET	4
150037	WILLISTON CREEK	US70	CARTERET	4
150038	SMYRNA CREEK	US70	CARTERET	4
150039	OYSTER CREEK	US70	CARTERET	4
150041	MARIA CREEK	US70	CARTERET	4
150045	SALTERS CREEK	US70	CARTERET	4
150049	WHITE OAK RIVER	SR1101	CARTERET	3
150068	BOGUE SOUND & ICW	SR1182	CARTERET	4
150073	THE STRAITS	SR1335	CARTERET	4
150096	THE STRAITS	SR1335	CARTERET	4
150101	CALICO CREEK	SR1243	CARTERET	4
200002	PEMBROKE CREEK	SR1204	CHOWAN	3

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Bridge Number	Waterway	Roadway	County	Criticality
200017	BRANCH	SR1204	CHOWAN	3
200035	CANAL	SR1170	CHOWAN	1
240060	TRENT RIVER	US70 BUS.	CRAVEN	3
240083	TRENT RIVER	US70	CRAVEN	4
240084	TRENT RIVER	US70	CRAVEN	4
240222	TRENT RIVER	9901RAMP BD(US17)	CRAVEN	4
240231	NEUSE R. & US70	US17	CRAVEN	4
240234	NEUSE R. & SCOTTS CR.	US 70BUS	CRAVEN	4
240235	NEUSE RIVER & SCOTTS CR.	US 17 RAMP CD	CRAVEN	4
240236	NEUSE RIVER	US70 BYP(RAMP DC)	CRAVEN	4
240237	NEUSE RIVER	US70 BUS(RAMP DA)	CRAVEN	4
260004	TULLS CREEK	SR1222	CURRITUCK	3
260007	CREEK	NC615	CURRITUCK	4
260008	COINJOCK BAY	SR1245	CURRITUCK	3
260012	CANAL	SR1142	CURRITUCK	3
260015	INTRACOASTAL WATERWAY	US158	CURRITUCK	4
260016	CURRITUCK SOUND	US158 EBL	CURRITUCK	4
260035	CURRITUCK SOUND	US158 WBL	CURRITUCK	4
270003	DEEP CREEK	US264	DARE	4
270004	JEAN GUITE CREEK	US158	DARE	4
270005	CREEK	SR1217	DARE	3
270006	COLINGTON CREEK	SR1217	DARE	3
270008	CANAL	NC12	DARE	4

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Bridge Number	Waterway	Roadway	County	Criticality
270009	CROATAN SOUND	US64	DARE	4
270011	OREGON INLET	NC12	DARE	4
270012	ROANOKE SOUND	US64	DARE	4
270013	STUMPY POINT CANAL	US264	DARE	4
270014	ROANOKE SOUND MINOR	US64	DARE	4
270038	CREEK	SR1216	DARE	3
270042	CANAL	SR1123	DARE	1
270043	DOUGH'S CREEK	NC400	DARE	4
270054	CROATAN SOUND	US64 BYP	DARE	4
470008	BURGESS MILL CREEK	US264	HYDE	4
470010	ISLAND CREEK	NC12	HYDE	4
470012	CANAL	SR1108	HYDE	1
470020	INTRACOASTAL WATERWAY	US264	HYDE	4
470029	SCRANTON CREEK	US264	HYDE	4
470031	OLD HAMMOCK CREEK	NC12	HYDE	4
470032	ROSE BAY CREEK	US264	HYDE	4
470039	MOLASSES CREEK	NC12	HYDE	4
470042	QUORKS POINT CREEK	NC12	HYDE	4
470044	PUNGO CREEK	SR1147	HYDE	3
470046	PARKERS CREEK	NC12	HYDE	4
470049	TRY YARD CREEK	NC12	HYDE	4
470050	CANAL	US264	HYDE	4
470052	CANAL	US264	HYDE	4

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Bridge Number	Waterway	Roadway	County	Criticality
470055	CANAL	US264	HYDE	4
470056	LONG SHOAL RIVER	US264	HYDE	4
470080	CANAL	SR1320	HYDE	1
470118	CANAL	SR1362	HYDE	3
470119	CANAL	SR1362	HYDE	3
640005	WHISKEY CREEK	SR1492	NEW HANOVER	1
640006	HEWLETS CREEK	SR1492	NEW HANOVER	1
640010	BRADLEY CREEK	SR1411	NEW HANOVER	1
640011	SR2649&NE CAPE FEAR RIVE	NC133	NEW HANOVER	4
640012	INTRACOASTAL WATERWAY	US74&76	NEW HANOVER	4
640013	CAPE FEAR RIVER&SR1300	US17/74/76/421	NEW HANOVER	4
640014	BRADLEY CREEK	US74 & 76	NEW HANOVER	4
640015	BARNARDS CREEK	SR1100	NEW HANOVER	2
640017	MOTTS CREEK	SR1100	NEW HANOVER	2
640019	LORDS CREEK	SR1100	NEW HANOVER	1
640021	BANKS CHANNEL	US76	NEW HANOVER	4
640022	KENAN CREEK	US74	NEW HANOVER	4
640024	BANKS CHANNEL	US74	NEW HANOVER	4
640027	CAPE FEAR RIVER	US421,NC133	NEW HANOVER	4
640029	SMITH CREEK	NC133	NEW HANOVER	2
640030	SR1532&INTRACOASTAL WW	US421	NEW HANOVER	4
660005	NORTHEAST CREEK	NC24 EBL	ONSLOW	4
660007	NORTHEAST CREEK	NC24 WBL	ONSLOW	4

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Bridge Number	Waterway	Roadway	County	Criticality
660017	NEW RIVER	NC172	ONSLOW	4
660021	BEAR CREEK	SR1503	ONSLOW	2
660024	NEW RIVER	US17	ONSLOW	4
660025	WHITE OAK RIVER	NC24	ONSLOW	4
660028	INTRACOASTAL WATERWAY	NC210	ONSLOW	4
660030	WHITE OAK RIVER	NC24	ONSLOW	4
660077	QUEENS CREEK	SR1509	ONSLOW	2
660191	NEW RIVER	SR1402	ONSLOW	2
660226	BRANCH OF NEW RIVER	SR1557	ONSLOW	2
660230	TIDAL DITCH	SR1568	ONSLOW	3
660231	TIDAL DITCH	SR1568	ONSLOW	3
660232	TIDAL DITCH	SR1568	ONSLOW	3
660233	TIDAL DITCH	SR1568	ONSLOW	3
660234	TIDAL DITCH	SR1568	ONSLOW	3
660235	TIDAL DITCH	SR1568	ONSLOW	3
660236	TIDAL DITCH	SR1568	ONSLOW	3
660237	TIDAL DITCH	SR1568	ONSLOW	3
660240	TIDAL DITCH	SR1568	ONSLOW	3
660241	TIDAL DITCH	SR1568	ONSLOW	3
660268	EDWARDS CREEK	US17 BYP	ONSLOW	4
680009	NORTH PRONG BAY RIVER	SR1002	PAMLICO	2
680011	SPRING CREEK	SR1230	PAMLICO	4
680015	INTRACOASTAL WATERWAY	NC33	PAMLICO	4

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Bridge Number	Waterway	Roadway	County	Criticality
680016	FORK OF BAY RIVER	SR1324	PAMLICO	2
680024	NORTH PRONG OF BAY RIVER	NC304	PAMLICO	4
680035	LITTLE VANDEMERE CREEK	NC304	PAMLICO	4
680036	SO. PRONG BAY RIVER	NC55	PAMLICO	4
680037	BRANCH OF TRENT CREEK	NC55	PAMLICO	4
680042	GALE CREEK	NC304	PAMLICO	4
680053	SMITH CREEK	SR1308	PAMLICO	2
680057	DAWSON CREEK	SR1302	PAMLICO	2
680065	STREAM	SR1304	PAMLICO	3
680075	FORK OF GALES CREEK	SR1224	PAMLICO	2
690018	CHARLES CREEK	NC34	PASQUOTANK	4
690019	PASQUOTANK RIVER	US158 EBL.	PASQUOTANK	4
690027	PASQUOTANK RIVER ICW	US158	PASQUOTANK	4
690087	CREEK	SR1126	PASQUOTANK	1
690092	CANAL	SR1220	PASQUOTANK	1
700016	INTRACOASTAL WATERWAY	NC50/NC210	PENDER	4
700236	OLD TOPSAIL CREEK	SR1653	PENDER	1
710002	MUDDY CREEK	SR1321	PERQUIMANS	2
710008	PERQUIMANS RIVER	US17 BUS.	PERQUIMANS	4
710011	CASTLETON CREEK	SR1338	PERQUIMANS	1
710014	PERQUIMANS RIVER	US17 SBL	PERQUIMANS	4
710019	BRIGHTS MILL CREEK	US17 BUS	PERQUIMANS	4
710031	CASTLETON CREEK	SR1336	PERQUIMANS	1

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Bridge Number	Waterway	Roadway	County	Criticality
710080	PERQUIMANS RIVER	US17 NBL	PERQUIMANS	4
730127	TAR RIVER OVERFLOW	SR1565	PITT	3
730129	TAR RIVER	SR1565	PITT	3
880002	SCUPPERNONG RIVER	US64	TYRRELL	4
880007	ALLIGATOR RIVER	US64	TYRRELL	4
880089	ALLIGATOR CREEK	SR1229	TYRRELL	2
930009	CONABY CREEK	NC45	WASHINGTON	4
930015	ALBEMARLE SOUND	NC32	WASHINGTON	4

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Table 5.3 Criticality Index Definition Table.

Criticality Index	Description
1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	Major impact if closed – only road to a barrier island, evacuation route with no reasonable alternatives
4	Extreme impact if closed – Interstate or major economic connector (detour very long)

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5.2 Method of Analysis

The procedure for identifying the vulnerability of the selected bridges begins with identifying the most critical span on each bridge. The structural parameters (span type, dimensions, low chord elevation, superstructure dead weight, etc.) for that span were provided to OEI by NCDOT. Next, the design forces and moments were computed along with a conservative estimate (i.e., a lower estimate) of the resistive forces and moments. The design forces include a load factor, the magnitude of which depends on the criticality of the bridge. The resistive forces are conservative in that only the dead weight of the superstructure is considered. If there are tie-downs or other means of increasing the resistance, then the actual resistive forces and moments will be greater. The vulnerability index is the ratio of the design force or moment divided by the maximum resistive force or moment. If the vulnerability index is greater than or equal to 1 for either force or moment, the bridge is considered to be vulnerable. The computer model used to compute the forces and moments is discussed briefly below with more detail given in Appendix H.

5.2.1 Physics Based Model

Until recently, the methods for predicting wave forces on horizontal structures such as bridge spans were not well developed. Kaplan (1992) and Kaplan et al. (1995) published an analytical approach for computing forces on the decks of offshore platforms using an approach similar to that used in the development of Morison's Equation (Morrison et al. 1959) for horizontal wave forces on vertical piles. There are, however, differences between offshore platform decks and bridge spans as well as differences in the range of wave frequencies (and thus wave lengths) encountered by most coastal bridges. Starting with Kaplan's Equations, Dr. Sheppard and his graduate students at the University of Florida developed predictive equations for wave-induced horizontal and vertical forces and the resulting moments on bridge superstructures [Marin and Sheppard (2009)]. OEA, Inc. developed a proprietary computer program (Physics Based Model or PBM) that evaluates these equations for a wide variety of bridge superstructure designs and met/ocean conditions. The PBM generated the data that formed the basis of the parametric force and moment equations in the AASHTO code "*Guide Specifications for Bridges Vulnerable to Coastal Storms.*" The PBM computed the surge/wave loads in this study. Information on the surge/wave force and moment equations is presented in Appendix H.

5.2.2 Surge/Wave Forces and Moments

The forces and moments were computed for two sets of conditions, the 100-year water elevation and the associated wave height and the 100-year wave height and the associated water elevation. The larger of the two forces and moments were used to compute the bridge vulnerability. The computed forces and moments are given in Table 5.4. In the table, three sets of forces/moments are presented —1) the maximum vertical force and associated horizontal force and moment, 2) the maximum horizontal force and associated vertical force and moment, and 3) the maximum moment and associated vertical and horizontal forces. Figure 5.1 illustrates these forces. The vertical force is positive upwards, horizontal force is positive to the right, and a clockwise overturning moment is

positive. These forces, along with the resistance provided by the span dead weight, provide the information needed to determine the vulnerability of each bridge span.

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Table 5.4 100-Year Surge/Wave Forces and Moments.

Bridge Number	Maximum Vertical Force			Maximum Horizontal Force			Maximum Overturning Moment about the Lower Trailing Edge		
	Maximum Vertical Force (kips)	Associated Horizontal Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Horizontal Force (kips)	Associated Vertical Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Moment about the Trailing Edge (ft-kips)	Associated Vertical Force (kips)	Associated Horizontal Force (kips)
60009	150	2	2250	7	97	471	2721	129	-5
60025	655	12	21618	33	406	-525	28402	507	-20
60028	246	6	4894	16	176	390	6036	192	-10
60045	217	6	2633	8	185	2136	4748	201	-7
60048	146	2	1951	7	119	989	2342	131	-6
60063	329	0	8722	6	260	5082	8883	326	0
60064	75	5	450	6	59	-8	1172	48	0
60066	117	1	2240	5	97	1015	2445	103	-4
60070	154	3	3665	9	120	1696	4137	144	-3
60077	200	10	2512	15	138	495	2979	179	2
60103	94	0	1944	3	71	918	2287	83	-3
60174	211	1	3510	4	181	2388	4146	200	-4
60249	30	0	337	1	26	224	368	29	0
60330	42	0	468	4	3	24	544	40	-1
70007	6	1	-7	2	0	-77	4	0	0
70038	1496	142	46891	166	1056	38754	46891	1160	142
70058	948	90	30065	95	701	27859	32774	599	54

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Bridge Number	Maximum Vertical Force			Maximum Horizontal Force			Maximum Overturning Moment about the Lower Trailing Edge		
	Maximum Vertical Force (kips)	Associated Horizontal Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Horizontal Force (kips)	Associated Vertical Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Moment about the Trailing Edge (ft-kips)	Associated Vertical Force (kips)	Associated Horizontal Force (kips)
90002	104	16	1733	38	16	-357	1733	92	16
90013	2	0	3	3	-47	-2923	7	0	0
90014	3	0	6	2	-53	-3028	13	1	0
90015	184	5	2863	9	144	1313	4089	154	-9
90022	180	4	2779	9	142	1336	3942	152	-8
90055	134	1	2095	7	95	1126	2207	124	-5
90056	134	1	2085	5	119	1286	2197	123	-5
90061	338	21	4303	28	192	930	8069	310	0
90071	317	16	3575	26	197	1302	7860	306	0
90072	1131	0	26614	20	973	18483	26733	1128	-1
90093	1129	0	26571	18	977	18720	26687	1127	-1
90103	368	28	3173	30	329	2754	11178	244	-21
90105	367	12	6054	24	211	5503	13205	295	15
90107	335	14	9588	21	262	8924	12313	287	12
90108	295	3	6976	10	221	3585	7014	293	4
90163	281	3	6570	8	221	3775	6631	280	4
90190	128	2	1708	5	109	1101	2178	120	-4
90198	130	2	1725	4	112	1243	2333	123	-3

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Bridge Number	Maximum Vertical Force			Maximum Horizontal Force			Maximum Overturning Moment about the Lower Trailing Edge		
	Maximum Vertical Force (kips)	Associated Horizontal Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Horizontal Force (kips)	Associated Vertical Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Moment about the Trailing Edge (ft-kips)	Associated Vertical Force (kips)	Associated Horizontal Force (kips)
90206	1	0	0	0	0	0	0	0	0
90207	62	1	1123	3	47	554	1303	53	-2
150003	198	1	3499	3	178	2699	4247	192	-3
150004	198	1	3499	3	178	2699	4247	192	-3
150006	564	68	9066	70	462	8896	9571	501	61
150009	576	67	8966	72	454	8698	9369	488	61
150010	218	2	4191	10	167	2081	4225	216	0
150011	106	6	6130	12	54	1948	6130	89	6
150012	221	7	3649	17	203	2335	5998	88	6
150013	221	7	3708	16	203	2456	4267	184	-9
150014	0	0	0	0	0	0	0	0	0
150016	116	0	2034	4	104	1381	2062	115	-1
150018	262	0	4698	6	212	2921	4708	262	0
150020	263	0	4767	6	214	2972	4774	263	0
150023	18	4	714	5	-6	-1198	733	16	2
150024	378	5	7071	25	296	3595	7125	375	0
150029	375	3	7152	21	298	3934	7170	374	2
150031	193	0	3785	5	154	2219	3802	192	-1

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Bridge Number	Maximum Vertical Force			Maximum Horizontal Force			Maximum Overturning Moment about the Lower Trailing Edge		
	Maximum Vertical Force (kips)	Associated Horizontal Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Horizontal Force (kips)	Associated Vertical Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Moment about the Trailing Edge (ft-kips)	Associated Vertical Force (kips)	Associated Horizontal Force (kips)
150032	190	0	3685	5	153	2206	3701	189	0
150033	190	10	2247	13	73	-1356	3722	162	6
150034	179	9	2199	12	73	-1104	3541	151	5
150035	254	9	4329	14	185	2045	7112	232	0
150037	254	9	4333	14	183	2015	7107	232	0
150038	238	7	4751	11	188	2628	6281	214	0
150039	165	3	2045	9	94	3128	3128	94	9
150041	171	4	2204	10	97	3321	3497	108	9
150045	131	8	3339	9	114	3467	3521	111	9
150049	266	4	5451	10	209	3393	5455	266	3
150068	831	61	41319	62	733	40699	41319	736	61
150073	788	64	37873	64	676	37384	37897	687	64
150096	60	3	474	3	36	268	661	32	2
150101	316	5	7884	9	300	6572	7978	303	0
200002	315	5	7862	15	69	89	7952	302	0
200017	76	7	716	20	-55	-687	1761	62	0
200035	45	4	342	6	33	23	578	20	0
240060	282	14	5535	20	195	906	6448	256	5

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Bridge Number	Maximum Vertical Force			Maximum Horizontal Force			Maximum Overturning Moment about the Lower Trailing Edge		
	Maximum Vertical Force (kips)	Associated Horizontal Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Horizontal Force (kips)	Associated Vertical Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Moment about the Trailing Edge (ft-kips)	Associated Vertical Force (kips)	Associated Horizontal Force (kips)
240083	611	0	19859	40	582	15961	19868	611	0
240084	610	0	19829	38	587	16353	19836	610	0
240222	609	0	19667	36	583	15915	19680	609	0
240231	327	55	18163	118	4	-12318	18163	273	55
240234	260	49	13285	96	-25	-14138	13709	219	47
240235	338	46	6871	75	29	-9998	7403	278	30
240236	3205	199	65058	792	2559	6375	74444	3129	40
240237	3188	204	63700	769	2543	7619	73396	3108	66
260004	787	61	9838	129	60	1442	11799	689	19
260007	474	-1	11316	120	55	1202	11478	468	2
260008	358	3	8672	14	186	2804	11347	321	-2
260012	234	5	4998	13	187	2944	5807	210	0
260015	1	0	1	0	-2	-28	1	0	0
260016	519	74	7120	74	389	7120	7479	218	6
260035	671	70	8061	84	473	9789	9789	473	84
270003	627	54	7305	70	447	8727	8727	447	70
270004	72	0	1171	2	57	617	1420	66	-2
270005	3	0	0	0	0	0	0	0	0

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Bridge Number	Maximum Vertical Force			Maximum Horizontal Force			Maximum Overturning Moment about the Lower Trailing Edge		
	Maximum Vertical Force (kips)	Associated Horizontal Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Horizontal Force (kips)	Associated Vertical Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Moment about the Trailing Edge (ft-kips)	Associated Vertical Force (kips)	Associated Horizontal Force (kips)
270006	18	2	147	3	-21	-1802	188	15	1
270008	22	0	495	2	-15	-1210	502	22	0
270009	851	24	7699	86	92	-4047	8746	520	34
270011	677	18	6272	31	457	6981	6981	457	31
270012	235	86	8193	114	173	7564	8193	180	86
270013	234	94	8183	107	179	7845	8258	156	12
270014	432	7	24353	19	378	13761	24899	421	1
270038	438	6	24440	19	382	13978	25049	425	0
270042	199	5	3238	19	168	1638	3241	199	4
270043	223	6	3426	13	177	1607	3878	204	-5
270054	1932	36	84414	54	1724	30423	97549	1742	26
470008	1880	35	81109	51	1713	32892	94546	1673	23
470010	37	0	591	1	32	412	652	35	-1
470012	171	0	2239	10	128	1247	2899	171	0
470020	170	1	2452	9	126	1256	2793	164	0
470029	266	0	5680	8	211	3245	5680	266	0
470031	266	0	5666	8	211	3251	5666	266	0
470032	245	3	6711	7	230	5318	6896	231	-1

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Bridge Number	Maximum Vertical Force			Maximum Horizontal Force			Maximum Overturning Moment about the Lower Trailing Edge		
	Maximum Vertical Force (kips)	Associated Horizontal Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Horizontal Force (kips)	Associated Vertical Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Moment about the Trailing Edge (ft-kips)	Associated Vertical Force (kips)	Associated Horizontal Force (kips)
470039	245	3	6742	7	230	5323	6929	231	-1
470042	0	0	0	0	0	0	0	0	0
470044	7	0	65	0	5	28	66	7	0
470046	7	0	65	0	5	28	66	7	0
470049	0	0	0	0	0	0	0	0	0
470050	123	0	2768	3	97	1486	2840	121	0
470052	290	0	6591	7	233	3906	6712	285	1
470055	289	0	6564	7	233	3909	6690	285	1
470056	19	1	294	1	16	208	406	16	0
470080	226	2	3524	9	202	2181	3728	209	-8
470118	226	1	3541	9	202	2186	3745	209	-8
470119	6	1	50	1	1	-3	50	2	1
640005	200	5	4411	14	162	1088	4848	195	1
640006	260	3	5884	14	162	1134	7256	218	-9
640010	374	7	7988	19	252	2400	9770	328	-12
640011	372	7	8043	19	252	2425	9697	328	-12
640012	528	13	15678	28	405	5228	22994	364	-25
640013	525	13	15584	27	404	5370	22825	367	-25

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Bridge Number	Maximum Vertical Force			Maximum Horizontal Force			Maximum Overturning Moment about the Lower Trailing Edge		
	Maximum Vertical Force (kips)	Associated Horizontal Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Horizontal Force (kips)	Associated Vertical Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Moment about the Trailing Edge (ft-kips)	Associated Vertical Force (kips)	Associated Horizontal Force (kips)
640014	512	0	17991	26	392	9812	19540	492	8
640015	509	1	17879	23	391	9804	19437	488	9
640017	175	11	1236	12	141	818	4171	118	-12
640019	171	10	1348	15	101	356	4085	125	-11
640021	681	25	12828	32	572	9909	28509	578	-31
640022	673	22	13361	30	570	10283	28031	582	-29
640024	239	3	5319	12	147	-69	7000	183	-9
640027	239	3	5353	12	147	-69	7004	184	-9
640029	72	3	1255	19	38	510	1634	56	2
640030	48	2	983	8	37	789	1284	38	2
660005	233	0	6464	13	161	2524	9050	232	0
660007	231	4	7505	11	192	2652	8864	229	0
660017	194	10	2431	10	190	2658	3942	130	0
660021	347	0	9623	6	286	6919	11552	334	0
660024	344	0	9505	6	285	6863	11363	331	0
660025	1050	34	34661	57	757	11750	50756	900	0
660028	1033	32	36368	52	748	13542	49146	886	0
660030	1383	32	62625	72	895	27267	65404	1213	0

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Bridge Number	Maximum Vertical Force			Maximum Horizontal Force			Maximum Overturning Moment about the Lower Trailing Edge		
	Maximum Vertical Force (kips)	Associated Horizontal Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Horizontal Force (kips)	Associated Vertical Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Moment about the Trailing Edge (ft-kips)	Associated Vertical Force (kips)	Associated Horizontal Force (kips)
660077	1373	32	62460	70	892	27575	64850	1207	0
660191	90	5	729	6	81	192	1271	69	2
660226	41	1	572	2	29	188	704	36	-1
660230	59	1	1110	4	48	482	1190	51	-3
660231	59	2	1090	4	47	440	1144	49	-3
660232	0	0	0	0	0	0	0	0	0
660233	3	1	43	1	2	45	45	2	1
660234	50	1	704	2	45	540	859	47	-1
660235	50	1	701	2	37	549	859	47	-1
660236	50	0	807	2	37	549	825	48	0
660237	50	0	807	2	46	678	825	48	0
660240	175	5	2754	8	152	1932	3428	163	-7
660241	176	5	2783	8	152	1945	3435	165	-6
660268	18	2	35	3	17	33	35	18	2
680009	222	0	4152	3	194	3057	4163	221	0
680011	222	0	4508	5	187	2881	4676	218	-1
680015	222	0	4516	5	187	2877	4687	218	-1
680016	192	4	2360	5	186	2251	2707	191	-4

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Bridge Number	Maximum Vertical Force			Maximum Horizontal Force			Maximum Overturning Moment about the Lower Trailing Edge		
	Maximum Vertical Force (kips)	Associated Horizontal Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Horizontal Force (kips)	Associated Vertical Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Moment about the Trailing Edge (ft-kips)	Associated Vertical Force (kips)	Associated Horizontal Force (kips)
680024	192	4	2365	5	186	2266	2690	190	-4
680035	192	0	2901	4	186	2710	2982	189	-3
680036	192	0	2904	4	186	2716	3188	136	-1
680037	257	0	5804	4	118	1658	5894	255	-1
680042	256	0	5783	3	214	3786	5868	254	-1
680044	21	0	349	0	15	160	502	18	0
680053	0	0	0	0	0	0	0	0	0
680057	287	22	3642	27	168	681	4117	198	16
680065	280	12	4924	32	176	-342	4958	278	10
680075	18	0	302	0	14	161	347	17	0
690018	56	1	1080	2	48	533	1128	47	-2
690019	210	13	1932	24	155	459	3729	137	-19
690027	239	11	2649	27	168	106	3711	159	-17
690087	49	1	990	3	39	335	1023	48	1
690092	97	5	1754	6	82	928	1846	89	4
700016	0	0	0	0	0	0	0	0	0
700236	70	1	686	3	48	755	981	52	3
710002	65	1	1155	3	49	584	1159	65	1

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Bridge Number	Maximum Vertical Force			Maximum Horizontal Force			Maximum Overturning Moment about the Lower Trailing Edge		
	Maximum Vertical Force (kips)	Associated Horizontal Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Horizontal Force (kips)	Associated Vertical Force (kips)	Associated Moment about the Trailing Edge (ft-kips)	Maximum Moment about the Trailing Edge (ft-kips)	Associated Vertical Force (kips)	Associated Horizontal Force (kips)
710008	180	10	1610	22	128	208	2614	117	-19
710011	85	1	1062	4	63	380	1558	72	-4
710014	803	64	6408	75	162	-4198	8983	571	62
710019	60	1	817	4	37	-31	1190	49	-2
710031	93	2	1598	5	61	198	1963	78	-2
710080	894	55	9383	63	195	-5217	12318	574	50
730127	31	0	391	1	25	205	446	29	-1
730129	40	0	419	2	33	107	647	31	-1
880002	1199	4	53917	26	858	26014	60470	1122	-14
880007	149	57	-1220	63	111	-1719	2976	78	-2
880089	112	2	1407	3	94	1014	2250	103	-2
930009	181	48	2189	56	144	2038	3712	136	28
930015	39	15	406	17	31	464	464	31	17

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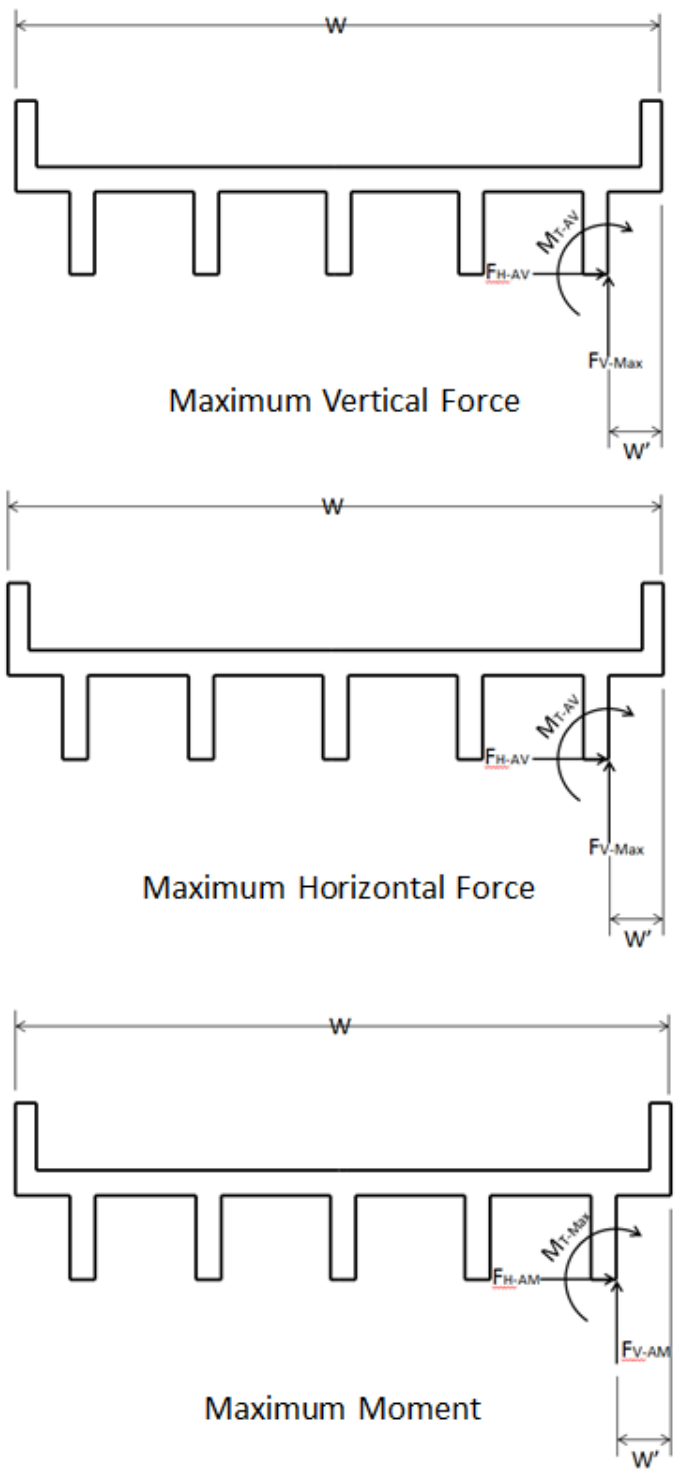

Figure 5.1 Force and Moment Definition Sketch.

5.2.3 Bridge Vulnerability

In this study, bridges with spans where the design surge/wave forces and/or moments (with the proper load factors) exceed the maximum resistive forces and/or moments are

classified as vulnerable. The AASHTO Code recommends a strength limit state wave force load factor of 1.75 for bridges classified by the owner as “critical/essential”. For bridges designated as “typical” the extreme event limit state wave force load factor is specified as 1.00. NCDOT provided the criticality classification for the bridges analyzed in this study. Bridges classified with a criticality of 3 or greater are considered “critical/essential” and are evaluated with a load factor of 1.75. Conversely, bridges classified with a criticality of 2 or less are considered “typical” and are evaluated with a load factor of 1.00.

The resistive forces consist of superstructure dead weight, tie-downs or other constraints (if present) and frictional forces between the super and substructure. Due to the effort required to obtain information on the existence and condition of tie-downs and estimating frictional forces, only superstructure dead weight is considered in this analysis. Bridges found to be vulnerable, from this conservative approach, should be analyzed in greater detail with more accurate tie-down information prior to making decisions regarding corrective action. The vulnerability index for both vertical force and moment were computed and these indices along with the resistive forces and moments are presented in Table 5.5. From the table, this analysis identified 105 bridges as vulnerable to the 100-year surge/wave loading.

NCDOT reviewed the 105 bridges found to be vulnerable and identified 58 select bridges for an extended analysis of all the spans. For those bridges, the NCDOT provided the structural parameters for the remaining spans which underwent the same analysis. Table 5.7 and Figure 5.2 present an example of the results for Bridge 60048. Table 5.7 presents the met/ocean conditions, structural parameters, 100-year forces and moment, and vulnerability for each span along the bridge. Figure 5.2 presents a simple profile plot of the bridge low chord, the bed elevation, the 100-year water surface elevation, and the 100-year wave crest elevation. Appendix I presents a similar table and plot for each of the 58 selected bridges.

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Table 5.5 Surge/Wave Forces, Moments, and Vulnerability Indices.

Bridge Number	Load Factor	Maximum Vertical Force (kips)	Dead Weight (kips)	Vertical Force Vulnerability Index	Maximum Moment (ft-Kips)	Dead Weight Resistive Moment (ft-kips)	Moment Vulnerability Index	Conclusion
60009	1	150	68	2.2	2721	738	3.7	Vulnerable
60025	1.75	1146	411	2.8	49703	11375	4.4	Vulnerable
60028	1.75	430	154	2.8	10562	2228	4.7	Vulnerable
60045	1.75	380	245	1.6	8309	3692	2.3	Vulnerable
60048	1.75	255	119	2.1	4098	1443	2.8	Vulnerable
60063	1.75	575	408	1.4	15546	9180	1.7	Vulnerable
60064	1.75	131	81	1.6	2051	807	2.5	Vulnerable
60066	1.75	204	107	1.9	4279	1332	3.2	Vulnerable
60070	1.75	270	176	1.5	7240	3704	2.0	Vulnerable
60077	1.75	349	79	4.4	5214	801	6.5	Vulnerable
60103	1.75	164	98	1.7	4002	1418	2.8	Vulnerable
60174	1.75	369	272	1.4	7256	4080	1.8	Vulnerable
60249	1.75	52	29	1.8	644	279	2.3	Vulnerable
60330	1	11	269	0.0	70	4443	0.0	Not Vulnerable
70007	1.75	0	368	0.0	0	4755	0.0	Not Vulnerable
70038	1.75	2618	363	7.2	82059	11950	6.9	Vulnerable
70058	1.75	182	316	0.6	3032	3790	0.8	Not Vulnerable
90002	1.75	0	491	0.0	0	10266	0.0	Not Vulnerable
90013	1.75	5	669	0.0	23	9443	0.0	Not Vulnerable

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Bridge Number	Load Factor	Maximum Vertical Force (kips)	Dead Weight (kips)	Vertical Force Vulnerability Index	Maximum Moment (ft-Kips)	Dead Weight Resistive Moment (ft-kips)	Moment Vulnerability Index	Conclusion
90014	1.75	0	2680	0.0	0	83077	0.0	Not Vulnerable
90015	1.75	323	324	1.0	7156	4863	1.5	Vulnerable
90022	1.75	192	235	0.8	3831	3550	1.1	Vulnerable
90055	1	134	196	0.7	2207	2644	0.8	Not Vulnerable
90056	1.75	0	424	0.0	0	8274	0.0	Not Vulnerable
90061	1.75	591	398	1.5	14121	7168	2.0	Vulnerable
90071	1.75	0	3492	0.0	0	48453	0.0	Not Vulnerable
90072	1.75	1979	2428	0.8	46783	50982	0.9	Not Vulnerable
90093	1.75	0	623	0.0	0	13240	0.0	Not Vulnerable
90103	1.75	644	479	1.3	19561	9406	2.1	Vulnerable
90105	1.75	627	479	1.3	23110	9406	2.5	Vulnerable
90107	1.75	517	322	1.6	12284	5616	2.2	Vulnerable
90108	1.75	511	223	2.3	12198	3884	3.1	Vulnerable
90163	1	81	126	0.6	1224	1306	0.9	Not Vulnerable
90190	1	130	180	0.7	2333	2434	0.9	Not Vulnerable
90198	1.75	0	431	0.0	0	6283	0.0	Not Vulnerable
90206	1	1	487	0.0	0	11698	0.0	Not Vulnerable
90207	1	62	39	1.6	1303	560	2.3	Vulnerable
150003	1.75	347	269	1.3	7433	4443	1.7	Vulnerable
150004	1.75	269	209	1.3	5604	3456	1.6	Vulnerable

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Bridge Number	Load Factor	Maximum Vertical Force (kips)	Dead Weight (kips)	Vertical Force Vulnerability Index	Maximum Moment (ft-Kips)	Dead Weight Resistive Moment (ft-kips)	Moment Vulnerability Index	Conclusion
150006	1.75	1009	397	2.5	16750	6317	2.7	Vulnerable
150009	1.75	384	227	1.7	7538	3751	2.0	Vulnerable
150010	1.75	0	205	0.0	0	3385	0.0	Not Vulnerable
150011	1.75	186	446	0.4	10728	15860	0.7	Not Vulnerable
150012	1.75	387	260	1.5	7655	3454	2.2	Vulnerable
150013	1.75	0	391	0.0	0	6202	0.0	Not Vulnerable
150014	1.75	0	1056	0.0	0	13767	0.0	Not Vulnerable
150016	1.75	203	244	0.8	3609	3784	0.9	Not Vulnerable
150018	1	263	326	0.8	4774	4896	0.9	Not Vulnerable
150020	1	0	392	0.0	0	8813	0.0	Not Vulnerable
150023	1.75	32	446	0.1	1282	15860	0.1	Not Vulnerable
150024	1.75	661	304	2.2	12548	5011	2.5	Vulnerable
150029	1.75	1	142	0.0	16	2505	0.0	Not Vulnerable
150031	1.75	338	239	1.4	6654	3949	1.7	Vulnerable
150032	1	97	132	0.7	1509	1776	0.8	Not Vulnerable
150033	1.75	333	177	1.9	6514	2643	2.5	Vulnerable
150034	1	103	177	0.6	2589	3203	0.8	Not Vulnerable
150035	1.75	445	478	0.9	12445	10564	1.2	Vulnerable
150037	1.75	419	465	0.9	11112	10259	1.1	Vulnerable
150038	1.75	187	522	0.4	3806	11523	0.3	Not Vulnerable

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Bridge Number	Load Factor	Maximum Vertical Force (kips)	Dead Weight (kips)	Vertical Force Vulnerability Index	Maximum Moment (ft-Kips)	Dead Weight Resistive Moment (ft-kips)	Moment Vulnerability Index	Conclusion
150039	1.75	300	596	0.5	5811	13169	0.4	Not Vulnerable
150041	1.75	232	475	0.5	6161	10499	0.6	Not Vulnerable
150045	1.75	0	700	0.0	0	9922	0.0	Not Vulnerable
150049	1.75	465	269	1.7	9545	3952	2.4	Vulnerable
150068	1.75	1454	912	1.6	72308	34745	2.1	Vulnerable
150073	1.75	66	285	0.2	519	4317	0.1	Not Vulnerable
150096	1.75	105	328	0.3	1156	4990	0.2	Not Vulnerable
150101	1.75	552	381	1.5	13962	7997	1.7	Vulnerable
200002	1.75	143	77	1.9	3124	1104	2.8	Vulnerable
200017	1.75	37	43	0.9	1037	942	1.1	Vulnerable
200035	1	45	46	1.0	382	304	1.3	Vulnerable
240060	1.75	494	150	3.3	11284	2156	5.2	Vulnerable
240083	1.75	1070	616	1.7	34770	15644	2.2	Vulnerable
240084	1.75	1068	616	1.7	34713	15644	2.2	Vulnerable
240222	1.75	0	506	0.0	0	8016	0.0	Not Vulnerable
240231	1.75	572	1854	0.3	31786	81038	0.4	Not Vulnerable
240234	1.75	0	673	0.0	0	9588	0.0	Not Vulnerable
240235	1.75	592	709	0.8	12955	11032	1.2	Vulnerable
240236	1.75	5610	1437	3.9	130278	20907	6.2	Vulnerable
240237	1.75	1399	407	3.4	20917	3966	5.3	Vulnerable

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Bridge Number	Load Factor	Maximum Vertical Force (kips)	Dead Weight (kips)	Vertical Force Vulnerability Index	Maximum Moment (ft-Kips)	Dead Weight Resistive Moment (ft-kips)	Moment Vulnerability Index	Conclusion
260004	1.75	830	991	0.8	20086	17839	1.1	Vulnerable
260007	1.75	630	470	1.3	19857	12690	1.6	Vulnerable
260008	1.75	409	300	1.4	10352	6297	1.6	Vulnerable
260012	1.75	2	229	0.0	5	3495	0.0	Not Vulnerable
260015	1.75	0	1934	0.0	0	56246	0.0	Not Vulnerable
260016	1.75	916	410	2.2	13281	6956	1.9	Vulnerable
260035	1.75	1175	410	2.9	17131	6956	2.5	Vulnerable
270003	1.75	130	75	1.7	2647	958	2.8	Vulnerable
270004	1.75	5	496	0.0	0	20584	0.0	Not Vulnerable
270005	1.75	1	426	0.0	0	7351	0.0	Not Vulnerable
270006	1.75	32	392	0.1	330	5831	0.1	Not Vulnerable
270008	1.75	39	37	1.1	879	649	1.4	Vulnerable
270009	1.75	1489	258	5.8	15306	2934	5.2	Vulnerable
270011	1.75	333	327	1.0	5565	4228	1.3	Vulnerable
270012	1.75	412	734	0.6	14451	20850	0.7	Not Vulnerable
270013	1.75	113	72	1.6	2018	919	2.2	Vulnerable
270014	1.75	767	957	0.8	43836	44515	0.9	Not Vulnerable
270038	1.75	348	245	1.4	5672	3305	1.7	Vulnerable
270042	1	54	42	1.3	1117	608	1.8	Vulnerable
270043	1.75	391	201	1.9	6787	2710	2.5	Vulnerable

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Bridge Number	Load Factor	Maximum Vertical Force (kips)	Dead Weight (kips)	Vertical Force Vulnerability Index	Maximum Moment (ft-Kips)	Dead Weight Resistive Moment (ft-kips)	Moment Vulnerability Index	Conclusion
270054	1.75	3381	932	3.6	170711	27719	6.2	Vulnerable
470008	1.75	64	45	1.4	1142	626	1.8	Vulnerable
470010	1.75	0	335	0.0	0	6022	0.0	Not Vulnerable
470012	1	171	245	0.7	2899	3305	0.9	Not Vulnerable
470020	1.75	0	978	0.0	0	18503	0.0	Not Vulnerable
470029	1.75	466	326	1.4	9940	5875	1.7	Vulnerable
470031	1.75	0	326	0.0	0	5875	0.0	Not Vulnerable
470032	1.75	429	375	1.1	12126	8446	1.4	Vulnerable
470039	1.75	0	333	0.0	0	5993	0.0	Not Vulnerable
470042	1.75	0	326	0.0	0	5875	0.0	Not Vulnerable
470044	1.75	12	11	1.0	115	79	1.5	Vulnerable
470046	1.75	0	326	0.0	0	5875	0.0	Not Vulnerable
470049	1.75	0	326	0.0	0	5875	0.0	Not Vulnerable
470050	1.75	216	241	0.9	4970	4609	1.1	Vulnerable
470052	1.75	507	354	1.4	11746	6895	1.7	Vulnerable
470055	1.75	15	14	1.1	316	187	1.7	Vulnerable
470056	1.75	33	33	1.0	711	450	1.6	Vulnerable
470080	1	226	304	0.7	3745	4098	0.9	Not Vulnerable
470118	1.75	0	29	0.0	0	351	0.0	Not Vulnerable
470119	1.75	10	29	0.3	90	351	0.3	Not Vulnerable

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Bridge Number	Load Factor	Maximum Vertical Force (kips)	Dead Weight (kips)	Vertical Force Vulnerability Index	Maximum Moment (ft-Kips)	Dead Weight Resistive Moment (ft-kips)	Moment Vulnerability Index	Conclusion
640005	1	200	397	0.5	4848	7088	0.7	Not Vulnerable
640006	1	260	391	0.7	7256	7025	1.0	Vulnerable
640010	1	374	333	1.1	9770	5938	1.6	Vulnerable
640011	1.75	1	616	0.0	50	18365	0.0	Not Vulnerable
640012	1.75	924	390	2.4	40240	11903	3.4	Vulnerable
640013	1.75	0	886	0.0	0	25374	0.0	Not Vulnerable
640014	1.75	896	533	1.7	34196	15994	2.1	Vulnerable
640015	1	139	218	0.6	3150	3919	0.8	Not Vulnerable
640017	1	175	227	0.8	4171	3751	1.1	Vulnerable
640019	1	159	109	1.5	3184	1660	1.9	Vulnerable
640021	1.75	1193	637	1.9	49890	15079	3.3	Vulnerable
640022	1.75	222	193	1.2	6608	3851	1.7	Vulnerable
640024	1.75	418	234	1.8	12257	3600	3.4	Vulnerable
640027	1.75	0	1595	0.0	0	48488	0.0	Not Vulnerable
640029	1	72	209	0.3	1634	2950	0.6	Not Vulnerable
640030	1.75	0	1149	0.0	0	34012	0.0	Not Vulnerable
660005	1.75	408	278	1.5	15838	7153	2.2	Vulnerable
660007	1.75	345	205	1.7	7083	3596	2.0	Vulnerable
660017	1.75	0	1335	0.0	0	20693	0.0	Not Vulnerable
660021	1	347	652	0.5	11552	14727	0.8	Not Vulnerable

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Bridge Number	Load Factor	Maximum Vertical Force (kips)	Dead Weight (kips)	Vertical Force Vulnerability Index	Maximum Moment (ft-Kips)	Dead Weight Resistive Moment (ft-kips)	Moment Vulnerability Index	Conclusion
660024	1.75	0	460	0.0	0	13184	0.0	Not Vulnerable
660025	1.75	1837	805	2.3	88822	29899	3.0	Vulnerable
660028	1.75	0	992	0.0	0	15343	0.0	Not Vulnerable
660030	1.75	2421	1107	2.2	114457	41172	2.8	Vulnerable
660077	1	115	103	1.1	2303	1355	1.7	Vulnerable
660191	1	0	572	0.0	0	13724	0.0	Not Vulnerable
660226	1	41	32	1.3	704	397	1.8	Vulnerable
660230	1.75	103	120	0.9	2083	1796	1.2	Vulnerable
660231	1.75	0	113	0.0	0	1688	0.0	Not Vulnerable
660232	1.75	0	113	0.0	0	1688	0.0	Not Vulnerable
660233	1.75	6	113	0.1	104	1688	0.1	Not Vulnerable
660234	1.75	87	113	0.8	1504	1688	0.9	Not Vulnerable
660235	1.75	73	113	0.7	1238	1688	0.7	Not Vulnerable
660236	1.75	88	113	0.8	1444	1688	0.9	Not Vulnerable
660237	1.75	86	113	0.8	1421	1688	0.8	Not Vulnerable
660240	1.75	308	264	1.2	6011	4361	1.4	Vulnerable
660241	1.75	31	288	0.1	61	432	0.1	Not Vulnerable
660268	1.75	0	1584	0.0	0	89185	0.0	Not Vulnerable
680009	1	222	275	0.8	4163	4569	0.9	Not Vulnerable
680011	1.75	389	294	1.3	8203	5312	1.5	Vulnerable

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Bridge Number	Load Factor	Maximum Vertical Force (kips)	Dead Weight (kips)	Vertical Force Vulnerability Index	Maximum Moment (ft-Kips)	Dead Weight Resistive Moment (ft-kips)	Moment Vulnerability Index	Conclusion
680015	1.75	0	1649	0.0	0	13122	0.0	Not Vulnerable
680016	1	192	320	0.6	2707	4076	0.7	Not Vulnerable
680024	1.75	80	45	1.8	1820	803	2.3	Vulnerable
680035	1.75	336	401	0.8	5223	5854	0.9	Not Vulnerable
680036	1.75	249	131	1.9	5585	2031	2.7	Vulnerable
680037	1.75	450	517	0.9	10314	9993	1.0	Vulnerable
680042	1.75	32	31	1.0	735	450	1.6	Vulnerable
680053	1	0	460	0.0	0	7327	0.0	Not Vulnerable
680057	1	287	110	2.6	4117	1481	2.8	Vulnerable
680065	1.75	489	304	1.6	8677	4098	2.1	Vulnerable
680075	1	18	31	0.6	347	407	0.9	Not Vulnerable
690018	1.75	99	61	1.6	1973	933	2.1	Vulnerable
690019	1.75	368	210	1.7	6527	2394	2.7	Vulnerable
690027	1.75	419	230	1.8	6495	2279	2.9	Vulnerable
690087	1	49	48	1.0	1023	773	1.3	Vulnerable
690092	1	97	86	1.1	1846	1087	1.7	Vulnerable
700016	1.75	0	164	0.0	0	2201	0.0	Not Vulnerable
700236	1	70	136	0.5	981	1843	0.5	Not Vulnerable
710002	1	65	97	0.7	1159	1492	0.8	Not Vulnerable
710008	1.75	316	166	1.9	4575	1362	3.4	Vulnerable

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Bridge Number	Load Factor	Maximum Vertical Force (kips)	Dead Weight (kips)	Vertical Force Vulnerability Index	Maximum Moment (ft-Kips)	Dead Weight Resistive Moment (ft-kips)	Moment Vulnerability Index	Conclusion
710011	1	85	81	1.0	1558	852	1.8	Vulnerable
710014	1.75	1406	335	4.2	15721	4038	3.9	Vulnerable
710019	1.75	105	49	2.2	2082	614	3.4	Vulnerable
710031	1	93	132	0.7	1963	1971	0.9	Not Vulnerable
710080	1.75	1564	401	3.9	21557	6467	3.3	Vulnerable
730127	1.75	55	26	2.1	780	264	2.9	Vulnerable
730129	1.75	69	53	1.3	1133	510	2.2	Vulnerable
880002	1.75	2098	1534	1.4	105822	54199	2.0	Vulnerable
880007	1.75	262	224	1.2	5208	2702	1.9	Vulnerable
880089	1	112	232	0.5	2250	3367	0.7	Not Vulnerable
930009	1.75	316	316	1.0	6496	3745	1.7	Vulnerable
930015	1.75	69	278	0.2	812	2226	0.4	Not Vulnerable

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Table 5.6 Bridges With All Spans Analyzed.

Bridge Number	Waterway	Roadway	County
60025	PAMLICO RIVER	US17	BEAUFORT
60028	BATH CREEK	NC92	BEAUFORT
60048	SOUTH CREEK	NC33	BEAUFORT
60064	PUNGO CREEK	NC99	BEAUFORT
60066	PUNGO RIVER	US264	BEAUFORT
60070	BR OF PUNGO CREEK	NC99	BEAUFORT
60077	PANTEGO CREEK	NC99	BEAUFORT
60103	RUNYON CREEK	NC32	BEAUFORT
90015	CALABASH RIVER	NC179 BUS	BRUNSWICK
90061	TOWN CREEK	NC133	BRUNSWICK
90103	BRUNSWICK RIVER	US17	BRUNSWICK
90105	BRUNSWICK RIVER	US17 SBL	BRUNSWICK
90107	ALLIGATOR CREEK	US17,74,76	BRUNSWICK
90108	ALLIGATOR CREEK	US17,74,76(SBL)	BRUNSWICK
150006	INTRACOASTAL WATERWAY	NC58	CARTERET
150012	THOROFARE BAY CHANNEL	NC12	CARTERET
150031	BRANCH NEWPORT RIVER	NC101	CARTERET
150033	NORTH RIVER	US70	CARTERET
150068	BOGUE SOUND & ICW	SR1182	CARTERET
200002	PEMBROKE CREEK	SR1204	CHOWAN
240060	TRENT RIVER	US70 BUS.	CRAVEN
240083	TRENT RIVER	US70	CRAVEN
240084	TRENT RIVER	US70	CRAVEN
240236	NEUSE RIVER	US70 BYP(RAMP DC)	CRAVEN
240237	NEUSE RIVER	US70 BUS(RAMP DA)	CRAVEN
260016	CURRITUCK SOUND	US158 EBL	CURRITUCK
260035	CURRITUCK SOUND	US158 WBL	CURRITUCK
270003	DEEP CREEK	US264	DARE

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Bridge Number	Waterway	Roadway	County
270009	CROATAN SOUND	US64	DARE
270011	OREGON INLET	NC12	DARE
270013	STUMPY POINT CANAL	US264	DARE
270038	CREEK	SR1216	DARE
270043	DOUGH'S CREEK	NC400	DARE
270054	CROATAN SOUND	US64 BYP	DARE
470008	BURGESS MILL CREEK	US264	HYDE
470029	SCRANTON CREEK	US264	HYDE
470032	ROSE BAY CREEK	US264	HYDE
470052	CANAL	US264	HYDE
640012	INTRACOASTAL WATERWAY	US74&76	NEW HANOVER
640021	BANKS CHANNEL	US76	NEW HANOVER
640022	KENAN CREEK	US74	NEW HANOVER
640024	BANKS CHANNEL	US74	NEW HANOVER
660025	WHITE OAK RIVER	NC24	ONSLOW
660030	WHITE OAK RIVER	NC24	ONSLOW
660226	BRANCH OF NEW RIVER	SR1557	ONSLOW
680011	SPRING CREEK	SR1230	PAMLICO
680024	NORTH PRONG OF BAY RIVER	NC304	PAMLICO
680036	SO. PRONG BAY RIVER	NC55	PAMLICO
680042	GALE CREEK	NC304	PAMLICO
680057	DAWSON CREEK	SR1302	PAMLICO
680065	STREAM	SR1304	PAMLICO
690018	CHARLES CREEK	NC34	PASQUOTANK
690019	PASQUOTANK RIVER	US158 EBL.	PASQUOTANK
690027	PASQUOTANK RIVER ICW	US158	PASQUOTANK
710014	PERQUIMANS RIVER	US17 SBL	PERQUIMANS
710019	BRIGHTS MILL CREEK	US17 BUS	PERQUIMANS
710080	PERQUIMANS RIVER	US17 NBL	PERQUIMANS
880007	ALLIGATOR RIVER	US64	TYRRELL

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Table 5.7 Example Results Table for the Extended Analysis on Select Bridges.

NCDOT BRIDGE NO. 60048

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY												
SPAN NUMBER	1	2	3	4	5	6	7	8	9	10	11	12
CRITICALITY INDEX (defined below)	4	4	4	4	4	4	4	4	4	4	4	4
VULNERABILITY INDEX (defined below)	2.0	2.0	2.0	2.0	2.0	2.7	2.0	2.0	2.0	2.0	2.0	2.0

SURGE/WAVE LOAD COMPUTATION INPUT VALUES												
HYDRAULIC VALUES												
100-yr Water Surface Elevation (ft - NAVD)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
Bed Elevation (ft - NAVD)	-1	-6	-9	-11	-12	-12	-10	-9	-8	-7	1	1
Low Chord Elevation (ft - NAVD)	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
100-yr Max Wave Crest Elevation (ft - NAVD)	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3
100-yr Wave Height (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
100-yr Wave Period (seconds)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
SPAN PROPERITES												
Span Length (ft)	24.3	23.5	25.5	24.6	24.5	39.2	24.5	24.5	24.5	24.5	24.5	24.5
Span Width (ft)	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Number of Beams	6	6	6	6	6	4	6	6	6	6	6	6
Beam Dead Weight (lb/lf) - Each	52	52	52	52	52	52	52	52	52	52	52	52
Beam Dead Weight (kip/ft) - Total	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Slab Dead Weight (kip/ft)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Total Dead Weight (kip/ft)	2.2	2.2	2.2	2.2	2.2	2.1	2.2	2.2	2.2	2.2	2.2	2.2
Resisting Moment (kft/ft)	25.8	25.8	25.8	25.8	25.8	24.6	25.8	25.8	25.8	25.8	25.8	25.8
Resisting Vertical Force (kip/ft)	2.2	2.2	2.2	2.2	2.2	2.1	2.2	2.2	2.2	2.2	2.2	2.2
100-YEAR FORCE-MOMENT VALUES												
Maximum Vertical Force (kips/span)	50.3	48.0	52.5	50.4	50.1	101.3	50.2	50.4	50.3	50.3	50.2	50.2
Maximum Vertical Force (kips/ft)	2.1	2.0	2.1	2.0	2.0	2.6	2.0	2.1	2.1	2.1	2.0	2.0
Maximum Horizontal Force (kips/span)	0.9	0.9	1.0	0.9	0.9	2.3	0.9	0.9	0.9	0.9	0.9	0.9
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	726.9	696.8	761.5	729.5	724.3	1487.5	727.7	731.9	731.1	729.1	723.8	723.8
Maximum Moment (k-ft/ft)	30.0	29.6	29.9	29.7	29.6	38.0	29.7	29.9	29.8	29.8	29.5	29.5

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

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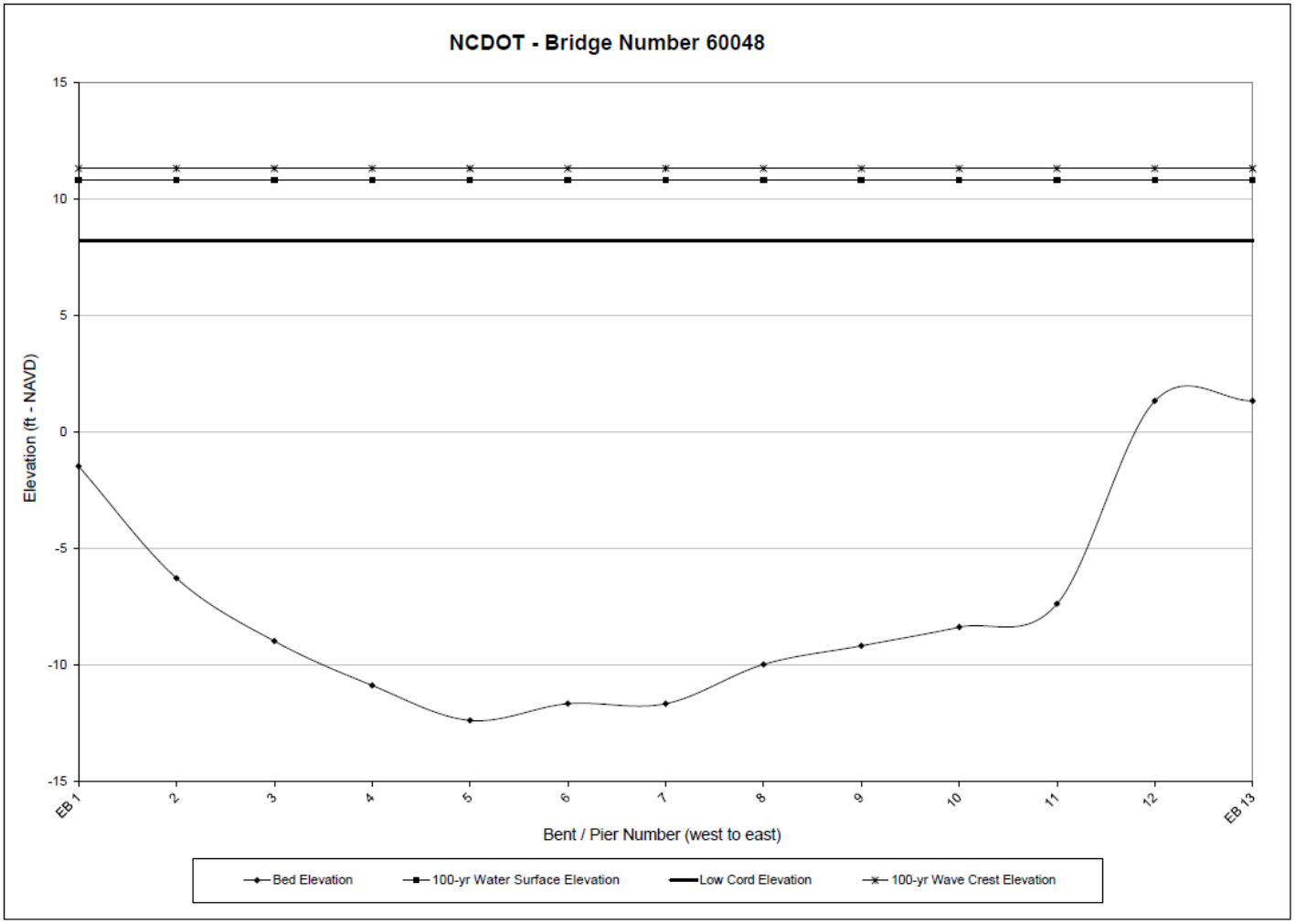

Figure 5.2 Example Results Plot for the Extended Analysis on Select Bridges.

6.0 Summary

The objectives of this study were to: 1) create a met/ocean database for 100-year storm conditions for North Carolina Coastal Waters, 2) from this information, compute the storm surge and wave loads on selected NCDOT bridge superstructures, and 3) based on these computed loads, assess the bridges' vulnerability. The database includes 100-year (1% chance of occurrence each year) depth-averaged current speeds, maximum water elevations with associated wave heights, and maximum wave heights with associated water elevations throughout the modeled area. The results are presented in a GIS database along with a public domain GIS reader. This information has many potential applications beyond that for computing surge/wave loading on bridge sub- and superstructures.

One hundred ninety-one (191) coastal bridges were examined in this study. The 100-year surge/wave forces and moments were computed for the most critical span(s) on these bridges. The resistive forces and moments (based on the superstructure dead weight) were also developed. The vulnerability index, which is the calculated forces/moments with the appropriate load factors divided by the resistive forces/moments, was then computed. Bridges with vulnerability indices equal to or greater than one were classified as vulnerable. Of the 191 bridges analyzed, 105 were vulnerable to these types of loads. For the bridges classified as vulnerable, the NCDOT provided structural and elevation information for the remaining spans. These spans were also analyzed via the same methodology.

If any of the vulnerable bridges have constraints (tie-downs, etc.) then a more accurate assessment of the resistive forces and moments becomes necessary, followed by re-computation of the vulnerability index.

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7.0 References

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Appendix A Data Sources

Bathymetry and Topography

The Level III evaluation of the North Carolina Bridges focuses on the development of complex wave and surge models to simulate the historical sea state. Development and application of the models requires aerial photography, bathymetry, and topography. This appendix describes the data collection effort.

Aerial Photography and Maps

Aerial photography and maps provide base map information from which to construct the model meshes. These data include a complete set of georeferenced, photographs for coastal North Carolina provided by the NCDOT, georeferenced USGS quadrangle maps, and NOAA navigation charts. Additional information obtained includes shoreline files and GIS basemaps. Details for each are provided below:

NCDOT Aerial Photography

Source:	North Carolina Department of Transportation
Agency:	FHWA
Georeferenced:	Yes
Hor. Coords:	State Plane North Carolina ft
Resolution	1 meter
Date of Aerials:	2010
Aerial Coverage:	Coast of North Carolina

Figure A. 1 displays the coverage (shaded region) of the obtained aerials.

Figure A. 1 Aerial Photographs.

NOAA Georeferenced Navigation Charts

Source: Chart Navigator (NOAA)
Georeferenced: Yes
Horizontal Datum: State Plane, North Carolina, NAD83, ft

Figure A. 2 presents an example of the NOAA navigation charts employed in this study.

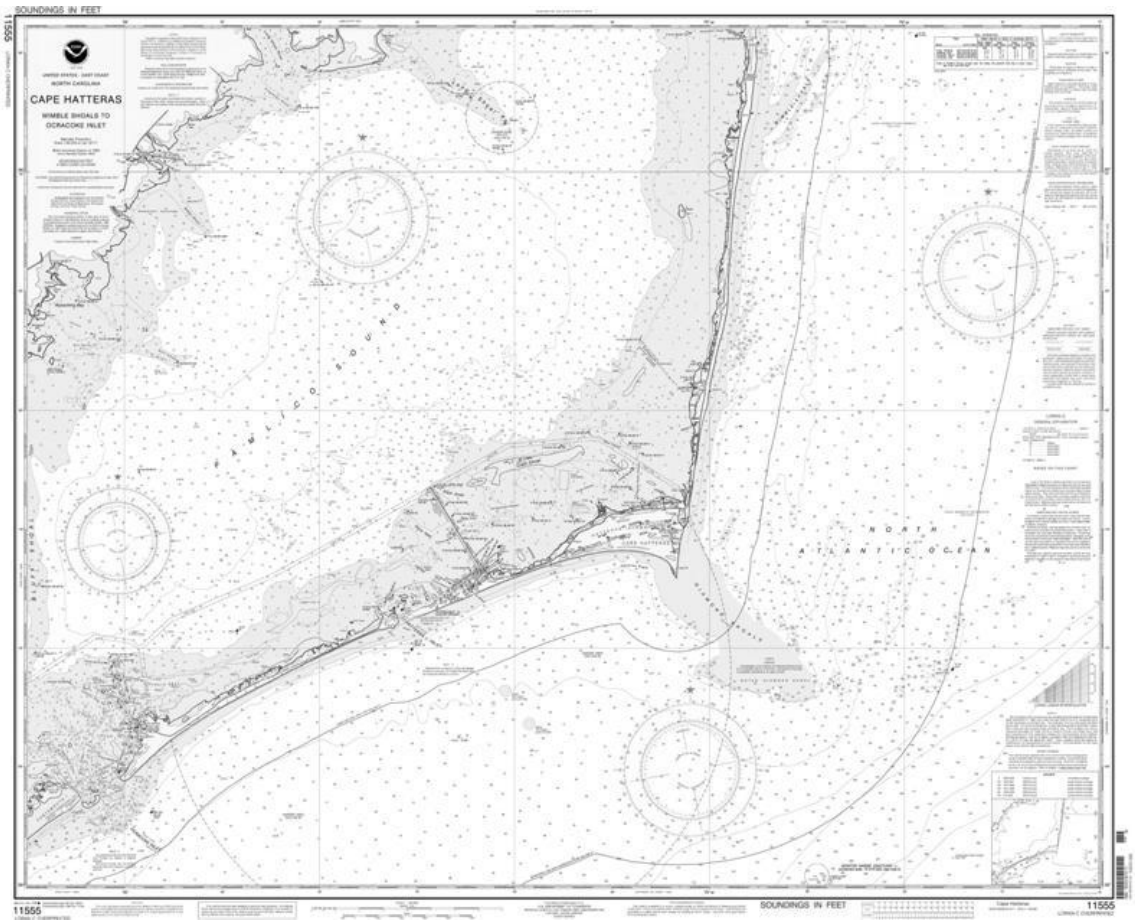

Figure A. 2 NOAA Nautical Chart 11555 Cape Hatteras.

Global Self-consistent, Hierarchical, High-resolution Shoreline Shapefile

Agency: National Geographic Data Center (NGDC)
Horizontal Datum: World Geographic (Latitude-Longitude)
Vertical Datum: NA
Extents: Global
Survey Description: GSHHS - A Global Self-consistent, Hierarchical, High-resolution Shoreline Database. GSHHS is a high-resolution shoreline data set amalgamated from two data bases in the public domain. The data have undergone extensive processing and are free of internal inconsistencies such as erratic points and crossing segments. The shorelines are constructed entirely from hierarchically arranged closed polygons. Shapefile created by David Divins (David.Divins@noaa.gov) at NGDC from GSHHS. Figure A. 3 and Figure A. 4 present this shoreline coverage.

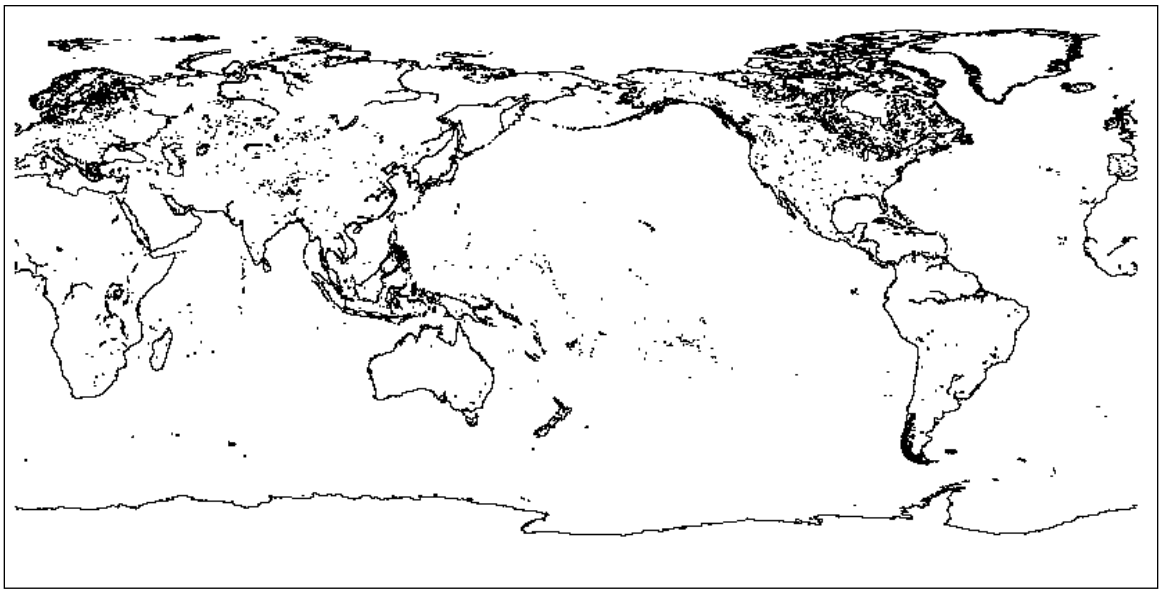

Figure A. 3 GSHHS Shapefile Complete Coverage.

Figure A. 4 GSHHS Shapefile North Carolina Coastal Coverage.

Bathymetry and Topography

The bathymetric and topographic surveys of the study area provide data to populate the meshes for the numerical wave and storm surge models. As such, the coverage of the data should include not only the North Carolina, but also the northwest Atlantic Ocean as well as the Gulf of Mexico. Several sources of bathymetric and topographic data from numerous on-line sources were located.

The data for constructing the models came primarily from two sources: the ETOPO2(5) and the Coastal Relief datasets maintained by the NGDC. These are described below.

Agency:	National Geographic Data Center (NGDC)	
Horizontal Datum:	World Geographic (Latitude-Longitude)	
Vertical Datum:	Mean Sea Level (meters)	
Survey Extents:	Latitude:	5° North to 46° North
	Longitude:	100° West to 60° West

Survey Description: ETOPO5 was generated from a digital data base of land and sea-floor elevations on a 5-minute latitude/longitude grid. The resolution of the gridded data varies from true 5-minute for the ocean floors, the USA., Europe, Japan, and Australia to 1 degree in data-deficient parts of Asia, South America, northern Canada, and Africa.

Data sources are as follows: Ocean Areas: US Naval Oceanographic Office; USA, W. Europe, Japan/Korea: US Defense Mapping Agency; Australia: Bureau of Mineral Resources, Australia; New Zealand: Department of Industrial and Scientific Research, New Zealand; balance of world land masses: US Navy Fleet Numerical Oceanographic Center. These various data bases were originally assembled in 1988 into the worldwide 5-minute grid by Margo Edwards, then at Washington University, St. Louis, MO. The ETOPO5 data may be credited in publications by reference to "Data Announcement 88-MGG-02, Digital relief of the Surface of the Earth. NOAA, National Geophysical Data Center, Boulder, Colorado, 1988." The version of the data making up ETOPO5 is from May, 1988, with the exception of a small area in Canada (120-130 W, 65-70 N), which was regridded in 1990. Figure A. 5 presents the ETOPO5 data for the North Atlantic Ocean.

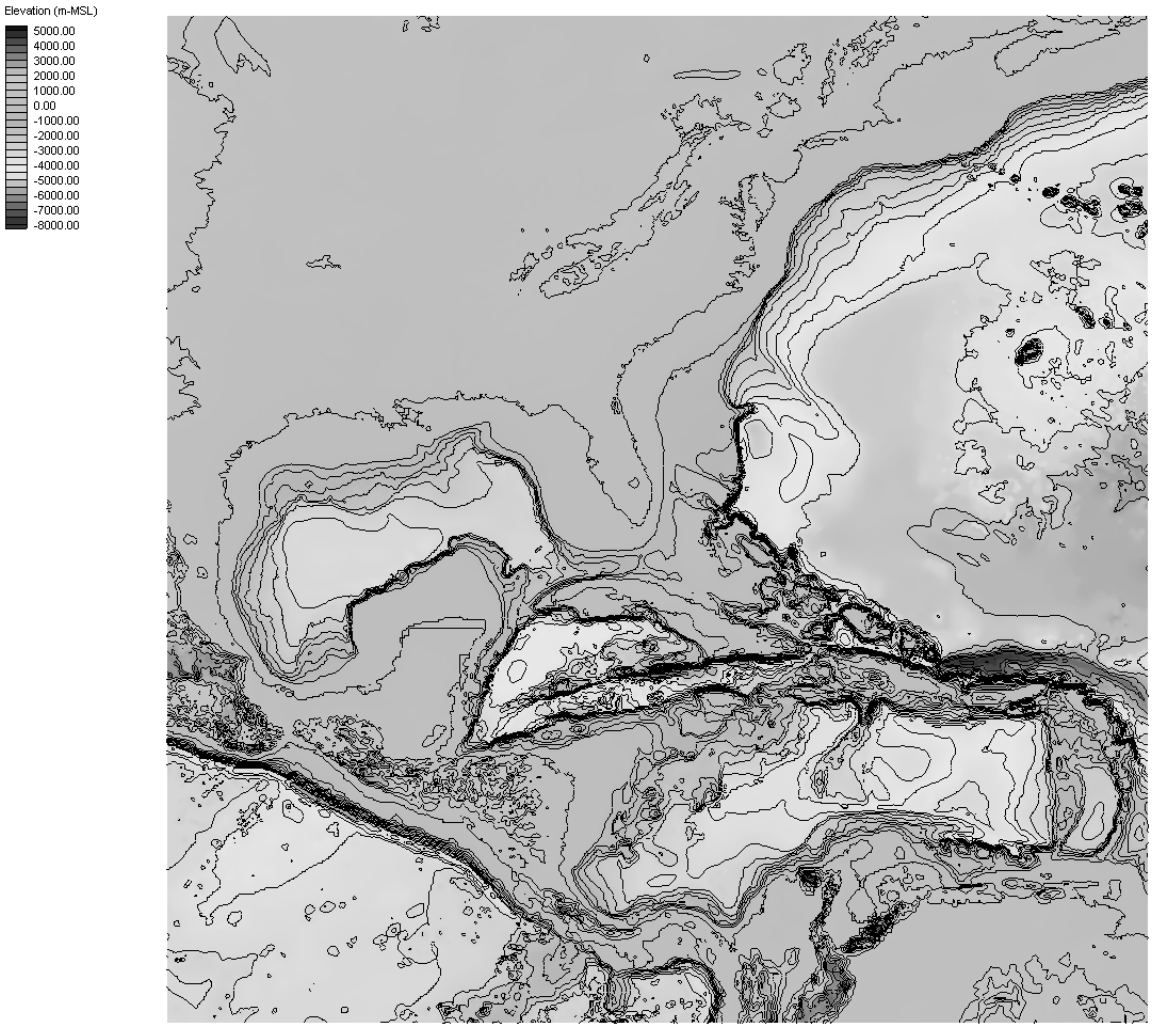

Figure A. 5 ETOPO5 Survey Data.

ETOPO2 Survey Data

Agency:	National Geographic Data Center (NGDC)	
Horizontal Datum:	World Geographic (Latitude-Longitude)	
Vertical Datum:	Mean Sea Level (meters)	
Survey Extents:	Latitude:	5° North to 46° North
	Longitude:	100° West to 60° West

Survey Description: World survey data spaced at 2' increments. The seafloor data between latitudes 64° North and 72° South are from the work of Smith and Sandwell (1997). These data were derived from satellite altimetry observations combined with carefully, quality-assured shipboard echo-sounding measurements, by Dr. Walter H.F. Smith, of the NOAA Laboratory for Satellite Altimetry and Dr. David T. Sandwell, of the Institute of Geophysics and Planetary Physics at the University of California, San Diego. Seafloor data southward of 72° South are from the US Naval Oceanographic Office's (NAVOCEANO) Digital Bathymetric Data Base Variable Resolution (DBDBV), version 4.1, gridded at 5 minute spacing; some data in this region are from the older DBDB5 (these data were also used in ETOPO5). Seafloor data northward from 64° North are from the new International Bathymetric Chart of the Arctic Ocean (IBCAO) Version 1. Land topography is from the GLOBE Project, an internationally designed, developed, and independently peer-reviewed global digital elevation model (DEM), at a latitude-longitude grid spacing of 30 arc-seconds (30"). The GLOBE Task Team was established by the Committee on Earth Observation Satellites (CEOS). It is part of Focus I of the International Geosphere-Biosphere Programme - Data and Information System. The ETOPO2 data may be credited in publications by reference to "U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Geophysical Data Center, 2001. 2-minute Gridded Global Relief Data (ETOPO2) http://www.ngdc.noaa.gov/mgg/fliers/01mgg04.html." Figure A. 6 presents the ETOPO2 dataset for the North Atlantic Ocean.

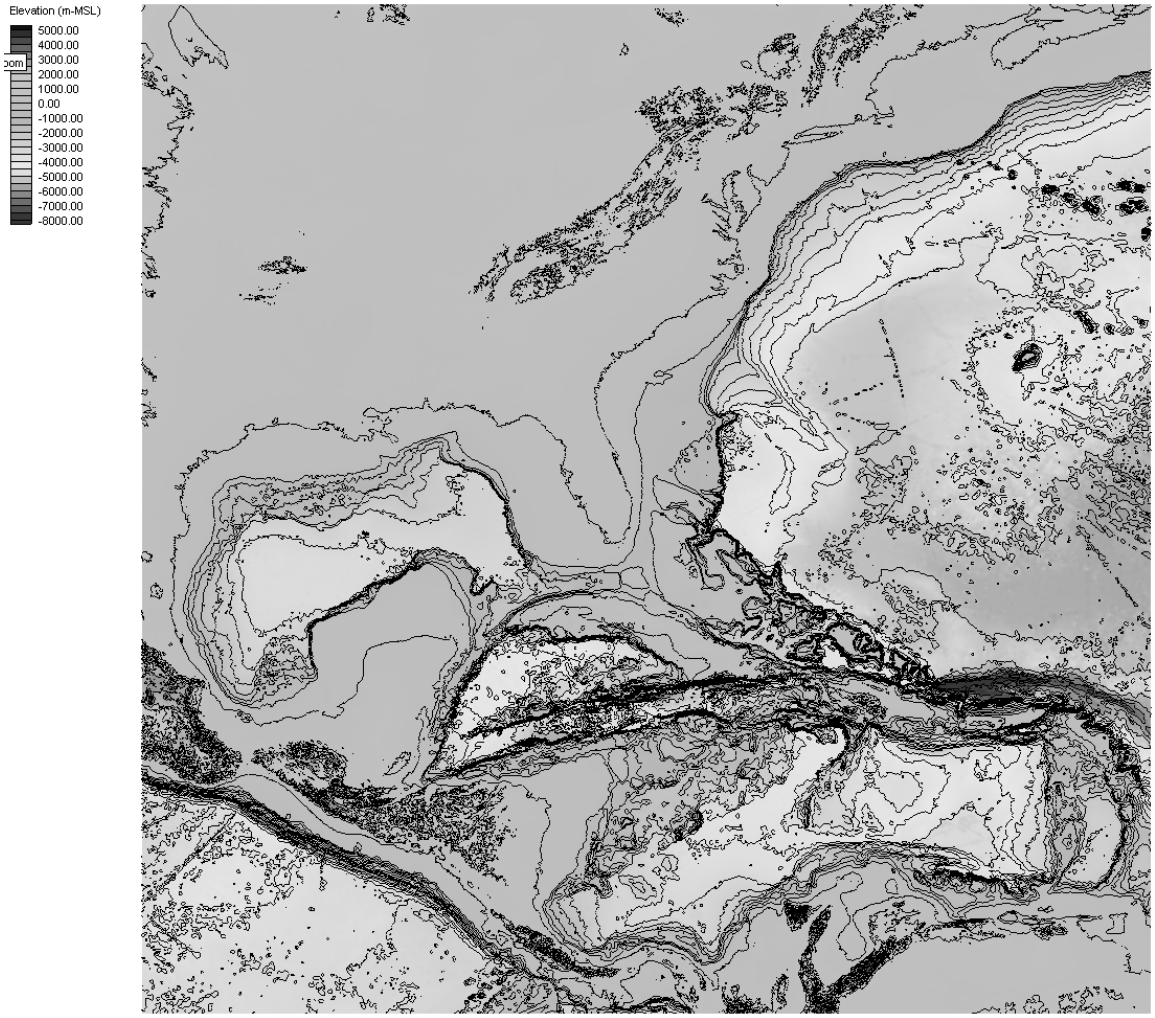

Figure A. 6 ETOPO2 Survey Data.

Coastal Relief Survey Data

Agency:	National Geographic Data Center (NGDC)	
Horizontal Datum:	World Geographic (Latitude-Longitude)	
Vertical Datum:	Mean Sea Level (meters)	
Survey Extents:	Latitude:	33° North to 37° North
	Longitude:	79° West to 75° West

Survey Description: U.S. Coastal Margin data spaced on a 3-arc second grid. Land elevations within the gridded dataset come from the United States Geological Survey/ National Image Mapping Agency (USGS/NIMA) 1:250,000 or 1° DEMs of the states. Soundings for each volume of the Coastal Relief model series are compiled from hydrographic surveys conducted by the National Ocean Service (NOS) and from various academic institutions. The surveys were carried out using a variety of sounding methods including SeaBeam 16-beam, 12-kHz swath mapping system (6000- >3000m operating water depths, General Instruments 17-beam, 36-kHz Hydrochart II swath mapping system (5-150m operating water depths), single-beam echosounder (e.g., 3.5 kHz narrow 2° beam), and lead-line sounding method. These latter surveys date as far back as the late 1800's. The vertical accuracy of the soundings is 0.3 m in 0 - 20 m of water, 1.0 m in 20 - 100 m of water, and 1% of the water depth in 100 m of water. The horizontal accuracy of the soundings is within a radius of 1.5 mm of the sounding location at the scale at which the soundings are recorded. NOS surveys are plotted at map scales that range from 1/10,000 for harbors and channels to 1/50,000 for open ocean surveys, with 1/20,000 being the most commonly used scale. The horizontal accuracy of the soundings is generally 30 m, but it can vary from as fine as 15 m in ports and estuaries to as coarse as 75 m in the offshore areas.

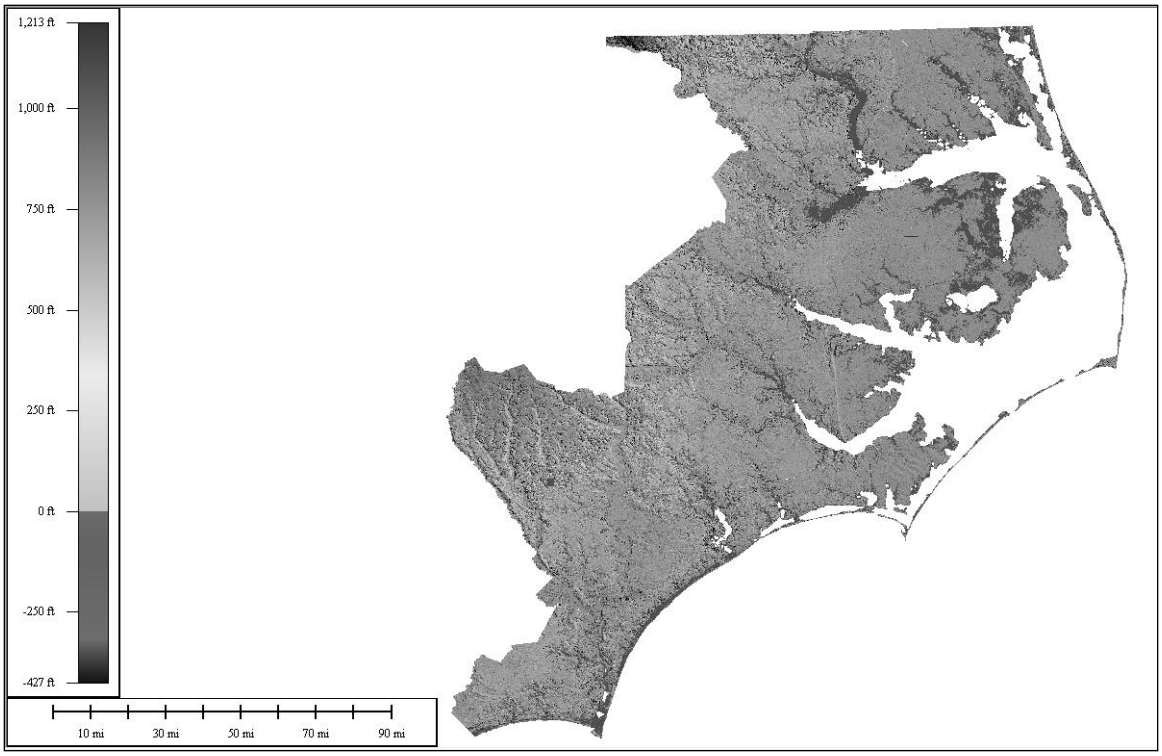

Figure A. 7 Coastal Relief Survey North Carolina.

USACE Condition Survey

Date Collected:	Varies (see Figure A.8 – Figure A.10)	
Agency:	U.S. Army Corps of Engineers (USACE) Jacksonville District	
Horizontal Datum:	State Plane, North Carolina, NAD83, ft	
Vertical Datum:	Mean Low Water (ft)	
Survey Extents:	Latitude:	Varies (see Figure A.8 – Figure A.10)
	Longitude:	Varies (see Figure A.8 – Figure A.10)

Survey Description: USACE condition surveys of federally authorized channels maintained by the Corps of Engineers http://www.saw.usace.army.mil/nav/ collected in accordance with USACE EM 1110-2-1003. The data are divided into eight categories; Atlantic Intracoastal Waterway (AIWW), Inlets and Crossings, Manteo and Oregon Inlet, Morehead City and Beaufort Harbor, River Projects, Side Channels, Small Harbors, and Wilmington Harbor. Figure A. 8 through Figure A. 10 present the locations of these surveys.

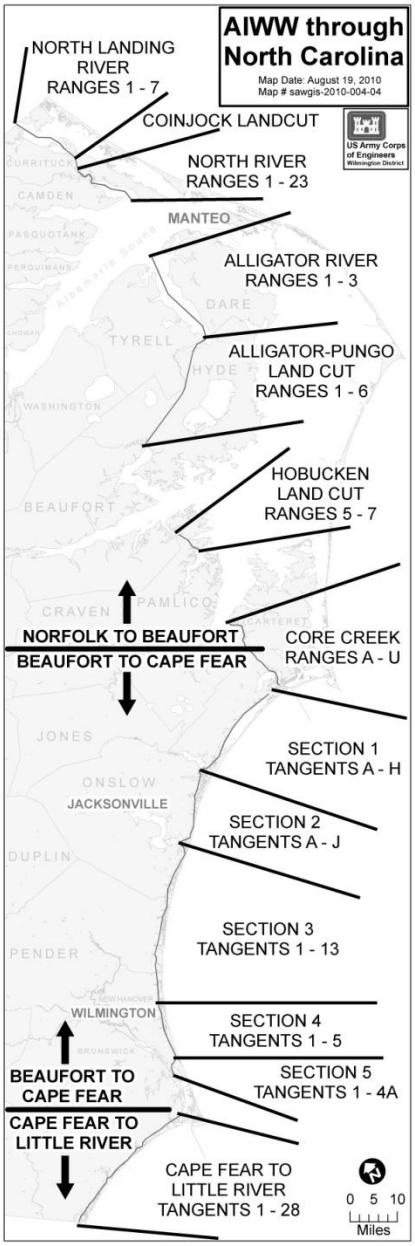

Figure A. 8 USACE AIWW Survey Locations.

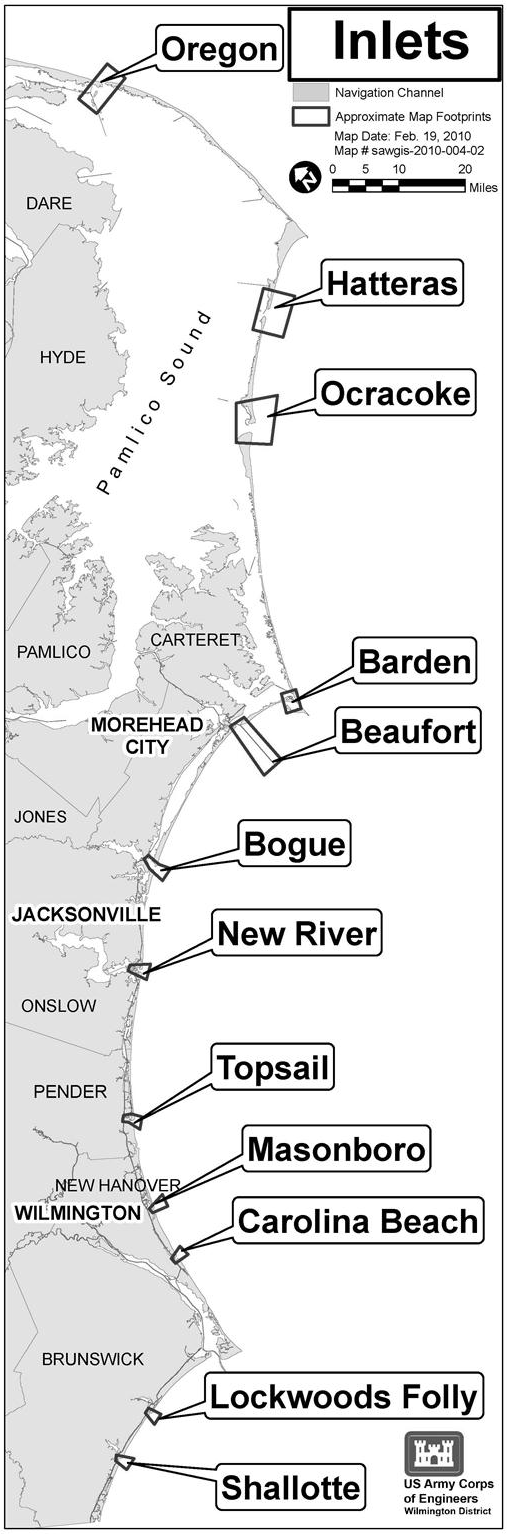

Figure A. 9 USACE Inlet Survey Locations.

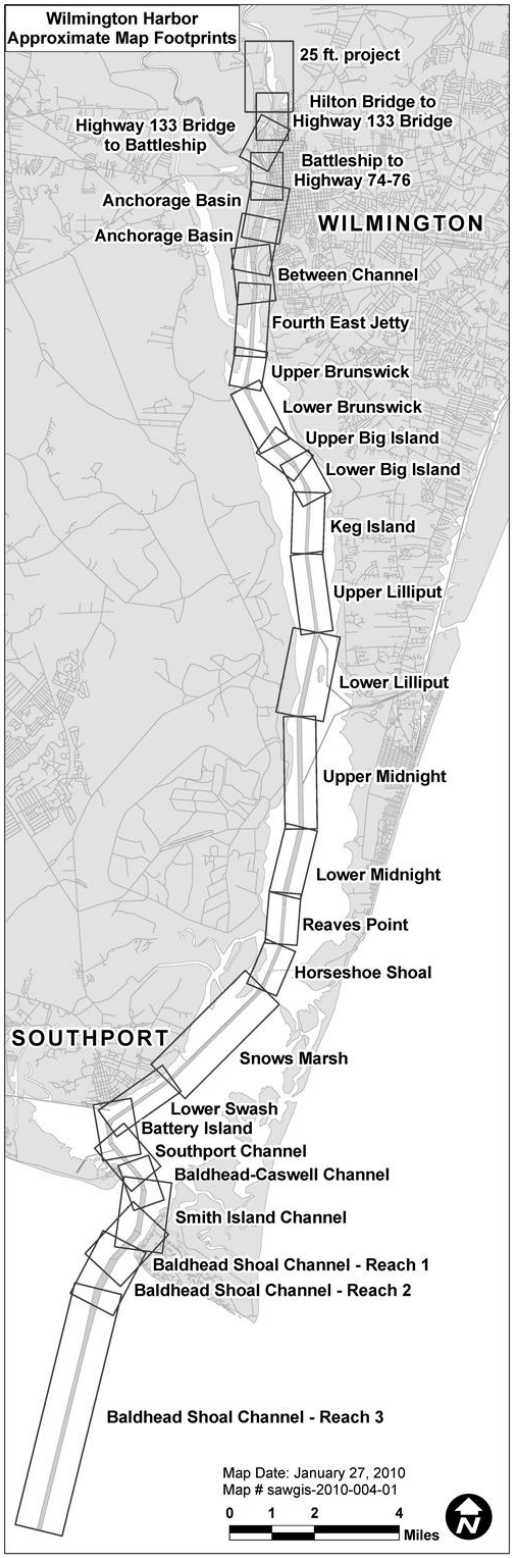

Figure A. 10 USACE Wilmington Survey Locations.

Appendix B Model Descriptions

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Introduction

As noted in the report, this study employed the latest hindcast technology, which uses the tightly coupled ADCIRC+SWAN model and hindcasted tropical storm and hurricane wind and pressure fields provided by Oceanweather, Inc. This appendix provides a more detailed description of ADCIRC and SWAN.

ADCIRC

The program ADCIRC (ADvanced CIRCulation Model for Coastal Ocean Hydrodynamics) simulated both the tidal circulation and the hurricane storm surges in the project area. ADCIRC is a numerical model developed specifically for generating long duration hydrodynamic circulation along shelves, coasts, and within estuaries. The intent of the model is to produce numerical simulations for very large computational domains in a unified and systematic manner. The collaboration of many researchers have led to the development of the ADCIRC model including investigators at the University of Notre Dame (J.J. Westerink), the University of North Carolina at Chapel Hill (R.A. Luettich), the University of Texas at Austin (M.F. Wheeler and C. Dawson), the University of Oklahoma (R. Kolar), the State of Texas (Jurji), and the Waterways Experiment Station (N. Scheffner) (Luettich and Westerink, 2000).

Both the U.S. Army and Navy have applied ADCIRC extensively for a wide range of tidal and hurricane storm surge predictions in regions including the western North Atlantic, Gulf of Mexico and Caribbean Sea, the Eastern Pacific Ocean, the North Sea, the Mediterranean Sea, the Persian Gulf, and the South China Sea. ADCIRC employs computational models of flow and transport in continental margin waters to predict free surface elevation and currents for a wide range of applications including evaluating coastal inundation, defining navigable depths and currents in near shore regions, to assessing pollutant and/or sediment movement on the continental shelf. An extensive list of publications describing the development and application of ADCIRC are available through the ADCIRC web site (http://adcirc.org/Related_publications.html).

ADCIRC is a robust computer program for solving the equations of motion for a moving fluid on a rotating earth. The equation formulation includes applying the traditional hydrostatic pressure and Boussinesq approximations and discretizing the equations in space via the finite element (FE) method and in time via the finite difference (FD) method. The ADCIRC program includes both a two-dimensional depth integrated (2DDI) mode and a three-dimensional (3D) mode. For both, the model solves for elevation via the depth-integrated continuity equation in Generalized Wave-Continuity Equation (GWCE) form. The model solves for velocity via either the 2DDI or 3D momentum equations. These equations retain all the nonlinear terms. ADCIRC includes solution capabilities in either a Cartesian or a spherical coordinate system.

ADCIRC solves the GWCE via either a consistent or a lumped mass matrix and an implicit or explicit time stepping scheme. If a lumped, fully explicit formulation is specified, no matrix solver is necessary. In all other cases, the GWCE is solved using the

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Jacobi preconditioned iterative solver from the ITPACKV 2D package. The 2DDI momentum equations are lumped and therefore require no matrix solver.

Possible boundary conditions for the model include specified elevation (harmonic tidal constituents or time series); specified boundary normal flow (harmonic tidal constituents or time series); zero boundary normal flow; slip or no slip conditions for velocity; external barrier overflow out of the domain; internal barrier overflow between sections of the domain; surface stress (wind and/or wave radiation stress); atmospheric pressure; or outward radiation of waves (Sommerfield condition). ADCIRC can be forced with: elevation boundary conditions, normal flow boundary conditions, surface stress (wind) boundary conditions, tidal potential,- or an earth load/self-attraction tide.

For this application the inputs to the ADCIRC model include a bathymetric/topographic unstructured mesh, hindcasted wind and pressure fields, tidal potentials, and wave radiation stresses from SWAN.

SWAN

The program SWAN (Simulating WAves Nearshore) was used to simulate wave heights and periods. SWAN, developed at the Delft University of Technology in the Netherlands, is a one-, and two-dimensional numerical model for estimating wave parameters in coastal areas, lakes and estuaries from given wind, bathymetric, and current conditions. The model is based on the wave action balance equation with sources and sinks (Holthuijsen et al., 2003). The wave propagation processes represented in SWAN include propagation through geographic space, refraction due to spatial variations in bottom and current, shoaling due to spatial variations in bottom and current, blocking and reflections by opposing currents, and transmission through, blockage by or reflection from obstacles. Wave generation and dissipation processes represented in SWAN include generation by wind, dissipation by white-capping, dissipation by depth-induced wave breaking, dissipation by bottom friction, and wave-wave interactions (quadruplets and triads). The model contains both stationary and non-stationary operational modes formulated for Cartesian, curvilinear, or spherical coordinate systems.

The inputs to the SWAN model include a bathymetric/topographic unstructured mesh, hindcasted wind field, water surface elevation, and currents from ADCIRC.

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Appendix C Model Calibration Details

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Introduction

Model calibration involves an iterative process of adjusting model parameters until the model results at set locations match measured data at those locations. Once calibrated, the model is verified by comparing model results to measured data for additional events to verify they meet established criteria. Three types of measured data were collected for the calibration: water surface elevation (WSE) data, hurricane high water marks, and wave data. The following paragraphs describe the data type, limitations of the data, and the spatial coverage.

Figure C. 1 presents the location of the NOAA tidal stations. One of the gages (8561370) is located in the Atlantic Ocean on the pier at the USCOE research facility in Duck. The other three are located in interior waters – (8652587) at the marina just inside the Oregon Inlet, (8656483) in the Beaufort Channel near Beaufort, and (8658120) in the Cape Fear River near Wilmington. Two sets of data are provided — measured and predicted. The measured data is the actual water surface elevation fluctuations at the gage location and includes effects of meteorological events. Conversely, the predicted data is a prediction created from tidal constituents and is based only on astronomical influences. Figure C. 2 presents an example of the NOAA gage data during the passing of Hurricane Isabel. In the figure, the gray line presents the predicted tide and the dashed black line presents the observed water surface elevation. As the figure illustrates, the predicted and observed water surface elevations do not always agree. The differences between the two results from wave setup and wind setup/set down, which are not included in NOAA's predictions.

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Figure C. 1 Location of NOAA Tide Stations in North Carolina.

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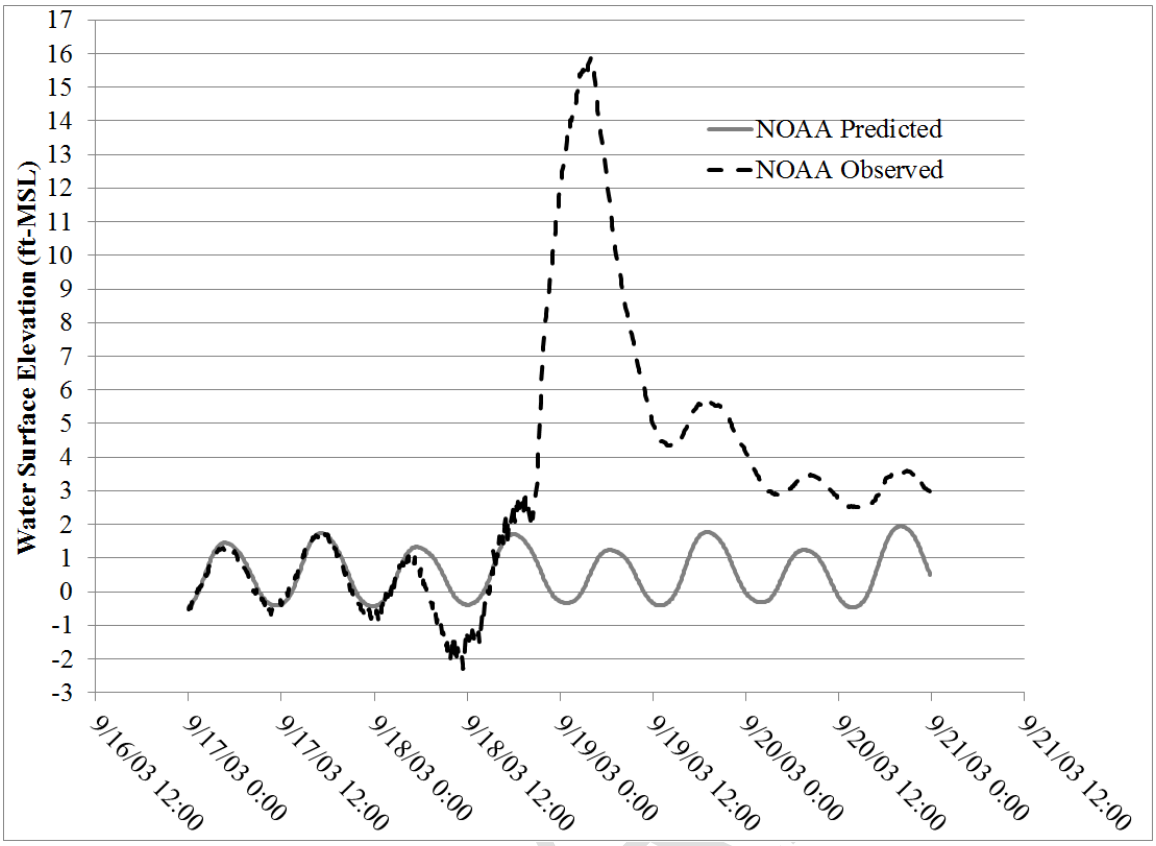

Figure C. 2 NOAA Gage 8652587 Historical Water Surface Data Recorded During Hurricane Isabel.

Hurricane high water marks represent the elevations of debris lines left by the hurricane storm surge. Debris lines found inside buildings or protected areas generally represent the peak still water elevation at that location during the storm. Debris lines found in open areas are deposited by either the peak still water, waves riding on the still water, or wave run-up. Figure C. 3 and Figure C. 4 present the location of the hurricane high water marks for Hurricanes Fran, Bonnie, and Isabel collected by various governmental organizations (FEMA, NOAA, USGS). Figure C. 3 presents the hurricane high water marks found in protected areas and generally represent the peak still water elevations. While Figure C. 4 presents the hurricane high water marks found in open areas and may represent the elevation of the peak still water, the elevation of waves riding on the still water, or the peak elevation of the wave run-up. Since the source of high water marks produced in open areas is uncertain, the calibration will focus on the still water high water mark data presented in Figure C. 3. As Figure C. 3 illustrates, the spatial coverage provides calibration points throughout the state

The following method was used to quantify the difference between model and measured values. The first equation provides an estimate of the mean error, E, the average of the deviation of the calculated from the measured values:

$$E = \frac{\sum_{i=1}^{N} (\chi_c - \chi_m)_i}{N}$$

where χ_c is the calculated value, χ_m is the measured value, and N is the total number of data points. A positive mean error indicates that the model overestimates the value, while a negative mean error indicates the model underestimates the measured value.

The root-mean square error, E_{rms}, given by the following equation, is a measure of the absolute value of the error. The variables are the same as in the previous equation.

$$E_{rms} = \sqrt{\frac{\sum_{i=1}^{N} (\chi_c - \chi_m)_i^2}{N}}$$

The final error estimator, E_{pct}, is the percent error. This parameter gives an indication of the degree to which the calculated values misrepresent the measured values. The percent error, in terms of rms error, is defined as:

$$E_{pct} = \frac{E_{rms}}{R}$$

where R is a representative range of the variable χ. The R-value for the wave and period calculations equals the maximum value measured during the comparison period. .

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Figure C. 3 Stillwater Hurricane High Water Marks.

Figure C. 4 Hurricane High Water Marks including Wave Run-up.

ADCIRC Model Calibration

The ADCIRC calibration includes the adjustment of model friction and lateral eddy viscosity until modeled water surface elevations match measured values within acceptable limits. FEMA (2007) defines this limit as 10% or less for tidal calibrations. For storm surge verifications, FEMA acknowledges the complexity associated with measurements during storms. Based on the complexity, FEMA notes that the acceptable error range exceeds that under normal tidal calibrations. The maximum error accepted in this study was 9% for the calibration and 22% for the verification.

Five events were used in the calibration of the storm surge/tidal circulation model (ADCIRC). The first event is a month of tides from July 17 to August 16, 2001. The remaining four events verify the calibrated model by comparing modeled and measured water surface elevations and modeled and measured high water elevations during Hurricanes Fran (1996), Bonnie (1998), Floyd (1999), and Isabel (2003).

The astronomical tide calibration focuses on the four tide gages distributed evenly along the North Carolina Coast, the locations of which are shown in Figure C. 5 and Figure C. 6. Figure C. 7 presents a comparison of the observed (NOAA) and simulated (ADCIRC) water surface elevations at NOAA Gage 8652587 during the entire length of the tide simulation. In the figure, the dashed black line represents the water surface elevation at the gage location predicted by ADCIRC and the solid gray line represents the measured water surface elevation at the gage. There are many instances where the two lines coincide, indicating good agreement between the modeled and measured data. Conversely, there are instances where the model either over predicts or under predicts the measured data. The instances where the model and measurement differ are primarily due to wind set up and set down. Although the observations from the gage include effects of wind, budget and time-constraints preclude the inclusion of wind in the model for the calibration procedure. That said, NOAA provides the predicted tides, which are derived from a network of tide gages, measuring stations and automated buoys up and down the U.S. coastline. The predicted tides only include the astronomical components. They do not include meteorological effects such as wind, rain, freshwater runoff and other short-term meteorological events. Figure C. 8 presents a comparison of the NOAA predicted (solid black line) and observed (solid gray line) water surface elevations along with a short portion (July 28, 2010 to July 30, 2010) of the modeled (dashed black line) water surface elevations. In the figure, the ADCIRC and NOAA predicted agree well while the NOAA observed only agrees for a small portion of time. The disagreement between ADCIRC/NOAA predicted and NOAA observed is due to wind set down occurring on July 28th and wind set up on July 30th. Similarly, the comparisons presented in Figure C. 9 for NOAA gage 8651370 shows wind effects on the open coast. The remainder of the NOAA gages, presented in Figure C. 10 and Figure C. 11, are on smaller waterways (8656483 and 8658120) where local wind set up/set down is not as significant.

Table C. 1 and Table C. 2 present a summary of the statistics from the calibration for the observed and predicted data for each gage. These tables further demonstrate the effect of wind on the comparison between the measured WSE and the predicted WSE. For

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example, the average error for the comparison between ADCIRC predicted and NOAA predicted at NOAA station 8652587 is less than half (7%) the difference between ADCIRC predicted and NOAA measured (16%). As Table C. 2 illustrates, for astronomical tides the model reproduced the NOAA predicted water surface elevations within FEMA's acceptable error range. This demonstrates the models ability to reproduce water surface elevations during astronomical tides. The meteorological effects (atmospheric pressure and wind speed and direction) are, of course, included in all of the hindcasts.

Figure C. 5 Northern North Carolina NOAA Gages.

Figure C. 6 Southern North Carolina NOAA Gages.

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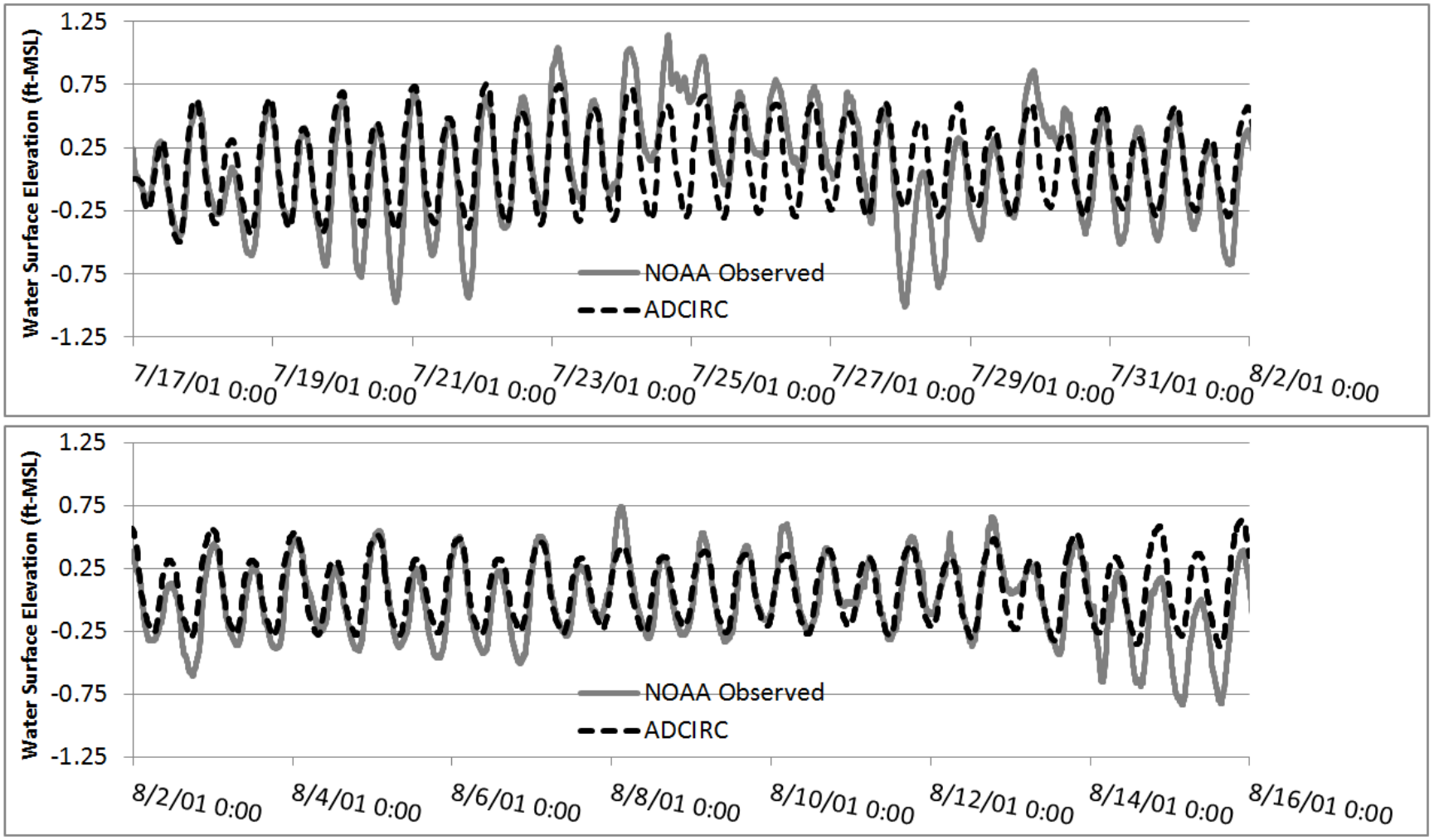

Figure C. 7 30 day Calibration Comparison Modeled versus Observed at NOAA Gage 8652587.

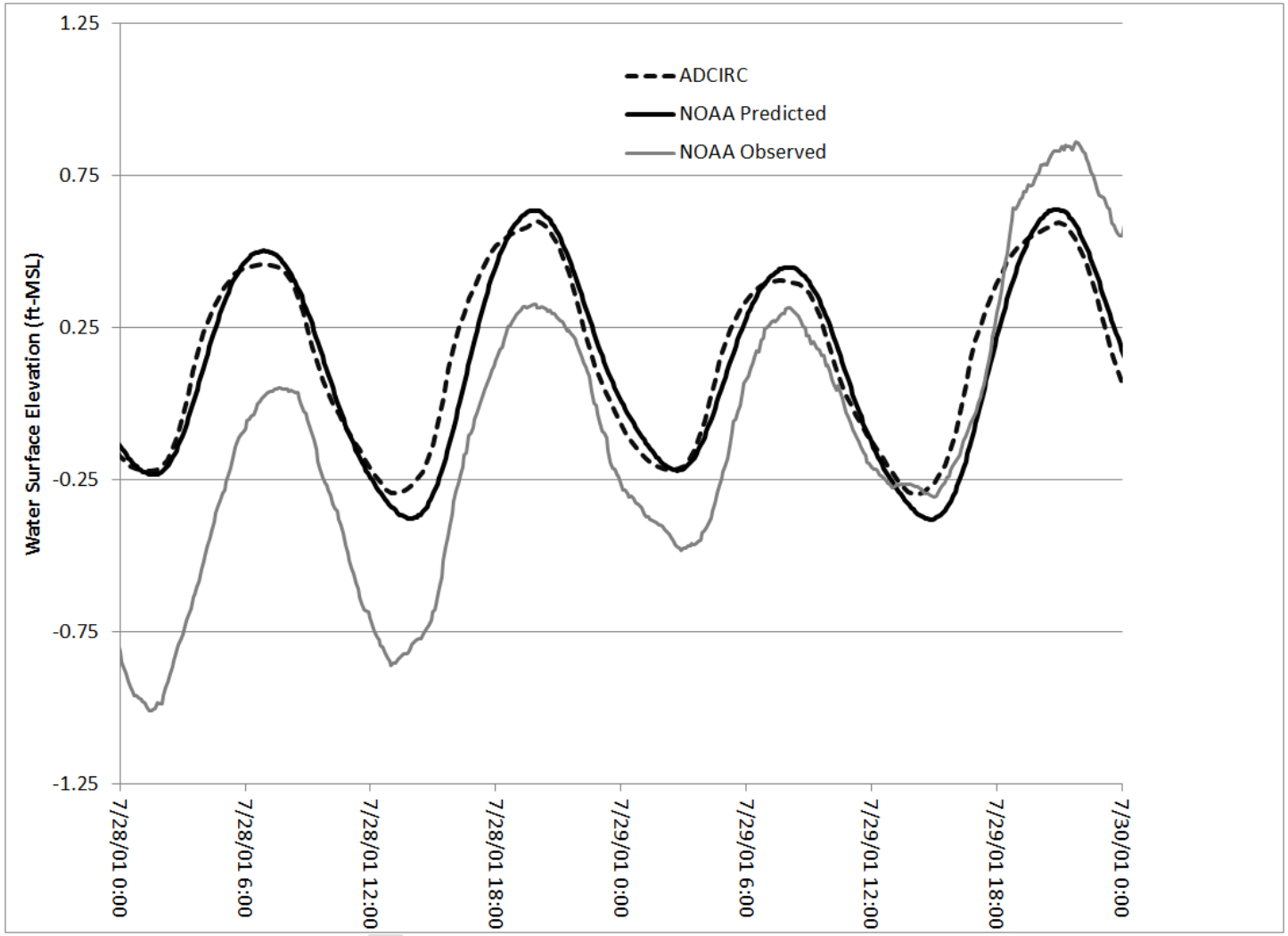

Figure C. 8 ADCIRC, NOAA Observed, and NOAA Predicted Comparisons at NOAA Gage 8652587.

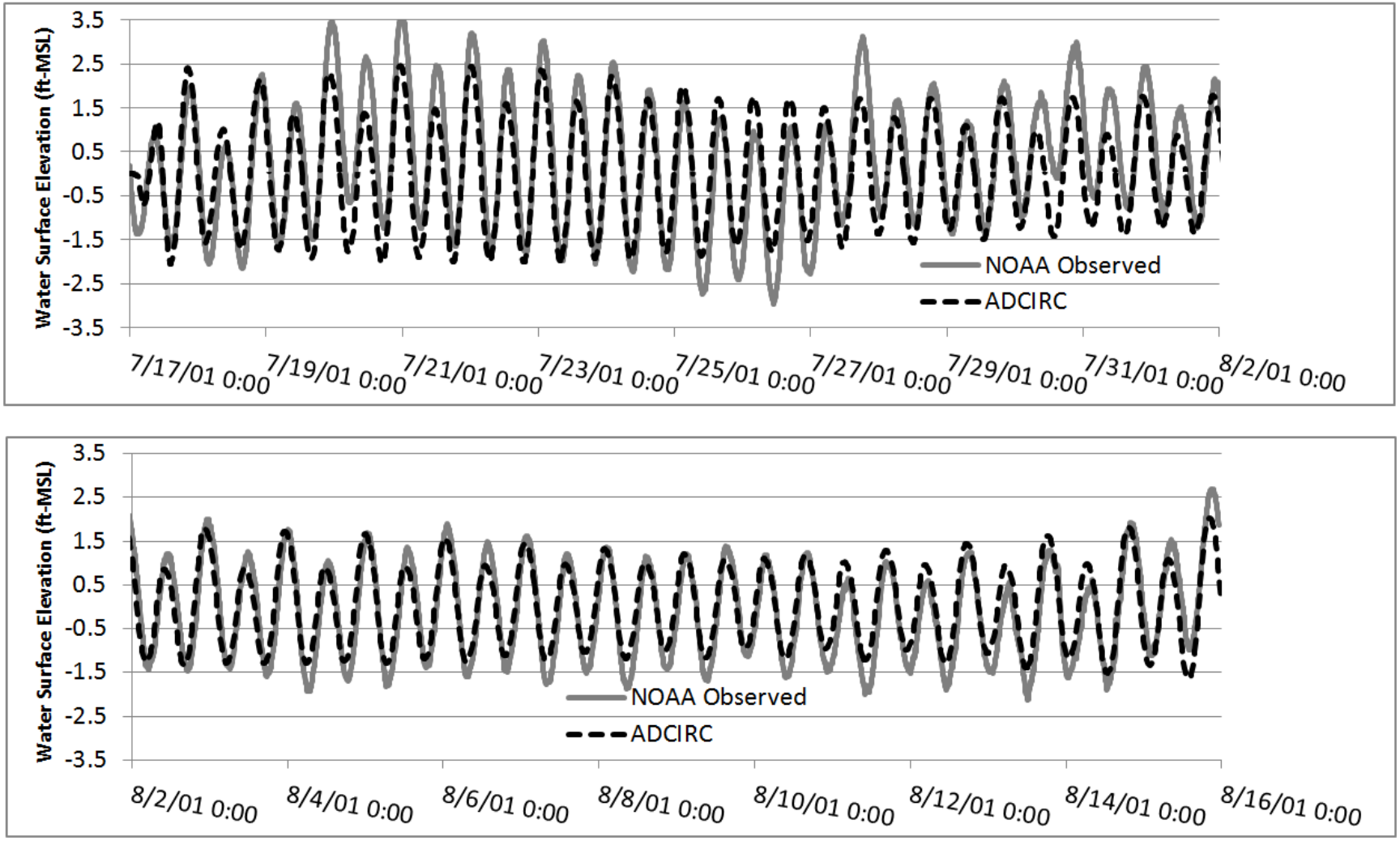

Figure C. 9 30 day Calibration Comparison Modeled versus Observed at NOAA Gage 8651370.

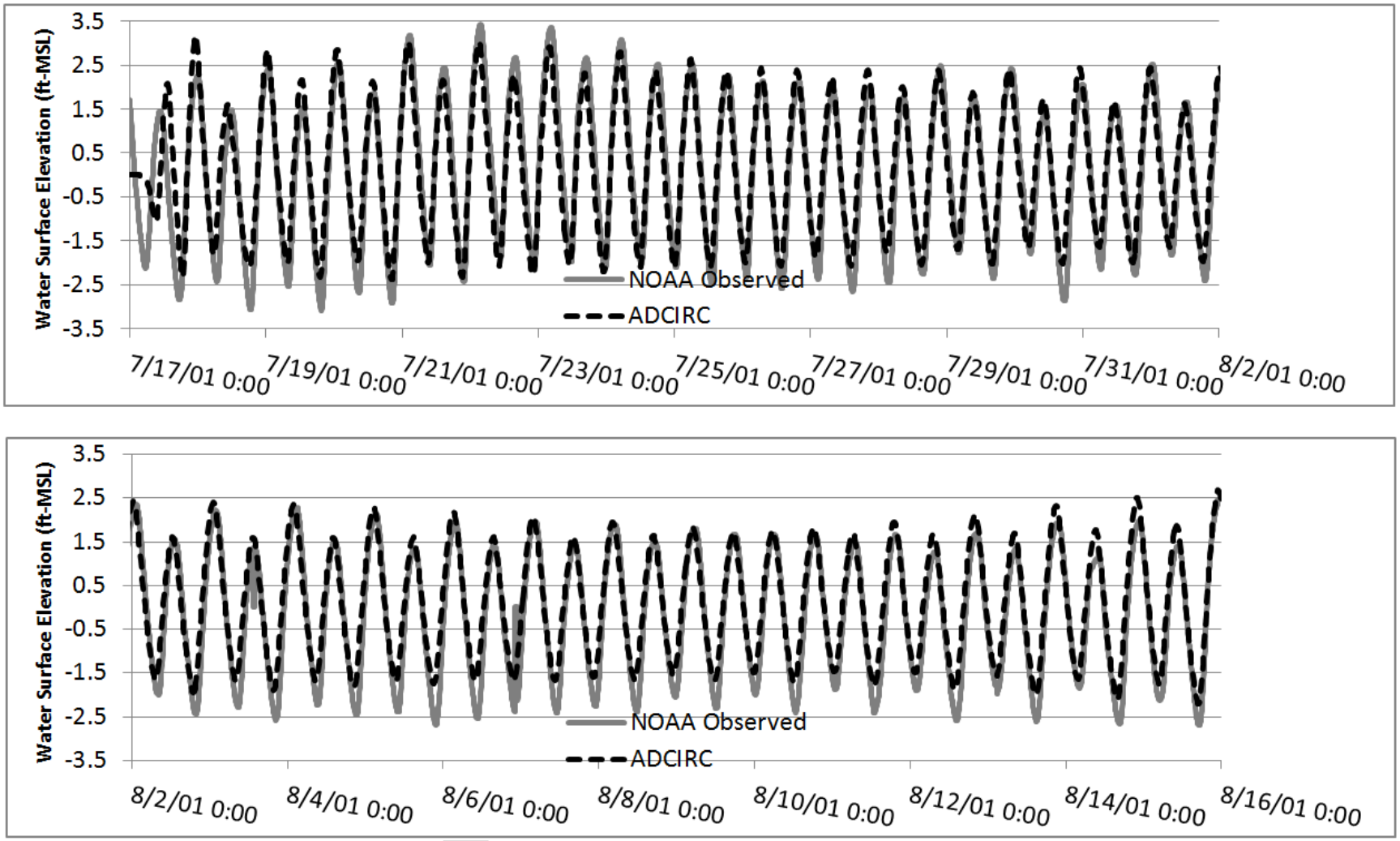

Figure C. 10 30 day Calibration Comparison Modeled versus Observed at NOAA Gage 8658120.

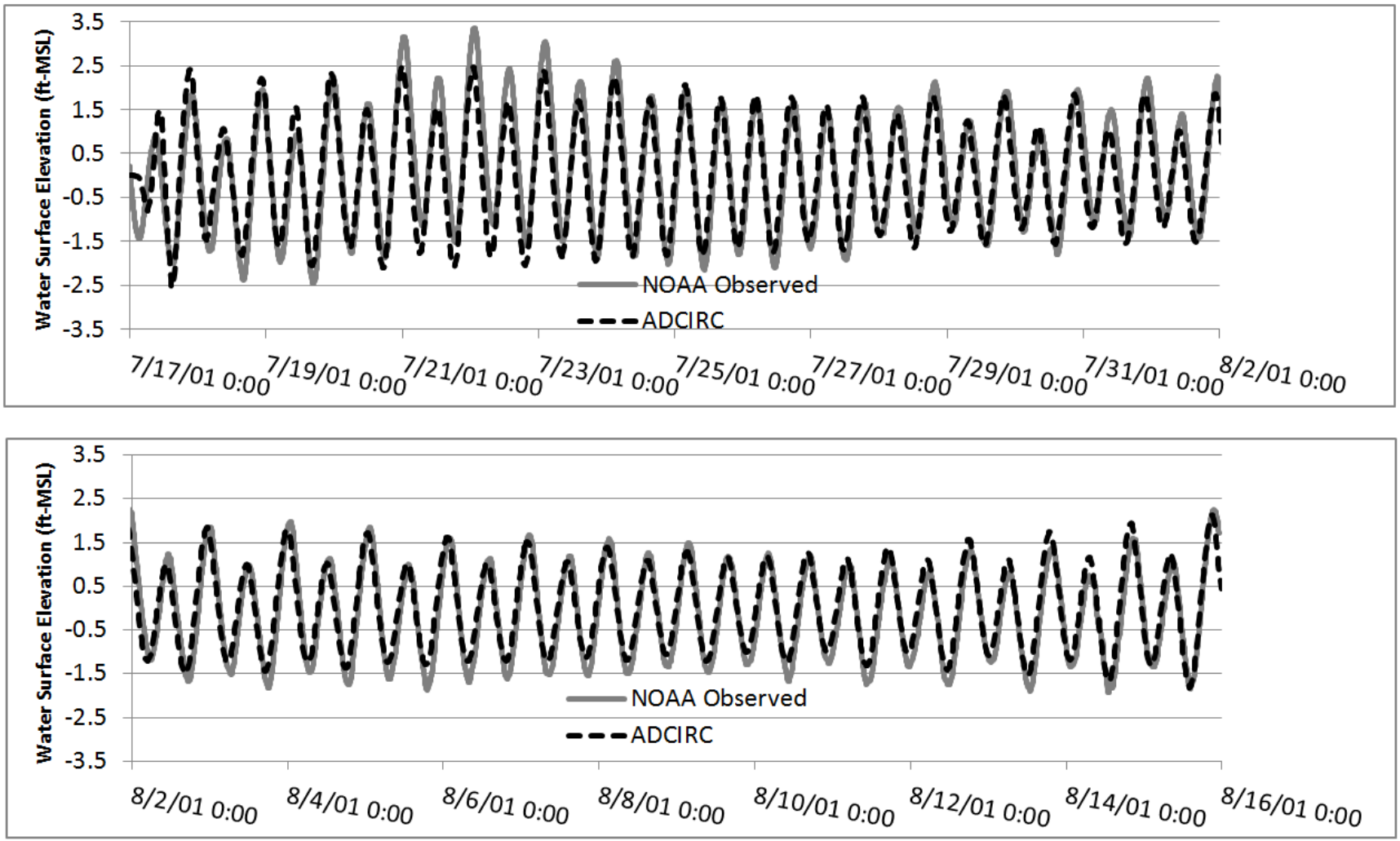

Figure C. 11 30 day Calibration Comparison Modeled versus Observed at NOAA Gage 8656483.

Table C. 1 ADCIRC Tidal Calibration Summary for NOAA Observed Tides.

Gage	Mean Error (ft)	RMSE (ft)	Average % Error
8652587	-0.06	0.25	16%
8651370	0.06	0.64	13%
8658120	-0.18	0.55	10%
8656483	-0.01	0.48	10%

Table C. 2 ADCIRC Tidal Calibration Summary for NOAA Predicted Tides.

Gage	Mean Error (ft)	RMSE (ft)	Average % Error
8652587	-0.01	0.11	7%
8651370	0.03	0.39	8%
8658120	-0.24	0.49	9%
8656483	0.05	0.39	8%

The next section demonstrates the ADCIRC models ability to reproduce water surface elevation fluctuations caused by meteorological events (hurricanes and tropical storms). For these comparisons, four hurricanes occurring between 1996 and 2003 were used. Figure C. 12 - Figure C. 15 present the results of the hurricane verification simulations. In the figure, the dashed black line represents the water surface elevation at the gage location predicted by ADCIRC and the solid gray line represents the measured water surface elevation at the gage. As the figures illustrate in most cases the ADCIRC model results agree well with the observations. There are however a few discrepancies. The differences are likely a result of changes to the bathymetry over the years. For example, the model bathymetry is based on the latest data available, much of which was collected within the past few years, some as recently as 2011 (USACE Surveys). By contrast, the hurricanes occurred as long as 15 years ago. Considerable bathymetric changes can occur in 15 years, which can easily account for the over/under predictions. Ideally, one would calibrate the storm with the exact bathymetry that was present at the time of the hurricane of interest. Unfortunately, this is not feasible due to a lack of survey data. Differences can also result from local bathymetric/topographic changes at the gage location. NOAA gages are usually located in marinas, which are commonly renovated/modified over time (i.e. seawalls are constructed or removed, new slip areas are added, etc.). The addition or removal of a seawall or the enlargement of a marina can change the local peak hurricane surge. For gages located well inland, differences are likely a function of over predicting wind speed. For example, ADCIRC predictions at NOAA gage 8658120 exceed the NOAA observation at the peak of the storm. This is a function of the location of the station — located almost nine miles from the coast in the Cape Fear River near Wilmington. As the hurricanes move inland, friction from vegetation and buildings

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reduces the wind speed near the surface. The wind and pressure model does not adjust for friction overland. This is to insure that the results have a conservative bias. Even with the possible variations in the site conditions, the model results generally agreed with the measured results. Table C. 3 summarizes results of the hurricane verifications. As the table demonstrates, ADCIRC predicts water surface elevations well within FEMA's tolerance for Hurricane verification with average mean errors of 12% or less for the most recently occurring event (Hurricane Isabel 2003).

As noted above, there is significant high water mark data available as can be seen in Figure C. 3 and Figure C. 4. The ADCIRC results were also compared to high water marks collected after the passage of hurricanes Isabel, Fran, and Bonnie. Figure C. 16 presents the location of the high water marks for the three storms. Figure C. 17 presents a comparison between the ADCIRC predicted peak still water elevation and the high water marks for the three storms. In the figure, the x-axis is measured and the y-axis predicted water elevations. The black diamonds represent the values at specific locations where measurements were made. The solid black line represents perfect agreement. Values above this line indicate over-prediction and those under the line under-prediction. In general, the model predicts slightly higher water surface elevations than measured.

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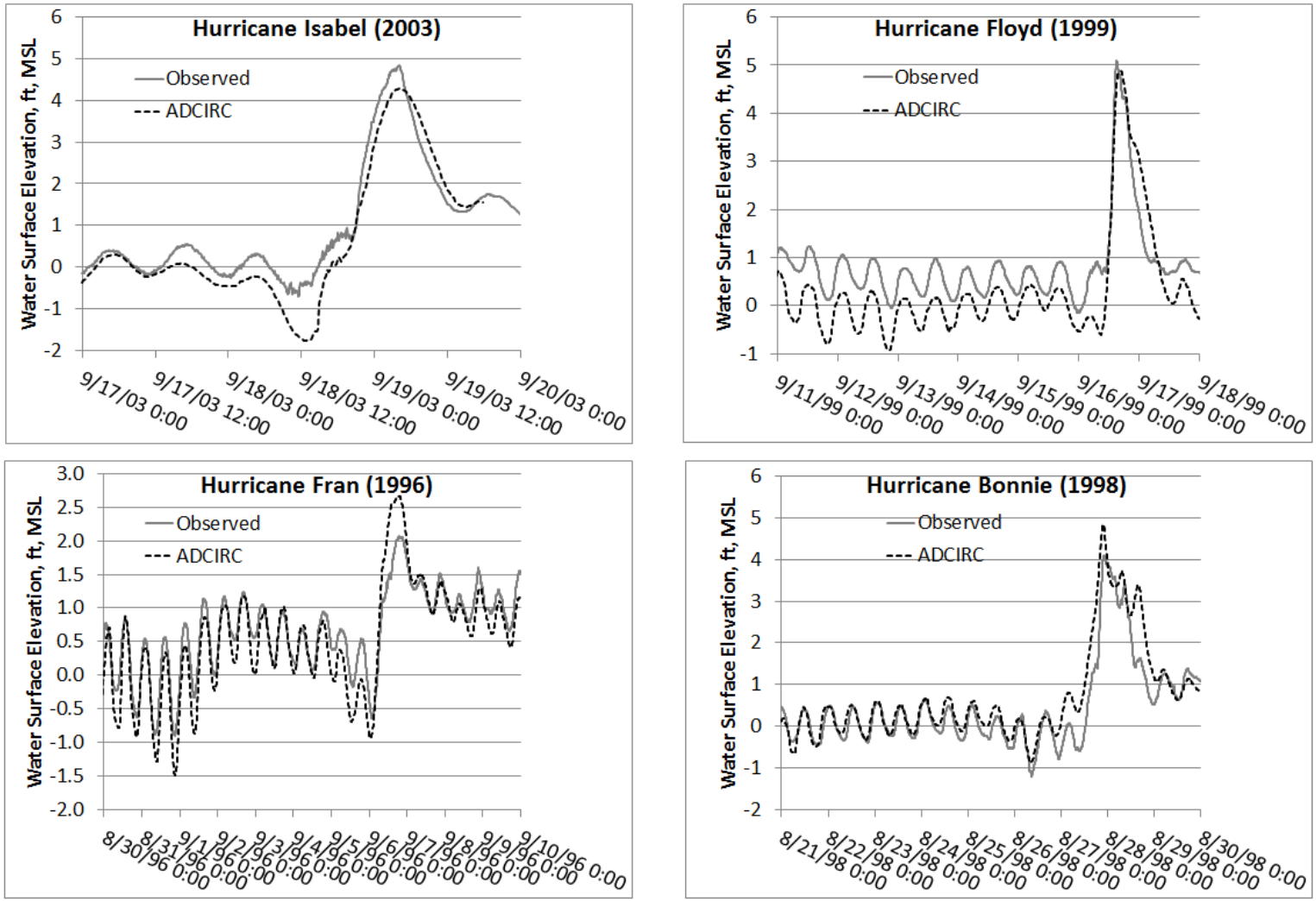

Figure C. 12 Hurricane Calibration Comparison Modeled versus Observed at NOAA Gage 8652587.

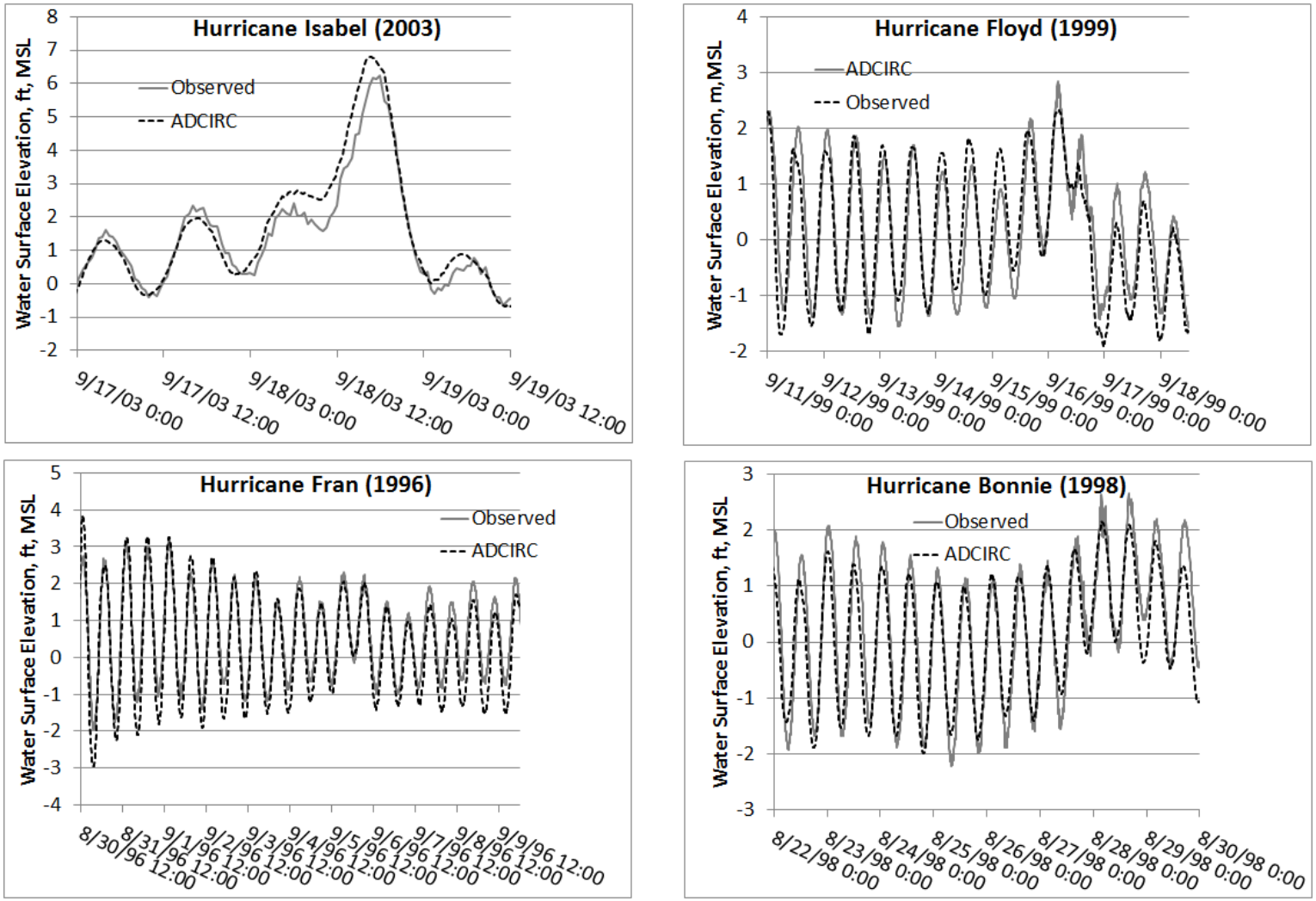

Figure C. 13 Hurricane Calibration Comparison Modeled versus Observed at NOAA Gage 8651370.

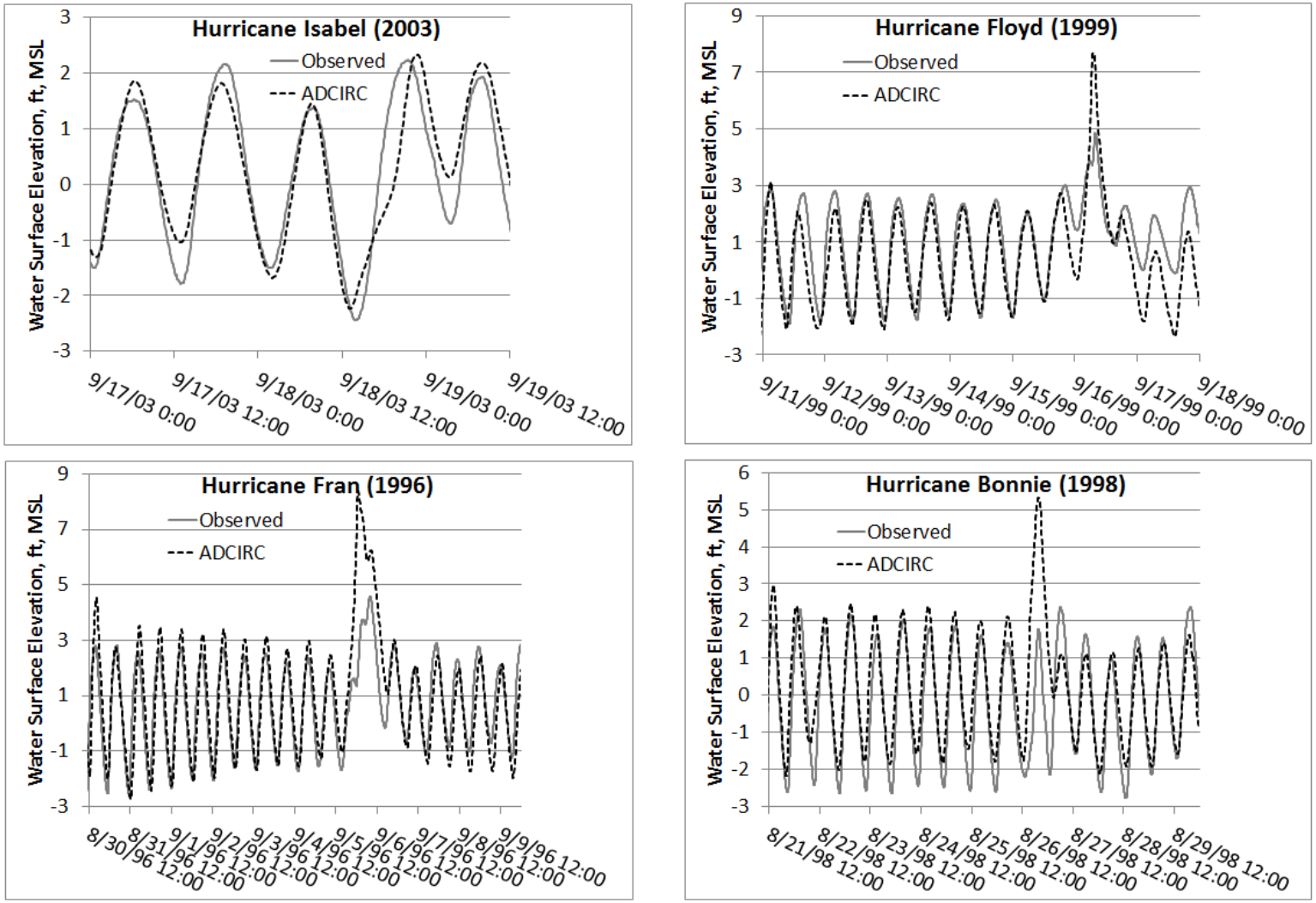

Figure C. 14 Hurricane Calibration Comparison Modeled versus Observed at NOAA Gage 8658120.

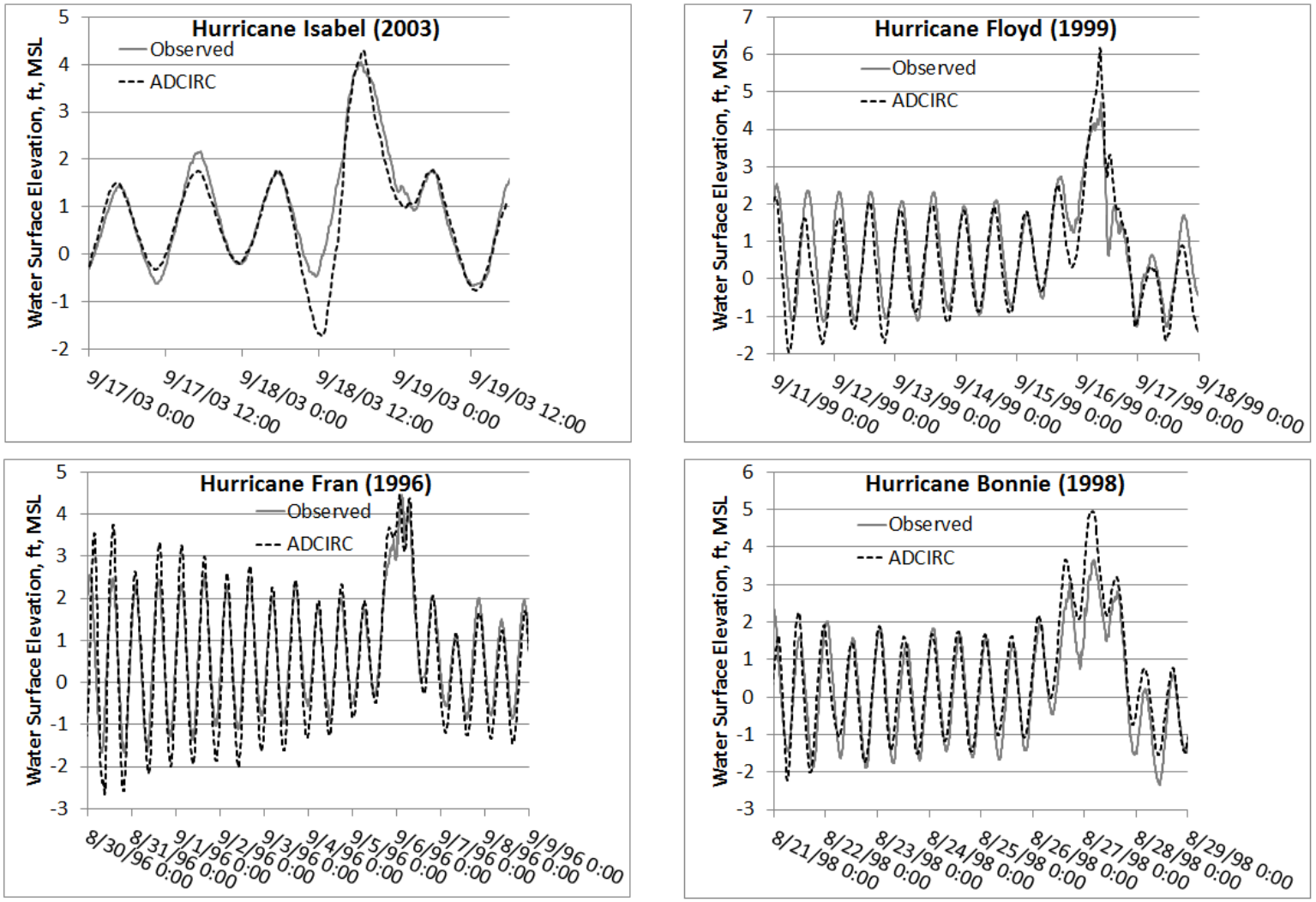

Figure C. 15 Hurricane Calibration Comparison Modeled versus Observed at NOAA Gage 8656483.

Table C. 3 ADCIRC Verification Results

Hurricane Isabel			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
8652587	0.31	0.55	10%
8651370	0.27	0.66	10%
8658120	-0.06	0.55	12%
8656483	0.15	0.43	9%

Hurricane Floyd			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
8652587	0.56	0.71	14%
8651370	0.10	0.58	12%
8658120	0.29	0.92	13%
8656483	0.30	0.69	11%

Hurricane Fran			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
8652587	0.13	0.36	12%
8651370	0.17	0.51	10%
8658120	-0.51	1.29	17%
8656483	0.04	0.55	8%

Hurricane Bonnie			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
8652587	-0.25	0.49	9%
8651370	0.15	0.53	11%
8658120	-0.42	1.11	22%
8656483	-0.20	0.65	11%

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Figure C. 16 Location of Hurricane High Water Marks for Hurricanes Isabel, Fran, and Bonnie.

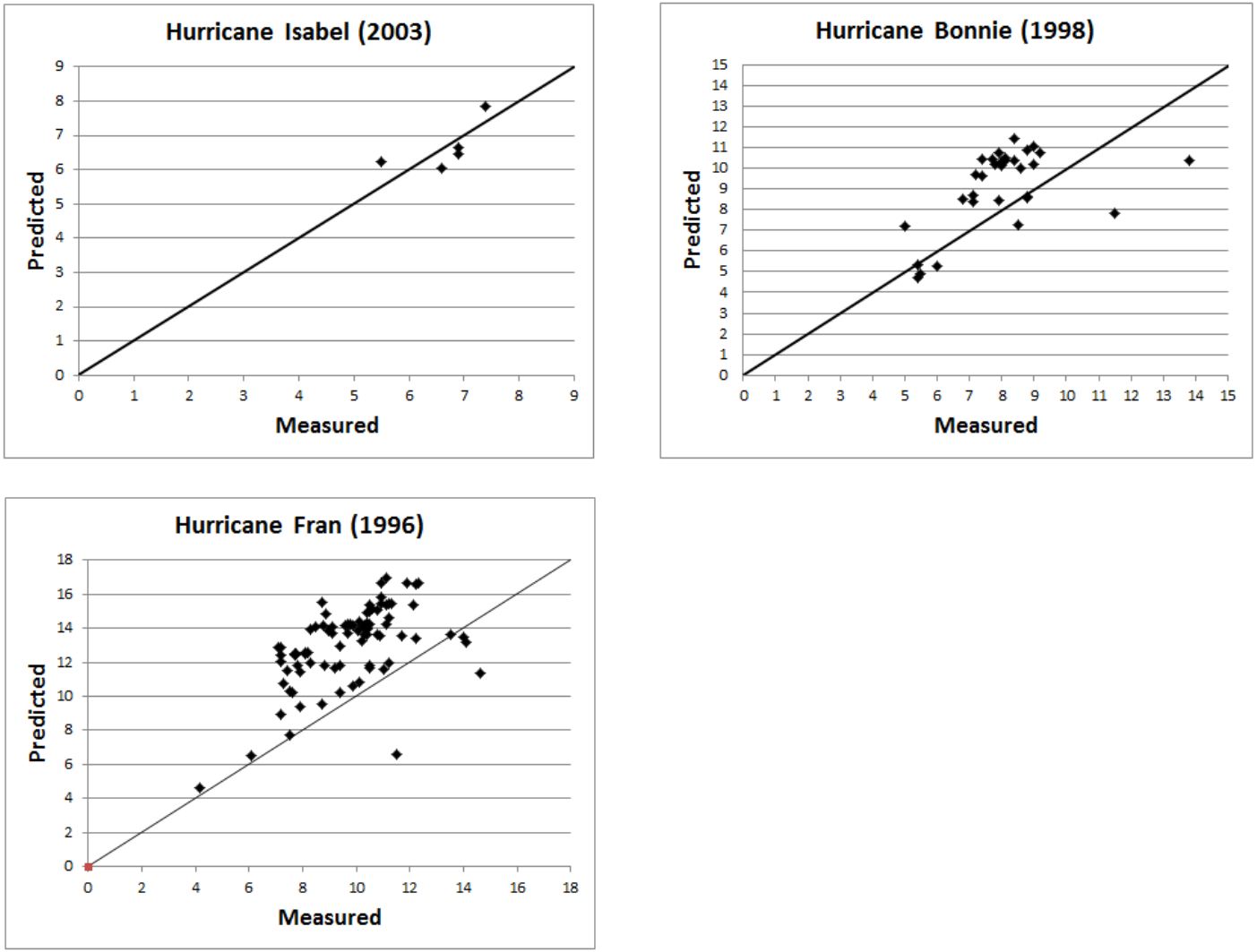

Figure C. 17 High Water Mark Predicted versus Measured Plots for hurricanes Isabel, Bonnie and Fran.

SWAN Model Calibration

Calibration of the SWAN model focused on the four National Data Buoy Center (NDBC) wave stations, the locations of which are shown in Figure C. 18. Figure C. 19 through Figure C. 22 present comparisons between SWAN predicted and NDBC measured significant wave heights at the four NDBC stations. Significant wave height is the average height of the one-third highest waves in a 20 minute wave record. Qualitatively, the model did a good job of predicting significant wave height. That said, there are some deviations, particularly in the days leading up to the storm. This is likely due to the presence of very small waves and the difficulty of predicting both meteorology and wave climate during times of relative quiescence. Table C. 4 presents a summary of the results. Positive values indicate over prediction of wave height and negative values under prediction. The average percent error ranged from a low of +5% to a high of +23% and an average of +10%. SWAN results consistently compared better with the observations at the near shore — gage FPSN7. This is due to the higher mesh resolution in the near shore region. Notably the mesh resolution is highest near the bridges, so one would expect better results in these areas. Given the low errors and the slight tendency to over predict, the calibration was deemed within acceptable bounds and as such, the wave model was considered calibrated.

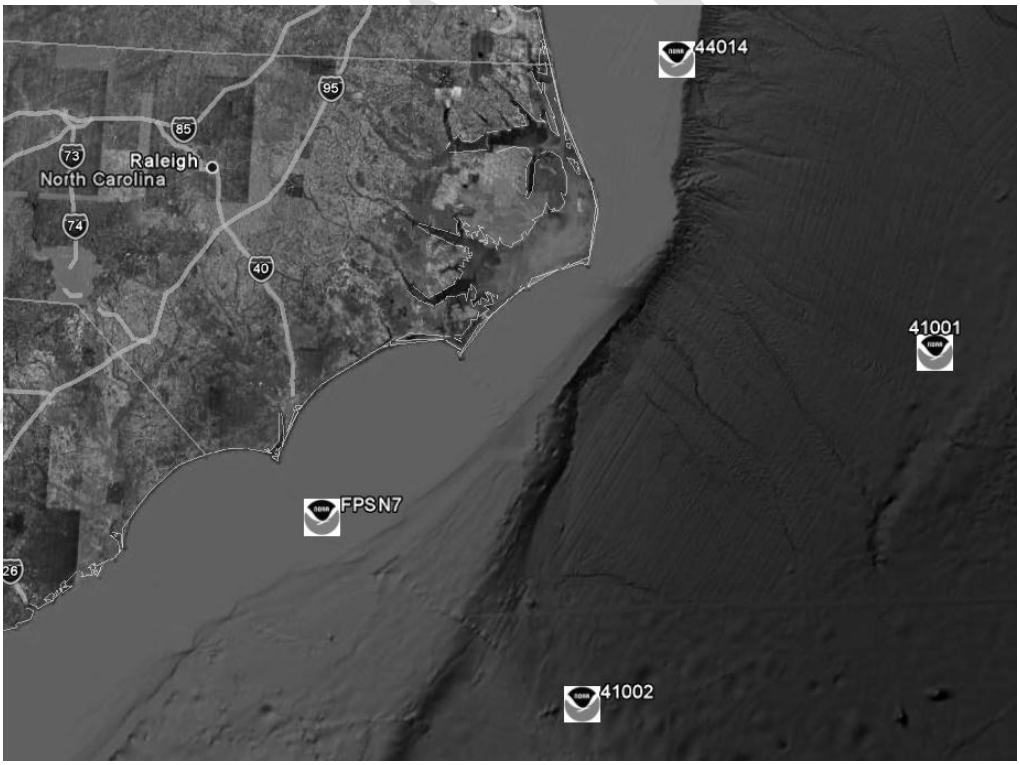

Figure C. 18 NOAA NDBC Wave Station Locations.

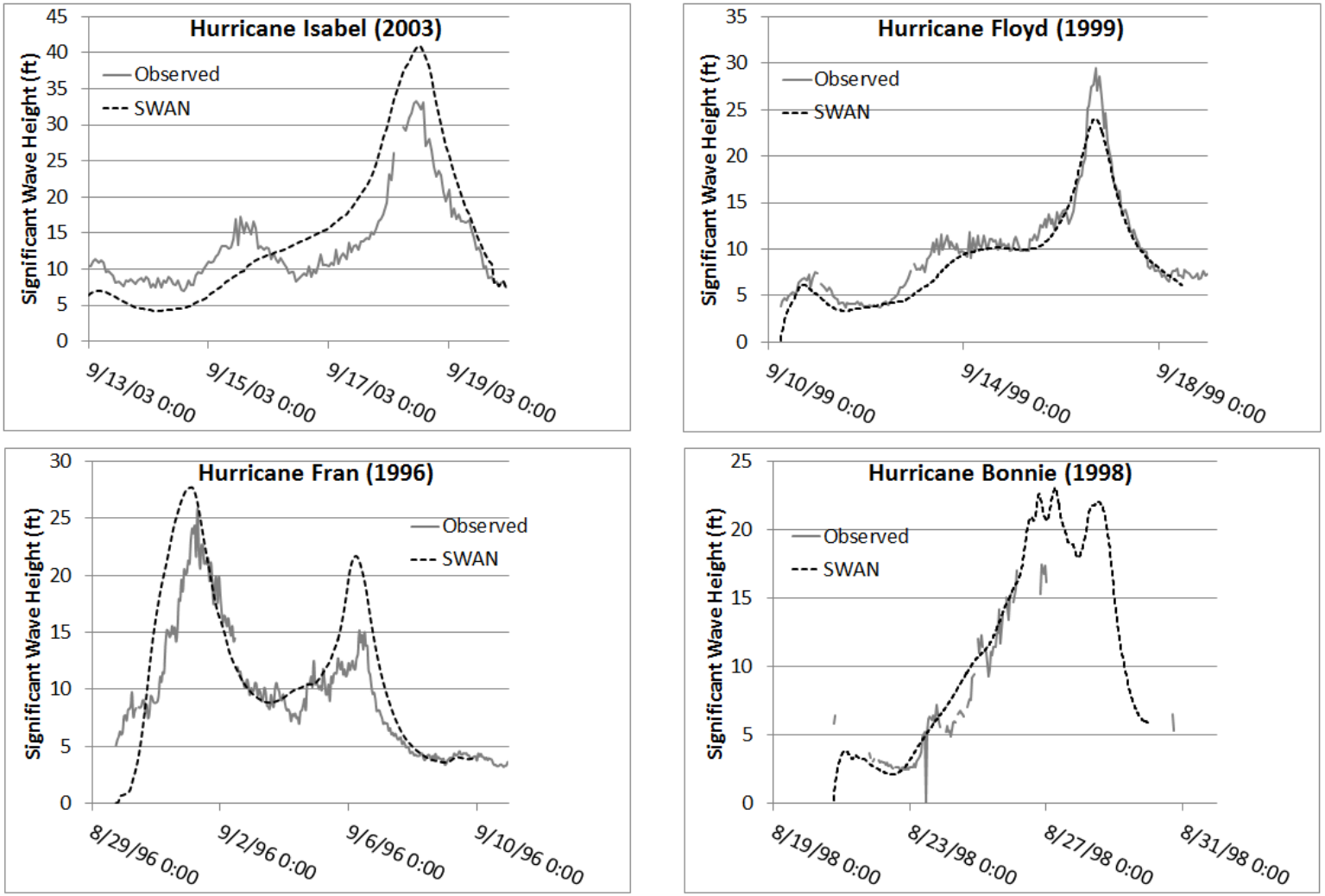

Figure C. 19 Hurricane Calibration Comparison Modeled versus Observed at NOAA NDBC Station 41001.

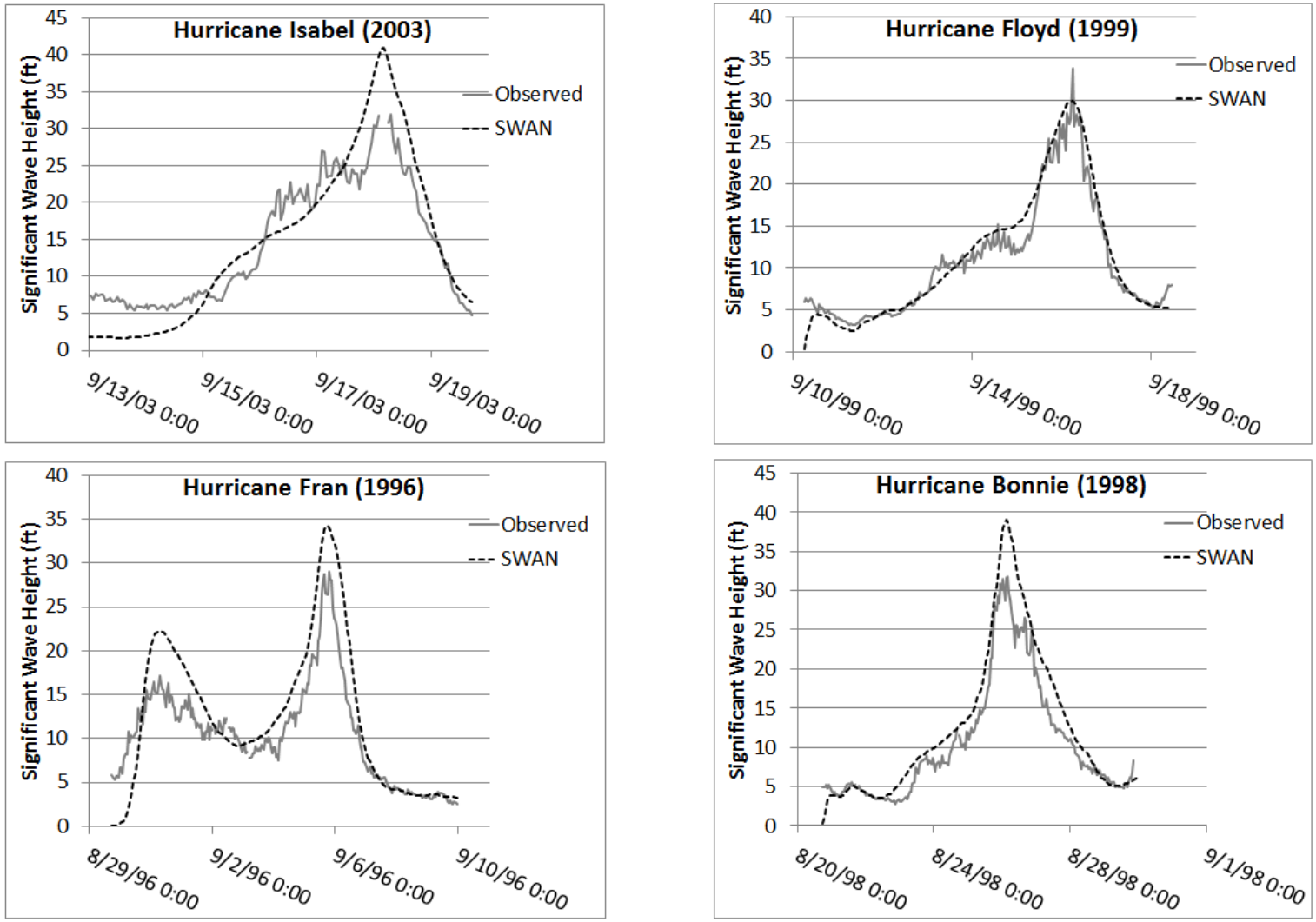

Figure C. 20 Hurricane Calibration Comparison Modeled versus Observed at NOAA NDBC Station 41002.

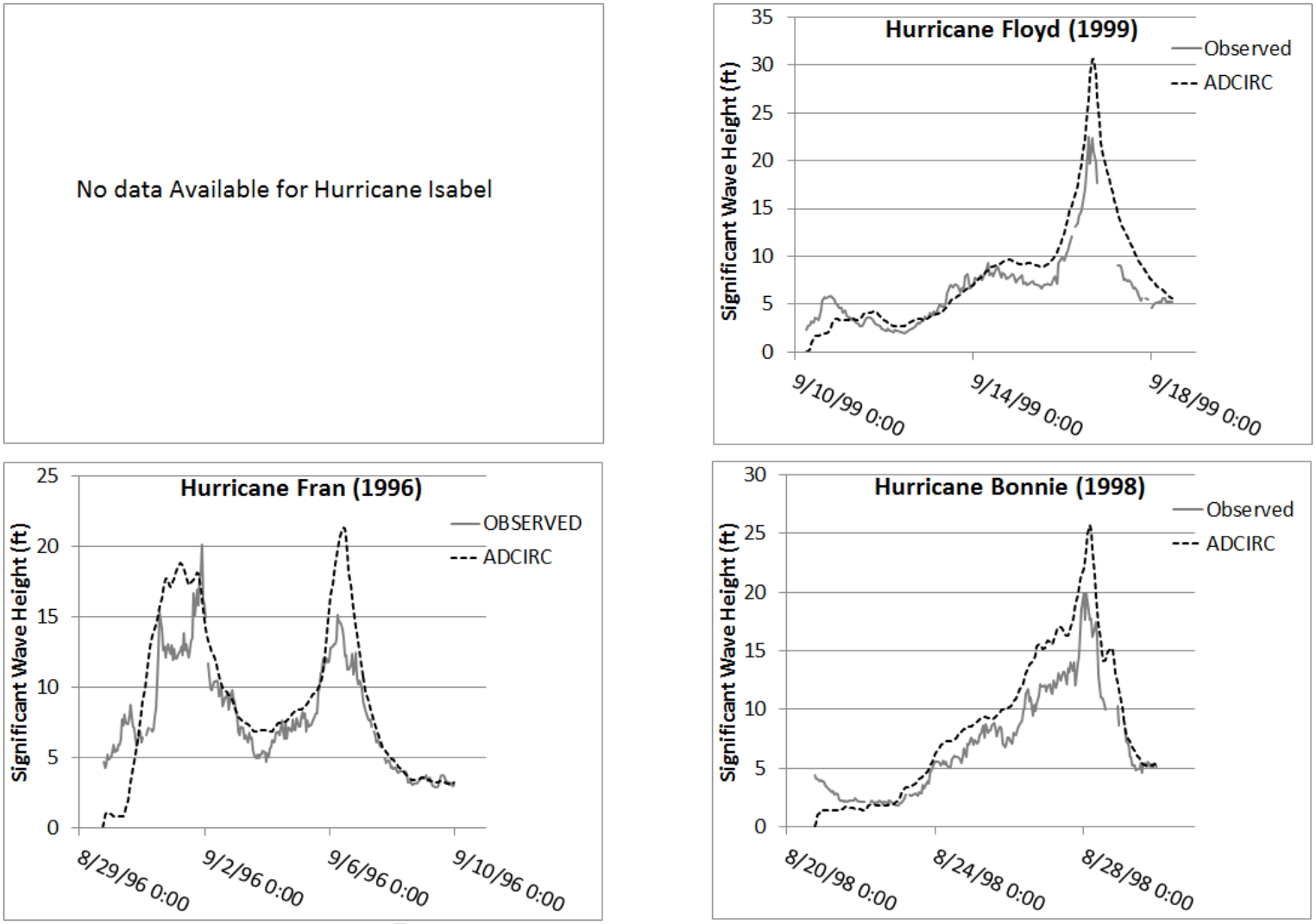

Figure C. 21 Hurricane Calibration Comparison Modeled versus Observed at NOAA NDBC Station 44014.

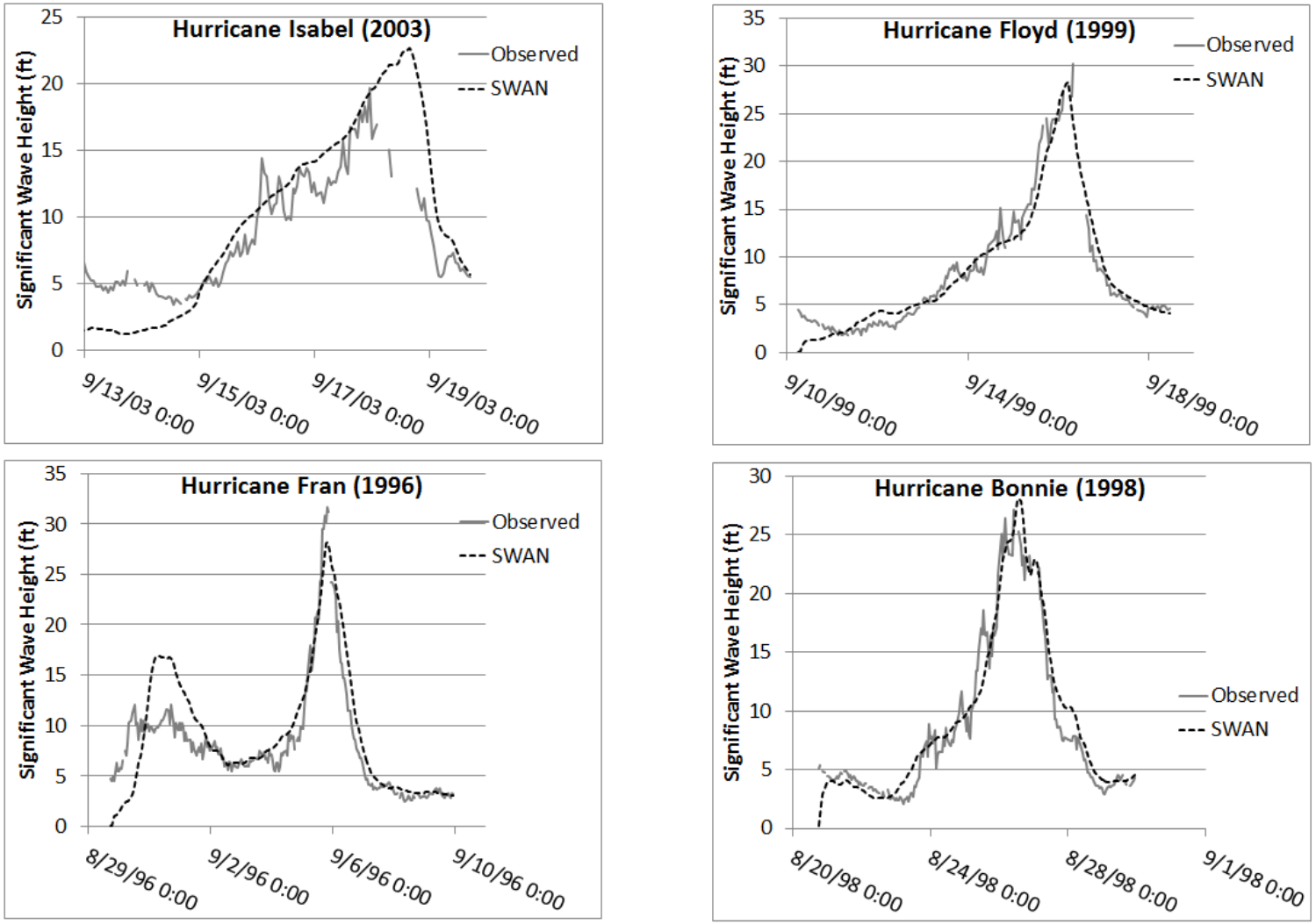

Figure C. 22 Hurricane Calibration Comparison Modeled versus Observed at NOAA NDBC Station FPSN7.

Table C. 4 SWAN Calibration Summary.

Hurricane Isabel			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
FPSN7	0.2	2.9	13%
41001	2.0	7.5	23%
41002	1.4	4.0	10%
44014	No Data Were Available		

Hurricane Floyd			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
FPSN7	0.01	1.50	5%
41001	0.91	1.57	7%
41002	0.64	1.72	6%
44014	1.61	2.66	9%

Hurricane Fran			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
FPSN7	0.96	2.30	8%
41001	2.29	3.72	13%
41002	3.94	4.87	6%
44014	1.97	2.93	9%

Hurricane Bonnie			
Gage	Mean Error (ft)	RMSE (ft)	Average % Error
FPSN7	0.50	1.72	6%
41001	0.75	1.32	9%
41002	2.32	3.30	8%
44014	1.09	3.03	12%

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Appendix D Shifted Storm Paths

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Shifted Storm Paths

The path of each hindcasted storm was shifted ½ degree (approximately 30 nautical miles) in either direction from the original path to increase the amount of data available for the extreme value analyses. The initial landfall location for all hurricanes was identified as the reference point. For non-land falling storms the reference point was chosen as the point closest to the shore. The shift vector was defined as the vector normal to the hurricane path at the reference point (Figure D. 1). The hurricane path was shifted 0.5 degrees in both directions along the shift vector. The original path is shown with thick gray and the shifted paths are shown with dashed lines.

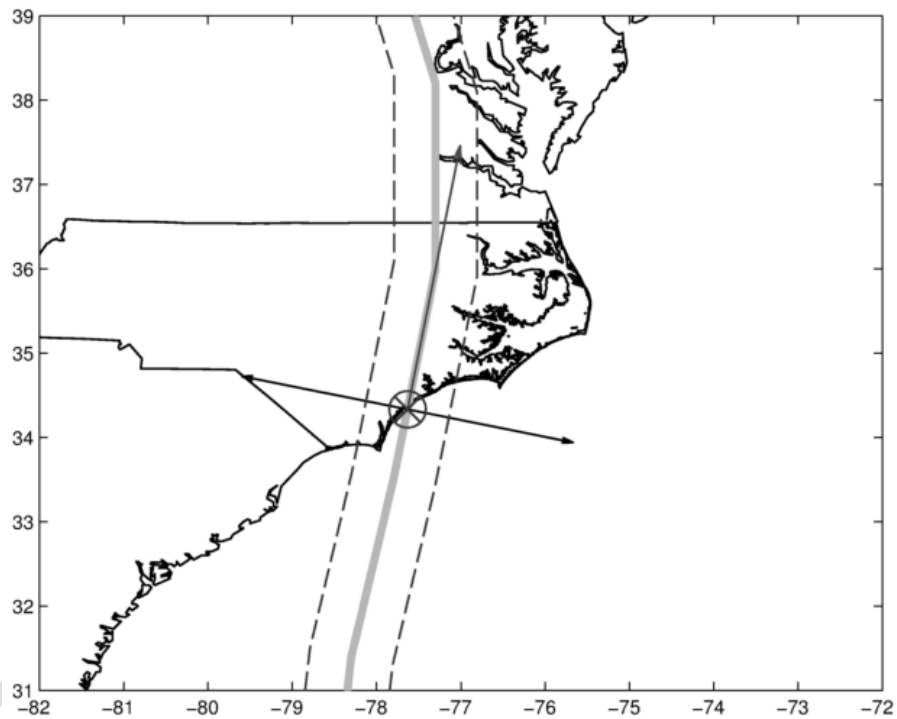

Figure D. 1 Example of Hurricane Path Shift Showing Unit Vectors.

These three storm paths do not have equal probability of occurrence. In order to calculate these probabilities first all the storms with similar strengths and headings were identified. Figure D. 2 shows the similar hurricane paths for the example storm. At the locations where each of these similar storms intersect the shift vector were identified and their distance from the reference point were calculated. These distances are used as a basis to create a hurricane path probability distribution. A kernel density estimator was used to create a continuous function to calculate probabilities for the original and shifted paths (Figure D. 3). The probabilities calculated for the three paths were normalized to add up to one giving relative probabilities for each.

Table D. 1 presents the computed path shift relative probabilities for a few example hurricanes along with the shift vector and number of similar storms used in the calculations.

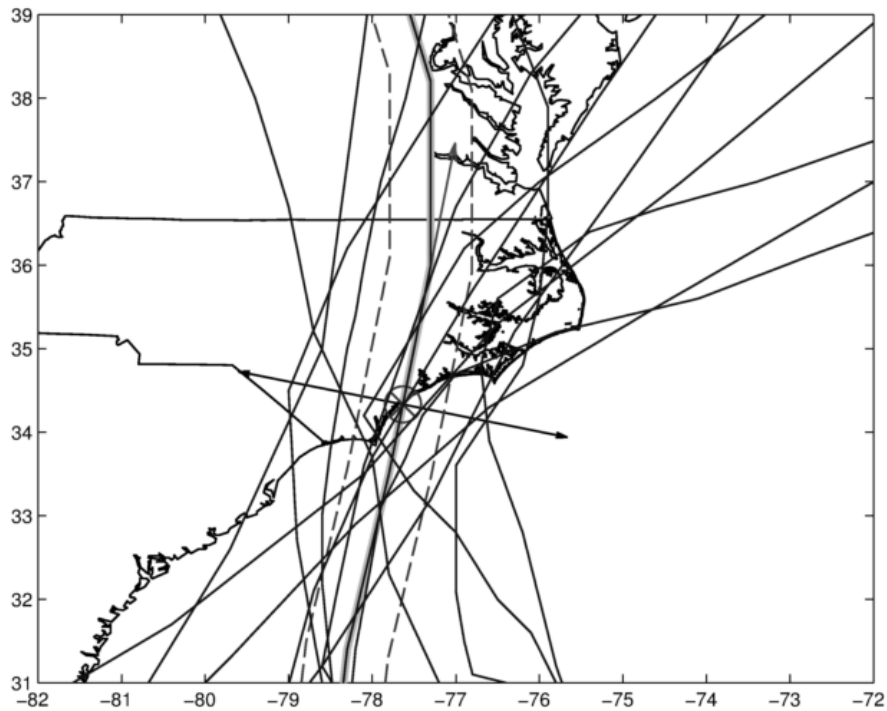

Figure D. 2 Hurricanes with Similar Strengths and Headings.

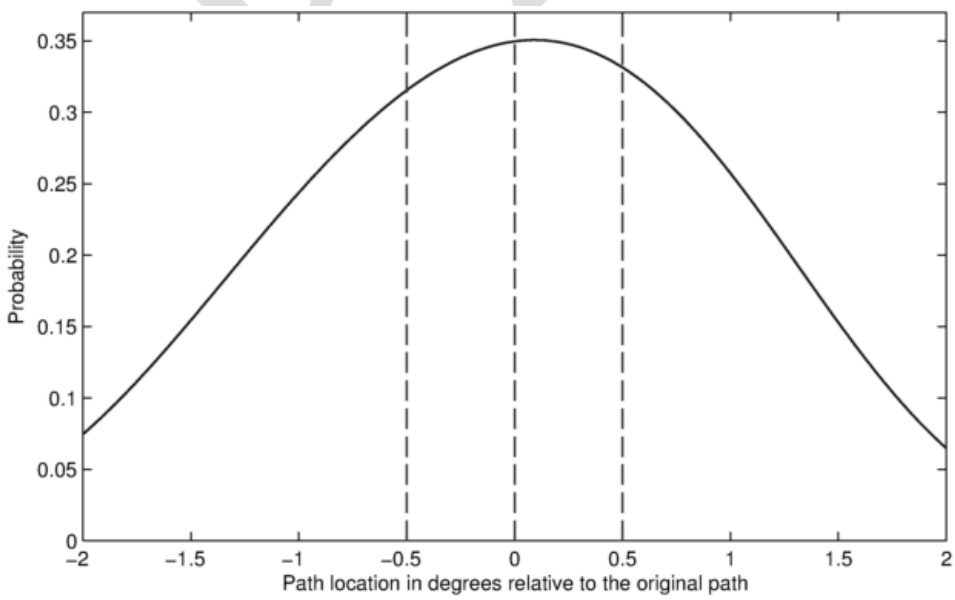

Figure D. 3 Hurricane Path Probability Distribution.

Table D. 1 Example Hurricane Path Shifts.

Hurricanes		Relative Probabilities			Number of Similar Hurricanes	Shift Unit Vector	
		Shifted	Original	Shifted			
Name	Date	Left	Path	Right		Lon	Lat
Not Named	9-Sep-44	0.19	0.33	0.48	38	-0.94	0.35
Not Named	21-Aug-49	0.3	0.42	0.28	39	-0.71	0.71
Barbara	11-Aug-53	0.22	0.25	0.53	35	-0.94	0.34
Carol	25-Aug-54	0.18	0.33	0.5	36	-0.85	0.52
Edna	2-Sep-54	0.33	0.38	0.29	44	-0.86	0.51
Hazel	5-Oct-54	0.27	0.2	0.53	22	-0.99	0.12
Connie	3-Aug-55	0.37	0.34	0.28	28	-0.97	0.24
Diane	7-Aug-55	0.29	0.35	0.37	6	-0.85	-0.53
Ione	10-Sep-55	0.34	0.41	0.25	13	-0.99	-0.11
Helene	21-Sep-58	0.23	0.34	0.43	26	-0.47	0.88
Donna	29-Aug-60	0.26	0.36	0.39	31	-0.87	0.5

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Appendix E Extreme Value Analyses Details

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Statistics at Bridge Sites

The purpose of the hindcasts is to capture the statistical properties of the hydrodynamics for the region including water surface elevations, wave heights, depth-average current speeds, etc. Water surface elevations and current speeds due to astronomical tides can amplify or reduce the effects of a storm depending on the phase of the tide during hurricane impact. This phasing is a random parameter, independent of the storm itself. In order to capture more of the variability of the storm effects, the phase of the tide was treated as a random parameter. One month of tide was simulated without wind and the results stored. The storms were simulated without tide and the tide values superimposed on the results for approximately 1,000 different phases for each storm. This superposition methodology was tested and found to be a valid approach as detailed in Astronomical Tides section of Appendix E.

Extreme value analysis typically involves fitting a probability distribution such as the Generalized Extreme Value Distribution to the data and the desired return interval values obtained from the distribution. The simulated storms were chosen such that any large storm that impacted at least one coastal bridge in the state was included. This means that some of the storms only impacted a portion of the study area. Using the entire data set for a particular location would mean including storms that were not extreme events for that location and thus the results would be skewed. There are distributions, such as Generalized Pareto (GP) distribution, that only use data larger than a defined threshold. However, there are no methods for choosing the thresholds and this procedure cannot be automated. Manually choosing the thresholds for hundreds of locations for five different parameters is not practical. Since in this case there is 480 years of data (with the caveats discussed in Section 3.0) and it is the 100-year conditions that are of interest, the empirical cumulative distribution functions or CDF method was determined to be the most appropriate for use here.

With the availability of 480 years of historical data the 100-year return interval for all the parameters of interest were calculated directly via the empirical cumulative distribution function (CDF) method. Figure E. 1 presents an example return interval value plot created with empirical CDFs. The sorted return values are shown on the y-axis and the x-axis shows the corresponding return values calculated using the following equation:

$$\mathrm{RI} = \frac{Ty}{i - 0.5},$$

where

$i \equiv$ ranking starting with highest value, and

$\mathrm{T_y} \equiv$ total observation period (480 years).

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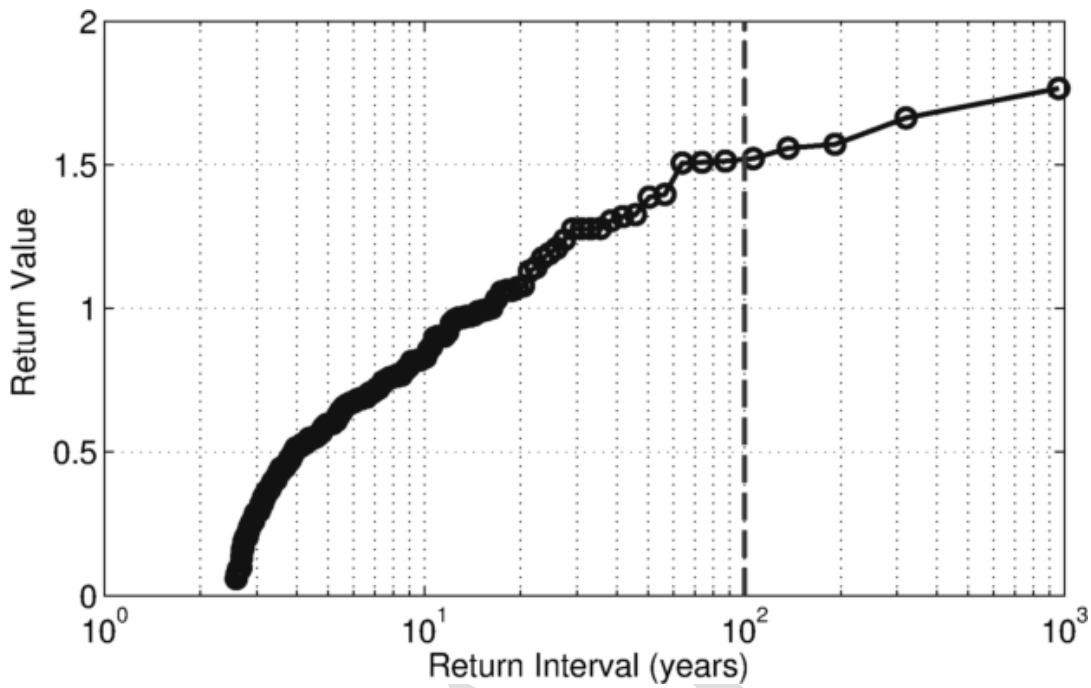

Figure E. 1 Example Return Interval Plot (Dashed Vertical Line Illustrates 100-Year Return Period).

Bootstrapping

Bootstrapping is a statistical method for finding confidence intervals for sample estimates. For this project, bootstrapping was employed to include different tide phases and different probabilities of occurrence for each storm into the statistical analysis. During the application of the bootstrapping method, data is re-sampled with replacement from the original dataset. Due to the replacement, some data points from the original data set appear more than once in the new data set, while others do not appear at all. This re-sampling process was repeated 1,000 times yielding 1,000 predictions of the desired statistic (for example, the 100-year wave height at the time of maximum water surface elevation at a particular bridge pier location). Finally, the median of the 1,000 values is calculated to produce the most likely value (the one used in these analyses).

The paths of each storm analyzed have a probability of occurrence (as determined by examining the paths of the storms impacting North Carolina coastal waters). This includes the actual storm paths as well as those created by shifting the paths. Note that the shifted path storm may have a higher probability of occurrence than the actual path.

In this application of the bootstrapping method the storms are resampled randomly based on their probability of occurrence. Once a storm is selected (resampled), the time series results, from the one month's tide simulation (with a random phase shift to that of the storm), are superimposed on the corresponding values from the storm simulation. For example, the phase shifted tide generated water surface elevations are added to the water surface elevations produced by the storm simulation at each mesh node and each time

step. The desired quantities (such as the wave heights at the point in time of maximum water surface elevation) at all nodes are then extracted from the resulting time series. The desired quantity is extracted for all 186 storms and the 100-year return value is calculated. This process was repeated 1,000 times yielding 1,000 100-year return values for the desired quantity. These values were ranked in size starting with the smallest value. The median of this collection was used in this analysis. The same procedure was repeated for different parameters of interest. A flowchart of the whole procedure is shown in Figure E. 2

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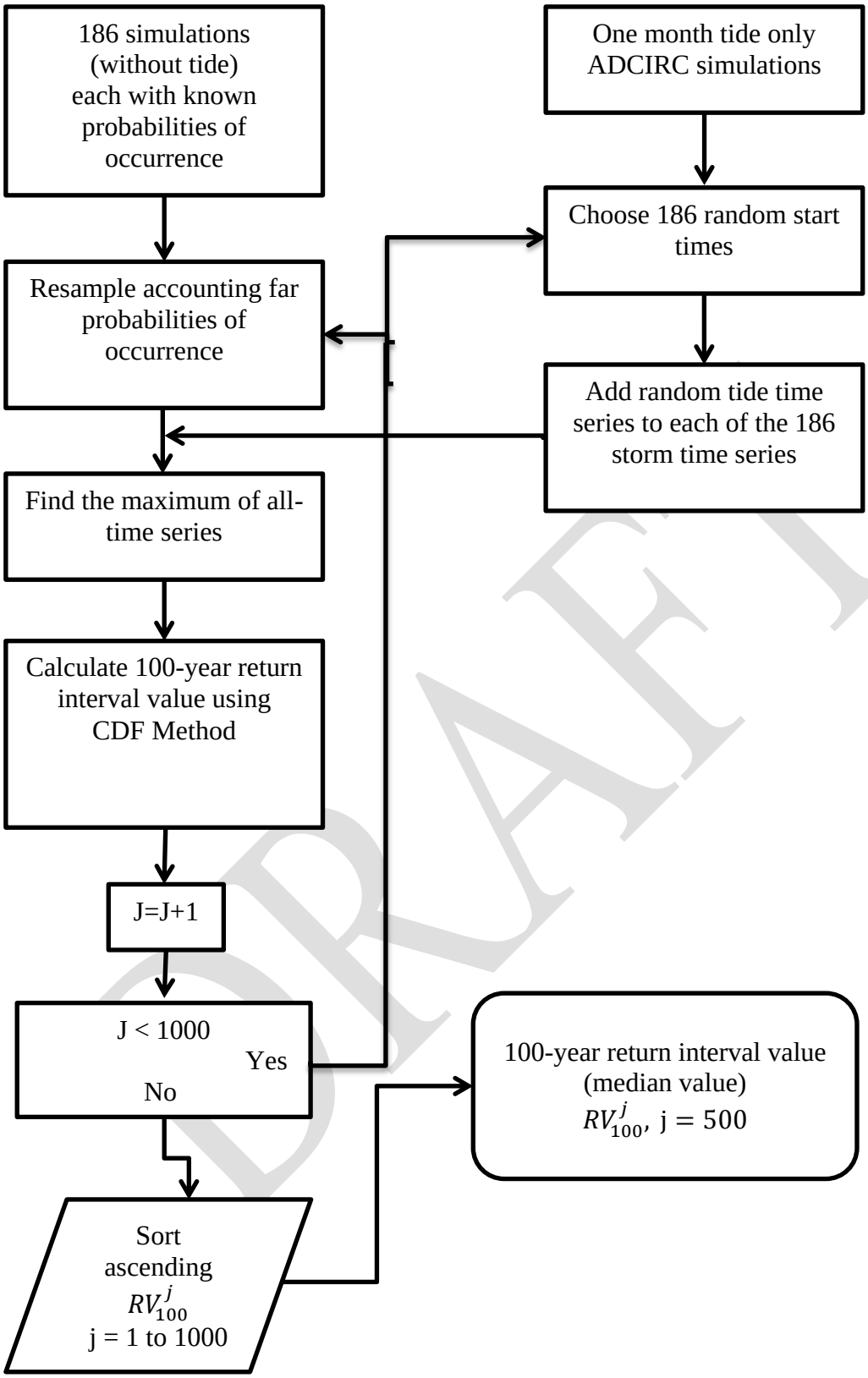

Figure E. 2 Flowchart of the Return Value Calculation Process for Bridge Locations via Non-parametric Bootstrapping.

Whole Domain Statistics

100-year return values were also calculated at all 207,000 nodes for use in the GIS application and contour plots. However, the bootstrapping method used for the bridge sites is computationally demanding and cannot be performed at all the nodes. At the nodes, the extreme value statistics were calculated once using the empirical CDF method, taking the different probabilities for hurricanes into account. Root mean squared values for tidal WSE and velocities were added to get the final result. Even though the mean tidal velocity and WSE is zero, their effect on the 100-year values is positive. Adding the root mean squared values was found to be a reasonable conservative method to take tidal effects into account. Due to the differences in methodology explained, the reported parameters at a bridge site calculated by the two different methods may be different. The values calculated at the bridge sites using the bootstrapping method are more accurate and should be used when available.

Maximum Values

Maximum current speeds and wind speeds are also provided as contour plots. Only the original 62 storms without shifts were used in this analysis. The root mean squared tidal currents were added to the reported current speeds, since the simulations did not include tides.

Astronomical Tides

As a check of the validity of superimposing the tides, water surface elevations, velocity magnitudes, and wave heights generated from calibration hindcast were compared to those generated by superimposing the tide and storm surge. Figure E. 3 through Figure E. 5 present comparisons of water surface elevation, velocity magnitude, and wave height at different bridge locations throughout North Carolina. In the figures, the vertical axes are the results from the superimposed tide method, the horizontal axis is the hindcasted (simulation with the tide) result, and each point represents the maximum value of the parameter during the storm at one bridge location. The diagonal line in the figures represents an exact agreement between the two methods, points above the line are cases where the superimposed tide method prediction is higher, and points below the line are cases where the hindcasted value is greater. As the figures demonstrate, the superposition method is more accurate for water surface elevation, but less accurate for velocity magnitude and wave height. That said, the differences are not biased in either direction, but rather are random. Bias in prediction influences 100-year return values more than random errors, since random errors will cancel each other out. There is very little over-prediction bias introduced by superposition. For the wave height results, there is no superposition of simulation results since the tide-only simulations do not include wind.

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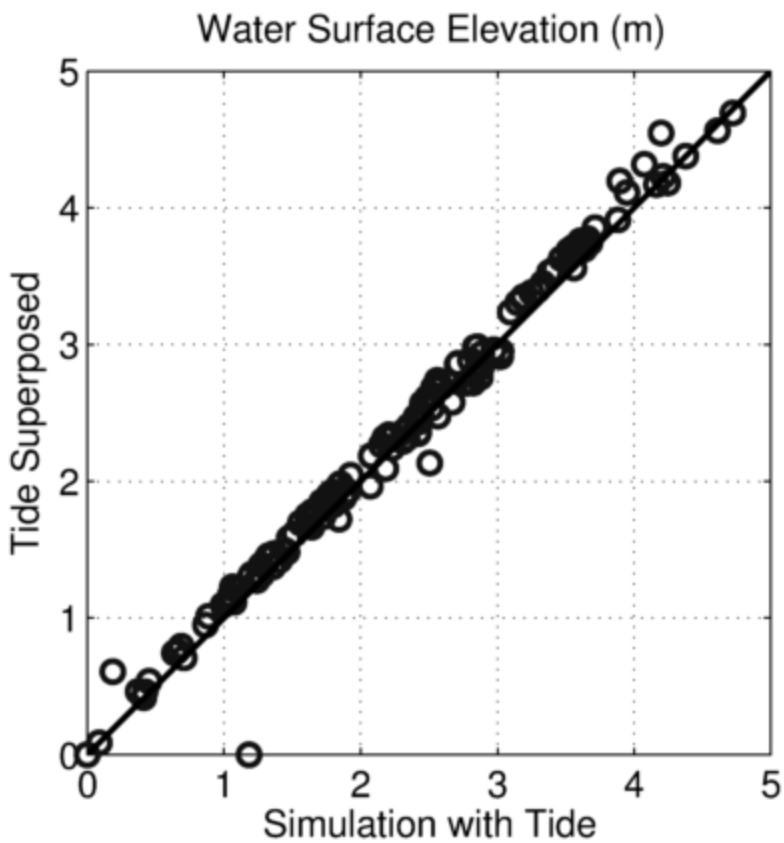

Figure E. 3 Accuracy of Superposition Method for Maximum Water Surface Elevations at NC Bridge Locations during Hurricane Isabel (2003).

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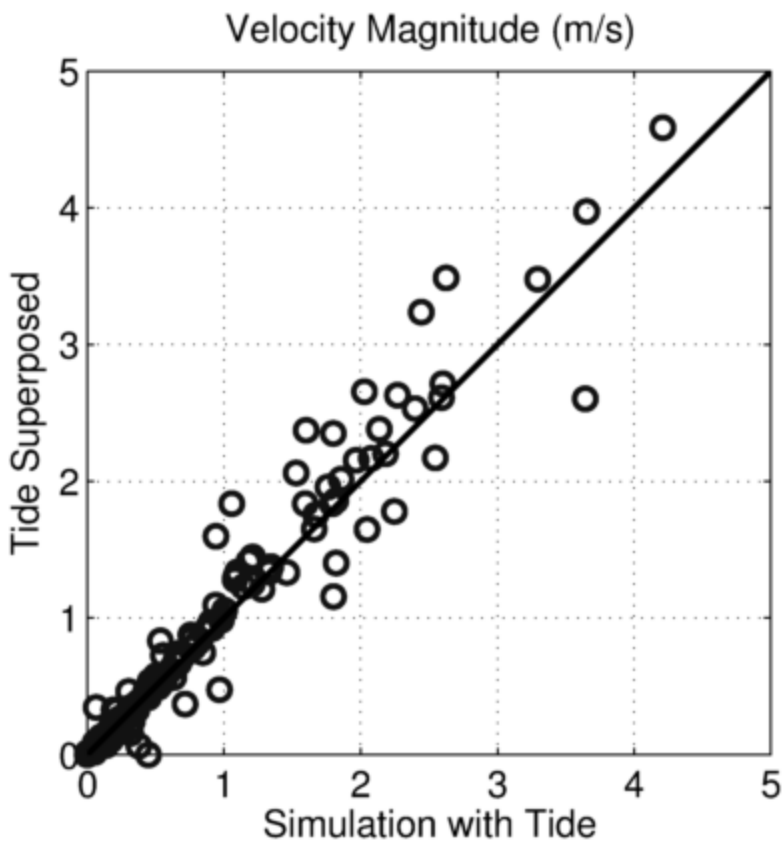

Figure E. 4 Accuracy of Superposition Method for Maximum Velocity Magnitude at NC Bridge Sites during Hurricane Isabel (2003).

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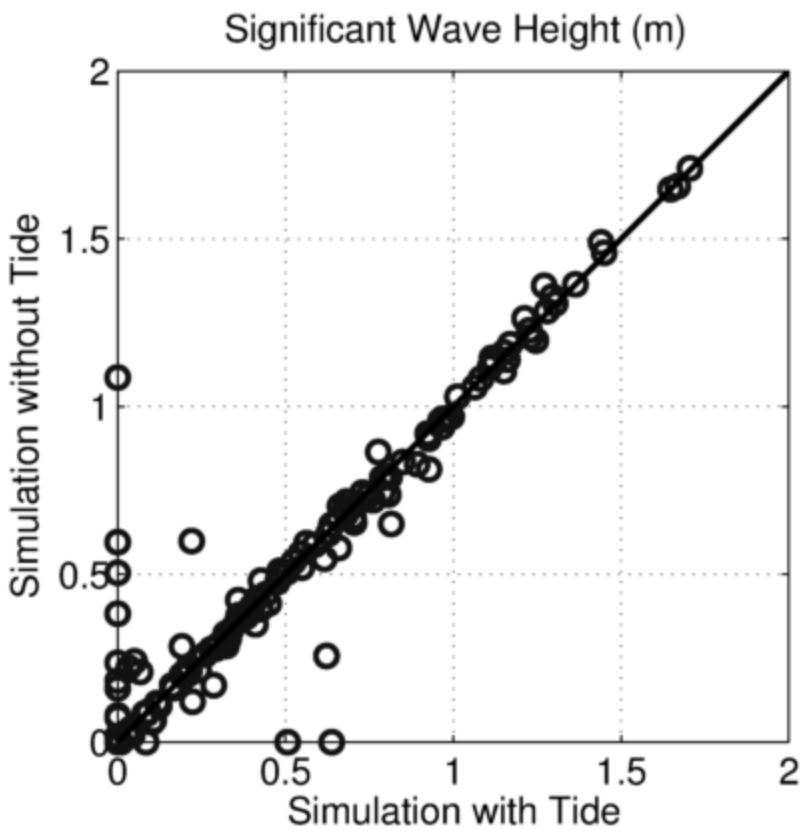

Figure E. 5 Accuracy of Superposition Method for Maximum Significant Wave Height at NC Bridge Sites during Hurricane Isabel (2003).

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Appendix F Design Wave Period

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Design Wave Period

The design wave height used in the analysis of surge/wave forces on bridge superstructures is 1.8 H_s where H_s is the significant wave height (average of the one-third highest waves). This height is, however, subject to the depth limited constraint,

$$H \leq 0.65\, y_0 .$$

The distribution of periods (and wave lengths) associated with maximum wave heights in coastal waters under hurricane conditions were analyzed as part of another study. The results of that analysis are summarized below.

Wave time series can be constructed from a given wave spectra (Dean and Dalrymple 1991 pg 207-208). This is based on the assumption of random phases for each of the wave components. Due to this random phasing of components a different time series results for each construction. If, however, a large number of constructions are performed the statistical properties of the design wave height and associated period can be calculated.

Six hurricanes out of 150 that were hindcasted for Tampa Bay were selected for use in this analysis. The wave spectra at the time of maximum wave heights at 6 different locations within the modeled area for each storm were used in the time series constructions. One-thousand time series were constructed for each wave spectra and zero-crossing analysis used to identify the individual waves. Each time series had approximately 120 waves or a total of approximately 120,000 waves for each spectrum. This large number of simulations was required since only a very small portion of the waves were close to the design wave height. All waves with a wave height greater than 1.7 times the significant wave height were extracted along with their periods for analysis. The significant wave period (average period of the 1/3 highest waves) for these waves was computed. This led to the following relationship between the significant wave period and significant wave height, H_s.

$$T_s(\text{for } H > 1.7H_s) = \alpha\sqrt{H_s}$$

where the constant α was found to equal 2.0 s/ft$^{1/2}$ with two standard deviation confidence limits of 1.8 s/ft$^{1/2}$ and 2.3 s/ft$^{1/2}$. Note that these values were developed for locations within bays and somewhat protected waters and are expected to be larger in the open ocean. Since surge/wave forces on bridge superstructures are a complex function of wave length, span width, span low chord elevation, etc. a range of periods need to be considered in their analysis. This equation with a coefficient of 2.3 s/ft$^{1/2}$ was used as the upper limit for the wave period in this study. Waves have a limited steepness which can be characterized by the ratio:

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$$\frac{H}{\lambda} = \frac{H}{T\sqrt{g\,y_0}} = \frac{1}{7} \quad \text{or}$$

$$T = \frac{7H}{\sqrt{g\,y_0}} \; .$$

The lower limit for the period used in this study was the steepness limited period.

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Appendix G Storm Surge and Wave GIS Database

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Navigating the Storm Surge and Wave GIS Database

Overview

A public domain ArcReader 10.1 Reader is provided with the Storm Surge and Wave Database. The ArcReader10 program needs to be installed on the computer(s) that will be for accessing the database. The database is approximately 1 GB in size and can be either copied to the computer(s) or accessed via a UPS memory stick. To open the database simply click on the NCDOT_Wave_Atlas.pmf file.

Workspace Layout

One of the key features in using a geo-referenced GIS map is the ease of navigation. At startup the image shown in Figure G. 1 is displayed. Note that the screen is divided into three regions or frames; a Toolbar Frame (highlighted here in green), Navigation Frame (highlighted here in blue) and a Map Frame (highlighted here in purple).

The Toolbar Frame contains several common features plus four that are unique to this application: .The Navigation Frame lists all of the graphical data that can be displayed in the Map Frame. Selecting/Deselecting (with a mouse click) a dataset or dataset group in the Navigation Frame will display/turn off the set or group in the Map Frame. The Map Frame displays the map of the coverage area at various scales and the graphical information selected in the Navigation Frame. Also, items selected (identified) in the Toolbar Frame will be displayed in tabular form in a window in the Map Frame.

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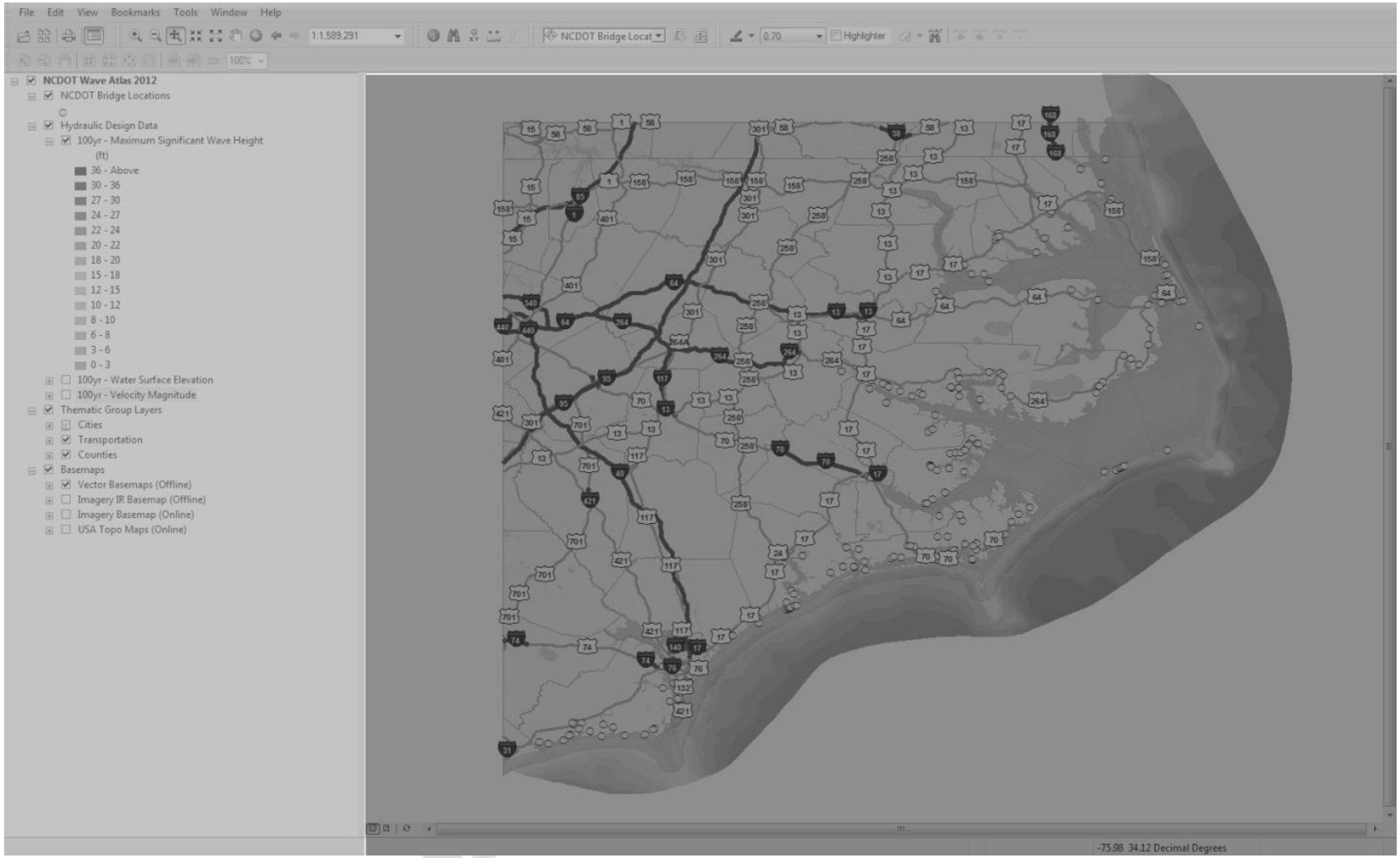

Figure G. 1 ArcGIS Navigation Frame Layout.

Toolbar Frame

Figure G. 2 displays the ArcReader 10.1 Toolbar. Features of this toolbar include printing, zooming and panning the map as well as selecting various display scales and performing data searches. The data search option includes four tools used to access and find data within the map.

The Identify Tool, blue circle with "i" in the center, is used to identify database information. The Search Tool, binoculars symbol, is used to search on bridge names, counties, roadways, or features. The Coordinate Search Tool, XY symbol, is used to search a specific geographic position using various coordinate systems (Lat.- Long., state plane, etc.). The Distance Measure Tool, ruler symbol, measures distance between any two points on the map.

The search tools in the toolbar are used to display the desired information at a particular location on the map in a window in tabular form in the Map Frame.

Figure G. 2 ArcGIS Reader 10.1 Toolbar.

Navigation Frame

Figure G. 3 shows the ArcReader 10.1 Navigation Frame. This frame lists the layers of graphical data contained in the Map Frame. Left mouse clicking on a data layer or data group selects or deselects the layer or group. Selecting a data set or data group causes the graphical information to be displayed in the Map Frame. For example, selecting 100-year water surface displays a color coded contour map of 100-year water elevations in the Map Frame. The color legend for the contours will be displayed in the Navigation Frame. To avoid a confusing image only the item of interest should be selected.

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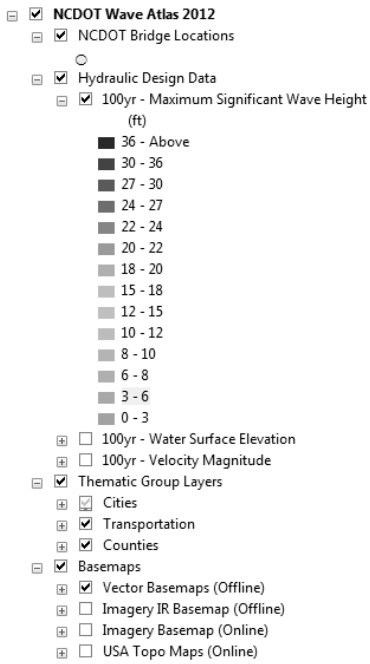

Figure G. 3 ArcGIS Reader Toolbar.

Mapping Frame

The ArcReader 10 Map Frame contains, or has links to, all of the data in the database. Graphical data can be displayed in this frame by selecting it in the Navigation Frame. Information at a specific location in the map can be displayed in tabular form in a superimposed window in the Map Frame by specifying the location with the coordinate (XY) or search (binocular) tools and identifying the desired quantity with the identify tool. The location can also be specified by the cursor and a left click of the mouse.

Figure G. 4 displays the default map for the NCDOT Storm Surge and Wave Database. The map can be panned and zoomed with the tools in the Tool Frame. Zooming to a specific area can also be achieved by selecting a rectangular area with the mouse. Zooming in and out in this frame changes the information that can be displayed, i.e., some information will only be displayed when the map is zoomed in to a certain point. For example, the bridge numbers can only be displayed when the map is zoomed in to a certain point. As an example, the zoomed in image of Oregon Inlet shown in Figure G. 5 displays the Bonner Bridge number. The bridge number was not displayed prior to the zoom.

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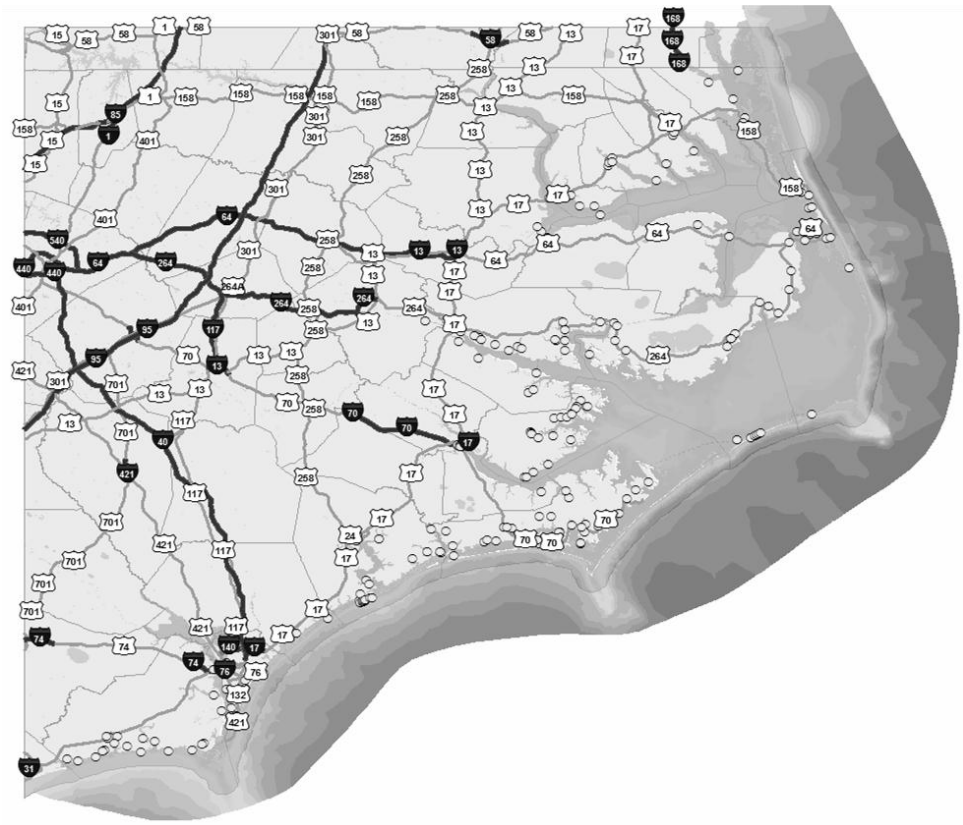

Figure G. 4 ArcGIS Reader 10 Default Map Frame Map.

Figure G. 5 Zoomed ArcGIS Reader Map at Oregon Inlet.

Appendix H Physics Based Model

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Storm Surge and Wave Forces

Storm Surge and Wave Force Equations

The forces exerted on bridge superstructures by waves are composed of drag, inertia, change in added mass, buoyancy (vertical only), and slamming. Of these forces, the first four, referred to as quasi-static forces (due to their relatively low frequency), are addressed directly in the PBM. The slamming force has to be analyzed separately using a parametric equation. The definition sketch presented in Figure H. 1, defines the parameters in the equations. The vertical and horizontal quasi-static forces are composed of the following components:

$$F_{Vertical} \equiv F_z = F_{Drag} + F_{Inertia} + F_{CAM} + F_{Buoyancy}$$

$$F_{Horizontal} \equiv F_x = F_{Drag} + F_{Inertia} + F_{CAM}$$

$$F_{CAM} \equiv \text{Change in added mass force}$$

The drag force is a function of the velocity squared and the inertia force a function of the acceleration as illustrated in the following equations.

$$F_z = \frac{d\left(m_{a(z)} V_z\right)}{dt} + \frac{1}{2}\rho\, L\, w\, C_{d(z)}\, V_z \left|V_z\right| + F_{buoyancy}$$

where:

$$\frac{d\left(m_{a(z)} V_z\right)}{dt} = \frac{dm_{a(z)}}{dt} V_z + m_{a(z)} \frac{dV_z}{dt}$$

$$m_{a(z)} \equiv \text{Added Mass} = \frac{C_{m(z)}\, \pi\, \rho\, L\, w(t)^2}{4\sqrt{1+\left(\frac{w(t)}{L}\right)^2}} \left(C_1 + C_2 \frac{h(t)}{L} + C_3 \sqrt{\frac{h(t)}{w(t)}} \right)$$

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$\rho \equiv$ density of water

$w \equiv$ wetted span width

$L \equiv$ span length

$h \equiv$ wetted span height

$t \equiv$ time

$m_{a(x)} \equiv$ added mass in horizontal-direction

$m_{a(z)} \equiv$ added mass in vertical-direction

$V_x \equiv$ horizontal velocity

$V_z \equiv$ vertical velocity

The buoyancy is a function of the submerged volume of the structure and the mass density of the water.

$$F_b = \rho \, g \, L \iint_{wcsa} dA$$

$F_b \equiv$ buoyancy force

$wcsa \equiv$ wetted cross-sectional area

The slamming force occurs when the air-water interface strikes the structure. While horizontal slamming forces usually occur when a breaking wave strikes the structure, vertical slamming forces are present anytime the low member elevation is above the wave trough elevation and below the wave crest elevation. Vertical slamming forces are included in the analysis for conditions where they exist. Due to their lower probability of occurrence, horizontal slamming forces are not included in the analysis. To evaluate these complex equations, OEA developed a computer program called the Physics Based Model or PBM. This program includes a non-linear wave theory (stream function) solver to compute the wave kinematics (velocities and accelerations) at each time step as the wave propagates past the structure.

The PBM equations include coefficients for drag, inertia, and added mass. The values for these coefficients were determined from wave tank tests conducted in the Coastal Engineering Laboratory at the University of Florida. Bridge failures and survivals during storm surge and wave loading in Florida, Mississippi, and Louisiana during the last few years provide field data to test both the coefficients and the PBM. Two bridges were evaluated; one that failed from wave loading, the I-10 Bridges over Escambia Bay during Hurricane Ivan and one that survived wave loading, the SR-687 Howard Franklin West Approach Bridge over Big Island Gap near Saint Petersburg, Florida during Hurricane Gladys. In both cases the PBM correctly predicted the bridge's response to the conditions.

The PBM solves the force and moment equations for each element in a grid surrounding the superstructure (Figure H. 2) at each time step of design wave propagation past the structure.

DRAFT

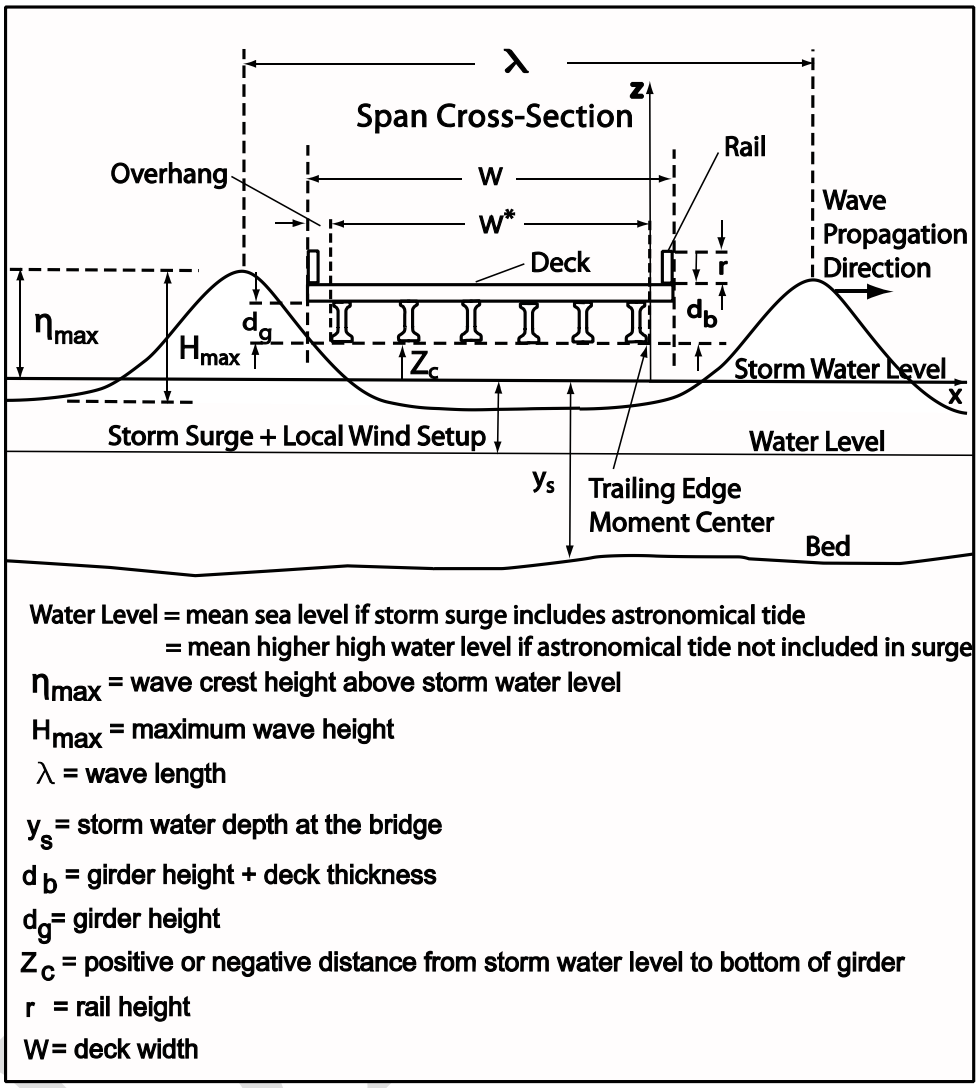


Figure H. 1 Definition Sketch for the PBM.

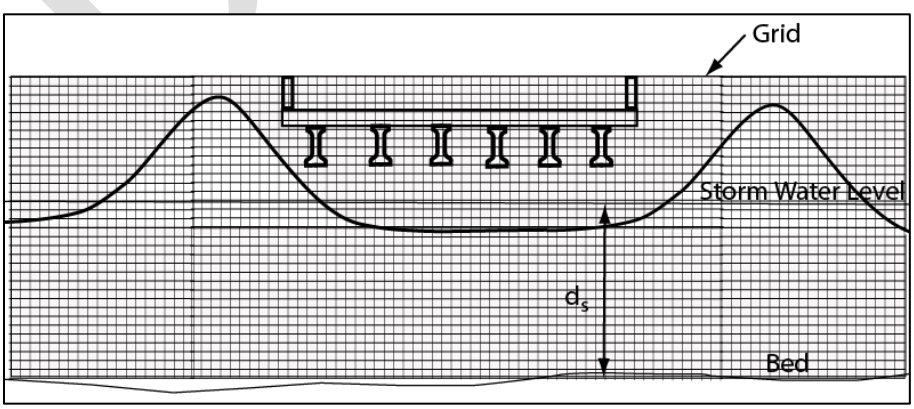


Figure H. 2 Variable resolution grid used by PBM to compute forces and moments.

Appendix I Results for Bridges Analyzed

DRAFT

BRIDGE NUMBER 60025

PAMLICO RIVER

US17

BEAUFORT COUNTY

DRAFT

NCDOT BRIDGE NO. 060025

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																		
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**4.4**	**4.3**	**4.4**	**4.4**	**4.4**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**	**4.6**	**4.6**	**4.7**	**4.8**	**4.8**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																		
100-yr Water Surface Elevation (ft - MSL)	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
Bed Elevation (ft - MSL)	-2	-4	-6	-8	-10	-11	-11	-11	-12	-13	-13	-14	-14	-15	-16	-21	-25	-22
Low Chord Elevation (ft - MSL)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
100-yr Max Wave Crest Elevation (ft - MSL)	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
100-yr Wave Height (ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
100-yr Wave Period (seconds)	5.7	5.3	5.1	4.9	4.7	4.6	4.6	4.6	4.6	4.6	4.5	4.5	4.5	4.4	4.4	4.1	4.0	4.1

SPAN PROPERITES																		
Span Length (ft)	28.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0
Span Width (ft)	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Number of Beams	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Beam Dead Weight (lb/lf) - Each	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900
Beam Dead Weight (kip/ft) - Total	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Slab Dead Weight (kip/ft)	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Total Dead Weight (kip/ft)	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Resisting Moment (kft/ft)	157.0	162.8	162.8	162.8	162.8	162.8	162.8	162.8	162.8	162.8	162.8	162.8	162.8	162.8	162.8	162.8	162.8	162.8
Resisting Vertical Force (kip/ft)	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6

100-YEAR FORCE-MOMENT VALUES																		
Maximum Vertical Force (kips/span)	300.9	318.4	319.2	321.3	324.4	325.3	325.3	325.3	330.4	332.5	334.4	337.5	337.5	339.0	339.9	356.3	359.6	361.3
Maximum Vertical Force (kips/ft)	10.7	11.0	11.0	11.1	11.2	11.2	11.2	11.2	11.4	11.5	11.5	11.6	11.6	11.7	11.7	12.3	12.4	12.5
Maximum Horizontal Force (kips/span)	42.1	39.5	37.9	35.7	34.5	33.4	33.4	33.4	32.9	32.9	32.6	32.0	32.0	31.6	31.4	30.9	31.3	31.1
Maximum Horizontal Force (kips/ft)	1.5	1.4	1.3	1.2	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Maximum Moment (k-ft)	10,985.0	11,543.1	11,775.8	11,819.8	11,976.1	12,051.3	12,051.3	12,051.3	12,200.1	12,240.3	12,240.1	12,260.0	12,260.0	12,443.5	12,427.2	12,724.4	12,948.1	12,961.8
Maximum Moment (k-ft/ft)	392.3	398.0	406.1	407.6	413.0	415.6	415.6	415.6	420.7	422.1	422.1	422.8	422.8	429.1	428.5	438.8	446.5	447.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-18 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 060025

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**4.8**	**4.8**	**4.8**	**4.8**	**5.5**	**2.1**	**5.6**	**8.8**	**4.7**	**4.6**	**4.7**	**4.7**	**4.7**	**4.5**	**4.2**	**4.2**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
Bed Elevation (ft - MSL)	-23	-23	-24	-24	-21	-24	-22	-18	-20	-16	-17	-17	-17	-11	0	0
Low Chord Elevation (ft - MSL)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
100-yr Max Wave Crest Elevation (ft - MSL)	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
100-yr Wave Height (ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
100-yr Wave Period (seconds)	4.1	4.1	4.0	4.0	4.1	4.0	4.1	4.3	4.1	4.4	4.3	4.3	4.3	4.7	6.0	6.0

SPAN PROPERITES																
Span Length (ft)	29.0	29.0	29.0	29.0	55.0	179.0	55.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0
Span Width (ft)	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Number of Beams	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Beam Dead Weight (lb/lf) - Each	900	900	900	900	102	102	102	102	900	900	900	900	900	900	900	900
Beam Dead Weight (kip/ft) - Total	7.2	7.2	7.2	7.2	0.8	0.8	0.8	0.8	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Slab Dead Weight (kip/ft)	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Total Dead Weight (kip/ft)	11.6	11.6	11.6	11.6	5.2	5.2	5.2	5.2	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Resisting Moment (kft/ft)	162.8	162.8	162.8	162.8	141.2	465.7	141.2	73.2	162.8	162.8	162.8	162.8	162.8	162.8	162.8	162.8
Resisting Vertical Force (kip/ft)	11.6	11.6	11.6	11.6	5.2	5.2	5.2	5.2	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	361.3	361.3	360.9	358.5	608.9	2224.3	611.7	281.9	354.1	339.9	345.9	345.9	343.9	326.4	309.1	308.9
Maximum Vertical Force (kips/ft)	12.5	12.5	12.4	12.4	11.1	12.4	11.1	9.7	12.2	11.7	11.9	11.9	11.9	11.3	10.7	10.7
Maximum Horizontal Force (kips/span)	31.3	31.3	31.0	30.8	41.0	140.2	43.4	22.0	30.9	31.4	31.2	31.2	31.1	34.1	43.9	44.2
Maximum Horizontal Force (kips/ft)	1.1	1.1	1.1	1.1	0.7	0.8	0.8	0.8	1.1	1.1	1.1	1.1	1.1	1.2	1.5	1.5
Maximum Moment (k-ft)	12,897.4	12,897.4	12,975.2	12,871.4	24,533.5	99,397.1	24,669.9	10,702.2	12,731.5	12,427.2	12,585.2	12,585.2	12,552.1	12,067.0	11,400.8	11,388.7
Maximum Moment (k-ft/ft)	444.7	444.7	447.4	443.8	446.1	555.3	448.5	369.0	439.0	428.5	434.0	434.0	432.8	416.1	393.1	392.7

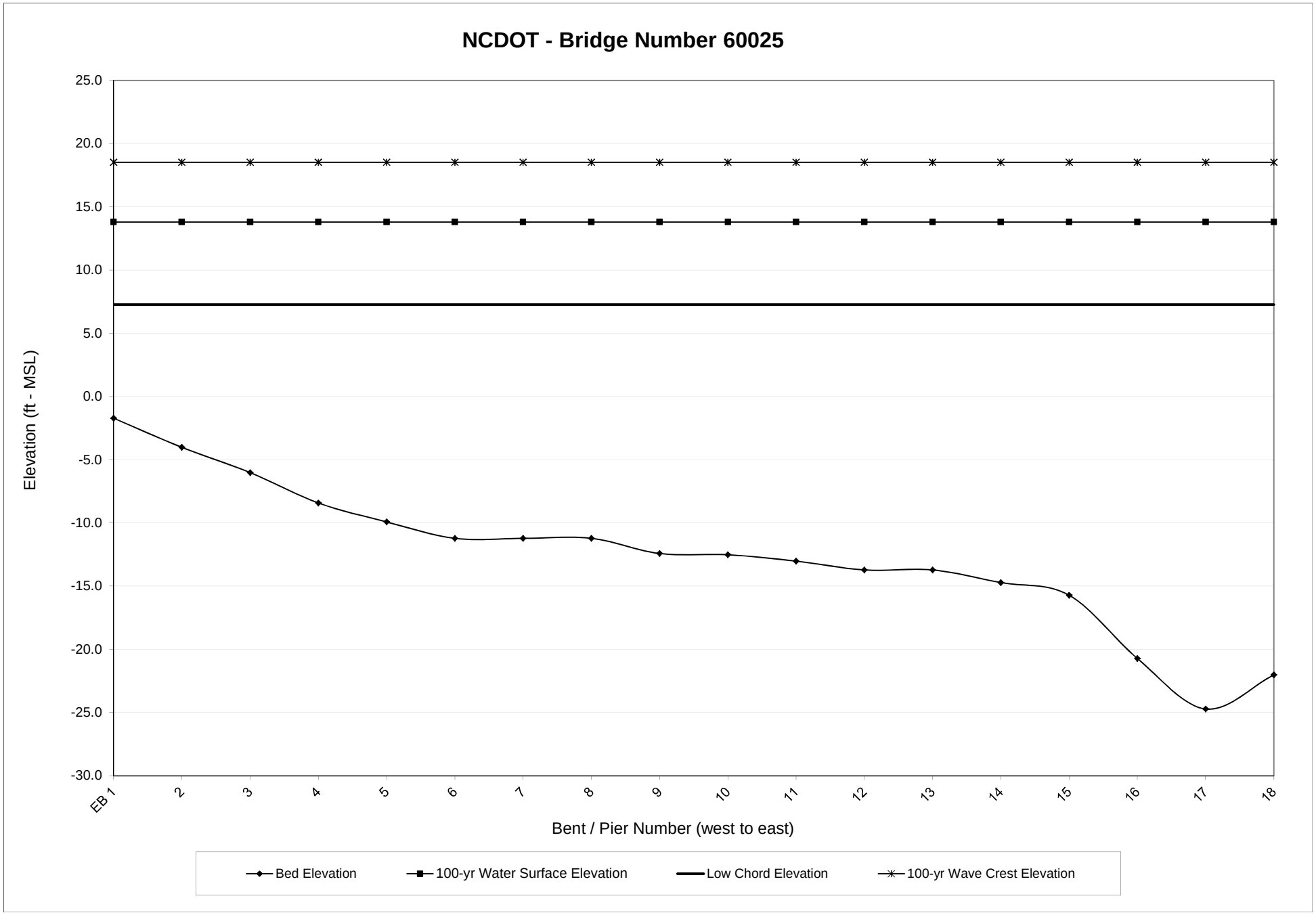
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

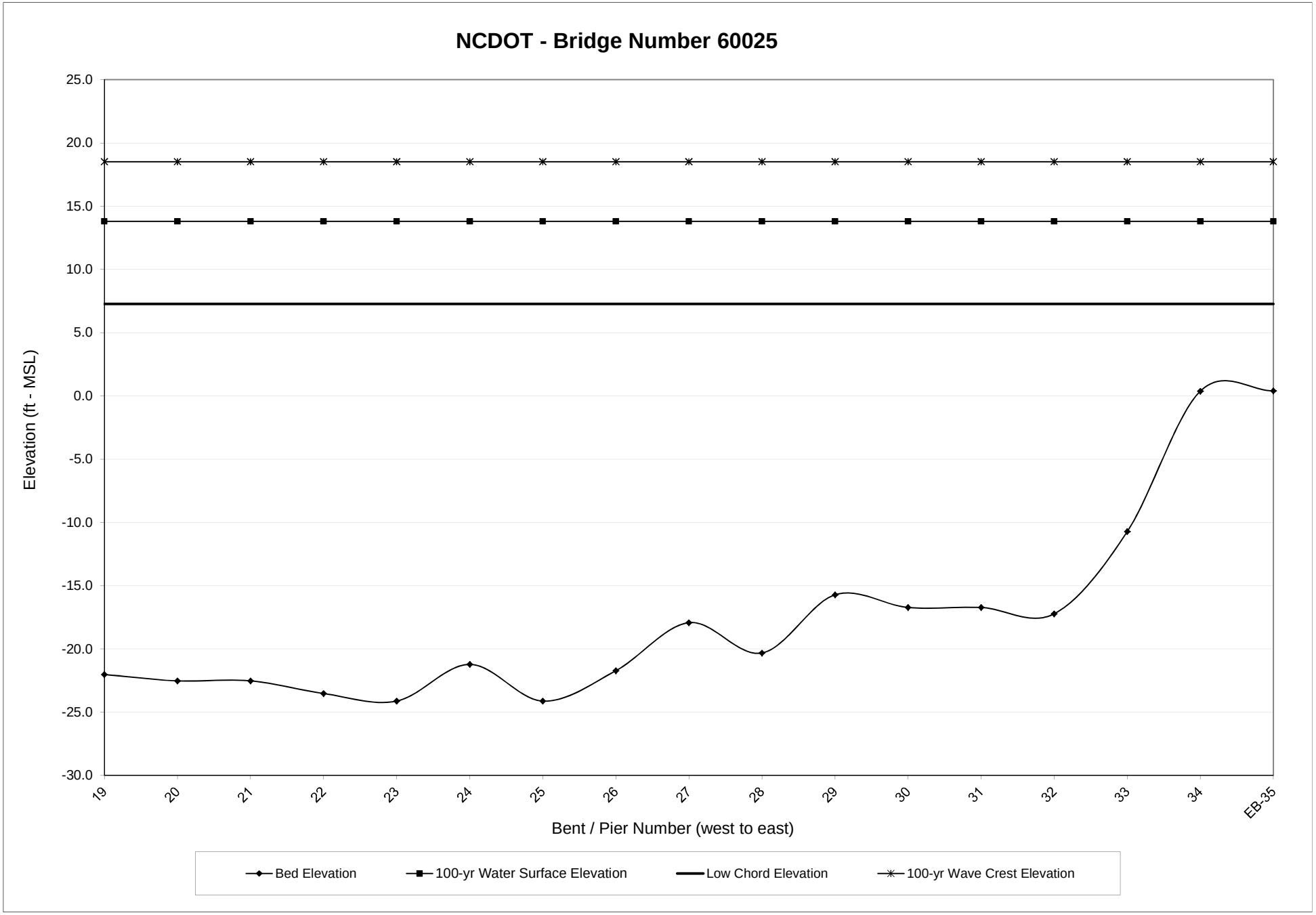
Notes:

1 - Bridge spans 19-34 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 60025
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 60025
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
Elevation (ft - MSL)
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
EB-35
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 60028

BATH CREEK

NC91

BEAUFORT COUNTY

DRAFT

NCDOT BRIDGE NO. 060028

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**3.2**	**3.2**	**2.8**	**3.4**	**3.3**	**3.4**	**4.4**	**3.8**	**4.1**	**4.1**	**4.6**	**4.6**	**4.7**	**4.7**	**4.7**	**4.7**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Bed Elevation (ft - MSL)	-1	-4	-5	-7	-8	-8	-9	-10	-11	-11	-12	-12	-12	-12	-13	-13
Low Chord Elevation (ft - MSL)	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
100-yr Max Wave Crest Elevation (ft - MSL)	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3
100-yr Wave Height (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
100-yr Wave Period (seconds)	4.4	4.1	3.9	3.8	3.8	3.7	3.6	3.6	3.6	3.6	3.5	3.5	3.5	3.5	3.4	3.4
SPAN PROPERITES																
Span Length (ft)	21.0	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1
Span Width (ft)	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Number of Beams	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Total Dead Weight (kip/ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Resisting Moment (kft/ft)	32.7	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8
Resisting Vertical Force (kip/ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	48.6	41.7	47.4	61.8	62.0	61.0	72.2	65.4	68.9	72.0	78.9	78.9	80.0	80.4	79.8	82.3
Maximum Vertical Force (kips/ft)	2.3	2.0	2.2	2.9	2.9	2.9	3.4	3.1	3.3	3.4	3.7	3.7	3.8	3.8	3.8	3.9
Maximum Horizontal Force (kips/span)	17.2	14.8	12.0	14.3	14.2	14.2	13.9	13.9	13.8	14.0	14.1	14.1	14.2	14.2	14.2	14.0
Maximum Horizontal Force (kips/ft)	0.8	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Maximum Moment (k-ft)	1,269.6	1,272.5	1,118.1	1,328.6	1,303.0	1,340.8	1,749.8	1,514.3	1,607.9	1,606.7	1,800.1	1,800.1	1,844.0	1,837.0	1,843.3	1,849.3
Maximum Moment (k-ft/ft)	60.5	60.4	53.0	63.0	61.8	63.6	83.0	71.8	76.3	76.2	85.4	85.4	87.5	87.1	87.4	87.7

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-16 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 060028

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**4.5**	**4.6**	**4.7**	**4.7**	**4.6**	**4.7**	**4.9**	**4.7**	**3.4**	**4.8**	**4.6**	**4.8**	**4.7**	**4.7**	**4.7**	**4.6**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Bed Elevation (ft - MSL)	-14	-14	-15	-15	-15	-16	-16	-16	-16	-17	-16	-17	-16	-16	-16	-15
Low Chord Elevation (ft - MSL)	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	8.0	9.2	9.2	9.2	9.2	9.2	9.2	9.2
100-yr Max Wave Crest Elevation (ft - MSL)	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3
100-yr Wave Height (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
100-yr Wave Period (seconds)	3.4	3.4	3.4	3.4	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3

SPAN PROPERITES																
Span Length (ft)	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	39.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Span Width (ft)	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	4.2	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Number of Beams	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Total Dead Weight (kip/ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Resisting Moment (kft/ft)	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	62.3	32.7	32.7	32.7	32.7	32.7	32.7	32.7
Resisting Vertical Force (kip/ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	78.8	80.7	81.7	81.5	80.1	80.7	85.3	80.4	176.4	84.1	79.9	84.0	80.2	81.3	81.4	79.7
Maximum Vertical Force (kips/ft)	3.7	3.8	3.9	3.9	3.8	3.8	4.0	3.8	4.5	4.0	3.8	4.0	3.8	3.9	3.9	3.8
Maximum Horizontal Force (kips/span)	14.2	14.3	14.1	14.4	14.3	14.5	14.6	14.5	23.6	14.5	14.5	14.6	14.5	14.4	14.5	14.2
Maximum Horizontal Force (kips/ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Maximum Moment (k-ft)	1,778.1	1,828.5	1,860.6	1,857.2	1,804.6	1,862.5	1,932.9	1,860.7	4,751.8	1,885.5	1,810.6	1,888.5	1,850.8	1,854.8	1,853.7	1,792.4
Maximum Moment (k-ft/ft)	84.3	86.7	88.2	88.1	85.6	88.3	91.7	88.3	121.8	89.8	86.2	89.9	88.1	88.3	88.3	85.4

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 060028

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																	
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**4.6**	**4.7**	**4.7**	**4.6**	**4.7**	**4.6**	**4.7**	**4.7**	**4.7**	**4.6**	**4.4**	**4.3**	**3.3**	**3.2**	**3.1**	**3.2**	**3.2**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																	
100-yr Water Surface Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Bed Elevation (ft - MSL)	-15	-15	-15	-14	-14	-13	-13	-13	-12	-12	-11	-9	-7	-4	-2	0	0
Low Chord Elevation (ft - MSL)	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
100-yr Max Wave Crest Elevation (ft - MSL)	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3
100-yr Wave Height (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
100-yr Wave Period (seconds)	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.5	3.5	3.5	3.5	3.6	3.8	4.1	4.3	4.7	4.7

SPAN PROPERITES																	
Span Length (ft)	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Span Width (ft)	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Number of Beams	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Total Dead Weight (kip/ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Resisting Moment (kft/ft)	32.7	32.7	32.7	32.7	32.7	32.7	32.7	32.7	32.7	32.7	32.7	32.7	32.7	32.7	32.7	32.7	32.7
Resisting Vertical Force (kip/ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3

100-YEAR FORCE-MOMENT VALUES																	
Maximum Vertical Force (kips/span)	81.1	80.9	81.2	80.7	82.2	79.9	79.1	79.9	79.8	78.4	76.7	68.8	61.7	41.6	42.2	47.6	48.6
Maximum Vertical Force (kips/ft)	3.9	3.9	3.9	3.8	3.9	3.8	3.8	3.8	3.8	3.7	3.7	3.3	2.9	2.0	2.0	2.3	2.3
Maximum Horizontal Force (kips/span)	14.2	14.3	14.1	14.0	13.9	14.2	14.0	14.2	14.2	14.1	14.0	13.9	14.2	15.0	16.0	17.4	17.4
Maximum Horizontal Force (kips/ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8
Maximum Moment (k-ft)	1,793.1	1,845.0	1,848.5	1,806.6	1,840.6	1,784.2	1,827.7	1,824.3	1,825.1	1,783.9	1,710.5	1,665.4	1,312.4	1,270.0	1,225.1	1,243.3	1,269.6
Maximum Moment (k-ft/ft)	85.4	87.9	88.0	86.0	87.6	85.0	87.0	86.9	86.9	84.9	81.5	79.3	62.5	60.5	58.3	59.2	60.5

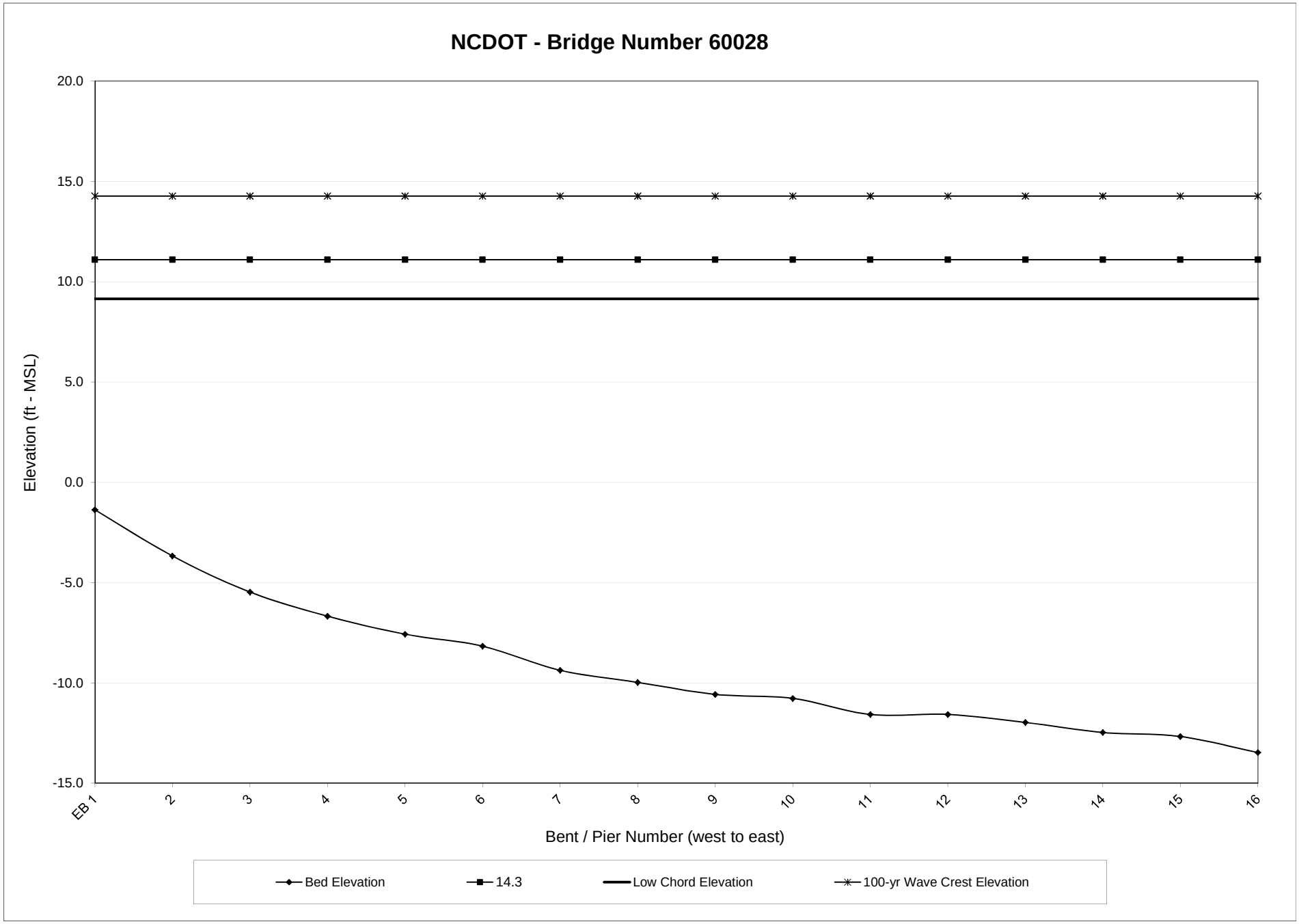
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

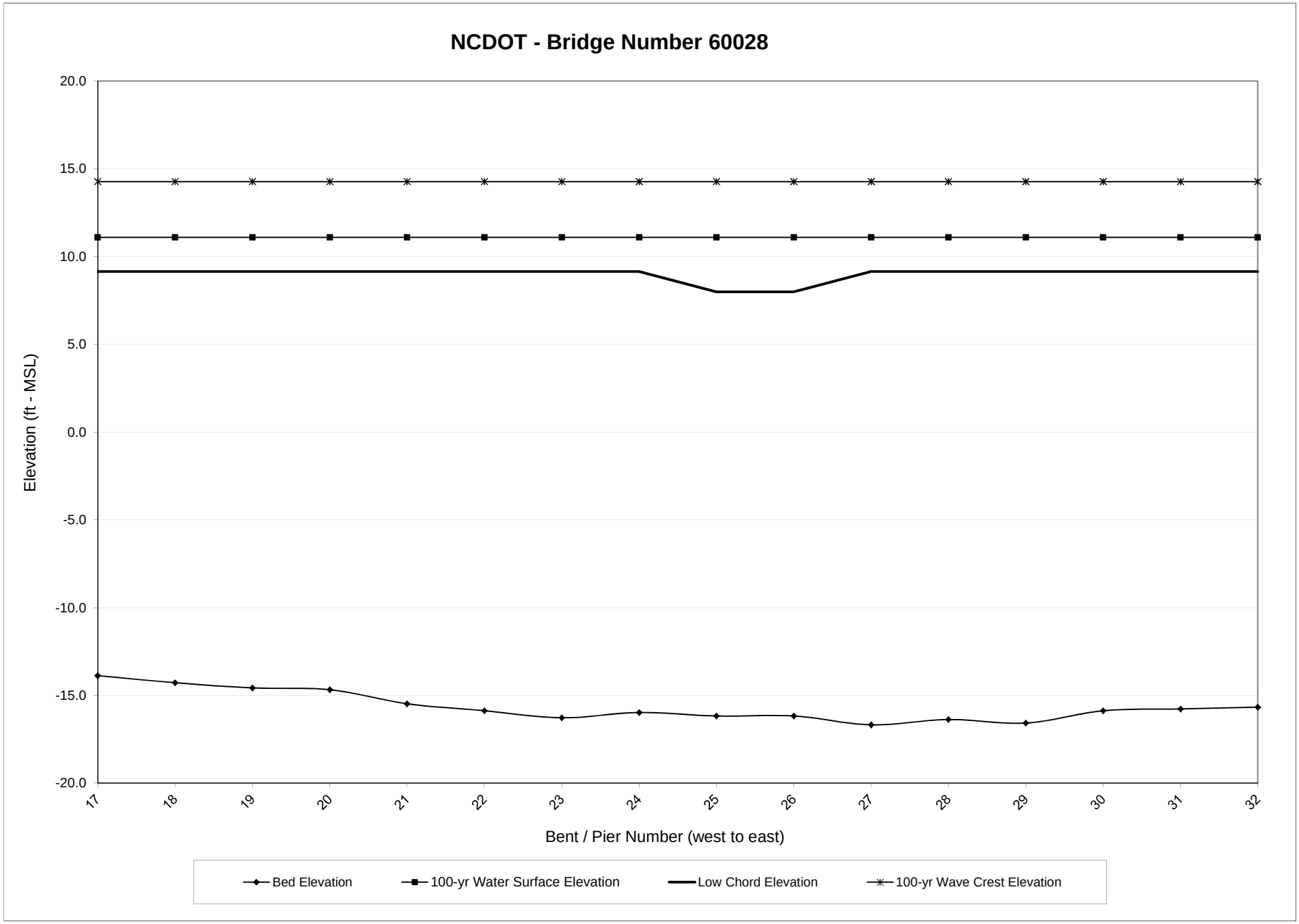
Notes:

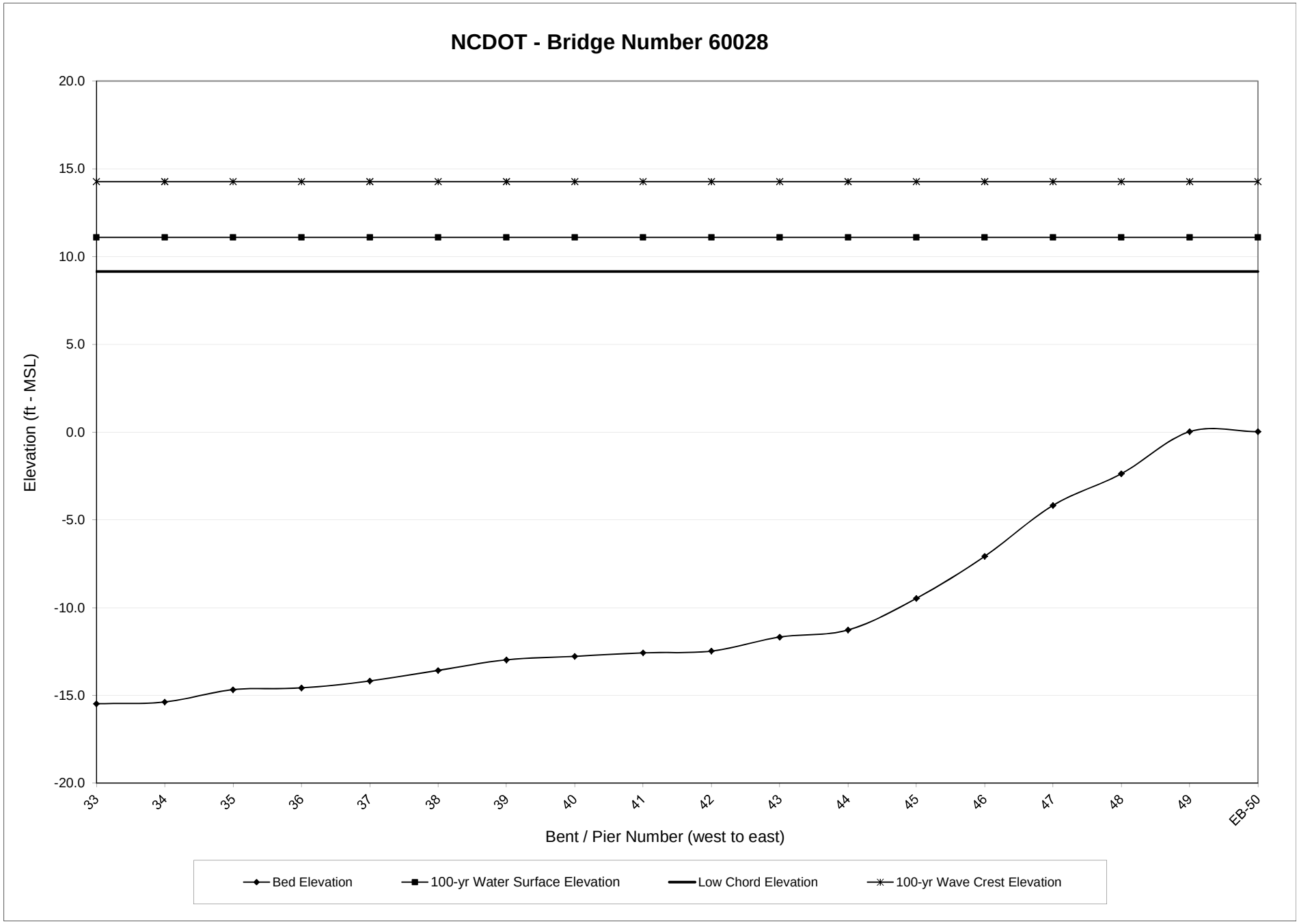
1 - Bridge spans 33-48 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 60028
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Bent / Pier Number (west to east)
Bed Elevation
14.3
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 60028
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 60028
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
EB-50
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 60048

SOUTH CREEK

NC33

BEAUFORT COUNTY

DRAFT

NCDOT BRIDGE NO. 60048

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY												
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.7**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES												
HYDRAULIC VALUES												
100-yr Water Surface Elevation (ft - MSL)	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Bed Elevation (ft - MSL)	-1	-6	-9	-11	-12	-12	-10	-9	-8	-7	1	1
Low Chord Elevation (ft - MSL)	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
100-yr Max Wave Crest Elevation (ft - MSL)	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3
100-yr Wave Height (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
100-yr Wave Period (seconds)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
SPAN PROPERITES												
Span Length (ft)	24.3	23.5	25.5	24.6	24.5	39.2	24.5	24.5	24.5	24.5	24.5	24.5
Span Width (ft)	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Number of Beams	6	6	6	6	6	4	6	6	6	6	6	6
Beam Dead Weight (lb/lf) - Each	52	52	52	52	52	52	52	52	52	52	52	52
Beam Dead Weight (kip/ft) - Total	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Slab Dead Weight (kip/ft)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Total Dead Weight (kip/ft)	2.2	2.2	2.2	2.2	2.2	2.1	2.2	2.2	2.2	2.2	2.2	2.2
Resisting Moment (kft/ft)	25.8	25.8	25.8	25.8	25.8	24.6	25.8	25.8	25.8	25.8	25.8	25.8
Resisting Vertical Force (kip/ft)	2.2	2.2	2.2	2.2	2.2	2.1	2.2	2.2	2.2	2.2	2.2	2.2
100-YEAR FORCE-MOMENT VALUES												
Maximum Vertical Force (kips/span)	50.3	48.0	52.5	50.4	50.1	101.3	50.2	50.4	50.3	50.3	50.2	50.2
Maximum Vertical Force (kips/ft)	2.1	2.0	2.1	2.0	2.0	2.6	2.0	2.1	2.1	2.1	2.0	2.0
Maximum Horizontal Force (kips/span)	0.9	0.9	1.0	0.9	0.9	2.3	0.9	0.9	0.9	0.9	0.9	0.9
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	726.9	696.8	761.5	729.5	724.3	1487.5	727.7	731.9	731.1	729.1	723.8	723.8
Maximum Moment (k-ft/ft)	30.0	29.6	29.9	29.7	29.6	38.0	29.7	29.9	29.8	29.8	29.5	29.5

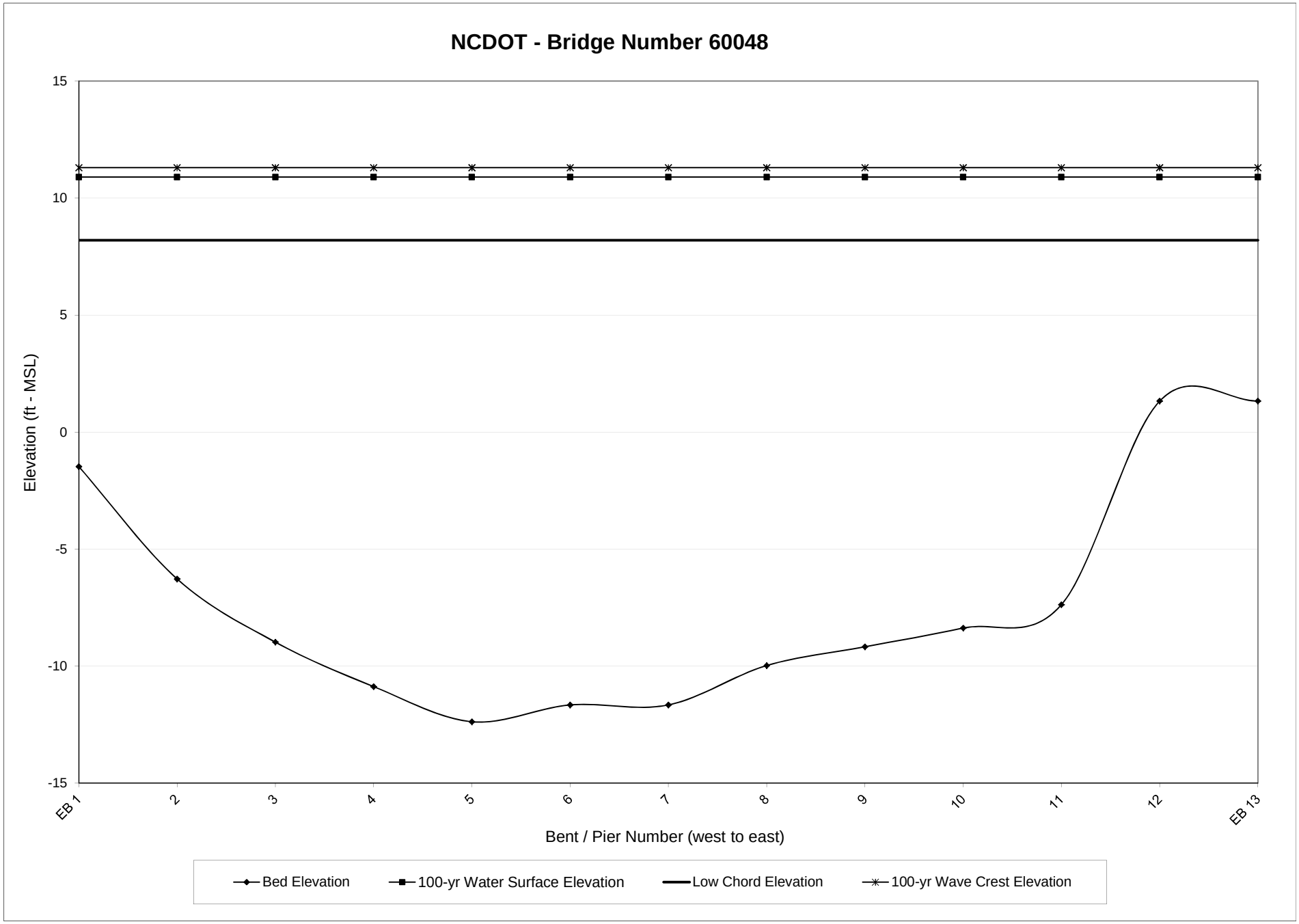
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-12 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 60048
15
10
5
0
-5
-10
-15
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
EB 13
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 60064

PUNGO CREEK

NC99

BEAUFORT COUNTY

DRAFT

NCDOT BRIDGE NO. 60064

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY															
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.1**	**1.1**	**1.0**	**0.9**	**1.1**	**1.2**	**1.0**	**1.0**	**1.1**	**1.1**	**1.0**	**1.0**	**1.1**	**1.0**	**1.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES															
100-yr Water Surface Elevation (ft - MSL)	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Bed Elevation (ft - MSL)	-9	-14	-23	-26	-27	-29	-29	-26	-26	-24	-22	-18	-15	-6	-6
Low Chord Elevation (ft - MSL)	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
100-yr Max Wave Crest Elevation (ft - MSL)	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3
100-yr Wave Height (ft)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
100-yr Wave Period (seconds)	3.1	2.9	2.7	2.6	2.6	2.6	2.6	2.6	2.6	2.7	2.7	2.8	2.9	3.4	3.4

SPAN PROPERITES															
Span Length (ft)	43.3	45.0	55.0	55.0	45.0	45.0	55.0	55.0	45.0	45.0	55.0	55.0	45.0	45.0	45.0
Span Width (ft)	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
Deck Thickness (ft)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Overhang (ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Beams	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Beam Dead Weight (lb/lf) - Each	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Total Dead Weight (kip/ft)	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Resisting Moment (kft/ft)	188.2	196.1	243.3	243.3	196.1	196.1	243.3	243.3	196.1	196.1	243.3	243.3	196.1	196.1	196.1
Resisting Vertical Force (kip/ft)	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5

100-YEAR FORCE-MOMENT VALUES															
Maximum Vertical Force (kips/span)	250	278	366	355	282	287	365	369	281	280	370	364	277	249	249
Maximum Vertical Force (kips/ft)	6	6	7	6	6	6	7	7	6	6	7	7	6	6	6
Maximum Horizontal Force (kips/span)	21	14	17	16	14	13	17	16	14	14	17	16	13	16	16
Maximum Horizontal Force (kips/ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum Moment (k-ft)	5,093	5,593	7,481	7,192	5,797	5,882	7,541	7,590	5,765	5,635	7,530	7,336	5,660	5,042	5,042
Maximum Moment (k-ft/ft)	118	124	136	131	129	131	137	138	128	125	137	133	126	112	112

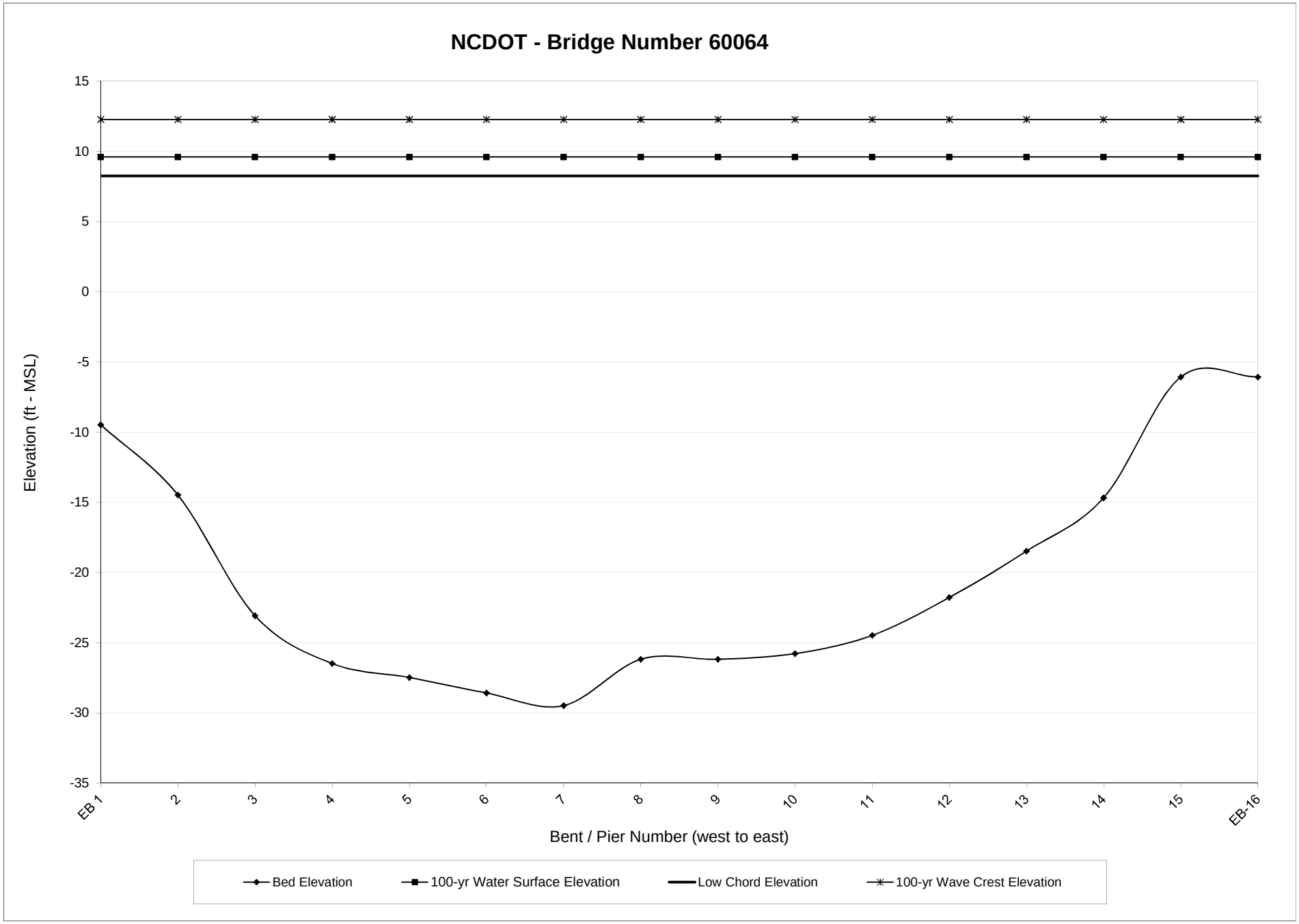
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-15 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 60064
Elevation (ft - MSL)
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
EB-16
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 60066

PUNGO RIVER

US264

BEAUFORT COUNTY

DRAFT

NCDOT BRIDGE NO. 60066

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																	
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.3**	**2.1**	**1.8**	**2.1**	**2.1**	**2.2**	**2.8**	**2.4**	**2.6**	**2.6**	**2.9**	**2.9**	**3.0**	**3.0**	**3.0**	**3.0**	**2.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																	
100-yr Water Surface Elevation (ft - MSL)	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
Bed Elevation (ft - MSL)	-3	-5	-7	-12	-18	-23	-24	-24	-22	-18	-15	-14	-12	-9	-7	-3	-3
Low Chord Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
100-yr Max Wave Crest Elevation (ft - MSL)	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
100-yr Wave Height (ft)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
100-yr Wave Period (seconds)	2.0	1.9	1.9	1.8	1.8	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.9	2.0	2.0

SPAN PROPERITES																	
Span Length (ft)	34.5	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
Span Width (ft)	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Total Dead Weight (kip/ft)	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Resisting Moment (kft/ft)	52.2	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4
Resisting Vertical Force (kip/ft)	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1

100-YEAR FORCE-MOMENT VALUES																	
Maximum Vertical Force (kips/span)	121.1	124.3	128.8	132.1	137.1	140.5	141.2	142.2	140.0	137.8	136.7	135.7	134.8	132.8	128.9	121.6	121.6
Maximum Vertical Force (kips/ft)	3.5	2.0	2.2	2.9	2.9	2.9	3.4	3.1	3.3	3.4	3.7	3.7	3.8	3.8	3.8	3.9	3.7
Maximum Horizontal Force (kips/span)	7.5	6.5	6.3	6.3	6.3	6.3	6.2	6.3	6.2	6.3	6.3	6.3	6.3	6.2	6.4	7.1	7.1
Maximum Horizontal Force (kips/ft)	0.2	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Maximum Moment (k-ft)	2,401.2	2,473.0	2,591.8	2,684.1	2,779.8	2,749.2	2,768.5	2,791.7	2,750.6	2,715.5	2,691.4	2,670.0	2,658.5	2,602.5	2,511.1	2,339.3	2,339.3
Maximum Moment (k-ft/ft)	69.6	60.4	53.0	63.0	61.8	63.6	83.0	71.8	76.3	76.2	85.4	85.4	87.5	87.1	87.4	87.7	84.3

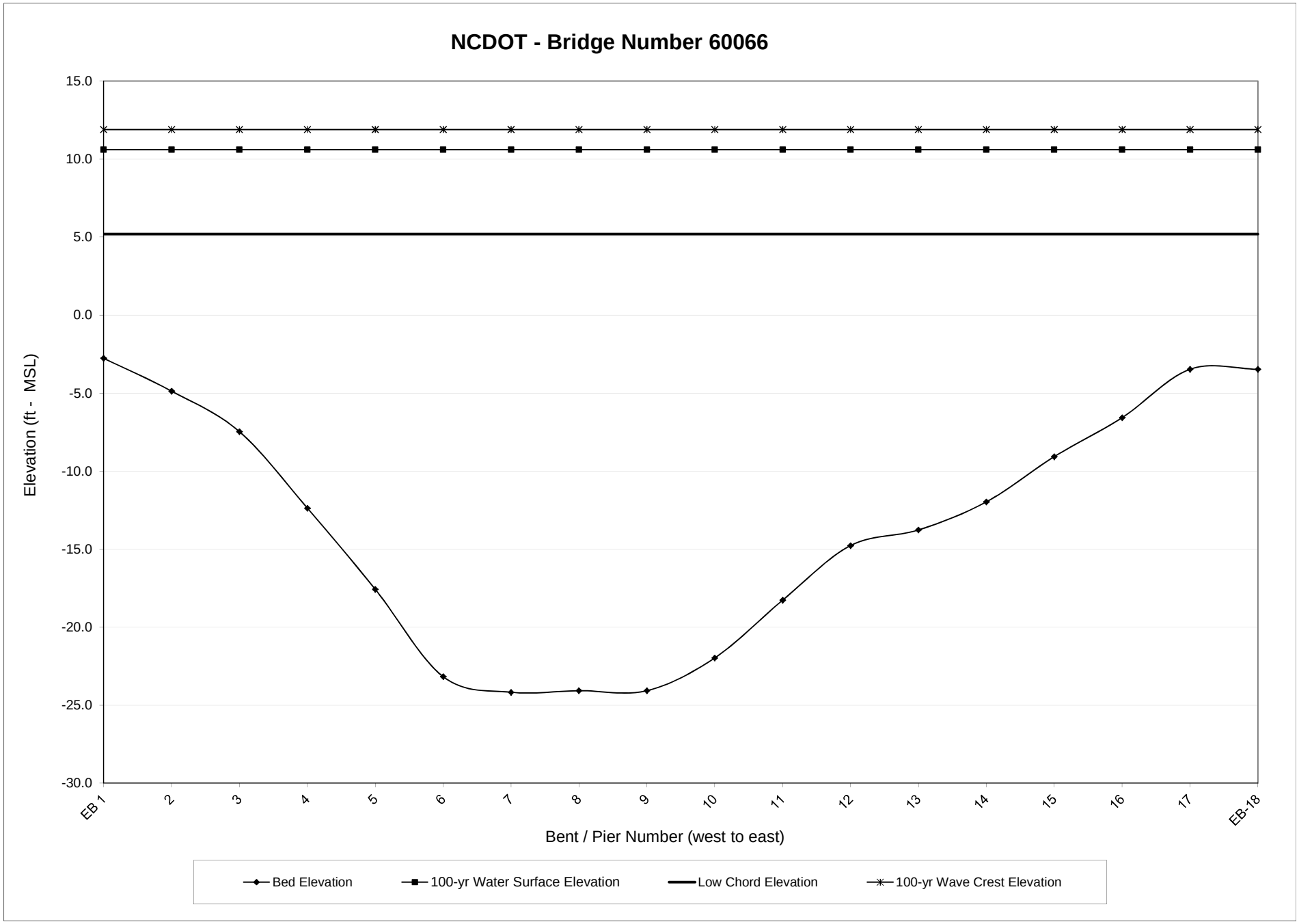
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-17 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 60066
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
EB-18
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 60070

BR OF PUNGO CREEK

NC99

BEAUFORT COUNTY

DRAFT

NCDOT BRIDGE NO. 60070

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY			
SPAN NUMBER	1	2	3
CRITICALITY INDEX (defined below)	4	4	4
VULNERABILITY INDEX (defined below)	2.8	0.9	0.8

SURGE/WAVE LOAD COMPUTATION INPUT VALUES			
HYDRAULIC VALUES			
100-yr Water Surface Elevation (ft - MSL)	9.6	9.6	9.6
Bed Elevation (ft - MSL)	-17	-17	-17
Low Chord Elevation (ft - MSL)	4.3	4.3	4.3
100-yr Max Wave Crest Elevation (ft - MSL)	12.5	12.5	12.5
100-yr Wave Height (ft)	4.2	4.2	4.2
100-yr Wave Period (seconds)	3.0	3.0	3.0
SPAN PROPERITES			
Span Length (ft)	24.0	24.0	24.0
Span Width (ft)	42.0	42.0	42.0
Deck Thickness (ft)	1.8	1.8	1.8
Overhang (ft)	0.0	0.0	0.0
Number of Beams	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	11.0	11.0	11.0
Total Dead Weight (kip/ft)	11.0	11.0	11.0
Resisting Moment (kft/ft)	113.0	113.0	113.0
Resisting Vertical Force (kip/ft)	11.0	11.0	11.0
100-YEAR FORCE-MOMENT VALUES			
Maximum Vertical Force (kips/span)	153.7	153.4	153.4
Maximum Vertical Force (kips/ft)	6.4	2.0	2.2
Maximum Horizontal Force (kips/span)	13.0	13.0	13.0
Maximum Horizontal Force (kips/ft)	0.5	0.7	0.6
Maximum Moment (k-ft)	4,282.8	4,305.0	4,305.0
Maximum Moment (k-ft/ft)	178.4	60.4	53.0

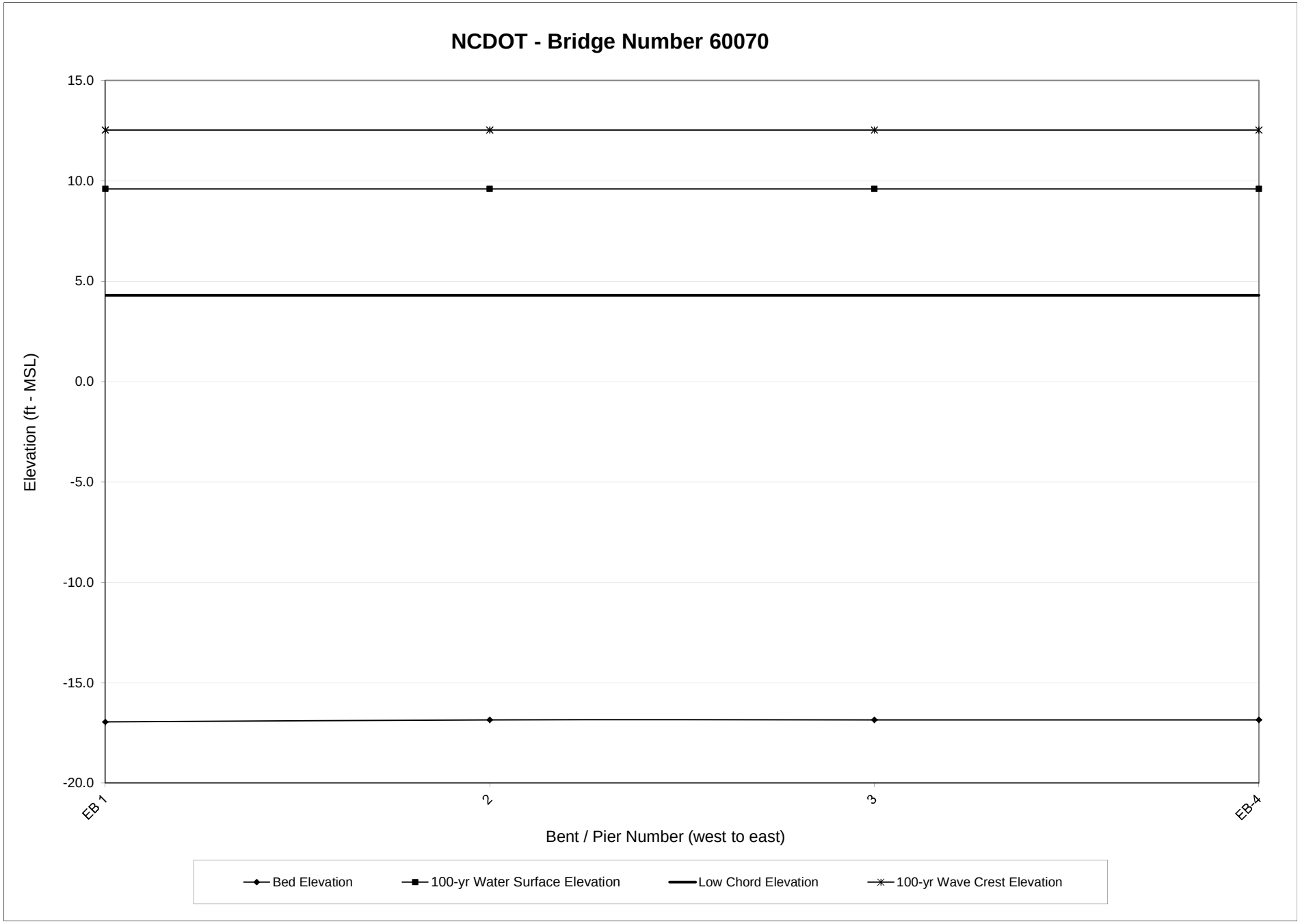
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-3 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 60070
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
EB 1
2
3
EB-4
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 60077

PANTEGO CREEK

NC97 - NC98 - NC99

BEAUFORT COUNTY

DRAFT

NCDOT BRIDGE NO. 60077

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																		
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.6**	**2.6**	**2.6**	**2.6**	**2.6**	**2.7**	**2.6**	**2.6**	**2.5**	**2.7**	**2.7**	**2.7**	**2.6**	**2.6**	**2.6**	**2.6**	**2.6**	**1.2**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																		
HYDRAULIC VALUES																		
100-yr Water Surface Elevation (ft - MSL)	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Bed Elevation (ft - MSL)	-4	-7	-7	-8	-9	-9	-9	-10	-10	-10	-10	-10	-10	-10	-11	-10	-11	-11
Low Chord Elevation (ft - MSL)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
100-yr Max Wave Crest Elevation (ft - MSL)	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
100-yr Wave Height (ft)	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
100-yr Wave Period (seconds)	6.7	6.2	6.1	6.0	5.9	5.9	5.9	5.8	5.8	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.6
SPAN PROPERITES																		
Span Length (ft)	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4
Span Width (ft)	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	7
Beam Dead Weight (lb/lf) - Each	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	442
Beam Dead Weight (kip/ft) - Total	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	3.1
Slab Dead Weight (kip/ft)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Total Dead Weight (kip/ft)	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	4.8
Resisting Moment (kft/ft)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	91.9
Resisting Vertical Force (kip/ft)	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	4.8
100-YEAR FORCE-MOMENT VALUES																		
Maximum Vertical Force (kips/span)	160.5	172.2	174.6	174.8	176.5	177.0	177.9	179.8	179.8	181.0	180.9	181.0	182.3	182.3	184.2	182.3	183.4	187.0
Maximum Vertical Force (kips/ft)	4.1	4.4	4.4	4.4	4.5	4.5	4.5	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.7	4.6	4.7	4.7
Maximum Horizontal Force (kips/span)	47.6	42.1	41.1	40.4	46.8	38.8	42.4	41.5	36.7	42.8	36.2	42.8	39.9	39.9	35.1	39.9	34.9	39.8
Maximum Horizontal Force (kips/ft)	1.2	1.1	1.0	1.0	1.2	1.0	1.1	1.1	0.9	1.1	0.9	1.1	1.0	1.0	0.9	1.0	0.9	1.0
Maximum Moment (k-ft)	2,296.9	2,338.1	2,355.2	2,307.0	2,306.0	2,394.4	2,309.6	2,300.6	2,291.6	2,418.3	2,406.4	2,418.3	2,316.9	2,316.9	2,370.3	2,316.9	2,366.8	2,445.8
Maximum Moment (k-ft/ft)	58.3	59.3	59.8	58.5	58.5	60.7	58.6	58.4	58.1	61.4	61.1	61.4	58.8	58.8	60.1	58.8	60.0	62.1

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-18 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 60077

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																	
SPAN NUMBER	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.6**	**2.6**	**2.6**	**2.6**	**2.7**	**2.6**	**2.7**	**2.6**	**2.6**	**2.6**	**2.5**	**2.6**	**2.6**	**2.6**	**2.6**	**2.6**	**2.6**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																	
100-yr Water Surface Elevation (ft - MSL)	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Bed Elevation (ft - MSL)	-11	-10	-10	-10	-10	-10	-10	-10	-10	-10	-8	-9	-9	-9	-8	-6	-6
Low Chord Elevation (ft - MSL)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
100-yr Max Wave Crest Elevation (ft - MSL)	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
100-yr Wave Height (ft)	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
100-yr Wave Period (seconds)	5.7	5.7	5.7	5.7	5.7	5.8	5.7	5.8	5.8	5.8	6.0	5.8	5.9	5.9	6.0	6.4	6.4

SPAN PROPERITES																	
Span Length (ft)	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4
Span Width (ft)	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
Beam Dead Weight (kip/ft) - Total	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Slab Dead Weight (kip/ft)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Total Dead Weight (kip/ft)	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Resisting Moment (kft/ft)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Resisting Vertical Force (kip/ft)	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1

100-YEAR FORCE-MOMENT VALUES																	
Maximum Vertical Force (kips/span)	184.2	182.3	182.3	182.3	180.9	181.4	181.0	179.8	179.8	179.8	174.4	179.4	175.5	176.5	173.4	168.0	168.0
Maximum Vertical Force (kips/ft)	4.7	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.4	4.6	4.5	4.5	4.4	4.3	4.3
Maximum Horizontal Force (kips/span)	35.1	39.9	39.9	39.9	43.1	36.4	42.8	41.5	41.5	41.5	39.4	37.4	38.6	46.8	40.1	53.8	53.8
Maximum Horizontal Force (kips/ft)	0.9	1.0	1.0	1.0	1.1	0.9	1.1	1.1	1.1	1.1	1.0	0.9	1.0	1.2	1.0	1.4	1.4
Maximum Moment (k-ft)	2,370.3	2,316.9	2,316.9	2,316.9	2,408.8	2,308.0	2,418.3	2,300.6	2,300.6	2,300.6	2,289.0	2,323.8	2,369.9	2,306.0	2,358.7	2,365.6	2,365.6
Maximum Moment (k-ft/ft)	60.1	58.8	58.8	58.8	61.1	58.6	61.4	58.4	58.4	58.4	58.1	59.0	60.1	58.5	59.8	60.0	60.0

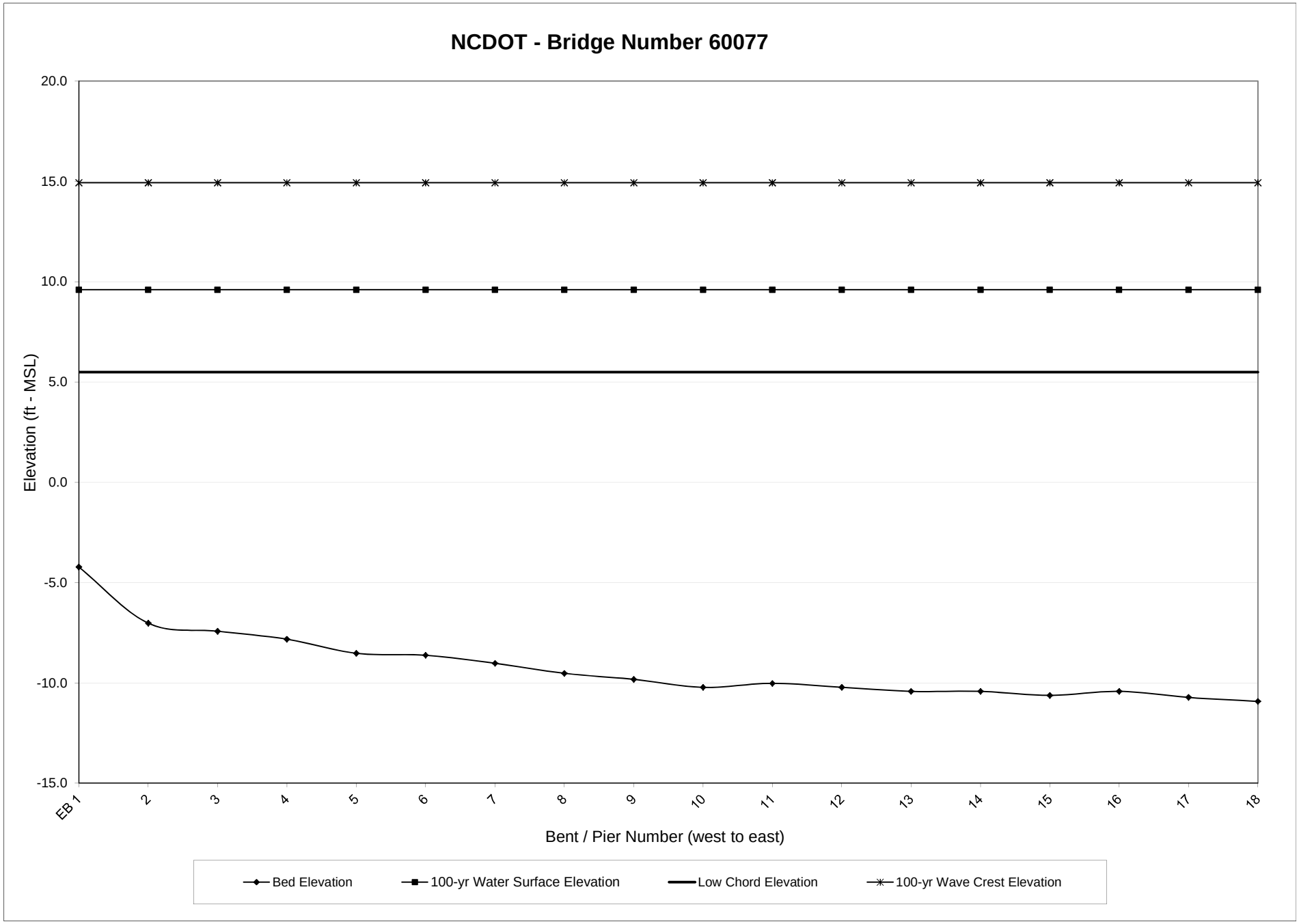
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

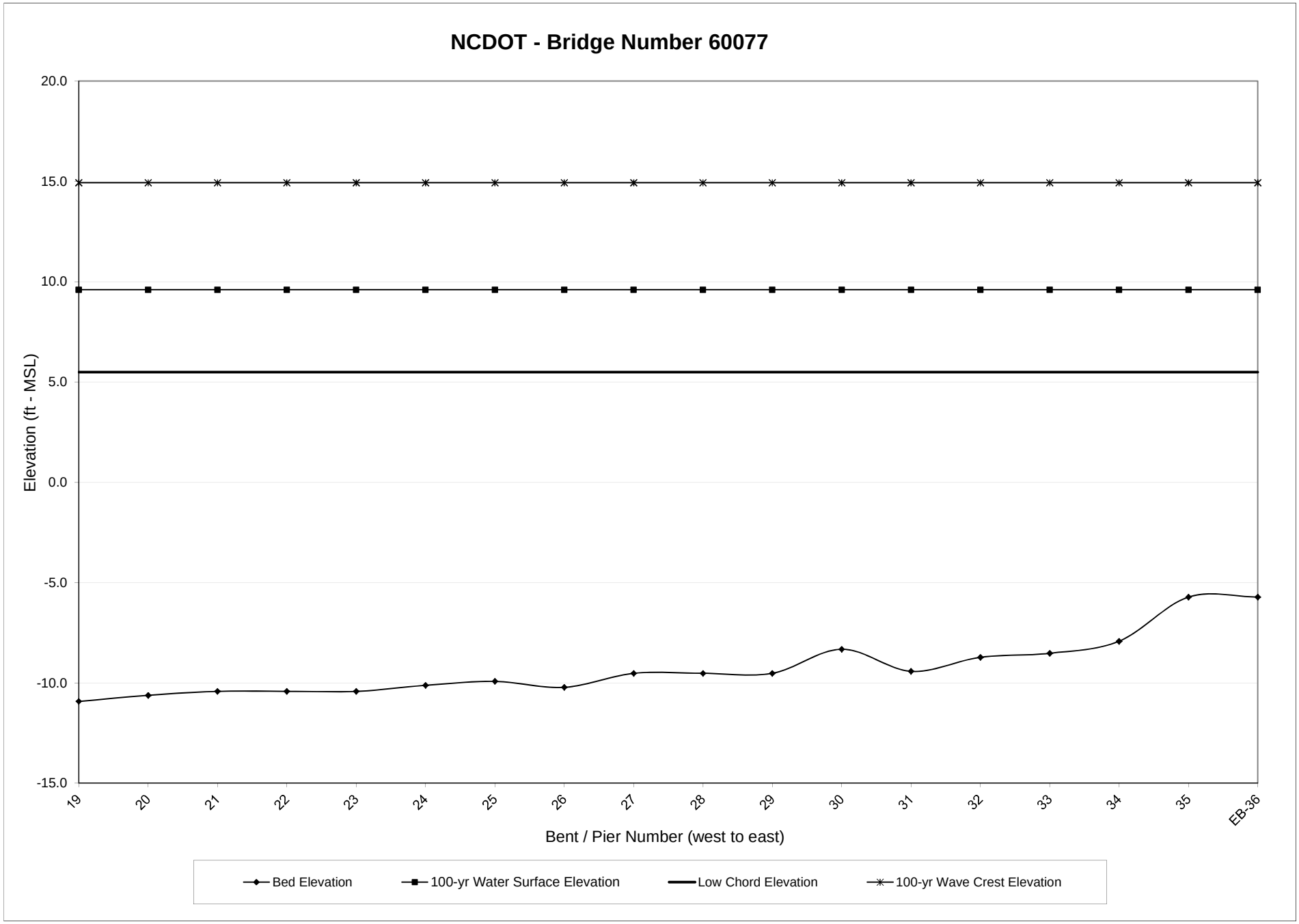
Notes:

1 - Bridge spans 19-35 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 60077
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 60077
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
EB-36
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 60103

RUNYON CREEK

NC32

BEAUFORT COUNTY

DRAFT

NCDOT BRIDGE NO. 60103

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY							
SPAN NUMBER	1	2	3	4	5	6	7
CRITICALITY INDEX (defined below)	4	4	4	4	4	4	4
VULNERABILITY INDEX (defined below)	1.7	1.7	1.7	1.7	1.7	1.7	1.7

SURGE/WAVE LOAD COMPUTATION INPUT VALUES							
HYDRAULIC VALUES							
100-yr Water Surface Elevation (ft - MSL)	13.6	13.6	13.6	13.6	13.6	13.6	13.6
Bed Elevation (ft - MSL)	-5	-10	-11	-13	-11	-6	-6
Low Chord Elevation (ft - MSL)	1.4	2.1	3.6	3.4	1.8	1.8	1.0
100-yr Max Wave Crest Elevation (ft - MSL)	15.5	15.5	15.5	15.5	15.5	15.5	15.5
100-yr Wave Height (ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9
100-yr Wave Period (seconds)	2.5	2.3	2.3	2.3	2.3	2.4	2.4
SPAN PROPERITES							
Span Length (ft)	62.8	63.0	63.0	63.0	63.0	63.0	62.8
Span Width (ft)	49.3	49.3	49.3	49.3	49.3	49.3	49.3
Deck Thickness (ft)	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Overhang (ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Number of Beams	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Total Dead Weight (kip/ft)	11.5	11.5	11.5	11.5	11.5	11.5	11.5
Resisting Moment (kft/ft)	349.1	350.1	350.1	350.1	350.1	350.1	349.1
Resisting Vertical Force (kip/ft)	11.5	11.5	11.5	11.5	11.5	11.5	11.5
100-YEAR FORCE-MOMENT VALUES							
Maximum Vertical Force (kips/span)	723.0	677.0	674.9	675.2	677.3	714.9	712.8
Maximum Vertical Force (kips/ft)	11.5	10.7	10.7	10.7	10.8	11.3	11.3
Maximum Horizontal Force (kips/span)	27.6	28.0	28.6	28.8	27.9	26.5	27.4
Maximum Horizontal Force (kips/ft)	0.4	0.4	0.5	0.5	0.4	0.4	0.4
Maximum Moment (k-ft)	21,648	21,088	21,052	21,251	21,489	21,280	21,223
Maximum Moment (k-ft/ft)	345	335	334	337	341	338	338

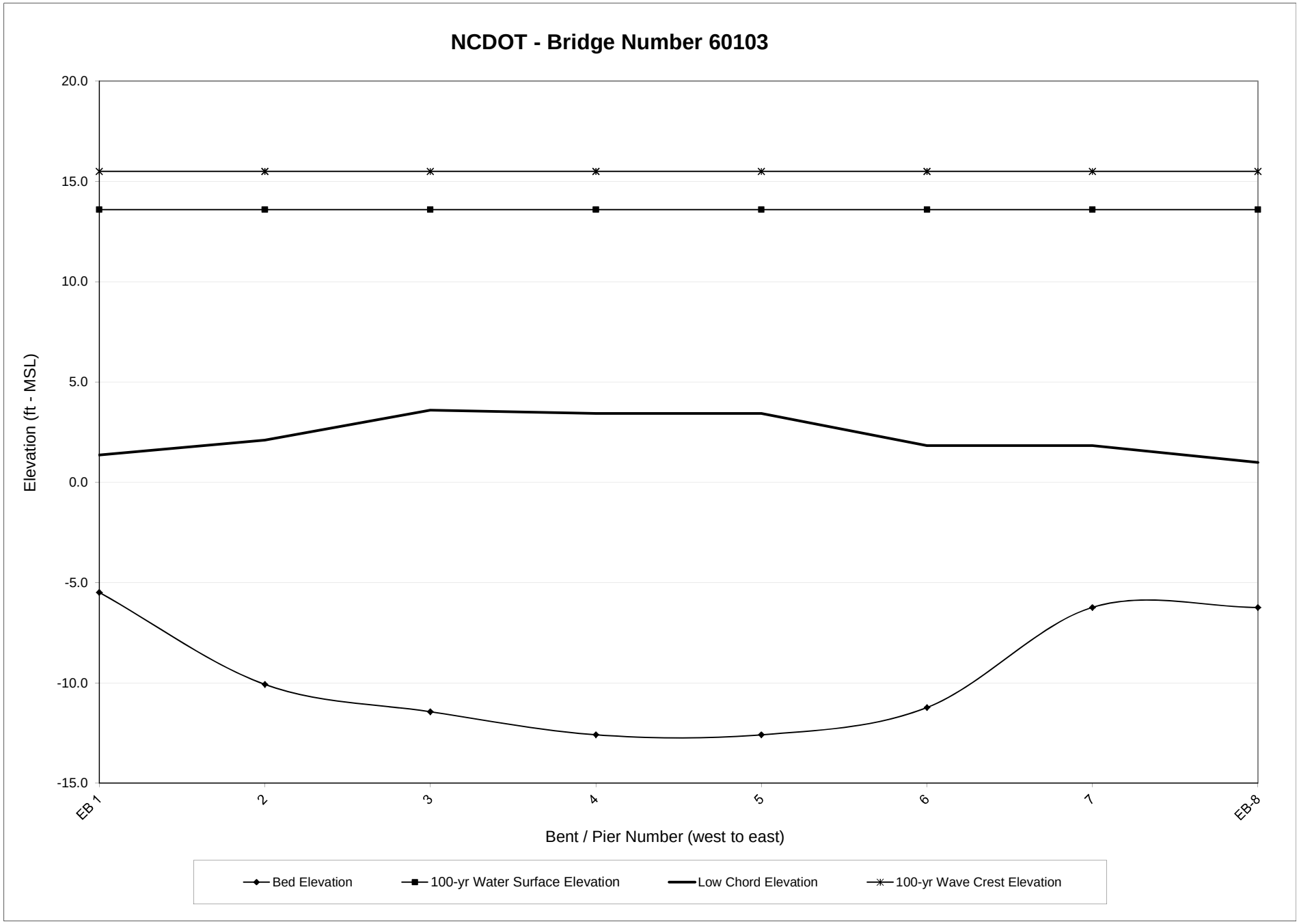
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-7 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 60103
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
EB-8
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 70038

CHOWAN RIVER

US15 - US16 - US17

BERTIE COUNTY

DRAFT

NCDOT BRIDGE NO. 70038

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Bed Elevation (ft - MSL)	2	1	1	0	0	-1	-2	-2	-3	-3	-4	-4	-4	-4	-4	-5
Low Chord Elevation (ft - MSL)	16.4	16.4	16.4	16.4	16.4	16.4	16.4	19.7	19.7	16.4	16.4	16.4	16.4	26.3	29.5	32.8
100-yr Max Wave Crest Elevation (ft - MSL)	12.8	12.8	13.7	14.6	14.8	13.7	15.7	15.0	15.4	15.5	16.4	16.4	16.4	16.4	16.4	16.4
100-yr Wave Height (ft)	7.1	7.1	8.4	9.7	10.0	8.4	11.3	10.2	10.8	11.0	12.2	12.2	12.2	12.2	12.2	12.2
100-yr Wave Period (seconds)	9.0	9.0	9.0	9.0	9.1	9.0	9.1	9.1	9.1	9.1	7.3	6.8	6.9	6.9	7.0	7.1
SPAN PROPERITES																
Span Length (ft)	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5
Span Width (ft)	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	1175	1175	1175	1175	1175	1175
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	8.2	8.2	8.2	8.2	8.2	8.2
Slab Dead Weight (kip/ft)	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
Total Dead Weight (kip/ft)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	19.0	19.0	19.0	19.0	19.0	19.0
Resisting Moment (kft/ft)	287.0	287.0	287.0	287.0	287.0	287.0	287.0	287.0	287.0	287.0	287.0	287.0	287.0	287.0	287.0	287.0
Resisting Vertical Force (kip/ft)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	19.0	19.0	19.0	19.0	19.0	19.0
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.5	11.4	12.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 11-13 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 70038

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Bed Elevation (ft - MSL)	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-4	-5	-5
Low Chord Elevation (ft - MSL)	36.1	39.4	42.1	44.8	47.6	50.3	53.1	55.8	58.5	61.3	64.0	64.0	64.0	64.0	61.9	59.7
100-yr Max Wave Crest Elevation (ft - MSL)	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
100-yr Wave Height (ft)	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
100-yr Wave Period (seconds)	7.2	7.2	7.2	7.3	7.3	7.3	7.3	7.2	7.4	7.3	7.5	7.6	7.6	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	55.5	55.5	55.5	55.5	55.5	55.5	56.6	134.5	134.5	134.5	134.5	134.5	196.9	229.7	196.9	134.5
Span Width (ft)	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	1175	1175	1175	1175	1175	1175	1175	1175	1175	1175	1175	1175	178	178	178	1175
Beam Dead Weight (kip/ft) - Total	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	1.2	1.2	1.2	8.2
Slab Dead Weight (kip/ft)	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
Total Dead Weight (kip/ft)	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	12.0	12.0	12.0	19.0
Resisting Moment (kft/ft)	287.0	287.0	287.0	287.0	287.0	287.0	292.7	710.8	710.8	710.8	710.8	710.8	1,045.2	1,221.2	1,045.2	710.8
Resisting Vertical Force (kip/ft)	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	12.0	12.0	12.0	19.0

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 70038

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Bed Elevation (ft - MSL)	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
Low Chord Elevation (ft - MSL)	57.5	55.2	53.0	50.8	48.6	46.4	44.1	41.9	39.7	37.5	35.3	33.0	30.8	28.6	26.4	26.3
100-yr Max Wave Crest Elevation (ft - MSL)	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
100-yr Wave Height (ft)	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
100-yr Wave Period (seconds)	7.5	7.5	7.6	7.5	7.5	7.6	7.6	7.8	7.8	7.8	7.9	7.9	8.2	8.1	8.4	8.6

SPAN PROPERITES																
Span Length (ft)	134.5	134.5	134.5	134.5	134.5	134.5	134.5	134.5	134.5	89.8	89.8	89.8	89.8	89.8	89.8	89.8
Span Width (ft)	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	1175	1175	1175	1175	1175	1175	1175	1175	1175	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
Total Dead Weight (kip/ft)	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Resisting Moment (kft/ft)	710.8	710.8	710.8	710.8	710.8	710.8	710.8	710.8	710.8	470.9	470.9	470.9	470.9	470.9	470.9	470.9
Resisting Vertical Force (kip/ft)	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	16.5	16.5	16.5	16.5	16.5	16.5	16.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 70038

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Bed Elevation (ft - MSL)	-5	-5	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Low Chord Elevation (ft - MSL)	25.9	25.5	25.2	24.8	24.4	24.1	23.7	23.3	23.0	22.6	22.2	21.9	21.5	21.1	20.8	20.4
100-yr Max Wave Crest Elevation (ft - MSL)	16.4	15.5	15.8	15.7	15.5	15.4	14.6	15.1	15.1	15.0	14.8	14.1	14.6	14.6	14.7	14.9
100-yr Wave Height (ft)	12.2	11.0	11.4	11.3	11.0	10.8	9.7	10.5	10.5	10.3	10.0	9.1	9.8	9.7	9.9	10.2
100-yr Wave Period (seconds)	9.1	9.1	9.1	9.1	9.1	9.1	9.0	9.1	9.1	9.1	9.1	9.0	9.0	9.0	9.0	9.1

SPAN PROPERITES																
Span Length (ft)	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8
Span Width (ft)	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
Total Dead Weight (kip/ft)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Resisting Moment (kft/ft)	470.9	470.9	470.9	470.9	470.9	470.9	470.9	470.9	470.9	470.9	470.9	470.9	470.9	470.9	470.9	470.9
Resisting Vertical Force (kip/ft)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 70038
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY									
SPAN NUMBER	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**1.4**	**1.3**	**1.5**	**1.0**	**1.2**	**1.2**	**1.2**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES									
100-yr Water Surface Elevation (ft - MSL)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Bed Elevation (ft - MSL)	-6	-6	-6	-6	-6	-6	-6	-6	-6
Low Chord Elevation (ft - MSL)	20.1	19.7	9.8	9.8	9.8	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	14.6	14.7	14.8	14.6	15.5	13.5	11.4	11.4	11.4
100-yr Wave Height (ft)	9.7	9.9	10.0	9.8	11.0	8.1	5.2	5.2	5.2
100-yr Wave Period (seconds)	9.0	9.0	9.1	9.0	9.1	9.0	8.9	8.9	8.9

SPAN PROPERITES									
Span Length (ft)	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.6	89.6
Span Width (ft)	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5	71.5
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Number of Beams	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
Total Dead Weight (kip/ft)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Resisting Moment (kft/ft)	470.9	470.9	470.9	470.9	470.9	470.9	470.9	470.1	470.1
Resisting Vertical Force (kip/ft)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5

100-YEAR FORCE-MOMENT VALUES									
Maximum Vertical Force (kips/span)	0.0	0.0	1258.8	1212.1	1519.9	1172.3	1487.9	1485.4	1485.4
Maximum Vertical Force (kips/ft)	0.0	0.0	14.0	13.5	16.9	13.1	16.6	16.6	16.6
Maximum Horizontal Force (kips/span)	0.0	0.0	430.3	378.9	409.1	351.9	85.1	85.0	85.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	4.8	4.2	4.6	3.9	0.9	0.9	0.9
Maximum Moment (k-ft)	0.0	0.0	33822.4	32159.7	36721.4	24024.7	28549.7	28501.5	28501.5
Maximum Moment (k-ft/ft)	0.0	0.0	376.7	358.1	408.9	267.5	317.9	317.9	317.9

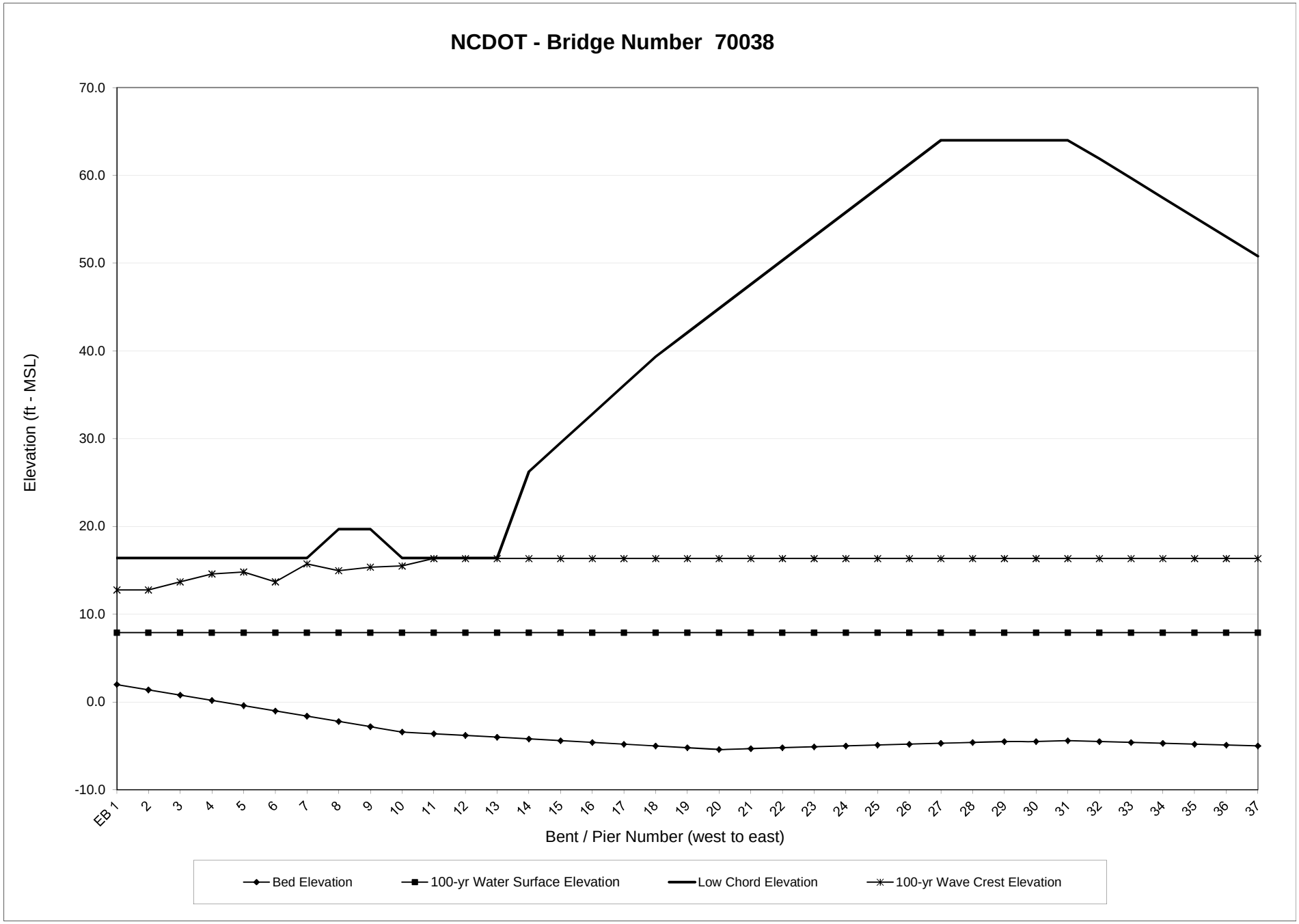
Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

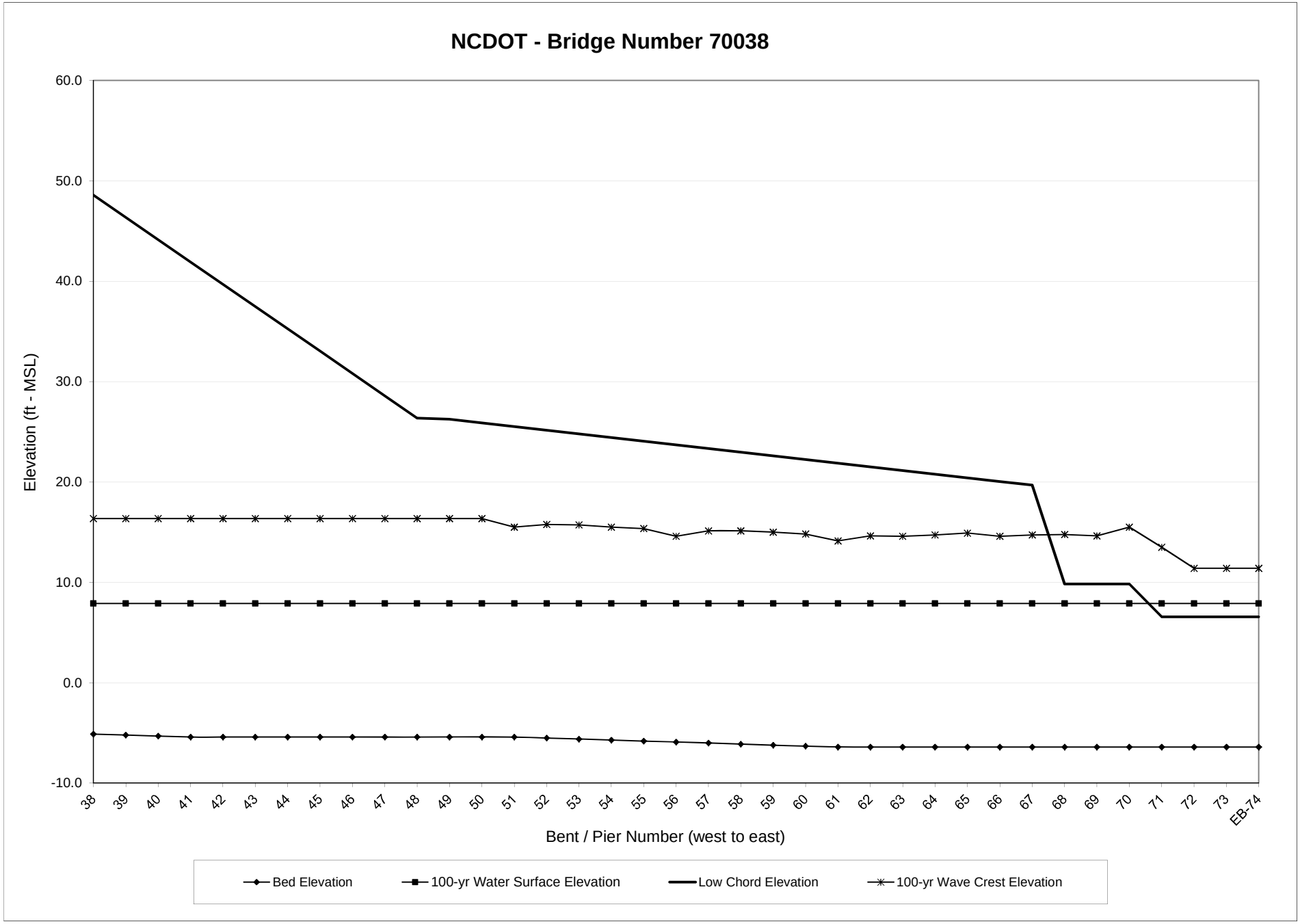
Notes:

1 - Bridge spans 65-73 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 70038
Elevation (ft - MSL)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 70038
Elevation (ft - MSL)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 EB-74
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 90015

CALABASH RIVER

NC179 BUS

BRUNSWICK COUNTY

DRAFT

NCDOT BRIDGE NO. 90015

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY							
SPAN NUMBER	1	2	3	4	5	6	7
CRITICALITY INDEX (defined below)	4	4	4	4	4	4	4
VULNERABILITY INDEX (defined below)	1.4	1.6	1.6	1.5	1.6	1.6	1.6

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES							
100-yr Water Surface Elevation (ft - MSL)	16.2	16.2	16.2	16.2	16.2	16.2	16.2
Bed Elevation (ft - MSL)	0	-4	-4	-3	-5	-6	-6
Low Chord Elevation (ft - MSL)	6.3	6.3	6.3	6.3	6.3	6.3	6.3
100-yr Max Wave Crest Elevation (ft - MSL)	18.9	18.9	18.9	18.9	18.9	18.9	18.9
100-yr Wave Height (ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5
100-yr Wave Period (seconds)	3.9	3.5	3.5	3.6	3.5	3.4	3.4

SPAN PROPERITES							
Span Length (ft)	39.5	39.3	39.3	39.3	39.3	39.3	39.3
Span Width (ft)	30.4	30.4	30.4	30.4	30.4	30.4	30.4
Deck Thickness (ft)	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Overhang (ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Beams	0	0	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Total Dead Weight (kip/ft)	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Resisting Moment (kft/ft)	118.5	118.0	118.0	118.0	118.0	118.0	118.0
Resisting Vertical Force (kip/ft)	6.5	6.5	6.5	6.5	6.5	6.5	6.5

100-YEAR FORCE-MOMENT VALUES							
Maximum Vertical Force (kips/span)	147.4	154.8	154.8	153.2	157.9	165.2	165.2
Maximum Vertical Force (kips/ft)	3.7	3.9	3.9	3.9	4.0	4.2	4.2
Maximum Horizontal Force (kips/span)	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Maximum Horizontal Force (kips/ft)	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Maximum Moment (k-ft)	3,846	4,259	4,259	3,944	4,135	4,304	4,304
Maximum Moment (k-ft/ft)	97	108	108	100	105	109	109

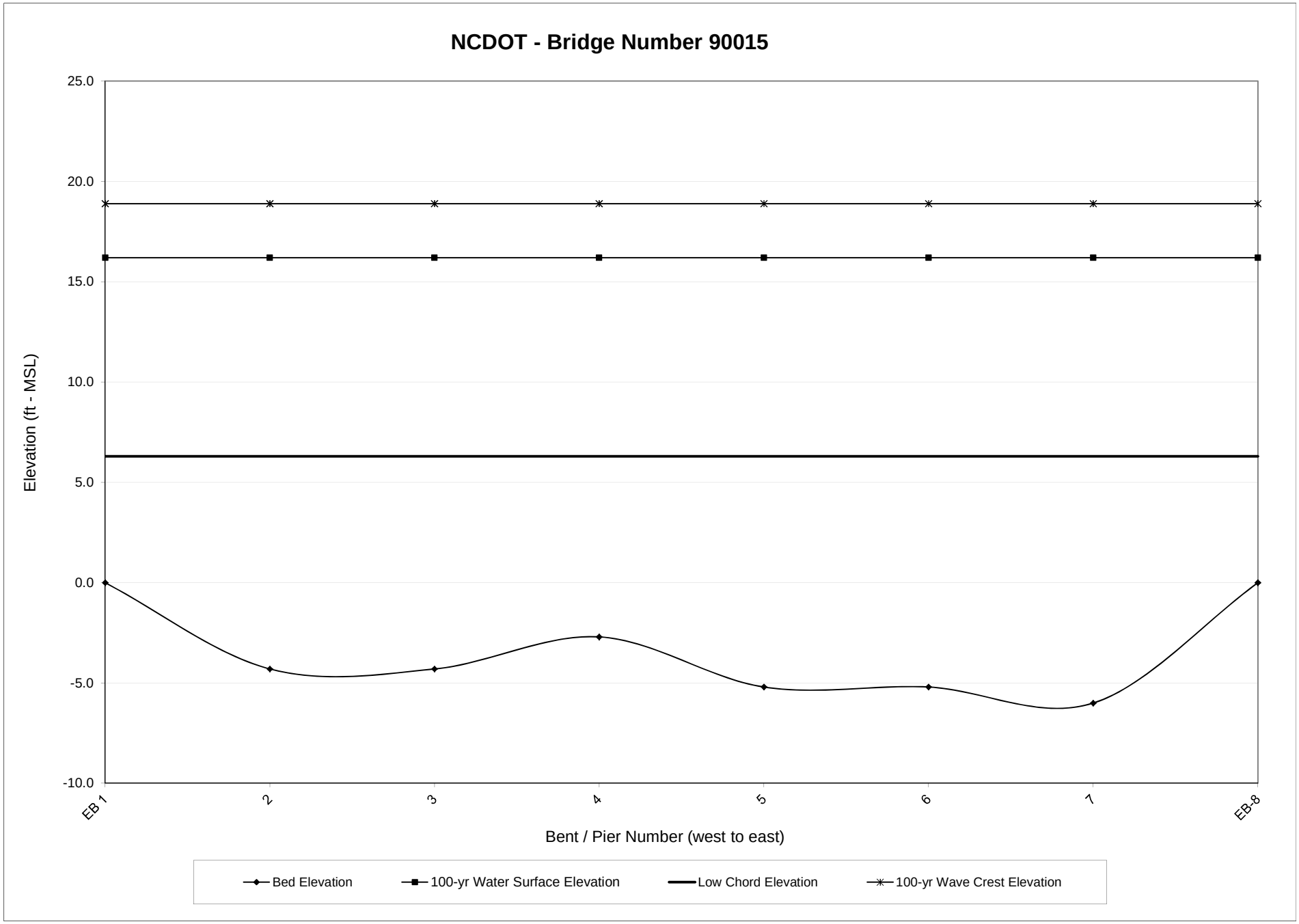
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-7 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 90015
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
EB-8
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 90061

TOWN CREEK

NC133

BRUNSWICK COUNTY

DRAFT

NCDOT BRIDGE NO. 90061
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY					
SPAN NUMBER	1	2	3	4	5
CRITICALITY INDEX (defined below)	4	4	4	4	4
VULNERABILITY INDEX (defined below)	1.0	1.1	1.1	1.1	0.9

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES					
100-yr Water Surface Elevation (ft - MSL)	9.0	9.0	9.0	9.0	9.0
Bed Elevation (ft - MSL)	-6	-19	-25	-21	0
Low Chord Elevation (ft - MSL)	4.2	4.2	4.2	4.2	4.2
100-yr Max Wave Crest Elevation (ft - MSL)	12.9	12.9	12.9	12.9	12.9
100-yr Wave Height (ft)	5.4	5.4	5.4	5.4	5.4
100-yr Wave Period (seconds)	4.8	4.8	4.8	5.8	6.8

SPAN PROPERITES					
Span Length (ft)	58.2	58.1	58.1	58.1	58.2
Span Width (ft)	36.0	36.0	36.0	36.0	36.0
Deck Thickness (ft)	1.8	1.8	1.8	1.8	1.8
Overhang (ft)	1.4	1.4	1.4	1.4	1.4
Number of Beams	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	9.5	9.5	9.5	9.5	9.5
Total Dead Weight (kip/ft)	9.5	9.5	9.5	9.5	9.5
Resisting Moment (kft/ft)	258.5	258.2	258.2	258.2	258.5
Resisting Vertical Force (kip/ft)	9.5	9.5	9.5	9.5	9.5

100-YEAR FORCE-MOMENT VALUES					
Maximum Vertical Force (kips/span)	329.1	369.3	385.5	377.6	301.7
Maximum Vertical Force (kips/ft)	5.7	6.4	6.6	6.5	5.2
Maximum Horizontal Force (kips/span)	57.1	48.0	49.1	48.7	57.1
Maximum Horizontal Force (kips/ft)	1.0	0.8	0.8	0.8	1.0
Maximum Moment (k-ft)	8,336	9,130	9,436	9,158	7,396
Maximum Moment (k-ft/ft)	143	157	162	158	127

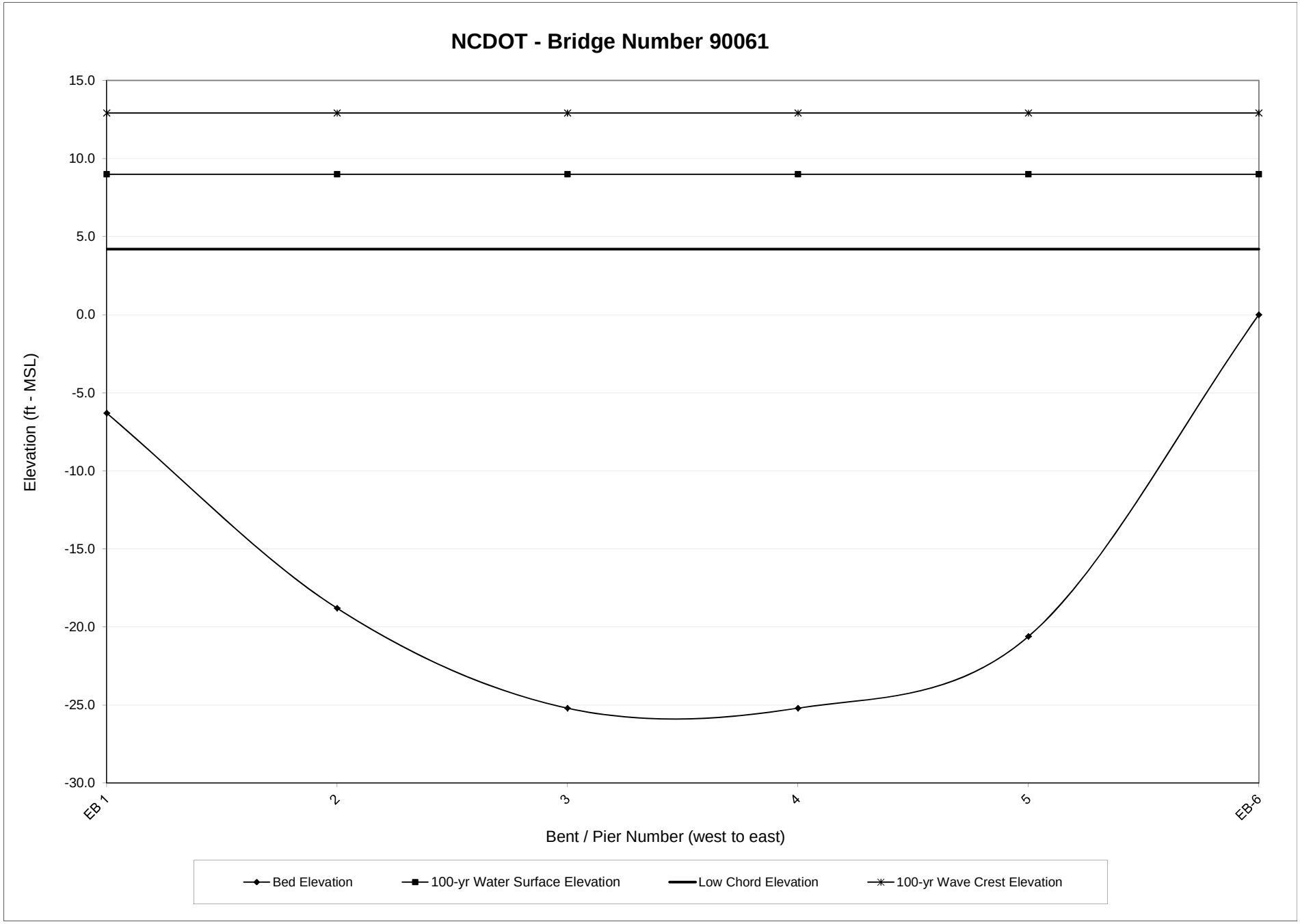
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-5 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 90061
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
Elevation (ft - MSL)
EB 1
2
3
4
5
EB-6
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 90103

BRUNSWICK RIVER

US17

BRUNSWICK COUNTY

DRAFT

NCDOT BRIDGE NO. 90103

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY													
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.7**	**0.7**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.3**	**1.5**	**1.2**	**0.9**	**0.6**	**0.6**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES													
100-yr Water Surface Elevation (ft - MSL)	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Bed Elevation (ft - MSL)	3	3	-6	-20	-35	-39	-31	-18	-12	-4	1	3	3
Low Chord Elevation (ft - MSL)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
100-yr Max Wave Crest Elevation (ft - MSL)	11.2	11.3	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.1	11.1
100-yr Wave Height (ft)	3.6	3.8	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.5	3.5
100-yr Wave Period (seconds)	5.2	5.2	3.6	2.8	2.6	2.6	2.6	2.9	3.1	3.8	4.6	5.2	5.2

SPAN PROPERITES													
Span Length (ft)	57.6	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9
Span Width (ft)	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Number of Beams	6	6	6	6	6	6	6	6	6	6	6	6	6
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Slab Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Total Dead Weight (kip/ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Resisting Moment (kft/ft)	149.7	149.7	149.7	149.7	149.7	149.7	149.7	149.7	149.7	149.7	149.7	149.7	149.7
Resisting Vertical Force (kip/ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

100-YEAR FORCE-MOMENT VALUES													
Maximum Vertical Force (kips/span)	137.3	141.0	293.7	310.6	307.4	307.1	309.6	295.8	304.6	285.1	184.2	124.7	124.7
Maximum Vertical Force (kips/ft)	2.4	2.4	5.1	5.4	5.3	5.3	5.3	5.1	5.3	4.9	3.2	2.2	2.2
Maximum Horizontal Force (kips/span)	62.0	70.0	27.2	22.5	25.6	26.1	24.0	22.3	23.9	28.9	57.1	56.0	56.0
Maximum Horizontal Force (kips/ft)	1.1	1.2	0.5	0.4	0.4	0.5	0.4	0.4	0.4	0.5	1.0	1.0	1.0
Maximum Moment (k-ft)	3,246.0	3,324.3	6,823.4	7,079.0	7,080.3	6,798.3	6,952.0	6,544.5	7,362.3	5,858.8	4,297.3	2,970.8	2,970.8
Maximum Moment (k-ft/ft)	56.3	57.4	117.9	122.3	122.3	117.5	120.1	113.1	127.2	101.2	74.2	51.3	51.3

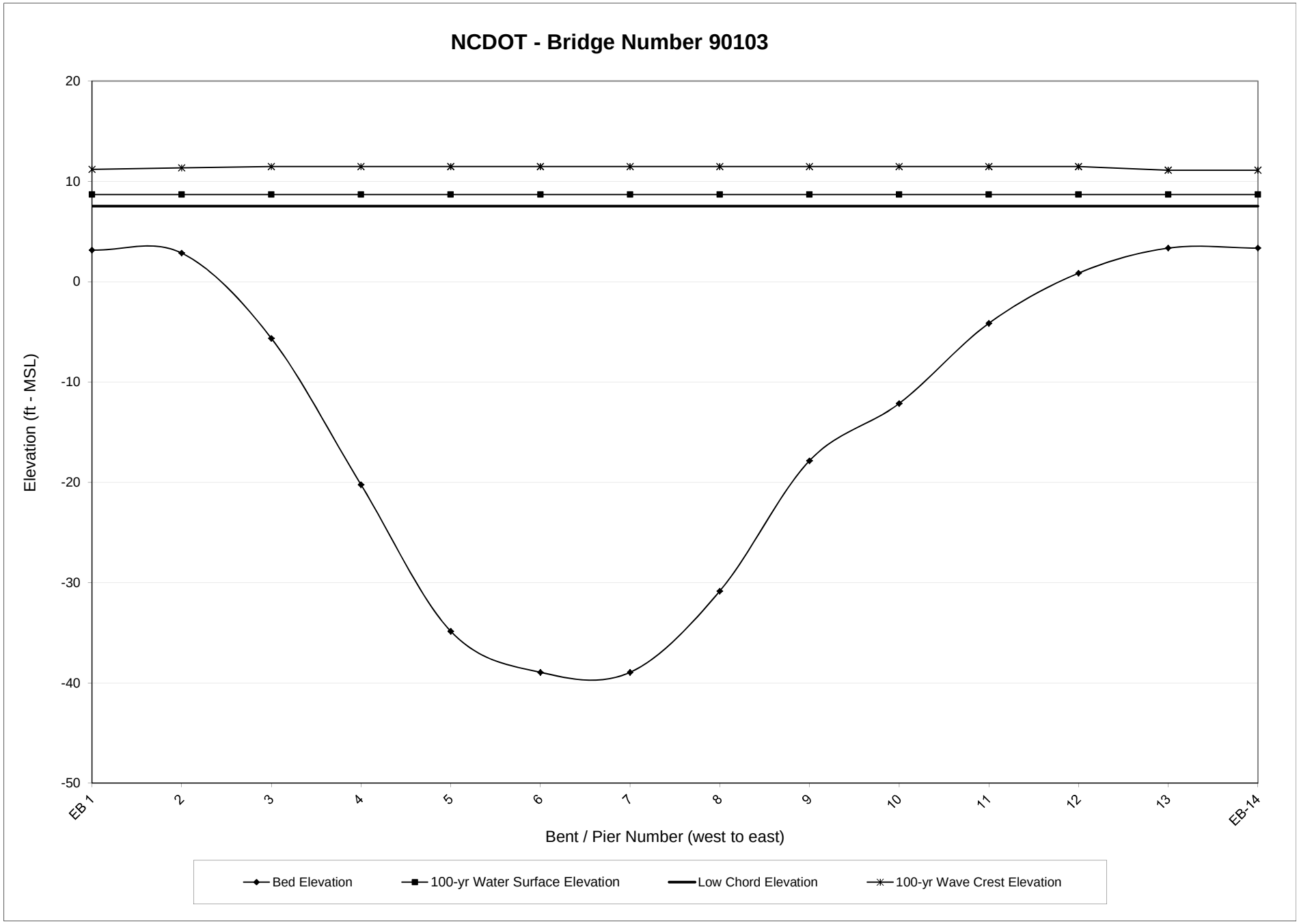
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-13 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 90103
20
10
0
-10
-20
-30
-40
-50
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
EB-14
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 90105

BRUNSWICK RIVER

US17 SBL

BRUNSWICK COUNTY

DRAFT

NCDOT BRIDGE NO. 90105

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY													
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.0**	**1.6**	**1.6**	**1.5**	**1.4**	**1.5**	**1.4**	**1.5**	**1.7**	**1.4**	**1.6**	**0.9**	**1.6**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES													
100-yr Water Surface Elevation (ft - MSL)	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Bed Elevation (ft - MSL)	0	0	-9	-27	-39	-36	-34	-18	-10	-2	0	2	2
Low Chord Elevation (ft - MSL)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
100-yr Max Wave Crest Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Wave Height (ft)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
100-yr Wave Period (seconds)	4.7	4.7	3.5	2.8	2.7	2.7	2.7	3.0	3.4	4.2	4.7	5.1	5.1

SPAN PROPERITES													
Span Length (ft)	57.4	57.8	60.3	60.3	60.3	60.3	60.3	60.3	60.3	60.3	60.3	60.3	60.3
Span Width (ft)	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Number of Beams	6	6	6	6	6	6	6	6	6	6	6	6	6
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Slab Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Total Dead Weight (kip/ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Resisting Moment (kft/ft)	147.9	147.9	147.9	147.9	147.9	147.9	147.9	147.9	147.9	147.9	147.9	147.9	147.9
Resisting Vertical Force (kip/ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

100-YEAR FORCE-MOMENT VALUES													
Maximum Vertical Force (kips/span)	231.9	324.6	347.3	351.6	352.0	361.5	353.7	352.5	356.4	344.3	342.2	202.1	335.8
Maximum Vertical Force (kips/ft)	4.0	5.6	5.8	5.8	5.8	6.0	5.9	5.8	5.9	5.7	5.7	3.3	5.6
Maximum Horizontal Force (kips/span)	60.8	59.7	28.8	26.5	25.7	25.7	26.1	27.3	30.6	46.2	62.5	79.5	79.5
Maximum Horizontal Force (kips/ft)	1.1	1.0	0.5	0.4	0.4	0.4	0.4	0.5	0.5	0.8	1.0	1.3	1.3
Maximum Moment (k-ft)	5,043.3	7,987.2	8,339.3	7,565.2	7,382.5	7,678.2	7,370.7	7,604.8	8,635.2	7,255.6	8,329.2	4,695.2	8,244.3
Maximum Moment (k-ft/ft)	87.8	138.3	138.2	125.4	122.4	127.3	122.2	126.0	143.1	120.3	138.1	77.8	136.6

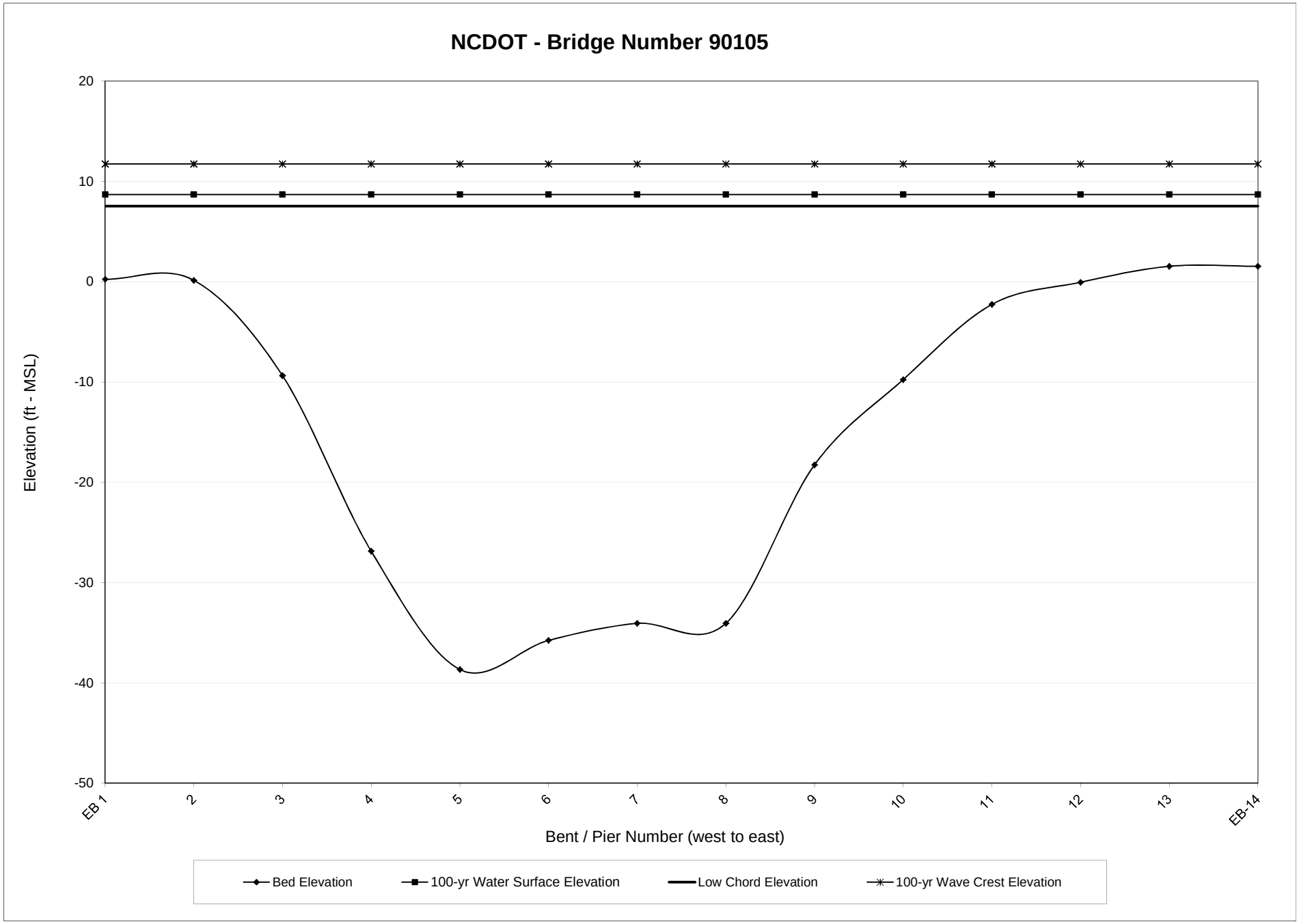
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-13 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 90105
20
10
0
-10
-20
-30
-40
-50
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
EB-14
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 90107

ALLIGATOR CREEK

US17,74,76

BRUNSWICK COUNTY

DRAFT

NCDOT BRIDGE NO. 90107

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY					
SPAN NUMBER	1	2	3	4	5
CRITICALITY INDEX (defined below)	4	4	4	4	4
VULNERABILITY INDEX (defined below)	1.5	1.7	1.7	1.6	1.5

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES					
100-yr Water Surface Elevation (ft - MSL)	8.7	8.7	8.7	8.7	8.7
Bed Elevation (ft - MSL)	2	-7	-14	-10	0
Low Chord Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6
100-yr Max Wave Crest Elevation (ft - MSL)	10.4	10.4	10.4	10.4	10.4
100-yr Wave Height (ft)	2.5	2.5	2.5	2.5	2.5
100-yr Wave Period (seconds)	3.3	2.3	2.1	2.2	2.9

SPAN PROPERITES					
Span Length (ft)	42.6	45.2	45.2	45.2	42.6
Span Width (ft)	38.9	38.9	38.9	38.9	38.9
Deck Thickness (ft)	0.4	0.4	0.4	0.4	0.4
Overhang (ft)	2.8	2.8	2.8	2.8	2.8
Number of Beams	6	6	6	6	6
Beam Dead Weight (lb/lf) - Each	900	900	900	900	900
Beam Dead Weight (kip/ft) - Total	5.4	5.4	5.4	5.4	5.4
Slab Dead Weight (kip/ft)	2.4	2.4	2.4	2.4	2.4
Total Dead Weight (kip/ft)	7.8	7.8	7.8	7.8	7.8
Resisting Moment (kft/ft)	163.5	173.6	173.6	173.6	163.5
Resisting Vertical Force (kip/ft)	7.8	7.8	7.8	7.8	7.8

100-YEAR FORCE-MOMENT VALUES					
Maximum Vertical Force (kips/span)	247.2	291.2	273.8	281.4	247.2
Maximum Vertical Force (kips/ft)	5.8	6.4	6.1	6.2	5.8
Maximum Horizontal Force (kips/span)	19.6	18.3	18.4	19.1	17.3
Maximum Horizontal Force (kips/ft)	0.5	0.4	0.4	0.4	0.4
Maximum Moment (k-ft)	5,893	7,436	7,435	7,280	5,893
Maximum Moment (k-ft/ft)	138	165	165	161	138

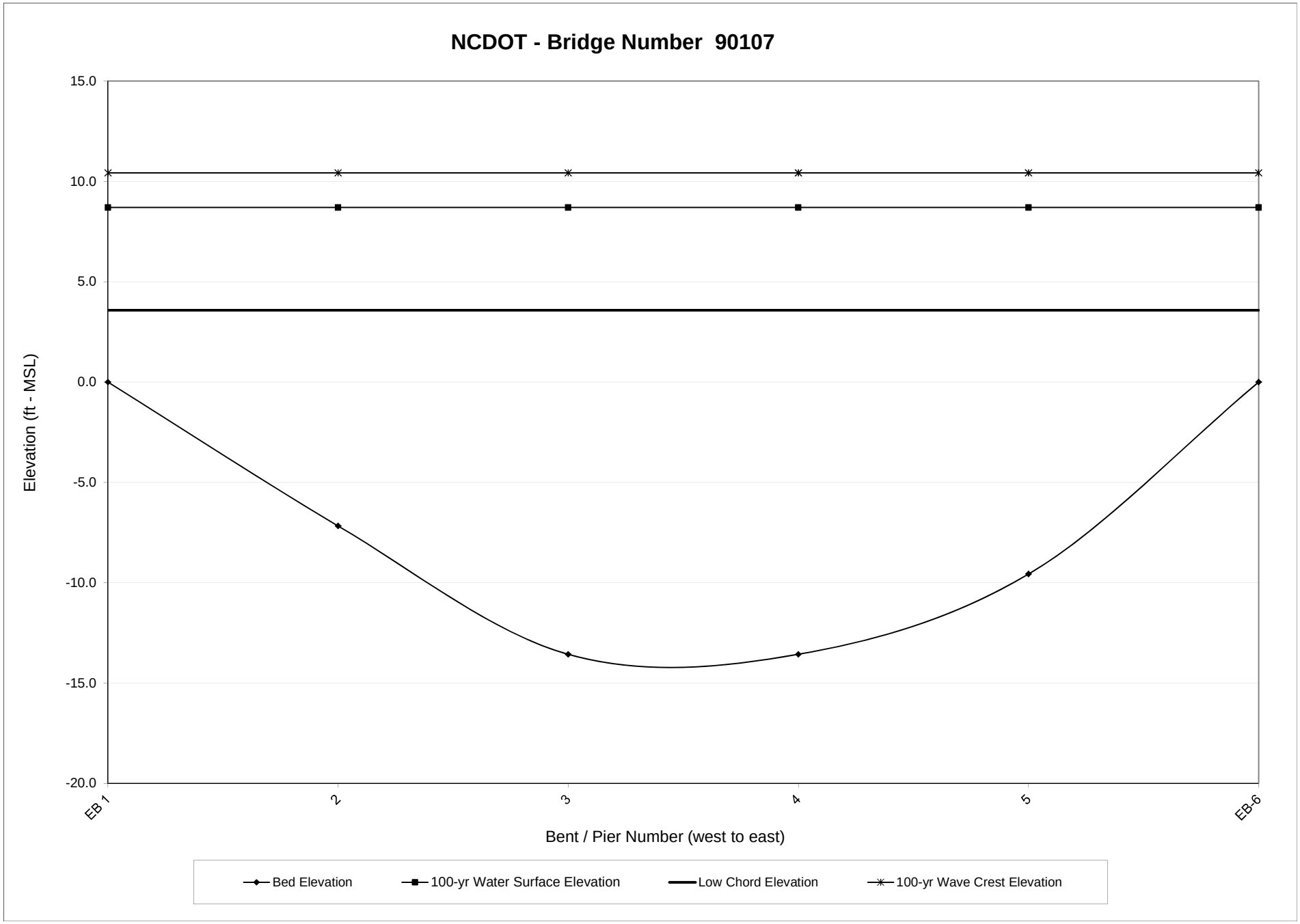
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-5 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 90107
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
EB 1
2
3
4
5
EB-6
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 90108

ALLIGATOR CREEK

US17,74,76(SBL)

BRUNSWICK COUNTY

DRAFT

NCDOT BRIDGE NO. 90108

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY						
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.2**	**1.3**	**1.3**	**1.3**	**1.1**	**1.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES						
100-yr Water Surface Elevation (ft - MSL)	8.2	8.2	8.2	8.2	8.2	8.2
Bed Elevation (ft - MSL)	-8	-14	-15	-16	-5	0
Low Chord Elevation (ft - MSL)	3.4	3.4	3.4	3.4	3.4	3.4
100-yr Max Wave Crest Elevation (ft - MSL)	9.9	9.9	9.9	9.9	9.9	9.9
100-yr Wave Height (ft)	2.4	2.4	2.4	2.4	2.4	2.4
100-yr Wave Period (seconds)	2.3	2.1	2.1	2.1	2.4	2.9

SPAN PROPERITES						
Span Length (ft)	45.7	45.7	45.7	45.7	45.7	45.7
Span Width (ft)	36.1	36.1	36.1	36.1	36.1	36.1
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.1	3.1	3.1	3.1	3.1	3.1
Number of Beams	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	900	900	900	900	900	901
Beam Dead Weight (kip/ft) - Total	4.5	4.5	4.5	4.5	4.5	4.5
Slab Dead Weight (kip/ft)	3.5	3.5	3.5	3.5	3.5	3.5
Total Dead Weight (kip/ft)	8.0	8.0	8.0	8.0	8.0	8.0
Resisting Moment (kft/ft)	177.5	177.5	177.5	177.5	177.5	177.7
Resisting Vertical Force (kip/ft)	8.0	8.0	8.0	8.0	8.0	8.0

100-YEAR FORCE-MOMENT VALUES						
Maximum Vertical Force (kips/span)	246.2	254.6	255.3	257.3	239.0	234.5
Maximum Vertical Force (kips/ft)	5.4	5.6	5.6	5.6	5.2	5.1
Maximum Horizontal Force (kips/span)	15.4	14.4	14.4	14.4	15.3	15.4
Maximum Horizontal Force (kips/ft)	0.3	0.3	0.3	0.3	0.3	0.3
Maximum Moment (k-ft)	5,542	6,099	6,083	6,139	5,285	4,859
Maximum Moment (k-ft/ft)	121	134	133	134	116	106

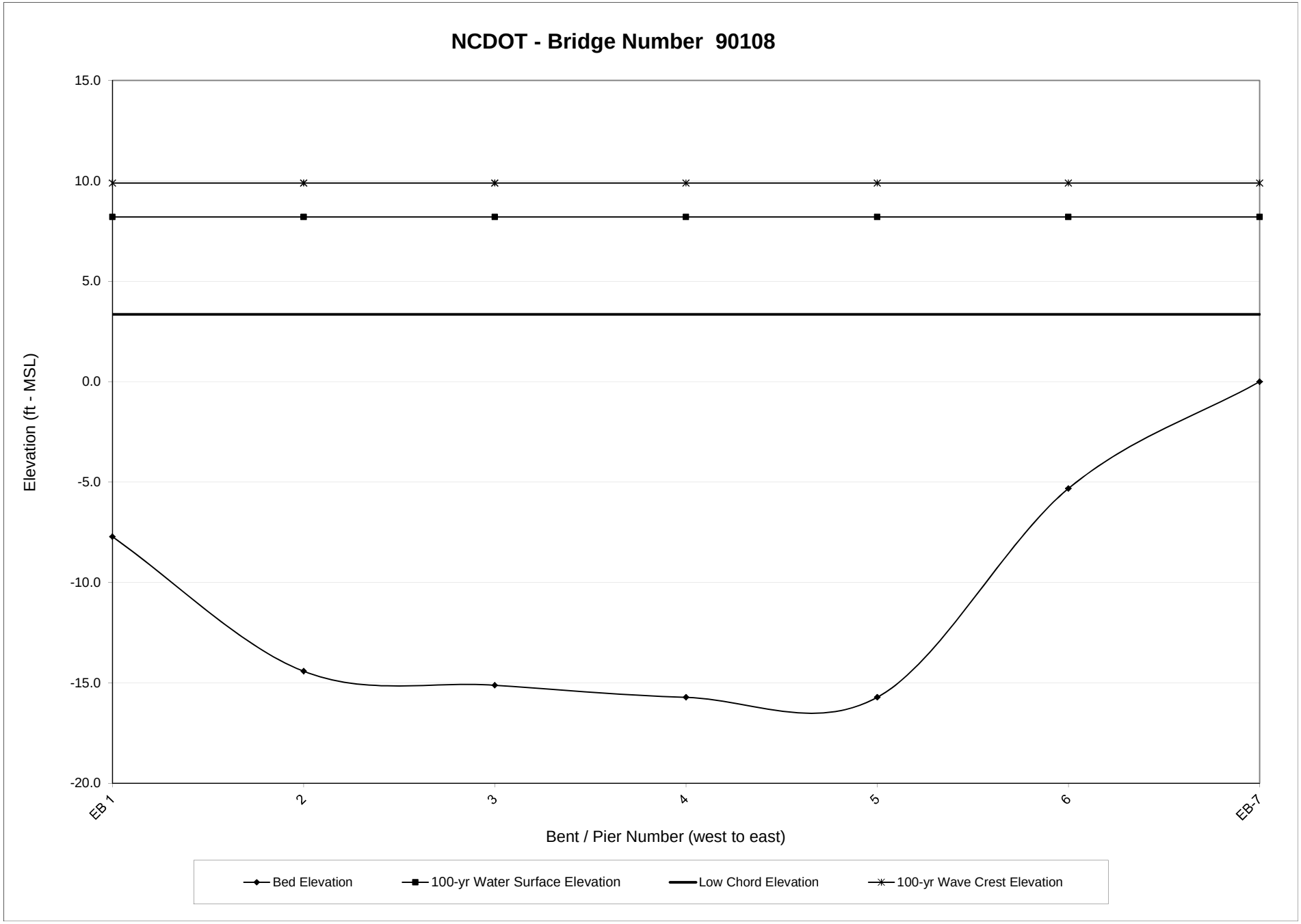
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-6 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 90108
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
EB-7
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 150006

INTRACOSTAL WATERWAY

NC56 - NC57 - NC58

CARTERET COUNTY

DRAFT

NCDOT BRIDGE NO. 150006

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.5**	**1.7**	**0.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Bed Elevation (ft - MSL)	-1	-8	-10	-12	-10	-6	-5	-6	-5	-4	-4	-6	-5	-5	-4	-4
Low Chord Elevation (ft - MSL)	4.9	6.7	8.5	10.3	12.1	13.9	15.8	17.6	19.4	21.2	23.1	24.9	26.7	28.5	30.4	32.2
100-yr Max Wave Crest Elevation (ft - MSL)	13.0	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
100-yr Wave Height (ft)	6.0	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
100-yr Wave Period (seconds)	6.8	5.6	5.3	5.1	5.3	5.8	6.0	5.8	6.0	6.2	6.2	5.8	6.1	6.2	6.2	6.3
SPAN PROPERITES																
Span Length (ft)	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2
Span Width (ft)	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Resisting Moment (kft/ft)	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0
Resisting Vertical Force (kip/ft)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	453.2	433.4	152.2	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	7.2	6.9	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	141.9	84.2	26.8	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	2.2	1.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	5399.0	6039.2	3313.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	85.5	95.6	52.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-4 are potentially subject to wave energy.
Bridge spans 5-16 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 150006

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Bed Elevation (ft - MSL)	-3	-3	-9	-9	-4	-3	-4	-4	-4	-2	-1	0	2	-2	-8	-15
Low Chord Elevation (ft - MSL)	34.0	35.9	37.7	39.5	41.3	43.2	45.0	46.8	48.7	50.5	52.3	54.1	56.0	57.8	59.6	61.4
100-yr Max Wave Crest Elevation (ft - MSL)	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.2	12.4	11.9	13.6	13.6	13.6
100-yr Wave Height (ft)	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.3	5.2	4.4	6.8	6.8	6.8
100-yr Wave Period (seconds)	6.5	6.6	5.5	5.4	6.3	6.5	6.4	6.4	6.4	6.8	6.8	6.7	6.7	6.8	5.6	4.8

SPAN PROPERITES																
Span Length (ft)	63.2	63.2	63.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	95.1
Span Width (ft)	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	7
Beam Dead Weight (lb/lf) - Each	581	581	581	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	5.8
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	6.1	6.1	6.1	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	9.0
Resisting Moment (kft/ft)	99.0	99.0	99.0	142.0	142.0	142.0	142.0	142.0	142.0	142.0	142.0	142.0	142.0	142.0	142.0	149.9
Resisting Vertical Force (kip/ft)	6.1	6.1	6.1	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	9.0

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 150006

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Bed Elevation (ft - MSL)	-11	-14	-6	-3	-2	0	-4	-4	-4	-3	-4	-9	-13	-11	-3	-4
Low Chord Elevation (ft - MSL)	61.8	58.5	55.2	51.9	48.5	45.2	41.9	38.6	35.3	32.0	28.7	25.4	22.0	18.7	15.4	12.1
100-yr Max Wave Crest Elevation (ft - MSL)	13.6	13.6	13.6	13.6	13.4	12.8	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
100-yr Wave Height (ft)	6.8	6.8	6.8	6.8	6.6	5.7	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
100-yr Wave Period (seconds)	5.2	4.9	6.0	6.5	6.8	6.8	6.4	6.3	6.3	6.5	6.4	5.4	5.0	5.2	6.6	6.3

SPAN PROPERITES																
Span Length (ft)	132.0	95.1	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	63.2	63.2
Span Width (ft)	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	7	7	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	581	581
Beam Dead Weight (kip/ft) - Total	5.8	5.8	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	2.9	2.9
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	9.0	9.0	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	6.1	6.1
Resisting Moment (kft/ft)	208.8	149.9	142.0	142.0	142.0	142.0	142.0	142.0	142.0	142.0	142.0	142.0	142.0	142.0	99.0	99.0
Resisting Vertical Force (kip/ft)	9.0	9.0	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	6.1	6.1

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 33-48 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 150006

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY											
SPAN NUMBER	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.1**	**0.4**	**0.6**	**0.8**	**1.1**	**1.4**	**1.6**	**1.9**	**2.5**	**1.0**	**1.2**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES											
100-yr Water Surface Elevation (ft - MSL)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Bed Elevation (ft - MSL)	-4	-4	-5	-5	-6	-6	-6	-4	-2	2	2
Low Chord Elevation (ft - MSL)	11.5	11.0	10.4	9.9	9.3	8.8	8.2	7.7	7.1	7.1	6.5
100-yr Max Wave Crest Elevation (ft - MSL)	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.5	11.8	11.8
100-yr Wave Height (ft)	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.7	4.3	4.3
100-yr Wave Period (seconds)	6.3	6.2	6.2	6.1	5.9	5.8	5.9	6.3	6.8	6.7	6.7

SPAN PROPERITES											
Span Length (ft)	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2
Span Width (ft)	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Resisting Moment (kft/ft)	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0
Resisting Vertical Force (kip/ft)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1

100-YEAR FORCE-MOMENT VALUES											
Maximum Vertical Force (kips/span)	49.9	75.8	111.5	155.0	193.3	260.1	381.8	453.5	555.2	225.8	289.0
Maximum Vertical Force (kips/ft)	0.8	1.2	1.8	2.5	3.1	4.1	6.0	7.2	8.8	3.6	4.6
Maximum Horizontal Force (kips/span)	30.5	47.7	56.5	70.0	68.7	71.6	90.6	134.3	162.7	104.1	104.1
Maximum Horizontal Force (kips/ft)	0.5	0.8	0.9	1.1	1.1	1.1	1.4	2.1	2.6	1.6	1.6
Maximum Moment (k-ft)	526.0	1,277.2	2,046.8	2,900.4	3,877.5	5,001.5	5,838.3	6,673.2	9,004.4	3,621.2	4,188.8
Maximum Moment (k-ft/ft)	8.3	20.2	32.4	45.9	61.4	79.2	92.4	105.6	142.5	57.3	66.3

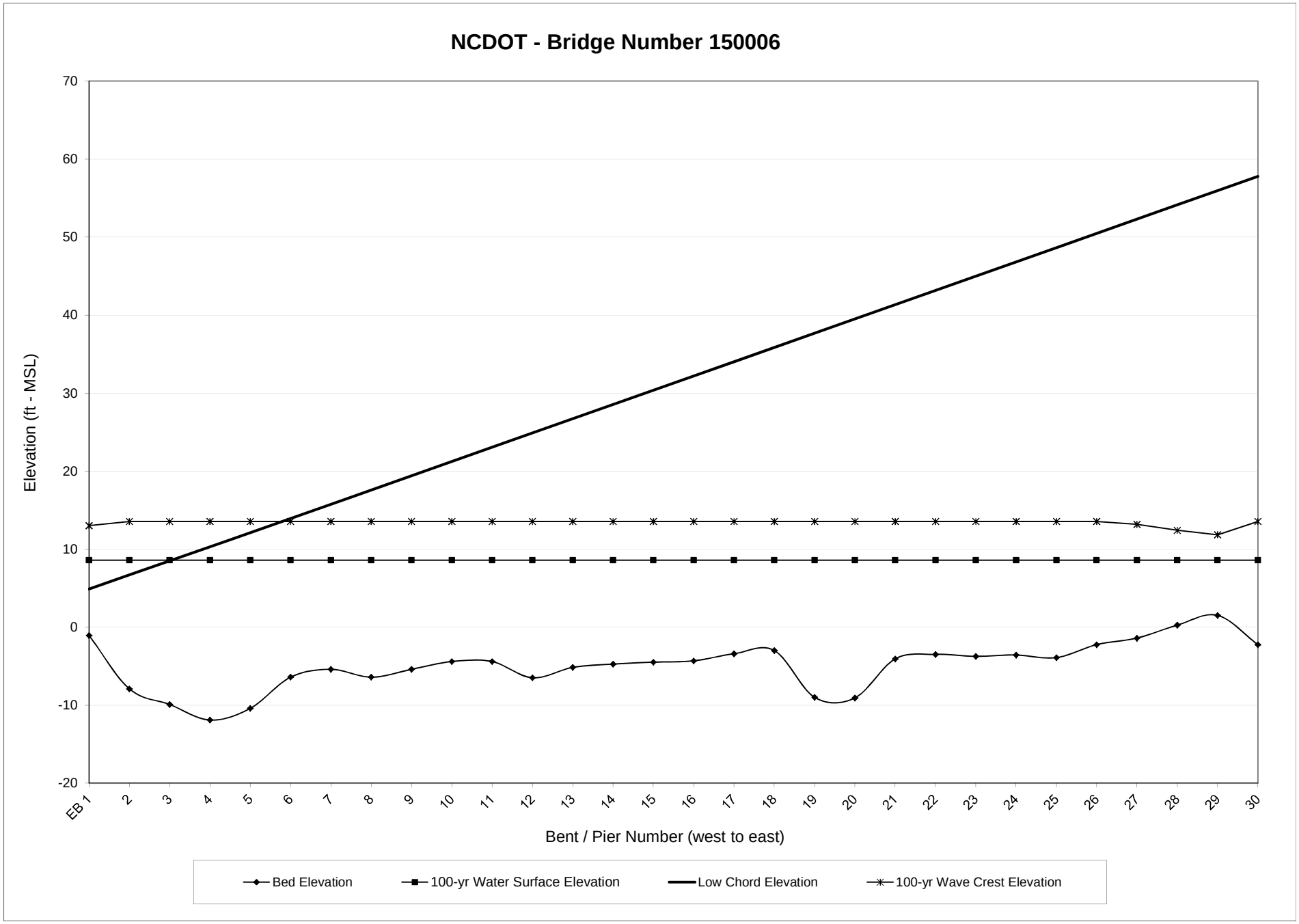
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

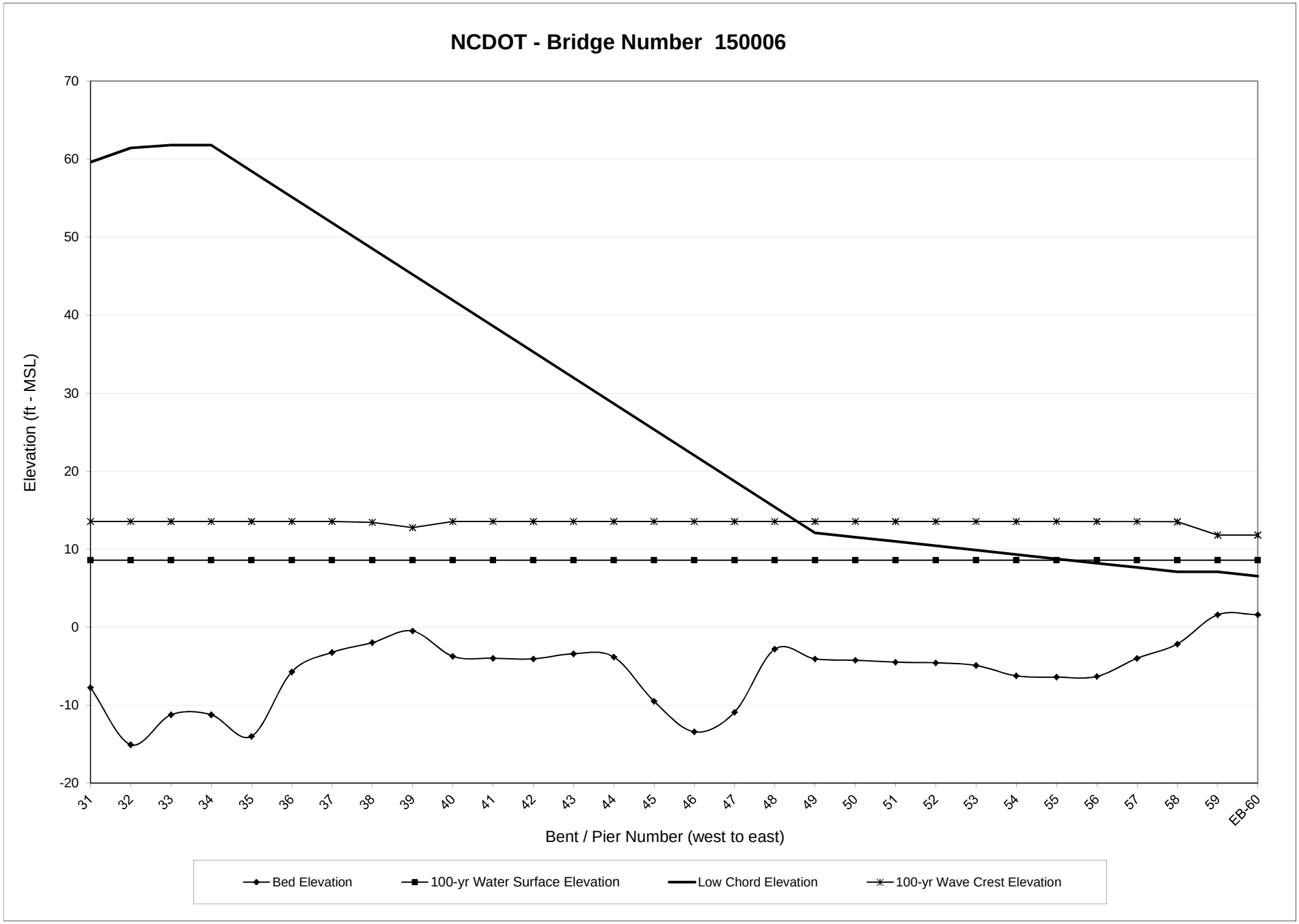
Notes:

1 - Bridge spans 49-59 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 150006
Elevation (ft - MSL)
70
60
50
40
30
20
10
0
-10
-20
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 150006
Elevation (ft - MSL)
70
60
50
40
30
20
10
0
-10
-20
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
EB-60
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 150012

THOROFARE BAY CHANNEL

NC12

CARTERET COUNTY

DRAFT

NCDOT BRIDGE NO. 150012

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																			
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.3**	**1.1**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																			
HYDRAULIC VALUES																			
100-yr Water Surface Elevation (ft - MSL)	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Bed Elevation (ft - MSL)	0	-1	-2	-1	-2	-2	-3	-3	-3	-2	-3	-2	-2	-1	-1	-1	-2	-1	-12
Low Chord Elevation (ft - MSL)	3.0	3.0	6.0	10.0	13.9	15.9	17.8	19.8	21.8	23.8	25.8	29.6	33.3	37.0	40.2	42.9	45.2	47.0	47.0
100-yr Max Wave Crest Elevation (ft - MSL)	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
100-yr Wave Height (ft)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
100-yr Wave Period (seconds)	2.9	2.7	2.7	2.8	2.7	2.7	2.6	2.6	2.6	2.7	2.6	2.7	2.7	2.8	2.8	2.8	2.7	2.8	2.2
SPAN PROPERITES																			
Span Length (ft)	50.0	49.5	50.0	50.0	49.5	50.0	50.0	49.5	49.9	91.8	91.4	91.8	91.8	91.4	91.8	91.8	91.4	91.8	142.6
Span Width (ft)	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	4.1
Slab Dead Weight (kip/ft)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Total Dead Weight (kip/ft)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	9.0
Resisting Moment (kft/ft)	153.3	151.7	153.1	153.1	151.7	153.1	153.1	151.7	153.0	366.1	364.4	366.1	366.1	364.4	366.1	366.1	364.4	366.1	630.8
Resisting Vertical Force (kip/ft)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	9.0
100-YEAR FORCE-MOMENT VALUES																			
Maximum Vertical Force (kips/span)	273.8	212.3	18.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	5.5	4.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	26.0	20.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	5,551.5	4,931.8	353.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	111.0	99.6	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-3 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 150012

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																			
SPAN NUMBER	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**1.0**	**1.2**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																			
HYDRAULIC VALUES																			
100-yr Water Surface Elevation (ft - MSL)	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Bed Elevation (ft - MSL)	-6	-2	0	0	0	-1	-1	-1	0	-1	-1	-1	-1	-1	0	0	1	1	1
Low Chord Elevation (ft - MSL)	47.0	47.0	45.2	42.9	40.3	37.1	33.3	30.6	27.8	25.0	22.3	20.2	18.0	16.0	14.0	10.0	6.0	3.0	3.0
100-yr Max Wave Crest Elevation (ft - MSL)	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
100-yr Wave Height (ft)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
100-yr Wave Period (seconds)	2.4	2.7	2.9	2.9	2.8	2.8	2.8	2.8	2.9	2.8	2.7	2.8	2.8	2.8	2.9	2.9	3.0	3.0	3.0
SPAN PROPERITES																			
Span Length (ft)	142.2	142.6	91.8	91.4	91.8	91.8	91.4	91.8	91.8	91.4	91.8	49.9	49.5	50.0	50.0	49.5	50.0	50.0	49.5
Span Width (ft)	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Number of Beams	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	4.1	4.1	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Total Dead Weight (kip/ft)	9.0	9.0	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Resisting Moment (kft/ft)	629.0	630.8	366.1	364.4	366.1	366.1	364.4	366.1	366.1	364.4	366.1	153.0	151.7	153.1	153.1	151.7	153.1	153.1	151.7
Resisting Vertical Force (kip/ft)	9.0	9.0	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
100-YEAR FORCE-MOMENT VALUES																			
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.9	213.1	263.7
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	4.3	5.3
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	20.6	25.4
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	303.1	4,352.0	5,118.8
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	87.1	103.4

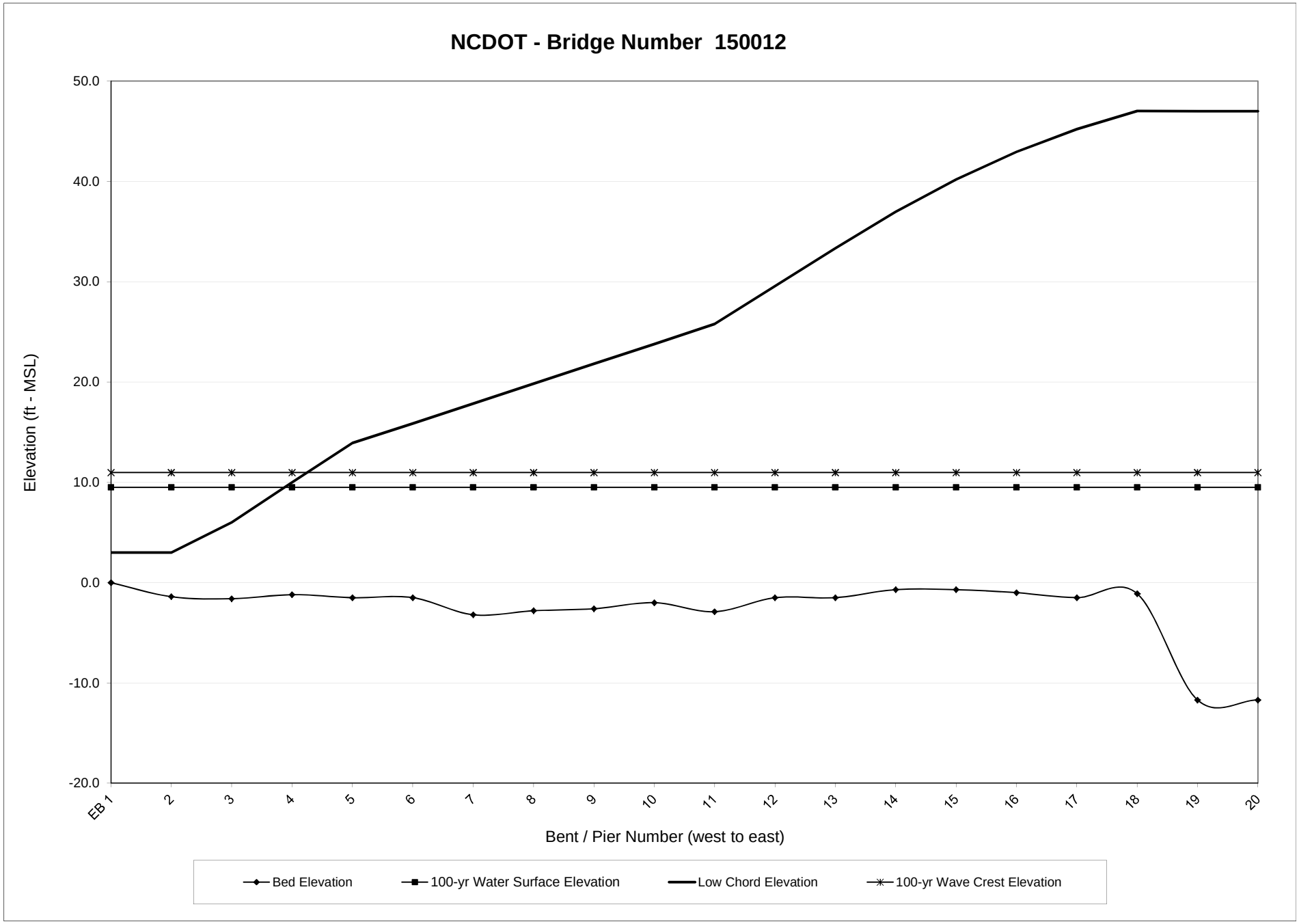
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

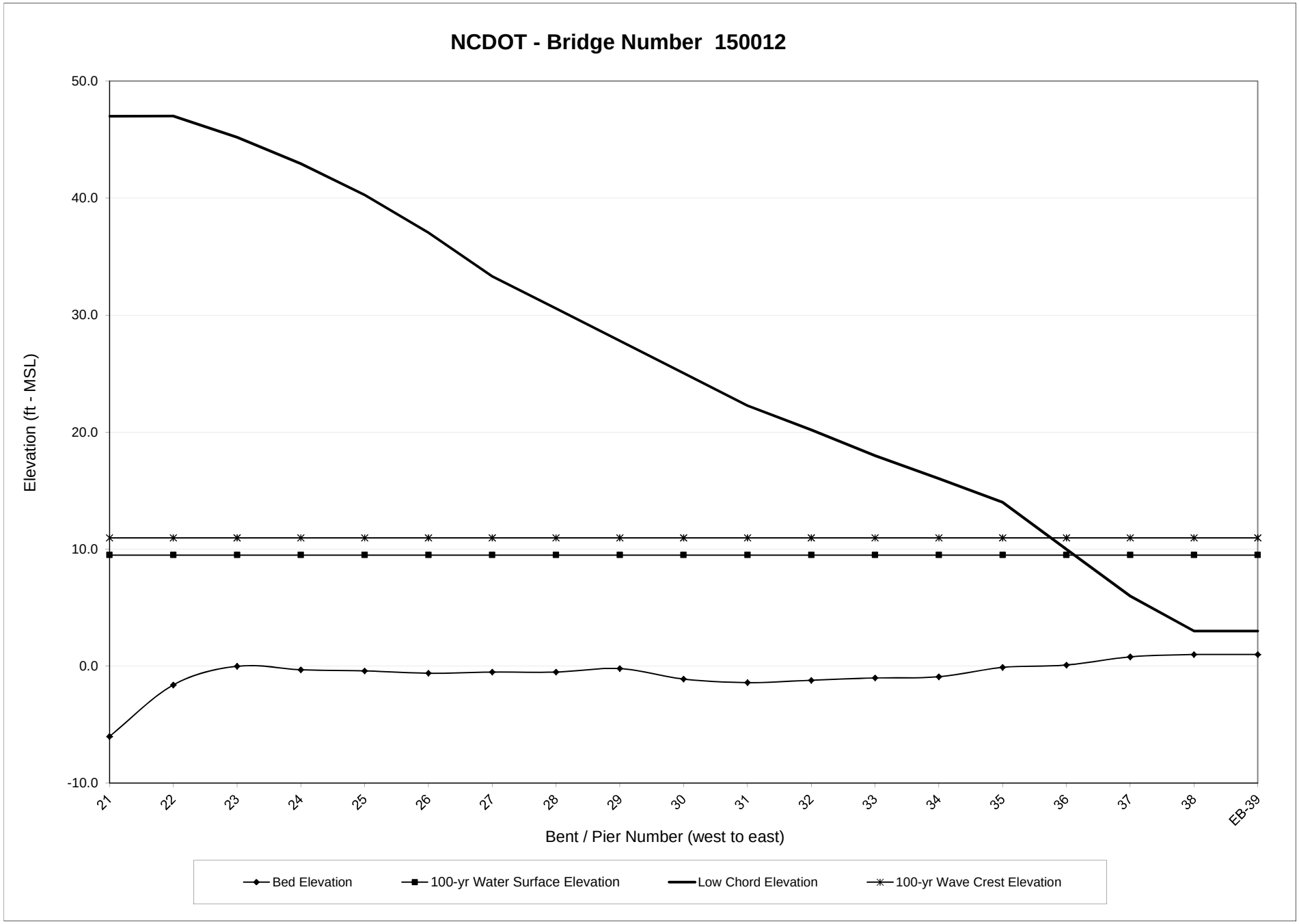
Notes:

1 - Bridge spans 36-38 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 150012
Elevation (ft - MSL)
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 150012
Elevation (ft - MSL)
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
EB-39
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 150031

BRANCH NEWPORT RIVER

NC101

CARTERET COUNTY

DRAFT

NCDOT BRIDGE NO. 150031

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY		
SPAN NUMBER	1	2
CRITICALITY INDEX (defined below)	4	4
VULNERABILITY INDEX (defined below)	1.1	0.7

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES		
100-yr Water Surface Elevation (ft - MSL)	8.5	8.5
Bed Elevation (ft - MSL)	-6	-6
Low Chord Elevation (ft - MSL)	3.3	3.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.5	9.5
100-yr Wave Height (ft)	1.9	1.9
100-yr Wave Period (seconds)	2.0	2.0

SPAN PROPERITES		
Span Length (ft)	38.5	38.5
Span Width (ft)	33.3	33.3
Deck Thickness (ft)	1.8	1.8
Overhang (ft)	0.0	0.0
Number of Beams	0	0
Beam Dead Weight (lb/lf) - Each	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0
Slab Dead Weight (kip/ft)	8.7	8.7
Total Dead Weight (kip/ft)	8.7	8.7
Resisting Moment (kft/ft)	152.7	152.7
Resisting Vertical Force (kip/ft)	8.7	8.7

100-YEAR FORCE-MOMENT VALUES		
Maximum Vertical Force (kips/span)	162.0	162.0
Maximum Vertical Force (kips/ft)	4.2	2.0
Maximum Horizontal Force (kips/span)	9.0	9.0
Maximum Horizontal Force (kips/ft)	0.2	0.7
Maximum Moment (k-ft)	3,606.0	3,606.0
Maximum Moment (k-ft/ft)	93.7	60.4

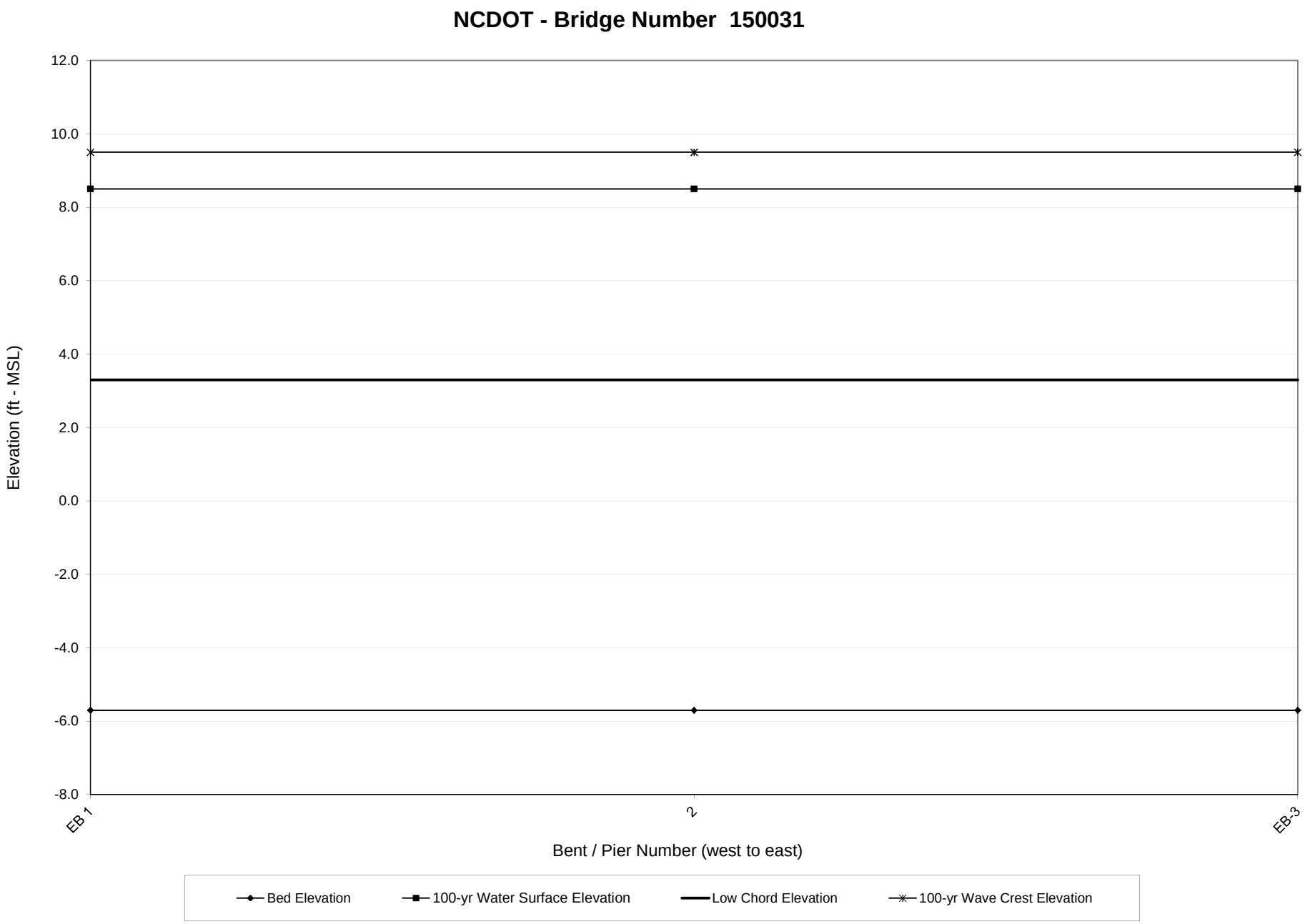
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-2 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 150031
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
Elevation (ft - MSL)
EB 1
2
EB-3
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 150033

NORTH RIVER

US70

CARTERET COUNTY

DRAFT

NCDOT BRIDGE NO. 150033

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.7**	**1.1**	**0.8**	**1.0**	**1.7**	**1.7**	**1.7**	**1.6**	**1.6**	**1.6**	**1.5**	**1.9**	**1.6**	**1.8**	**1.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Bed Elevation (ft - MSL)	5	3	2	0	-1	-4	-5	-4	-4	-4	-4	-3	-4	-4	-5	-4
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.2	10.2	10.7	11.6	12.0	13.4	13.7	13.4	13.2	13.3	13.5	13.1	13.6	13.5	13.7	13.6
100-yr Wave Height (ft)	1.6	3.2	3.9	5.1	5.7	7.8	8.1	7.7	7.5	7.6	7.8	7.3	8.0	7.8	8.1	8.0
100-yr Wave Period (seconds)	7.2	7.2	7.3	7.3	7.3	7.4	7.3	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.3	7.4

SPAN PROPERITES																
Span Length (ft)	21.5	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8
Span Width (ft)	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
Deck Thickness (ft)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Overhang (ft)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Number of Beams	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Total Dead Weight (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Resisting Moment (kft/ft)	65.6	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4
Resisting Vertical Force (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	26.3	53.0	63.6	79.7	134.0	149.1	133.1	126.5	128.5	135.8	123.4	142.8	135.8	149.1	142.8
Maximum Vertical Force (kips/ft)	0.0	1.2	2.4	2.9	3.7	6.2	6.9	6.1	5.8	5.9	6.2	5.7	6.6	6.2	6.9	6.6
Maximum Horizontal Force (kips/span)	0.0	1.9	7.2	28.8	37.8	27.9	47.6	51.5	52.4	52.0	52.2	52.1	48.4	52.2	51.0	48.4
Maximum Horizontal Force (kips/ft)	0.0	0.1	0.3	1.3	1.7	1.3	2.2	2.4	2.4	2.4	2.4	2.4	2.2	2.4	2.3	2.2
Maximum Moment (k-ft)	0.0	541.4	908.5	665.4	823.7	1384.3	1435.4	1377.1	1289.6	1334.7	1292.4	1241.3	1532.4	1292.4	1448.0	1532.4
Maximum Moment (k-ft/ft)	0.0	24.9	41.8	30.6	37.9	63.6	66.0	63.3	59.3	61.4	59.4	57.1	70.5	59.4	66.6	70.5

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 2-16 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 150033

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.8**	**1.9**	**1.8**	**2.0**	**1.9**	**1.9**	**1.9**	**1.7**	**1.9**	**1.8**	**1.9**	**1.8**	**1.8**	**1.8**	**1.8**	**1.8**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Bed Elevation (ft - MSL)	-5	-6	-8	-9	-9	-9	-9	-9	-9	-9	-8	-7	-6	-6	-7	-6
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.3	7.1	6.7	6.5	6.4	6.4	6.5	6.5	6.5	6.6	6.7	6.8	7.1	7.2	6.9	7.1

SPAN PROPERITES																
Span Length (ft)	21.8	21.8	21.8	21.8	21.8	21.8	21.8	25.0	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8
Span Width (ft)	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
Deck Thickness (ft)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Overhang (ft)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Number of Beams	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Total Dead Weight (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Resisting Moment (kft/ft)	66.4	66.4	66.4	66.4	66.4	66.4	66.4	78.0	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4
Resisting Vertical Force (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	149.1	152.7	162.4	169.7	174.3	174.3	169.7	202.0	175.5	169.3	162.6	162.9	157.5	150.7	162.9	157.5
Maximum Vertical Force (kips/ft)	6.9	7.0	7.5	7.8	8.0	8.0	7.8	8.1	8.1	7.8	7.5	7.5	7.2	6.9	7.5	7.2
Maximum Horizontal Force (kips/span)	51.0	47.9	41.0	37.5	36.2	36.2	36.9	42.5	37.4	38.2	40.5	42.6	46.0	48.3	43.7	46.0
Maximum Horizontal Force (kips/ft)	2.3	2.2	1.9	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.9	2.0	2.1	2.2	2.0	2.1
Maximum Moment (k-ft)	1,448.0	1,530.6	1,497.0	1,616.6	1,596.0	1,596.0	1,596.7	1,871.7	1,603.1	1,508.0	1,604.7	1,503.4	1,453.7	1,482.9	1,475.5	1,453.7
Maximum Moment (k-ft/ft)	66.6	70.4	68.8	74.3	73.4	73.4	73.4	74.9	73.7	69.3	73.8	69.1	66.8	68.2	67.8	66.8

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 150033

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY															
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.8**	**1.8**	**1.8**	**1.7**	**1.7**	**1.7**	**1.6**	**1.4**	**1.0**	**1.0**	**0.8**	**0.5**	**0.6**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES															
100-yr Water Surface Elevation (ft - MSL)	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Bed Elevation (ft - MSL)	-7	-6	-6	-6	-5	-5	-4	-3	-1	-1	0	1	2	6	6
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.5	13.0	12.3	12.1	11.6	11.0	10.5	9.0	9.0
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	7.8	7.2	6.1	5.8	5.2	4.2	3.6	1.4	1.4
100-yr Wave Period (seconds)	6.8	7.1	7.1	7.1	7.3	7.4	7.4	7.4	7.4	7.3	7.3	7.3	7.3	7.2	7.2

SPAN PROPERITES															
Span Length (ft)	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8
Span Width (ft)	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
Deck Thickness (ft)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Overhang (ft)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Number of Beams	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Total Dead Weight (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Resisting Moment (kft/ft)	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4
Resisting Vertical Force (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1

100-YEAR FORCE-MOMENT VALUES															
Maximum Vertical Force (kips/span)	162.9	157.5	157.5	153.6	149.1	139.1	135.8	119.5	91.2	84.0	64.0	41.4	33.2	0.0	0.0
Maximum Vertical Force (kips/ft)	7.5	7.2	7.2	7.1	6.9	6.4	6.2	5.5	4.2	3.9	2.9	1.9	1.5	0.0	0.0
Maximum Horizontal Force (kips/span)	42.6	46.0	46.0	47.4	47.3	47.8	52.2	52.3	45.1	39.2	28.4	16.1	3.8	0.0	0.0
Maximum Horizontal Force (kips/ft)	2.0	2.1	2.1	2.2	2.2	2.2	2.4	2.4	2.1	1.8	1.3	0.7	0.2	0.0	0.0
Maximum Moment (k-ft)	1,503.4	1,453.7	1,453.7	1,418.7	1,391.9	1,436.6	1,292.4	1,195.1	815.4	810.6	678.8	384.6	513.9	0.0	0.0
Maximum Moment (k-ft/ft)	69.1	66.8	66.8	65.2	64.0	66.1	59.4	54.9	37.5	37.3	31.2	17.7	23.6	0.0	0.0

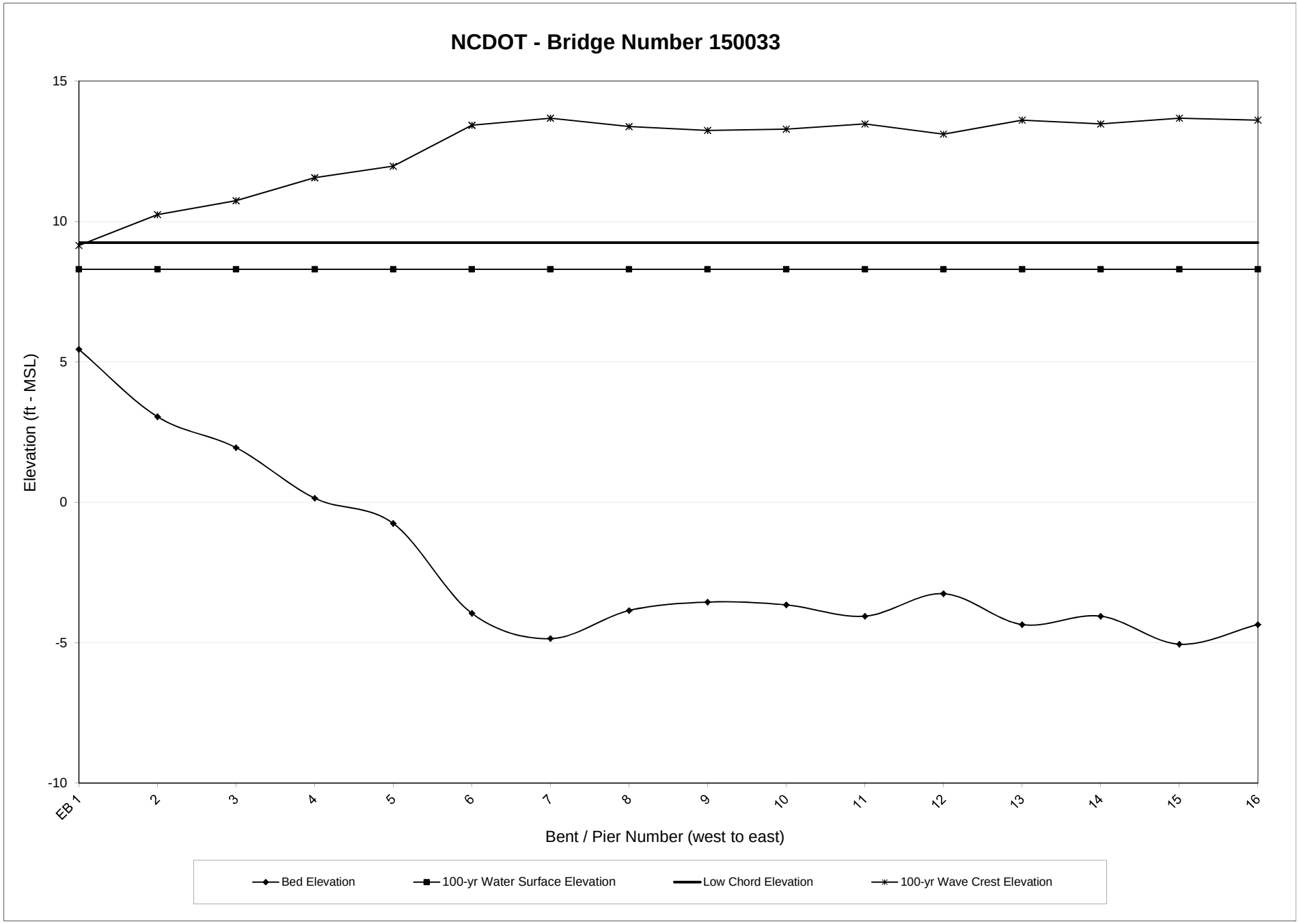
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

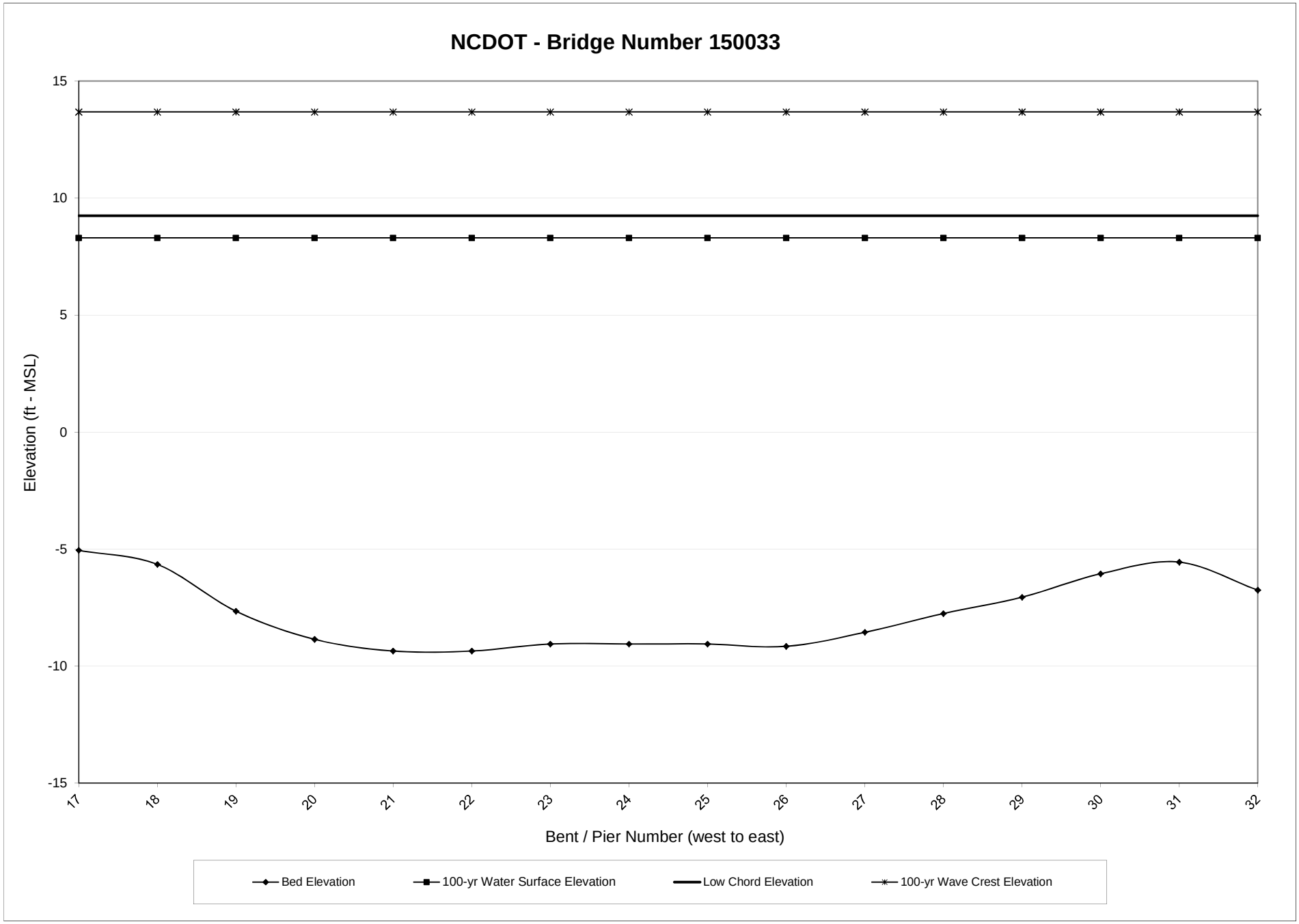
Notes:

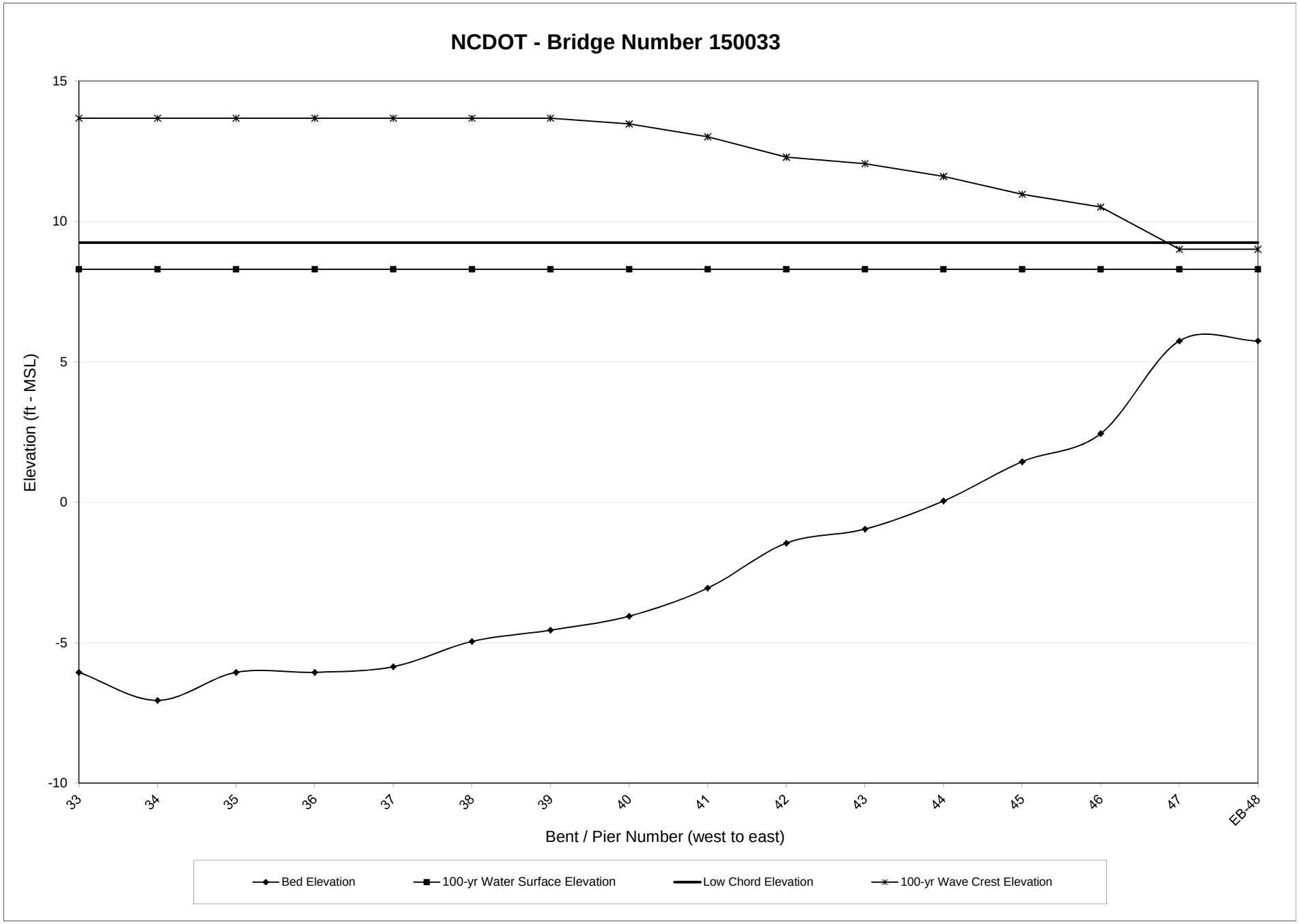
1 - Bridge spans 33-45 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 150033
15
10
5
0
-5
-10
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 150033
15
10
5
0
-5
-10
-15
Elevation (ft - MSL)
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 150033
15
10
5
0
-5
-10
Elevation (ft - MSL)
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
EB-48
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 150068

BOGUE SOUND & ICW

SR1180-1181-1182

CARTERET COUNTY

DRAFT

NCDOT BRIDGE NO. 150068

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.0**	**1.6**	**1.2**	**0.9**	**0.8**	**0.6**	**0.4**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Bed Elevation (ft - MSL)	-3	-8	-11	-11	-11	-10	-8	-14	-14	-14	-13	-12	-9	-8	-7	-5
Low Chord Elevation (ft - MSL)	4.6	4.6	5.3	5.8	6.4	7.0	7.5	8.1	8.7	9.2	9.8	10.1	10.4	11.5	13.4	16.1
100-yr Max Wave Crest Elevation (ft - MSL)	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3
100-yr Wave Height (ft)	6.1	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
100-yr Wave Period (seconds)	6.6	5.7	5.2	5.1	5.1	5.4	5.6	4.9	4.9	4.9	5.0	5.0	5.5	5.6	5.9	6.3

SPAN PROPERITES																
Span Length (ft)	61.8	62.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	62.5	61.5	82.5	82.5	82.5	82.5	82.5
Span Width (ft)	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Slab Dead Weight (kip/ft)	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Total Dead Weight (kip/ft)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Resisting Moment (kft/ft)	318.1	322.1	316.8	316.8	316.8	316.8	316.8	316.8	316.8	322.1	316.8	427.5	427.5	427.5	427.5	427.5
Resisting Vertical Force (kip/ft)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	391.0	582.4	457.5	331.7	233.0	178.1	131.3	62.6	26.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	6.3	9.3	7.4	5.4	3.8	2.9	2.1	1.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	148.1	103.4	66.0	57.1	45.6	38.6	37.9	11.3	5.8	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	2.4	1.7	1.1	0.9	0.7	0.6	0.6	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	10820.6	18846.3	12960.7	10545.3	8690.8	6695.5	4440.1	1779.8	368.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	175.2	301.5	210.7	171.5	141.3	108.9	72.2	28.9	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-9 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 150068

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Bed Elevation (ft - MSL)	-6	-7	-6	-5	-6	-6	-6	-7	-9	-10	-16	-22	-20	-20	-25	-25
Low Chord Elevation (ft - MSL)	19.4	24.2	28.9	33.7	38.5	43.2	47.6	51.5	55.0	57.9	61.0	64.0	64.0	62.0	60.0	58.0
100-yr Max Wave Crest Elevation (ft - MSL)	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3
100-yr Wave Height (ft)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
100-yr Wave Period (seconds)	6.1	5.9	6.0	6.2	6.1	6.0	5.9	5.8	5.5	5.3	4.7	4.2	4.4	4.4	4.1	4.1

SPAN PROPERITES																
Span Length (ft)	82.5	82.5	82.5	82.5	82.5	82.5	82.5	81.5	82.5	82.5	109.5	109.5	103.5	115.5	111.5	109.5
Span Width (ft)	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Slab Dead Weight (kip/ft)	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Total Dead Weight (kip/ft)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Resisting Moment (kft/ft)	427.5	427.5	427.5	427.5	427.5	427.5	427.5	422.3	427.5	427.5	569.9	569.9	538.2	601.5	580.4	569.9
Resisting Vertical Force (kip/ft)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are NOTsubject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 150068

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																	
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.9**	**0.8**	**1.1**	**1.6**	**0.8**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																	
100-yr Water Surface Elevation (ft - MSL)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Bed Elevation (ft - MSL)	-22	-22	-20	-13	-10	-9	-7	-6	-4	-5	-14	-8	-4	0	0	0	0
Low Chord Elevation (ft - MSL)	56.0	54.0	49.3	44.7	40.0	35.3	30.7	26.0	21.0	16.0	11.0	6.0	5.0	4.0	3.0	3.0	4.0
100-yr Max Wave Crest Elevation (ft - MSL)	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3
100-yr Wave Height (ft)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.3	3.9	3.9	3.9	3.9
100-yr Wave Period (seconds)	4.3	4.3	4.4	5.0	5.4	5.4	5.7	6.1	6.5	6.3	4.8	5.6	6.6	6.5	6.5	6.5	6.5

SPAN PROPERITES																	
Span Length (ft)	109.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5	42.5	41.5	42.5	42.5
Span Width (ft)	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Slab Dead Weight (kip/ft)	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Total Dead Weight (kip/ft)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Resisting Moment (kft/ft)	569.9	427.5	427.5	427.5	427.5	427.5	427.5	427.5	427.5	427.5	427.5	427.5	427.5	216.6	211.3	216.6	216.6
Resisting Vertical Force (kip/ft)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5

100-YEAR FORCE-MOMENT VALUES																	
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	455.4	128.8	154.0	236.5	128.8
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	3.0	3.7	5.6	3.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	241.9	53.1	47.4	49.6	53.1
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	1.2	1.1	1.2	1.2
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17256.1	4159.0	5664.4	8313.8	4159.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	209.2	97.9	136.5	195.6	97.9

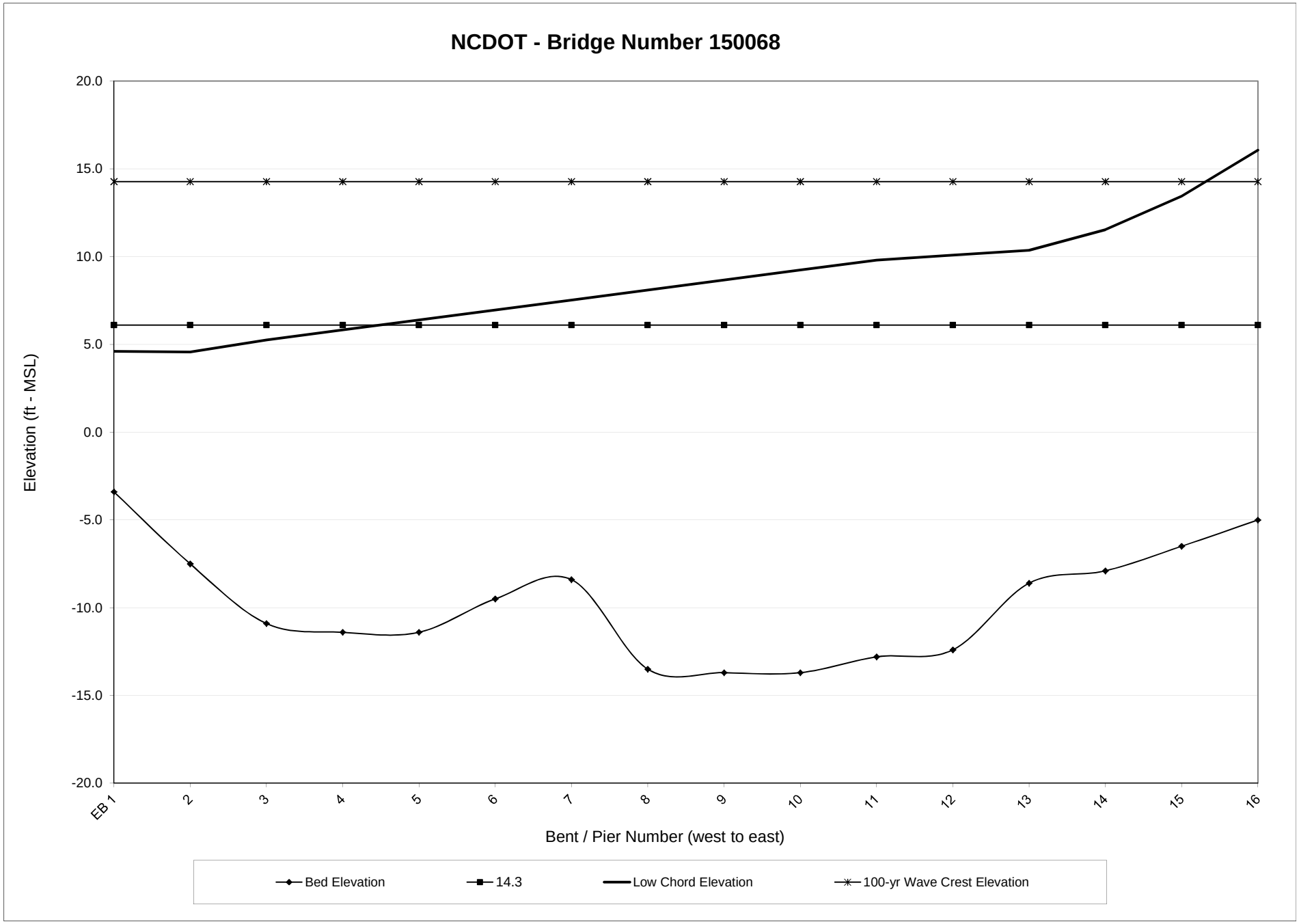
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

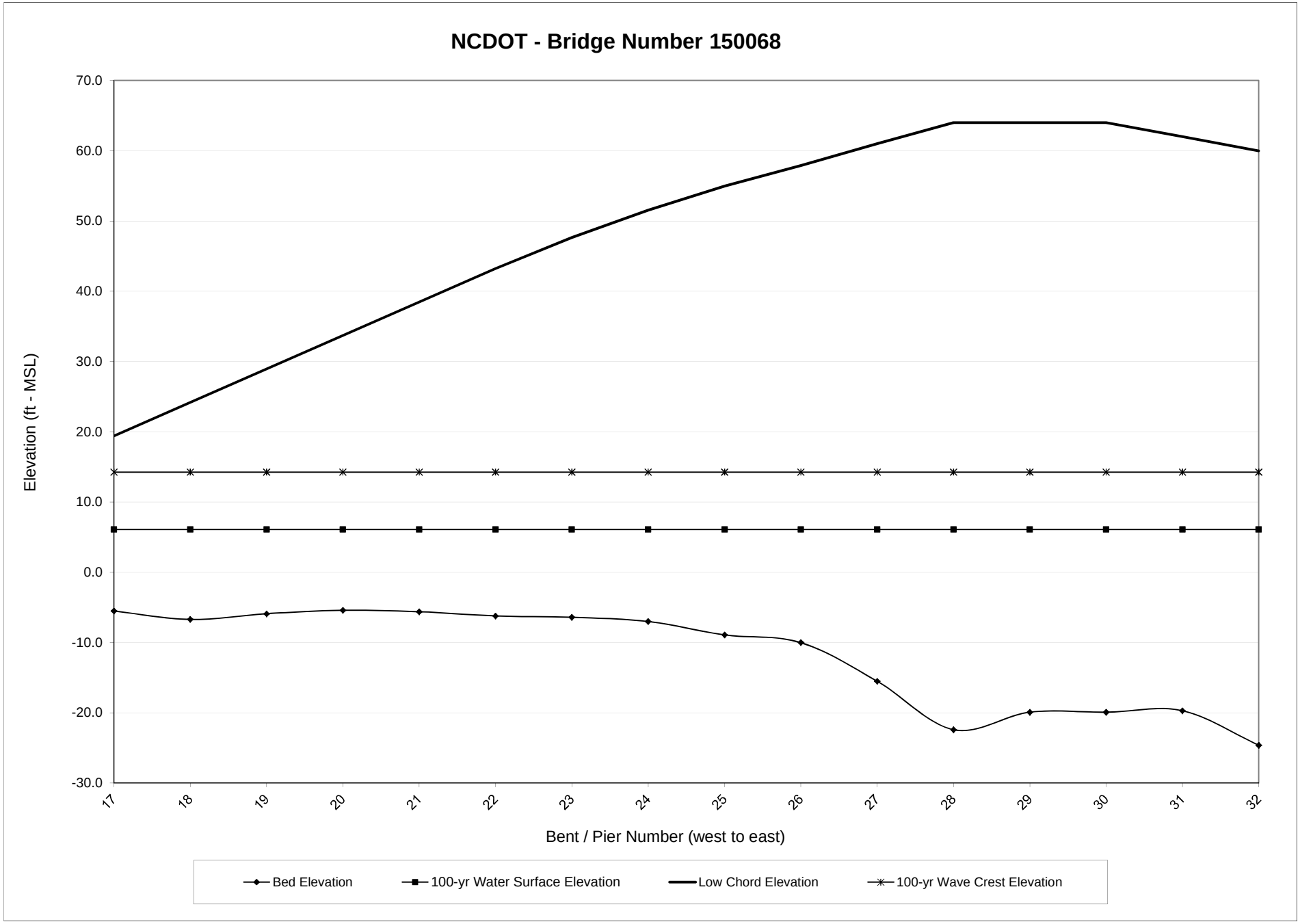
Notes:

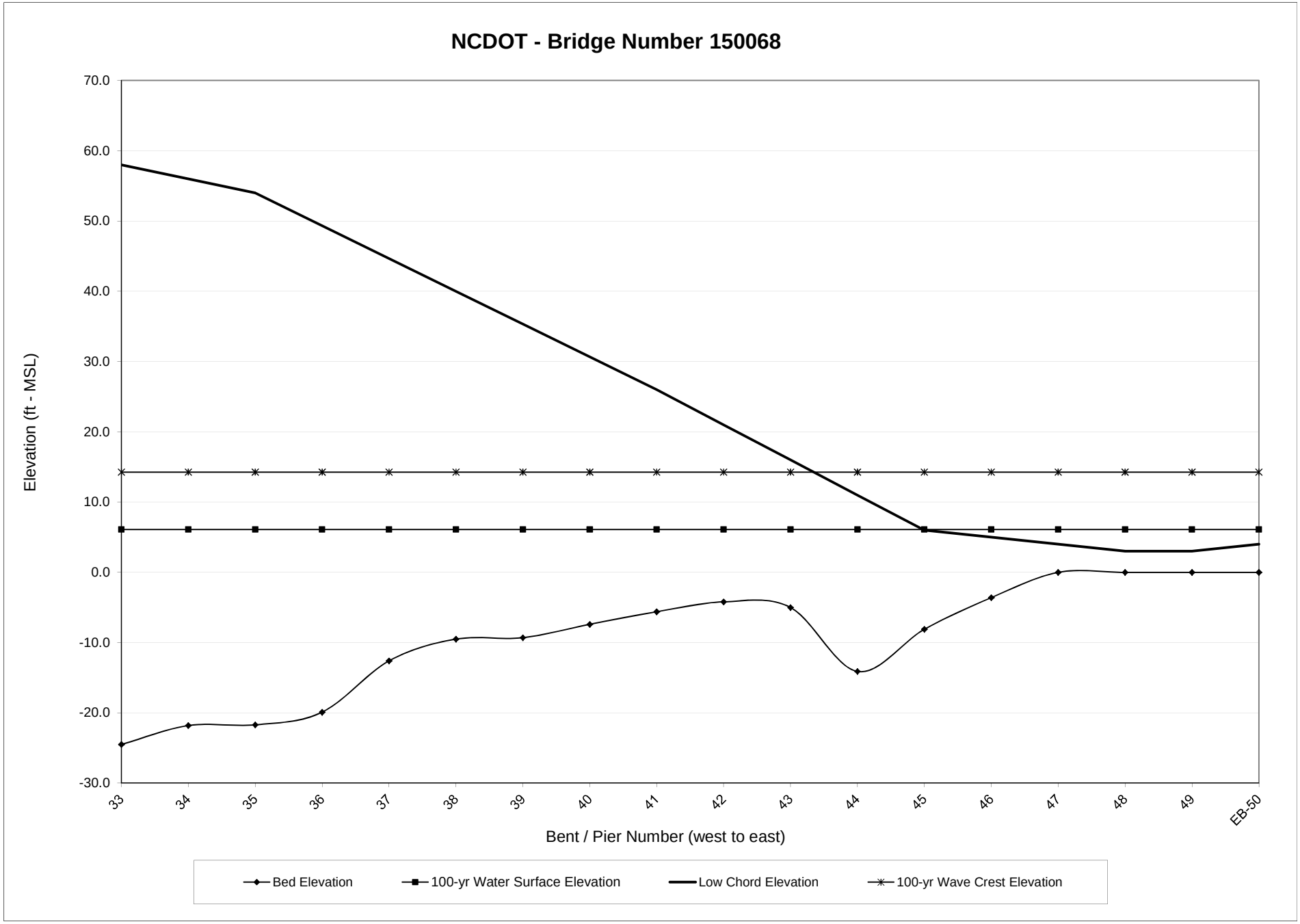
1 - Bridge spans 45-49 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 150068
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Bent / Pier Number (west to east)
Bed Elevation
14.3
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 150068
Elevation (ft - MSL)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 150068
Elevation (ft - MSL)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
EB-50
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 150101

CALICO CREEK

SR1243

CARTERET COUNTY

DRAFT

NCDOT BRIDGE NO. 150101

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY	
SPAN NUMBER	1
CRITICALITY INDEX (defined below)	4
VULNERABILITY INDEX (defined below)	0.9

SURGE/WAVE LOAD COMPUTATION INPUT VALUES	
HYDRAULIC VALUES	
100-yr Water Surface Elevation (ft - MSL)	8.0
Bed Elevation (ft - MSL)	-1
Low Chord Elevation (ft - MSL)	5.3
100-yr Max Wave Crest Elevation (ft - MSL)	8.9
100-yr Wave Height (ft)	1.8
100-yr Wave Period (seconds)	3.7
SPAN PROPERITES	
Span Length (ft)	46.0
Span Width (ft)	42.1
Deck Thickness (ft)	1.8
Overhang (ft)	0.0
Number of Beams	0
Beam Dead Weight (lb/lf) - Each	0
Beam Dead Weight (kip/ft) - Total	0.0
Slab Dead Weight (kip/ft)	11.0
Total Dead Weight (kip/ft)	11.0
Resisting Moment (kft/ft)	234.7
Resisting Vertical Force (kip/ft)	11.0
100-YEAR FORCE-MOMENT VALUES	
Maximum Vertical Force (kips/span)	229.0
Maximum Vertical Force (kips/ft)	5.0
Maximum Horizontal Force (kips/span)	10.0
Maximum Horizontal Force (kips/ft)	0.2
Maximum Moment (k-ft)	5,604
Maximum Moment (k-ft/ft)	122

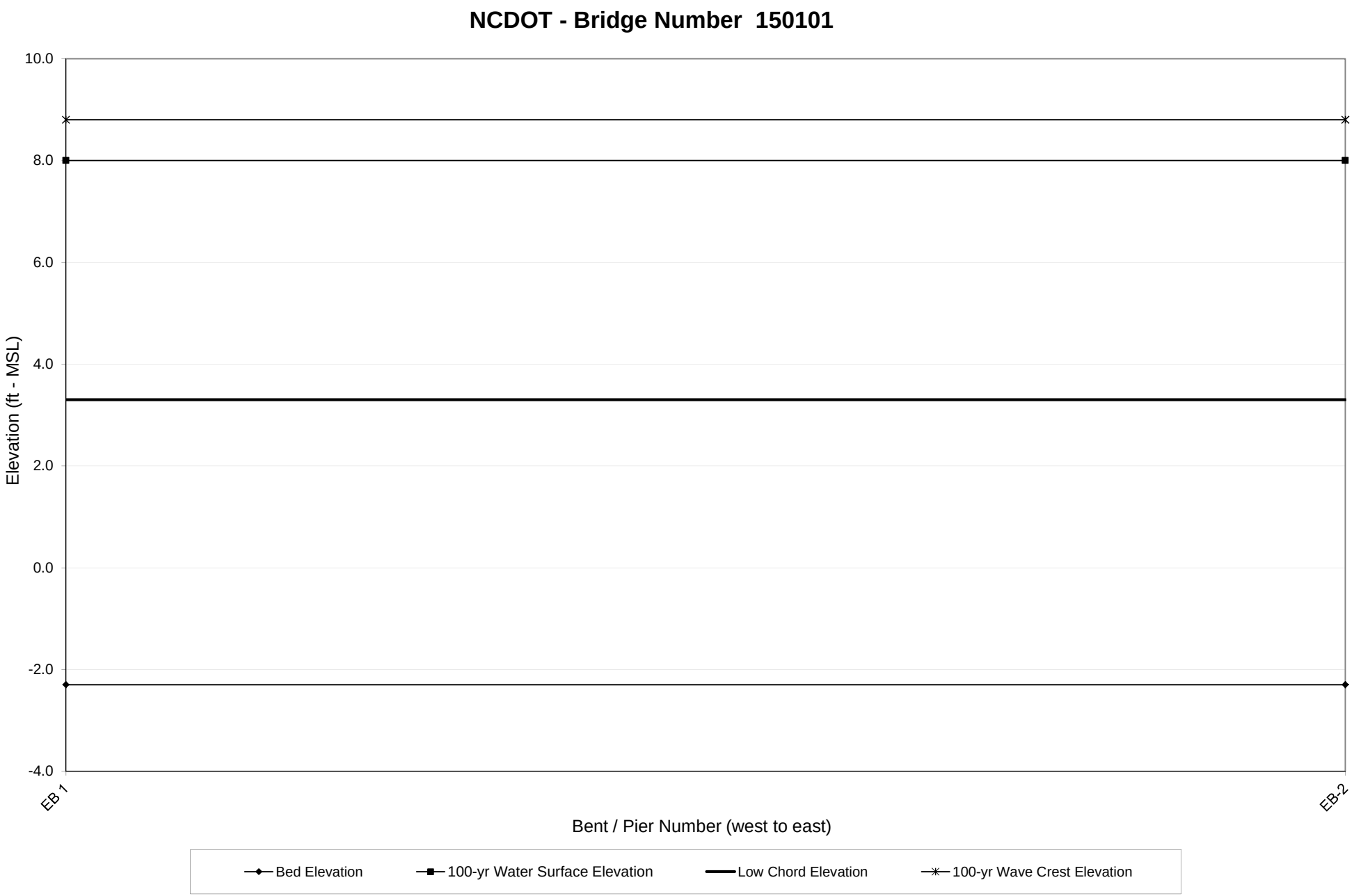
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge span is potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 150101
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
Elevation (ft - MSL)
EB 1
EB-2
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 200002

PEMBROKE CREEK

SR1204

CHOWAN COUNTY

DRAFT

NCDOT BRIDGE NO. 200002

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY														
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
CRITICALITY INDEX (defined below)	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
VULNERABILITY INDEX (defined below)	**4.7**	**4.9**	**5.8**	**6.6**	**6.7**	**6.6**	**6.3**	**6.4**	**5.8**	**5.6**	**5.4**	**5.6**	**5.1**	**5.1**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES														
100-yr Water Surface Elevation (ft - MSL)	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
Bed Elevation (ft - MSL)	-3	-6	-12	-15	-16	-17	-16	-13	-12	-11	-9	-8	-5	-5
Low Chord Elevation (ft - MSL)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
100-yr Max Wave Crest Elevation (ft - MSL)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
100-yr Wave Height (ft)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
100-yr Wave Period (seconds)	6.1	5.5	4.7	4.5	4.4	4.4	4.4	4.6	4.7	4.9	5.0	5.2	5.7	5.7

SPAN PROPERITES														
Span Length (ft)	23.0	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Span Width (ft)	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Beam Dead Weight (kip/ft) - Total	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Resisting Moment (kft/ft)	34.7	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9
Resisting Vertical Force (kip/ft)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5

100-YEAR FORCE-MOMENT VALUES														
Maximum Vertical Force (kips/span)	87.3	90.0	100.5	109.4	112.3	111.4	110.1	108.1	107.3	105.9	103.4	103.5	95.5	95.5
Maximum Vertical Force (kips/ft)	3.8	4.0	4.5	4.9	5.0	5.0	4.9	4.8	4.8	4.7	4.6	4.6	4.2	4.2
Maximum Horizontal Force (kips/span)	32.7	30.8	23.3	22.4	22.4	22.3	22.3	23.1	23.3	23.9	24.6	26.2	29.4	29.4
Maximum Horizontal Force (kips/ft)	1.4	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.2	1.3	1.3
Maximum Moment (k-ft)	2,137.1	2,155.5	2,506.3	2,895.1	2,900.6	2,888.0	2,763.1	2,769.4	2,506.3	2,429.3	2,333.7	2,445.7	2,204.2	2,204.2
Maximum Moment (k-ft/ft)	92.9	95.8	111.4	128.7	128.9	128.4	122.8	123.1	111.4	108.0	103.7	108.7	98.0	98.0

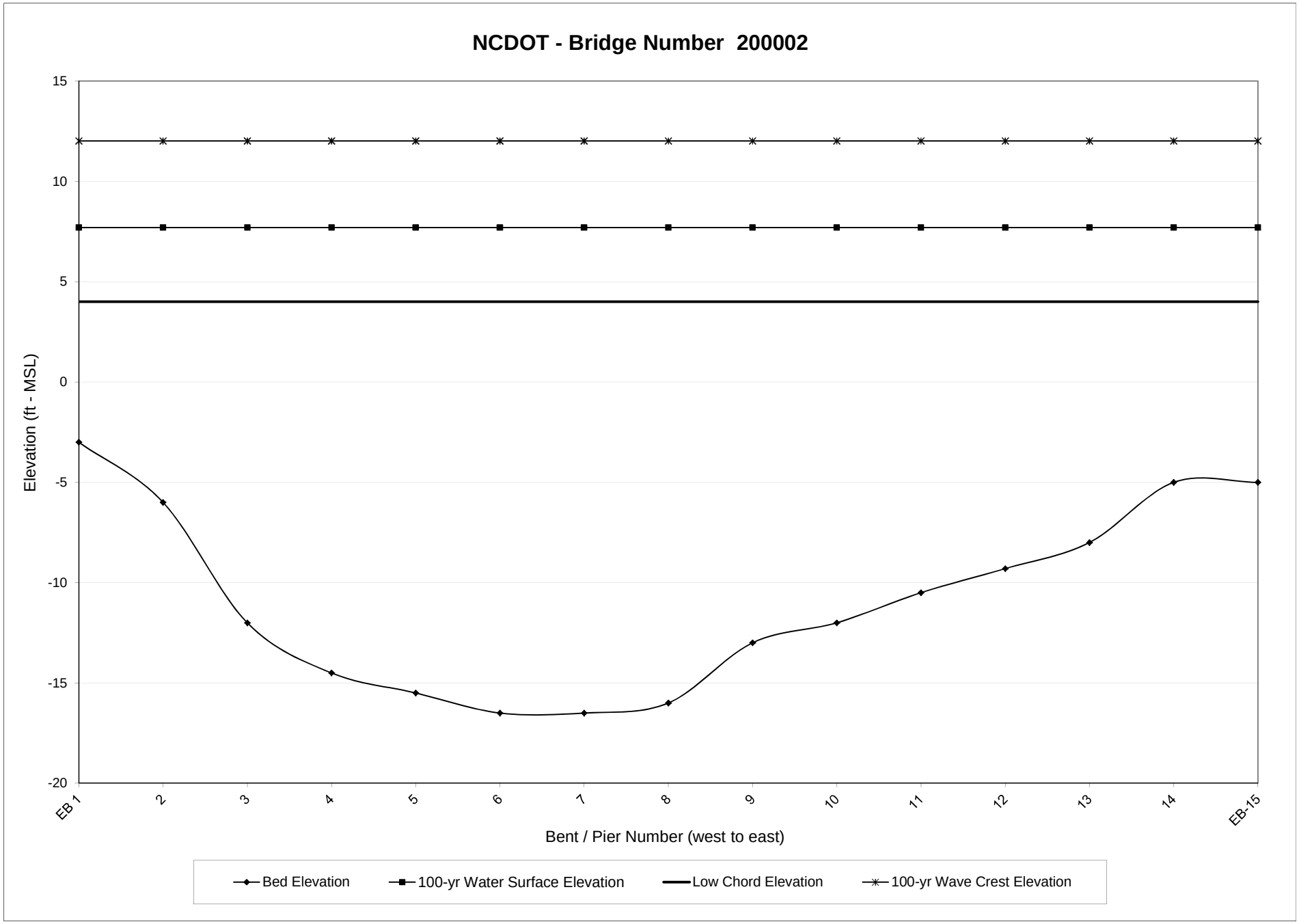
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-14 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 200002
15
10
5
0
-5
-10
-15
-20
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
EB-15
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 240060

TRENT RIVER

US70 BUS.

CRAVEN COUNTY

DRAFT

NCDOT BRIDGE NO. 240060

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																			
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
CRITICALITY INDEX (defined below)	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
VULNERABILITY INDEX (defined below)	**1.1**	**1.1**	**1.2**	**1.3**	**1.3**	**1.4**	**1.3**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**2.3**	**0.0**	**2.4**	**1.7**	**1.6**	**1.4**	**1.5**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																			
100-yr Water Surface Elevation (ft - MSL)	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
Bed Elevation (ft - MSL)	-9	-12	-16	-19	-21	-23	-23	-25	-25	-27	-27	-27	-22	-22	-25	-20	-16	-11	-1
Low Chord Elevation (ft - MSL)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	50.0	7.0	7.0	7.0	7.0	7.0
100-yr Max Wave Crest Elevation (ft - MSL)	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.4
100-yr Wave Height (ft)	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.0
100-yr Wave Period (seconds)	6.7	6.3	6.0	5.7	5.6	5.5	5.5	5.4	5.3	5.2	5.3	5.2	5.5	5.5	5.3	5.7	5.9	6.4	8.0

SPAN PROPERITES																			
Span Length (ft)	92.6	92.4	92.4	92.2	92.2	92.4	92.4	92.2	92.2	92.4	92.4	92.2	77.0	196.0	76.3	69.7	69.9	69.9	70.1
Span Width (ft)	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	48.1	36.1	48.1	36.1	36.1	36.1	36.1
Deck Thickness (ft)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.7	1.3	1.3	1.3	1.3	1.3
Overhang (ft)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.0	3.7	3.7	3.7	3.7	3.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	6	5	6	4	4	4	4
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	5.0	4.1	5.0	3.3	3.3	3.3	3.3
Slab Dead Weight (kip/ft)	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	9.0	3.6	9.0	6.8	6.8	6.8	6.8
Total Dead Weight (kip/ft)	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	14.0	7.7	14.0	10.1	10.1	10.1	10.1
Resisting Moment (kft/ft)	304.7	304.0	304.0	303.3	303.3	304.0	304.0	303.3	303.3	304.0	304.0	303.3	335.6	351.4	332.6	227.2	227.9	227.9	228.6
Resisting Vertical Force (kip/ft)	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	14.0	7.7	14.0	10.1	10.1	10.1	10.1

100-YEAR FORCE-MOMENT VALUES																			
Maximum Vertical Force (kips/span)	886.6	923.1	947.6	959.6	960.1	967.8	962.4	956.2	956.5	972.7	967.6	970.4	1005.6	0.0	1016.4	717.3	714.6	687.9	549.9
Maximum Vertical Force (kips/ft)	9.6	10.0	10.3	10.4	10.4	10.5	10.4	10.4	10.4	10.5	10.5	10.5	13.1	0.0	13.3	10.3	10.2	9.8	7.8
Maximum Horizontal Force (kips/span)	307.2	232.4	206.6	206.3	196.7	198.3	201.0	198.2	196.6	198.1	198.6	197.6	187.6	0.0	180.3	151.8	157.8	172.7	242.7
Maximum Horizontal Force (kips/ft)	3.3	2.5	2.2	2.2	2.1	2.1	2.2	2.2	2.1	2.1	2.1	2.1	2.4	0.0	2.4	2.2	2.3	2.5	3.5
Maximum Moment (k-ft)	17,521.6	17,285.1	19,193.3	20,369.4	21,107.0	21,989.2	21,591.7	22,389.1	22,316.5	22,945.5	22,592.9	22,893.8	34,415.6	0.0	35,210.1	15,284.8	14,561.9	12,712.3	13,353.0
Maximum Moment (k-ft/ft)	189.3	187.1	207.8	221.0	229.0	238.0	233.7	242.9	242.1	248.4	244.6	248.4	447.2	0.0	461.5	219.4	208.4	181.9	190.5

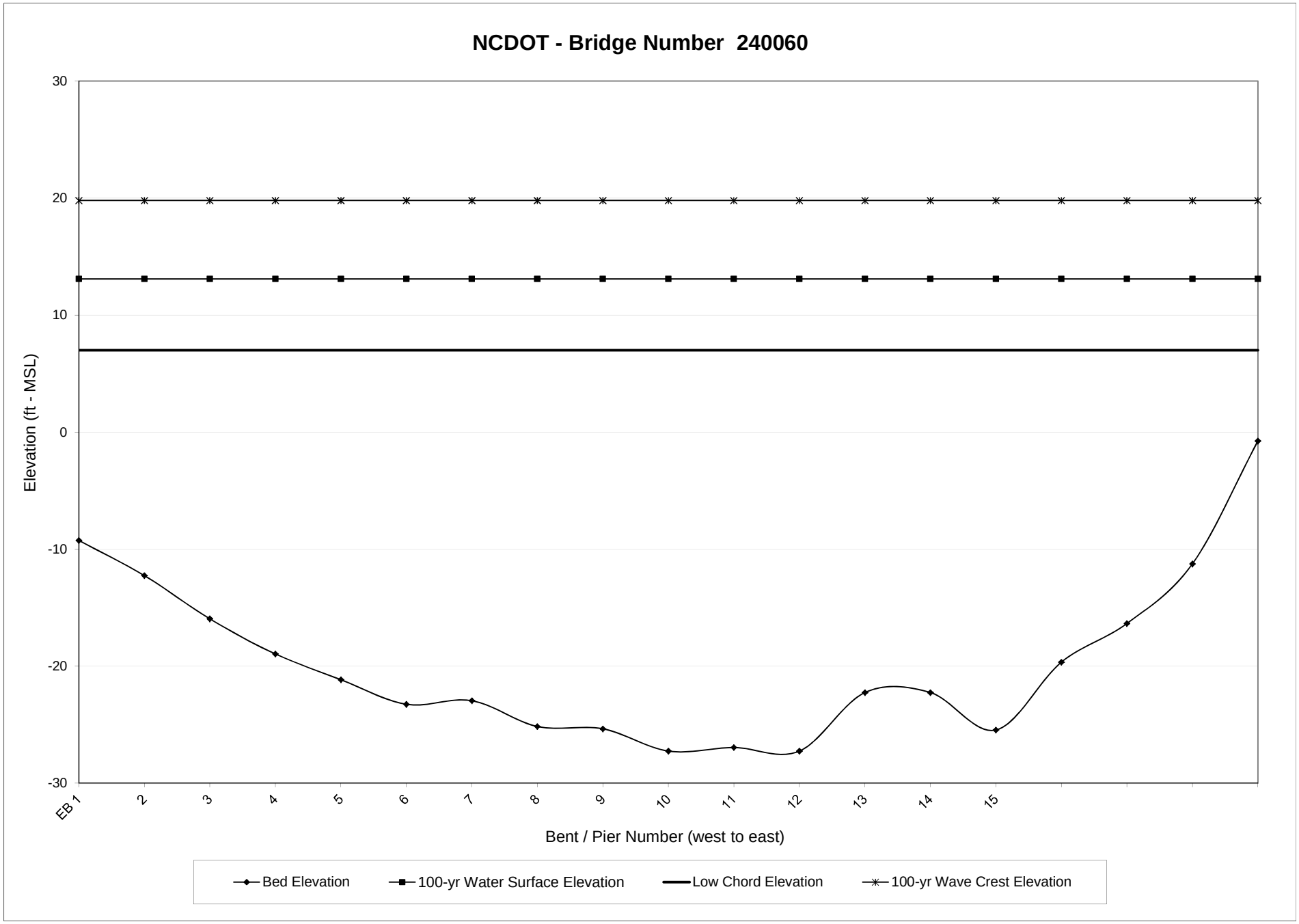
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-14 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 240060
30
20
10
0
-10
-20
-30
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 240083

TRENT RIVER

US17

CRAVEN COUNTY

DRAFT

NCDOT BRIDGE NO. 240083

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.7**	**2.3**	**2.0**	**1.8**	**1.8**	**1.2**	**0.8**	**0.6**	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Bed Elevation (ft - MSL)	2	-2	-2	1	0	0	0	1	0	0	-1	-1	-2	-1	-2	-2
Low Chord Elevation (ft - MSL)	9.6	10.3	10.9	11.6	12.3	12.9	13.6	14.3	15.0	15.6	16.3	17.0	17.7	18.3	19.0	19.7
100-yr Max Wave Crest Elevation (ft - MSL)	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3
100-yr Wave Height (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
100-yr Wave Period (seconds)	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
SPAN PROPERITES																
Span Length (ft)	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3
Span Width (ft)	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Number of Beams	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Slab Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Total Dead Weight (kip/ft)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Resisting Moment (kft/ft)	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6
Resisting Vertical Force (kip/ft)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	634.0	567.9	519.8	492.9	0.0	282.4	168.7	107.2	56.4	7.5	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	9.4	8.4	7.7	7.3	6.4	4.2	2.5	1.6	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	83.0	57.4	44.8	55.0	45.6	32.9	27.5	23.0	11.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	1.2	0.9	0.7	0.8	0.7	0.5	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	19501.1	16294.5	14429.8	12538.6	12656.8	8274.5	5898.6	4210.4	1911.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	289.6	242.0	214.3	186.2	188.0	122.9	87.6	62.5	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-10 are potentially subject to wave energy.
Bridge spans 11-16 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 240083

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Bed Elevation (ft - MSL)	-2	-3	-3	-3	-3	-7	-8	-8	-8	-10	-12	-12	-12	-12	-12	-12
Low Chord Elevation (ft - MSL)	20.3	21.0	21.7	22.4	23.0	23.7	24.4	25.1	25.7	26.4	27.1	27.8	28.4	29.1	29.8	30.4
100-yr Max Wave Crest Elevation (ft - MSL)	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3
100-yr Wave Height (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
100-yr Wave Period (seconds)	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9

SPAN PROPERITES																
Span Length (ft)	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3
Span Width (ft)	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Number of Beams	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Slab Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Total Dead Weight (kip/ft)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Resisting Moment (kft/ft)	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6	184.6
Resisting Vertical Force (kip/ft)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 240083

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Bed Elevation (ft - MSL)	-12	-11	-13	-13	-13	-13	-14	-14	-15	-17	-24	-25	-24	-25	-22	-18
Low Chord Elevation (ft - MSL)	31.1	31.8	32.5	33.1	33.8	34.5	35.2	35.8	36.5	37.2	37.8	38.5	39.2	39.9	40.5	41.2
100-yr Max Wave Crest Elevation (ft - MSL)	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3
100-yr Wave Height (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
100-yr Wave Period (seconds)	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9

SPAN PROPERITES																
Span Length (ft)	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	67.3	74.0	62.3	62.3	62.3
Span Width (ft)	54.3	54.3	54.3	54.3	54.3	90.3	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Number of Beams	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	4.6	4.6	4.6	4.6	4.6	4.6	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Slab Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	9.3	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Total Dead Weight (kip/ft)	10.2	10.2	10.2	10.2	10.2	14.0	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Resisting Moment (kft/ft)	184.6	184.6	184.6	184.6	184.6	307.2	144.6	144.6	144.6	144.6	144.6	144.6	159.3	133.7	133.7	133.7
Resisting Vertical Force (kip/ft)	10.2	10.2	10.2	10.2	10.2	14.0	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 33-48 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 240083

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY					
SPAN NUMBER	**49**	**50**	**51**	**52**	**53**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES					
100-yr Water Surface Elevation (ft - MSL)	13.3	13.3	13.3	13.3	13.3
Bed Elevation (ft - MSL)	-13	-9	-3	4	4
Low Chord Elevation (ft - MSL)	41.9	42.6	43.2	43.9	43.9
100-yr Max Wave Crest Elevation (ft - MSL)	16.3	16.3	16.3	16.3	16.3
100-yr Wave Height (ft)	4.7	4.7	4.7	4.7	4.7
100-yr Wave Period (seconds)	5.9	5.9	5.9	5.9	5.9

SPAN PROPERITES					
Span Length (ft)	62.3	62.3	62.3	62.3	62.3
Span Width (ft)	42.5	42.5	42.5	42.5	42.5
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.9	2.9	2.9	2.9	2.9
Number of Beams	6	6	6	6	6
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	3.5	3.5	3.5	3.5	3.5
Slab Dead Weight (kip/ft)	4.4	4.4	4.4	4.4	4.4
Total Dead Weight (kip/ft)	7.9	7.9	7.9	7.9	7.9
Resisting Moment (kft/ft)	133.7	133.7	133.7	133.7	133.7
Resisting Vertical Force (kip/ft)	7.9	7.9	7.9	7.9	7.9

100-YEAR FORCE-MOMENT VALUES					
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0

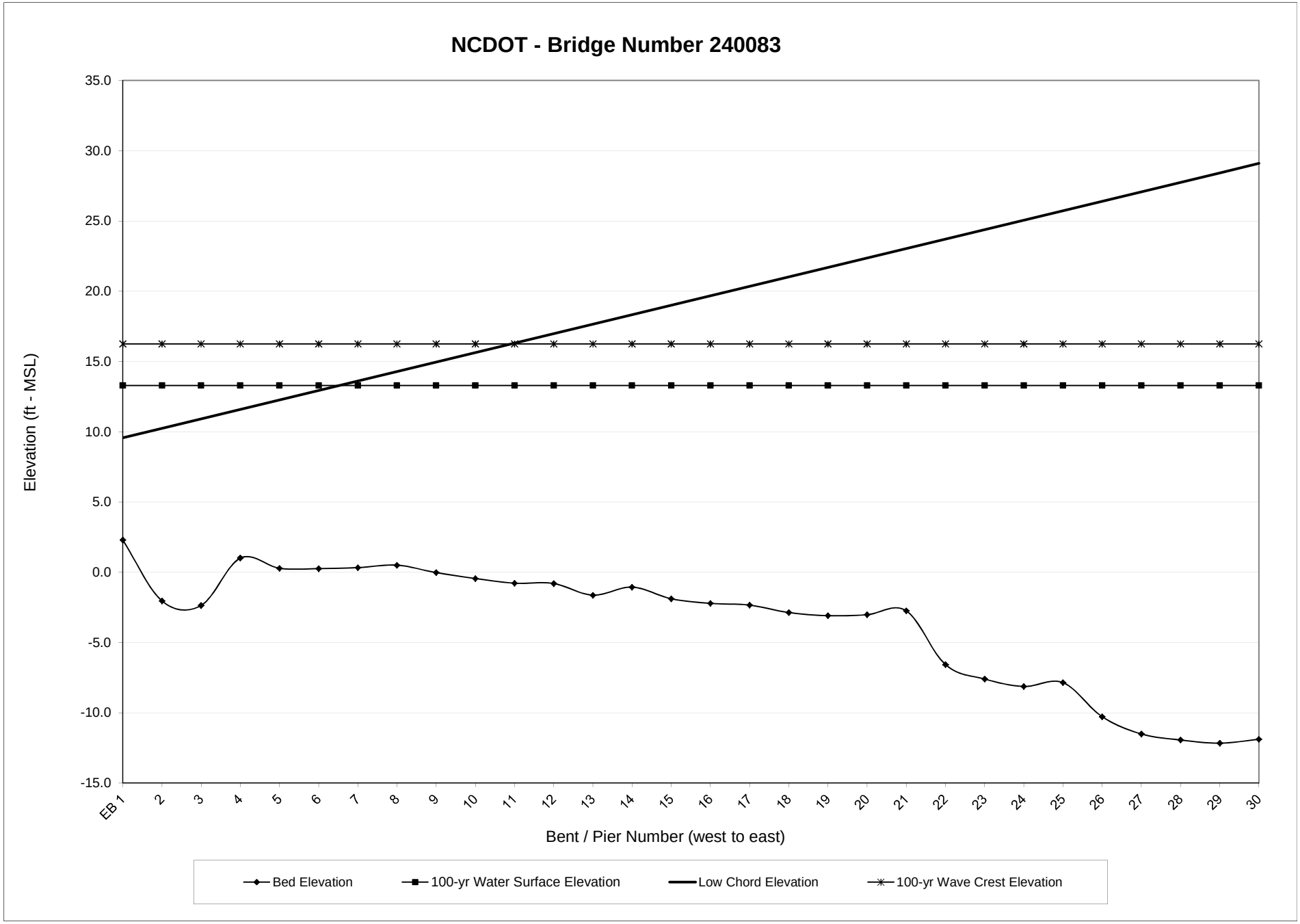
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

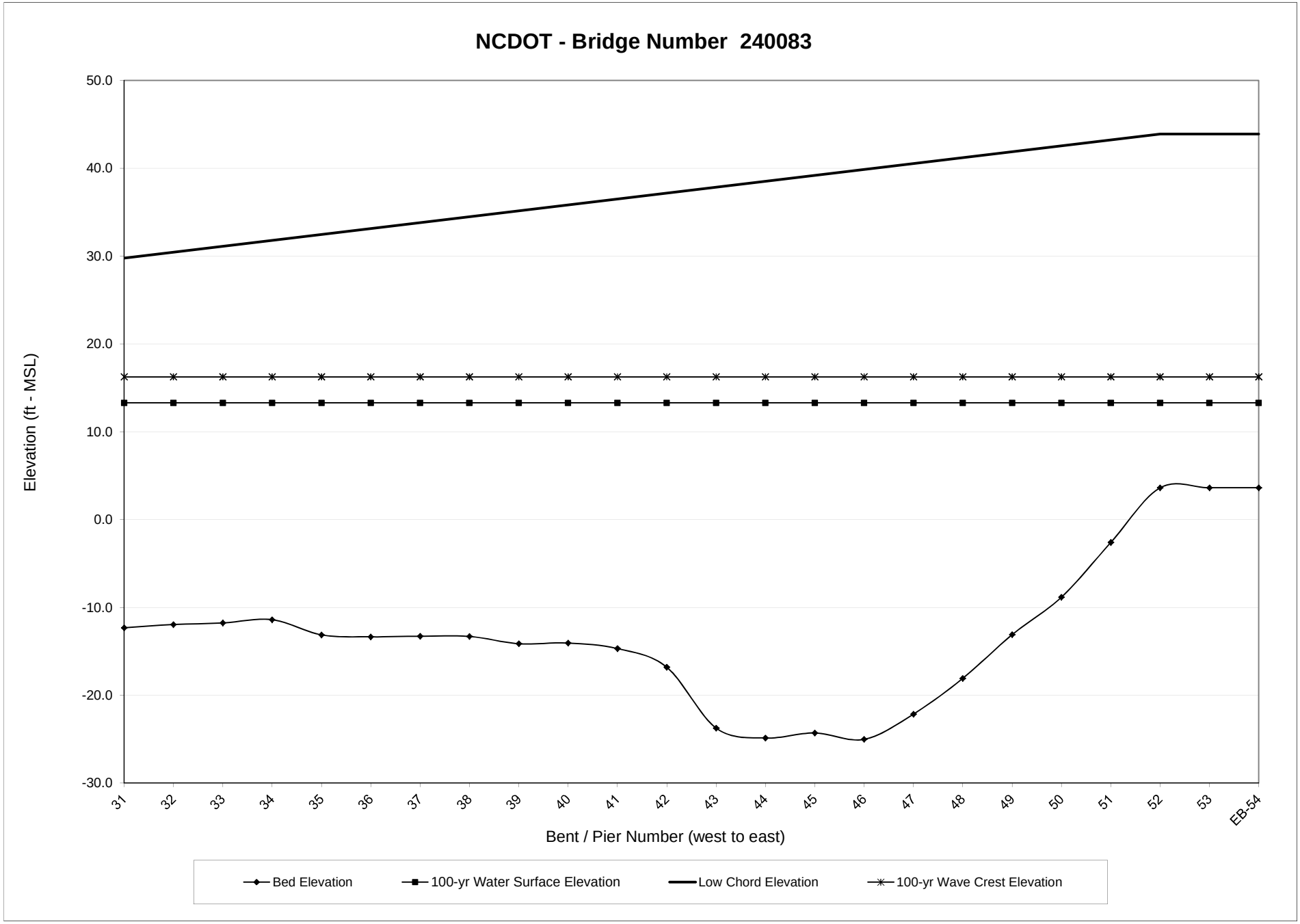
Notes:

1 - Bridge spans 49-53 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 240083
Elevation (ft - MSL)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 240083
Elevation (ft - MSL)
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
EB-54
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 240084

TRENT RIVER

US17

CRAVEN COUNTY

DRAFT

NCDOT BRIDGE NO. 240084

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.7**	**2.2**	**2.0**	**1.7**	**1.8**	**1.1**	**0.8**	**0.6**	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Bed Elevation (ft - MSL)	-1	-8	-10	-12	-10	-6	-5	-6	-5	-4	-4	-6	-5	-5	-4	-4
Low Chord Elevation (ft - MSL)	9.6	10.3	10.9	11.6	12.3	12.9	13.6	14.3	15.0	15.6	16.3	17.0	17.7	18.3	19.0	19.7
100-yr Max Wave Crest Elevation (ft - MSL)	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3
100-yr Wave Height (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
100-yr Wave Period (seconds)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
SPAN PROPERITES																
Span Length (ft)	67.3	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0
Span Width (ft)	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Number of Beams	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Slab Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Total Dead Weight (kip/ft)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Resisting Moment (kft/ft)	184.6	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3
Resisting Vertical Force (kip/ft)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	642.3	581.0	528.9	528.1	0.0	294.0	179.2	108.3	60.3	10.9	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	9.5	8.4	7.7	7.7	6.7	4.3	2.6	1.6	0.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	90.2	59.5	53.6	53.6	53.0	33.8	28.5	20.9	11.6	3.4	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	1.3	0.9	0.8	0.8	0.8	0.5	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	18973.7	16570.7	15122.8	12764.8	13606.2	8563.7	6160.4	4266.4	2040.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	281.8	240.2	219.2	185.0	197.2	124.1	89.3	61.8	29.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-4 are potentially subject to wave energy.
Bridge spans 5-16 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 240084

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Bed Elevation (ft - MSL)	-3	-3	-9	-9	-4	-3	-4	-4	-4	-2	-1	0	2	-2	-8	-15
Low Chord Elevation (ft - MSL)	20.3	21.0	21.7	22.4	23.0	23.7	24.4	25.1	25.7	26.4	27.1	27.8	28.4	29.1	29.8	30.4
100-yr Max Wave Crest Elevation (ft - MSL)	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3
100-yr Wave Height (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
100-yr Wave Period (seconds)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0

SPAN PROPERITES																
Span Length (ft)	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0
Span Width (ft)	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Number of Beams	8	8	8	8	8	8	8	9	9	9	9	9	9	9	9	9
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	4.6	4.6	4.6	4.6	4.6	4.6	4.6	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Slab Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Total Dead Weight (kip/ft)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
Resisting Moment (kft/ft)	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3
Resisting Vertical Force (kip/ft)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 240084

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Bed Elevation (ft - MSL)	-11	-14	-6	-3	-2	0	-4	-4	-4	-3	-4	-9	-13	-11	-3	-4
Low Chord Elevation (ft - MSL)	31.1	31.8	32.5	33.1	33.8	34.5	35.2	35.8	36.5	37.2	37.8	38.5	39.2	39.9	40.5	41.2
100-yr Max Wave Crest Elevation (ft - MSL)	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3
100-yr Wave Height (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
100-yr Wave Period (seconds)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0

SPAN PROPERITES																
Span Length (ft)	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	74.0	64.0	64.0	64.0
Span Width (ft)	54.3	54.3	54.3	54.3	54.3	90.3	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Number of Beams	9	9	9	9	9	9	9	9	10	10	10	10	10	10	11	11
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.8	5.8	5.8	5.8	5.8	5.8	6.4	6.4
Slab Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	9.3	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Total Dead Weight (kip/ft)	10.8	10.8	10.8	10.8	10.8	14.5	9.6	9.6	10.2	10.2	10.2	10.2	10.2	10.2	10.8	10.8
Resisting Moment (kft/ft)	189.3	189.3	189.3	189.3	189.3	314.9	148.3	148.3	148.3	148.3	148.3	148.3	159.3	137.3	137.3	137.3
Resisting Vertical Force (kip/ft)	10.8	10.8	10.8	10.8	10.8	14.5	9.6	9.6	10.2	10.2	10.2	10.2	10.2	10.2	10.8	10.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 33-48 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 240084
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY					
SPAN NUMBER	**49**	**50**	**51**	**52**	**53**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES					
100-yr Water Surface Elevation (ft - MSL)	13.3	13.3	13.3	13.3	13.3
Bed Elevation (ft - MSL)	-4	-4	-5	-5	-6
Low Chord Elevation (ft - MSL)	41.9	42.6	43.2	43.9	43.9
100-yr Max Wave Crest Elevation (ft - MSL)	16.3	16.3	16.3	16.1	16.1
100-yr Wave Height (ft)	4.7	4.7	4.7	4.5	4.5
100-yr Wave Period (seconds)	6.0	6.0	6.0	6.0	6.0

SPAN PROPERITES					
Span Length (ft)	64.0	64.0	64.0	64.0	64.0
Span Width (ft)	42.5	42.5	42.5	42.5	42.5
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.9	2.9	2.9	2.9	2.9
Number of Beams	11	11	11	12	12
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	6.4	6.4	6.4	7.0	7.0
Slab Dead Weight (kip/ft)	4.4	4.4	4.4	4.4	4.4
Total Dead Weight (kip/ft)	10.8	10.8	10.8	11.4	11.4
Resisting Moment (kft/ft)	137.3	137.3	137.3	137.3	137.3
Resisting Vertical Force (kip/ft)	10.8	10.8	10.8	11.4	11.4

100-YEAR FORCE-MOMENT VALUES					
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0

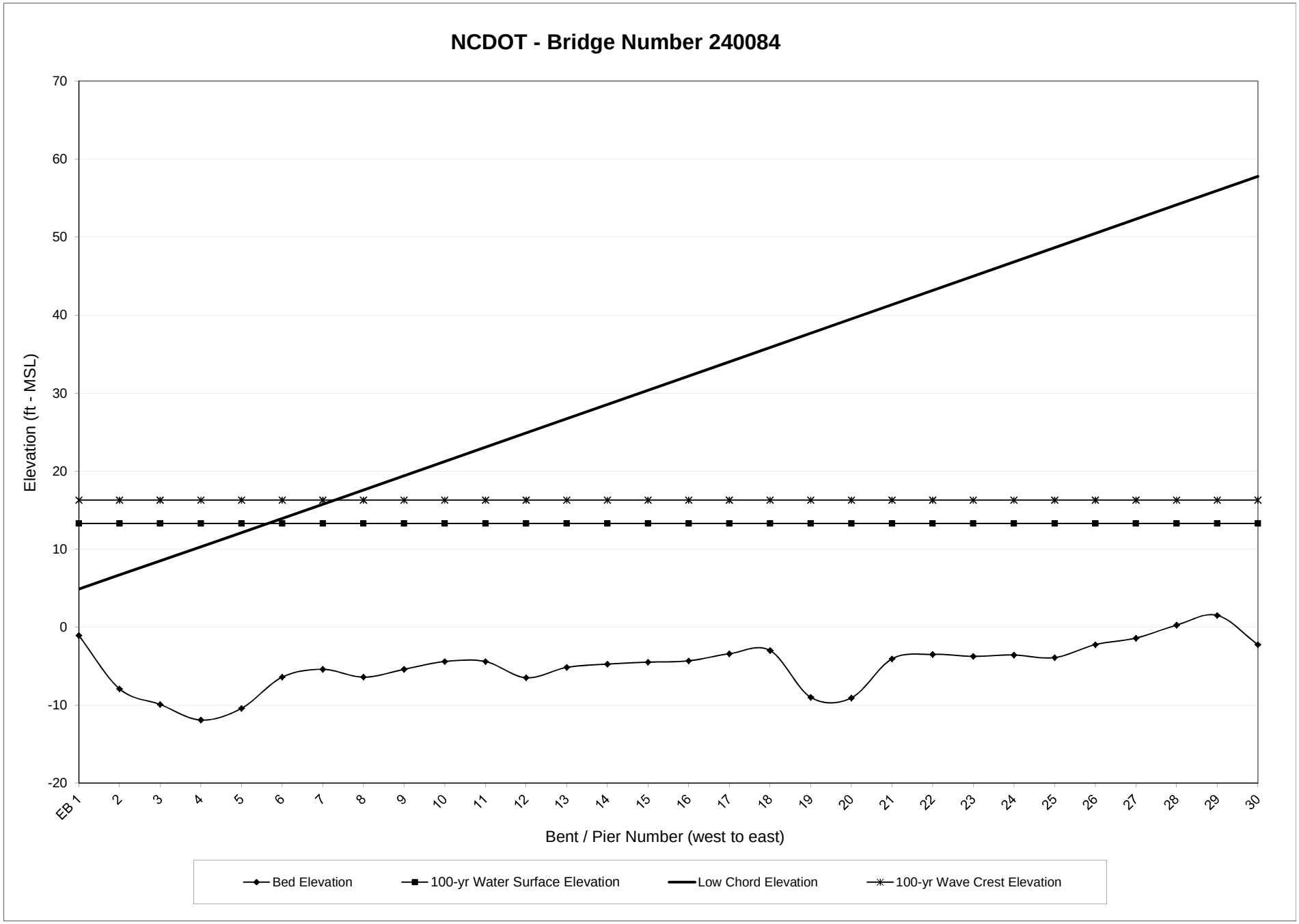
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

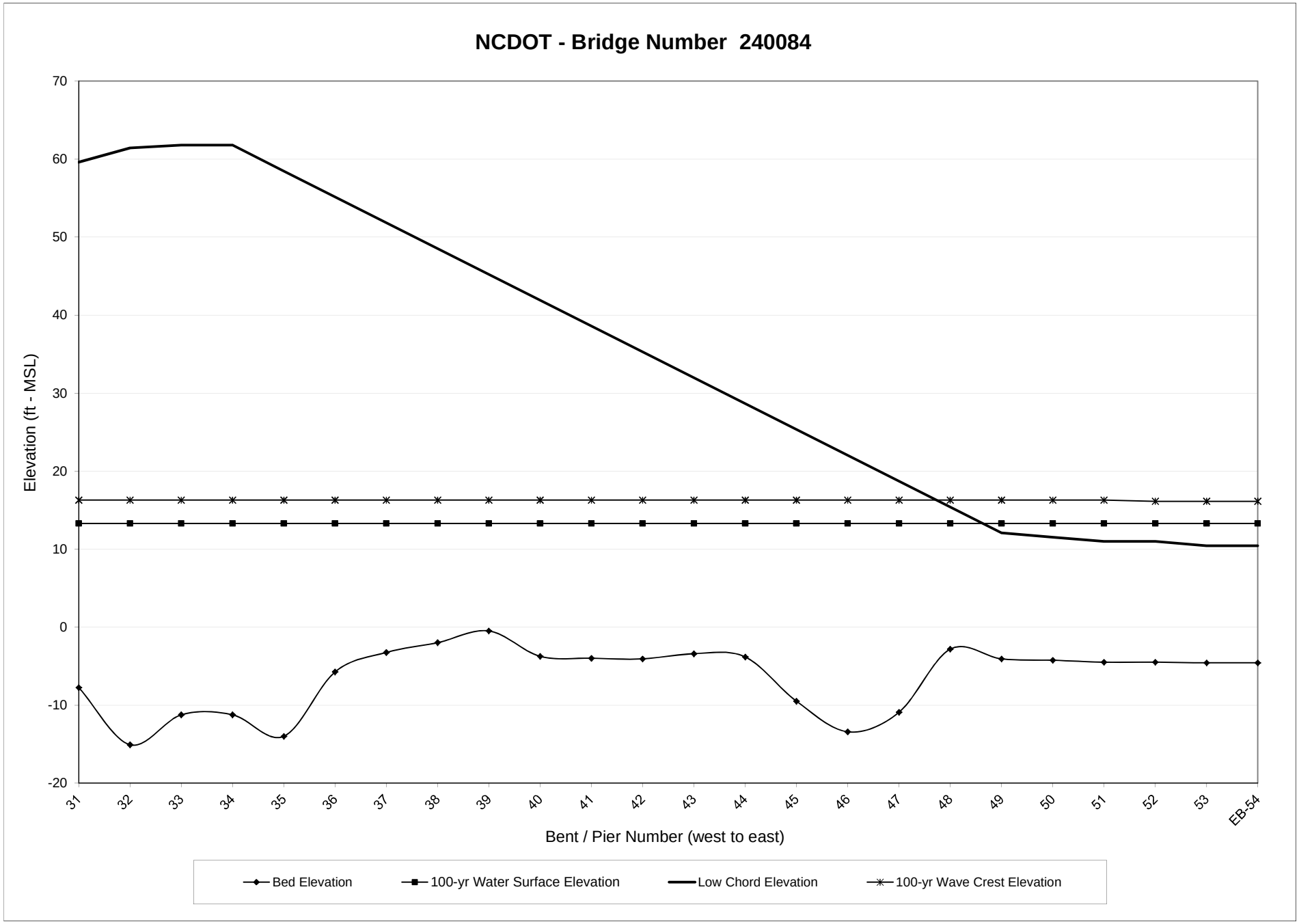
Notes:

1 - Bridge spans 49-59 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 240084
Elevation (ft - MSL)
70
60
50
40
30
20
10
0
-10
-20
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 240084
Elevation (ft - MSL)
70
60
50
40
30
20
10
0
-10
-20
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
EB-54
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 240236

NEUSE RIVER

US70 BYP(RAMP DC)

CRAVEN COUNTY

DRAFT

NCDOT BRIDGE NO. 240236

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
Bed Elevation (ft - MSL)	-3	-3	-3	-4	-4	-3	-2	-2	-2	-2	-3	-3	-3	-2	-2	-3
Low Chord Elevation (ft - MSL)	50.0	50.5	57.1	63.6	70.2	63.6	60.3	50.5	53.8	47.2	40.7	34.1	30.8	21.0	14.4	14.4
100-yr Max Wave Crest Elevation (ft - MSL)	20.1	20.2	20.2	20.2	20.2	19.9	19.8	19.7	19.7	19.9	19.9	19.9	19.9	19.8	19.5	20.0
100-yr Wave Height (ft)	10.3	10.4	10.4	10.4	10.4	10.0	9.9	9.7	9.7	9.9	10.1	10.1	10.1	9.8	9.4	10.1
100-yr Wave Period (seconds)	8.4	8.4	8.4	8.2	8.2	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
SPAN PROPERITES																
Span Length (ft)	184.2	184.2	184.2	249.3	184.2	184.2	184.2	127.4	126.2	127.4	123.7	122.4	122.4	123.7	123.7	122.4
Span Width (ft)	42.3	36.3	36.3	36.3	36.3	36.3	36.3	38.4	60.0	90.0	47.7	40.9	40.8	40.8	40.8	40.8
Deck Thickness (ft)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Overhang (ft)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Number of Beams	4	4	4	4	4	4	4	9	9	9	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	178	178	178	178	178	178	178	900	900	900	900	900	900	900	900	900
Beam Dead Weight (kip/ft) - Total	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.1	8.1	8.1	3.6	3.6	3.6	3.6	3.6	3.6
Slab Dead Weight (kip/ft)	6.7	5.7	5.7	5.7	5.7	5.7	5.7	6.0	9.5	14.2	7.5	6.4	6.4	6.4	6.4	6.4
Total Dead Weight (kip/ft)	7.4	6.4	6.4	6.4	6.4	6.4	6.4	14.1	17.6	22.3	11.1	10.0	10.0	10.0	10.0	10.0
Resisting Moment (kft/ft)	671.5	585.5	585.5	795.2	585.5	585.5	585.5	886.3	1,088.6	1,395.7	675.2	603.9	603.2	609.5	609.5	603.2
Resisting Vertical Force (kip/ft)	7.4	6.4	6.4	6.4	6.4	6.4	6.4	14.1	17.6	22.3	11.1	10.0	10.0	10.0	10.0	10.0
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.1	1,075.3	1,241.7
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	8.7	10.1
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.2	14.2	14.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,837.0	1,843.3	1,849.3
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.9	14.9	15.1

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 14-16 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 240236

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY						
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.2**	**0.2**	**0.5**	**0.5**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES						
100-yr Water Surface Elevation (ft - MSL)	12.9	12.9	12.9	12.9	12.9	12.9
Bed Elevation (ft - MSL)	-3	-3	-2	-2	-1	-1
Low Chord Elevation (ft - MSL)	11.1	7.8	7.8	5.0	5.0	5.0
100-yr Max Wave Crest Elevation (ft - MSL)	20.1	20.1	19.8	19.6	19.3	19.3
100-yr Wave Height (ft)	10.3	10.3	9.9	9.5	9.1	9.1
100-yr Wave Period (seconds)	8.4	8.4	8.4	8.4	8.4	8.4

SPAN PROPERITES						
Span Length (ft)	122.4	123.6	62.3	62.3	39.3	39.3
Span Width (ft)	40.8	40.8	40.8	40.8	40.8	40.8
Deck Thickness (ft)	1.1	1.1	1.1	1.1	1.1	1.1
Overhang (ft)	4.2	4.2	4.2	4.2	4.2	4.2
Number of Beams	4	4	5	5	5	5
Beam Dead Weight (lb/lf) - Each	900	900	581	581	384	384
Beam Dead Weight (kip/ft) - Total	3.6	3.6	2.9	2.9	1.9	1.9
Slab Dead Weight (kip/ft)	6.4	6.4	6.4	6.4	6.4	6.4
Total Dead Weight (kip/ft)	10.0	10.0	9.3	9.3	8.3	8.3
Resisting Moment (kft/ft)	603.2	609.5	281.1	281.1	155.4	155.4
Resisting Vertical Force (kip/ft)	10.0	10.0	9.3	9.3	8.3	8.3

100-YEAR FORCE-MOMENT VALUES						
Maximum Vertical Force (kips/span)	2,045.8	976.7	473.3	583.5	322.8	325.8
Maximum Vertical Force (kips/ft)	16.7	7.9	7.6	9.4	8.2	8.3
Maximum Horizontal Force (kips/span)	14.2	14.3	14.1	14.4	14.3	14.5
Maximum Horizontal Force (kips/ft)	0.1	0.1	0.2	0.2	0.4	0.4
Maximum Moment (k-ft)	1,778.1	1,828.5	1,860.6	1,857.2	1,804.6	1,862.5
Maximum Moment (k-ft/ft)	14.5	14.8	29.8	29.8	45.9	47.3

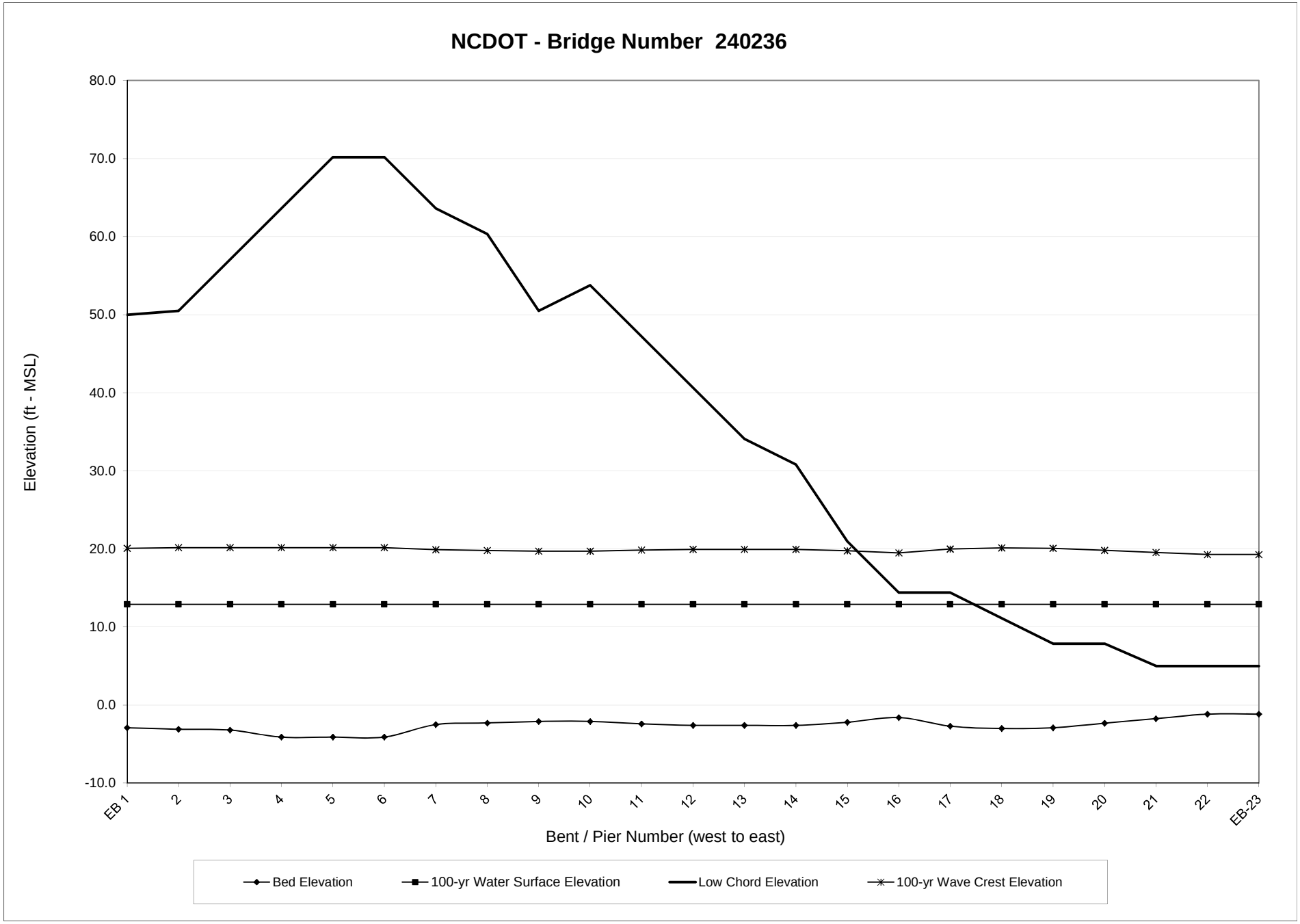
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-22 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 240236
Elevation (ft - MSL)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
EB-23
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 240237

NEUSE RIVER

NC55

CRAVEN COUNTY

DRAFT

NCDOT BRIDGE NO. 240237

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY								
SPAN NUMBER	1	2	3	4	5	6	7	8
CRITICALITY INDEX (defined below)	4	4	4	4	4	4	4	4
VULNERABILITY INDEX (defined below)	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES								
100-yr Water Surface Elevation (ft - MSL)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Bed Elevation (ft - MSL)	-12	-12	-12	-12	-12	-10	-12	-12
Low Chord Elevation (ft - MSL)	38.1	34.1	31.1	28.1	25.1	21.1	11.1	8.1
100-yr Max Wave Crest Elevation (ft - MSL)	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9
100-yr Wave Height (ft)	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
100-yr Wave Period (seconds)	5.7	5.7	5.7	5.7	5.7	5.9	5.7	5.7

SPAN PROPERITES								
Span Length (ft)	116.1	114.8	114.8	114.8	116.1	116.1	114.8	114.8
Span Width (ft)	30.1	26.5	26.5	26.5	26.5	26.5	31.4	31.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Number of Beams	3	3	3	3	3	3	4	4
Beam Dead Weight (lb/lf) - Each	96	96	96	96	96	96	96	96
Beam Dead Weight (kip/ft) - Total	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4
Slab Dead Weight (kip/ft)	4.5	4.0	4.0	4.0	4.0	4.0	4.7	4.7
Total Dead Weight (kip/ft)	4.8	4.3	4.3	4.3	4.3	4.3	5.1	5.1
Resisting Moment (kft/ft)	273.9	240.3	240.3	240.3	243.0	243.0	287.5	287.5
Resisting Vertical Force (kip/ft)	4.8	4.3	4.3	4.3	4.3	4.3	5.1	5.1

100-YEAR FORCE-MOMENT VALUES								
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.1	2127.7	2127.7
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	18.5	18.5
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	195.6	250.3
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	1.7	2.2
Maximum Moment (k-ft)	0	0	0	0	0	0	21,260	21,260
Maximum Moment (k-ft/ft)	0	0	0	0	0	0	185	185

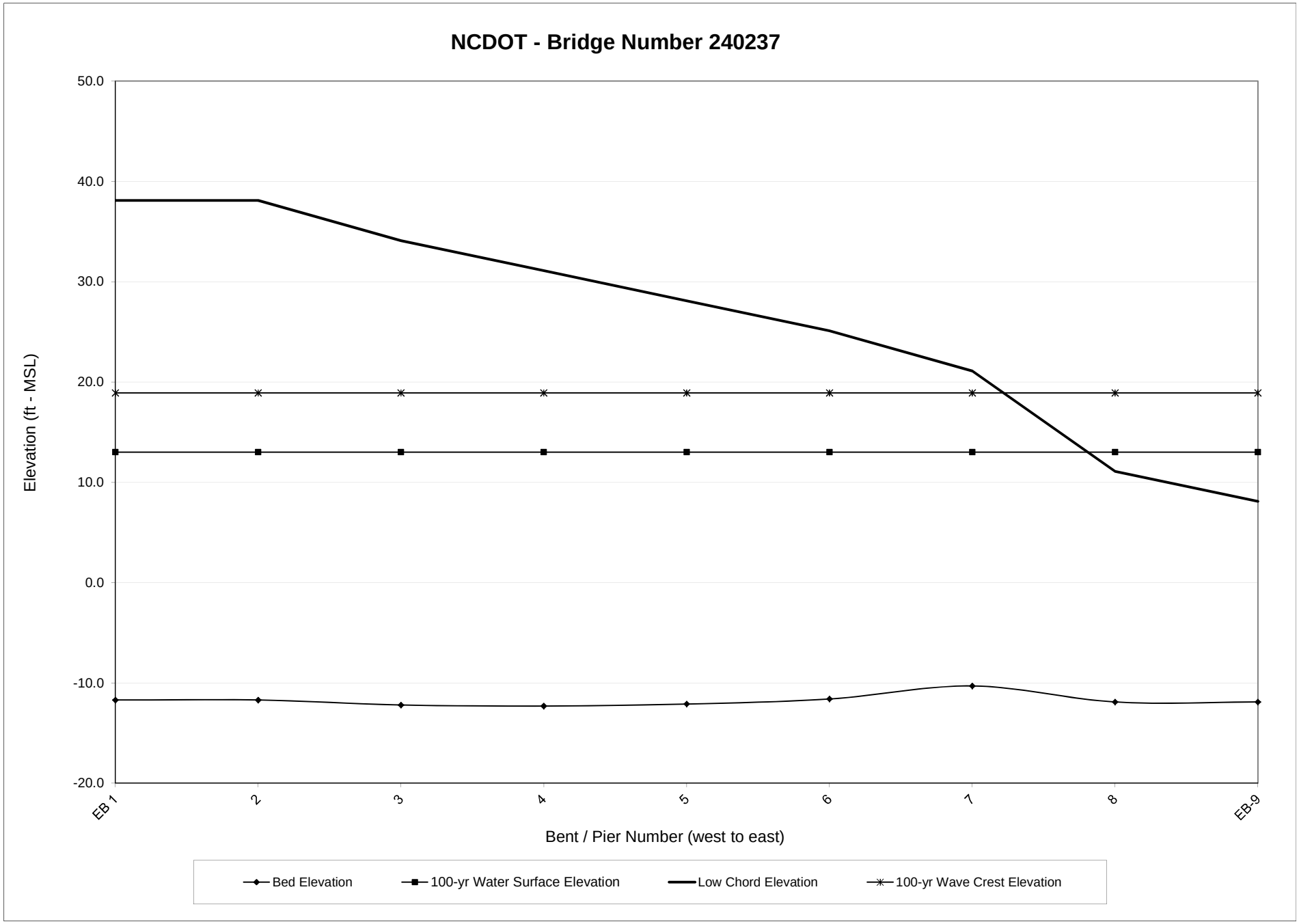
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 7-8 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 240237
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
EB-9
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 260016

CURRITUCK SOUND

US158 EBL

CURRITUCK COUNTY

DRAFT

NCDOT BRIDGE NO. 260016

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.2**	**0.2**	**0.6**	**0.4**	**0.4**	**0.7**	**0.5**	**0.6**	**0.6**	**0.6**	**0.7**	**0.7**	**0.6**	**0.6**	**0.7**	**0.7**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	1	1	1	0	0	0	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	7.1	7.2	7.3	7.5	7.6	7.7	7.9	8.0	8.2	8.3	8.3	8.3	8.4	8.4	8.4	8.4
100-yr Wave Height (ft)	2.7	2.9	3.1	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.5	4.5	4.5	4.5	4.6	4.6
100-yr Wave Period (seconds)	6.8	6.8	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
SPAN PROPERITES																
Span Length (ft)	60.3	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	95.5	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	32.4	37.0	91.7	52.1	59.6	96.7	77.8	84.4	92.8	101.9	105.3	106.5	103.8	105.5	112.0	112.6
Maximum Vertical Force (kips/ft)	0.5	0.6	1.6	0.9	1.0	1.6	1.3	1.4	1.6	1.7	1.8	1.8	1.8	1.8	1.9	1.9
Maximum Horizontal Force (kips/span)	3.7	5.5	11.8	27.8	31.8	39.8	47.0	49.3	54.2	62.2	62.1	65.4	66.1	66.9	65.9	63.9
Maximum Horizontal Force (kips/ft)	0.1	0.1	0.2	0.5	0.5	0.7	0.8	0.8	0.9	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Maximum Moment (k-ft)	635.2	763.7	1938.5	1198.5	1353.6	2177.7	1692.1	1784.8	1855.9	2015.4	2090.3	2126.5	1986.5	2008.8	2217.3	2191.5
Maximum Moment (k-ft/ft)	10.5	12.9	32.9	20.3	22.9	36.9	28.7	30.3	31.5	34.2	35.4	36.0	33.7	34.0	37.6	37.1

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-16 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	8.5	8.5	8.5	8.5	8.5	8.6	8.6	8.6	8.6	8.7	8.7	8.7	8.7	8.7	8.7	8.7
100-yr Wave Height (ft)	4.6	4.7	4.7	4.7	4.8	4.8	4.8	4.9	4.9	4.9	5.0	5.0	5.0	5.1	5.1	5.1
100-yr Wave Period (seconds)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	110.9	113.5	113.6	113.9	122.0	120.6	123.0	123.1	121.2	122.5	128.2	129.5	131.6	129.2	129.2	129.2
Maximum Vertical Force (kips/ft)	1.9	1.9	1.9	1.9	2.1	2.0	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.2	2.2	2.2
Maximum Horizontal Force (kips/span)	66.6	68.0	70.3	71.9	72.4	74.1	73.4	74.6	72.7	74.7	77.9	76.9	77.6	82.7	82.7	82.7
Maximum Horizontal Force (kips/ft)	1.1	1.2	1.2	1.2	1.2	1.3	1.2	1.3	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4
Maximum Moment (k-ft)	2120.2	2177.3	2147.1	2086.7	2318.0	2189.4	2245.6	2211.6	2225.3	2135.2	2250.9	2179.7	2267.7	2209.0	2209.0	2209.0
Maximum Moment (k-ft/ft)	35.9	36.9	36.4	35.4	39.3	37.1	38.1	37.5	37.7	36.2	38.2	36.9	38.4	37.4	37.4	37.4

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
100-yr Wave Height (ft)	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
100-yr Wave Period (seconds)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	129.2	129.2	129.2	129.2	129.2	129.2	129.2	129.2	129.2	129.2	129.2	129.2	129.2	129.2	129.2	129.2
Maximum Vertical Force (kips/ft)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Maximum Horizontal Force (kips/span)	82.7	82.7	82.7	82.7	82.7	82.7	82.7	82.7	82.7	82.7	82.7	82.7	82.7	82.7	82.7	82.7
Maximum Horizontal Force (kips/ft)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Maximum Moment (k-ft)	2209.0	2209.0	2209.0	2209.0	2209.0	2209.0	2209.0	2209.0	2209.0	2209.0	2209.0	2209.0	2209.0	2209.0	2209.0	2209.0
Maximum Moment (k-ft/ft)	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 33-48 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.8**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-2	-2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	8.7	8.7	8.8	8.8	8.9	8.9	9.0	9.0	9.1	9.1	9.2	9.2	9.2	9.2	9.2	9.2
100-yr Wave Height (ft)	5.1	5.1	5.1	5.2	5.3	5.3	5.4	5.5	5.5	5.6	5.7	5.7	5.7	5.7	5.7	5.7
100-yr Wave Period (seconds)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	129.2	129.2	130.5	132.1	136.4	136.8	142.0	144.8	147.5	154.8	168.8	172.7	172.7	172.7	172.7	172.7
Maximum Vertical Force (kips/ft)	2.2	2.2	2.2	2.2	2.3	2.3	2.4	2.5	2.5	2.6	2.9	2.9	2.9	2.9	2.9	2.9
Maximum Horizontal Force (kips/span)	82.7	82.7	86.7	86.4	88.7	86.8	92.3	95.6	88.2	95.4	101.5	105.4	105.4	105.4	105.4	105.4
Maximum Horizontal Force (kips/ft)	1.4	1.4	1.5	1.5	1.5	1.5	1.6	1.6	1.5	1.6	1.7	1.8	1.8	1.8	1.8	1.8
Maximum Moment (k-ft)	2209.0	2209.0	2209.2	2119.9	2241.6	2106.0	2460.8	2370.5	2375.3	2583.4	2857.9	2904.9	2904.9	2904.9	2904.9	2904.9
Maximum Moment (k-ft/ft)	37.4	37.4	37.4	35.9	38.0	35.7	41.7	40.2	40.3	43.8	48.4	49.2	49.2	49.2	49.2	49.2

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 49-64 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
100-yr Wave Height (ft)	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	172.7	172.7	172.7	172.7	172.7	172.7	172.7	172.7	172.7	172.7	172.7	172.7	172.7	172.7	172.7	172.7
Maximum Vertical Force (kips/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Maximum Horizontal Force (kips/span)	105.4	105.4	105.4	105.4	105.4	105.4	105.4	105.4	105.4	105.4	105.4	105.4	105.4	105.4	105.4	105.4
Maximum Horizontal Force (kips/ft)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Maximum Moment (k-ft)	2904.9	2904.9	2904.9	2904.9	2904.9	2904.9	2904.9	2904.9	2904.9	2904.9	2904.9	2904.9	2904.9	2904.9	2904.9	2904.9
Maximum Moment (k-ft/ft)	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 65-80 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.9**	**0.9**	**1.0**	**0.9**	**1.0**	**0.9**	**0.9**	**1.0**	**0.9**	**0.9**	**0.9**	**0.9**	**1.0**	**0.9**	**1.0**	**0.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-3	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	9.2	9.2	9.3	9.3	9.3	9.3	9.4	9.4	9.4	9.4	9.5	9.5	9.5	9.5	9.5	9.6
100-yr Wave Height (ft)	5.8	5.8	5.8	5.8	5.9	5.9	5.9	6.0	6.0	6.0	6.1	6.1	6.1	6.2	6.2	6.2
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	173.1	175.5	185.8	180.2	189.1	182.1	182.9	195.3	183.8	188.1	182.2	185.7	195.0	191.5	198.5	193.3
Maximum Vertical Force (kips/ft)	2.9	3.0	3.1	3.1	3.2	3.1	3.1	3.3	3.1	3.2	3.1	3.1	3.3	3.2	3.4	3.3
Maximum Horizontal Force (kips/span)	104.9	105.1	106.8	105.2	110.5	107.7	109.8	117.1	113.4	115.2	113.2	115.6	119.1	124.8	120.6	118.2
Maximum Horizontal Force (kips/ft)	1.8	1.8	1.8	1.8	1.9	1.8	1.9	2.0	1.9	2.0	1.9	2.0	2.0	2.1	2.0	2.0
Maximum Moment (k-ft)	2875.3	2883.9	3109.1	2946.4	3120.2	2913.1	2943.4	3180.0	2898.6	2976.2	2787.9	2836.4	3065.1	2910.0	3046.4	2891.2
Maximum Moment (k-ft/ft)	48.7	48.9	52.7	49.9	52.9	49.4	49.9	53.9	49.1	50.4	47.3	48.1	52.0	49.3	51.6	49.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 81-96 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.9**	**0.9**	**0.9**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	9.6	9.6	9.6	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
100-yr Wave Height (ft)	6.3	6.3	6.3	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	194.4	196.2	200.9	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7
Maximum Vertical Force (kips/ft)	3.3	3.3	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Maximum Horizontal Force (kips/span)	122.8	128.5	124.8	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5
Maximum Horizontal Force (kips/ft)	2.1	2.2	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Maximum Moment (k-ft)	2932.8	2947.1	2924.0	3005.0	3005.0	3005.0	3005.0	3005.0	3005.0	3005.0	3005.0	3005.0	3005.0	3005.0	3005.0	3005.0
Maximum Moment (k-ft/ft)	49.7	50.0	49.6	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 97-112 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**0.9**	**0.9**	**1.0**	**1.0**	**0.9**	**0.9**	**0.9**	**1.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-4	-4	-4	-4	-4	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.8	9.8	9.9	9.9	10.0	10.0
100-yr Wave Height (ft)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.5	6.6	6.6	6.7	6.8	6.8	6.9
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	201.8	203.1	216.7	218.6	216.1	215.5	224.6	238.1
Maximum Vertical Force (kips/ft)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.4	3.4	3.7	3.7	3.7	3.7	3.8	4.0
Maximum Horizontal Force (kips/span)	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	134.6	133.9	147.4	149.0	150.6	156.6	159.8	172.7
Maximum Horizontal Force (kips/ft)	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.3	2.3	2.5	2.5	2.6	2.7	2.7	2.9
Maximum Moment (k-ft)	3005.0	3005.0	3005.0	3005.0	3005.0	3005.0	3005.0	3005.0	2840.3	2790.6	3025.4	3005.5	2854.2	2764.4	2847.4	3144.0
Maximum Moment (k-ft/ft)	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	48.1	47.3	51.3	50.9	48.4	46.9	48.3	53.3

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 113-128 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**	**142**	**143**	**144**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
100-yr Wave Height (ft)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	234.4	239.9	239.9	239.9	239.9	239.9	239.9	239.9	239.9	239.9	239.9	239.9	239.9	239.9	239.9	239.9
Maximum Vertical Force (kips/ft)	4.0	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Maximum Horizontal Force (kips/span)	171.8	169.5	169.5	169.5	169.5	169.5	169.5	169.5	169.5	169.5	169.5	169.5	169.5	169.5	169.5	169.5
Maximum Horizontal Force (kips/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Maximum Moment (k-ft)	2977.6	2980.9	2980.9	2980.9	2980.9	2980.9	2980.9	2980.9	2980.9	2980.9	2980.9	2980.9	2980.9	2980.9	2980.9	2980.9
Maximum Moment (k-ft/ft)	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 129-144 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**	**153**	**154**	**155**	**156**	**157**	**158**	**159**	**160**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**1.0**	**1.1**	**1.1**	**0.8**	**1.0**	**1.0**	**1.1**	**1.0**	**1.0**	**1.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-5	-5	-5	-5	-5	-5	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	8.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	10.1	10.1	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.3	10.3	10.3	10.3	10.3	10.3	10.3
100-yr Wave Height (ft)	7.0	7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.9	6.9	6.9	6.8

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	44.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	5	0	5	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.9	0.0	2.9	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	6.1	3.2	6.1	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	69.1	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	6.1	3.2	6.1	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	239.9	239.9	239.9	239.9	239.9	239.9	247.7	263.9	265.4	106.2	272.3	265.4	276.0	273.4	271.7	265.7
Maximum Vertical Force (kips/ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.2	4.5	4.5	2.4	4.6	4.5	4.7	4.6	4.6	4.5
Maximum Horizontal Force (kips/span)	169.5	169.5	169.5	169.5	169.5	169.5	174.7	186.9	192.7	9.3	178.8	174.6	173.9	172.4	167.5	166.9
Maximum Horizontal Force (kips/ft)	2.9	2.9	2.9	2.9	2.9	2.9	3.0	3.2	3.3	0.2	3.0	3.0	2.9	2.9	2.8	2.8
Maximum Moment (k-ft)	2980.9	2980.9	2980.9	2980.9	2980.9	2980.9	3071.3	3433.7	3406.5	1442.7	3235.0	3139.4	3370.7	3202.5	3153.8	3024.7
Maximum Moment (k-ft/ft)	50.5	50.5	50.5	50.5	50.5	50.5	52.1	58.2	57.7	32.8	54.8	53.2	57.1	54.3	53.5	51.3

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 145-160 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**161**	**162**	**163**	**164**	**165**	**166**	**167**	**168**	**169**	**170**	**171**	**172**	**173**	**174**	**175**	**176**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**0.5**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	7.6	10.6	13.6	16.6	19.4	22.3	25.1	27.9
100-yr Max Wave Crest Elevation (ft - MSL)	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
100-yr Wave Height (ft)	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
100-yr Wave Period (seconds)	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	265.7	265.7	265.7	265.7	265.7	265.7	265.7	265.7	170.1	42.4	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	2.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	166.9	166.9	166.9	166.9	166.9	166.9	166.9	166.9	115.1	12.4	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	3024.7	3024.7	3024.7	3024.7	3024.7	3024.7	3024.7	3024.7	1687.3	415.5	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	51.3	51.3	51.3	51.3	51.3	51.3	51.3	51.3	28.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 161-170 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**177**	**178**	**179**	**180**	**181**	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**	**190**	**191**	**192**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Low Chord Elevation (ft - MSL)	30.8	33.6	31.6	29.6	27.6	25.6	23.6	21.6	19.6	17.6	16.7	15.8	14.9	14.0	13.2	12.3
100-yr Max Wave Crest Elevation (ft - MSL)	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
100-yr Wave Height (ft)	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
100-yr Wave Period (seconds)	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.9	6.9

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 177-192 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**193**	**194**	**195**	**196**	**197**	**198**	**199**	**200**	**201**	**202**	**203**	**204**	**205**	**206**	**207**	**208**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.5**	**0.3**	**0.8**	**1.1**	**1.0**	**0.9**	**0.9**	**1.0**	**0.9**	**0.9**	**0.9**	**1.0**	**1.0**	**0.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-6	-6	-6	-6	-6	-6	-6	-5	-5	-5	-5	-5	-5	-5	-5	-5
Low Chord Elevation (ft - MSL)	11.4	10.5	9.6	8.6	7.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	10.3	10.3	10.3	10.3	10.2	10.2	10.2	10.1	10.1	10.0	10.0	9.9	9.9	9.8	9.8	9.7
100-yr Wave Height (ft)	7.2	7.2	7.2	7.2	7.2	7.1	7.1	7.0	7.0	6.9	6.8	6.8	6.7	6.6	6.6	6.5
100-yr Wave Period (seconds)	6.9	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	1.2	3.3	90.3	115.8	168.8	263.9	247.7	239.9	234.4	238.1	224.6	215.5	216.1	218.6	216.7	203.1
Maximum Vertical Force (kips/ft)	0.0	0.1	1.5	2.0	2.9	4.5	4.2	4.1	4.0	4.0	3.8	3.7	3.7	3.7	3.7	3.4
Maximum Horizontal Force (kips/span)	0.0	18.7	60.6	99.1	134.0	186.9	174.7	169.5	171.8	172.7	159.8	156.6	150.6	149.0	147.4	133.9
Maximum Horizontal Force (kips/ft)	0.0	0.3	1.0	1.7	2.3	3.2	3.0	2.9	2.9	2.9	2.7	2.7	2.6	2.5	2.5	2.3
Maximum Moment (k-ft)	0.0	0.0	1480.9	1089.3	2631.1	3433.7	3071.3	2980.9	2977.6	3144.0	2847.4	2764.4	2854.2	3005.5	3025.4	2790.6
Maximum Moment (k-ft/ft)	0.0	0.0	25.1	18.5	44.6	58.2	52.1	50.5	50.5	53.3	48.3	46.9	48.4	50.9	51.3	47.3

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 195-208 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**209**	**210**	**211**	**212**	**213**	**214**	**215**	**216**	**217**	**218**	**219**	**220**	**221**	**222**	**223**	**224**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.9**	**1.0**	**0.9**	**0.9**	**1.0**	**0.9**	**0.9**	**0.8**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-5	-4	-4	-4	-4	-4	-3	-3	-3	-3	-3	-2	-2	-2	-2	-2
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	9.7	9.7	9.6	9.5	9.4	9.3	9.2	9.1	9.0	8.9	8.8	8.7	8.7	8.7	8.6	8.6
100-yr Wave Height (ft)	6.4	6.4	6.2	6.1	6.0	5.8	5.7	5.6	5.5	5.3	5.2	5.1	5.0	4.9	4.9	4.8
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.9	6.9	6.9	6.9	6.9	6.9	6.9

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	201.8	205.7	193.3	185.7	195.3	180.2	172.7	154.8	144.8	136.8	132.1	129.2	129.5	122.5	123.1	120.6
Maximum Vertical Force (kips/ft)	3.4	3.5	3.3	3.1	3.3	3.1	2.9	2.6	2.5	2.3	2.2	2.2	2.2	2.1	2.1	2.0
Maximum Horizontal Force (kips/span)	134.6	126.5	118.2	115.6	117.1	105.2	105.4	95.4	95.6	86.8	86.4	82.7	76.9	74.7	74.6	74.1
Maximum Horizontal Force (kips/ft)	2.3	2.1	2.0	2.0	2.0	1.8	1.8	1.6	1.6	1.5	1.5	1.4	1.3	1.3	1.3	1.3
Maximum Moment (k-ft)	2840.3	3005.0	2891.2	2836.4	3180.0	2946.4	2904.9	2583.4	2370.5	2106.0	2119.9	2209.0	2179.7	2135.2	2211.6	2189.4
Maximum Moment (k-ft/ft)	48.1	50.9	49.0	48.1	53.9	49.9	49.2	43.8	40.2	35.7	35.9	37.4	36.9	36.2	37.5	37.1

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 209-224 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**225**	**226**	**227**	**228**	**229**	**230**	**231**	**232**	**233**	**234**	**235**	**236**	**237**	**238**	**239**	**240**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.7**	**0.7**	**0.7**	**0.6**	**0.7**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.7**	**0.6**	**0.5**	**0.5**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-2	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	8.5	8.5	8.4	8.4	8.3	8.3	8.2	8.2	8.2	8.1	8.1	8.0	8.0	7.9	7.9	7.8
100-yr Wave Height (ft)	4.7	4.7	4.6	4.5	4.5	4.4	4.4	4.3	4.2	4.2	4.1	4.0	4.0	3.9	3.8	3.8
100-yr Wave Period (seconds)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	113.9	113.5	112.6	105.5	106.5	101.9	97.8	98.5	92.8	90.5	91.4	84.4	105.9	85.5	77.8	73.7
Maximum Vertical Force (kips/ft)	1.9	1.9	1.9	1.8	1.8	1.7	1.7	1.7	1.6	1.5	1.5	1.4	1.8	1.4	1.3	1.2
Maximum Horizontal Force (kips/span)	71.9	68.0	63.9	66.9	65.4	62.2	58.4	54.3	54.2	49.7	51.4	49.3	42.6	46.9	47.0	43.6
Maximum Horizontal Force (kips/ft)	1.2	1.2	1.1	1.1	1.1	1.1	1.0	0.9	0.9	0.8	0.9	0.8	0.7	0.8	0.8	0.7
Maximum Moment (k-ft)	2086.7	2177.3	2191.5	2008.8	2126.5	2015.4	1935.1	2010.3	1855.9	1856.1	1971.5	1784.8	2348.8	1890.9	1692.1	1649.6
Maximum Moment (k-ft/ft)	35.4	36.9	37.1	34.0	36.0	34.2	32.8	34.1	31.5	31.5	33.4	30.3	39.8	32.0	28.7	28.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 225-240 are potentiallysubject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260016

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY								
SPAN NUMBER	**241**	**242**	**243**	**244**	**245**	**246**	**247**	**248**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.7**	**0.7**	**0.5**	**0.4**	**0.4**	**0.6**	**0.2**	**0.2**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES								
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	0	0	0	0	1	1	1	1
Low Chord Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
100-yr Max Wave Crest Elevation (ft - MSL)	7.7	7.7	7.6	7.5	7.4	7.3	7.2	7.2
100-yr Wave Height (ft)	3.6	3.5	3.4	3.2	3.1	3.0	2.9	2.9
100-yr Wave Period (seconds)	6.9	6.9	6.9	6.9	6.9	6.9	6.8	6.8

SPAN PROPERITES								
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Number of Beams	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Total Dead Weight (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Resisting Moment (kft/ft)	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4
Resisting Vertical Force (kip/ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6

100-YEAR FORCE-MOMENT VALUES								
Maximum Vertical Force (kips/span)	96.7	79.7	64.3	52.1	57.4	91.8	37.0	38.1
Maximum Vertical Force (kips/ft)	1.6	1.4	1.1	0.9	1.0	1.6	0.6	0.6
Maximum Horizontal Force (kips/span)	39.8	26.9	31.1	27.8	24.5	10.8	5.5	5.6
Maximum Horizontal Force (kips/ft)	0.7	0.5	0.5	0.5	0.4	0.2	0.1	0.1
Maximum Moment (k-ft)	2177.7	2318.9	1454.2	1198.5	1369.1	2024.8	763.7	781.4
Maximum Moment (k-ft/ft)	36.9	39.3	24.6	20.3	23.2	34.3	12.9	13.2

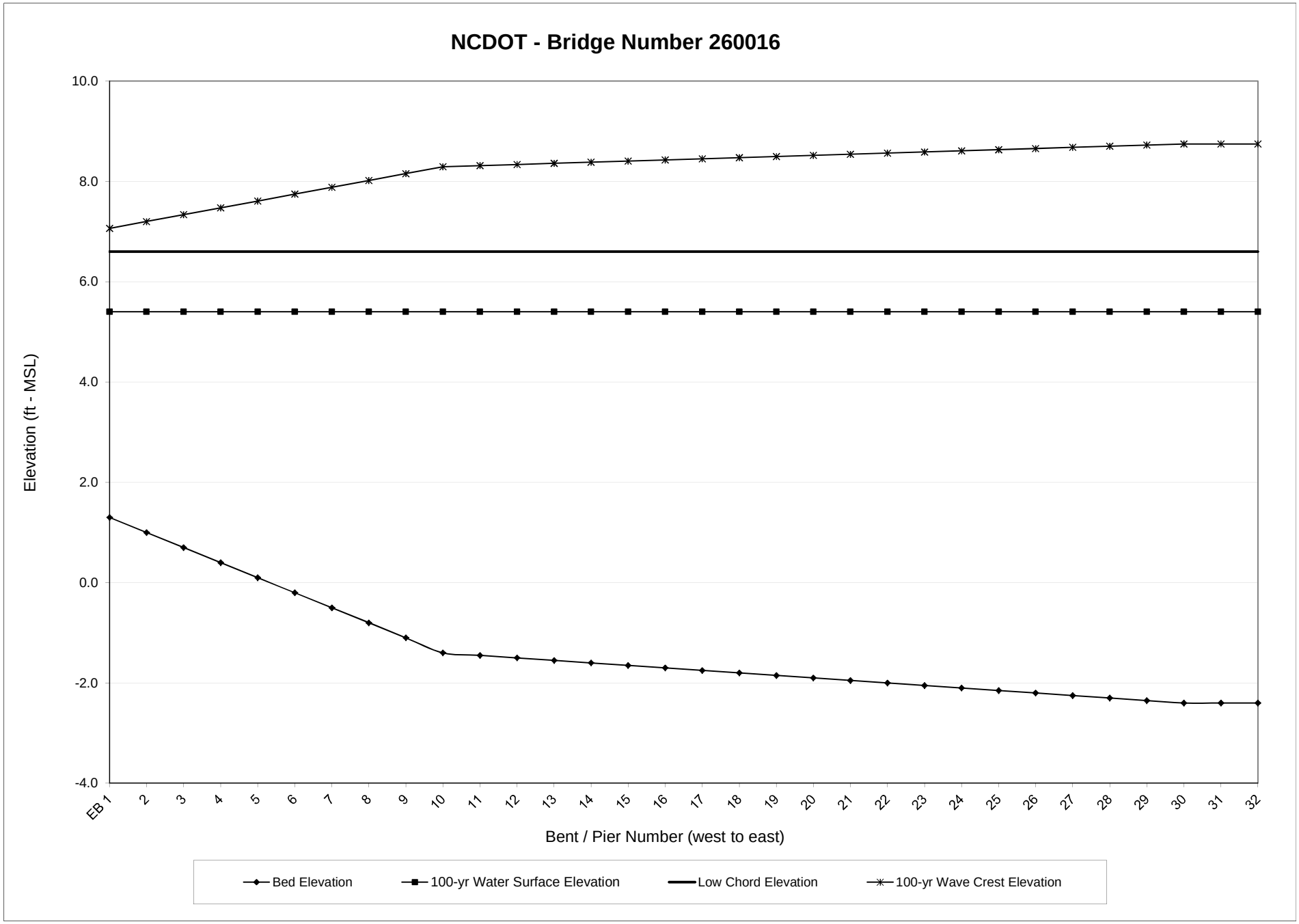
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

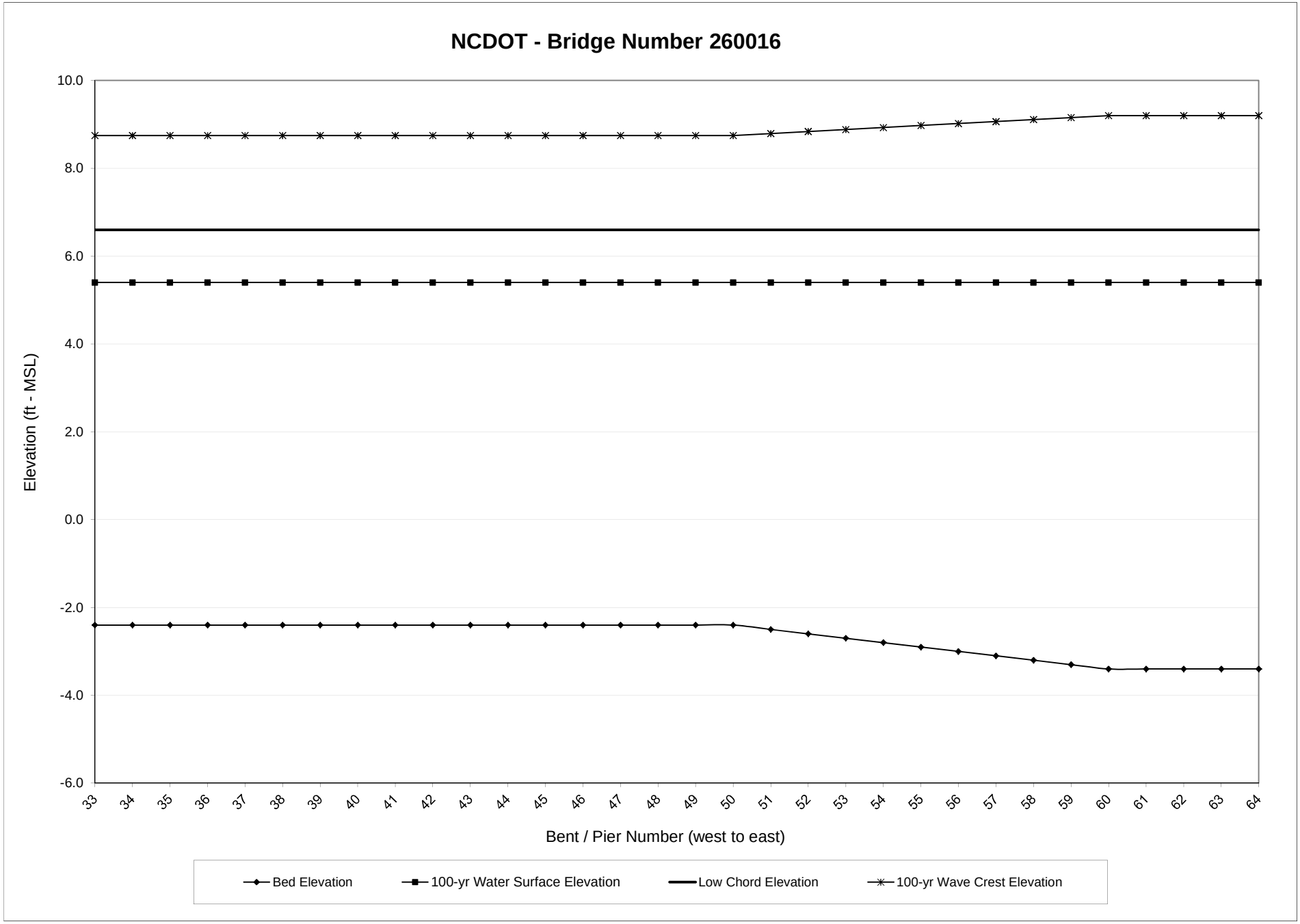
Notes:

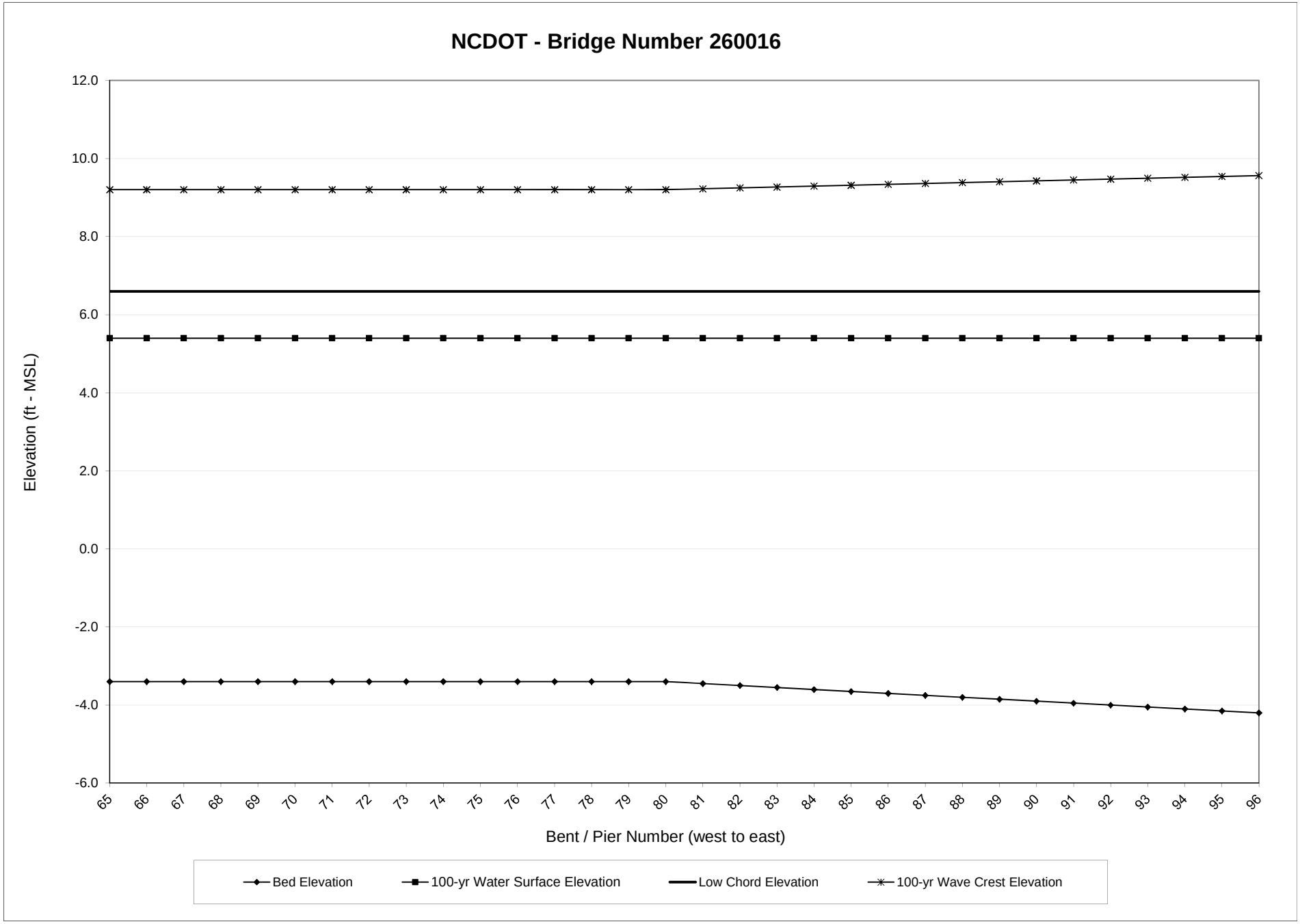
1 - Bridge spans 241-248 are potentially subject to wave energy.

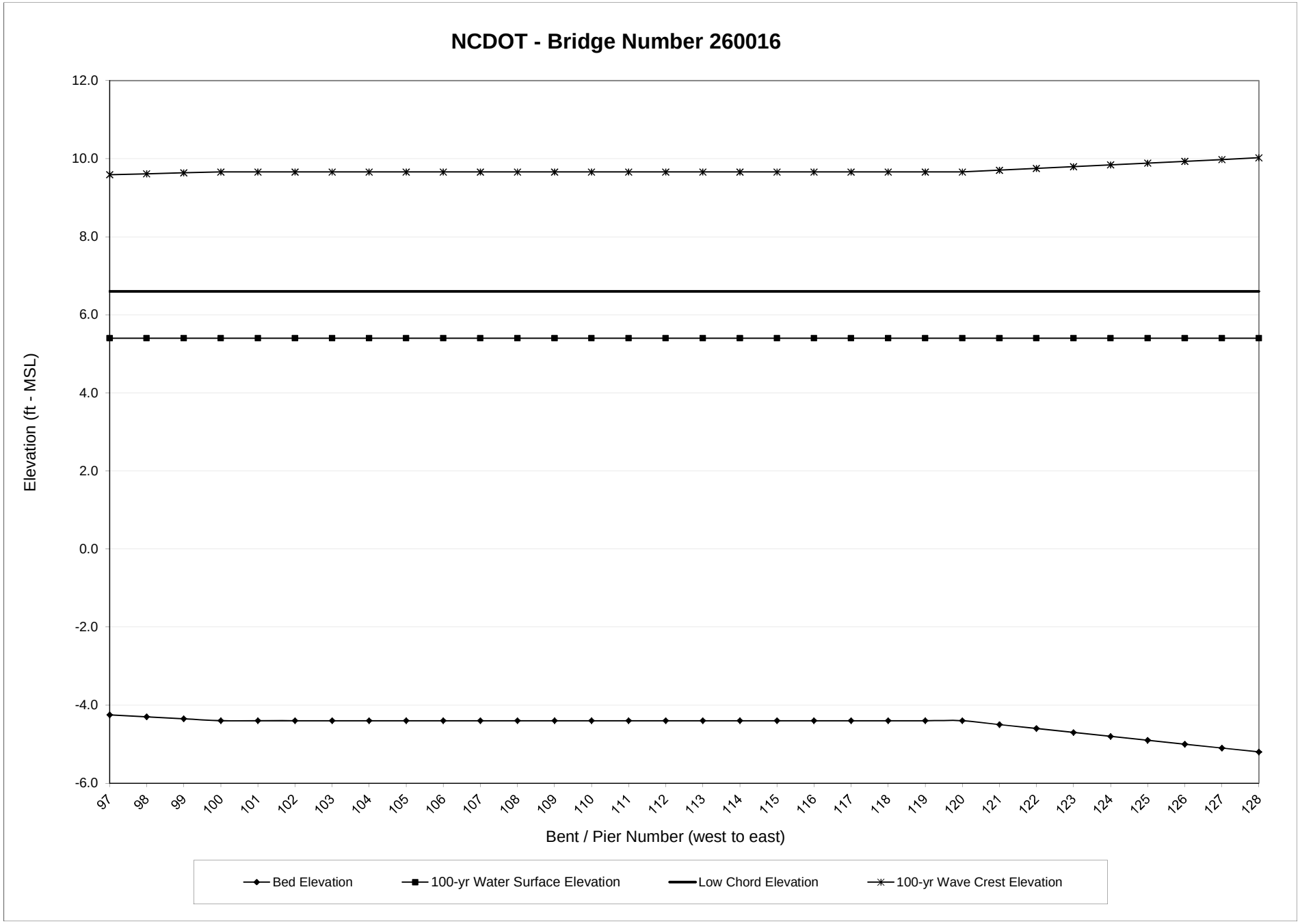
2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

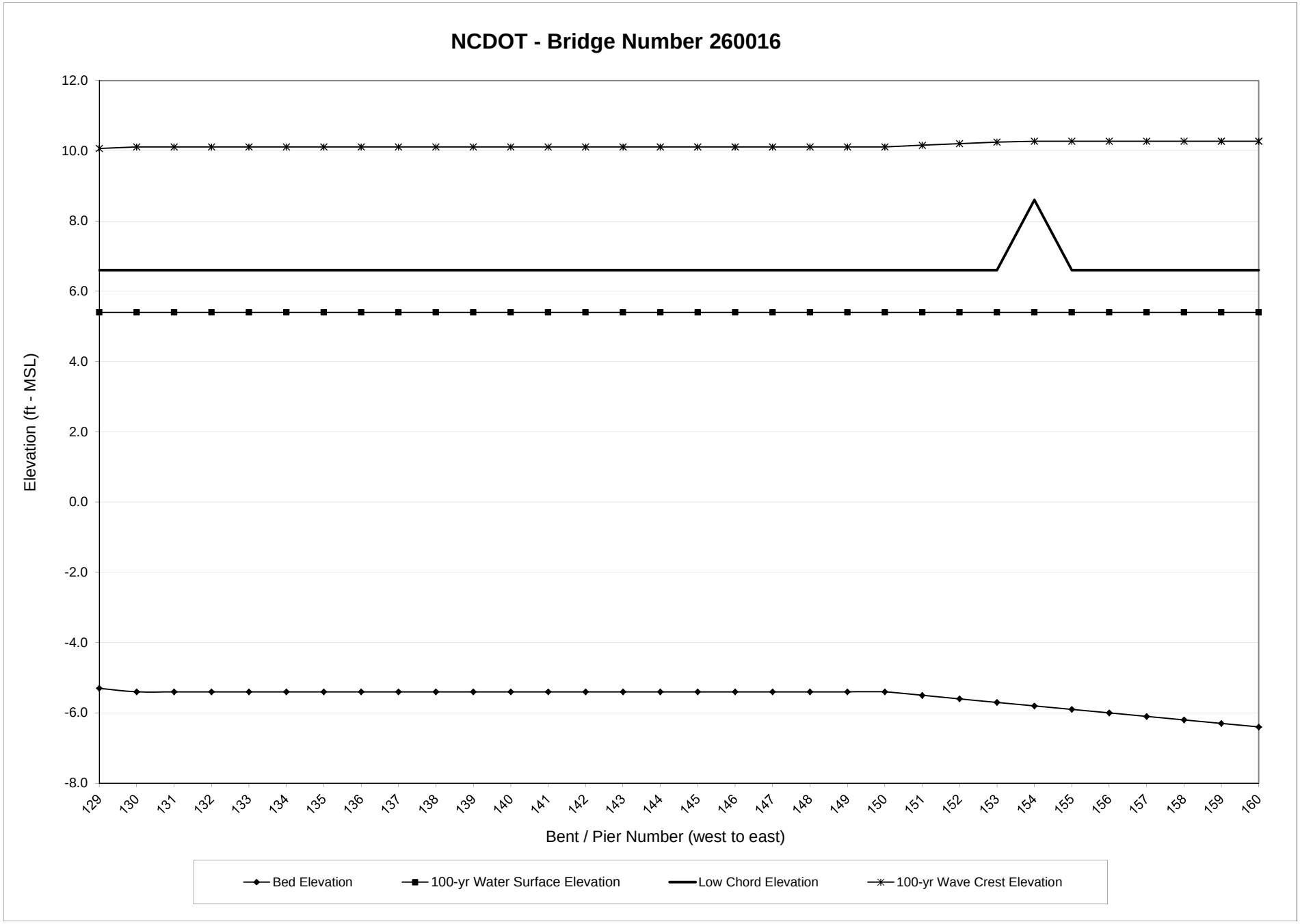
Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

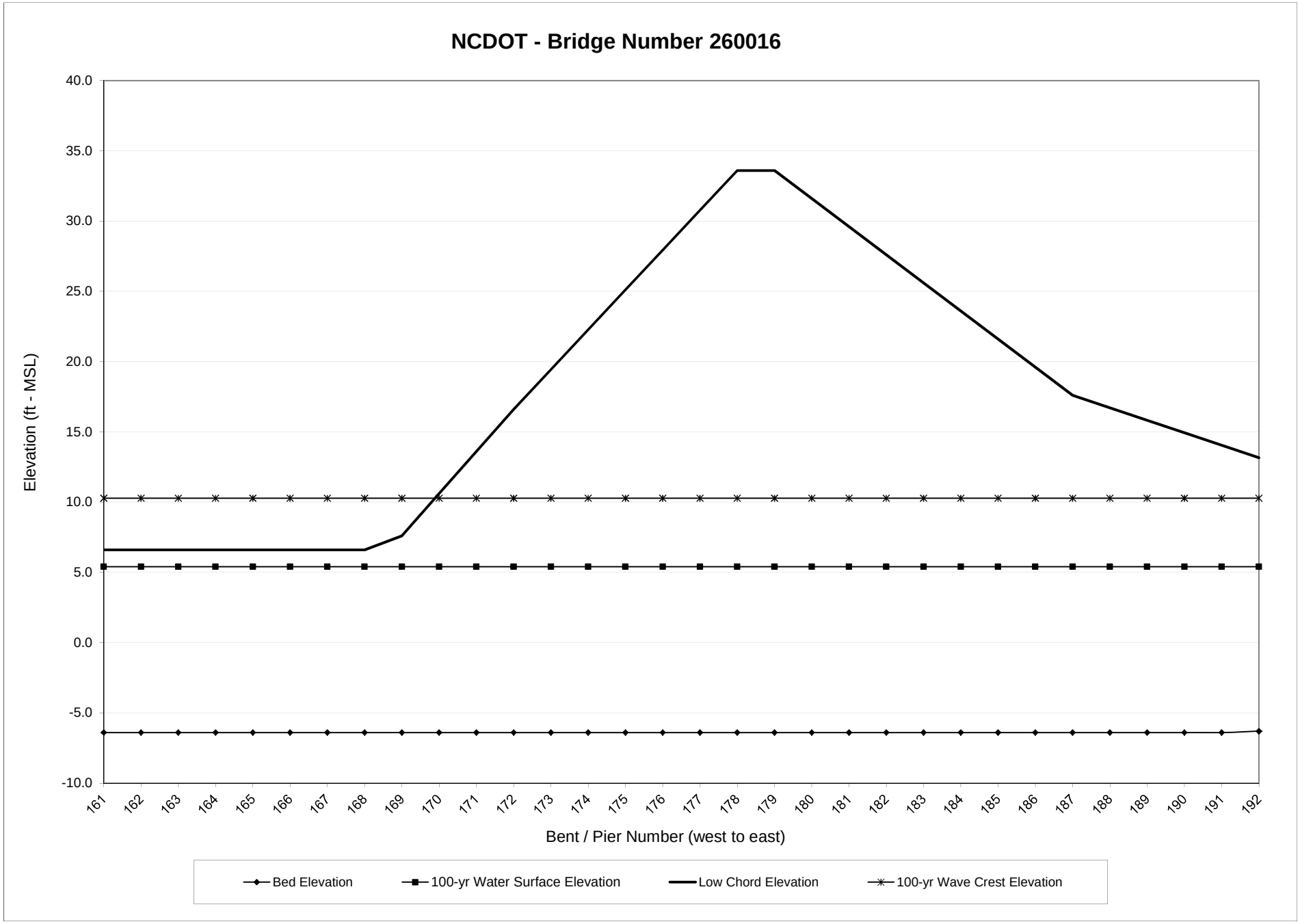

NCDOT - Bridge Number 260016
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

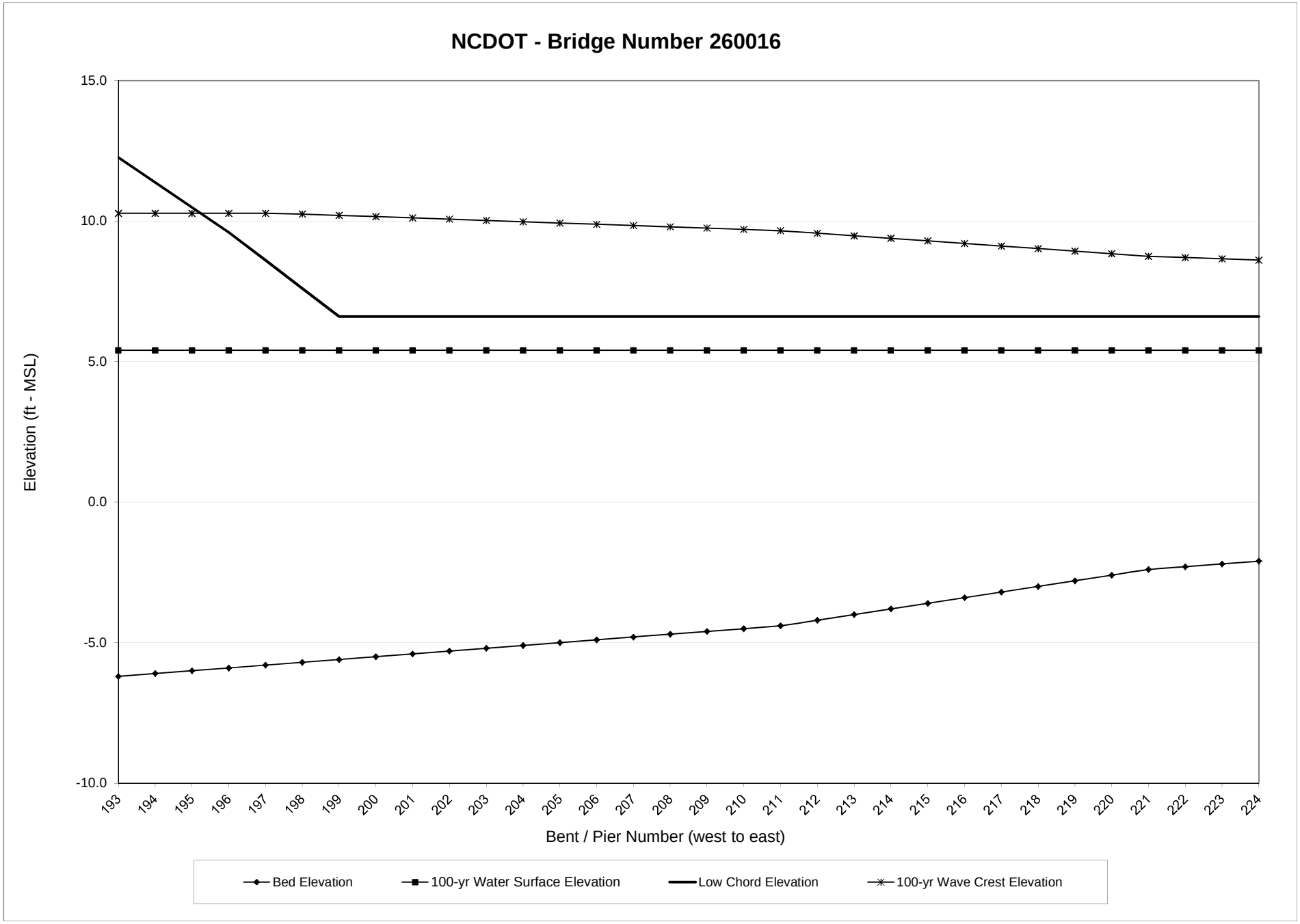

NCDOT - Bridge Number 260016
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
Elevation (ft - MSL)
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

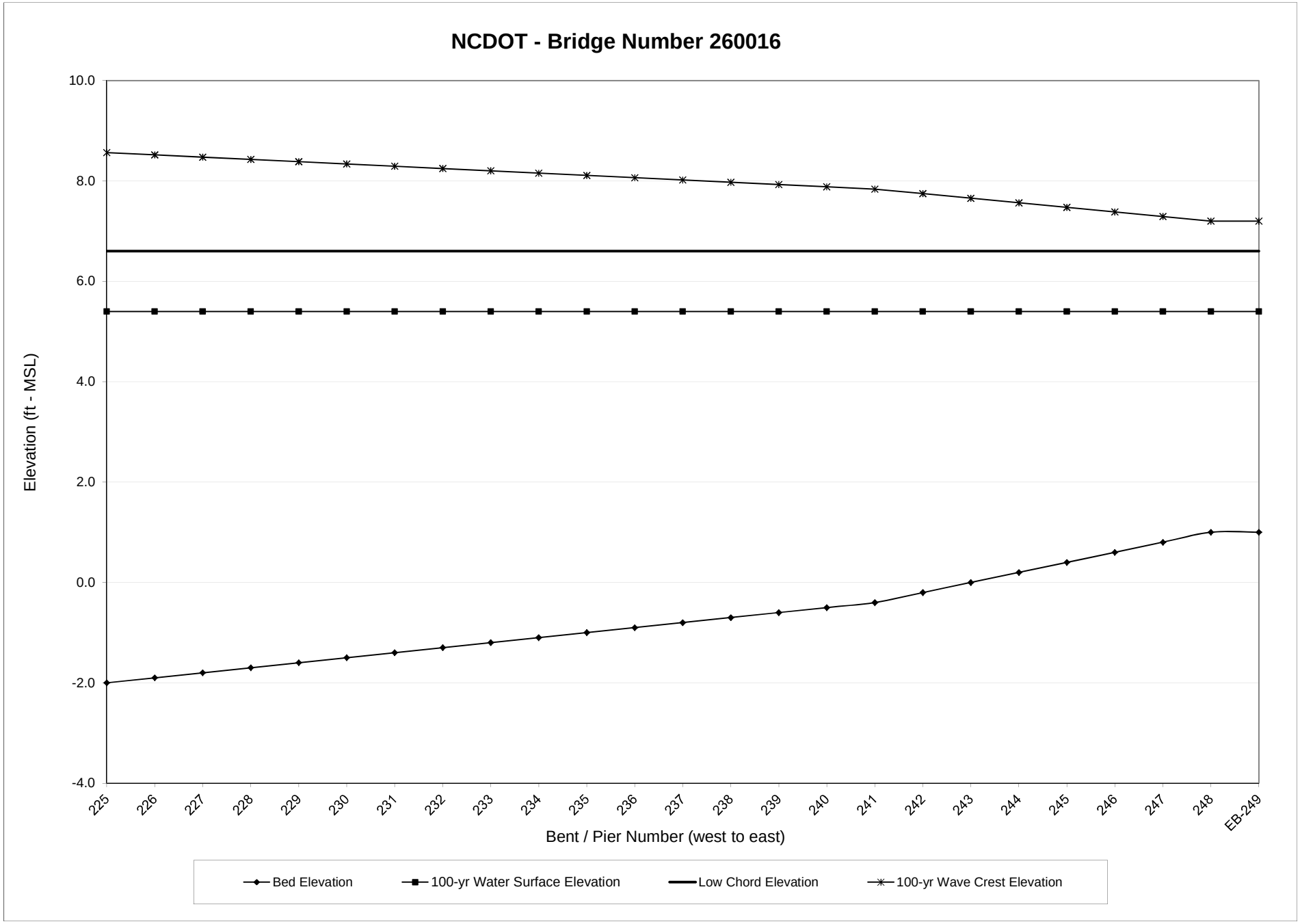

NCDOT - Bridge Number 260016
Elevation (ft - MSL)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 260016
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
Elevation (ft - MSL)
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 260016
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
Elevation (ft - MSL)
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 260016
Elevation (ft - MSL)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 260016
15.0
10.0
5.0
0.0
-5.0
-10.0
Elevation (ft - MSL)
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 260016
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
Elevation (ft - MSL)
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
EB-249
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 260035

CURRITUCK SOUND

US158 WBL

CURRITUCK COUNTY

DRAFT

NCDOT BRIDGE NO. 260035

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	2	1	1	0	0	-1	-2	-2	-3	-3	-4	-4	-4	-4	-4	-5
Low Chord Elevation (ft - MSL)	6.3	7.2	8.2	9.1	10.0	10.9	11.8	12.8	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	6.8	7.1	7.4	7.6	7.9	8.2	8.5	8.7	9.0	9.3	9.4	9.5	9.6	9.6	9.7	9.8
100-yr Wave Height (ft)	2.2	2.6	3.0	3.3	3.7	4.1	4.5	4.9	5.3	5.7	5.8	5.9	6.1	6.2	6.3	6.5
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	49.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	1098.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	1306.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	21.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge span 1 is potentially subject to wave energy.
Bridge spans 2-16 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-4	-5	-5
Low Chord Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	9.9	10.0	10.1	10.2	10.1	10.1	10.1	10.0	10.0	9.9	9.9	9.8	9.8	9.7	9.8	9.8
100-yr Wave Height (ft)	6.6	6.7	6.9	7.0	6.9	6.9	6.8	6.7	6.7	6.6	6.5	6.5	6.4	6.3	6.4	6.5
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
Low Chord Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	9.9	9.9	10.0	10.0	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
100-yr Wave Height (ft)	6.5	6.6	6.7	6.7	6.8	6.9	6.9	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 33-48 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-5	-5	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Low Chord Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	10.2	10.2	10.2	10.3	10.3	10.4	10.4	10.5	10.5	10.6	10.6	10.6	10.6	10.6	10.6	10.6
100-yr Wave Height (ft)	7.0	7.0	7.1	7.1	7.2	7.2	7.3	7.4	7.4	7.5	7.6	7.6	7.6	7.6	7.6	7.6
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 49-64 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Low Chord Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
100-yr Wave Height (ft)	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 65-80 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Low Chord Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
100-yr Wave Height (ft)	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 81-96 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-6	-6	-6	-6	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7
Low Chord Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	10.6	10.6	10.6	10.6	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
100-yr Wave Height (ft)	7.6	7.6	7.6	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 97-112 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7
Low Chord Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
100-yr Wave Height (ft)	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 113-128 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**	**142**	**143**	**144**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-7	-7	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
Low Chord Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
100-yr Wave Height (ft)	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 129-144 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**	**153**	**154**	**155**	**156**	**157**	**158**	**159**	**160**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
Low Chord Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
100-yr Wave Height (ft)	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 145-160 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**161**	**162**	**163**	**164**	**165**	**166**	**167**	**168**	**169**	**170**	**171**	**172**	**173**	**174**	**175**	**176**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-7	-7
Low Chord Elevation (ft - MSL)	13.7	15.5	17.3	19.2	21.0	22.8	24.7	26.5	28.3	30.1	32.0	33.8	35.6	37.5	39.3	39.6
100-yr Max Wave Crest Elevation (ft - MSL)	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
100-yr Wave Height (ft)	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 161-176 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**177**	**178**	**179**	**180**	**181**	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**	**190**	**191**	**192**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-7	-7	-7	-7	-7	-7	-7	-7	-6	-7	-7	-7	-7	-7	-7	-7
Low Chord Elevation (ft - MSL)	39.6	39.6	40.1	40.1	39.6	39.6	39.6	39.3	37.5	35.6	33.8	32.0	30.1	28.3	26.5	24.7
100-yr Max Wave Crest Elevation (ft - MSL)	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.6	10.7	10.7	10.7	10.7	10.7	10.7	10.7
100-yr Wave Height (ft)	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.7
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	61.2	61.2	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	163.5	163.5	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 177-192 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**193**	**194**	**195**	**196**	**197**	**198**	**199**	**200**	**201**	**202**	**203**	**204**	**205**	**206**	**207**	**208**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-7	-7	-6	-6	-6	-6	-6	-5	-5	-5	-5	-5	-5	-5	-5	-5
Low Chord Elevation (ft - MSL)	22.8	21.0	19.2	17.3	15.5	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	10.7	10.7	10.6	10.6	10.5	10.4	10.3	10.2	10.1	10.1	10.1	10.0	10.0	9.9	9.9	9.8
100-yr Wave Height (ft)	7.7	7.7	7.6	7.5	7.4	7.2	7.1	7.0	6.9	6.9	6.8	6.7	6.7	6.6	6.5	6.5
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 193-208 are notsubject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**209**	**210**	**211**	**212**	**213**	**214**	**215**	**216**	**217**	**218**	**219**	**220**	**221**	**222**	**223**	**224**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-5	-4	-4	-4	-4	-3	-3	-3	-2	-2	-2	-1	-1	-1	-1	-1
Low Chord Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.7	9.6	9.5	9.3	9.2	9.1	8.9	8.8	8.6	8.5	8.4	8.3	8.3	8.2	8.2
100-yr Wave Height (ft)	6.4	6.3	6.1	5.9	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.4	4.3	4.3	4.2	4.1
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 209-224 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**225**	**226**	**227**	**228**	**229**	**230**	**231**	**232**	**233**	**234**	**235**	**236**	**237**	**238**	**239**	**240**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0
Low Chord Elevation (ft - MSL)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.1	12.5
100-yr Max Wave Crest Elevation (ft - MSL)	8.1	8.1	8.1	8.0	8.0	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
100-yr Wave Height (ft)	4.1	4.0	3.9	3.9	3.8	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 225-240 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 260035

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY									
SPAN NUMBER	**241**	**242**	**243**	**244**	**245**	**246**	**247**	**248**	**249**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES									
100-yr Water Surface Elevation (ft - MSL)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bed Elevation (ft - MSL)	0	0	1	1	1	2	2	2	2
Low Chord Elevation (ft - MSL)	11.9	11.3	10.7	10.1	9.5	8.9	8.3	7.7	7.7
100-yr Max Wave Crest Elevation (ft - MSL)	7.8	7.6	7.5	7.3	7.2	7.0	6.9	6.7	6.7
100-yr Wave Height (ft)	3.5	3.3	3.1	2.9	2.7	2.4	2.2	2.0	2.0
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES									
Span Length (ft)	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.1
Span Width (ft)	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4	38.4
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Total Dead Weight (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Resisting Moment (kft/ft)	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6	160.6
Resisting Vertical Force (kip/ft)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4

100-YEAR FORCE-MOMENT VALUES									
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

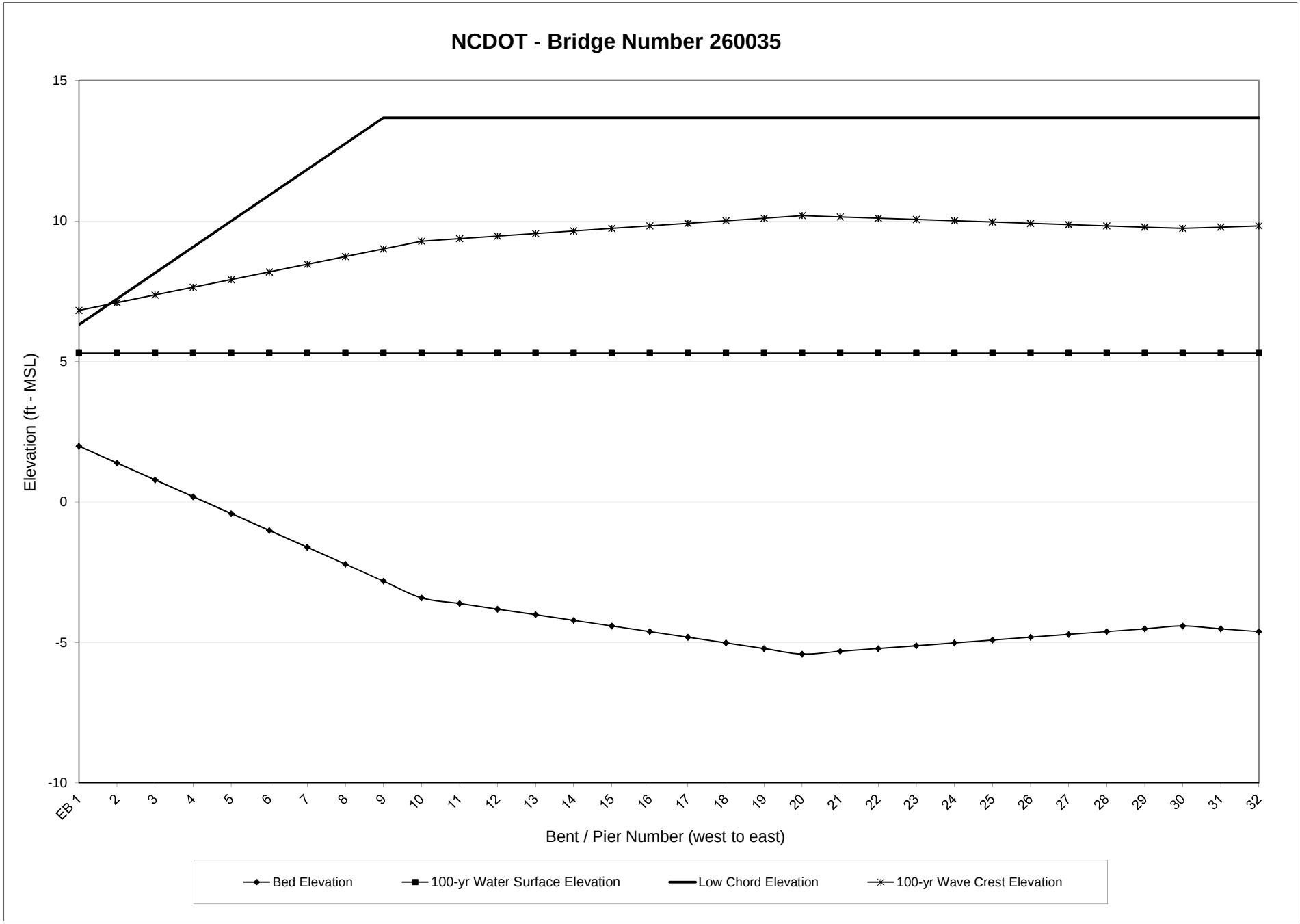
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

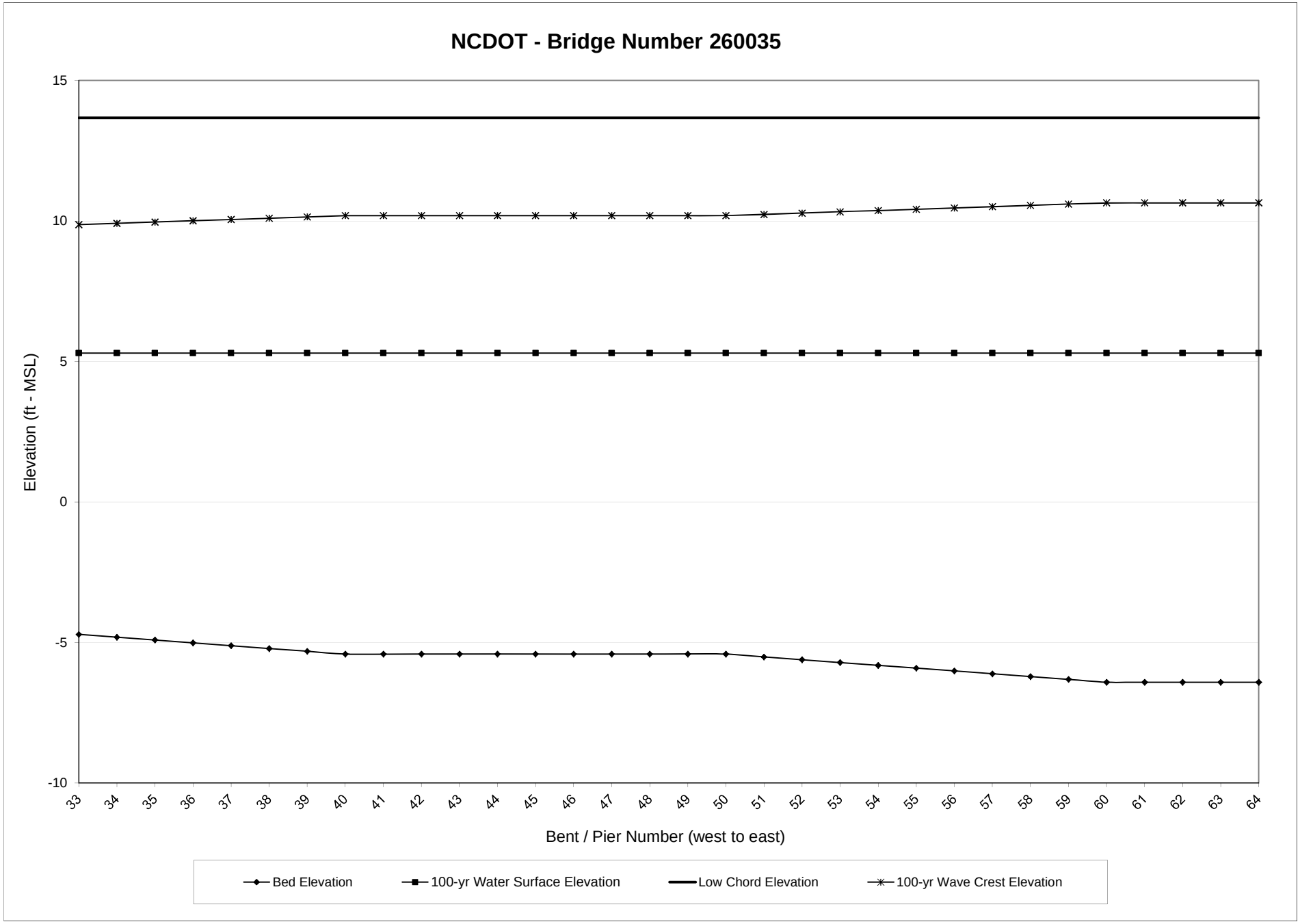
Notes:

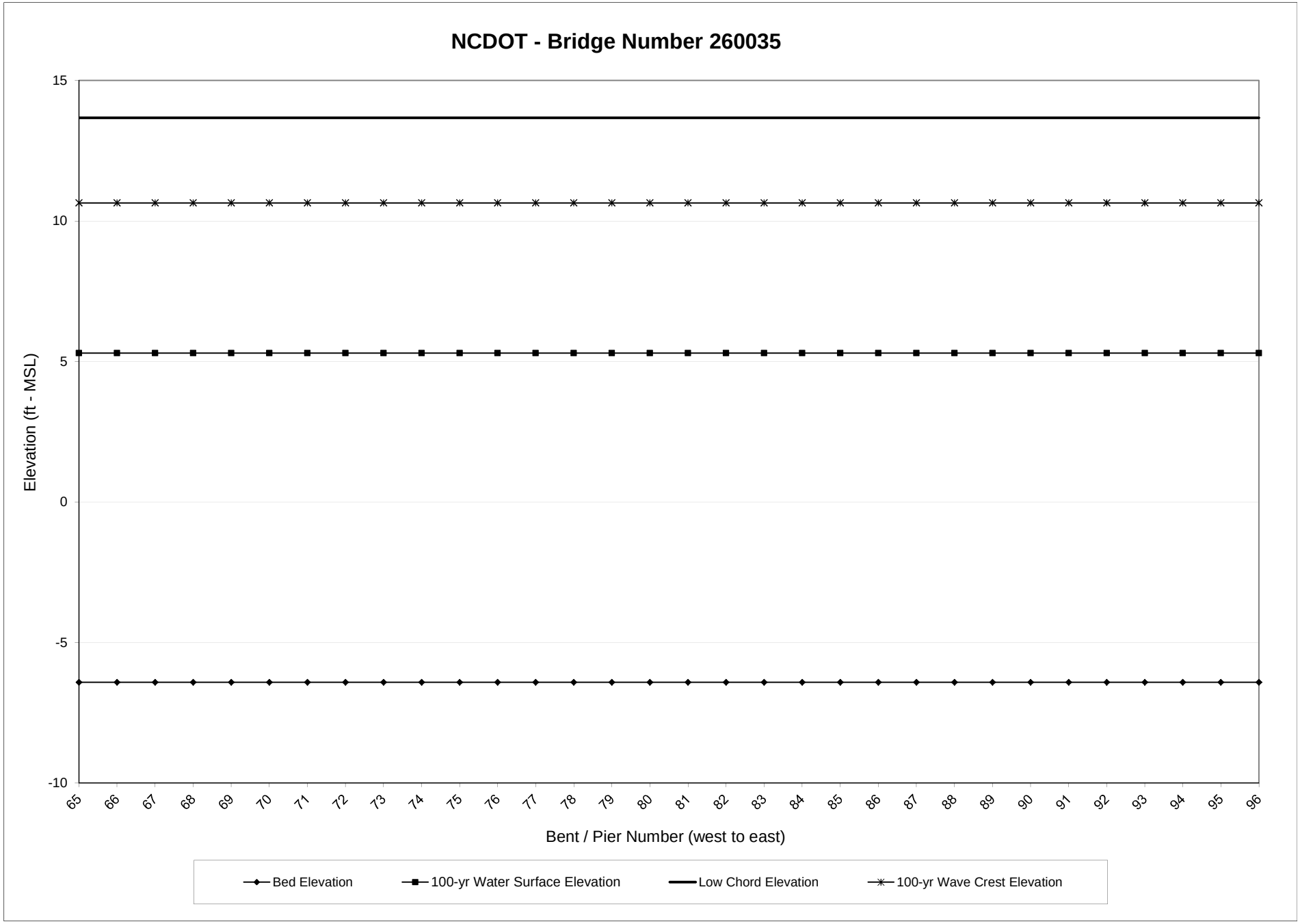
1 - Bridge spans 241-249 are not subject to wave energy.

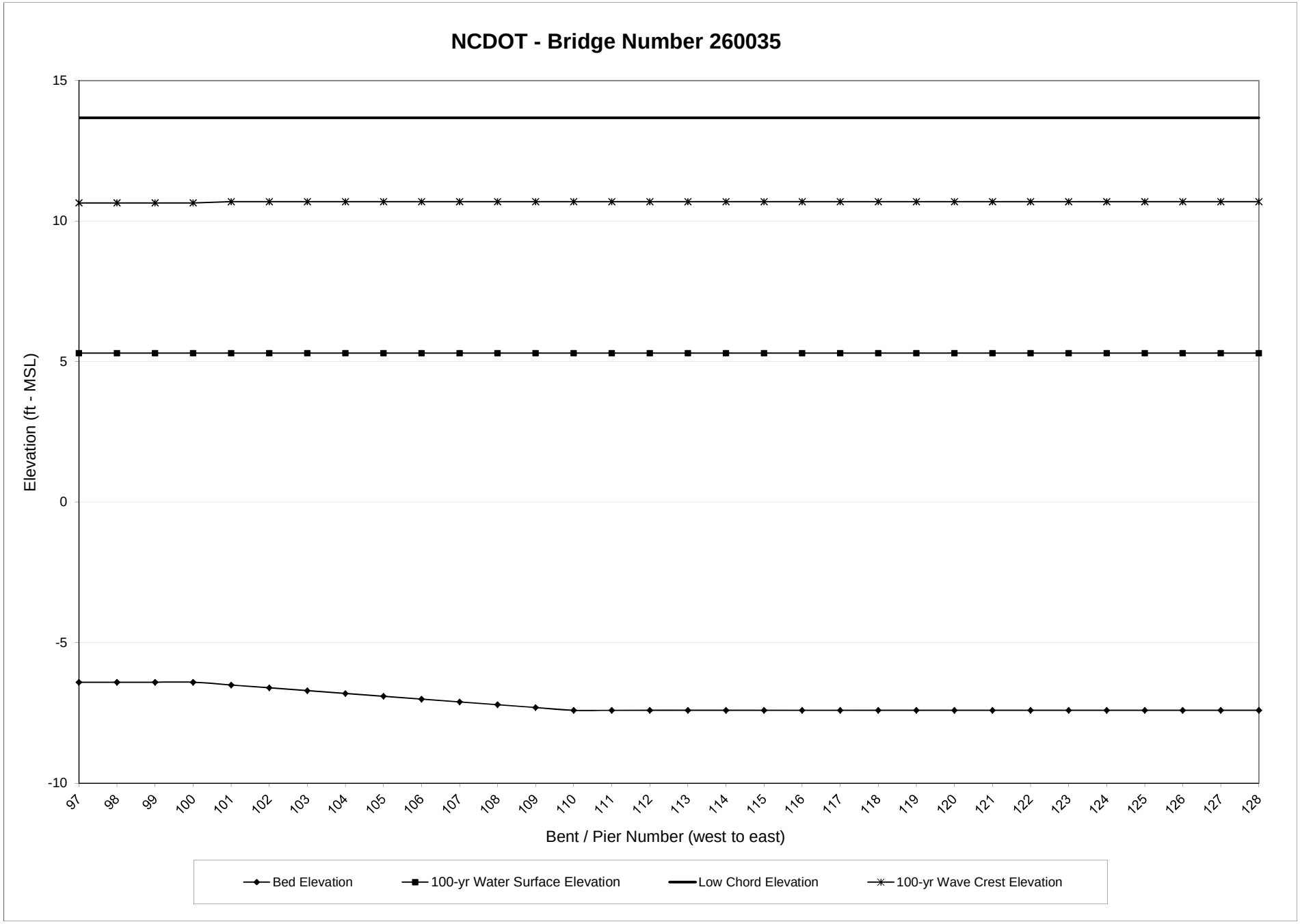
2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

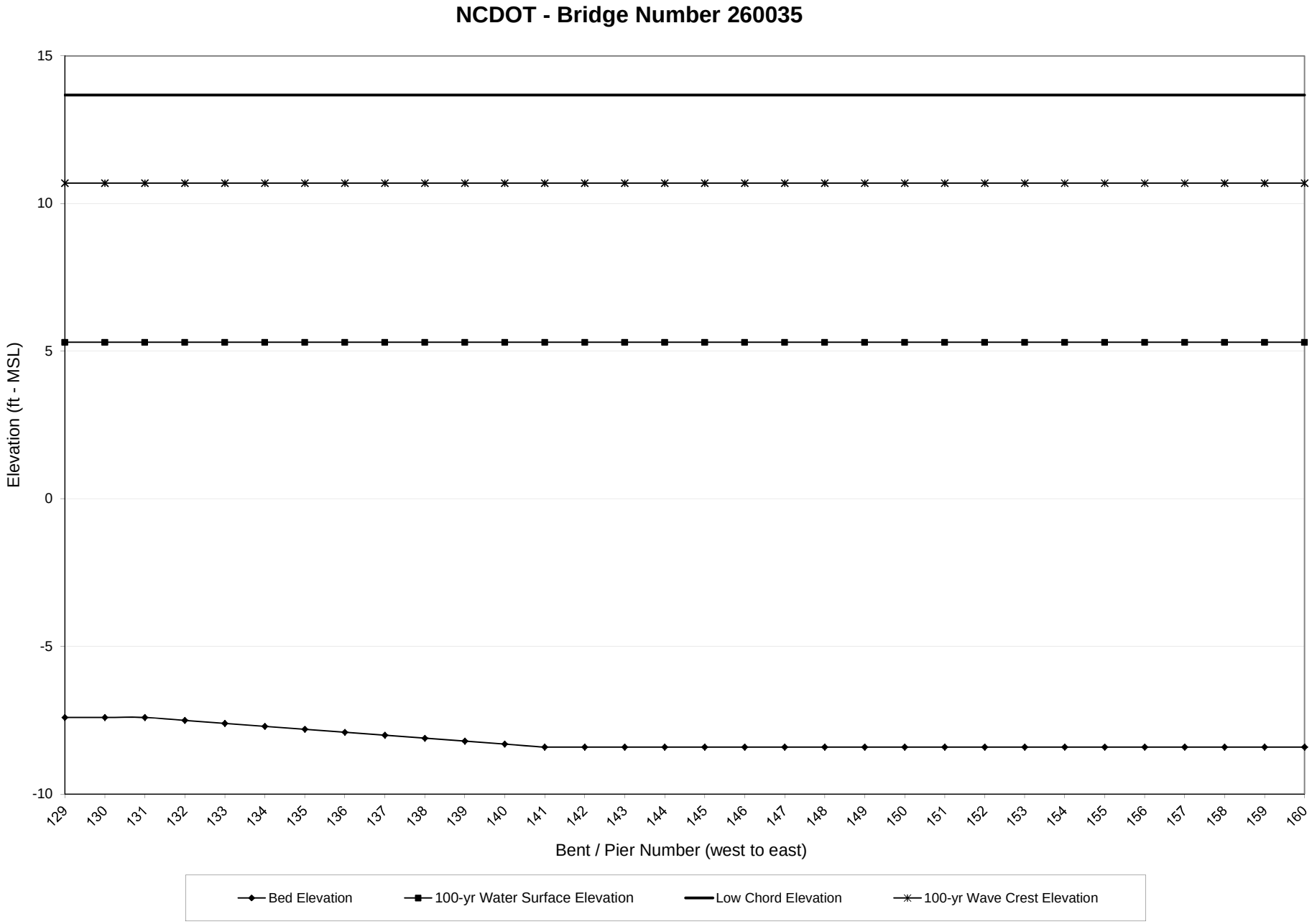
Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

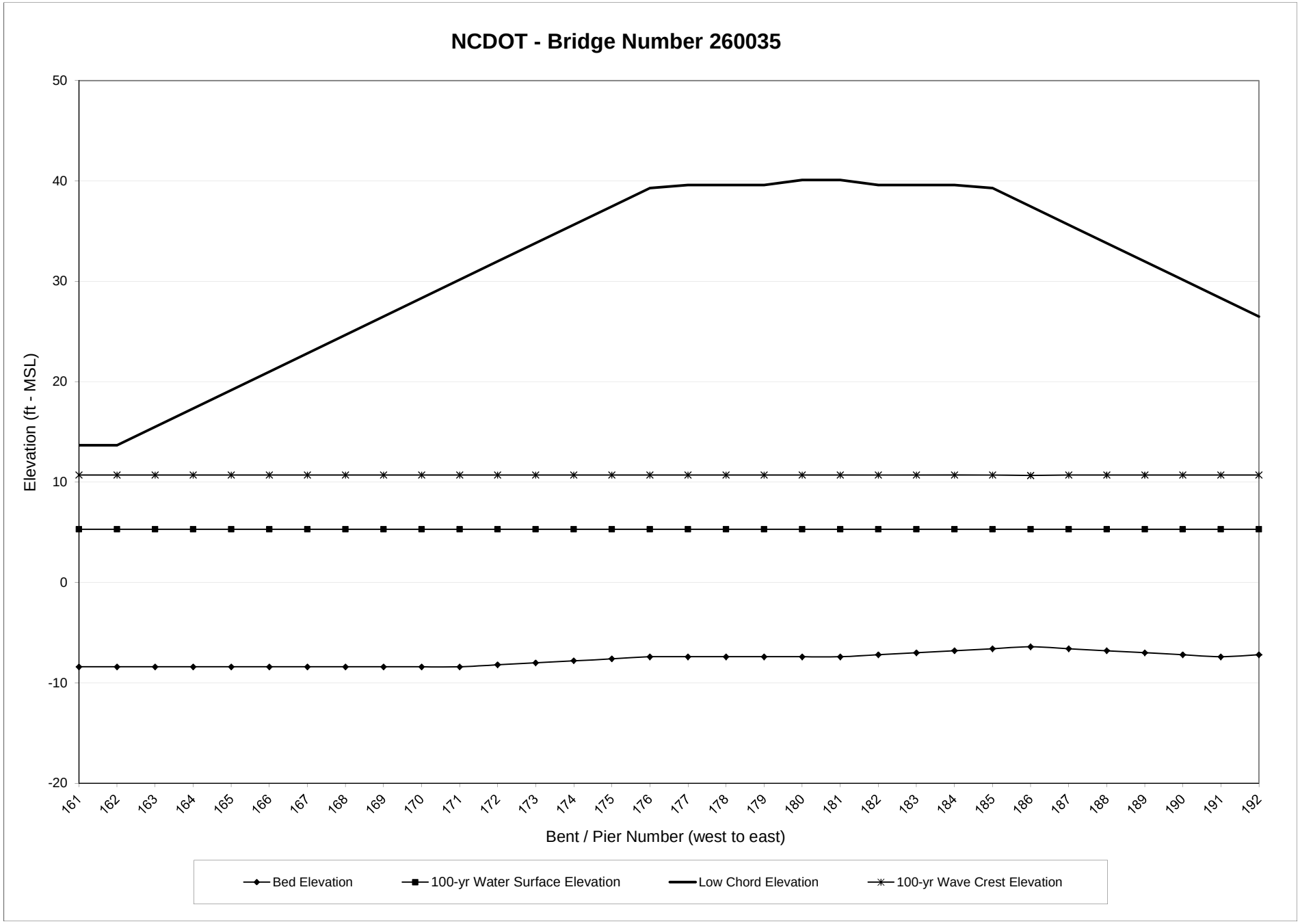

NCDOT - Bridge Number 260035
15
10
5
0
-5
-10
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

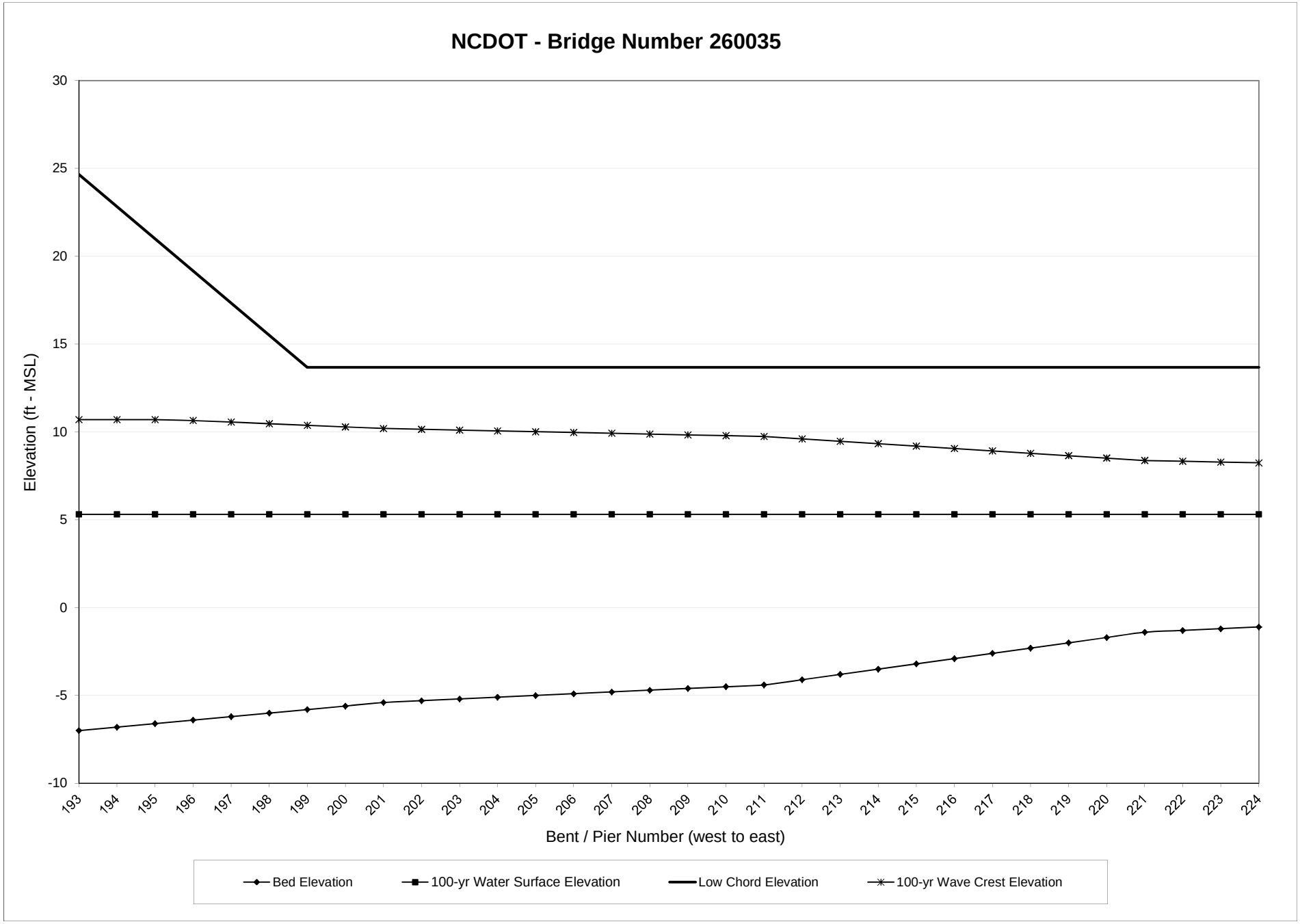

NCDOT - Bridge Number 260035
15
10
5
0
-5
-10
Elevation (ft - MSL)
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

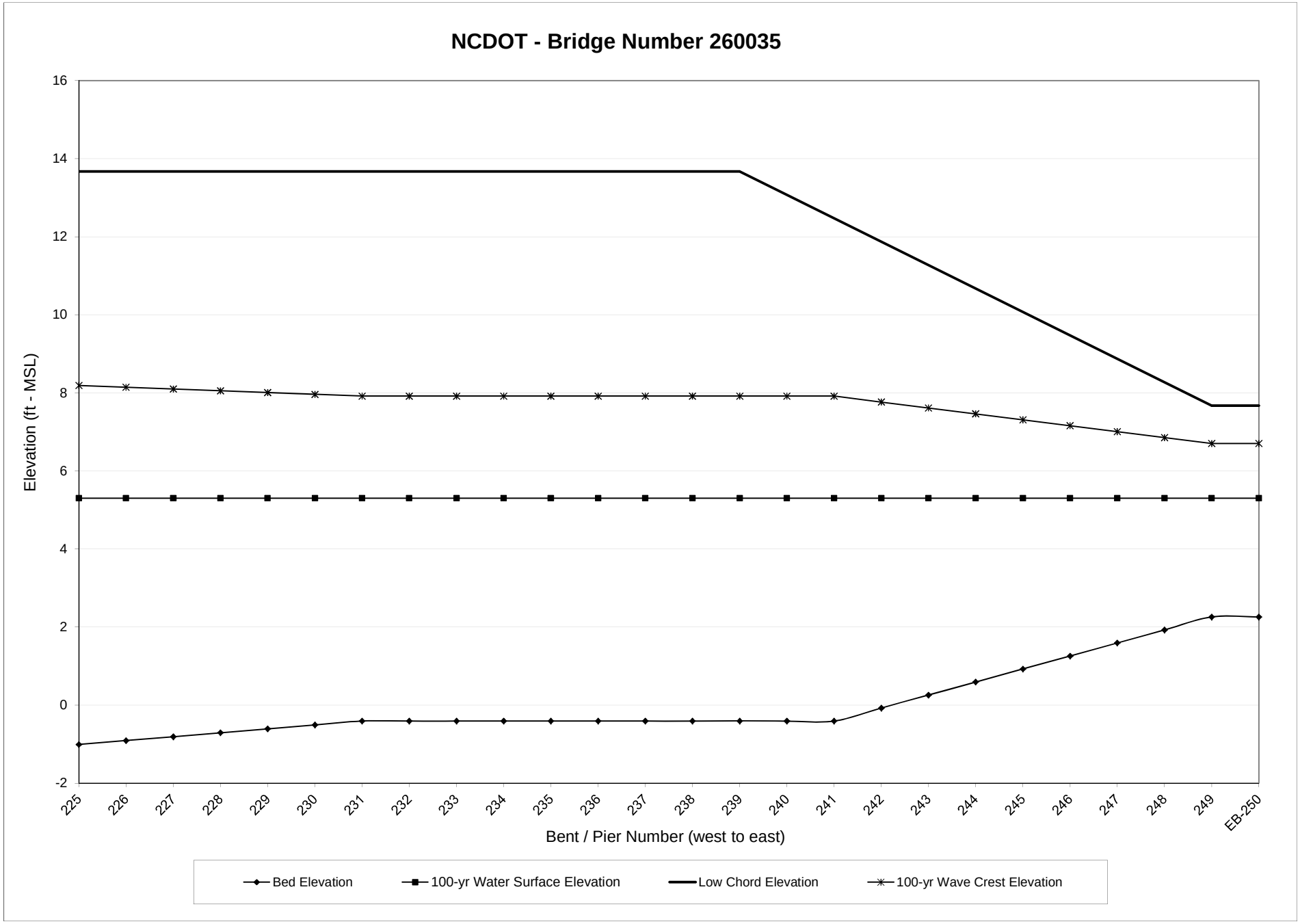

NCDOT - Bridge Number 260035
15
10
5
0
-5
-10
Elevation (ft - MSL)
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 260035
15
10
5
0
-5
-10
Elevation (ft - MSL)
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 260035
15
10
5
0
-5
-10
Elevation (ft - MSL)
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 260035
Elevation (ft - MSL)
50
40
30
20
10
0
-10
-20
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 260035
Elevation (ft - MSL)
30
25
20
15
10
5
0
-5
-10
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 260035
Elevation (ft - MSL)
16
14
12
10
8
6
4
2
0
-2
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
EB-250
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 270003

DEEP CREEK

US264

DARE COUNTY

DRAFT

NCDOT BRIDGE NO. 270003
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY						
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**4.9**	**5.4**	**3.0**	**3.0**	**5.6**	**5.3**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES						
HYDRAULIC VALUES						
100-yr Water Surface Elevation (ft - MSL)	8.8	8.8	8.8	8.8	8.8	8.8
Bed Elevation (ft - MSL)	2	-3	-5	-1	3	3
Low Chord Elevation (ft - MSL)	2.0	2.0	2.0	2.0	2.0	2.0
100-yr Max Wave Crest Elevation (ft - MSL)	10.3	10.3	10.3	10.3	10.3	10.3
100-yr Wave Height (ft)	2.1	2.1	2.1	2.1	2.1	2.1
100-yr Wave Period (seconds)	4.0	4.0	4.0	4.0	4.0	4.0
SPAN PROPERITES						
Span Length (ft)	12.0	12.0	24.5	24.5	12.0	12.0
Span Width (ft)	29.1	29.1	29.1	29.1	29.1	29.1
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	2.1	2.1	2.1	2.1	2.1	2.1
Number of Beams	6	6	6	6	6	6
Beam Dead Weight (lb/lf) - Each	58	58	58	58	58	58
Beam Dead Weight (kip/ft) - Total	0.3	0.3	0.3	0.3	0.3	0.3
Slab Dead Weight (kip/ft)	2.7	2.7	2.7	2.7	2.7	2.7
Total Dead Weight (kip/ft)	3.1	3.1	3.1	3.1	3.1	3.1
Resisting Moment (kft/ft)	16.5	16.5	35.7	35.7	16.5	16.5
Resisting Vertical Force (kip/ft)	3.1	3.1	3.1	3.1	3.1	3.1
100-YEAR FORCE-MOMENT VALUES						
Maximum Vertical Force (kips/span)	35.1	37.7	83.7	84.8	38.8	36.9
Maximum Vertical Force (kips/ft)	2.9	3.1	3.4	3.5	3.2	3.1
Maximum Horizontal Force (kips/span)	2.0	2.1	4.2	4.2	2.0	2.1
Maximum Horizontal Force (kips/ft)	0.2	0.2	0.2	0.2	0.2	0.2
Maximum Moment (k-ft)	556	616	1,492	1,521	640	601
Maximum Moment (k-ft/ft)	46	51	61	62	53	50

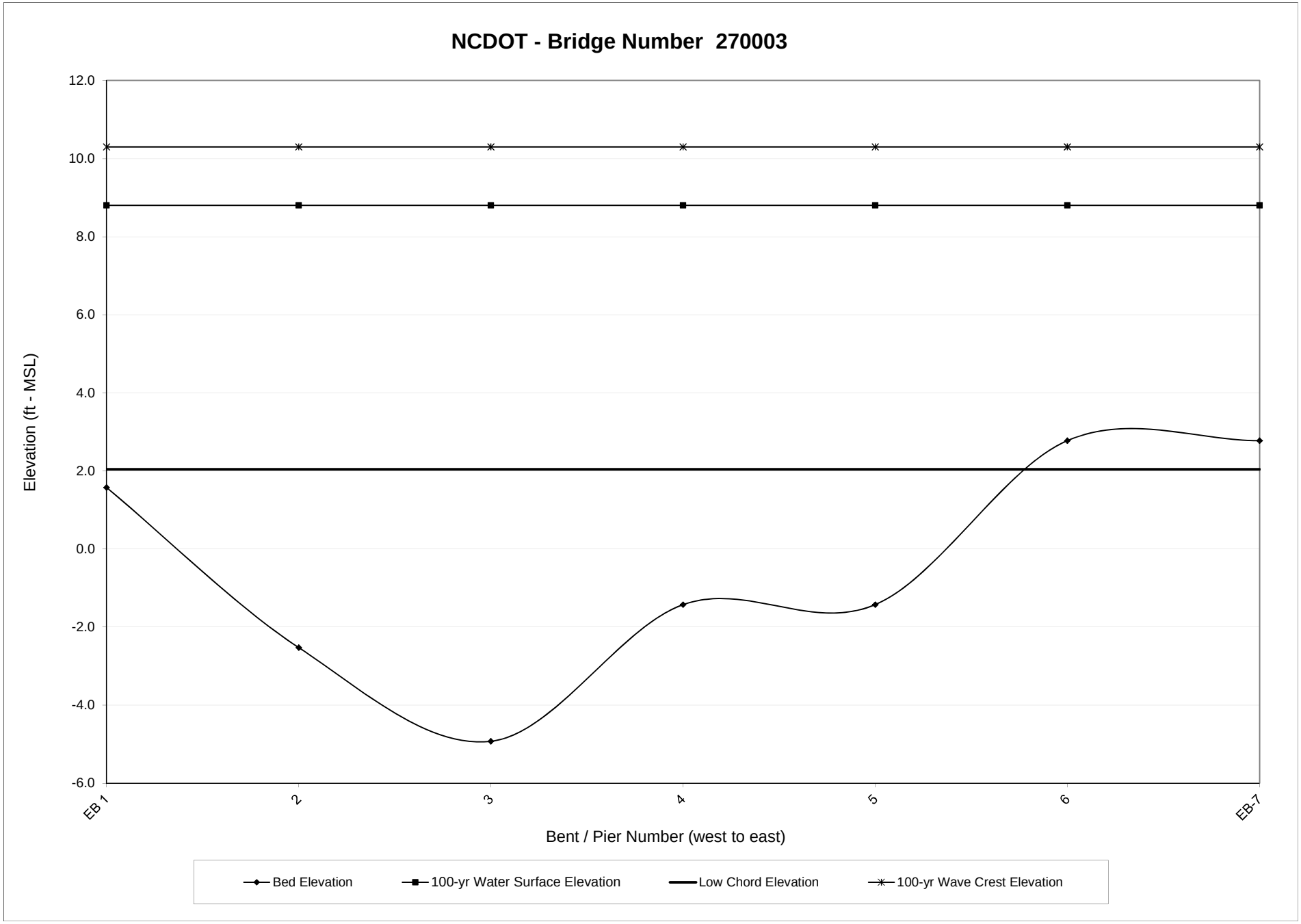
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-6 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 270003
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
EB-7
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 270009

CROATAN SOUND

US62-US63-US64

DARE COUNTY

DRAFT

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.2**	**1.8**	**1.8**	**1.2**	**1.2**	**1.2**	**1.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-2	-6	-6	-7	-8	-8	-9	-11	-11	-11	-12	-14	-15	-16	-16	-16
Low Chord Elevation (ft - MSL)	7.2	7.2	9.2	9.2	9.2	9.2	9.2	11.2	11.2	11.2	11.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	8.6	10.3	10.5	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	4.9	7.3	7.6	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	7.2	7.3	7.3	7.3	7.1	7.0	6.9	6.6	6.5	6.4	6.4	6.1	5.9	5.8	5.8	5.7
SPAN PROPERITES																
Span Length (ft)	40.0	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	44.9	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	149.7	156.7	156.7	86.4	86.4	83.0	84.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	3.7	3.7	3.7	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	27.4	84.2	84.2	75.8	75.8	31.9	48.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.7	2.0	2.0	1.8	1.8	0.8	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	2283.9	2115.2	2115.2	1371.4	1385.7	1343.4	1346.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	57.1	49.8	49.8	32.3	32.6	31.6	31.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-7 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-17	-16	-15	-15	-15	-13	-13	-13	-13	-12	-12	-12	-12	-12	-11	-11
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	5.7	5.8	5.9	5.9	6.0	6.1	6.1	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.4	6.4

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-11	-11	-11	-12	-11	-11	-11	-11	-10	-10	-10	-10	-11	-10	-10	-10
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	6.4	6.4	6.5	6.4	6.5	6.5	6.5	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.7

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 33-48 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-10	-10	-10	-10	-11	-11	-10	-11	-10	-10	-11	-10	-11	-11	-10	-10
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	6.6	6.6	6.6	6.6	6.6	6.5	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 49-64 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-10	-10	-10	-10	-10	-10	-9	-10	-10	-9	-10	-9	-10	-10	-10	-10
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	6.7	6.7	6.7	6.6	6.6	6.7	6.9	6.7	6.7	6.9	6.7	6.9	6.7	6.7	6.7	6.7

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 65-80 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-9	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-11	-11	-11	-11	-12
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	6.9	6.7	6.7	6.7	6.6	6.6	6.7	6.7	6.7	6.6	6.6	6.6	6.5	6.5	6.4	6.4

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 81-96 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-13	-14	-15	-15	-18	-18	-16	-17	-17	-17	-17	-15	-15	-16	-15	-15
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	6.2	6.0	5.9	5.8	5.6	5.5	5.7	5.7	5.7	5.6	5.6	5.8	5.9	5.8	5.8	5.9

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 97-112 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-14	-16	-16	-16	-14	-14	-16	-14	-18	-18	-17	-22	-25	-28	-32	-36
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	15.2	16.9	18.5	20.2	21.8	23.5	25.1	26.8	28.4
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	6.0	5.8	5.8	5.8	6.1	6.0	5.8	6.0	5.6	5.6	5.6	5.2	5.0	4.8	4.6	4.5

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	70.0	70.0	70.0	70.0	70.0	70.0	70.0
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	157	157	157	157	157	157	157
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	79.6	79.6	79.6	79.6	79.6	79.6	79.6
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.9	2.9	2.9	2.9	2.9	2.9	2.9

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 113-128 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**	**142**	**143**	**144**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-39	-41	-42	-46	-46	-52	-53	-55	-50	-53	-53	-52	-54	-45	-45	-44
Low Chord Elevation (ft - MSL)	30.0	31.7	33.3	35.0	36.6	38.3	39.9	41.6	43.2	44.2	43.2	41.2	40.2	38.2	36.2	35.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	4.4	4.3	4.3	4.2	4.2	4.0	4.0	4.0	4.1	4.0	4.0	4.0	4.0	4.2	4.2	4.2

SPAN PROPERITES																
Span Length (ft)	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	130.0	70.0	70.0	70.0	70.0	70.0	70.0
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157
Beam Dead Weight (kip/ft) - Total	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Resisting Moment (kft/ft)	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	148.8	79.6	79.6	79.6	79.6	79.6	79.6
Resisting Vertical Force (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 129-144 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**	**153**	**154**	**155**	**156**	**157**	**158**	**159**	**160**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-41	-38	-35	-31	-30	-27	-24	-22	-19	-18	-15	-16	-14	-14	-14	-14
Low Chord Elevation (ft - MSL)	33.2	31.2	30.2	28.2	27.2	25.2	23.2	22.2	20.2	18.2	17.2	15.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	4.3	4.4	4.5	4.7	4.7	4.9	5.1	5.2	5.5	5.6	5.9	5.8	6.0	6.0	6.0	6.0

SPAN PROPERITES																
Span Length (ft)	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	157	157	157	157	157	157	157	157	157	157	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	79.6	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 145-160 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**161**	**162**	**163**	**164**	**165**	**166**	**167**	**168**	**169**	**170**	**171**	**172**	**173**	**174**	**175**	**176**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-14	-15	-15	-14	-14	-15	-16	-15	-15	-15	-16	-15	-16	-16	-17	-16
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	6.0	6.0	5.9	6.0	6.0	6.0	5.8	6.0	5.9	5.9	5.8	5.9	5.8	5.7	5.6	5.7

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 161-170 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**177**	**178**	**179**	**180**	**181**	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**	**190**	**191**	**192**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-16	-16	-16	-16	-17	-16	-16	-16	-16	-16	-12	-12	-13	-14	-15	-15
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	5.7	5.7	5.8	5.7	5.7	5.8	5.8	5.8	5.8	5.8	6.3	6.4	6.2	6.1	5.9	5.8

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 177-192 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**193**	**194**	**195**	**196**	**197**	**198**	**199**	**200**	**201**	**202**	**203**	**204**	**205**	**206**	**207**	**208**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-16	-16	-17	-17	-16	-15	-13	-13	-13	-13	-13	-12	-11	-11	-11	-11
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	5.8	5.7	5.7	5.7	5.8	5.9	6.1	6.1	6.1	6.2	6.2	6.2	6.4	6.4	6.5	6.5

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 193-208 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**209**	**210**	**211**	**212**	**213**	**214**	**215**	**216**	**217**	**218**	**219**	**220**	**221**	**222**	**223**	**224**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-12	-13	-15	-15	-13	-13	-13	-12	-12	-11	-11	-11	-11	-9	-9	-9
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
100-yr Wave Period (seconds)	6.3	6.2	5.9	5.9	6.1	6.1	6.2	6.4	6.4	6.5	6.4	6.5	6.5	6.9	6.9	6.9

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 209-224 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**225**	**226**	**227**	**228**	**229**	**230**	**231**	**232**	**233**	**234**	**235**	**236**	**237**	**238**	**239**	**240**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-9	-8	-8	-8	-8	-9	-9	-9	-9	-9	-8	-7	-7	-7	-7	-7
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.7	10.8	10.8
100-yr Wave Height (ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	7.9	8.0	8.0
100-yr Wave Period (seconds)	7.0	7.0	7.1	7.1	7.0	7.0	6.9	6.9	6.9	6.9	7.1	7.3	7.4	7.4	7.4	7.4

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 225-240 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**241**	**242**	**243**	**244**	**245**	**246**	**247**	**248**	**249**	**250**	**251**	**252**	**253**	**254**	**255**	**256**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-7	-7	-7	-7	-6	-7	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.8	10.7	10.7	10.8	10.5	10.6	10.5	10.4	10.4	10.2	10.3	10.3	10.3	10.2	10.2	10.2
100-yr Wave Height (ft)	8.0	7.9	7.9	8.0	7.6	7.7	7.5	7.4	7.5	7.2	7.3	7.3	7.3	7.1	7.1	7.1
100-yr Wave Period (seconds)	7.4	7.4	7.4	7.4	7.3	7.4	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 241-248 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**257**	**258**	**259**	**260**	**261**	**262**	**263**	**264**	**265**	**266**	**267**	**268**	**269**	**270**	**271**	**272**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.2	10.2	10.4	10.2	10.3	10.3	10.2	10.2	10.2	10.1	10.1	10.3	10.3	10.3	10.4	10.4
100-yr Wave Height (ft)	7.1	7.1	7.4	7.1	7.3	7.3	7.2	7.1	7.1	7.0	7.0	7.3	7.3	7.3	7.4	7.5
100-yr Wave Period (seconds)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slab Dead Weight (kip/ft)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Dead Weight (kip/ft)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 257-272 are notsubject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**273**	**274**	**275**	**276**	**277**	**278**	**279**	**280**	**281**	**282**	**283**	**284**	**285**	**286**	**287**	**288**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-6	-6	-6	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.4	10.1	10.2	10.0	9.8	9.9	9.9	9.8	9.8	9.9	9.9	9.9	9.9	9.9	10.0	10.0
100-yr Wave Height (ft)	7.4	7.0	7.1	6.8	6.6	6.7	6.8	6.6	6.6	6.7	6.7	6.7	6.8	6.8	6.8	6.8
100-yr Wave Period (seconds)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slab Dead Weight (kip/ft)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Dead Weight (kip/ft)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 273-288 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**289**	**290**	**291**	**292**	**293**	**294**	**295**	**296**	**297**	**298**	**299**	**300**	**301**	**302**	**303**	**304**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-5	-5	-5	-6	-6	-6	-6	-6	-6	-7	-7	-7	-6	-3	-4	-4
Low Chord Elevation (ft - MSL)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	11.2	11.2
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.9	10.0	10.1	10.2	10.3	10.3	10.4	10.4	10.6	10.7	10.7	10.4	9.1	9.2	9.5
100-yr Wave Height (ft)	6.6	6.8	6.9	7.0	7.1	7.3	7.3	7.4	7.4	7.7	7.9	7.8	7.4	5.5	5.8	6.2
100-yr Wave Period (seconds)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.4	7.4	7.4	7.3	7.3	7.3	7.3

SPAN PROPERITES																
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slab Dead Weight (kip/ft)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Dead Weight (kip/ft)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 289-304 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270009
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY									
SPAN NUMBER	**305**	**306**	**307**	**308**	**309**	**310**	**311**	**312**	**313**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.8**	**0.8**	**0.5**	**0.5**	**0.5**	**0.8**	**0.8**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES									
100-yr Water Surface Elevation (ft - MSL)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Bed Elevation (ft - MSL)	-4	-5	-5	-4	-4	-4	-3	-3	-3
Low Chord Elevation (ft - MSL)	11.2	11.2	9.2	9.2	9.2	9.2	9.2	7.2	7.2
100-yr Max Wave Crest Elevation (ft - MSL)	9.6	9.7	9.7	9.6	9.3	9.2	9.2	8.9	8.9
100-yr Wave Height (ft)	6.3	6.4	6.4	6.3	5.9	5.7	5.6	5.3	5.3
100-yr Wave Period (seconds)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3

SPAN PROPERITES									
Span Length (ft)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Span Width (ft)	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.4
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	118	118	118	118	118	118	118	118	118
Beam Dead Weight (kip/ft) - Total	0	0	0	0	0	0	0	0	0
Slab Dead Weight (kip/ft)	2	2	2	2	2	2	2	2	2
Total Dead Weight (kip/ft)	3	3	3	3	3	3	3	3	3
Resisting Moment (kft/ft)	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
Resisting Vertical Force (kip/ft)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

100-YEAR FORCE-MOMENT VALUES									
Maximum Vertical Force (kips/span)	0.0	0.0	49.4	49.4	30.9	34.0	30.3	63.7	63.7
Maximum Vertical Force (kips/ft)	0.0	0.0	1.2	1.2	0.7	0.8	0.7	1.5	1.5
Maximum Horizontal Force (kips/span)	0.0	0.0	17.6	17.6	11.7	11.7	9.1	34.1	34.1
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.4	0.4	0.3	0.3	0.2	0.8	0.8
Maximum Moment (k-ft)	0.0	0.0	935.4	935.4	529.4	611.3	535.1	973.4	973.4
Maximum Moment (k-ft/ft)	0.0	0.0	22.0	22.0	12.5	14.4	12.6	22.9	22.9

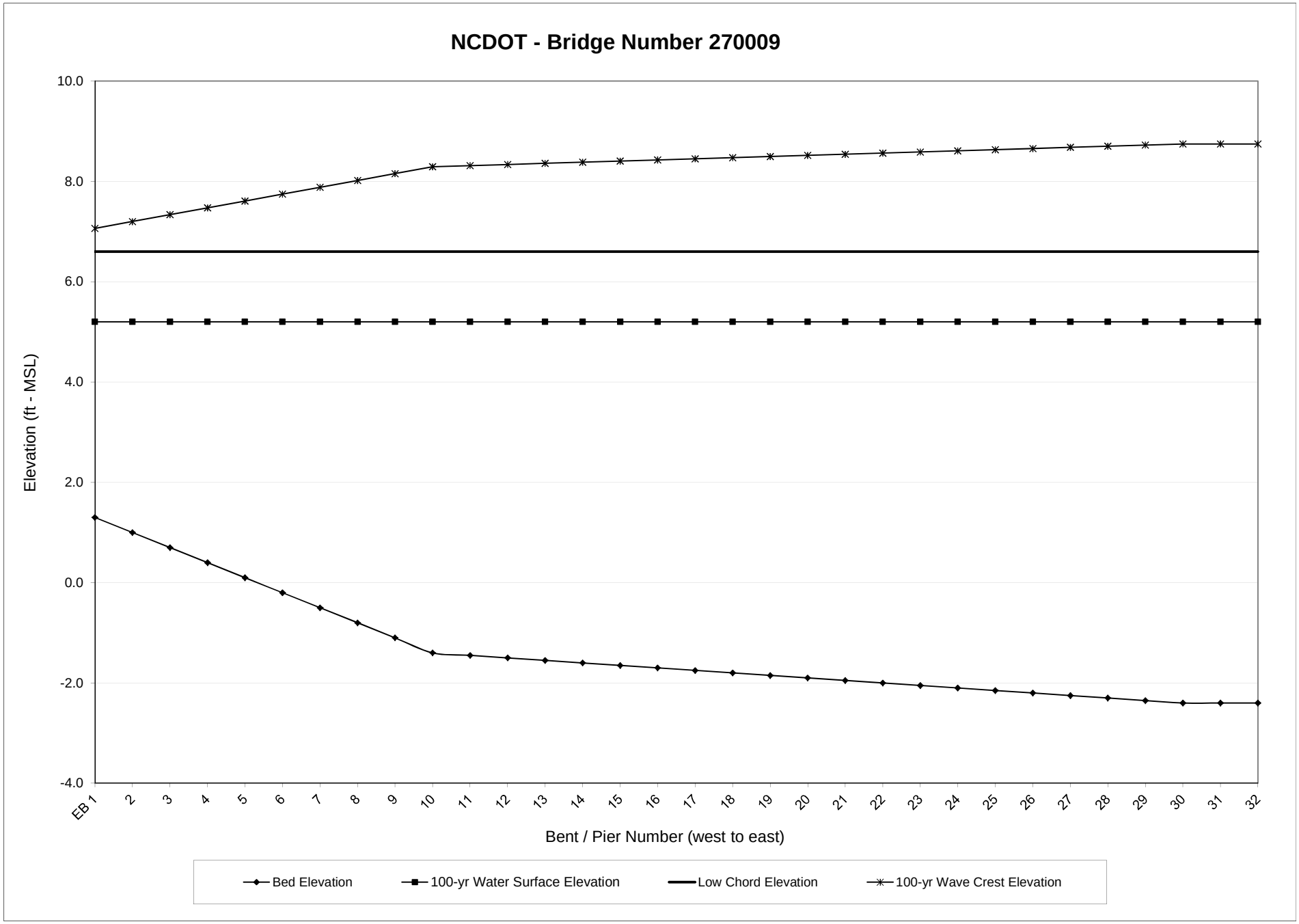
Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

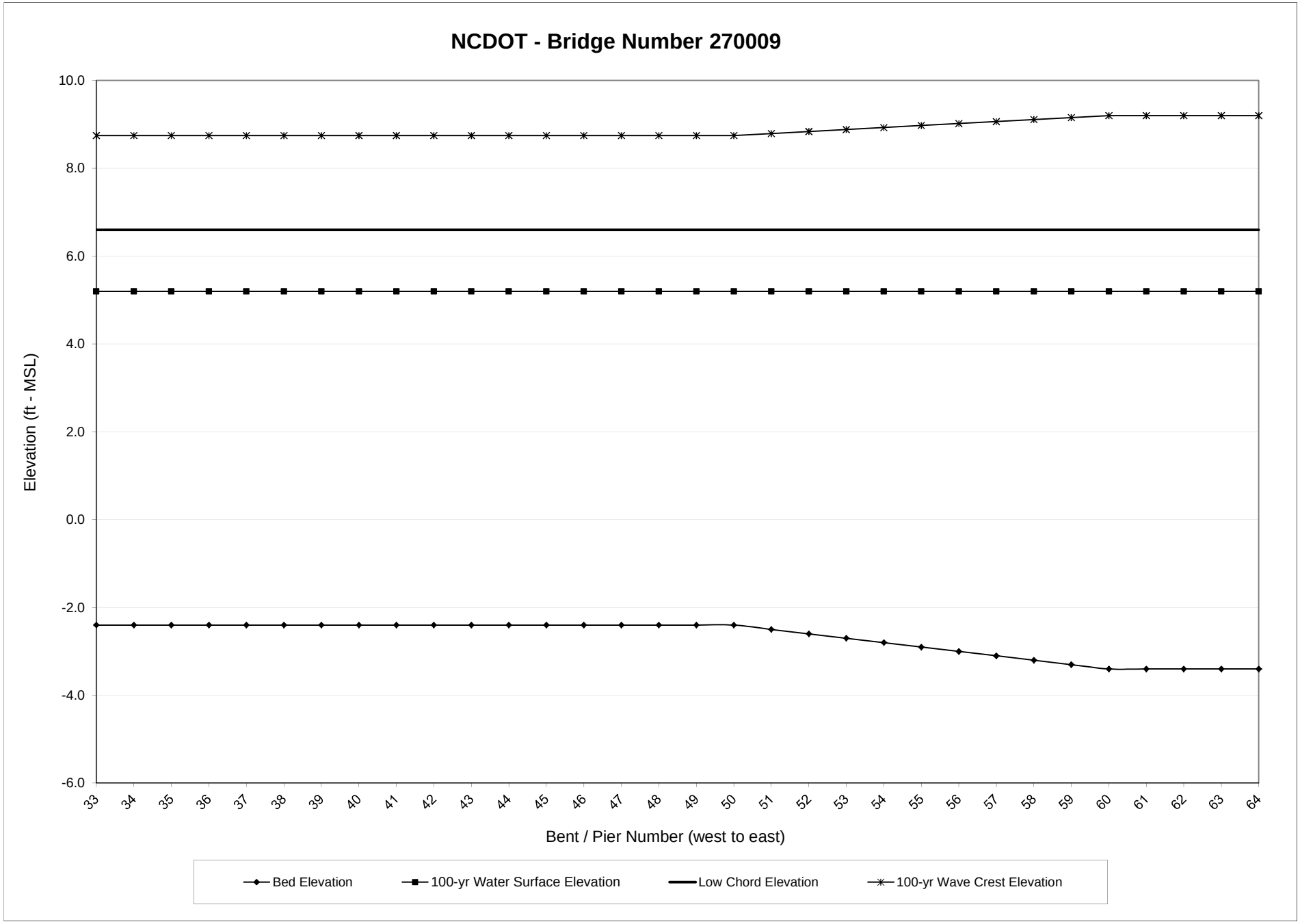
Notes:

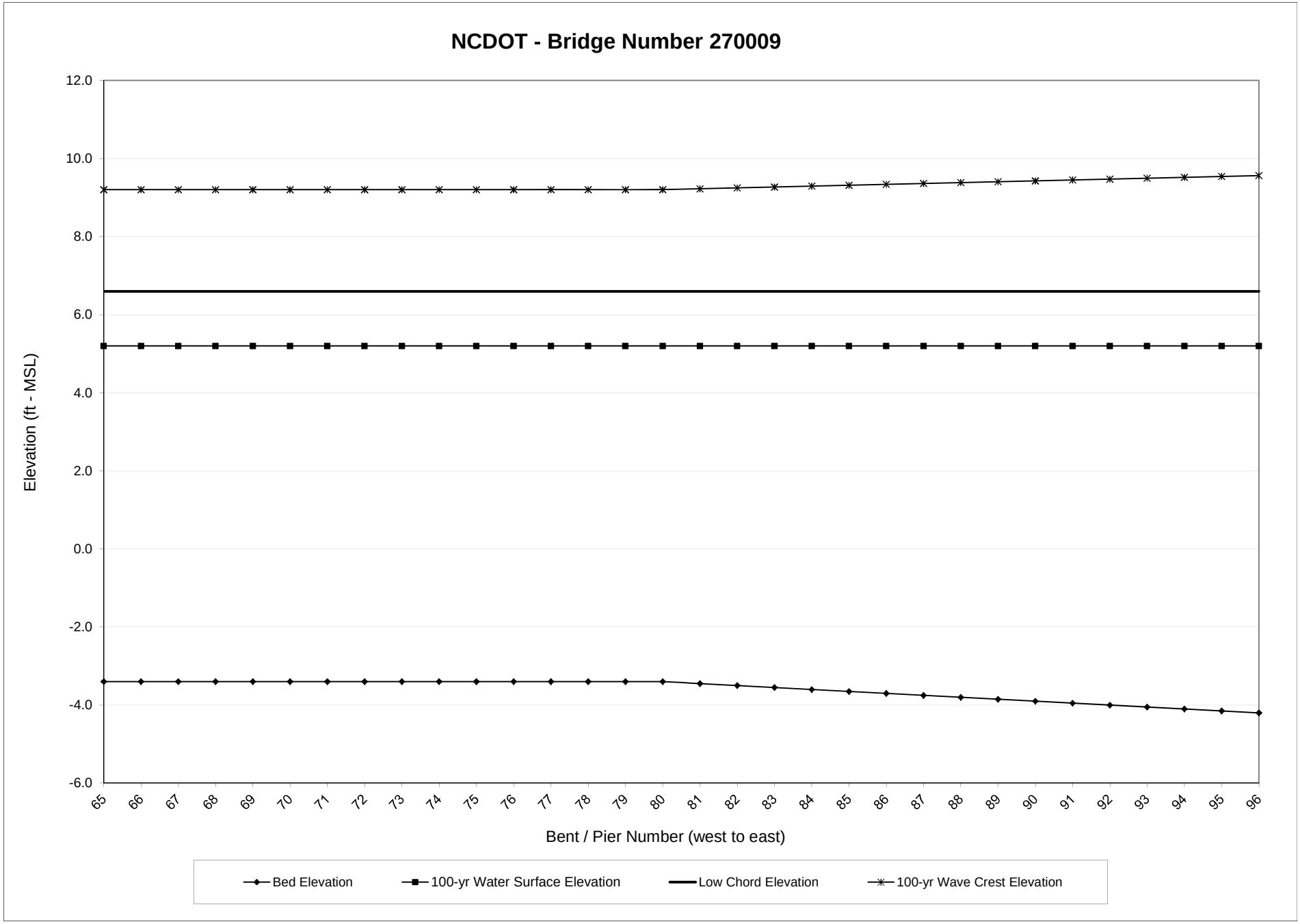
1 - Bridge spans 307-313 are potentially subject to wave energy.

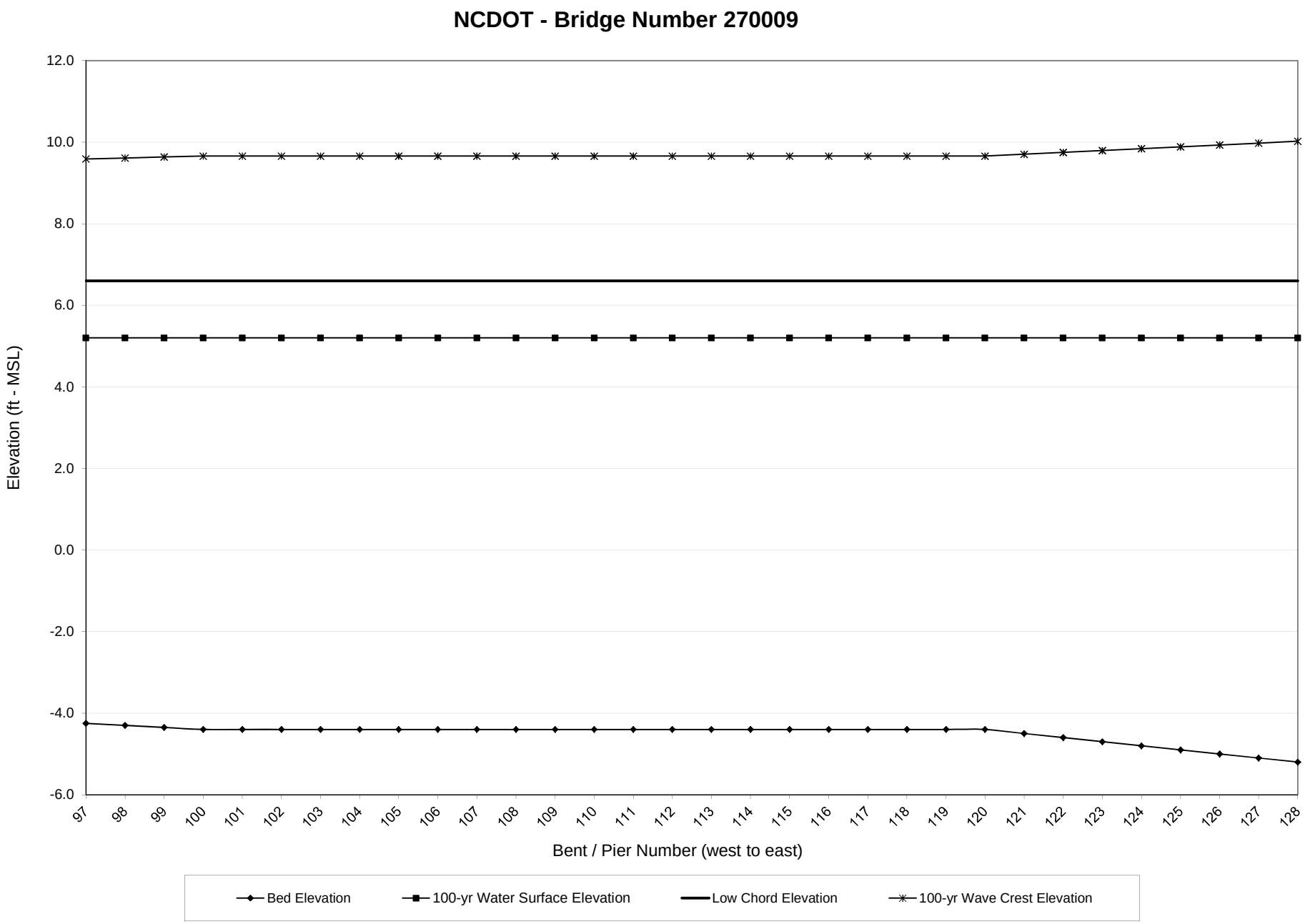
2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

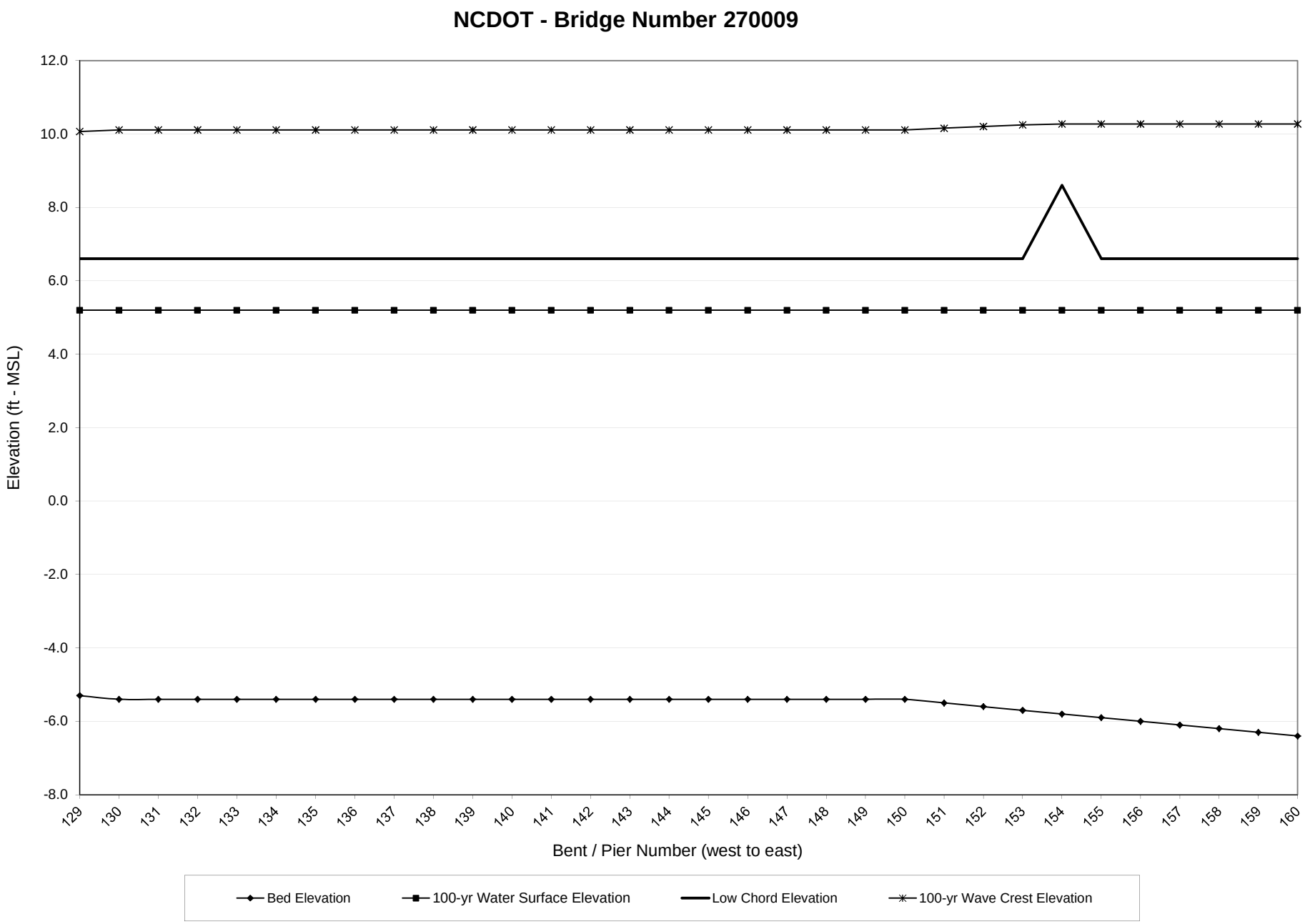
Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

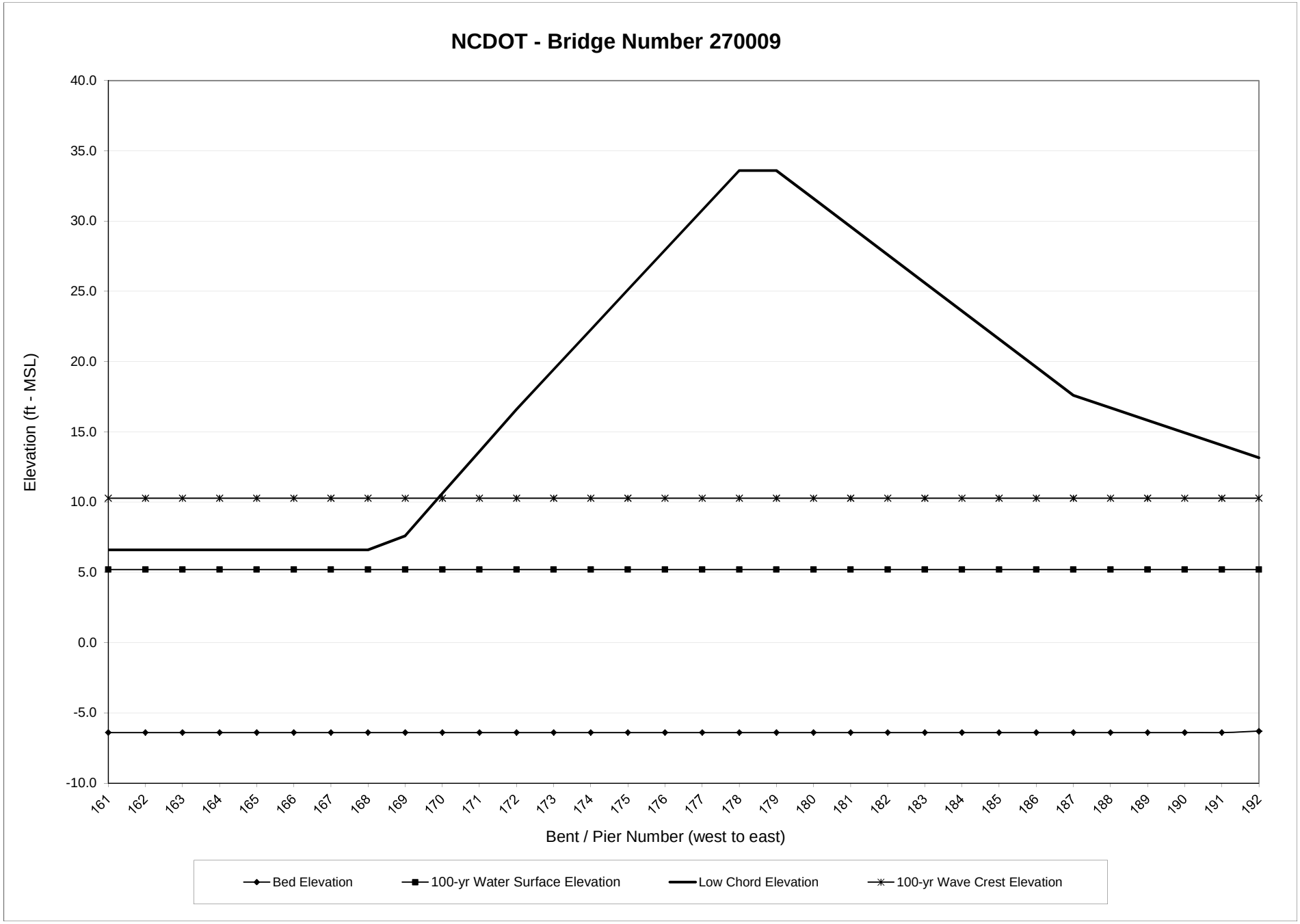

NCDOT - Bridge Number 270009
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

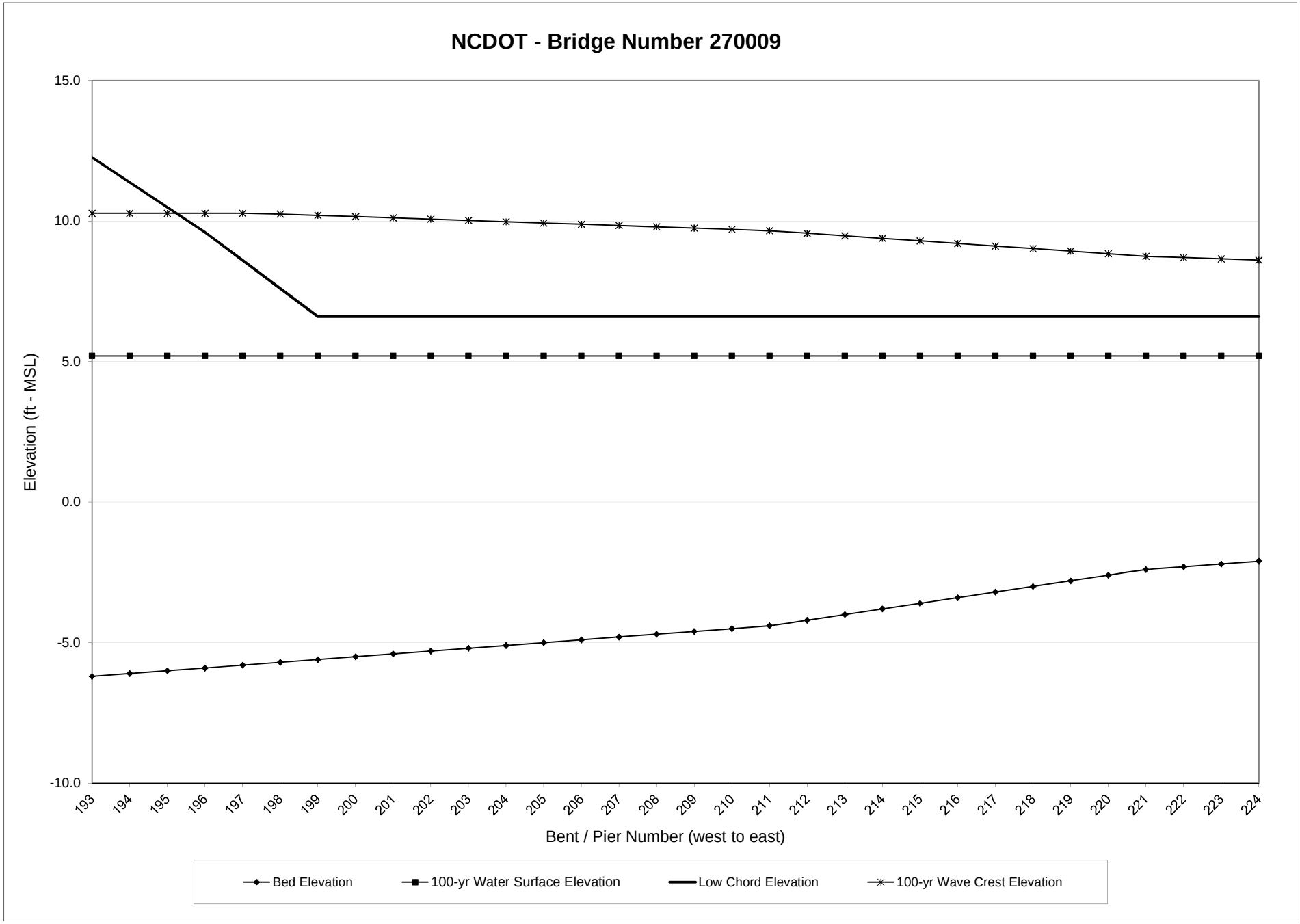

NCDOT - Bridge Number 270009
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
Elevation (ft - MSL)
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

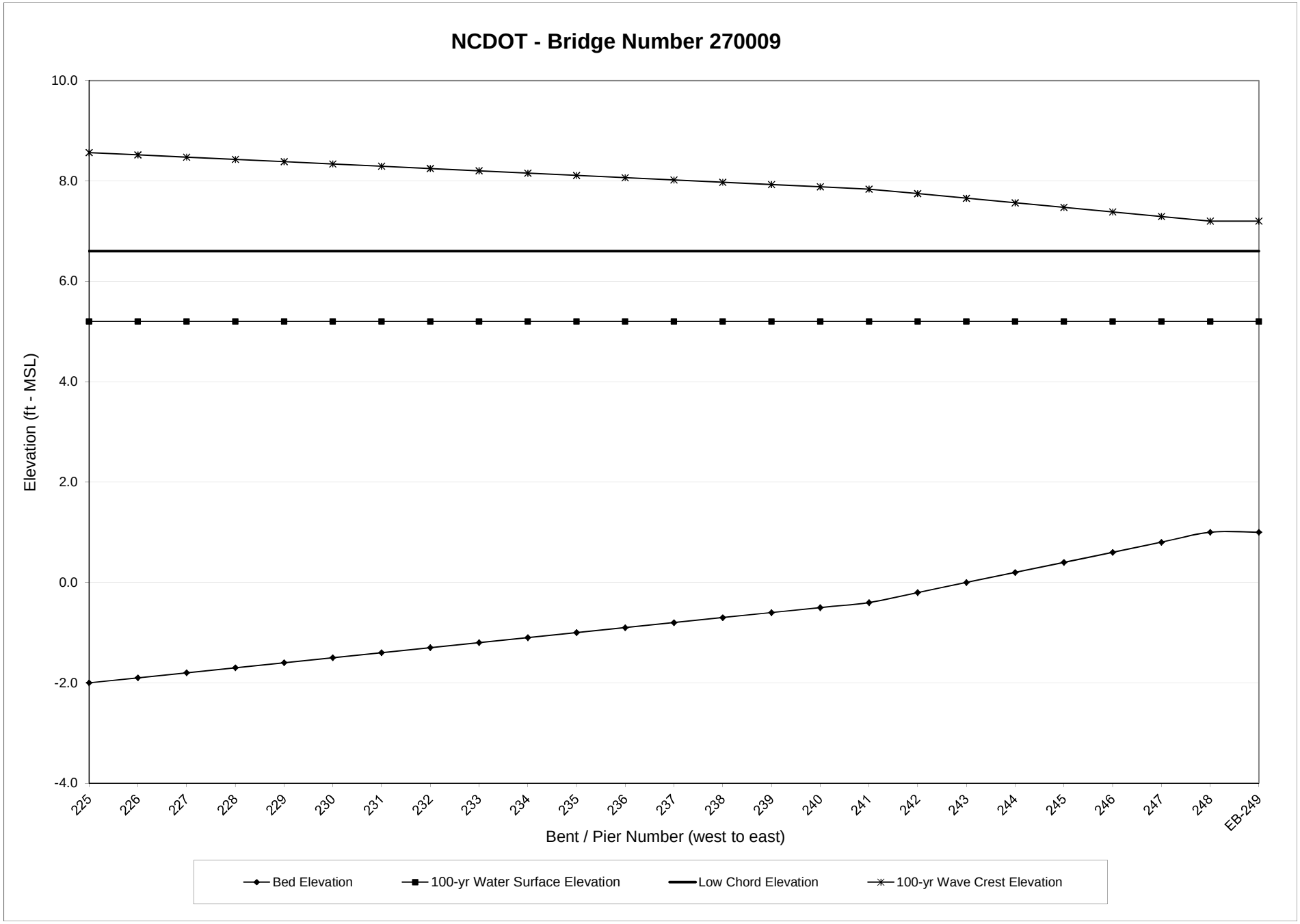

NCDOT - Bridge Number 270009
Elevation (ft - MSL)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270009
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
Elevation (ft - MSL)
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270009
Elevation (ft - MSL)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270009
Elevation (ft - MSL)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270009
15.0
10.0
5.0
0.0
-5.0
-10.0
Elevation (ft - MSL)
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270009
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
Elevation (ft - MSL)
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
EB-249
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 270011

OREGON INLET

NC9-10-11-12

DARE COUNTY

DRAFT

NCDOT BRIDGE NO. 270011

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.5**	**0.4**	**0.8**	**0.3**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	-3	-3	-4	-5	-6	-10	-14	-19	-23	-24	-32	-31	-30	-31	-27	-25
Low Chord Elevation (ft - MSL)	8.6	9.1	9.6	10.1	10.6	11.1	11.6	12.1	12.6	13.1	13.1	13.1	13.1	13.1	13.1	13.1
100-yr Max Wave Crest Elevation (ft - MSL)	10.2	10.2	10.7	11.1	11.6	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Wave Height (ft)	5.9	5.9	6.5	7.2	7.8	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
100-yr Wave Period (seconds)	7.3	7.3	7.3	7.3	7.3	6.5	5.8	5.4	5.1	5.0	4.6	4.6	4.7	4.6	4.8	4.9
SPAN PROPERITES																
Span Length (ft)	58.8	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Resisting Moment (kft/ft)	87.1	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Resisting Vertical Force (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	93.4	75.9	126.3	79.3	70.1	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	1.6	1.3	2.1	1.3	1.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	73.5	58.2	68.8	73.2	65.7	12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	1.2	1.0	1.2	1.2	1.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	1,358.4	1,054.7	2,523.8	820.6	368.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	23.1	17.7	42.3	13.8	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-6 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270011

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	-22	-19	-17	-14	-13	-13	-12	-12	-11	-11	-11	-12	-12	-12	-12	-13
Low Chord Elevation (ft - MSL)	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
100-yr Max Wave Crest Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Wave Height (ft)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
100-yr Wave Period (seconds)	5.1	5.3	5.6	5.9	6.0	6.1	6.1	6.2	6.3	6.3	6.3	6.2	6.2	6.2	6.1	6.1

SPAN PROPERITES																
Span Length (ft)	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Resisting Moment (kft/ft)	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Resisting Vertical Force (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270011

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	-13	-14	-14	-14	-13	-13	-12	-12	-11	-11	-10	-10	-9	-9	-10	-10
Low Chord Elevation (ft - MSL)	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
100-yr Max Wave Crest Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Wave Height (ft)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
100-yr Wave Period (seconds)	6.0	6.0	5.9	6.0	6.0	6.1	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.6	6.5	6.5

SPAN PROPERITES																
Span Length (ft)	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Resisting Moment (kft/ft)	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Resisting Vertical Force (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 33-48 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270011

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	1	1	2	2	2	2
Low Chord Elevation (ft - MSL)	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
100-yr Max Wave Crest Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	8.4	8.4	8.0	8.0	8.0	8.0
100-yr Wave Height (ft)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	3.3	3.3	2.7	2.7	2.7	2.7
100-yr Wave Period (seconds)	6.4	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	7.2	7.2	7.1	7.1	7.1	7.1

SPAN PROPERITES																
Span Length (ft)	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Resisting Moment (kft/ft)	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Resisting Vertical Force (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 49-64 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270011

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	3	4	4	4	4	5	4	3	3	2	1	1	1	1	1	1
Low Chord Elevation (ft - MSL)	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
100-yr Max Wave Crest Elevation (ft - MSL)	7.5	7.1	7.1	7.1	7.1	6.6	7.1	7.5	7.5	8.0	8.4	8.4	8.4	8.4	8.4	8.4
100-yr Wave Height (ft)	2.0	1.4	1.4	1.4	1.4	0.7	1.4	2.0	2.0	2.7	3.3	3.3	3.3	3.3	3.3	3.3
100-yr Wave Period (seconds)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.2	7.2	7.2	7.2	7.2	7.2

SPAN PROPERITES																
Span Length (ft)	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Resisting Moment (kft/ft)	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Resisting Vertical Force (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 65-80 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270011
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	2	2	2	2	2	3	3	3	3	3	4	4	4	4	4	4
Low Chord Elevation (ft - MSL)	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
100-yr Max Wave Crest Elevation (ft - MSL)	8.2	8.2	8.2	8.2	8.0	7.7	7.7	7.7	7.7	7.5	7.3	7.3	7.3	7.3	7.1	7.3
100-yr Wave Height (ft)	3.0	3.0	3.0	3.0	2.7	2.3	2.3	2.3	2.3	2.0	1.7	1.7	1.7	1.7	1.4	1.7
100-yr Wave Period (seconds)	7.2	7.2	7.2	7.2	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1

SPAN PROPERITES																
Span Length (ft)	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Resisting Moment (kft/ft)	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Resisting Vertical Force (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 81-96 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	4	4	4	3	-6	-7	-8	-11	-13	-12	-13	-13	-14	-15	-17	-17
Low Chord Elevation (ft - MSL)	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
100-yr Max Wave Crest Elevation (ft - MSL)	7.3	7.3	7.3	7.5	11.6	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Wave Height (ft)	1.7	1.7	1.7	2.0	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
100-yr Wave Period (seconds)	7.1	7.1	7.1	7.1	7.3	7.1	6.9	6.3	6.0	6.2	6.0	6.0	5.9	5.8	5.6	5.6

SPAN PROPERITES																
Span Length (ft)	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Resisting Moment (kft/ft)	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Resisting Vertical Force (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 97-112 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270011

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	-18	-18	-18	-18	-20	-20	-20	-21	-20	-21	-22	-23	-24	-19	-19	-19
Low Chord Elevation (ft - MSL)	13.1	13.1	13.1	13.1	13.1	13.6	14.1	14.1	15.1	16.1	17.6	19.1	21.1	23.6	26.1	28.5
100-yr Max Wave Crest Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Wave Height (ft)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
100-yr Wave Period (seconds)	5.5	5.5	5.5	5.5	5.3	5.3	5.3	5.2	5.3	5.2	5.1	5.1	5.0	5.4	5.4	5.4

SPAN PROPERITES																
Span Length (ft)	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	45.0	45.0	45.0	45.0	45.0
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	36.0	36.0	36.0	36.0	36.0
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.8	1.8	1.8	1.8	1.8
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	0.0	0.0	0.0	0.0	0.0
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	9.5	9.5	9.5	9.5	9.5
Total Dead Weight (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	9.5	9.5	9.5	9.5	9.5
Resisting Moment (kft/ft)	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	196.3	196.3	196.3	196.3	196.3
Resisting Vertical Force (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	9.5	9.5	9.5	9.5	9.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 113-128 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270011
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**	**142**	**143**	**144**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	-18	-19	-22	-21	-20	-20	-18	-18	-18	-19	-20	-20	-19	-19	-20	-27
Low Chord Elevation (ft - MSL)	31.0	33.4	35.9	38.4	40.8	43.3	45.7	48.2	50.7	53.1	55.6	58.1	60.1	62.1	64.1	66.1
100-yr Max Wave Crest Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Wave Height (ft)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
100-yr Wave Period (seconds)	5.5	5.4	5.1	5.2	5.3	5.3	5.5	5.5	5.5	5.4	5.3	5.3	5.4	5.4	5.3	4.8

SPAN PROPERITES																
Span Length (ft)	45.0	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	60.3	160.0
Span Width (ft)	36.0	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	1.8	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	0.0	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	0	581	581	581	581	581	581	581	581	581	581	581	581	581	581	1201
Beam Dead Weight (kip/ft) - Total	0.0	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	4.8
Slab Dead Weight (kip/ft)	9.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	9.5	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	7.8
Resisting Moment (kft/ft)	196.3	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	89.4	240.1
Resisting Vertical Force (kip/ft)	9.5	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	7.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 129-144 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270011
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**	**153**	**154**	**155**	**156**	**157**	**158**	**159**	**160**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	-24	-23	-27	-29	-31	-31	-31	-27	-29	-30	-28	-24	-25	-43	-45	-42
Low Chord Elevation (ft - MSL)	66.1	63.6	62.1	60.1	58.1	55.6	53.2	50.7	48.3	45.8	43.3	40.9	38.4	36.0	33.5	31.0
100-yr Max Wave Crest Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Wave Height (ft)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
100-yr Wave Period (seconds)	5.0	5.1	4.8	4.7	4.6	4.6	4.6	4.8	4.7	4.7	4.8	5.0	4.9	4.2	4.2	4.2

SPAN PROPERITES																
Span Length (ft)	180.0	160.0	60.3	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	1201	1201	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	4.8	4.8	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	7.8	7.8	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Resisting Moment (kft/ft)	270.3	240.1	89.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Resisting Vertical Force (kip/ft)	7.8	7.8	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 145-160 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270011
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**161**	**162**	**163**	**164**	**165**	**166**	**167**	**168**	**169**	**170**	**171**	**172**	**173**	**174**	**175**	**176**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	-40	-36	-32	-30	-31	-33	-32	-35	-33	-31	-30	-27	-24	-20	-19	-21
Low Chord Elevation (ft - MSL)	28.6	26.1	23.6	21.1	19.1	17.6	16.1	15.1	15.1	14.6	14.6	14.1	14.1	14.1	14.1	14.1
100-yr Max Wave Crest Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Wave Height (ft)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
100-yr Wave Period (seconds)	4.3	4.4	4.6	4.7	4.6	4.5	4.6	4.5	4.5	4.6	4.7	4.8	5.0	5.3	5.4	5.2

SPAN PROPERITES																
Span Length (ft)	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Resisting Moment (kft/ft)	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Resisting Vertical Force (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 161-176 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270011

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**177**	**178**	**179**	**180**	**181**	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**	**190**	**191**	**192**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	-22	-23	-21	-24	-24	-24	-24	-24	-26	-28	-25	-25	-30	-31	-36	-32
Low Chord Elevation (ft - MSL)	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1
100-yr Max Wave Crest Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Wave Height (ft)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
100-yr Wave Period (seconds)	5.1	5.1	5.2	5.0	5.0	5.0	5.0	5.0	4.9	4.8	4.9	4.9	4.7	4.6	4.4	4.6

SPAN PROPERITES																
Span Length (ft)	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Resisting Moment (kft/ft)	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Resisting Vertical Force (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 177-192 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270011
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY												
SPAN NUMBER	**193**	**194**	**195**	**196**	**197**	**198**	**199**	**200**	**201**	**202**	**203**	**204**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**1.1**	**0.6**	**1.2**	**0.8**	**0.8**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES												
100-yr Water Surface Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Bed Elevation (ft - MSL)	-28	-27	-26	-27	-22	-23	-22	-22	0	0	0	0
Low Chord Elevation (ft - MSL)	14.1	14.1	13.6	13.1	11.1	10.1	9.1	8.1	7.1	6.1	5.1	5.1
100-yr Max Wave Crest Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	8.9	8.9	8.9	8.9
100-yr Wave Height (ft)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	4.0	4.0	4.0	4.0
100-yr Wave Period (seconds)	4.8	4.8	4.9	4.8	5.1	5.1	5.1	5.1	7.2	7.2	7.2	7.2

SPAN PROPERITES												
Span Length (ft)	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
Span Width (ft)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Dead Weight (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Resisting Moment (kft/ft)	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Resisting Vertical Force (kip/ft)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3

100-YEAR FORCE-MOMENT VALUES												
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.7	11.3	106.7	240.1	92.0	172.7	177.8	177.8
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.2	1.8	4.0	1.5	2.9	3.0	3.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	3.8	14.9	27.3	55.8	74.5	85.4	85.4
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.5	0.9	1.2	1.4	1.4
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	1,522.8	3,461.0	1,909.7	3,715.3	2,560.6	2,560.6
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	25.5	58.0	32.0	62.3	42.9	42.9

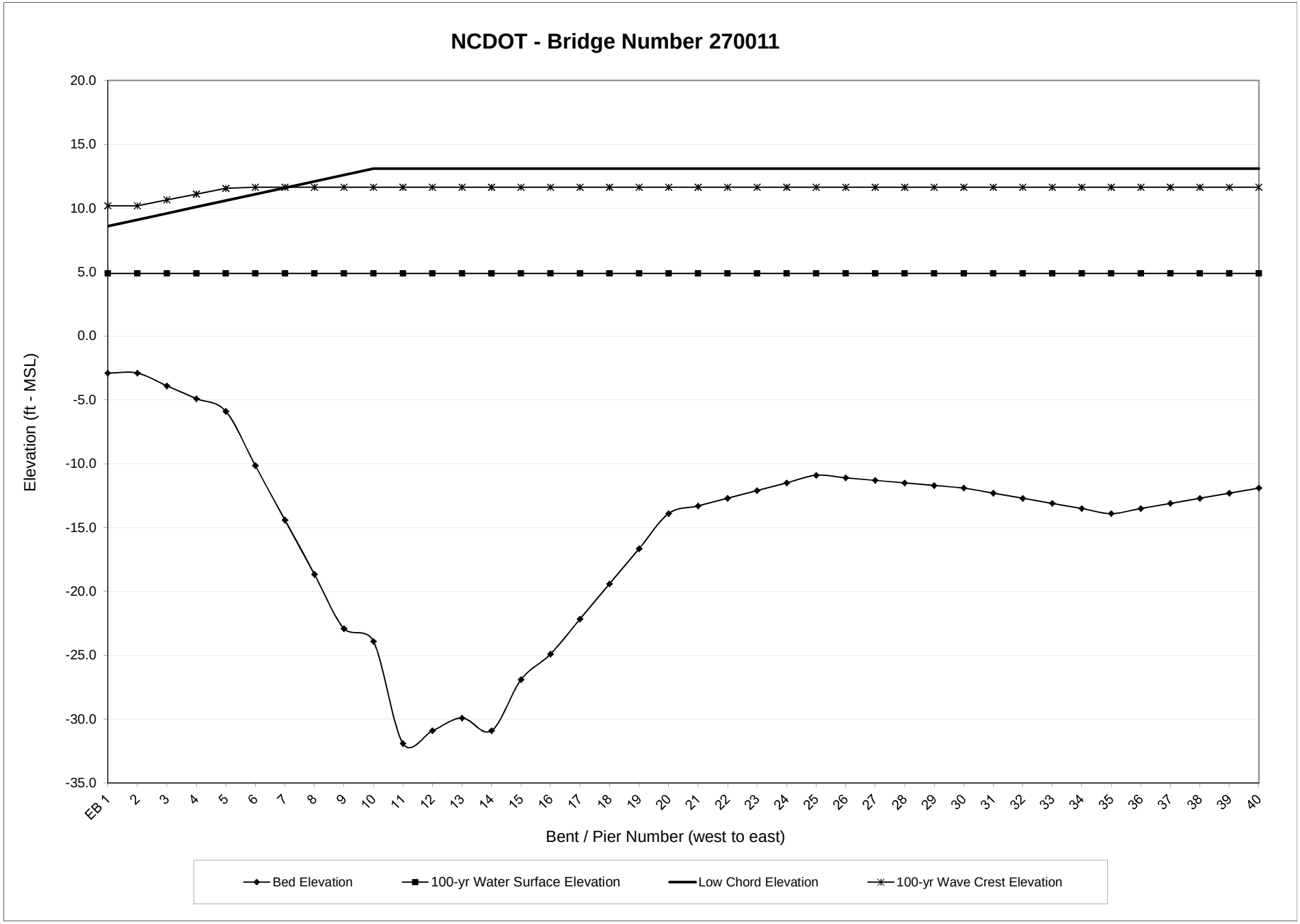
Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

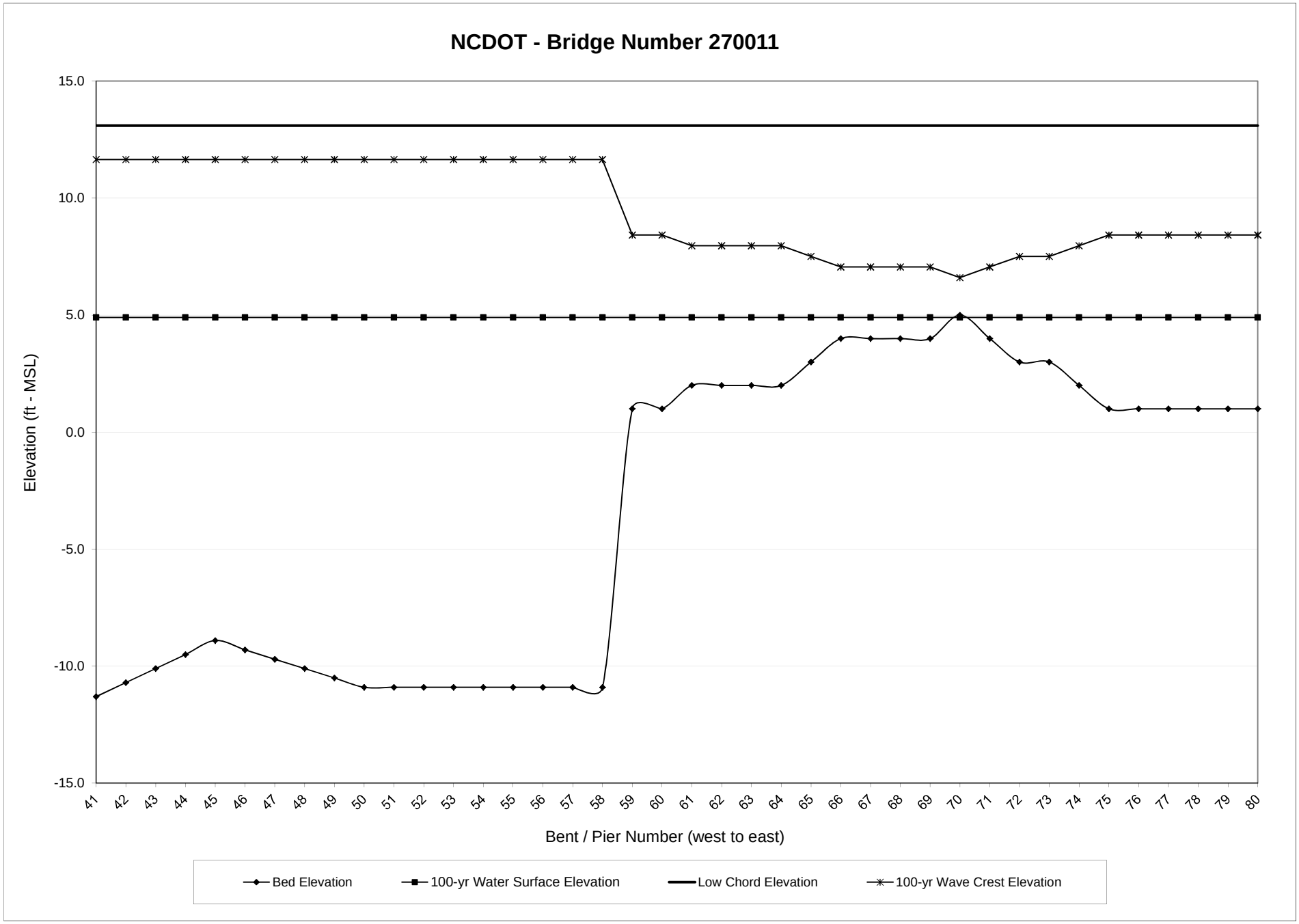
Notes:

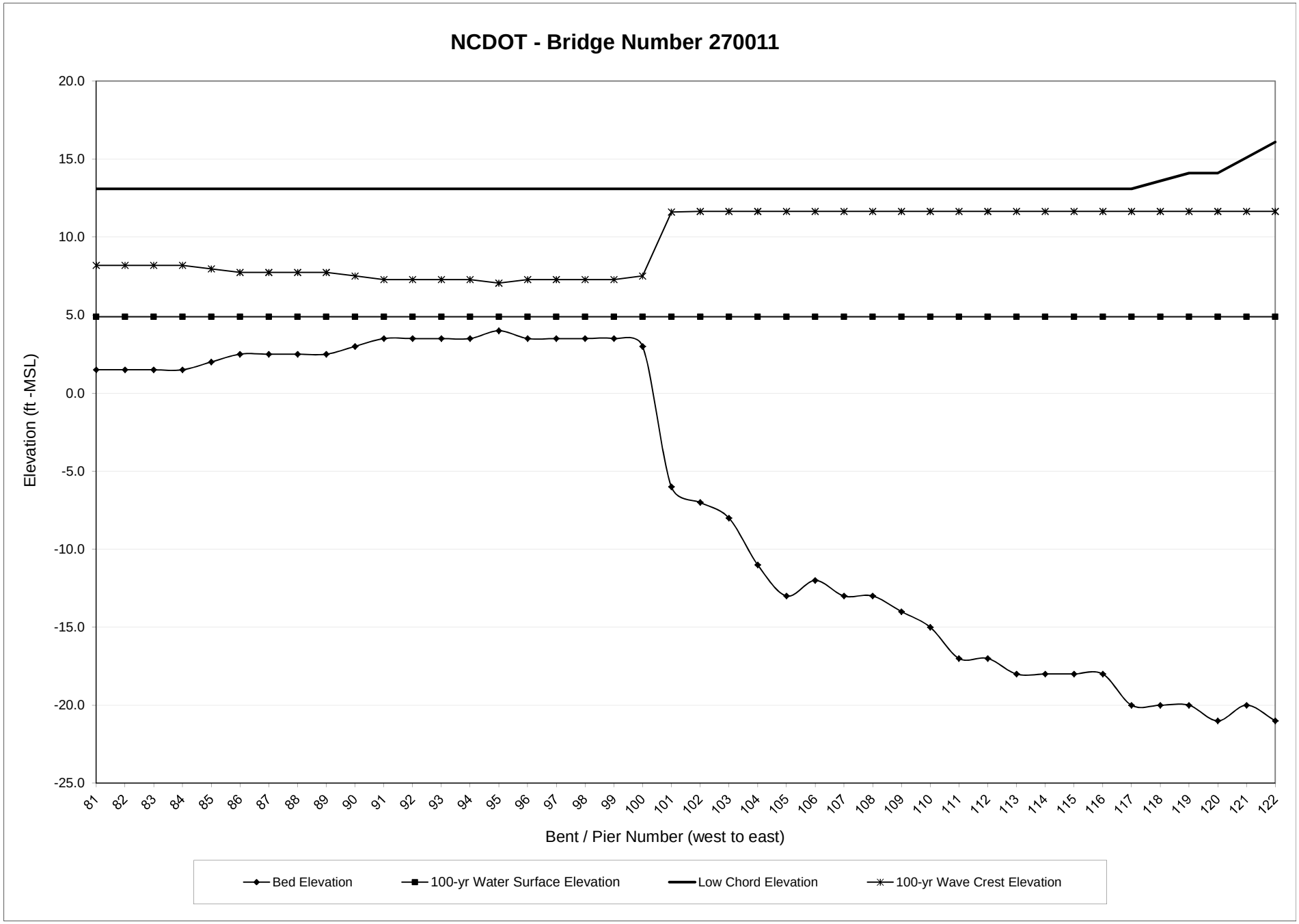
1 - Bridge spans 198-204 are potentially subject to wave energy.

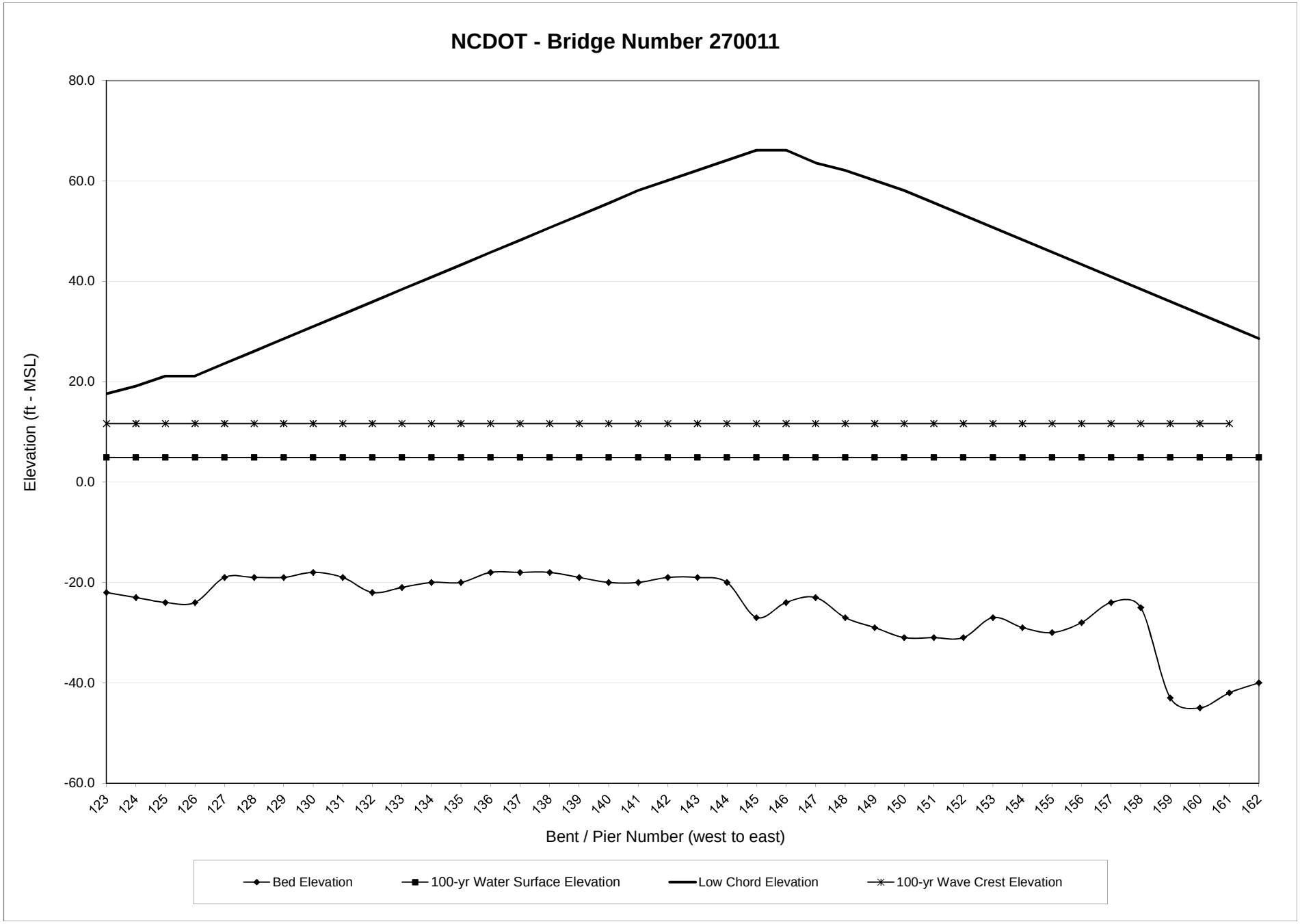
2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

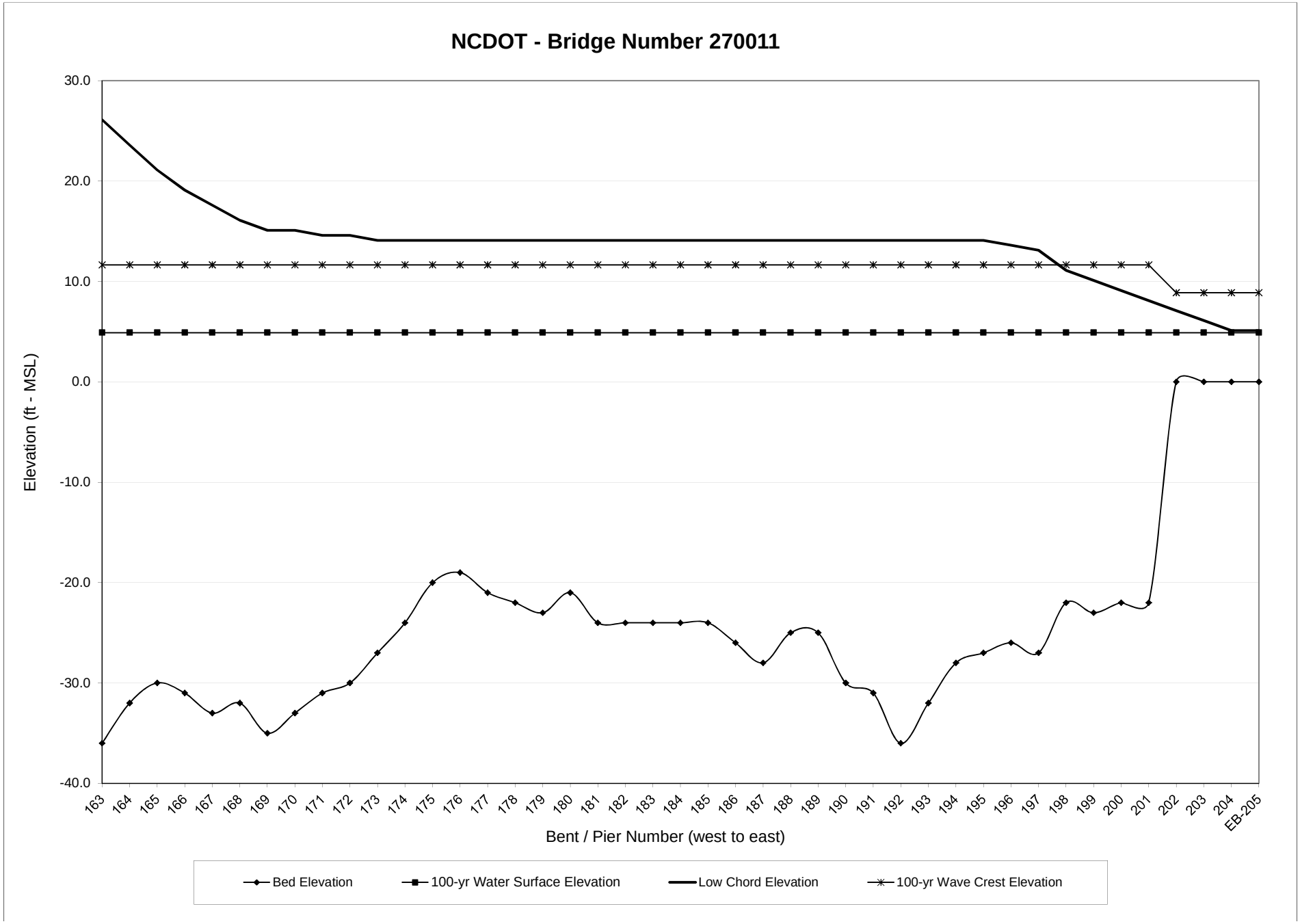
Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 270011
Elevation (ft - MSL)
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270011
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270011
Elevation (ft -MSL)
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270011
80.0
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
Elevation (ft - MSL)
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270011
Elevation (ft - MSL)
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 EB-205
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 270013

STUMPY POINT CANAL

US264

DARE COUNTY

DRAFT

NCDOT BRIDGE NO. 270013
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY				
SPAN NUMBER	1	2	3	4
CRITICALITY INDEX (defined below)	4	4	4	4
VULNERABILITY INDEX (defined below)	2.8	2.9	2.8	2.8

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES				
100-yr Water Surface Elevation (ft - MSL)	6.2	6.2	6.2	6.2
Bed Elevation (ft - MSL)	-13	-15	-13	-13
Low Chord Elevation (ft - MSL)	4.1	4.1	4.1	4.1
100-yr Max Wave Crest Elevation (ft - MSL)	9.0	9.0	9.0	9.0
100-yr Wave Height (ft)	4.0	4.0	4.0	4.0
100-yr Wave Period (seconds)	3.3	3.2	3.3	3.3

SPAN PROPERITES				
Span Length (ft)	24.8	24.8	24.8	24.8
Span Width (ft)	29.6	29.6	29.6	29.6
Deck Thickness (ft)	0.6	0.6	0.6	0.6
Overhang (ft)	3.0	3.0	3.0	3.0
Number of Beams	6	6	6	6
Beam Dead Weight (lb/lf) - Each	58	58	58	58
Beam Dead Weight (kip/ft) - Total	0.3	0.3	0.3	0.3
Slab Dead Weight (kip/ft)	2.6	2.6	2.6	2.6
Total Dead Weight (kip/ft)	2.9	2.9	2.9	2.9
Resisting Moment (kft/ft)	34.6	34.6	34.6	34.6
Resisting Vertical Force (kip/ft)	2.9	2.9	2.9	2.9

100-YEAR FORCE-MOMENT VALUES				
Maximum Vertical Force (kips/span)	64.8	65.1	64.7	64.9
Maximum Vertical Force (kips/ft)	2.6	2.6	2.6	2.6
Maximum Horizontal Force (kips/span)	22.6	14.4	14.3	22.6
Maximum Horizontal Force (kips/ft)	0.9	0.6	0.6	0.9
Maximum Moment (k-ft)	1,383	1,401	1,384	1,384
Maximum Moment (k-ft/ft)	56	57	56	56

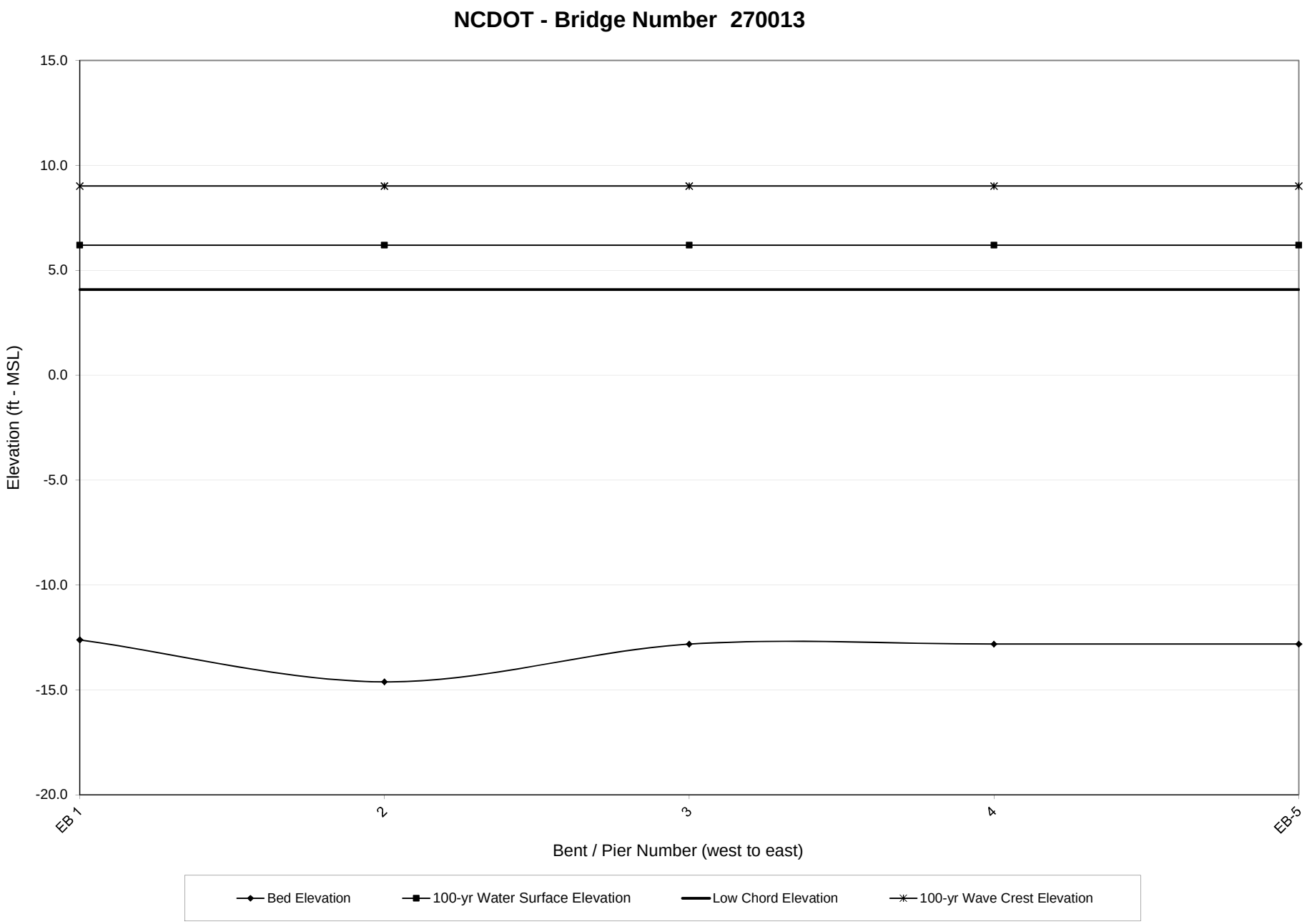
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-4 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 270013
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
EB 1
2
3
4
EB-5
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 270038

CREEK

SR1216

DARE COUNTY

DRAFT

NCDOT BRIDGE NO. 270038

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY	
SPAN NUMBER	1
CRITICALITY INDEX (defined below)	3
VULNERABILITY INDEX (defined below)	0.8

SURGE/WAVE LOAD COMPUTATION INPUT VALUES	
HYDRAULIC VALUES	
100-yr Water Surface Elevation (ft - MSL)	6.9
Bed Elevation (ft - MSL)	-2
Low Chord Elevation (ft - MSL)	3.1
100-yr Max Wave Crest Elevation (ft - MSL)	10.1
100-yr Wave Height (ft)	4.6
100-yr Wave Period (seconds)	5.1
SPAN PROPERITES	
Span Length (ft)	49.0
Span Width (ft)	27.0
Deck Thickness (ft)	1.8
Overhang (ft)	0.0
Number of Beams	0
Beam Dead Weight (lb/lf) - Each	0
Beam Dead Weight (kip/ft) - Total	0.0
Slab Dead Weight (kip/ft)	7.1
Total Dead Weight (kip/ft)	7.1
Resisting Moment (kft/ft)	161.2
Resisting Vertical Force (kip/ft)	7.1
100-YEAR FORCE-MOMENT VALUES	
Maximum Vertical Force (kips/span)	194.0
Maximum Vertical Force (kips/ft)	4.0
Maximum Horizontal Force (kips/span)	25.0
Maximum Horizontal Force (kips/ft)	0.5
Maximum Moment (k-ft)	3,471
Maximum Moment (k-ft/ft)	71

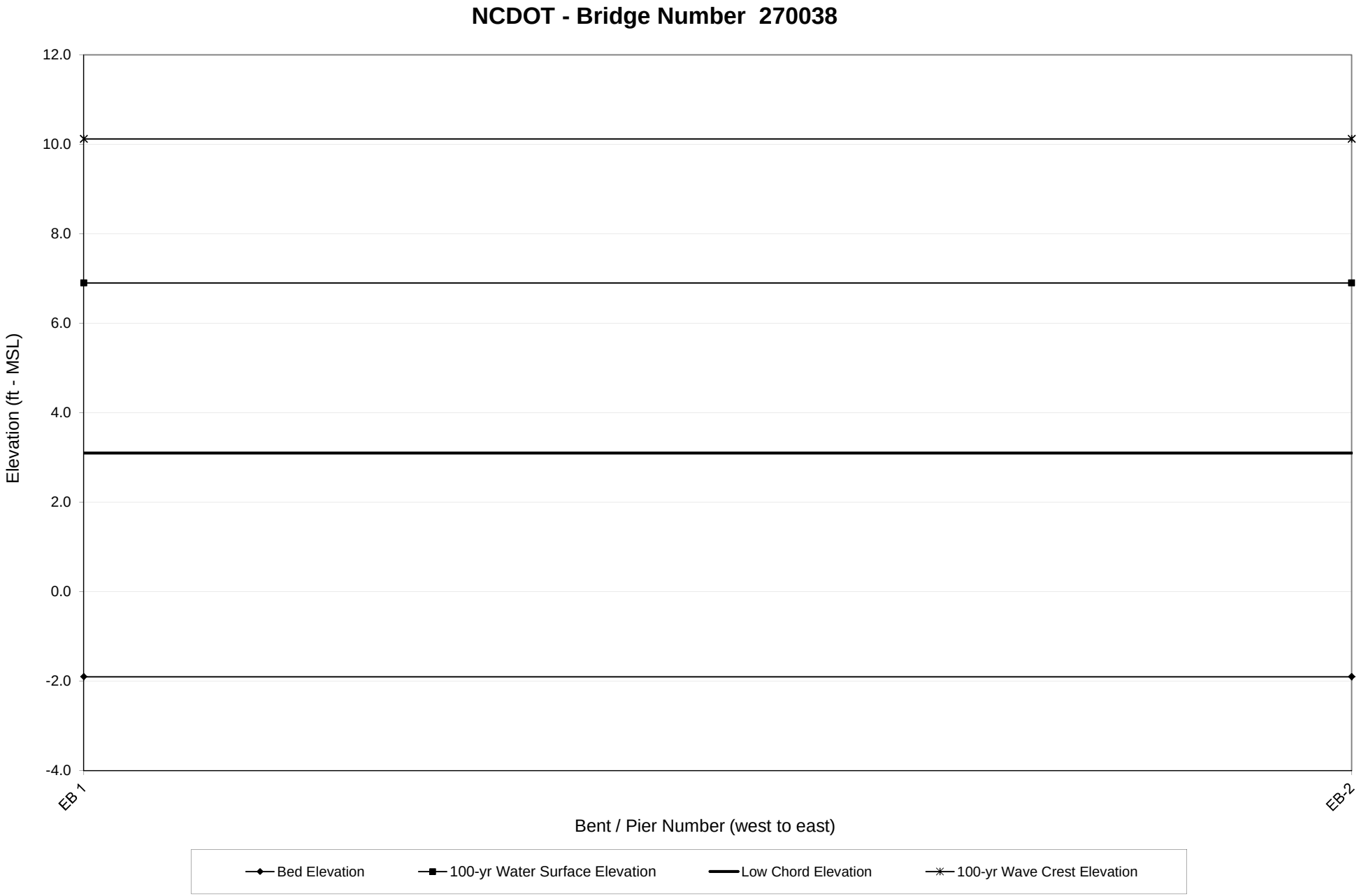
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge span is potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 270038
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
Elevation (ft - MSL)
EB 1
EB-2
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 270043

DOUGH'S CREEK

NC400

DARE COUNTY

DRAFT

NCDOT BRIDGE NO. 270043

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY										
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.9**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**0.9**	**0.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES										
100-yr Water Surface Elevation (ft - MSL)	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Bed Elevation (ft - MSL)	-5	-10	-14	-15	-15	-16	-15	-9	-4	-4
Low Chord Elevation (ft - MSL)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
100-yr Max Wave Crest Elevation (ft - MSL)	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
100-yr Wave Height (ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
100-yr Wave Period (seconds)	3.1	2.7	2.5	2.5	2.5	2.5	2.5	2.8	3.2	3.2

SPAN PROPERITES										
Span Length (ft)	39.2	39.2	39.2	39.2	39.2	39.2	39.2	39.2	39.2	39.2
Span Width (ft)	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1
Deck Thickness (ft)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Overhang (ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Beams	0	0	0	0	0	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	7,114	7,114	7,114	7,114	7,114	7,114	7,114	7,114	7,114	7,114
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Total Dead Weight (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Resisting Moment (kft/ft)	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9
Resisting Vertical Force (kip/ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1

100-YEAR FORCE-MOMENT VALUES										
Maximum Vertical Force (kips/span)	147.7	151.2	154.8	159.2	159.2	157.2	155.4	153.3	142.2	142.3
Maximum Vertical Force (kips/ft)	3.8	3.9	4.0	4.1	4.1	4.0	4.0	3.9	3.6	3.6
Maximum Horizontal Force (kips/span)	37.0	15.5	15.1	15.0	15.0	14.9	15.1	15.7	18.4	22.6
Maximum Horizontal Force (kips/ft)	0.9	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.6
Maximum Moment (k-ft)	2,595.1	2,743.9	2,858.7	2,977.7	2,977.7	2,978.5	2,891.4	2,833.9	2,439.3	2,439.3
Maximum Moment (k-ft/ft)	66.3	70.1	73.0	76.0	76.0	76.0	73.8	72.4	62.3	62.3

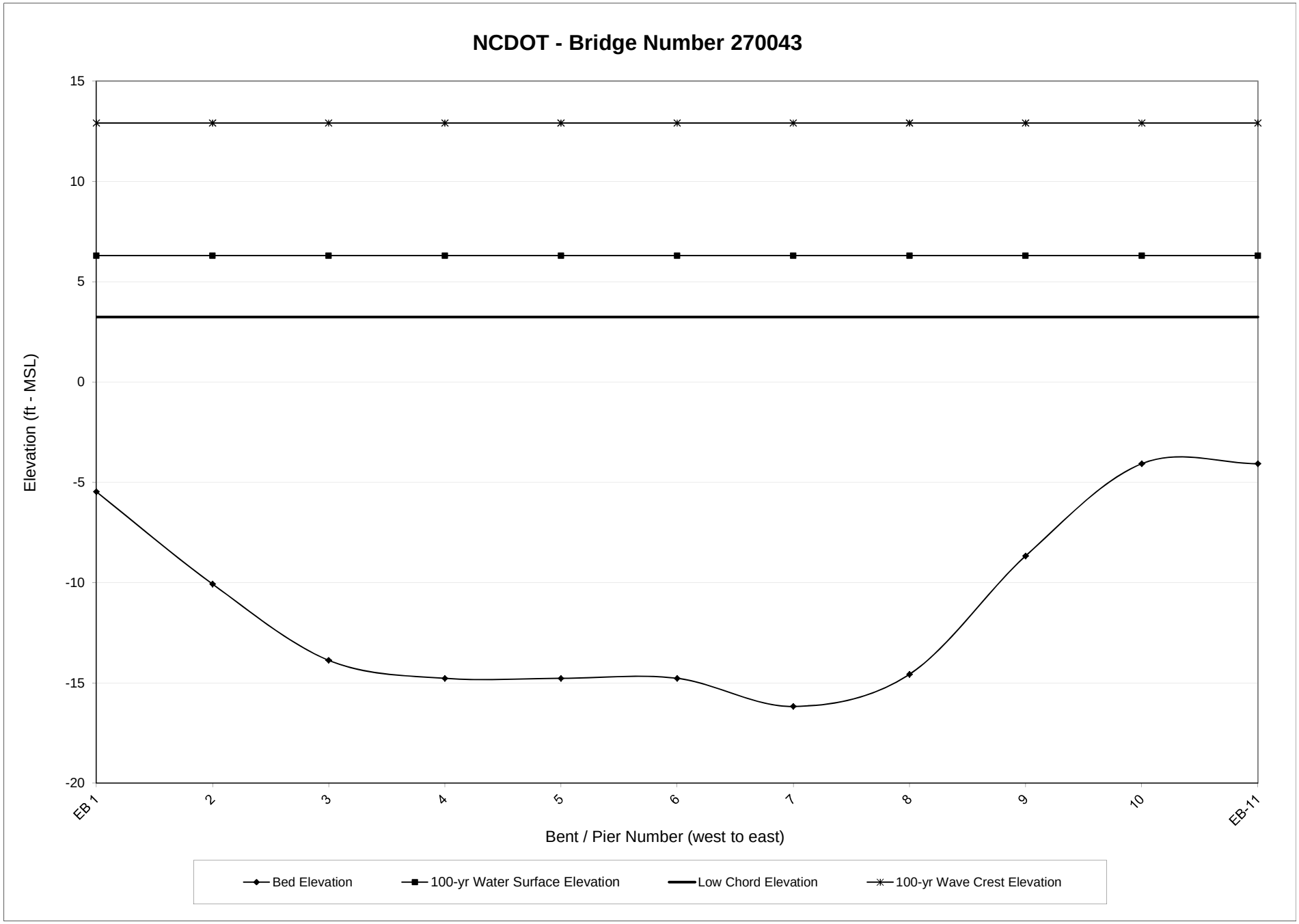
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-10 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 270043
15
10
5
0
-5
-10
-15
-20
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
EB-11
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 270054

CROATAN SOUND

US64 BYP

DARE COUNTY

DRAFT

NCDOT BRIDGE NO. 270054

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.5**	**0.2**	**0.1**	**0.1**	**0.4**	**0.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	4	4	4	3	2	1	1	2	2	1	2	1	-1	-1	-1	-1
Low Chord Elevation (ft - MSL)	1.8	1.8	1.8	1.8	5.1	5.1	8.4	8.4	8.4	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Max Wave Crest Elevation (ft - MSL)	6.0	6.0	5.9	6.2	6.8	7.2	7.4	6.9	6.9	7.1	6.9	7.3	8.3	8.3	8.1	8.1
100-yr Wave Height (ft)	0.9	0.9	0.7	1.1	2.0	2.6	2.8	2.2	2.2	2.4	2.2	2.7	4.1	4.1	3.9	3.9
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
SPAN PROPERITES																
Span Length (ft)	95.3	95.3	95.3	95.3	95.3	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	314.2	314.2	314.2	314.2	314.2	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	232.6	70.1	56.3	53.3	129.1	165.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	2.4	0.7	0.6	0.6	1.4	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	35.8	8.1	3.4	4.5	8.9	19.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.4	0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	9356.5	2622.4	2120.2	2395.3	7407.5	8933.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	98.2	27.5	22.3	25.1	77.8	92.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-1	-1	-3	-6	-7	-9	-10	-10	-11	-11	-11	-10	-10	-9	-9	-9
Low Chord Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Max Wave Crest Elevation (ft - MSL)	8.3	8.3	9.2	10.2	10.9	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	4.1	4.1	5.4	6.9	7.9	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.3	1.8	1.6	1.3	1.0	0.9	0.9	0.9	1.0	1.1	1.7	1.6	1.6
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-10	-10	-10	-10	-10	-10
Low Chord Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.6	97.6	97.6	97.6	97.6	97.6	97.6
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	322.1	322.1	322.1	322.1	322.1	322.1	322.1
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	1.6	1.6	1.6	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.0	1.0	1.1	1.2	1.3	1.3
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-9	-9	-9	-9	-10	-10	-10	-10	-11	-11	-11	-10	-10	-10	-10	-10
Low Chord Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	1.4	1.6	1.6	1.4	1.3	1.2	1.2	1.1	0.9	0.9	0.9	1.0	1.2	1.2	1.2	1.2
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-9	-9	-8	-8	-8	-9	-9	-9	-9	-9	-9	-10	-10	-10	-10	-10
Low Chord Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	1.4	1.7	2.0	2.2	1.9	1.6	1.4	1.4	1.4	1.4	1.4	1.2	1.0	1.0	1.2	1.2
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-10	-10	-10	-9	-9	-10	-10	-11	-10	-10	-10	-10	-9	-9	-9	-8
Low Chord Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	1.3	1.3	1.3	1.6	1.4	1.2	1.0	0.9	1.2	1.2	1.1	1.2	1.4	1.7	1.7	1.9
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-8	-8	-8	-8	-8	-8	-8	-8	-8	-9	-9	-11	-12	-14	-14	-14
Low Chord Elevation (ft - MSL)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	9.0	12.2	15.5	18.7	22.0
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	137.8	137.8	137.8	137.8	137.8
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	1201	1201	1201	1201	1201
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	8.4	8.4	8.4	8.4	8.4
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	15.1	15.1	15.1	15.1	15.1
Resisting Moment (kft/ft)	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	456.6	456.6	456.6	456.6	456.6
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	15.1	15.1	15.1	15.1	15.1

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	2.0	2.0	2.0	2.0	2.2	2.2	2.2	2.2	2.0	1.7	1.4	242.3	0.1	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	114.7	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7006.5	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.8	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-13	-13	-13	-13	-13	-13	-13	-14	-14	-14	-15	-15	-15	-15	-15	-14
Low Chord Elevation (ft - MSL)	25.2	28.4	31.7	34.9	38.2	41.4	44.7	47.9	51.1	54.4	57.6	54.3	54.3	57.6	54.7	51.9
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	137.8	137.8	137.8	137.8	137.8	137.8	137.8	135.3	135.3	135.3	135.3	168.4	168.4	168.4	135.3	135.3
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201
Beam Dead Weight (kip/ft) - Total	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1
Resisting Moment (kft/ft)	456.6	456.6	456.6	456.6	456.6	456.6	456.6	448.3	448.3	448.3	448.3	559.0	559.0	559.0	448.3	448.3
Resisting Vertical Force (kip/ft)	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**	**142**	**143**	**144**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**0.5**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-12	-12	-12	-12	-12	-12	-12	-12	-12	-13	-12	-11	-11	-11	-11	-11
Low Chord Elevation (ft - MSL)	49.0	46.1	43.3	40.4	37.5	34.6	31.8	28.9	26.0	23.2	20.3	17.4	14.6	11.7	8.4	8.4
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	135.3	135.3	137.8	137.8	137.8	137.8	137.8	137.8	137.8	137.8	137.8	137.8	137.8	137.8	97.6	97.6
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201	1201	825	825
Beam Dead Weight (kip/ft) - Total	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	12.5	12.5
Resisting Moment (kft/ft)	448.3	448.3	456.6	456.6	456.6	456.6	456.6	456.6	456.6	456.6	456.6	456.6	456.6	456.6	321.9	321.9
Resisting Vertical Force (kip/ft)	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	224.9	224.9
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	2.3
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	118.1	118.1
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8146.3	8146.3
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.5	83.5

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**	**153**	**154**	**155**	**156**	**157**	**158**	**159**	**160**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-11	-11	-11	-11	-11	-11	-11	-11	-12	-12	-12	-11	-11	-11	-12	-12
Low Chord Elevation (ft - MSL)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	321.9	321.9	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	224.9	227.3	227.4	227.4	227.4	225.0	227.4	218.3	223.4	223.4	223.4	218.3	218.3	218.3	223.4	223.4
Maximum Vertical Force (kips/ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.2	2.3	2.3	2.3	2.2	2.2	2.2	2.3	2.3
Maximum Horizontal Force (kips/span)	118.1	110.1	110.2	110.2	110.2	118.2	110.2	82.2	82.7	82.7	82.7	82.2	82.2	82.2	82.7	82.7
Maximum Horizontal Force (kips/ft)	1.2	1.1	1.1	1.1	1.1	1.2	1.1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Maximum Moment (k-ft)	8146.3	8176.8	8181.6	8181.6	8181.6	8151.1	8181.6	7558.3	8083.6	8083.6	8083.6	7558.3	7558.3	7558.3	8083.6	8083.6
Maximum Moment (k-ft/ft)	83.5	83.8	83.8	83.8	83.8	83.5	83.8	77.4	82.8	82.8	82.8	77.4	77.4	77.4	82.8	82.8

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**161**	**162**	**163**	**164**	**165**	**166**	**167**	**168**	**169**	**170**	**171**	**172**	**173**	**174**	**175**	**176**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-12	-12	-12	-12	-12	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11
Low Chord Elevation (ft - MSL)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	223.4	223.4	223.4	223.4	223.4	218.3	227.4	227.4	227.4	227.4	227.4	225.0	225.0	225.0	225.0	225.0
Maximum Vertical Force (kips/ft)	2.3	2.3	2.3	2.3	2.3	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Maximum Horizontal Force (kips/span)	82.7	82.7	82.7	82.7	82.7	82.2	110.2	110.2	110.2	110.2	110.2	118.2	118.2	118.2	118.2	118.2
Maximum Horizontal Force (kips/ft)	0.8	0.8	0.8	0.8	0.8	0.8	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2
Maximum Moment (k-ft)	8083.6	8083.6	8083.6	8083.6	8083.6	7558.3	8181.6	8181.6	8181.6	8181.6	8181.6	8151.1	8151.1	8151.1	8151.1	8151.1
Maximum Moment (k-ft/ft)	82.8	82.8	82.8	82.8	82.8	77.4	83.8	83.8	83.8	83.8	83.8	83.5	83.5	83.5	83.5	83.5

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**177**	**178**	**179**	**180**	**181**	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**	**190**	**191**	**192**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-11	-11	-11	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
Low Chord Elevation (ft - MSL)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	225.0	225.0	225.0	231.3	231.3	229.4	232.6	232.6	232.6	232.6	223.5	223.5	223.5	223.5	232.6	232.6
Maximum Vertical Force (kips/ft)	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.3	2.4	2.4
Maximum Horizontal Force (kips/span)	118.2	118.2	118.2	106.0	106.0	109.0	107.5	107.5	107.5	107.5	112.2	112.2	112.2	112.2	107.5	107.5
Maximum Horizontal Force (kips/ft)	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Maximum Moment (k-ft)	8151.1	8151.1	8151.1	8506.1	8506.1	8474.6	7943.9	7943.9	7943.9	7943.9	7440.8	7440.8	7440.8	7440.8	7943.9	7943.9
Maximum Moment (k-ft/ft)	83.5	83.5	83.5	87.1	87.1	86.8	81.4	81.4	81.4	81.4	76.2	76.2	76.2	76.2	81.4	81.4

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**193**	**194**	**195**	**196**	**197**	**198**	**199**	**200**	**201**	**202**	**203**	**204**	**205**	**206**	**207**	**208**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.4**	**0.4**	**0.4**	**0.4**	**0.5**	**0.5**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.5**	**0.5**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
Low Chord Elevation (ft - MSL)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1	322.1
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	232.6	232.6	232.6	232.6	229.4	229.4	232.6	223.5	223.5	223.5	223.5	223.5	223.5	232.6	229.4	229.4
Maximum Vertical Force (kips/ft)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4
Maximum Horizontal Force (kips/span)	107.5	107.5	107.5	107.5	109.0	109.0	107.5	112.2	112.2	112.2	112.2	112.2	112.2	107.5	109.0	109.0
Maximum Horizontal Force (kips/ft)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Maximum Moment (k-ft)	7943.9	7943.9	7943.9	7943.9	8474.6	8474.6	7943.9	7440.8	7440.8	7440.8	7440.8	7440.8	7440.8	7943.9	8474.6	8474.6
Maximum Moment (k-ft/ft)	81.4	81.4	81.4	81.4	86.8	86.8	81.4	76.2	76.2	76.2	76.2	76.2	76.2	81.4	86.8	86.8

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**209**	**210**	**211**	**212**	**213**	**214**	**215**	**216**	**217**	**218**	**219**	**220**	**221**	**222**	**223**	**224**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.4**	**0.5**	**0.5**	**0.5**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-10	-10	-10	-10	-11	-11	-11	-12	-12	-12	-12	-13	-13	-13	-13	-13
Low Chord Elevation (ft - MSL)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	97.6	97.6	97.6	97.6	97.6	97.1	97.1	97.1	97.1	97.1	97.1	97.1	145.7	145.7	145.7	145.7
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	322.1	322.1	322.1	322.1	322.1	320.5	320.5	320.5	320.5	320.5	320.5	320.5	482.9	482.9	482.9	482.9
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	231.3	231.3	231.3	231.3	225.0	226.2	217.2	222.3	222.7	222.7	216.3	224.4	339.5	339.5	324.6	324.6
Maximum Vertical Force (kips/ft)	2.4	2.4	2.4	2.4	2.3	2.3	2.2	2.3	2.3	2.3	2.2	2.3	2.3	2.3	2.2	2.2
Maximum Horizontal Force (kips/span)	106.0	106.0	106.0	106.0	118.2	109.6	81.8	82.3	72.9	72.9	77.9	81.8	122.7	122.7	89.5	89.5
Maximum Horizontal Force (kips/ft)	1.1	1.1	1.1	1.1	1.2	1.1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.6	0.6
Maximum Moment (k-ft)	8506.1	8506.1	8506.1	8506.1	8151.1	8138.9	7519.4	8041.7	8207.9	8207.9	7713.8	7688.7	11633.7	11633.7	11737.7	11737.7
Maximum Moment (k-ft/ft)	87.1	87.1	87.1	87.1	83.5	83.8	77.4	82.8	84.5	84.5	79.4	79.2	79.9	79.9	80.6	80.6

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**225**	**226**	**227**	**228**	**229**	**230**	**231**	**232**	**233**	**234**	**235**	**236**	**237**	**238**	**239**	**240**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-13	-12	-12	-12	-11	-10	-10	-10	-10	-10	-10	-11	-11	-11	-10	-10
Low Chord Elevation (ft - MSL)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES																
Span Length (ft)	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	339.5	326.5	336.3	336.4	328.4	347.2	347.2	347.2	345.3	345.3	345.3	337.4	337.4	337.4	347.2	347.2
Maximum Vertical Force (kips/ft)	2.3	2.2	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.4	2.4
Maximum Horizontal Force (kips/span)	122.7	116.9	109.4	123.4	122.7	158.2	158.2	158.2	162.7	162.7	162.7	176.4	176.4	176.4	158.2	158.2
Maximum Horizontal Force (kips/ft)	0.8	0.8	0.8	0.8	0.8	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.1	1.1
Maximum Moment (k-ft)	11633.7	11670.7	12358.7	12118.9	11327.1	12752.1	12752.1	12752.1	12676.5	12676.5	12676.5	12250.6	12250.6	12250.6	12752.1	12752.1
Maximum Moment (k-ft/ft)	79.9	80.1	84.8	83.2	77.8	87.5	87.5	87.5	87.0	87.0	87.0	84.1	84.1	84.1	87.5	87.5

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**241**	**242**	**243**	**244**	**245**	**246**	**247**	**248**	**249**	**250**	**251**	**252**	**253**	**254**	**255**	**256**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.3**	**0.3**	**0.3**	**0.3**	**0.2**	**0.1**	**0.1**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	-11	-10	-9	-8	-7	-6	-5	1	1	0	-3	-1	1	1	1	0
Low Chord Elevation (ft - MSL)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1	11.1	10.7	10.2	10.1	7.4	7.2	7.5	9.2	8.1	7.2	7.2	7.2	7.8
100-yr Wave Height (ft)	8.1	8.1	8.1	8.1	7.5	6.9	6.6	2.8	2.6	3.0	5.4	3.9	2.6	2.6	2.6	3.4
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
SPAN PROPERITES																
Span Length (ft)	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7	145.7
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Slab Dead Weight (kip/ft)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total Dead Weight (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Resisting Moment (kft/ft)	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9	482.9
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	337.4	345.3	344.6	357.3	260.7	196.3	181.0	0.0	0.0	0.0	87.9	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	2.3	2.4	2.4	2.5	1.8	1.3	1.2	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	176.4	162.7	221.7	299.3	282.4	206.7	177.7	0.0	0.0	0.0	56.3	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	1.2	1.1	1.5	2.1	1.9	1.4	1.2	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	12250.6	12676.5	10149.6	10302.8	7029.3	5694.9	5544.9	0.0	0.0	0.0	2970.1	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	84.1	87.0	69.7	70.7	48.3	39.1	38.1	0.0	0.0	0.0	20.4	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 270054

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY												
SPAN NUMBER	**257**	**258**	**259**	**260**	**261**	**262**	**263**	**264**	**265**	**266**	**267**	**268**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.4**	**0.5**	**0.5**	**0.5**	**1.6**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES												
100-yr Water Surface Elevation (ft - MSL)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Bed Elevation (ft - MSL)	1	2	3	2	3	2	2	2	2	2	2	2
Low Chord Elevation (ft - MSL)	8.4	8.4	8.4	8.4	8.4	8.4	8.4	5.1	3.5	3.5	1.8	1.8
100-yr Max Wave Crest Elevation (ft - MSL)	7.2	6.6	6.5	6.8	6.5	6.6	6.8	6.8	6.9	6.9	6.8	6.8
100-yr Wave Height (ft)	2.6	1.7	1.5	2.0	1.5	1.7	2.0	2.0	2.2	2.2	2.0	2.0
100-yr Wave Period (seconds)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

SPAN PROPERITES												
Span Length (ft)	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	96.7	96.7	96.7	96.7
Span Width (ft)	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	825	825	825	825	825	825	825	825	825	825	825	825
Beam Dead Weight (kip/ft) - Total	6	6	6	6	6	6	6	6	6	6	6	6
Slab Dead Weight (kip/ft)	7	7	7	7	7	7	7	7	7	7	7	7
Total Dead Weight (kip/ft)	12	12	12	12	12	12	12	12	12	12	12	12
Resisting Moment (kft/ft)	320.5	320.5	320.5	320.5	320.5	320.5	320.5	320.5	319.1	319.1	319.1	319.1
Resisting Vertical Force (kip/ft)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5

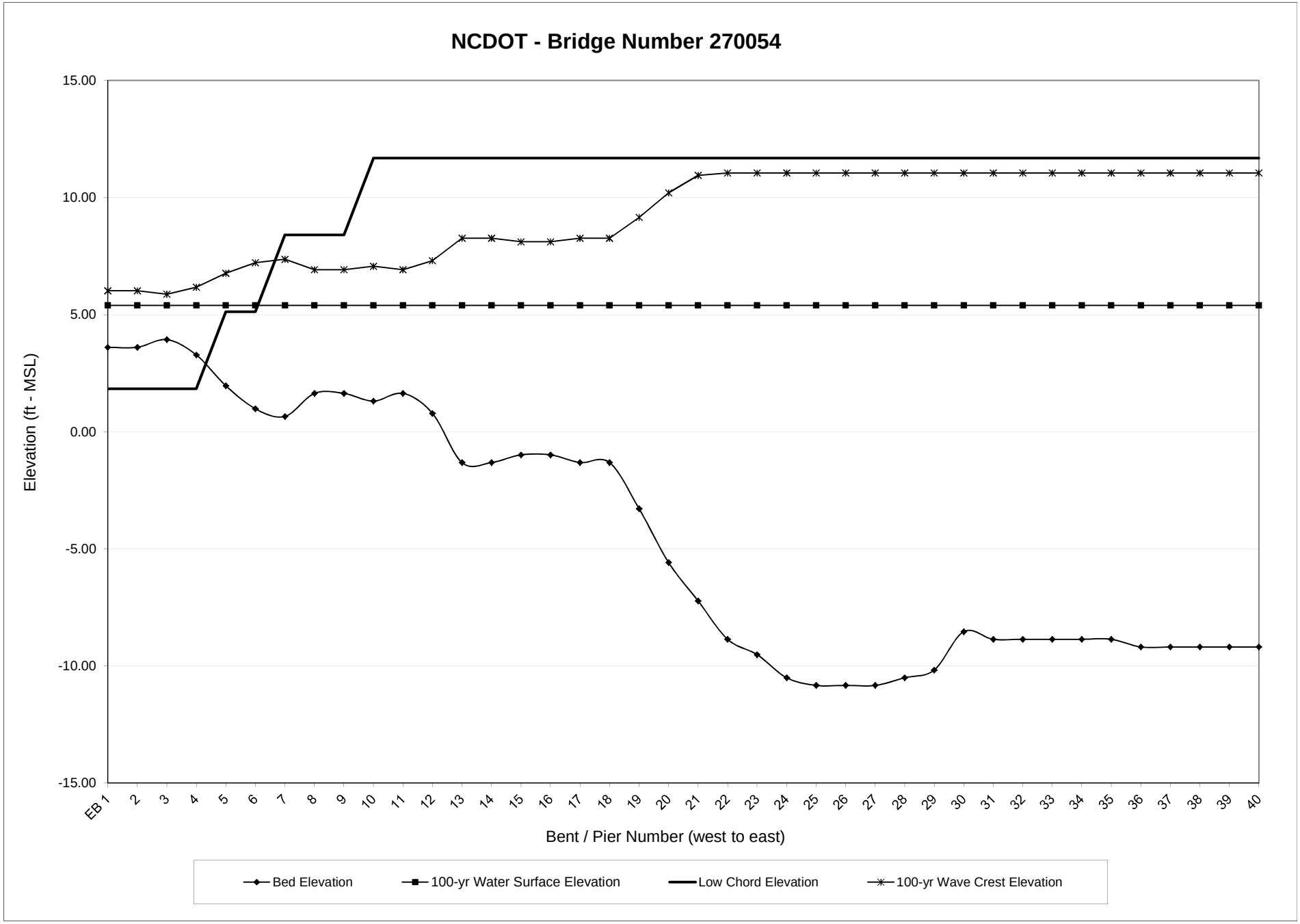
100-YEAR FORCE-MOMENT VALUES												
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	132.0	207.5	207.5	224.5	703.9
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	2.1	2.1	2.3	7.3
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	22.9	22.9	21.7	37.5
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.4
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7568.3	8957.9	8957.9	8794.1	28936.7
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	77.9	92.6	92.6	90.9	299.3

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 270054
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
Elevation (ft - MSL)
EB 1
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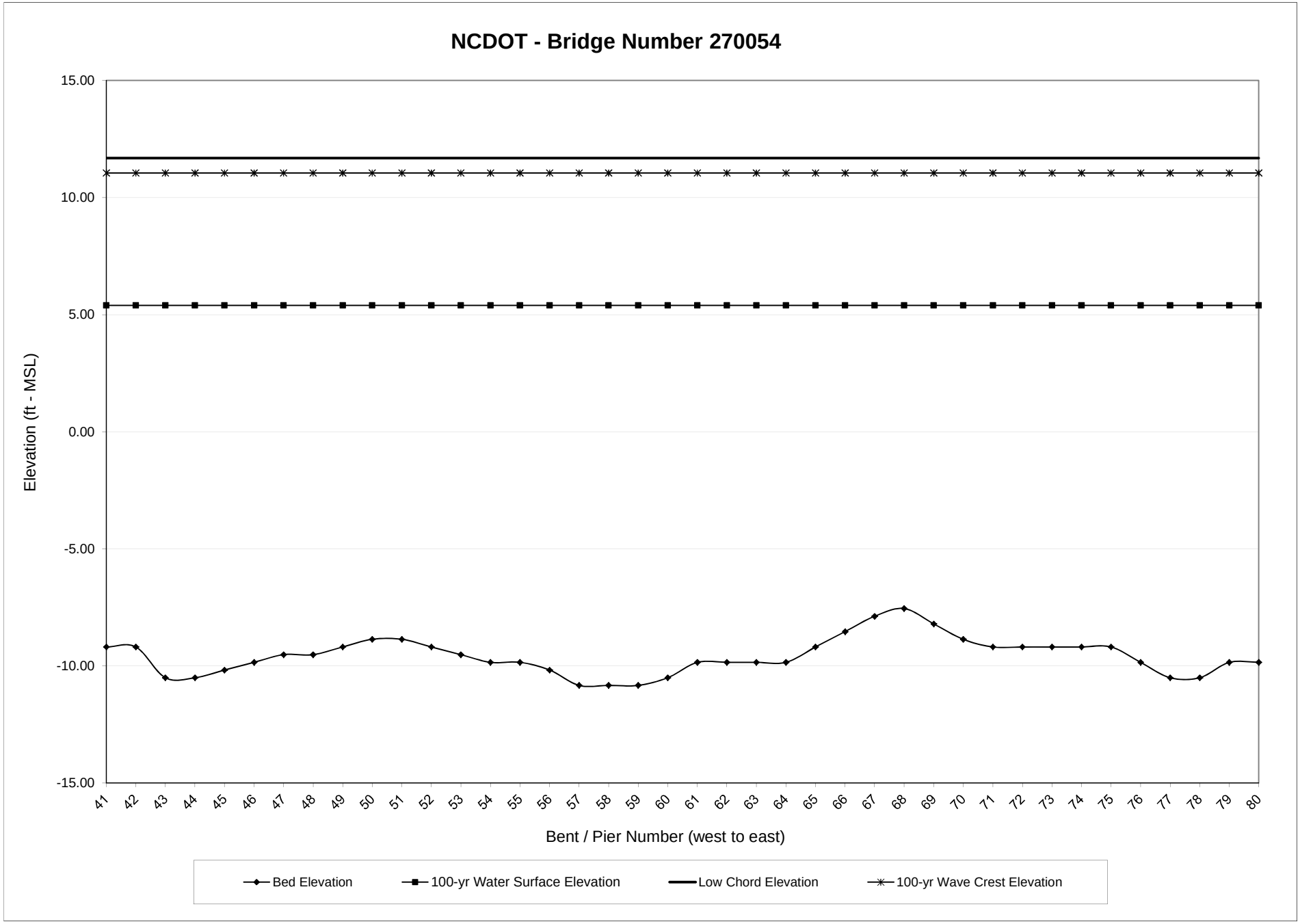
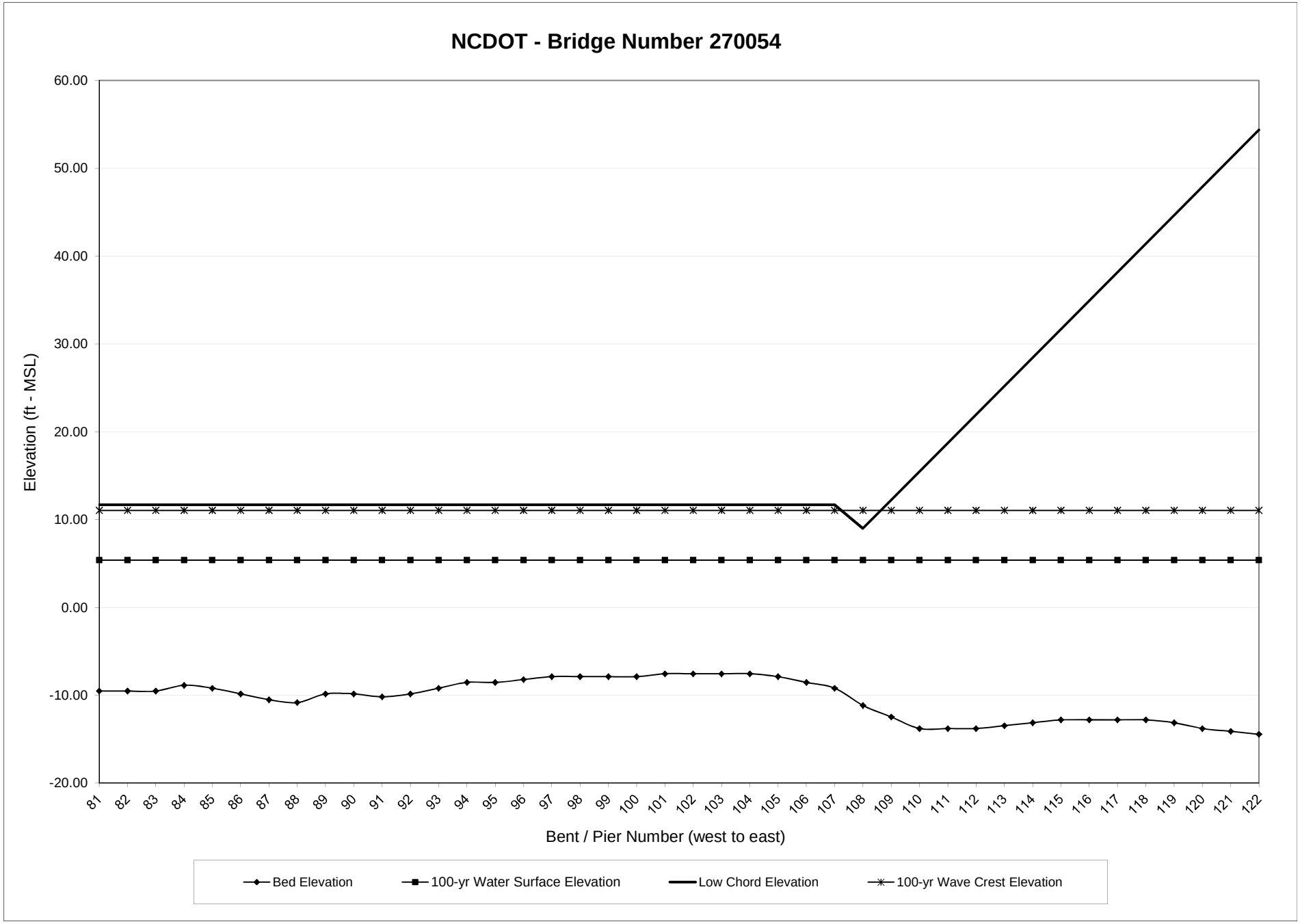
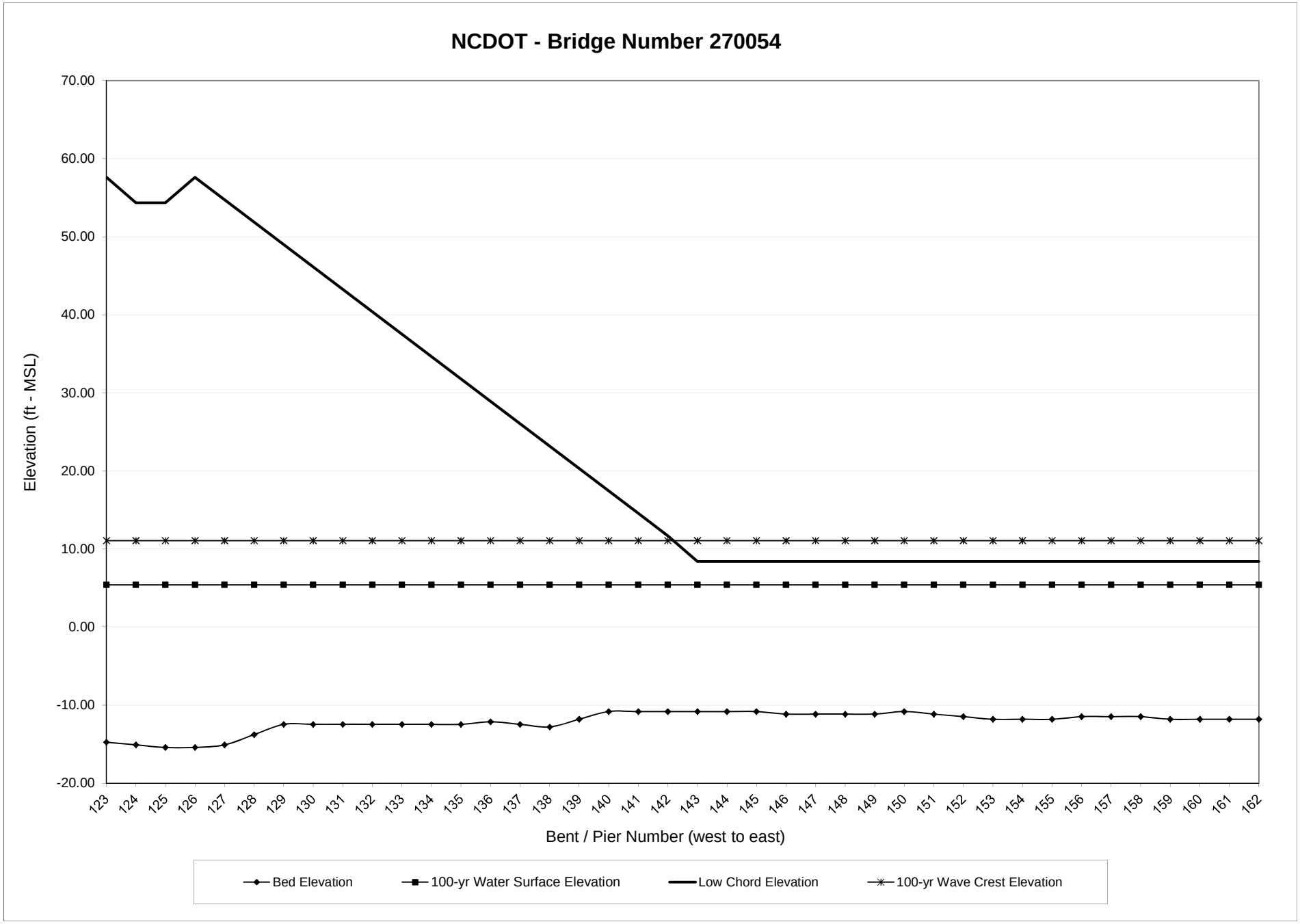
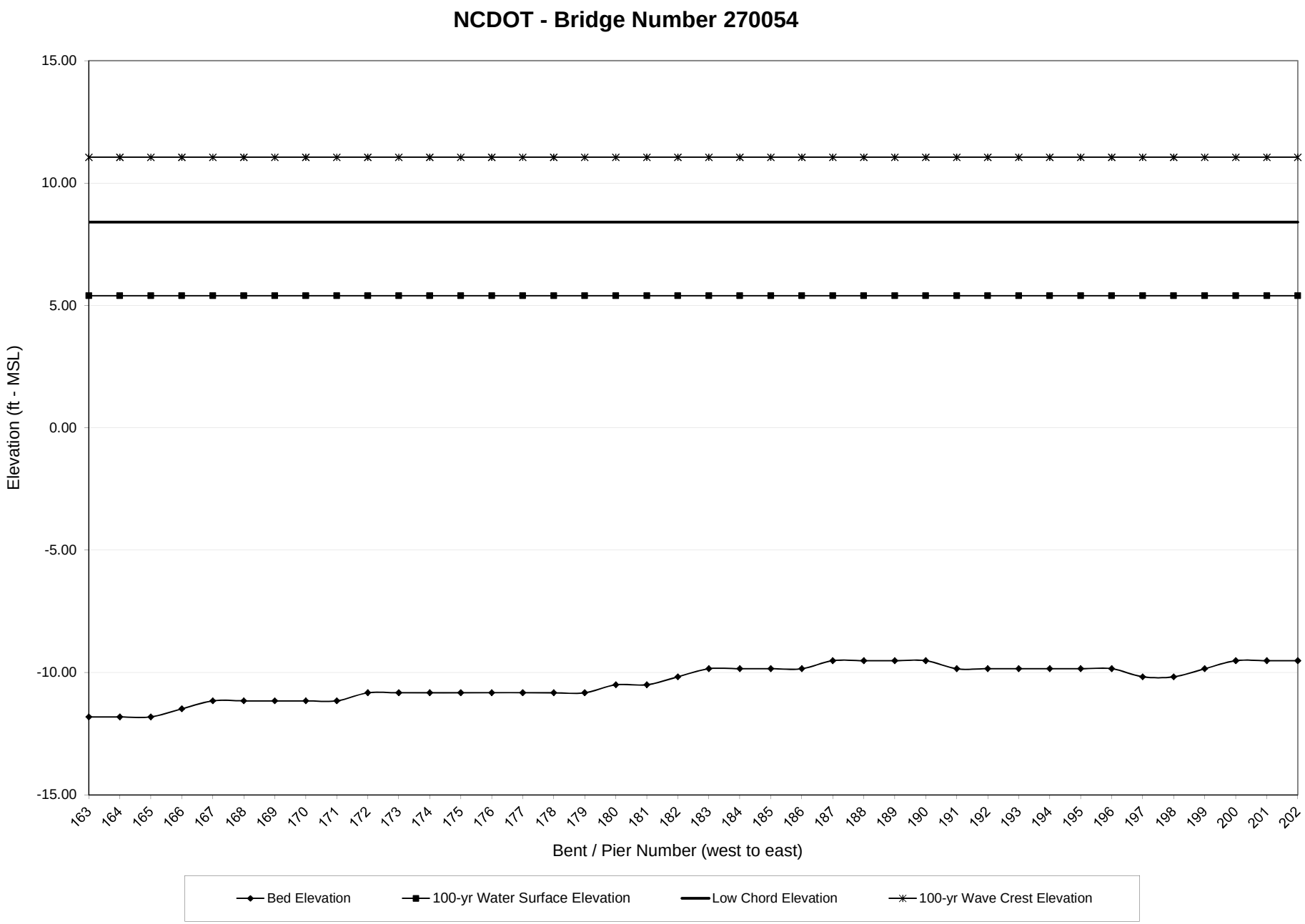
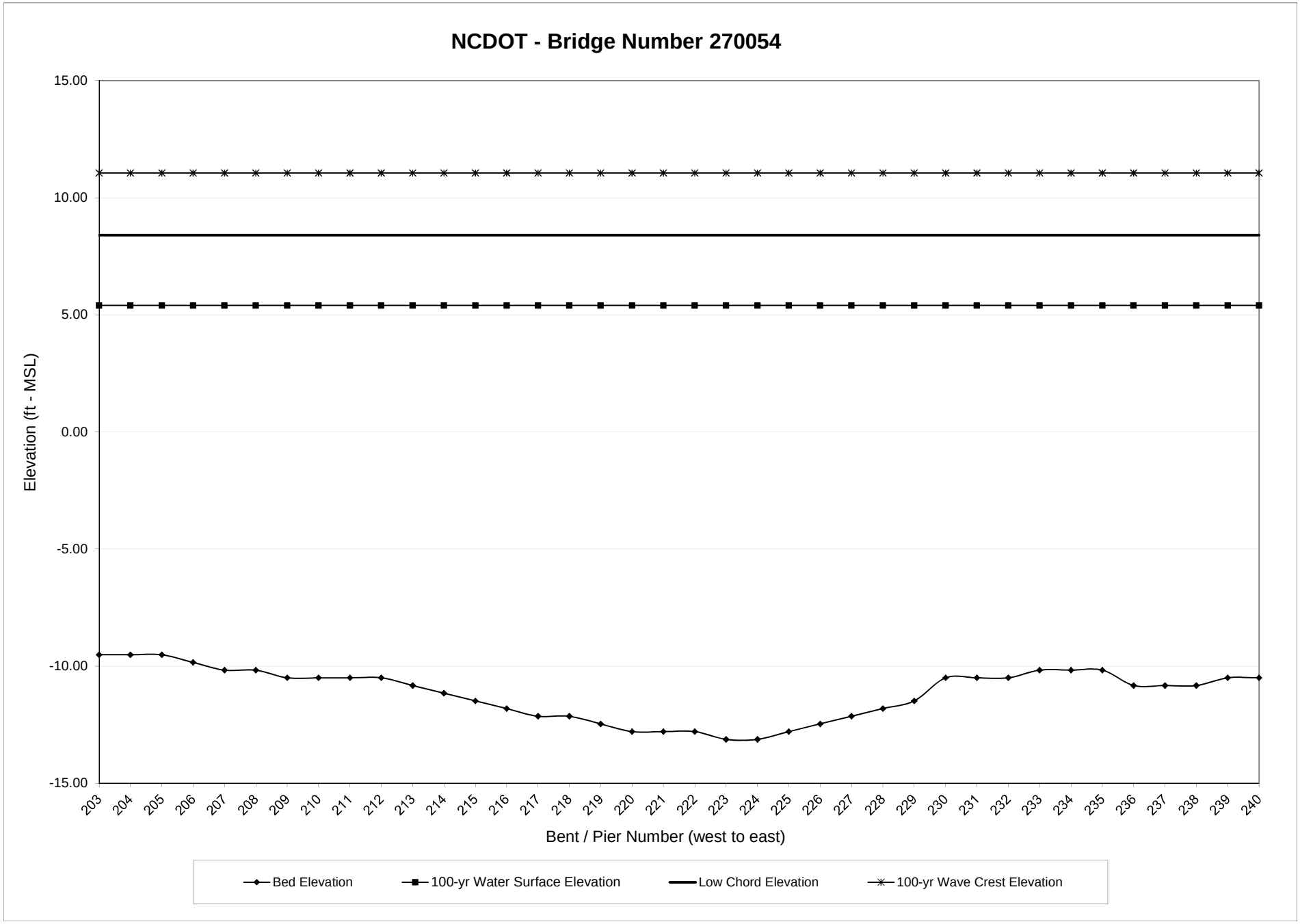
40
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

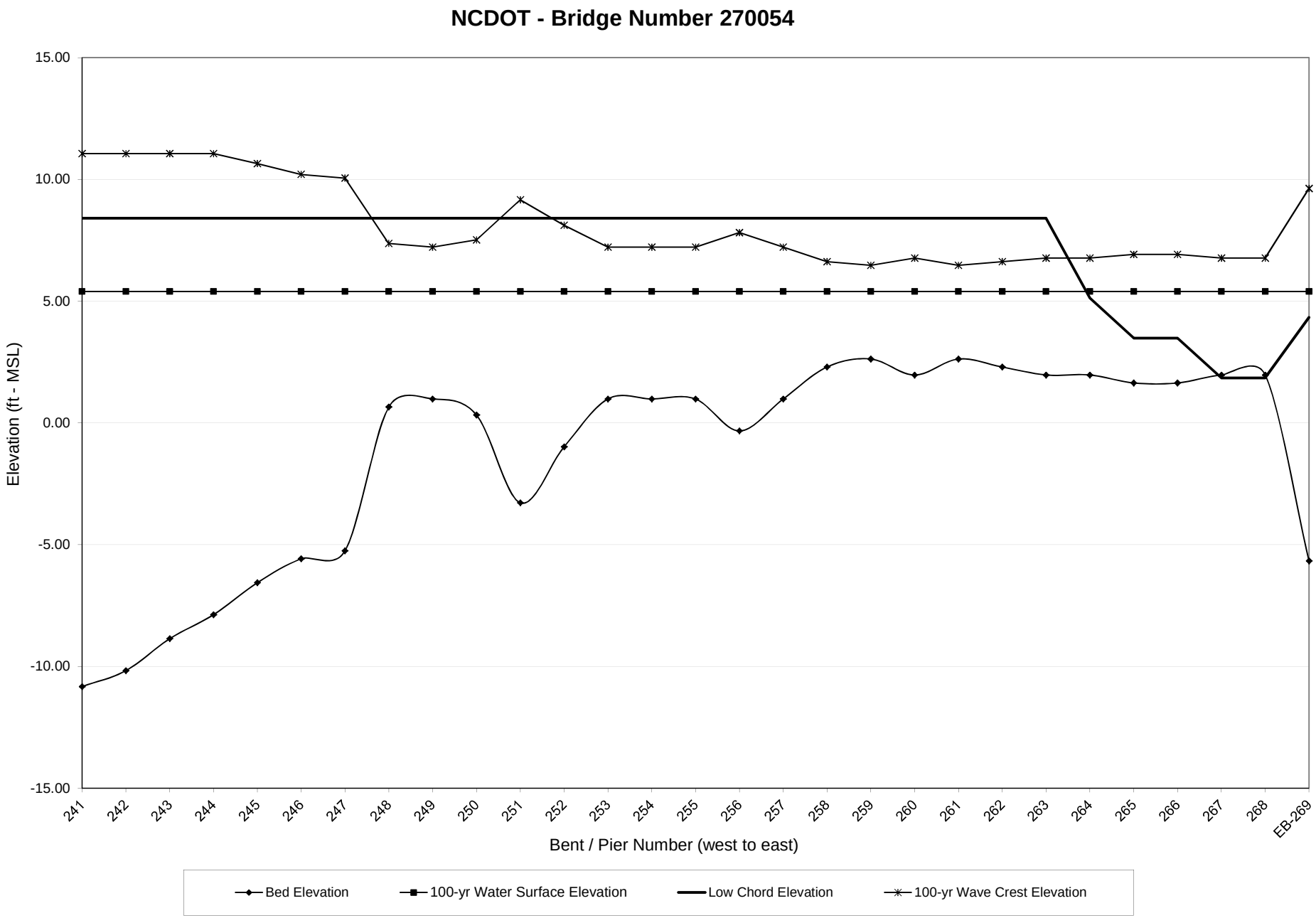

NCDOT - Bridge Number 270054
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
Elevation (ft - MSL)
41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270054
Elevation (ft - MSL)
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270054
Elevation (ft - MSL)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270054
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
Elevation (ft - MSL)
163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270054
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
Elevation (ft - MSL)
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 270054
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
Elevation (ft - MSL)
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
EB-269
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 470008

BURGESS MILL CREEK

US264

HYDE COUNTY

DRAFT

NCDOT BRIDGE NO. 470008

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY														
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.9**	**1.9**	**2.0**	**2.0**	**2.0**	**1.9**	**2.0**	**2.0**	**2.0**	**1.9**	**1.9**	**2.0**	**2.0**	**2.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES														
100-yr Water Surface Elevation (ft - MSL)	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
Bed Elevation (ft - MSL)	0	-2	-3	-5	-5	-4	-6	-8	-5	-2	-2	-1	-1	-1
Low Chord Elevation (ft - MSL)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
100-yr Max Wave Crest Elevation (ft - MSL)	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
100-yr Wave Height (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
100-yr Wave Period (seconds)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

SPAN PROPERITES														
Span Length (ft)	12.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Span Width (ft)	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	52	52	52	52	52	52	52	52	52	52	52	52	52	52
Beam Dead Weight (kip/ft) - Total	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Slab Dead Weight (kip/ft)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Total Dead Weight (kip/ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Resisting Moment (kft/ft)	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9
Resisting Vertical Force (kip/ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6

100-YEAR FORCE-MOMENT VALUES														
Maximum Vertical Force (kips/span)	30.6	31.7	32.0	32.1	32.0	31.9	31.8	31.9	32.0	31.8	31.7	31.8	31.9	31.9
Maximum Vertical Force (kips/ft)	2.5	2.5	2.6	2.6	2.6	2.6	2.5	2.6	2.6	2.5	2.5	2.5	2.6	2.6
Maximum Horizontal Force (kips/span)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Maximum Horizontal Force (kips/ft)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	477.6	499.0	501.8	504.3	501.6	498.9	499.7	502.2	501.8	496.9	497.3	500.2	502.2	502.2
Maximum Moment (k-ft/ft)	39.8	39.9	40.1	40.3	40.1	39.9	40.0	40.2	40.1	39.8	39.8	40.0	40.2	40.2

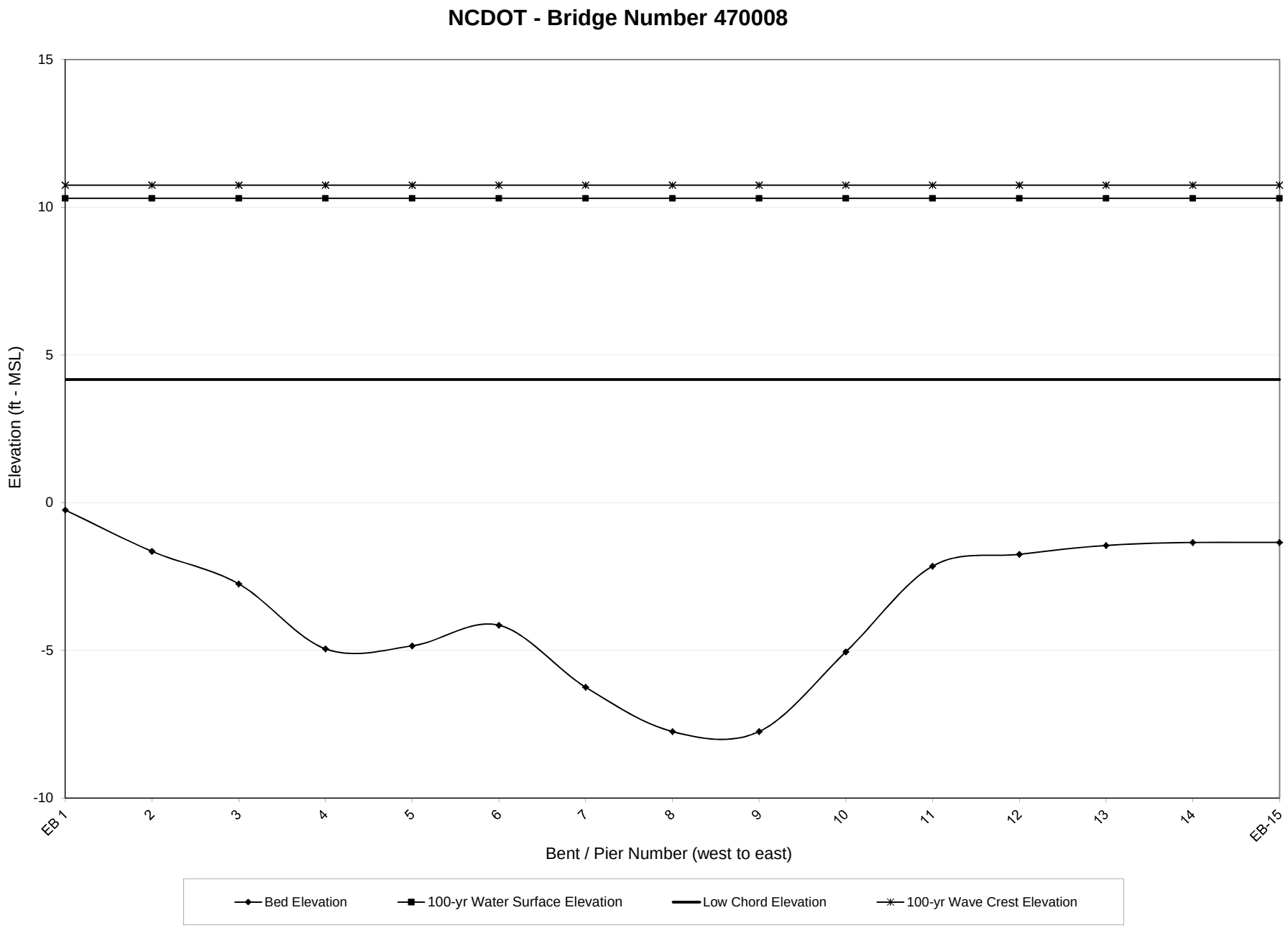
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-14 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 470008
15
10
5
0
-5
-10
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
EB-15
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 470029

SCRANTON CREEK

US264

HYDE COUNTY

DRAFT

NCDOT BRIDGE NO. 470029
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY							
SPAN NUMBER	1	2	3	4	5	6	7
CRITICALITY INDEX (defined below)	4	4	4	4	4	4	4
VULNERABILITY INDEX (defined below)	1.1	0.8	0.8	0.8	0.8	0.8	0.8

SURGE/WAVE LOAD COMPUTATION INPUT VALUES							
HYDRAULIC VALUES							
100-yr Water Surface Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3
Bed Elevation (ft - MSL)	-5	-6	-9	-10	-8	-8	-8
Low Chord Elevation (ft - MSL)	3.3	3.3	3.3	3.3	3.3	3.3	3.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.9	9.9	9.9	9.9	9.9	9.9	9.9
100-yr Wave Height (ft)	0.9	0.9	0.9	0.9	0.9	0.9	0.9
100-yr Wave Period (seconds)	1.2	1.2	1.2	1.2	1.2	1.2	1.2
SPAN PROPERITES							
Span Length (ft)	35.5	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	36.0	36.0	36.0	36.0	36.0	36.0	36.0
Deck Thickness (ft)	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Overhang (ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Beams	0	0	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Total Dead Weight (kip/ft)	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Resisting Moment (kft/ft)	151.2	215.0	215.0	215.0	215.0	215.0	215.0
Resisting Vertical Force (kip/ft)	9.5	9.5	9.5	9.5	9.5	9.5	9.5
100-YEAR FORCE-MOMENT VALUES							
Maximum Vertical Force (kips/span)	156.1	215.2	213.3	211.2	213.2	221.8	221.8
Maximum Vertical Force (kips/ft)	4.4	4.4	4.4	4.3	4.4	4.5	4.5
Maximum Horizontal Force (kips/span)	2.6	3.4	3.3	3.3	3.3	3.5	3.5
Maximum Horizontal Force (kips/ft)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Maximum Moment (k-ft)	3,284	4,642	4,647	4,520	4,636	4,893	4,893
Maximum Moment (k-ft/ft)	93	95	95	92	95	100	100

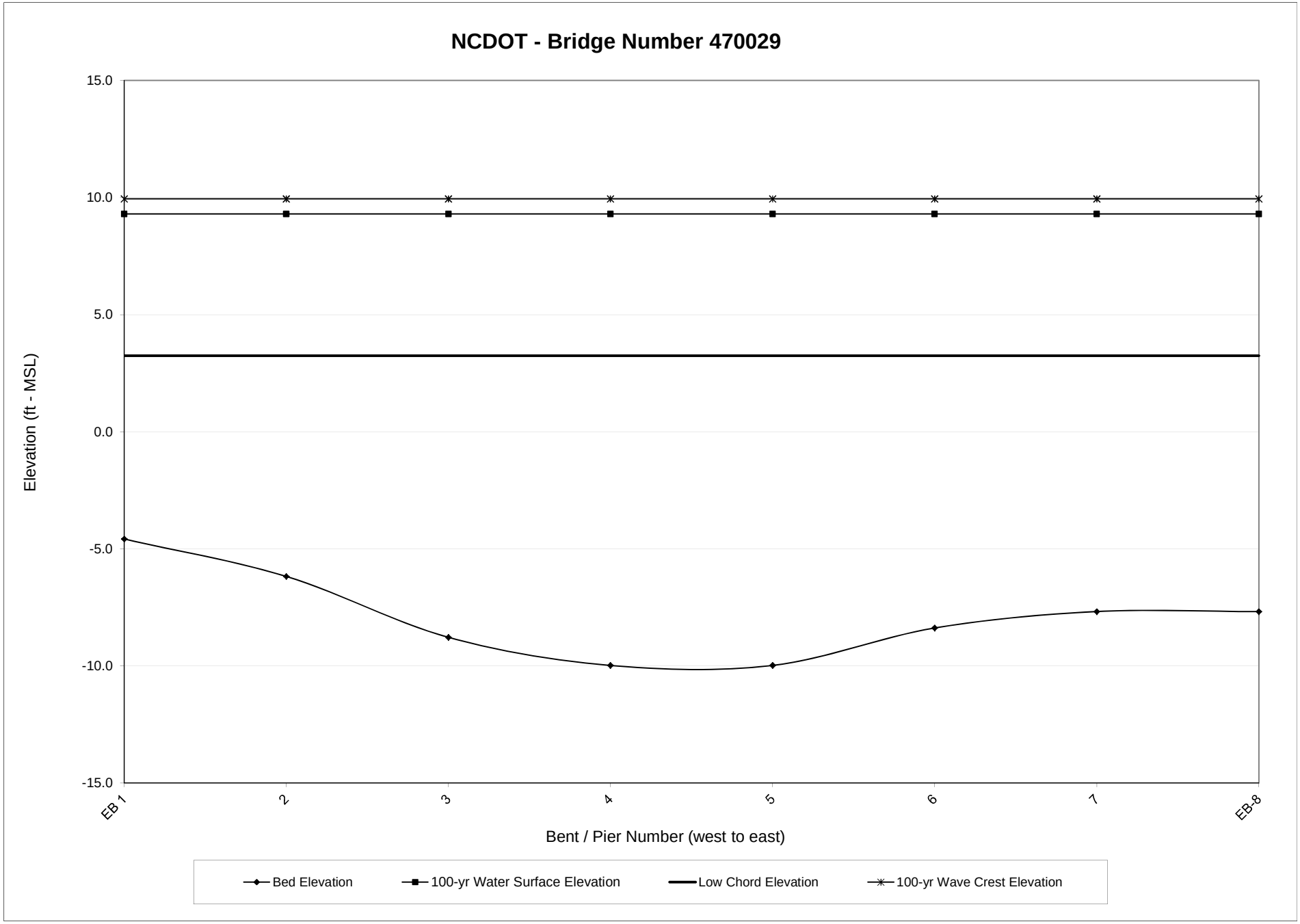
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-7 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 470029
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
EB-8
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 470032

ROSE BAY CREEK

US264

HYDE COUNTY

DRAFT

NCDOT BRIDGE NO. 470032

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY			
SPAN NUMBER	1	2	3
CRITICALITY INDEX (defined below)	4	4	4
VULNERABILITY INDEX (defined below)	1.3	0.5	0.4

SURGE/WAVE LOAD COMPUTATION INPUT VALUES			
HYDRAULIC VALUES			
100-yr Water Surface Elevation (ft - MSL)	9.3	9.3	9.3
Bed Elevation (ft - MSL)	-4	-5	-5
Low Chord Elevation (ft - MSL)	3.3	3.3	3.3
100-yr Max Wave Crest Elevation (ft - MSL)	10.5	10.5	10.5
100-yr Wave Height (ft)	1.8	1.8	1.8
100-yr Wave Period (seconds)	1.9	1.8	1.8
SPAN PROPERITES			
Span Length (ft)	42.1	42.8	42.8
Span Width (ft)	45.0	45.0	45.0
Deck Thickness (ft)	1.8	1.8	1.8
Overhang (ft)	0.0	0.0	0.0
Number of Beams	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	11.8	11.8	11.8
Total Dead Weight (kip/ft)	11.8	11.8	11.8
Resisting Moment (kft/ft)	228.1	231.8	231.8
Resisting Vertical Force (kip/ft)	11.8	11.8	11.8
100-YEAR FORCE-MOMENT VALUES			
Maximum Vertical Force (kips/span)	246.6	265.7	265.7
Maximum Vertical Force (kips/ft)	5.9	2.0	2.2
Maximum Horizontal Force (kips/span)	9.9	9.2	9.4
Maximum Horizontal Force (kips/ft)	0.2	0.7	0.6
Maximum Moment (k-ft)	7,068.7	7,763.4	7,763.4
Maximum Moment (k-ft/ft)	167.8	60.4	53.0

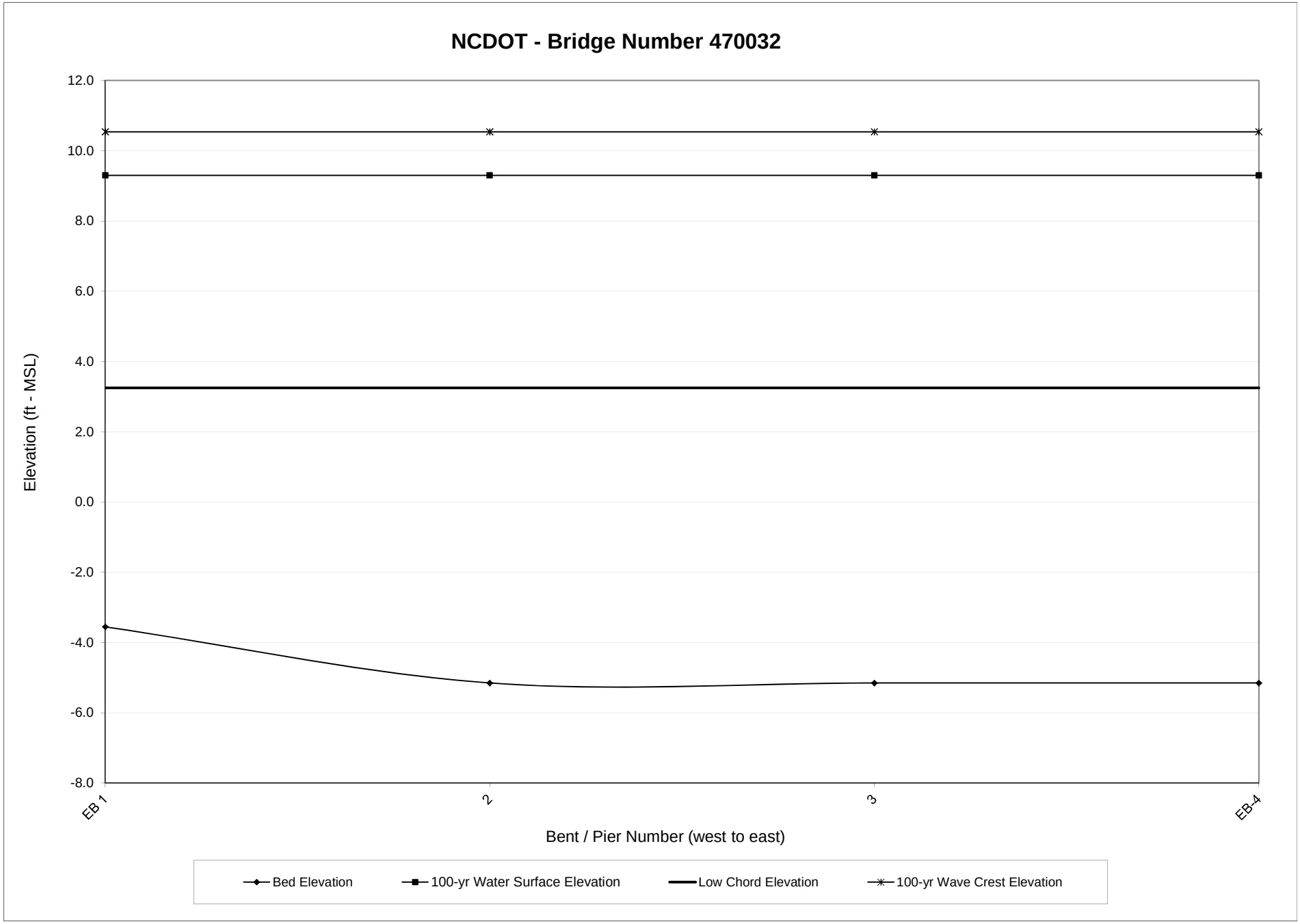
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-3 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 470032
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
Elevation (ft - MSL)
EB 1
2
3
EB-4
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 470052

CANAL

US264

HYDE COUNTY

DRAFT

NCDOT BRIDGE NO. 470052

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY	
SPAN NUMBER	1
CRITICALITY INDEX (defined below)	4
VULNERABILITY INDEX (defined below)	1.0

SURGE/WAVE LOAD COMPUTATION INPUT VALUES	
HYDRAULIC VALUES	
100-yr Water Surface Elevation (ft - MSL)	6.3
Bed Elevation (ft - MSL)	-3
Low Chord Elevation (ft - MSL)	2.3
100-yr Max Wave Crest Elevation (ft - MSL)	7.8
100-yr Wave Height (ft)	2.1
100-yr Wave Period (seconds)	4.4
SPAN PROPERITES	
Span Length (ft)	44.0
Span Width (ft)	39.0
Deck Thickness (ft)	1.8
Overhang (ft)	0.0
Number of Beams	0
Beam Dead Weight (lb/lf) - Each	0
Beam Dead Weight (kip/ft) - Total	0.0
Slab Dead Weight (kip/ft)	10.2
Total Dead Weight (kip/ft)	10.2
Resisting Moment (kft/ft)	207.3
Resisting Vertical Force (kip/ft)	10.2
100-YEAR FORCE-MOMENT VALUES	
Maximum Vertical Force (kips/span)	207.0
Maximum Vertical Force (kips/ft)	4.7
Maximum Horizontal Force (kips/span)	14.0
Maximum Horizontal Force (kips/ft)	0.3
Maximum Moment (k-ft)	5,126
Maximum Moment (k-ft/ft)	116

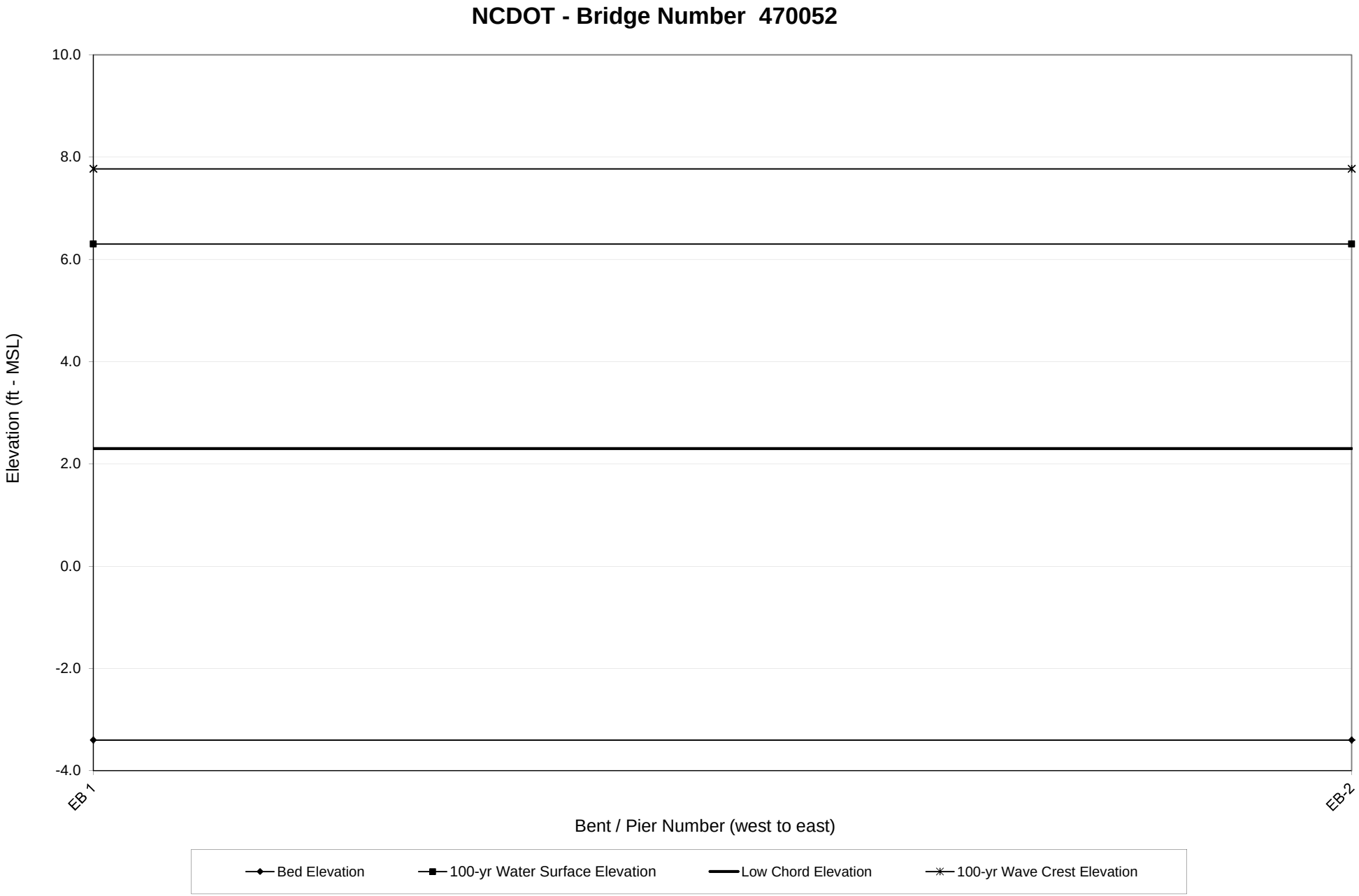
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge span is potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 470052
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
Elevation (ft - MSL)
EB 1
EB-2
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 640012

INTRACOASTAL WATERWAY

US74&76

NEW HANOVER COUNTY

DRAFT

NCDOT BRIDGE NO. 640012

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY															
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.2**	**1.8**	**1.1**	**0.6**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.3**	**0.5**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES															
100-yr Water Surface Elevation (ft - MSL)	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
Bed Elevation (ft - MSL)	1	-5	-8	-11	-13	-20	-24	-20	-15	-3	-1	0	2	5	5
Low Chord Elevation (ft - MSL)	9.3	10.3	11.3	12.3	13.3	14.3	15.3	17.3	50.0	15.3	15.3	14.8	14.8	13.8	13.8
100-yr Max Wave Crest Elevation (ft - MSL)	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	14.2	14.2
100-yr Wave Height (ft)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	4.0	4.0
100-yr Wave Period (seconds)	5.6	4.6	4.3	4.1	4.0	3.7	3.5	3.7	3.9	5.0	5.3	5.3	5.8	6.1	6.1

SPAN PROPERITES															
Span Length (ft)	38.6	39.1	39.1	39.1	39.1	39.1	39.1	39.1	169.0	39.1	39.1	39.1	39.1	39.1	39.1
Span Width (ft)	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6
Deck Thickness (ft)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Overhang (ft)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Number of Beams	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Beam Dead Weight (lb/lf) - Each	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900
Beam Dead Weight (kip/ft) - Total	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Slab Dead Weight (kip/ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Total Dead Weight (kip/ft)	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
Resisting Moment (kft/ft)	291.4	295.0	295.0	295.0	295.0	295.0	295.0	295.0	1,319.4	295.0	295.0	295.0	295.0	295.0	295.0
Resisting Vertical Force (kip/ft)	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8

100-YEAR FORCE-MOMENT VALUES															
Maximum Vertical Force (kips/span)	338.6	379.5	240.4	97.7	38.5	0.5	0.1	0.0	0.0	0.3	0.5	9.8	42.3	45.4	90.4
Maximum Vertical Force (kips/ft)	8.8	9.7	6.2	2.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.1	1.2	2.3
Maximum Horizontal Force (kips/span)	34.0	30.1	21.6	11.6	5.6	0.0	0.0	0.0	0.0	0.0	0.6	4.9	12.3	10.6	28.8
Maximum Horizontal Force (kips/ft)	0.9	0.8	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.7
Maximum Moment (k-ft)	14,295.7	12,072.0	7,554.6	3,944.7	1,236.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,707.1	2,212.1	3,285.1
Maximum Moment (k-ft/ft)	370.1	308.9	193.3	100.9	31.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.7	56.6	84.1

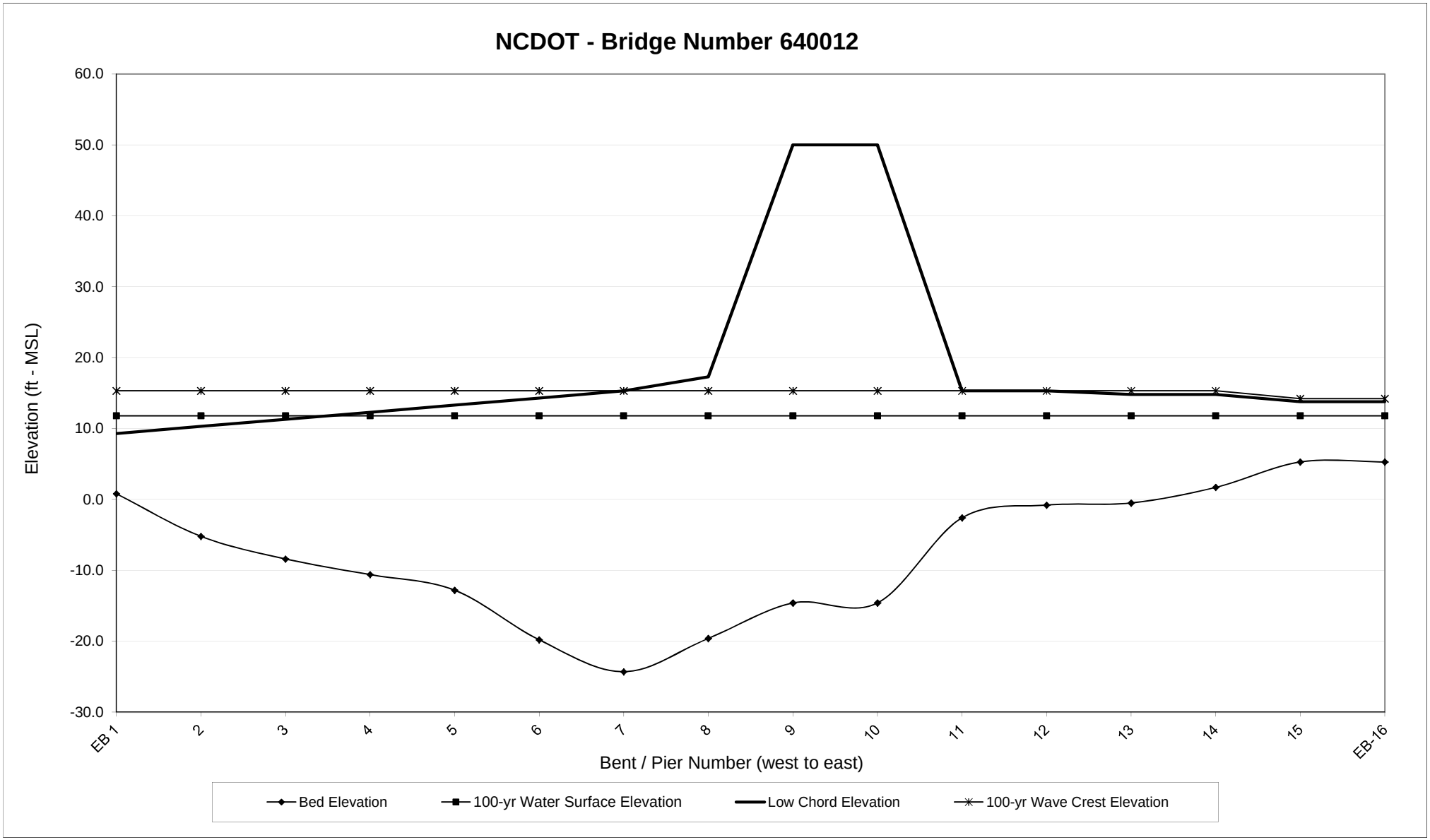
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-7 and 10-15 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 640012
Elevation (ft - MSL)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
EB-16
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 640021

BANKS CHANNEL

US76

NEW HANOVER COUNTY

DRAFT

NCDOT BRIDGE NO. 640021

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY														
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**4.0**	**4.1**	**3.6**	**3.2**	**2.9**	**2.4**	**2.1**	**2.3**	**2.8**	**3.1**	**3.5**	**3.9**	**3.5**	**3.5**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES														
100-yr Water Surface Elevation (ft - MSL)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Bed Elevation (ft - MSL)	-2	-8	-9	-15	-12	-12	-10	-11	-14	-14	-12	-5	0	0
Low Chord Elevation (ft - MSL)	4.5	6.0	7.2	8.2	8.8	9.3	9.5	9.3	9.0	8.4	7.4	6.3	4.9	4.9
100-yr Max Wave Crest Elevation (ft - MSL)	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3
100-yr Wave Height (ft)	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
100-yr Wave Period (seconds)	3.6	3.2	3.1	2.9	3.0	3.0	3.1	3.0	2.9	2.9	3.0	3.4	3.9	3.9

SPAN PROPERITES														
Span Length (ft)	60.1	60.6	60.6	60.6	60.6	60.6	60.6	60.6	60.6	60.4	60.4	60.4	60.4	60.4
Span Width (ft)	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Number of Beams	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Slab Dead Weight (kip/ft)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Total Dead Weight (kip/ft)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Resisting Moment (kft/ft)	178.7	180.4	180.4	180.4	180.4	180.4	180.4	180.4	180.4	179.6	179.6	179.6	179.6	179.6
Resisting Vertical Force (kip/ft)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2

100-YEAR FORCE-MOMENT VALUES														
Maximum Vertical Force (kips/span)	652	647	581	503	437	448	383	427	469	470	565	628	627	627
Maximum Vertical Force (kips/ft)	11	11	10	8	7	7	6	7	8	8	9	10	10	10
Maximum Horizontal Force (kips/span)	49	44	36	35	33	31	24	28	33	33	34	44	55	55
Maximum Horizontal Force (kips/ft)	1	1	1	1	1	1	0	0	1	1	1	1	1	1
Maximum Moment (k-ft)	24,409	25,852	22,339	19,932	18,369	14,891	13,177	14,488	17,277	19,520	21,861	24,301	21,527	21,527
Maximum Moment (k-ft/ft)	406	426	368	329	303	246	217	239	285	323	362	402	357	357

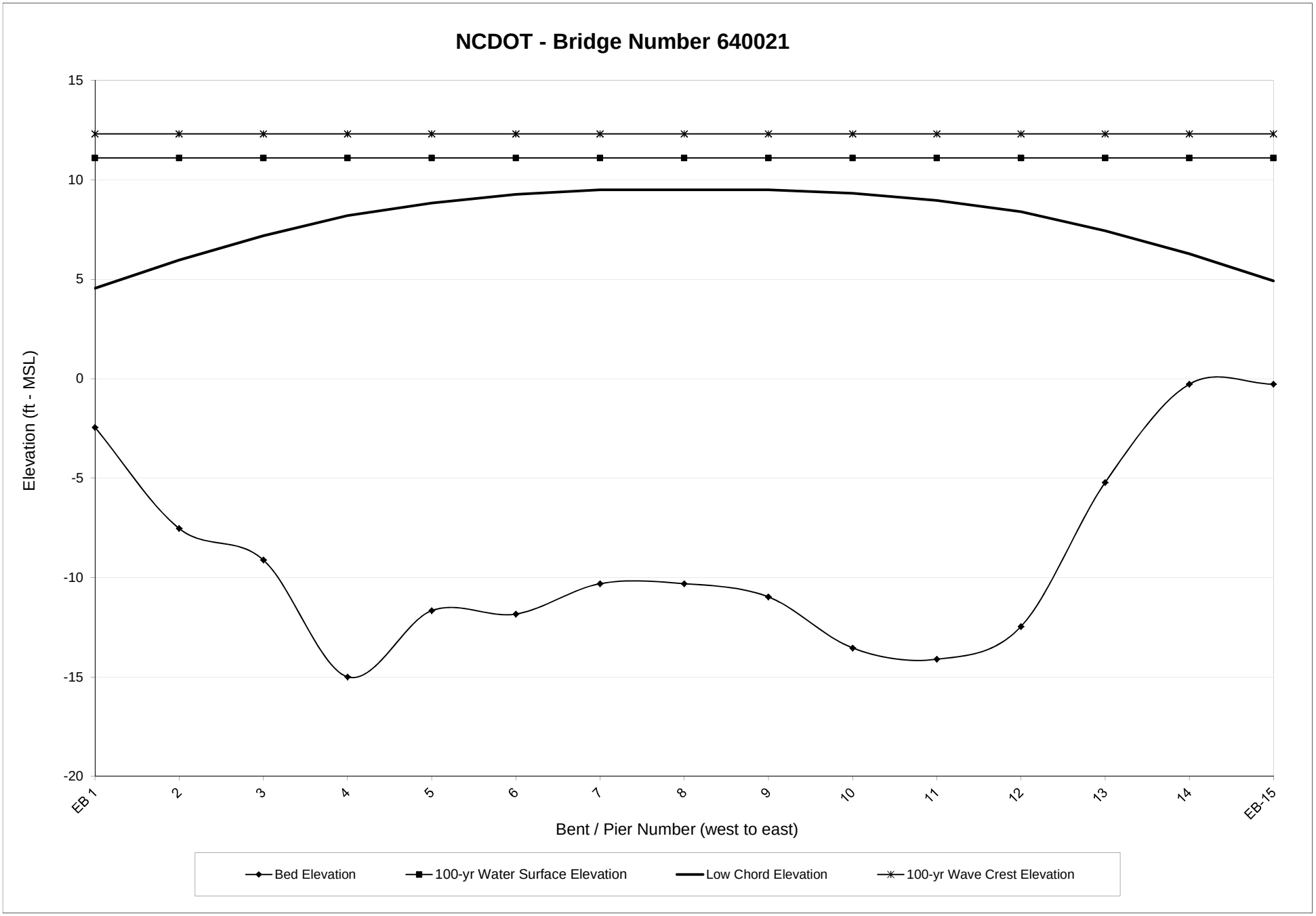
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-14 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 640021
15
10
5
0
-5
-10
-15
-20
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
EB-15
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 640022

KENAN CREEK

US74

NEW HANOVER COUNTY

DRAFT

NCDOT BRIDGE NO. 640022

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY				
SPAN NUMBER	1	2	3	4
CRITICALITY INDEX (defined below)	4	4	4	4
VULNERABILITY INDEX (defined below)	0.1	0.1	0.1	0.1

SURGE/WAVE LOAD COMPUTATION INPUT VALUES				
HYDRAULIC VALUES				
100-yr Water Surface Elevation (ft - MSL)	11.0	11.0	11.0	11.0
Bed Elevation (ft - MSL)	-11	-12	-11	-11
Low Chord Elevation (ft - MSL)	5.3	5.3	5.3	5.3
100-yr Max Wave Crest Elevation (ft - MSL)	14.8	14.8	14.8	14.8
100-yr Wave Height (ft)	5.4	5.4	5.4	5.4
100-yr Wave Period (seconds)	4.0	3.9	4.0	4.0
SPAN PROPERITES				
Span Length (ft)	20.5	19.8	19.8	19.8
Span Width (ft)	48.3	48.3	48.3	48.3
Deck Thickness (ft)	1.3	1.3	1.3	1.3
Overhang (ft)	4.2	4.2	4.2	4.2
Number of Beams	0	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	9.1	9.1	9.1	9.1
Total Dead Weight (kip/ft)	9.1	9.1	9.1	9.1
Resisting Moment (kft/ft)	81.6	78.2	78.2	78.2
Resisting Vertical Force (kip/ft)	9.1	9.1	9.1	9.1
100-YEAR FORCE-MOMENT VALUES				
Maximum Vertical Force (kips/span)	23.2	22.2	11.0	11.0
Maximum Vertical Force (kips/ft)	1.1	1.1	0.6	0.6
Maximum Horizontal Force (kips/span)	6.0	6.0	6.0	6.0
Maximum Horizontal Force (kips/ft)	0.3	0.3	0.3	0.3
Maximum Moment (k-ft)	48	48	48	47
Maximum Moment (k-ft/ft)	2	2	2	2

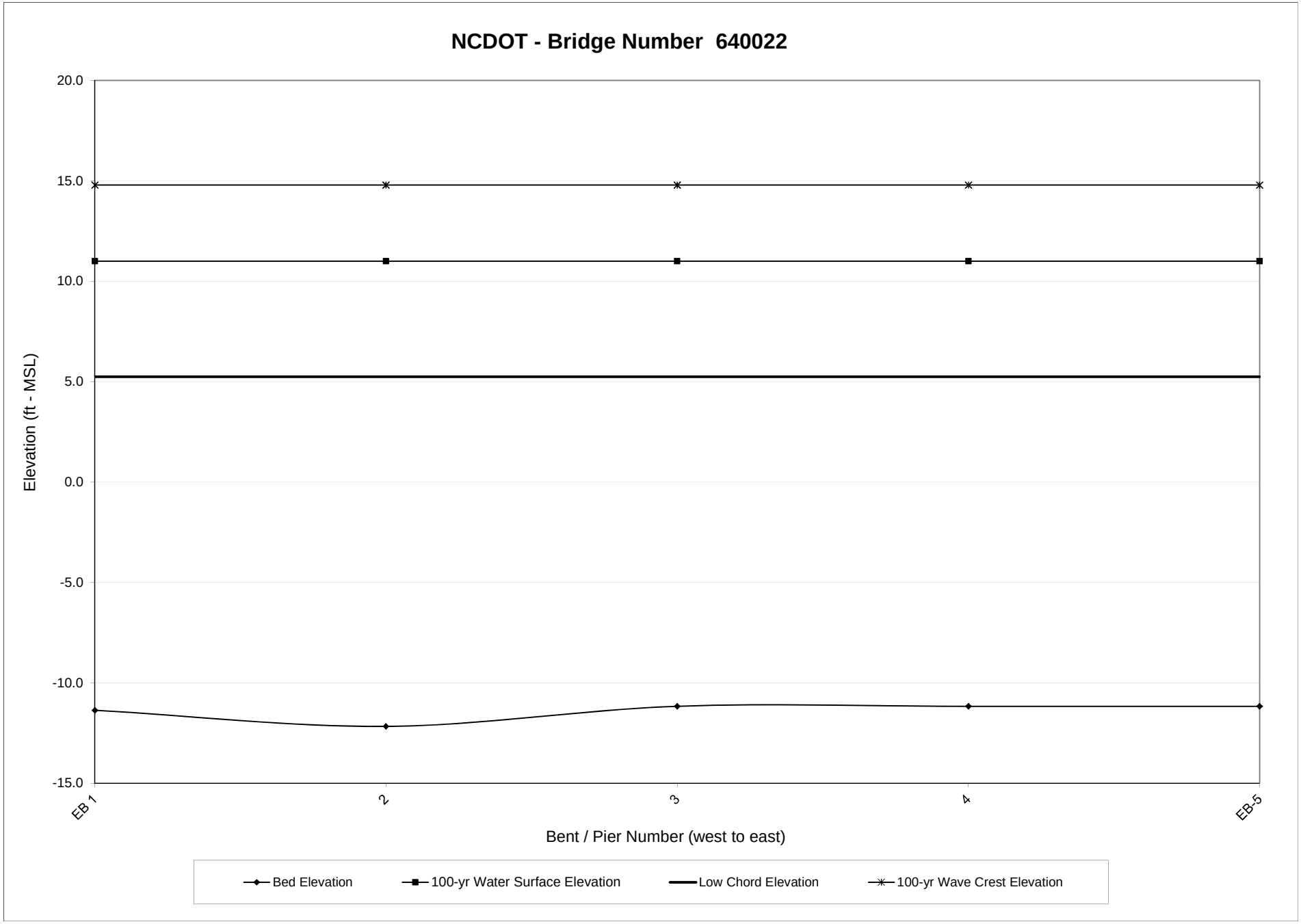
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-4 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 640022
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
EB 1
2
3
4
EB-5
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 640024

BANKS CHANNEL

US74

NEW HANOVER COUNTY

DRAFT

NCDOT BRIDGE NO. 640024

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.8**	**0.8**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.8**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4
Bed Elevation (ft - MSL)	-6	-7	-8	-8	-11	-7	-13	-16	-16	-16	-17	-17	-18	-14	-6	-6
Low Chord Elevation (ft - MSL)	7.1	7.1	7.6	8.6	9.1	9.1	9.1	9.1	9.6	10.1	9.6	9.1	8.1	7.1	7.1	7.1
100-yr Max Wave Crest Elevation (ft - MSL)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
100-yr Wave Height (ft)	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
100-yr Wave Period (seconds)	3.7	3.6	3.5	3.5	3.3	3.6	3.2	3.1	3.1	3.1	3.1	3.1	3.1	3.2	3.7	3.7

SPAN PROPERITES																
Span Length (ft)	36.3	37.1	37.2	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0
Span Width (ft)	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900
Beam Dead Weight (kip/ft) - Total	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Slab Dead Weight (kip/ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Total Dead Weight (kip/ft)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Resisting Moment (kft/ft)	137.1	140.0	140.4	139.7	139.7	139.7	139.7	139.7	139.7	139.7	139.7	139.7	139.7	139.7	139.7	139.7
Resisting Vertical Force (kip/ft)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	222.1	229.7	230.6	218.7	217.8	202.3	217.0	205.9	200.5	152.8	198.6	197.1	230.7	253.1	226.4	226.6
Maximum Vertical Force (kips/ft)	6.1	6.2	6.2	5.9	5.9	5.5	5.9	5.6	5.4	4.1	5.4	5.3	6.2	6.8	6.1	6.1
Maximum Horizontal Force (kips/span)	33.2	26.1	23.8	21.6	19.8	20.5	19.1	18.2	21.7	17.3	22.4	17.3	19.7	24.7	26.2	33.1
Maximum Horizontal Force (kips/ft)	0.9	0.7	0.6	0.6	0.5	0.6	0.5	0.5	0.6	0.5	0.6	0.5	0.5	0.7	0.7	0.9
Maximum Moment (k-ft)	2,401.2	2,473.0	2,591.8	2,684.1	2,779.8	2,749.2	2,768.5	2,791.7	2,750.6	2,715.5	2,691.4	2,670.0	2,658.5	2,602.5	2,511.1	2,339.3
Maximum Moment (k-ft/ft)	66.1	66.7	69.7	72.5	75.1	74.3	74.8	75.5	74.3	73.4	72.7	72.2	71.9	70.3	67.9	63.2

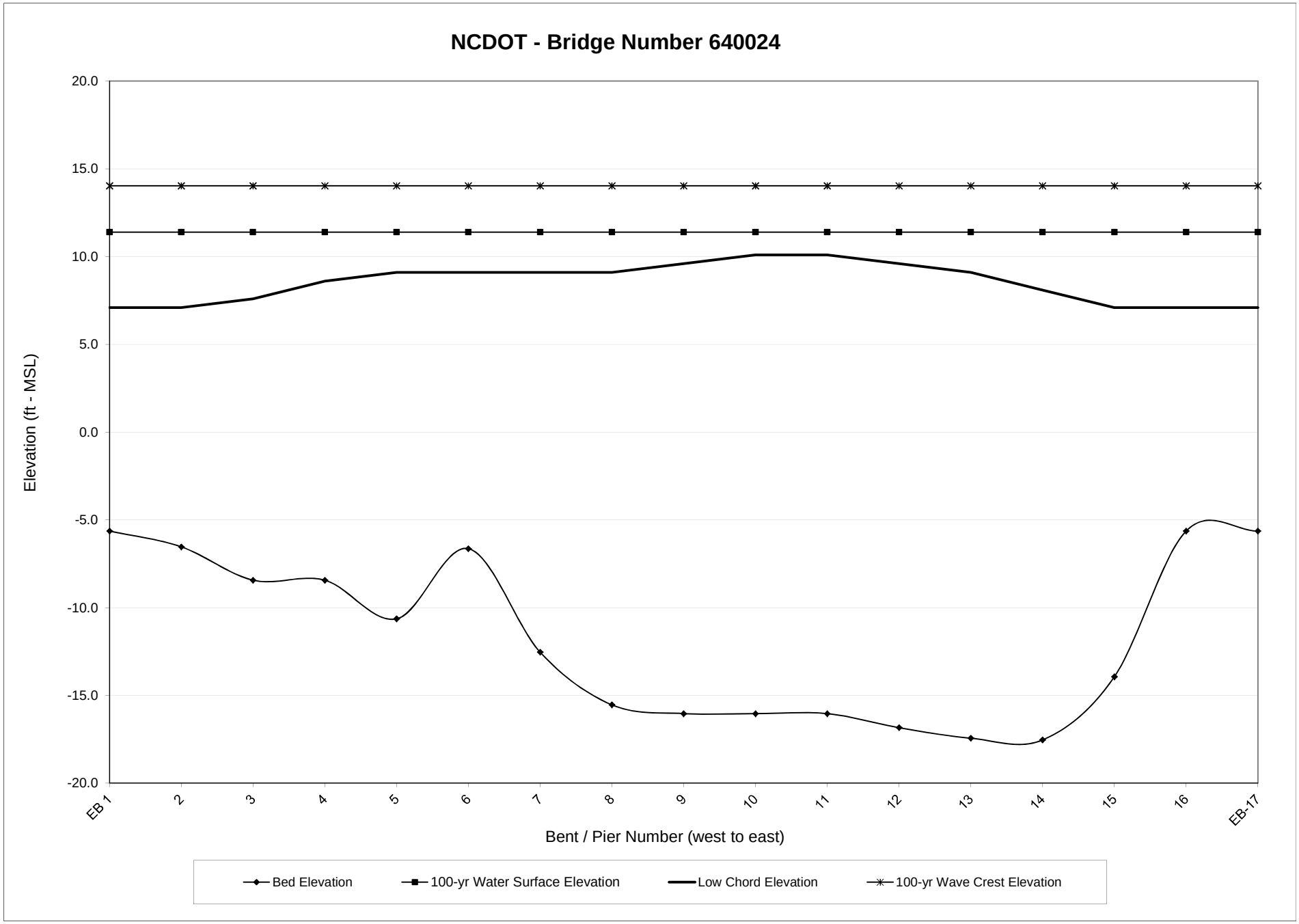
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-16 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 640024
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
EB-17
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 660025

WHITE OAK RIVER

NC24

ONSLOW COUNTY

DRAFT

NCDOT BRIDGE NO. 660025

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY												
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.1**	**3.5**	**3.6**	**3.6**	**3.6**	**3.6**	**3.3**	**3.6**	**3.1**	**2.8**	**2.8**	**2.8**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES												
HYDRAULIC VALUES												
100-yr Water Surface Elevation (ft - MSL)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Bed Elevation (ft - MSL)	-8	-25	-30	-33	-37	-38	-35	-29	-19	-15	-14	-14
Low Chord Elevation (ft - MSL)	5.3	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
100-yr Max Wave Crest Elevation (ft - MSL)	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
100-yr Wave Height (ft)	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
100-yr Wave Period (seconds)	5.9	4.5	4.3	4.2	4.1	4.0	4.1	4.3	4.8	5.1	5.2	5.2
SPAN PROPERITES												
Span Length (ft)	27.8	62.8	63.3	63.3	63.3	63.3	51.8	63.3	62.8	62.8	62.8	62.8
Span Width (ft)	77.4	77.4	77.4	77.4	77.4	77.4	77.4	77.4	77.4	77.4	77.4	77.4
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Number of Beams	11	11	11	11	11	11	11	11	11	11	11	11
Beam Dead Weight (lb/lf) - Each	384	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	4.2	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Slab Dead Weight (kip/ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Total Dead Weight (kip/ft)	12.2	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4
Resisting Moment (kft/ft)	445.0	524.0	524.0	524.0	524.0	524.0	524.0	524.0	524.0	524.0	524.0	524.0
Resisting Vertical Force (kip/ft)	12.2	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4
100-YEAR FORCE-MOMENT VALUES												
Maximum Vertical Force (kips/span)	332.2	1177.3	1154.7	1117.8	1082.7	1061.2	894.4	1164.5	1119.3	1106.7	1085.0	1085.0
Maximum Vertical Force (kips/ft)	12.0	18.8	18.3	17.7	17.1	16.8	17.3	18.4	17.8	17.6	17.3	17.3
Maximum Horizontal Force (kips/span)	64.5	101.5	99.8	100.2	102.0	103.8	82.7	99.6	107.6	119.6	124.2	166.3
Maximum Horizontal Force (kips/ft)	2.3	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.9	2.0	2.7
Maximum Moment (k-ft)	14914.9	65012.7	67364.6	67677.9	67819.0	67782.8	51541.8	67593.3	58054.6	53188.1	52056.9	52056.9
Maximum Moment (k-ft/ft)	537.5	1036.1	1065.1	1070.0	1072.2	1071.7	996.0	1068.7	925.2	847.6	829.6	829.6

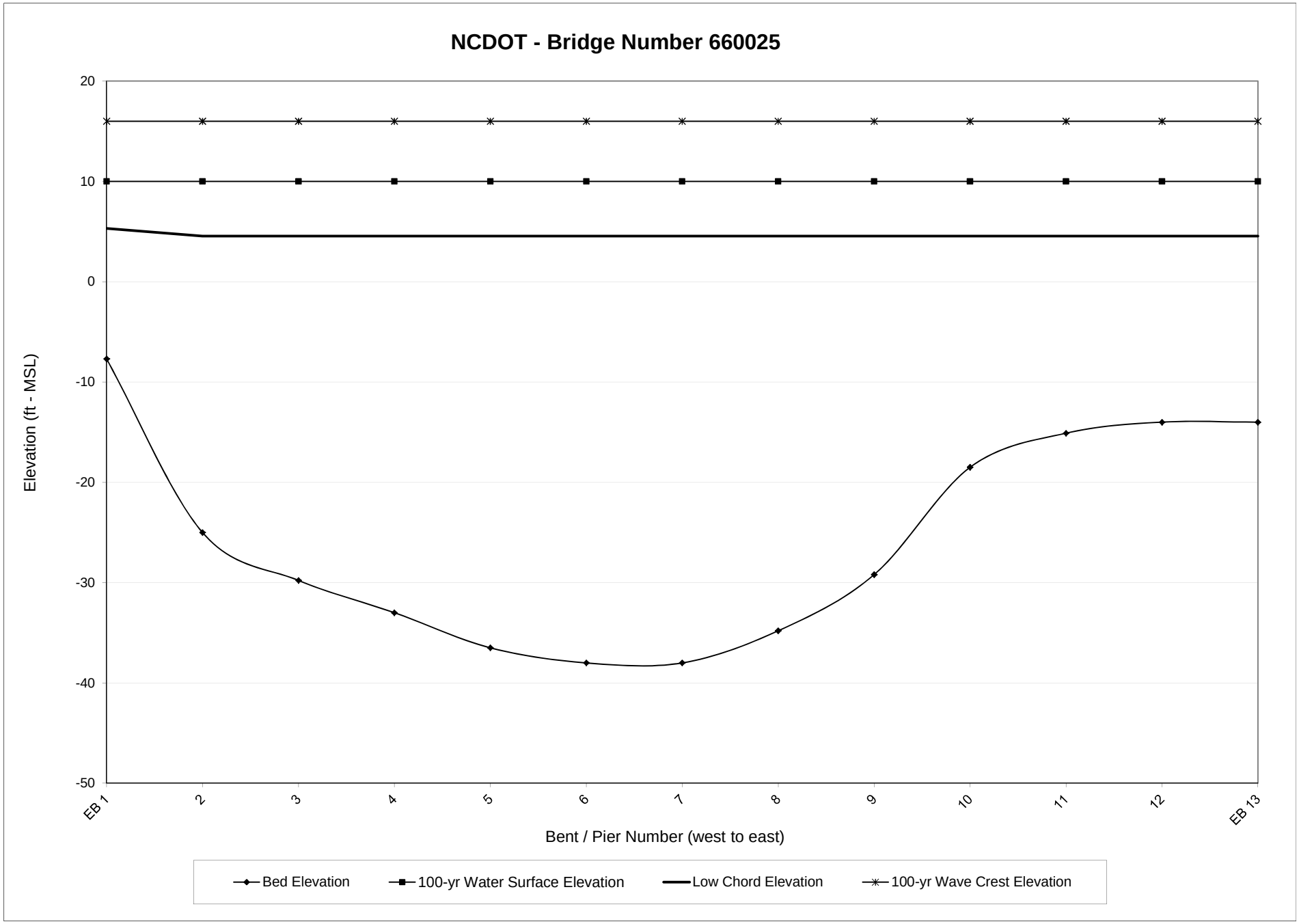
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-12 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 660025
20
10
0
-10
-20
-30
-40
-50
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
EB 13
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 660030

WHITE OAK RIVER

NC24

ONSLOW COUNTY

DRAFT

NCDOT BRIDGE NO. 660030

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY														
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**3.7**	**5.4**	**5.7**	**5.5**	**5.5**	**6.1**	**6.4**	**6.6**	**4.9**	**4.1**	**4.2**	**3.2**	**3.4**	**3.4**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES														
100-yr Water Surface Elevation (ft - MSL)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Bed Elevation (ft - MSL)	-1	-18	-24	-26	-32	-31	-28	-23	-12	-9	-7	3	5	5
Low Chord Elevation (ft - MSL)	6.6	7.3	7.5	7.6	7.4	7.3	7.1	6.9	6.8	6.6	6.4	6.2	6.0	6.0
100-yr Max Wave Crest Elevation (ft - MSL)	14.5	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	13.0	12.0	12.0
100-yr Wave Height (ft)	6.7	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	4.5	3.2	3.2
100-yr Wave Period (seconds)	7.1	4.9	4.6	4.5	4.2	4.3	4.4	4.6	5.4	5.8	6.0	7.0	7.0	7.0

SPAN PROPERITES														
Span Length (ft)	63.3	61.1	61.8	61.8	62.3	55.3	55.3	55.8	55.3	61.8	62.3	61.8	62.3	62.3
Span Width (ft)	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Number of Beams	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Slab Dead Weight (kip/ft)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Total Dead Weight (kip/ft)	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4
Resisting Moment (kft/ft)	247.6	239.1	241.6	241.6	243.6	215.6	215.6	217.6	215.6	241.6	243.6	241.6	243.6	243.6
Resisting Vertical Force (kip/ft)	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4

100-YEAR FORCE-MOMENT VALUES														
Maximum Vertical Force (kips/span)	764	933	991	1,007	1,024	879	873	859	727	774	764	639	683	683
Maximum Vertical Force (kips/ft)	12	15	16	16	16	16	16	15	13	13	12	10	11	11
Maximum Horizontal Force (kips/span)	199	86	77	73	69	63	68	76	96	128	153	104	67	67
Maximum Horizontal Force (kips/ft)	3	1	1	1	1	1	1	1	2	2	2	2	1	1
Maximum Moment (k-ft)	32,789	45,030	48,969	47,136	47,273	41,463	43,287	45,620	33,019	34,695	36,283	27,150	29,544	29,544
Maximum Moment (k-ft/ft)	518	737	793	763	759	750	783	818	598	562	583	440	475	475

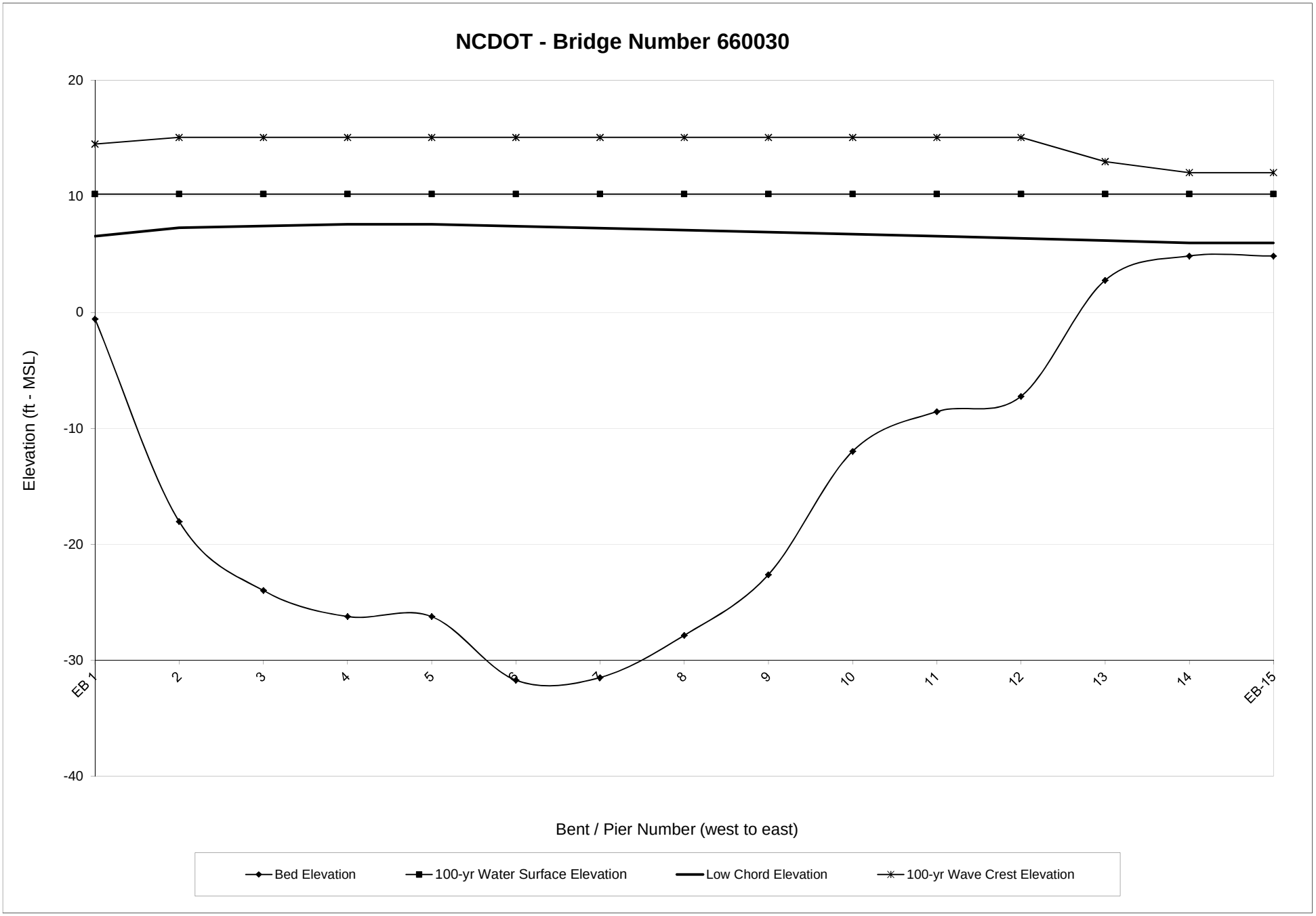
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-14 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 660030
20
10
0
-10
-20
-30
-40
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
EB-15
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 660226

NEW RIVER

SR1557

ONSLOW COUNTY

DRAFT

NCDOT BRIDGE NO. 660226

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY			
SPAN NUMBER	1	2	3
CRITICALITY INDEX (defined below)	2	2	2
VULNERABILITY INDEX (defined below)	0.8	1.3	1.1

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES			
100-yr Water Surface Elevation (ft - MSL)	9.0	9.0	9.0
Bed Elevation (ft - MSL)	-3	-2	-2
Low Chord Elevation (ft - MSL)	5.6	5.6	5.6
100-yr Max Wave Crest Elevation (ft - MSL)	11.0	11.0	11.0
100-yr Wave Height (ft)	2.9	2.9	2.9
100-yr Wave Period (seconds)	4.7	4.7	4.7

SPAN PROPERITES			
Span Length (ft)	17.0	16.5	16.5
Span Width (ft)	25.2	25.2	25.2
Deck Thickness (ft)	0.4	0.4	0.4
Overhang (ft)	0.4	0.4	0.4
Number of Beams	19	19	19
Beam Dead Weight (lb/lf) - Each	235	235	235
Beam Dead Weight (kip/ft) - Total	4.5	4.5	4.5
Slab Dead Weight (kip/ft)	1.6	1.6	1.6
Total Dead Weight (kip/ft)	6.0	6.0	6.0
Resisting Moment (kft/ft)	48.8	47.3	47.3
Resisting Vertical Force (kip/ft)	6.0	6.0	6.0

100-YEAR FORCE-MOMENT VALUES			
Maximum Vertical Force (kips/span)	42.0	40.1	40.1
Maximum Vertical Force (kips/ft)	2.5	2.0	2.2
Maximum Horizontal Force (kips/span)	5.0	5.0	5.0
Maximum Horizontal Force (kips/ft)	0.3	0.7	0.6
Maximum Moment (k-ft)	627.7	595.8	595.8
Maximum Moment (k-ft/ft)	36.9	60.4	53.0

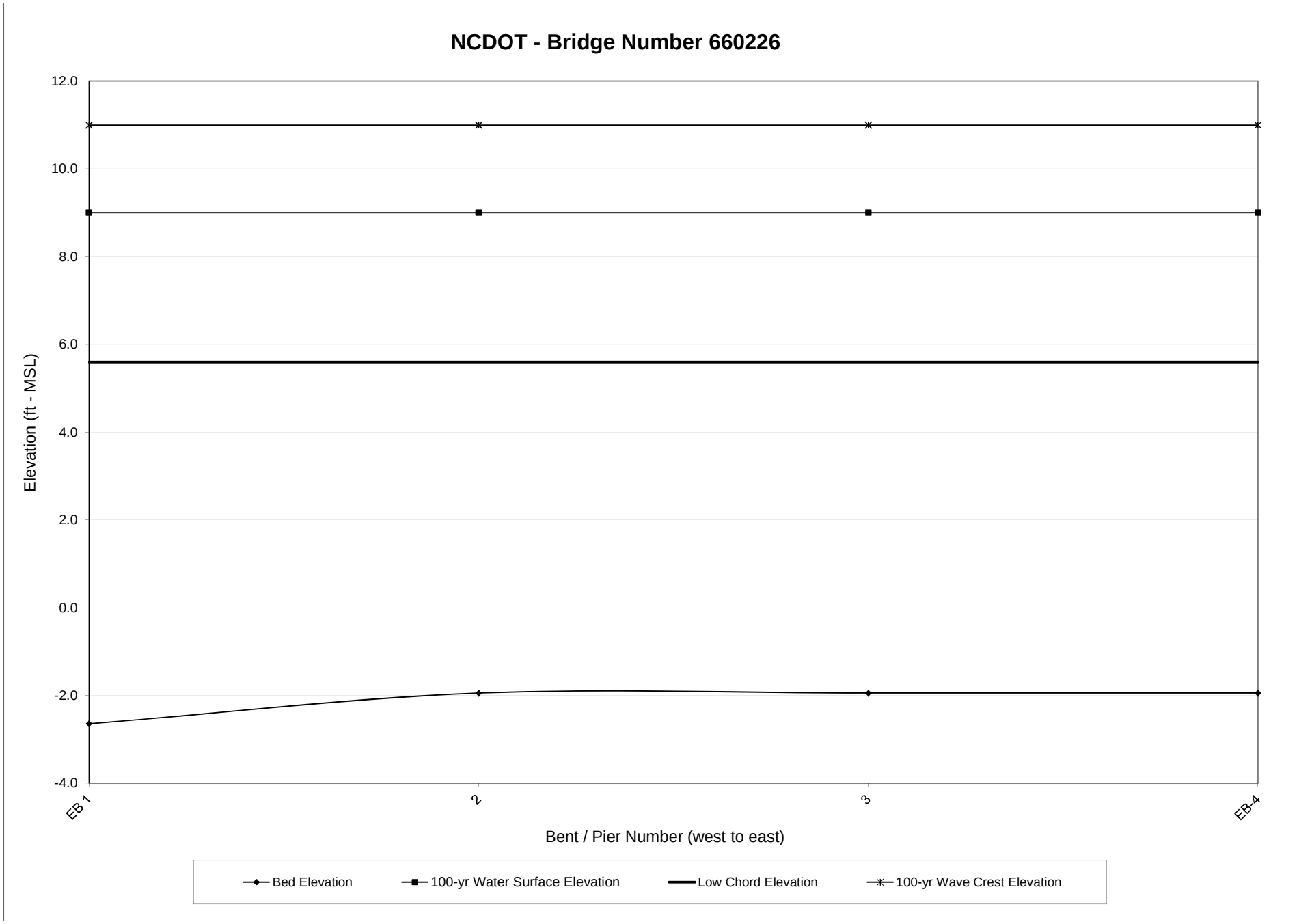
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-3 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 660226
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
Elevation (ft - MSL)
EB 1
2
3
EB-4
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 680011

GOOSE CREEK

SR1230

PAMLICO COUNTY

DRAFT

NCDOT BRIDGE NO. 680011

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY	
SPAN NUMBER	1
CRITICALITY INDEX (defined below)	4
VULNERABILITY INDEX (defined below)	0.0

SURGE/WAVE LOAD COMPUTATION INPUT VALUES	
HYDRAULIC VALUES	
100-yr Water Surface Elevation (ft - MSL)	8.1
Bed Elevation (ft - MSL)	-2
Low Chord Elevation (ft - MSL)	3.3
100-yr Max Wave Crest Elevation (ft - MSL)	8.8
100-yr Wave Height (ft)	1.0
100-yr Wave Period (seconds)	2.8
SPAN PROPERITES	
Span Length (ft)	41.0
Span Width (ft)	36.2
Deck Thickness (ft)	1.8
Overhang (ft)	0.0
Number of Beams	0
Beam Dead Weight (lb/lf) - Each	0
Beam Dead Weight (kip/ft) - Total	0.0
Slab Dead Weight (kip/ft)	9.5
Total Dead Weight (kip/ft)	9.5
Resisting Moment (kft/ft)	178.0
Resisting Vertical Force (kip/ft)	9.5
100-YEAR FORCE-MOMENT VALUES	
Maximum Vertical Force (kips/span)	8.0
Maximum Vertical Force (kips/ft)	0.2
Maximum Horizontal Force (kips/span)	5.0
Maximum Horizontal Force (kips/ft)	0.1
Maximum Moment (k-ft)	36
Maximum Moment (k-ft/ft)	1

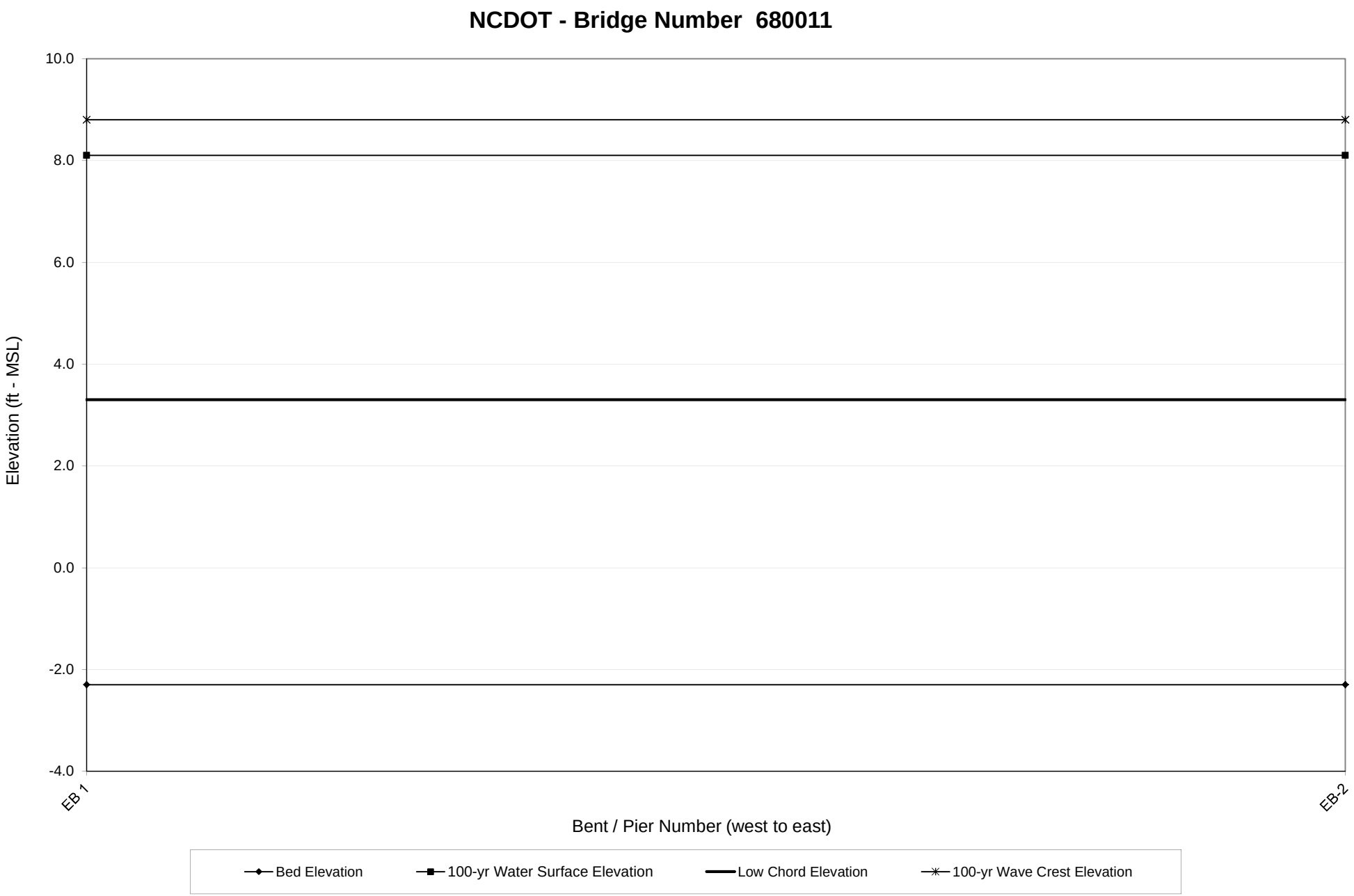
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge span is potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 680011
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
Elevation (ft - MSL)
EB 1
EB-2
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 680024

NORTH PRONG OF BAY RIVER

NC304

PAMLICO COUNTY

DRAFT

NCDOT BRIDGE NO. 680024

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY				
SPAN NUMBER	1	2	3	4
CRITICALITY INDEX (defined below)	4	4	4	4
VULNERABILITY INDEX (defined below)	2.6	2.6	2.6	2.6

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES				
100-yr Water Surface Elevation (ft - MSL)	12.8	12.8	12.8	12.8
Bed Elevation (ft - MSL)	-9	-11	-5	-5
Low Chord Elevation (ft - MSL)	4.5	4.5	4.5	4.5
100-yr Max Wave Crest Elevation (ft - MSL)	12.9	12.9	12.9	12.9
100-yr Wave Height (ft)	0.3	0.3	0.3	0.3
100-yr Wave Period (seconds)	1.5	1.5	1.5	1.5

SPAN PROPERITES				
Span Length (ft)	17.2	17.0	17.0	17.0
Span Width (ft)	36.1	36.1	36.1	36.1
Deck Thickness (ft)	0.4	0.4	0.4	0.4
Overhang (ft)	0.5	0.5	0.5	0.5
Number of Beams	27	27	27	27
Beam Dead Weight (lb/lf) - Each	127	127	127	127
Beam Dead Weight (kip/ft) - Total	3.4	3.4	3.4	3.4
Slab Dead Weight (kip/ft)	2.3	2.3	2.3	2.3
Total Dead Weight (kip/ft)	5.7	5.7	5.7	5.7
Resisting Moment (kft/ft)	46.4	46.0	46.0	46.0
Resisting Vertical Force (kip/ft)	5.7	5.7	5.7	5.7

100-YEAR FORCE-MOMENT VALUES				
Maximum Vertical Force (kips/span)	62.5	61.7	61.8	62.5
Maximum Vertical Force (kips/ft)	3.6	3.6	3.6	3.7
Maximum Horizontal Force (kips/span)	0.2	0.1	0.1	0.2
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	1,163	1,146	1,152	1,163
Maximum Moment (k-ft/ft)	68	67	68	68

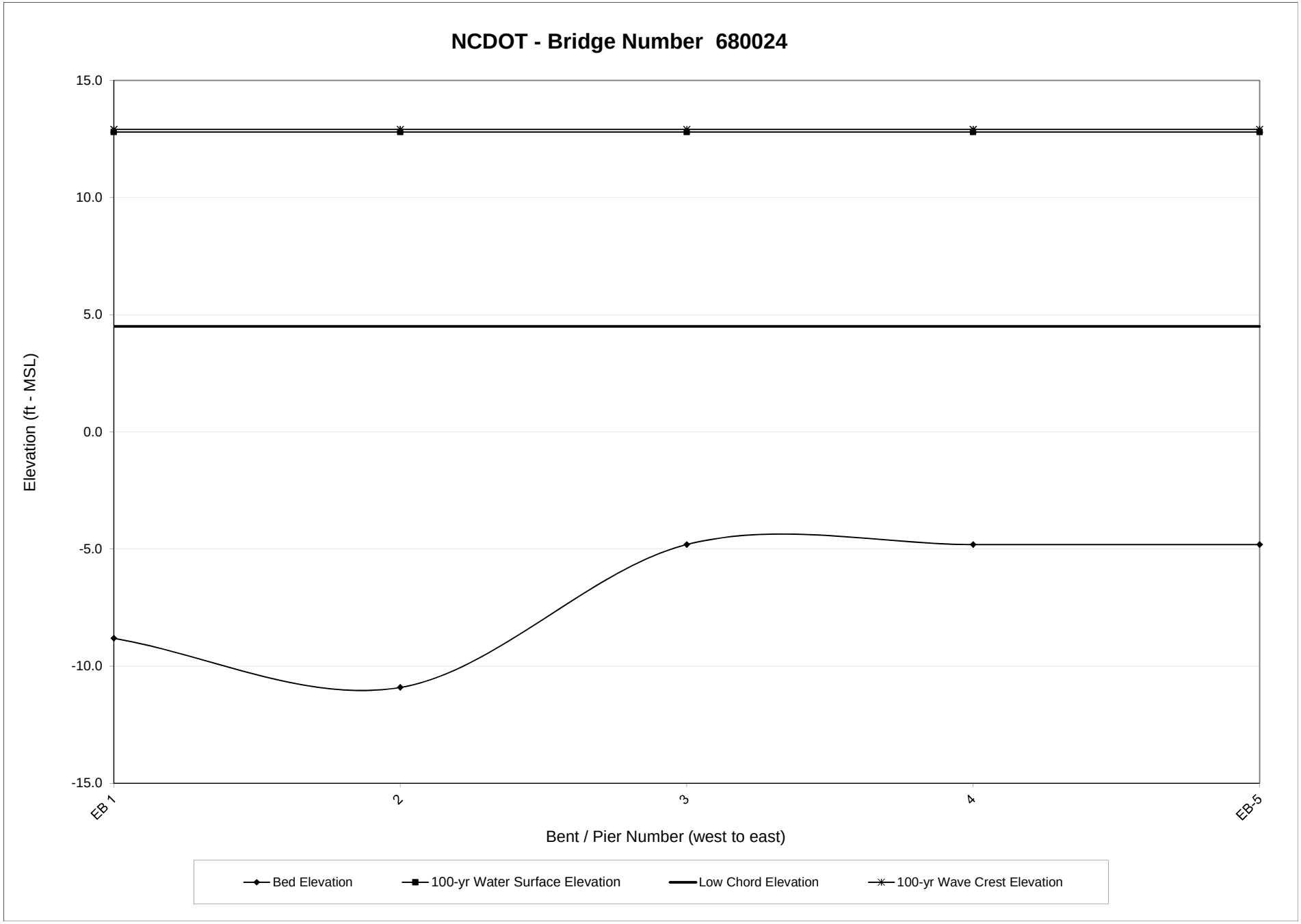
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-4 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 680024
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
EB 1
2
3
4
EB-5
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 680036

SO. PRONG BAY RIVER

NC55

PAMLICO COUNTY

DRAFT

NCDOT BRIDGE NO. 680036
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY					
SPAN NUMBER	1	2	3	4	5
CRITICALITY INDEX (defined below)	4	4	4	4	4
VULNERABILITY INDEX (defined below)	1.8	2.0	2.0	2.0	2.5

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES					
100-yr Water Surface Elevation (ft - MSL)	12.8	12.8	12.8	12.8	12.8
Bed Elevation (ft - MSL)	-2	-14	-12	-2	-2
Low Chord Elevation (ft - MSL)	7.1	7.1	7.1	7.1	7.1
100-yr Max Wave Crest Elevation (ft - MSL)	12.9	12.9	12.9	12.9	12.9
100-yr Wave Height (ft)	0.3	0.3	0.3	0.3	0.3
100-yr Wave Period (seconds)	1.4	1.4	1.4	1.4	1.4

SPAN PROPERITES					
Span Length (ft)	38.3	32.5	32.5	32.5	32.5
Span Width (ft)	36.1	36.1	36.1	36.1	36.1
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.0	3.0	3.0	3.0	3.0
Number of Beams	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	143	143	143	143	143
Beam Dead Weight (kip/ft) - Total	0.7	0.7	0.7	0.7	0.7
Slab Dead Weight (kip/ft)	3.4	3.4	3.4	3.4	3.4
Total Dead Weight (kip/ft)	4.1	4.1	4.1	4.1	4.1
Resisting Moment (kft/ft)	75.8	64.0	64.0	64.0	64.0
Resisting Vertical Force (kip/ft)	4.1	4.1	4.1	4.1	4.1

100-YEAR FORCE-MOMENT VALUES					
Maximum Vertical Force (kips/span)	158.2	130.6	130.4	130.8	157.6
Maximum Vertical Force (kips/ft)	4.1	4.0	4.0	4.0	4.8
Maximum Horizontal Force (kips/span)	1.0	1.0	1.0	1.0	1.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	2,926	2,406	2,405	2,425	2,924
Maximum Moment (k-ft/ft)	76	74	74	75	90

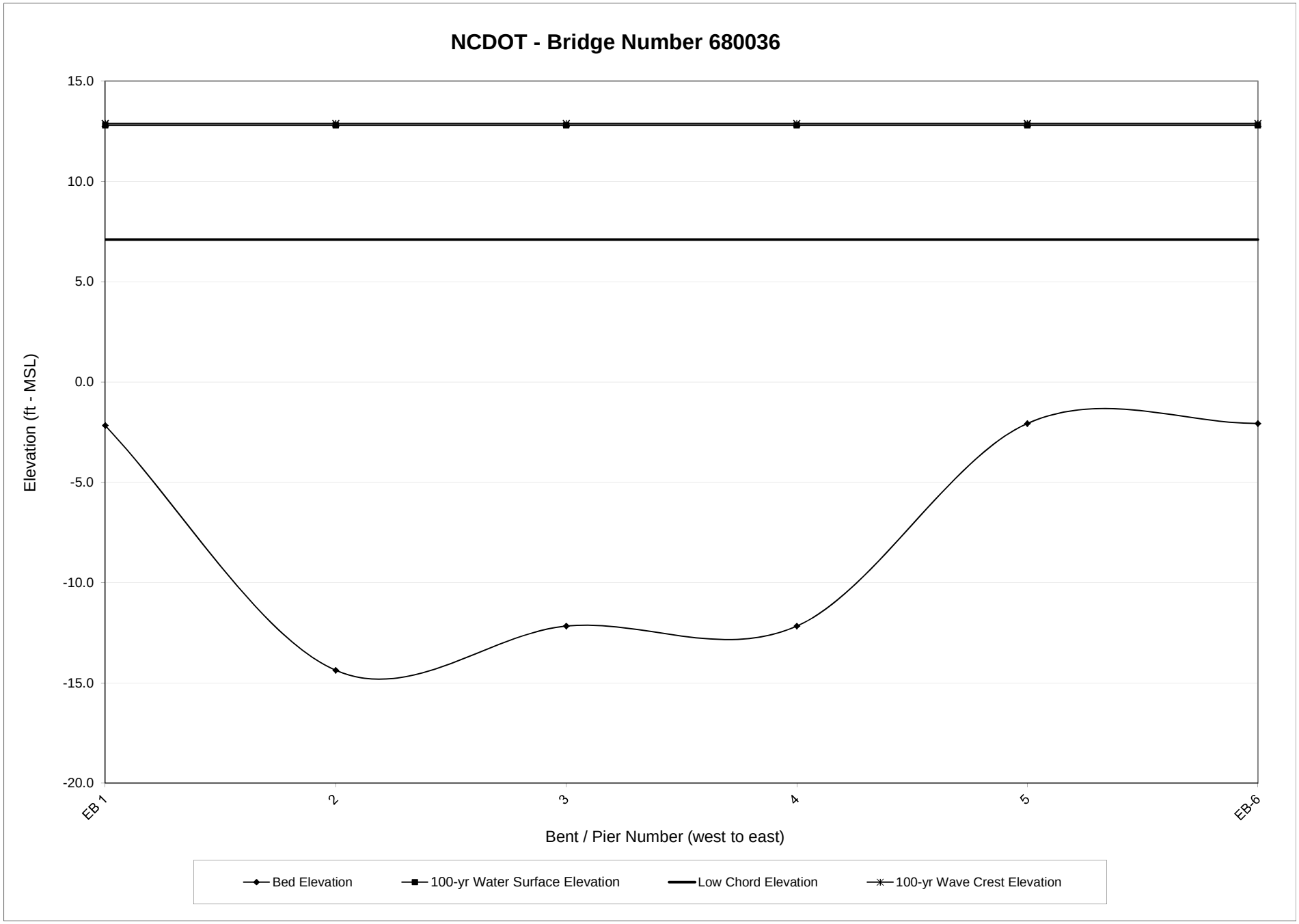
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-5 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 680036
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
EB 1
2
3
4
5
EB-6
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 680042

GALE CREEK

NC304

PAMLICO COUNTY

DRAFT

NCDOT BRIDGE NO. 680042

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY			
SPAN NUMBER	1	2	3
CRITICALITY INDEX (defined below)	4	4	4
VULNERABILITY INDEX (defined below)	0.0	0.0	0.0

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES			
100-yr Water Surface Elevation (ft - MSL)	10.3	10.3	10.3
Bed Elevation (ft - MSL)	-7	-7	-7
Low Chord Elevation (ft - MSL)	2.3	2.3	2.3
100-yr Max Wave Crest Elevation (ft - MSL)	11.1	11.1	11.1
100-yr Wave Height (ft)	1.3	1.3	1.3
100-yr Wave Period (seconds)	1.4	1.4	1.4

SPAN PROPERITES			
Span Length (ft)	29.0	50.0	50.0
Span Width (ft)	36.0	36.0	36.0
Deck Thickness (ft)	1.8	1.8	1.8
Overhang (ft)	0.0	0.0	0.0
Number of Beams	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	9.5	9.5	9.5
Total Dead Weight (kip/ft)	9.5	9.5	9.5
Resisting Moment (kft/ft)	120.5	219.7	219.7
Resisting Vertical Force (kip/ft)	9.5	9.5	9.5

100-YEAR FORCE-MOMENT VALUES			
Maximum Vertical Force (kips/span)	17.0	17.0	0.0
Maximum Vertical Force (kips/ft)	0.6	0.3	0.0
Maximum Horizontal Force (kips/span)	8.0	8.0	0.0
Maximum Horizontal Force (kips/ft)	0.3	0.2	0.0
Maximum Moment (k-ft)	36.0	36.0	0.0
Maximum Moment (k-ft/ft)	1.2	0.7	0.0

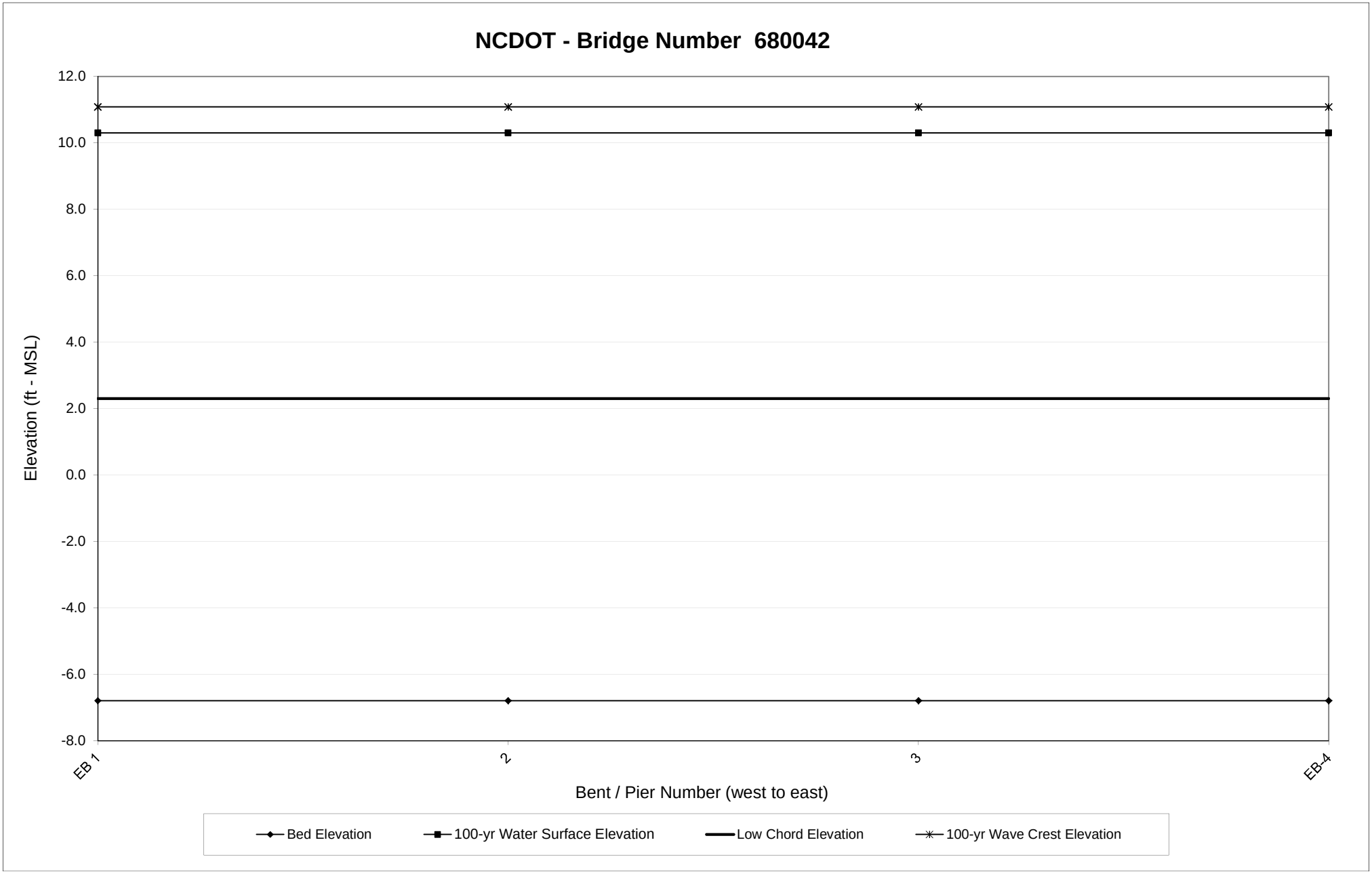
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-2 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 680042
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
Elevation (ft - MSL)
EB 1
2
3
EB-4
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 680057

DAWSON CREEK

SR1302

PAMLICO COUNTY

DRAFT

NCDOT BRIDGE NO. 680057
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY									
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
CRITICALITY INDEX (defined below)	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
VULNERABILITY INDEX (defined below)	**2.4**	**1.9**	**1.9**	**2.0**	**2.0**	**2.3**	**2.4**	**2.0**	**2.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES									
100-yr Water Surface Elevation (ft - MSL)	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
Bed Elevation (ft - MSL)	1	-12	-12	-12	-12	-10	-12	-12	-12
Low Chord Elevation (ft - MSL)	10.2	10.5	10.7	10.8	10.8	10.7	10.5	10.3	10.3
100-yr Max Wave Crest Elevation (ft - MSL)	15.5	15.5	15.5	15.5	15.5	15.5	15.5	14.9	14.9
100-yr Wave Height (ft)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	6.3	6.3
100-yr Wave Period (seconds)	6.9	4.9	5.0	5.2	5.4	6.3	6.4	6.9	6.9

SPAN PROPERITES									
Span Length (ft)	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
Span Width (ft)	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Number of Beams	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	102	102	102	102	102	102	102	102	102
Beam Dead Weight (kip/ft) - Total	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slab Dead Weight (kip/ft)	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Total Dead Weight (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Resisting Moment (kft/ft)	53.3	53.3	53.3	53.3	53.3	53.3	53.3	53.3	53.3
Resisting Vertical Force (kip/ft)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2

100-YEAR FORCE-MOMENT VALUES									
Maximum Vertical Force (kips/span)	306.1	286.3	278.3	263.0	264.5	274.8	287.7	252.7	275.3
Maximum Vertical Force (kips/ft)	9.0	8.4	8.2	7.7	7.8	8.1	8.5	7.4	8.1
Maximum Horizontal Force (kips/span)	73.4	24.0	25.0	34.0	36.7	59.7	61.5	73.7	73.7
Maximum Horizontal Force (kips/ft)	2.2	0.7	0.7	1.0	1.1	1.8	1.8	2.2	2.2
Maximum Moment (k-ft)	4,300	3,383	3,432	3,537	3,686	4,194	4,266	3,579	3,579
Maximum Moment (k-ft/ft)	126	100	101	104	108	123	125	105	105

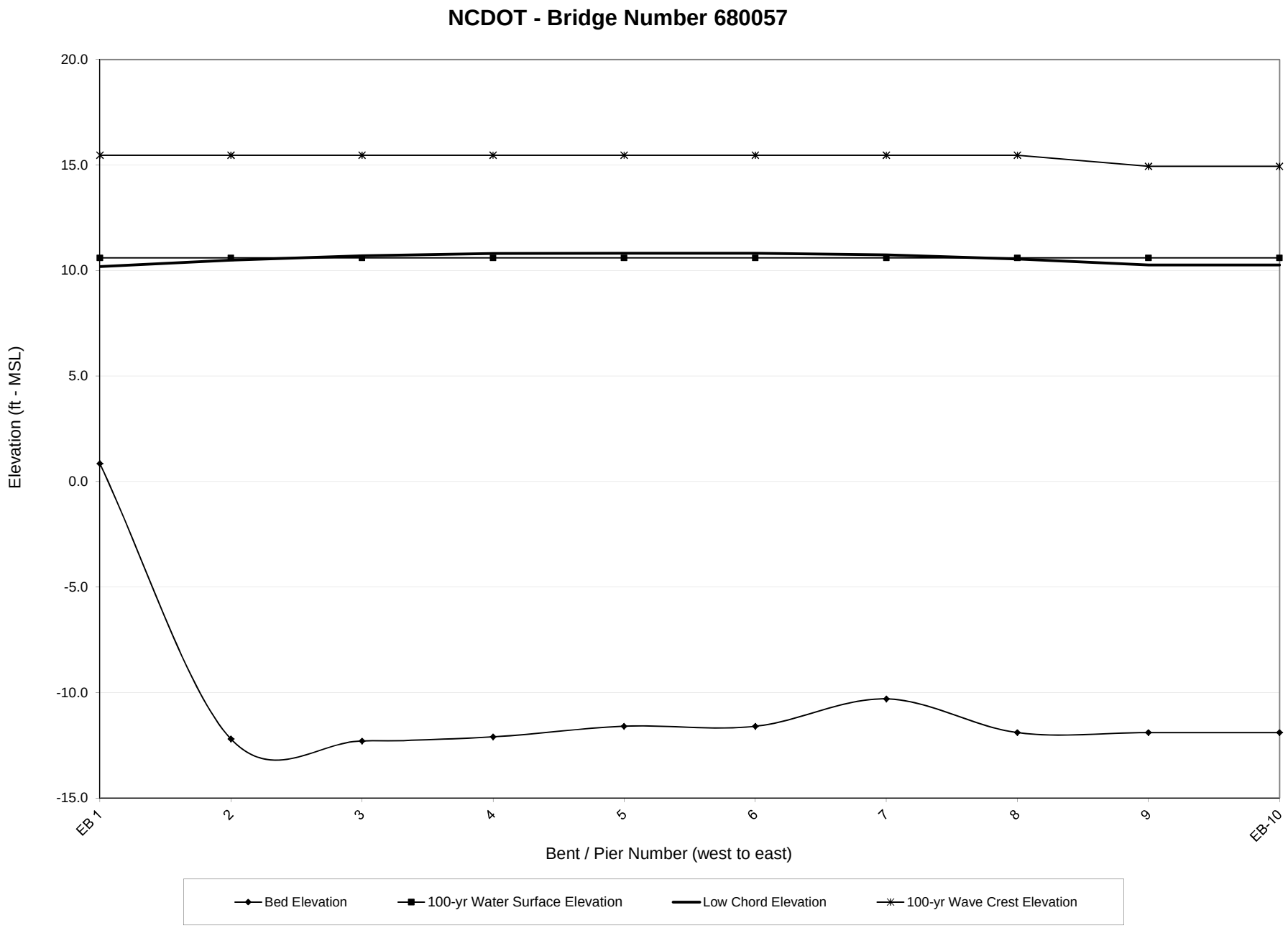
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-9 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 680057
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
EB-10
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 680065

STREAM

SR1304

PAMLICO COUNTY

DRAFT

NCDOT BRIDGE NO. 680065

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY			
SPAN NUMBER	1	2	3
CRITICALITY INDEX (defined below)	3	3	3
VULNERABILITY INDEX (defined below)	0.7	0.7	0.7

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES			
100-yr Water Surface Elevation (ft - MSL)	11.0	11.0	11.0
Bed Elevation (ft - MSL)	-1	-1	0
Low Chord Elevation (ft - MSL)	3.3	3.3	3.3
100-yr Max Wave Crest Elevation (ft - MSL)	16.0	16.0	15.8
100-yr Wave Height (ft)	7.1	7.1	6.9
100-yr Wave Period (seconds)	6.7	6.8	7.0

SPAN PROPERITES			
Span Length (ft)	58.0	58.0	58.0
Span Width (ft)	27.1	27.1	27.1
Deck Thickness (ft)	1.8	1.8	1.8
Overhang (ft)	0.0	0.0	0.0
Number of Beams	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	7.1	7.1	7.1
Total Dead Weight (kip/ft)	7.1	7.1	7.1
Resisting Moment (kft/ft)	193.7	193.7	193.7
Resisting Vertical Force (kip/ft)	7.1	7.1	7.1

100-YEAR FORCE-MOMENT VALUES			
Maximum Vertical Force (kips/span)	230.5	231.0	221.1
Maximum Vertical Force (kips/ft)	4.0	4.0	3.8
Maximum Horizontal Force (kips/span)	37.7	37.9	37.5
Maximum Horizontal Force (kips/ft)	0.6	0.7	0.6
Maximum Moment (k-ft)	4,578.3	4,605.6	4,270.0
Maximum Moment (k-ft/ft)	78.9	79.4	73.6

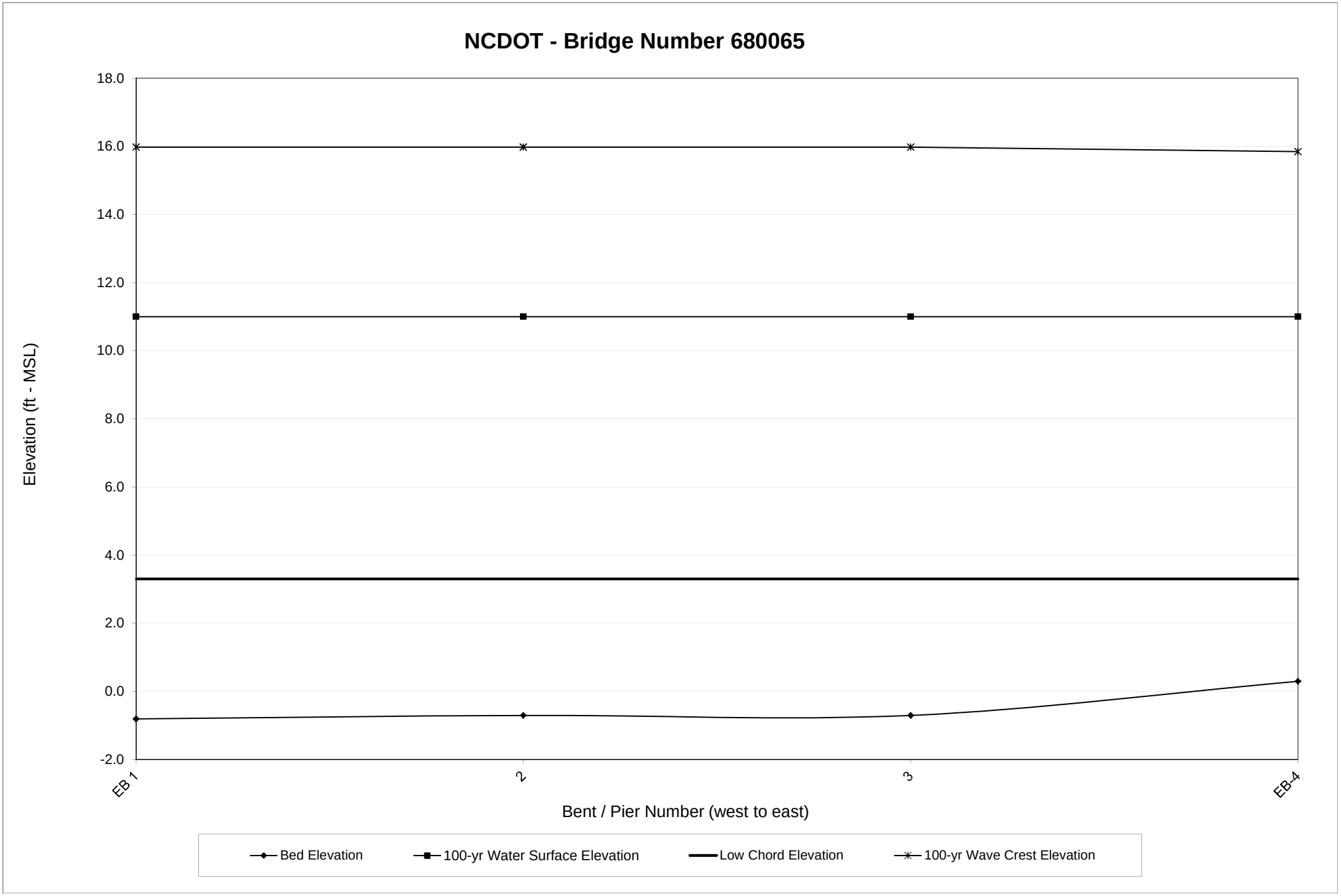
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-3 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 680065
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
Elevation (ft - MSL)
EB 1
2
3
EB-4
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 690018

CHARLES CREEK

NC34

PASQUOTANK COUNTY

DRAFT

NCDOT BRIDGE NO. 690018

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY		
SPAN NUMBER	1	2
CRITICALITY INDEX (defined below)	4	4
VULNERABILITY INDEX (defined below)	4.0	4.0

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES		
100-yr Water Surface Elevation (ft - MSL)	6.1	6.1
Bed Elevation (ft - MSL)	-11	-11
Low Chord Elevation (ft - MSL)	2.1	2.1
100-yr Max Wave Crest Elevation (ft - MSL)	7.8	7.8
100-yr Wave Height (ft)	2.6	2.6
100-yr Wave Period (seconds)	2.3	2.3

SPAN PROPERITES		
Span Length (ft)	19.8	19.8
Span Width (ft)	31.6	31.6
Deck Thickness (ft)	0.6	0.6
Overhang (ft)	0.8	0.8
Number of Beams	7	7
Beam Dead Weight (lb/lf) - Each	58	58
Beam Dead Weight (kip/ft) - Total	0.4	0.4
Slab Dead Weight (kip/ft)	2.8	2.8
Total Dead Weight (kip/ft)	3.2	3.2
Resisting Moment (kft/ft)	29.4	29.4
Resisting Vertical Force (kip/ft)	3.2	3.2

100-YEAR FORCE-MOMENT VALUES		
Maximum Vertical Force (kips/span)	67.0	67.0
Maximum Vertical Force (kips/ft)	3.4	3.4
Maximum Horizontal Force (kips/span)	3.0	3.0
Maximum Horizontal Force (kips/ft)	0.2	0.2
Maximum Moment (k-ft)	1,320.0	1,320.0
Maximum Moment (k-ft/ft)	66.8	66.8

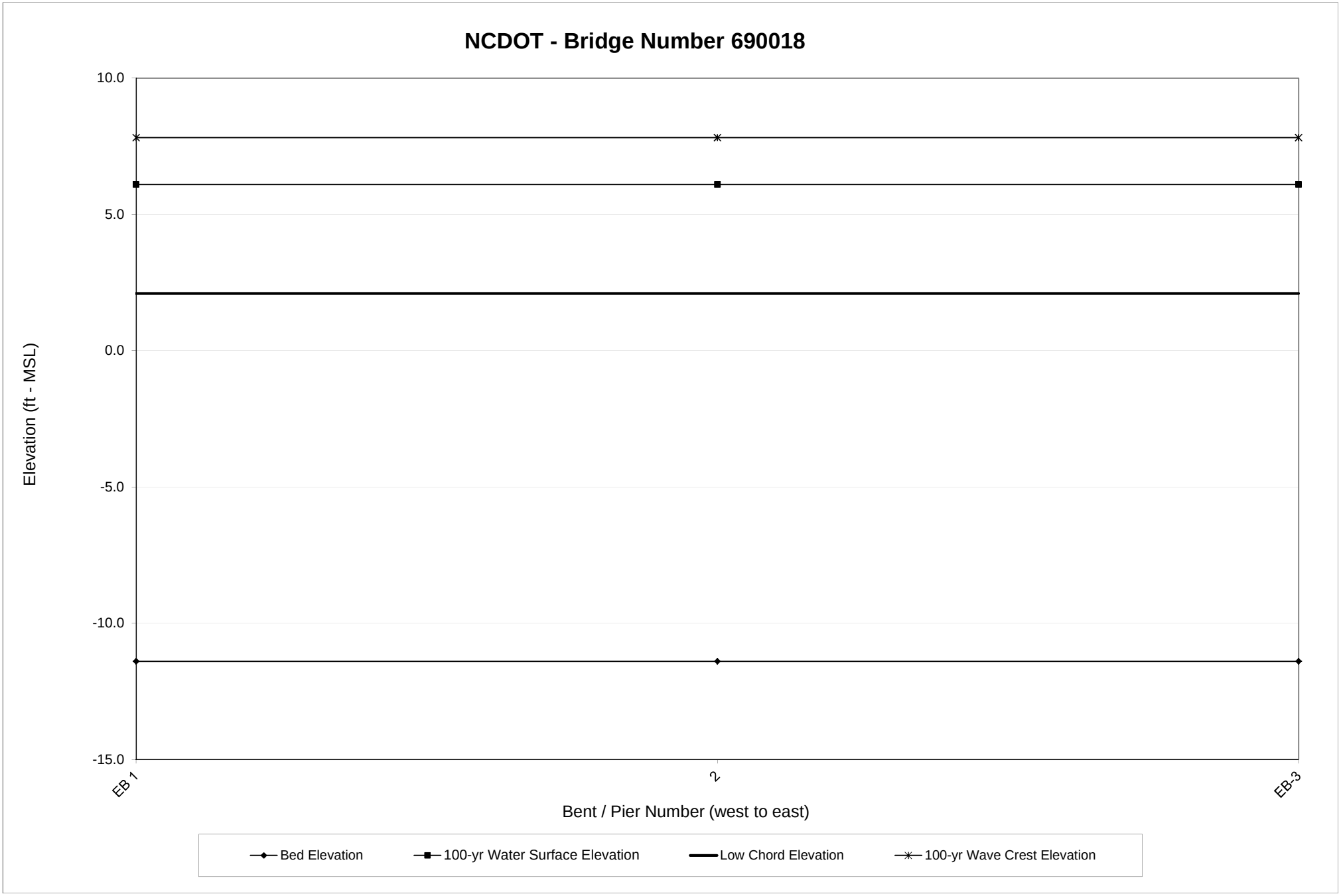
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-2 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 690018
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
EB 1
2
EB-3
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 690019

PASQUOTANK RIVER

US158 EBL.

PASQUOTANK COUNTY

DRAFT

NCDOT BRIDGE NO. 690019

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																		
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.7**	**0.1**	**2.4**	**1.0**	**1.1**	**1.1**	**1.1**	**1.0**	**1.0**	**15.7**	**15.3**	**15.6**	**16.2**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																		
100-yr Water Surface Elevation (ft - MSL)	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Bed Elevation (ft - MSL)	-9	-12	-20	-34	-35	-30	-26	-21	-10	-12	-4	-6	-3	0	1	1	1	1
Low Chord Elevation (ft - MSL)	1.9	2.9	2.9	3.9	4.9	4.9	4.9	4.9	3.9	2.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
100-yr Max Wave Crest Elevation (ft - MSL)	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	9.1	8.7	8.8	8.7	8.7
100-yr Wave Height (ft)	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	4.0	3.5	3.6	3.4	3.5
100-yr Wave Period (seconds)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7

SPAN PROPERITES																		
Span Length (ft)	37.0	37.0	37.0	37.0	37.0	29.0	130.0	24.0	37.0	37.0	37.0	37.0	37.0	37.0	10.0	10.0	10.0	10.0
Span Width (ft)	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Number of Beams	4	4	4	4	4	4	11	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	900	900	900	900	900	900	204	900	900	900	900	900	900	900	900	900	900	900
Beam Dead Weight (kip/ft) - Total	3.6	3.6	3.6	3.6	3.6	3.6	2.2	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Slab Dead Weight (kip/ft)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Total Dead Weight (kip/ft)	6.0	6.0	6.0	6.0	6.0	6.0	4.6	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Resisting Moment (kft/ft)	107.5	107.5	107.5	107.5	107.5	83.5	299.1	68.5	107.5	107.5	107.5	107.5	107.5	107.5	26.5	26.5	26.5	26.5
Resisting Vertical Force (kip/ft)	6.0	6.0	6.0	6.0	6.0	6.0	4.6	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0

100-YEAR FORCE-MOMENT VALUES																		
Maximum Vertical Force (kips/span)	160.5	172.2	174.6	174.8	176.5	177.0	177.9	179.8	179.8	181.0	180.9	181.0	182.3	182.3	184.2	182.3	183.4	187.0
Maximum Vertical Force (kips/ft)	4.3	4.7	4.7	4.7	4.8	6.1	1.4	7.5	4.9	4.9	4.9	4.9	4.9	4.9	18.4	18.2	18.3	18.7
Maximum Horizontal Force (kips/span)	47.6	42.1	41.1	40.4	46.8	38.8	42.4	41.5	36.7	42.8	36.2	42.8	39.9	39.9	35.1	39.9	34.9	39.8
Maximum Horizontal Force (kips/ft)	1.3	1.1	1.1	1.1	1.3	1.3	0.3	1.7	1.0	1.2	1.0	1.2	1.1	1.1	3.5	4.0	3.5	4.0
Maximum Moment (k-ft)	2,296.9	2,338.1	2,355.2	2,307.0	2,306.0	2,394.4	2,309.6	2,300.6	2,291.6	2,418.3	2,406.4	2,418.3	2,316.9	2,316.9	2,370.3	2,316.9	2,366.8	2,445.8
Maximum Moment (k-ft/ft)	62.1	63.2	63.7	62.4	62.3	82.6	17.8	95.9	61.9	65.4	65.0	65.4	62.6	62.6	237.0	231.7	236.7	244.6

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-18 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 690019
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY															
SPAN NUMBER	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**15.7**	**15.3**	**15.3**	**15.3**	**15.9**	**15.2**	**16.0**	**15.2**	**15.2**	**15.2**	**15.1**	**15.3**	**15.7**	**15.2**	**15.6**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES															
100-yr Water Surface Elevation (ft - MSL)	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Bed Elevation (ft - MSL)	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1
Low Chord Elevation (ft - MSL)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
100-yr Max Wave Crest Elevation (ft - MSL)	8.7	8.9	8.3	8.3	8.4	8.3	8.7	8.7	8.7	8.9	8.9	8.7	8.7	8.6	8.6
100-yr Wave Height (ft)	3.5	3.7	2.9	2.9	3.0	2.8	3.5	3.5	3.5	3.7	3.7	3.5	3.5	3.3	3.3
100-yr Wave Period (seconds)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7

SPAN PROPERITES															
Span Length (ft)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Span Width (ft)	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900
Beam Dead Weight (kip/ft) - Total	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Slab Dead Weight (kip/ft)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Total Dead Weight (kip/ft)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Resisting Moment (kft/ft)	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5
Resisting Vertical Force (kip/ft)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0

100-YEAR FORCE-MOMENT VALUES															
Maximum Vertical Force (kips/span)	184.2	182.3	182.3	182.3	180.9	181.4	181.0	179.8	179.8	179.8	174.4	179.4	175.5	176.5	173.4
Maximum Vertical Force (kips/ft)	18.4	18.2	18.2	18.2	18.1	18.1	18.1	18.0	18.0	18.0	17.4	17.9	17.6	17.7	17.3
Maximum Horizontal Force (kips/span)	35.1	39.9	39.9	39.9	43.1	36.4	42.8	41.5	41.5	41.5	39.4	37.4	38.6	46.8	40.1
Maximum Horizontal Force (kips/ft)	3.5	4.0	4.0	4.0	4.3	3.6	4.3	4.2	4.2	4.2	3.9	3.7	3.9	4.7	4.0
Maximum Moment (k-ft)	2,370.3	2,316.9	2,316.9	2,316.9	2,408.8	2,308.0	2,418.3	2,300.6	2,300.6	2,300.6	2,289.0	2,323.8	2,369.9	2,306.0	2,358.7
Maximum Moment (k-ft/ft)	237.0	231.7	231.7	231.7	240.9	230.8	241.8	230.1	230.1	230.1	228.9	232.4	237.0	230.6	235.9

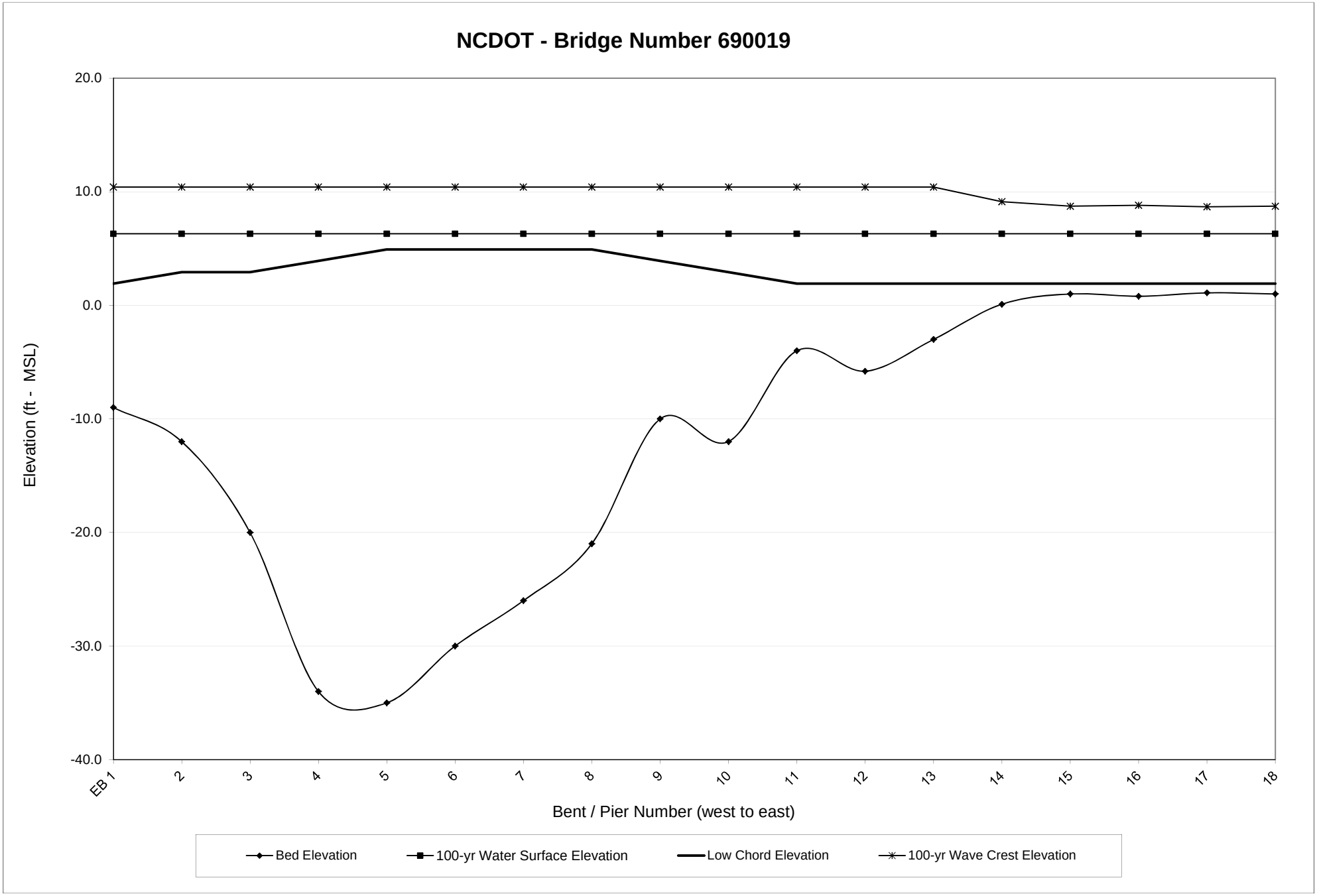
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

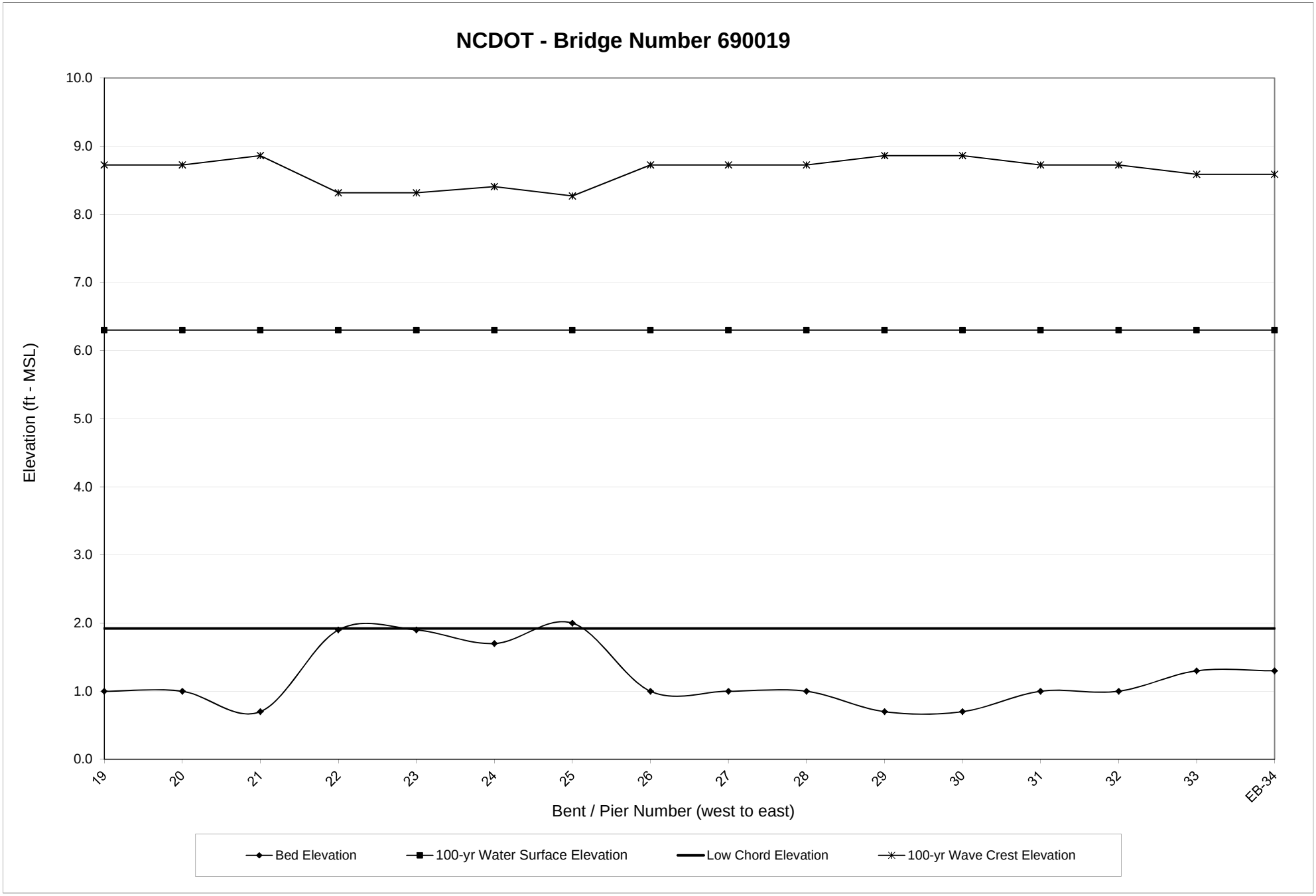
Notes:

1 - Bridge spans 19-33 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 690019
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 690019
Elevation (ft - MSL)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
EB-34
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 690027

PASQUOTANK RIVER ICW

US158

PASQUOTANK COUNTY

DRAFT

NCDOT BRIDGE NO. 690027

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.1**	**1.8**	**1.7**	**1.6**	**1.6**	**0.7**	**0.5**	**0.6**	**1.2**	**1.4**	**1.4**	**1.7**	**1.3**	**1.3**	**0.1**	**1.3**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Bed Elevation (ft - MSL)	-8	-13	-26	-34	-38	-39	-34	-21	-17	-15	-9	-7	-3	3	5	5
Low Chord Elevation (ft - MSL)	1.0	2.0	2.5	4.0	4.0	5.0	5.0	6.0	4.0	3.0	1.5	1.0	1.0	1.0	2.0	2.0
100-yr Max Wave Crest Elevation (ft - MSL)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.3	7.6	7.0	6.9
100-yr Wave Height (ft)	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.7	1.9	0.9	0.9
100-yr Wave Period (seconds)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7

SPAN PROPERITES																
Span Length (ft)	35.5	36.0	36.0	36.0	36.0	70.0	137.0	52.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	22.0
Span Width (ft)	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Number of Beams	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	0
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	581	204	581	384	384	384	384	384	384	384	0
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	3.5	1.2	3.5	2.3	2.3	2.3	2.3	2.3	2.3	2.3	0.0
Slab Dead Weight (kip/ft)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
Total Dead Weight (kip/ft)	9.2	9.2	9.2	9.2	9.2	10.4	8.1	10.4	9.2	9.2	9.2	9.2	9.2	9.2	9.2	6.9
Resisting Moment (kft/ft)	154.4	156.7	156.7	156.7	156.7	353.5	548.9	260.0	156.7	156.7	156.7	156.7	156.7	156.7	156.7	69.2
Resisting Vertical Force (kip/ft)	9.2	9.2	9.2	9.2	9.2	10.4	8.1	10.4	9.2	9.2	9.2	9.2	9.2	9.2	9.2	6.9

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	261.6	222.7	203.0	359.3	356.3	448.8	939.1	187.0	158.3	219.6	278.6	311.2	162.9	156.2	13.2	36.1
Maximum Vertical Force (kips/ft)	7.4	6.2	5.6	10.0	9.9	6.4	6.9	3.6	4.4	6.1	7.7	8.6	4.5	4.3	0.4	1.6
Maximum Horizontal Force (kips/span)	64.2	46.5	27.2	15.8	15.2	22.5	45.5	13.5	19.3	25.2	37.1	50.5	70.8	11.4	2.1	1.2
Maximum Horizontal Force (kips/ft)	1.8	1.3	0.8	0.4	0.4	0.3	0.3	0.3	0.5	0.7	1.0	1.4	2.0	0.3	0.1	0.1
Maximum Moment (k-ft)	6631.1	5750.8	5403.5	5274.8	5229.4	10492.6	21545.4	4846.5	3897.9	4379.8	4665.9	5337.1	4216.3	4046.6	328.7	1100.4
Maximum Moment (k-ft/ft)	186.8	159.7	150.1	146.5	145.3	149.9	157.3	93.2	108.3	121.7	129.6	148.3	117.1	112.4	9.1	50.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-16 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 690027

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY					
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.0**	**1.3**	**1.1**	**1.0**	**1.8**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES					
100-yr Water Surface Elevation (ft - MSL)	6.3	6.3	6.3	6.3	6.3
Bed Elevation (ft - MSL)	5	5	5	5	5
Low Chord Elevation (ft - MSL)	2.0	2.0	2.0	2.0	2.0
100-yr Max Wave Crest Elevation (ft - MSL)	7.0	6.9	7.0	7.0	7.0
100-yr Wave Height (ft)	0.9	0.9	1.1	0.9	0.9
100-yr Wave Period (seconds)	6.7	6.7	6.7	6.7	6.7

SPAN PROPERITES					
Span Length (ft)	22.0	22.0	22.0	22.0	22.0
Span Width (ft)	46.8	46.8	46.8	46.8	46.8
Deck Thickness (ft)	1.0	1.0	1.0	1.0	1.0
Overhang (ft)	4.3	4.3	4.3	4.3	4.3
Number of Beams	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	6.9	6.9	6.9	6.9	6.9
Total Dead Weight (kip/ft)	6.9	6.9	6.9	6.9	6.9
Resisting Moment (kft/ft)	69.2	69.2	69.2	69.2	69.2
Resisting Vertical Force (kip/ft)	6.9	6.9	6.9	6.9	6.9

100-YEAR FORCE-MOMENT VALUES					
Maximum Vertical Force (kips/span)	29.8	36.1	29.8	29.8	50.5
Maximum Vertical Force (kips/ft)	1.4	1.6	1.4	1.4	2.3
Maximum Horizontal Force (kips/span)	1.3	1.2	0.9	1.3	28.0
Maximum Horizontal Force (kips/ft)	0.1	0.1	0.0	0.1	1.3
Maximum Moment (k-ft)	878.8	1100.4	982.0	878.8	1569.2
Maximum Moment (k-ft/ft)	39.9	50.0	44.6	39.9	71.3

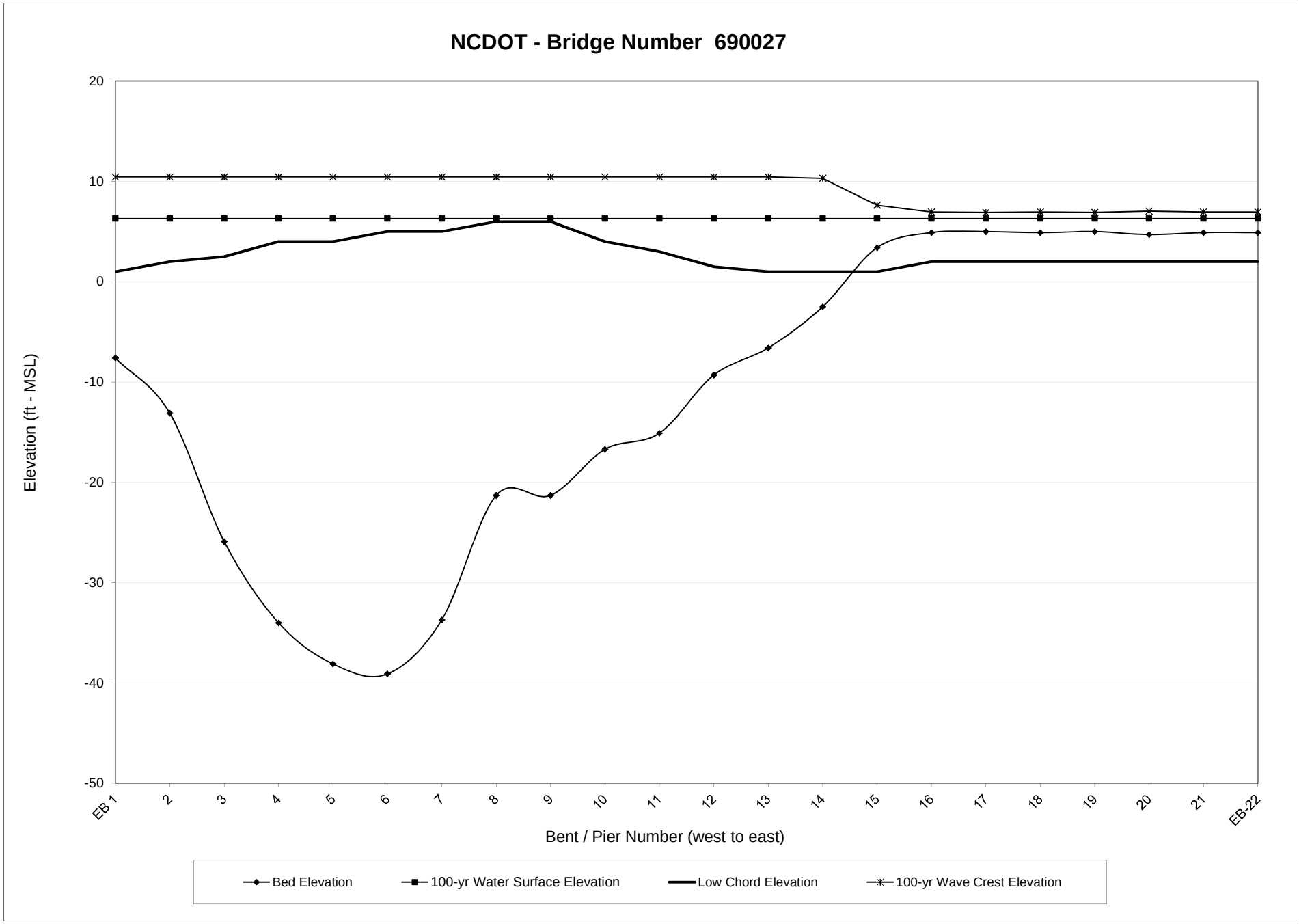
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-21 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 690027
Elevation (ft - MSL)
20
10
0
-10
-20
-30
-40
-50
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
EB-22
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 710008

PERQUIMANS RIVER

US17 BUS.

PERQUIMANS COUNTY

DRAFT

NCDOT BRIDGE NO. 710008

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.5**	**0.5**	**NA**	**NA**	**0.8**	**0.5**	**0.5**	**0.4**	**0.5**	**0.5**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Bed Elevation (ft - MSL)	-11	-21	-18	-18	-4	-2	-4	-3	-2	-2	-2	-2	-2	-2	-2	-2
Low Chord Elevation (ft - MSL)	4.9	4.9	5.9	5.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
100-yr Max Wave Crest Elevation (ft - MSL)	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
100-yr Wave Height (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
100-yr Wave Period (seconds)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6

SPAN PROPERITES																
Span Length (ft)	37.5	37.5	158.0	158.0	37.5	37.5	37.5	37.5	37.5	37.5	14.0	14.0	14.0	14.0	14.0	14.0
Span Width (ft)	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2
Deck Thickness (ft)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Overhang (ft)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Number of Beams	3	3	TRUSS	TRUSS	3	3	3	3	3	3	0	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	900	900	NA	NA	900	900	900	900	900	900	0	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	2.7	2.7	NA	NA	2.7	2.7	2.7	2.7	2.7	2.7	0.0	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	6.6	6.6	NA	NA	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
Total Dead Weight (kip/ft)	9.3	9.3	NA	NA	9.3	9.3	9.3	9.3	9.3	9.3	6.6	6.6	6.6	6.6	6.6	6.6
Resisting Moment (kft/ft)	156.7	156.7	NA	NA	156.7	156.7	156.7	156.7	156.7	156.7	33.7	33.7	33.7	33.7	33.7	33.7
Resisting Vertical Force (kip/ft)	9.3	9.3	NA	NA	9.3	9.3	9.3	9.3	9.3	9.3	6.6	6.6	6.6	6.6	6.6	6.6

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	105.1	107.0	NA	NA	179.2	105.1	102.9	101.3	103.6	103.0	40.9	40.9	40.7	40.8	41.0	40.9
Maximum Vertical Force (kips/ft)	2.8	2.9	NA	NA	4.8	2.8	2.7	2.7	2.8	2.7	2.9	2.9	2.9	2.9	2.9	2.9
Maximum Horizontal Force (kips/span)	13.6	13.8	NA	NA	22.0	14.7	14.4	14.6	15.0	14.5	6.3	6.3	3.7	3.6	6.2	6.3
Maximum Horizontal Force (kips/ft)	0.4	0.4	NA	NA	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.3	0.3	0.4	0.5
Maximum Moment (k-ft)	1688.7	1731.4	NA	NA	2614.0	1637.5	1558.1	1488.3	1535.0	1521.4	547.8	550.3	546.3	547.1	551.9	550.3
Maximum Moment (k-ft/ft)	45.0	46.2	NA	NA	69.7	43.7	41.5	39.7	40.9	40.6	39.1	39.3	39.0	39.1	39.4	39.3

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-16 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 710008

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY					
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.1**	**2.0**	**2.0**	**2.0**	**1.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES					
100-yr Water Surface Elevation (ft - MSL)	7.3	7.3	7.3	7.3	7.3
Bed Elevation (ft - MSL)	-2	-2	-2	-1	-1
Low Chord Elevation (ft - MSL)	4.9	4.9	4.9	4.9	4.9
100-yr Max Wave Crest Elevation (ft - MSL)	9.1	9.1	9.1	9.1	9.1
100-yr Wave Height (ft)	2.6	2.6	2.6	2.6	2.6
100-yr Wave Period (seconds)	2.6	2.6	2.6	2.6	2.6

SPAN PROPERITES					
Span Length (ft)	14.0	14.0	14.0	14.0	14.0
Span Width (ft)	23.2	23.2	23.2	23.2	23.2
Deck Thickness (ft)	1.9	1.9	1.9	1.9	1.9
Overhang (ft)	6.0	6.0	6.0	6.0	6.0
Number of Beams	0	0	0	0	0
Beam Dead Weight (lb/lf) - Each	0	0	0	0	0
Beam Dead Weight (kip/ft) - Total	0.0	0.0	0.0	0.0	0.0
Slab Dead Weight (kip/ft)	6.6	6.6	6.6	6.6	6.6
Total Dead Weight (kip/ft)	6.6	6.6	6.6	6.6	6.6
Resisting Moment (kft/ft)	33.7	33.7	33.7	33.7	33.7
Resisting Vertical Force (kip/ft)	6.6	6.6	6.6	6.6	6.6

100-YEAR FORCE-MOMENT VALUES					
Maximum Vertical Force (kips/span)	40.9	40.6	40.9	40.9	40.1
Maximum Vertical Force (kips/ft)	2.9	2.9	2.9	2.9	2.9
Maximum Horizontal Force (kips/span)	3.6	3.7	6.4	6.4	6.7
Maximum Horizontal Force (kips/ft)	0.3	0.3	0.5	0.5	0.5
Maximum Moment (k-ft)	552.5	542.3	544.1	544.1	522.9
Maximum Moment (k-ft/ft)	39.5	38.7	38.9	38.9	37.4

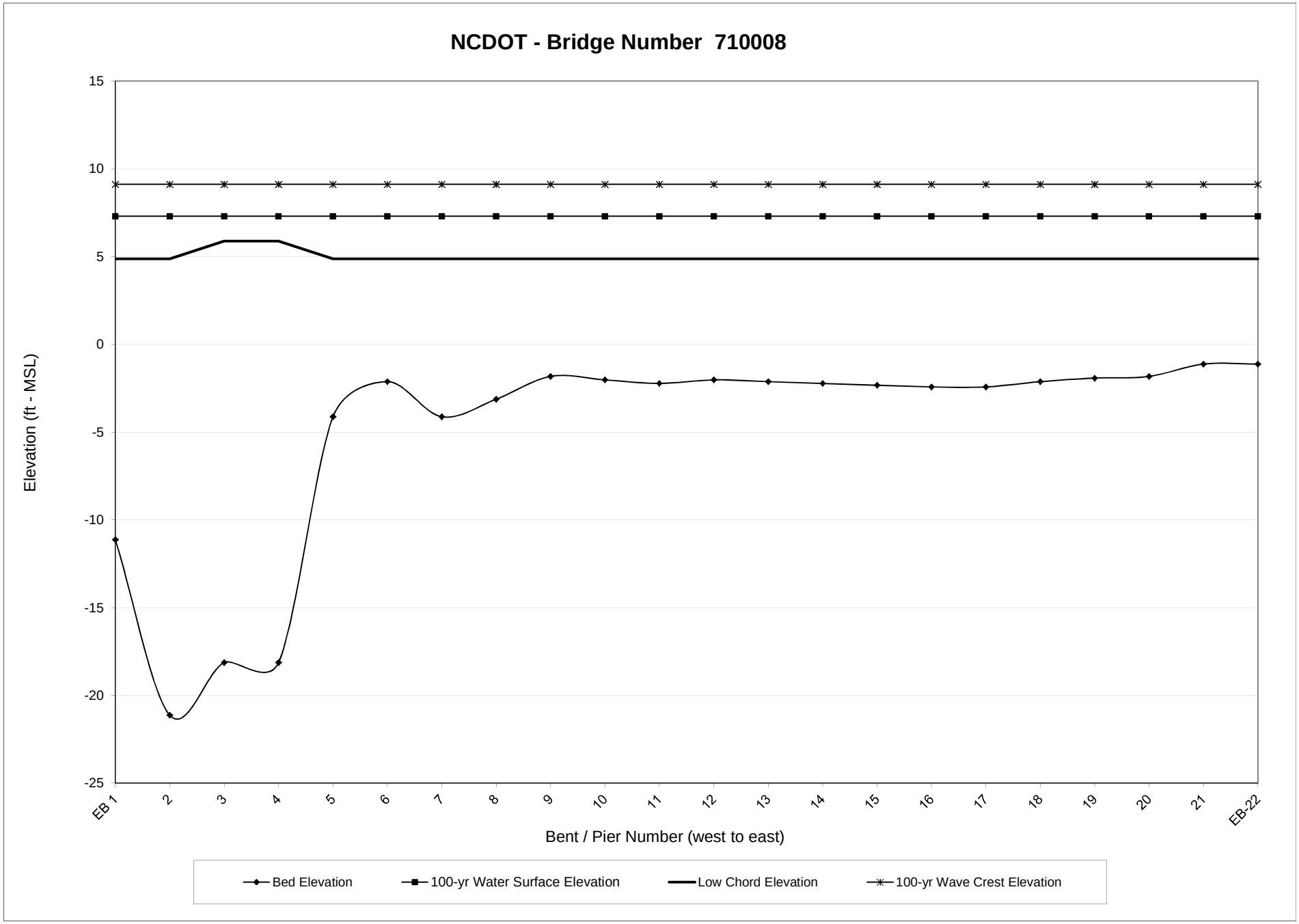
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-21 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 710008
Elevation (ft - MSL)
15
10
5
0
-5
-10
-15
-20
-25
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
EB-22
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 710014

PERQUIMANS RIVER

US17 SBL

PERQUIMANS COUNTY

DRAFT

NCDOT BRIDGE NO. 710014

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**1.1**	**0.8**	**0.7**	**0.3**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Bed Elevation (ft - MSL)	-1	-2	-2	-4	-5	-7	-7	-8	-8	-8	-9	-9	-9	-10	-10	-11
Low Chord Elevation (ft - MSL)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.8	6.1	7.5	8.8	10.2	11.5	12.8	14.2
100-yr Max Wave Crest Elevation (ft - MSL)	11.0	11.4	11.4	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
100-yr Wave Height (ft)	5.5	6.2	6.2	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	6.7	6.3	6.3	6.1	6.1	6.1	5.9	5.9	5.9	5.8	5.8	5.6

SPAN PROPERITES																
Span Length (ft)	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Span Width (ft)	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Total Dead Weight (kip/ft)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Resisting Moment (kft/ft)	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8
Resisting Vertical Force (kip/ft)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	217.9	201.2	201.2	192.2	190.2	194.6	194.6	212.2	220.5	646.4	445.5	222.9	111.8	14.9	0.4	0.0
Maximum Vertical Force (kips/ft)	3.6	3.4	3.4	3.2	3.2	3.2	3.2	3.5	3.7	10.8	7.4	3.7	1.9	0.2	0.0	0.0
Maximum Horizontal Force (kips/span)	140.1	155.6	155.6	169.2	159.7	142.2	142.2	129.6	130.5	111.9	89.1	58.3	30.7	6.6	0.0	0.0
Maximum Horizontal Force (kips/ft)	2.3	2.6	2.6	2.8	2.7	2.4	2.4	2.2	2.2	1.9	1.5	1.0	0.5	0.1	0.0	0.0
Maximum Moment (k-ft)	3136.1	2820.5	2820.5	3099.5	3065.3	3044.1	3044.1	3222.9	3193.9	5636.8	4302.9	3321.2	1638.7	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	52.3	47.0	47.0	51.7	51.1	50.7	50.7	53.7	53.2	93.9	71.7	55.4	27.3	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-15 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 710014

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Bed Elevation (ft - MSL)	-10	-11	-11	-11	-11	-12	-11	-12	-12	-12	-12	-12	-11	-13	-13	-12
Low Chord Elevation (ft - MSL)	15.5	16.9	18.2	19.5	20.9	22.2	23.6	24.9	26.2	27.6	28.9	30.3	31.6	31.6	31.6	30.6
100-yr Max Wave Crest Elevation (ft - MSL)	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
100-yr Wave Height (ft)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
100-yr Wave Period (seconds)	5.8	5.6	5.6	5.6	5.6	5.5	5.6	5.5	5.5	5.5	5.5	5.6	5.6	5.4	5.5	5.5

SPAN PROPERITES																
Span Length (ft)	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	80.0	60.0	60.0
Span Width (ft)	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Total Dead Weight (kip/ft)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Resisting Moment (kft/ft)	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	198.2	147.8	147.8
Resisting Vertical Force (kip/ft)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 710014

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																	
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.4**	**0.1**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																	
HYDRAULIC VALUES																	
100-yr Water Surface Elevation (ft - MSL)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Bed Elevation (ft - MSL)	-12	-12	-12	-12	-11	-11	-11	-11	-11	-10	-9	-3	-3	-3	-3	-3	-3
Low Chord Elevation (ft - MSL)	28.6	27.6	26.6	24.6	23.6	22.6	20.6	19.6	18.6	16.6	15.6	14.6	12.6	11.6	10.6	8.6	8.6
100-yr Max Wave Crest Elevation (ft - MSL)	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	11.9	11.9	11.9	11.9	11.9	11.9
100-yr Wave Height (ft)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	6.8	6.8	6.8	6.8	6.8	6.8
100-yr Wave Period (seconds)	5.5	5.5	5.5	5.6	5.6	5.6	5.6	5.6	5.6	5.8	5.9	7.0	7.0	7.0	7.0	7.0	7.0
SPAN PROPERITES																	
Span Length (ft)	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Span Width (ft)	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0
Deck Thickness (ft)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overhang (ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Slab Dead Weight (kip/ft)	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Total Dead Weight (kip/ft)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Resisting Moment (kft/ft)	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8	147.8
Resisting Vertical Force (kip/ft)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
100-YEAR FORCE-MOMENT VALUES																	
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.3	36.9	73.7	199.8	36.9
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.2	3.3	0.6
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	36.6	81.8	147.5	36.6
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.4	2.5	0.6
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	494.0	573.1	1895.9	494.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2	9.6	31.6	8.2

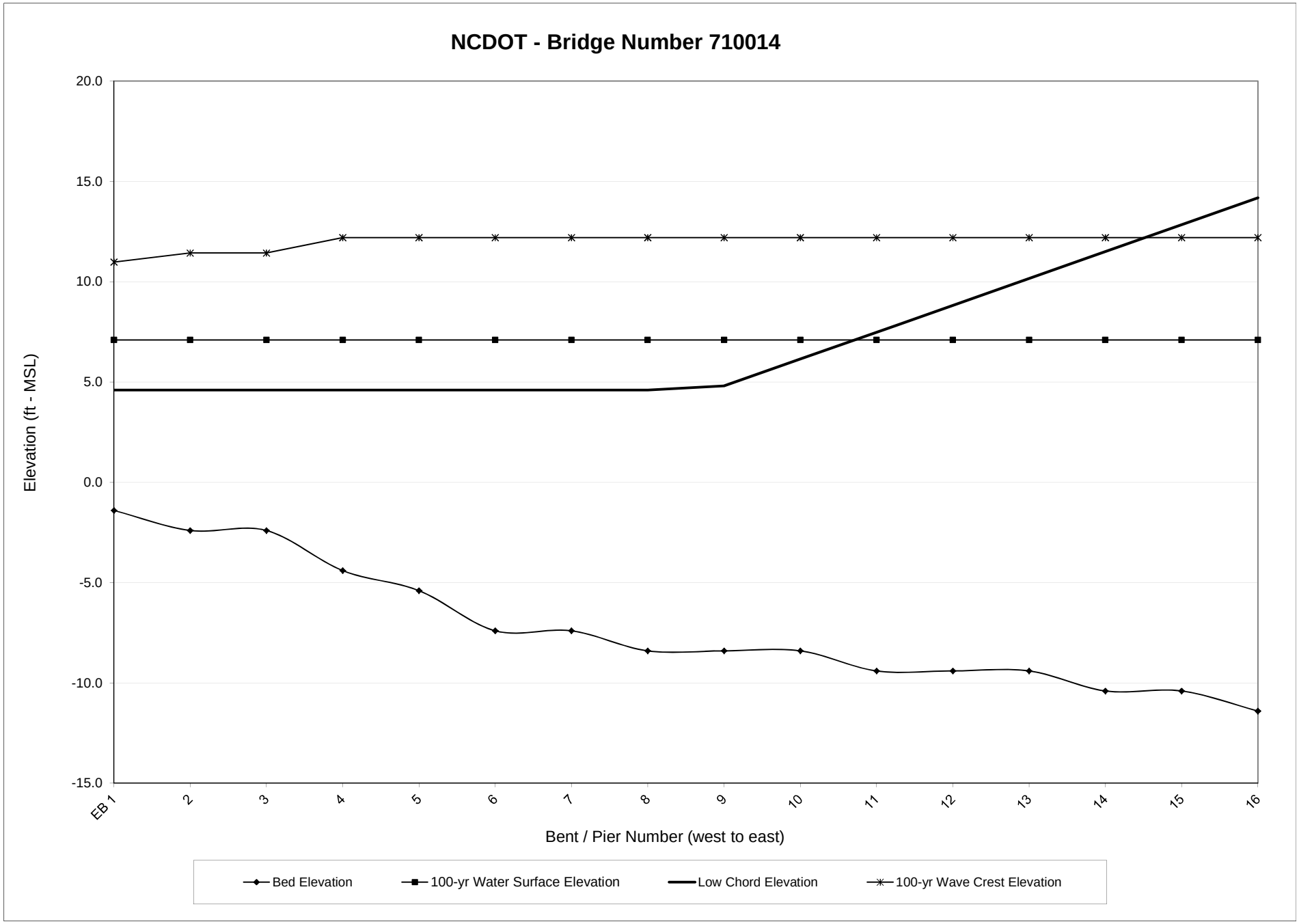
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

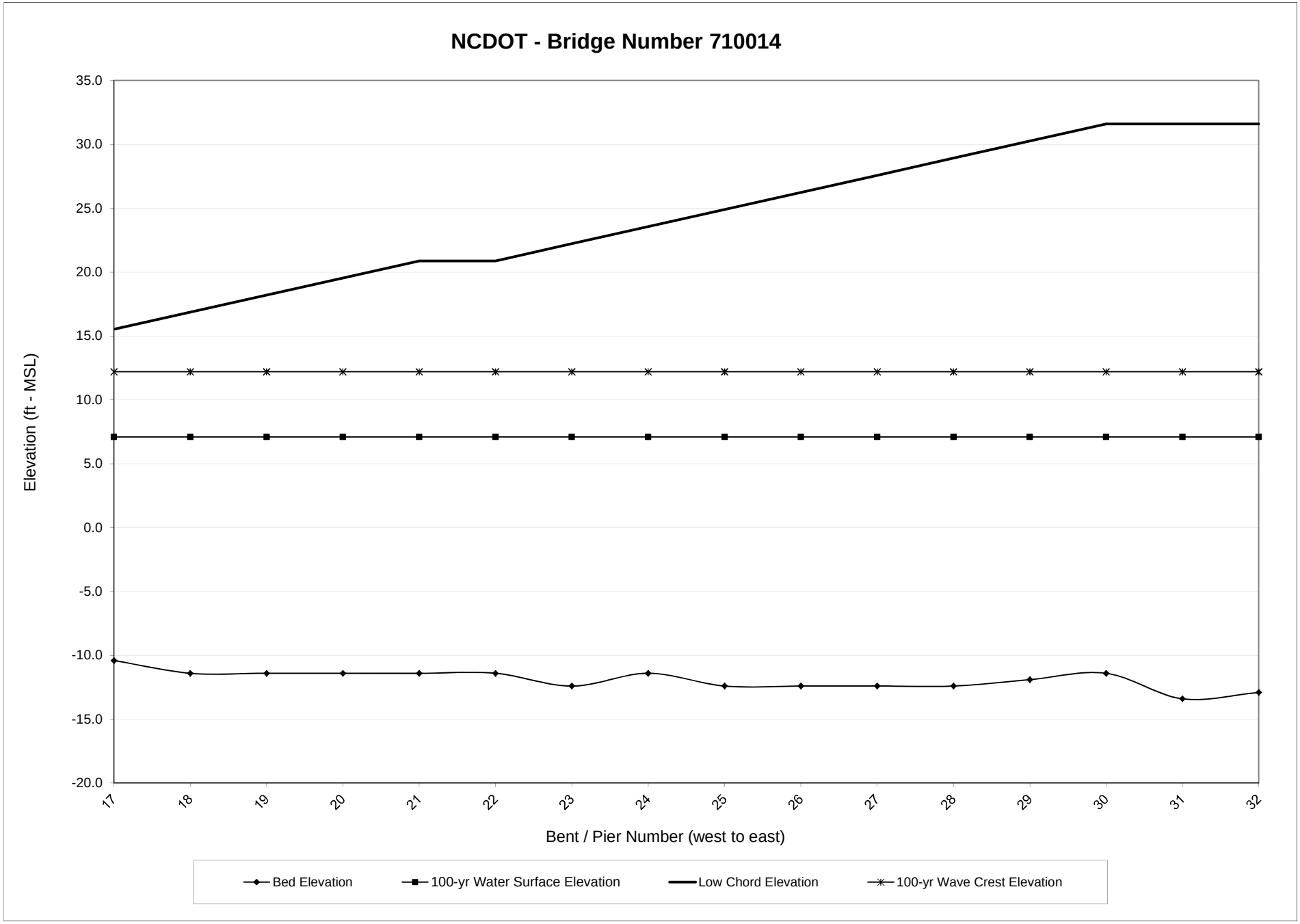
Notes:

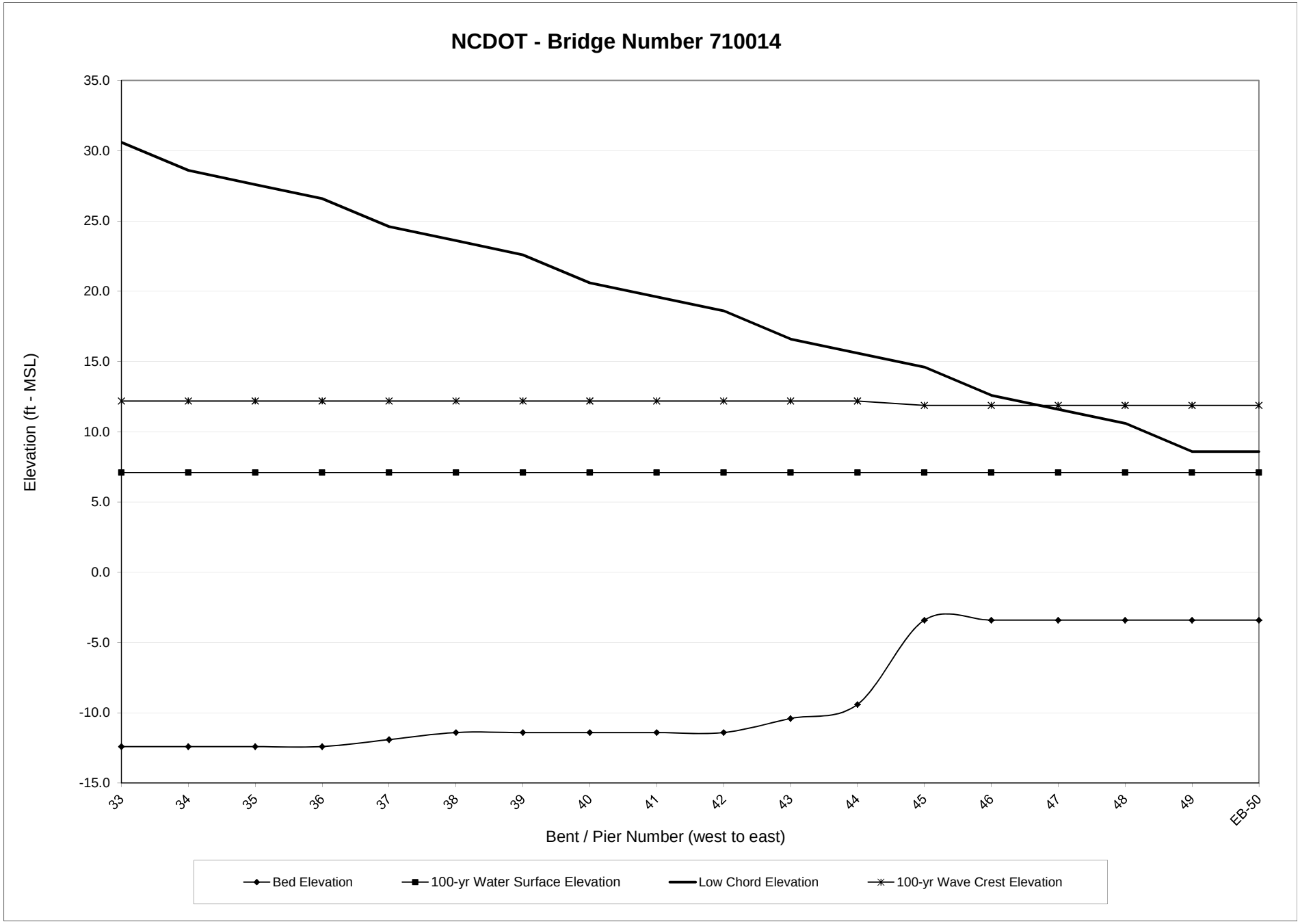
1 - Bridge spans 44-49 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 710014
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 710014
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 710014
Elevation (ft - MSL)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
EB-50
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 710019

BRIGHTS MILL CREEK

US17 BUS

PERQUIMANS COUNTY

DRAFT

NCDOT BRIDGE NO. 710019

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY								
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**3.9**	**4.1**	**4.2**	**4.2**	**4.0**	**3.6**	**3.4**	**3.4**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES								
100-yr Water Surface Elevation (ft - MSL)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Bed Elevation (ft - MSL)	-4	-14	-15	-15	-5	-2	-1	-1
Low Chord Elevation (ft - MSL)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
100-yr Wave Period (seconds)	3.6	2.9	2.8	2.8	3.5	3.9	4.1	4.1

SPAN PROPERITES								
Span Length (ft)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Span Width (ft)	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0
Deck Thickness (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Overhang (ft)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Number of Beams	7	7	7	7	7	7	7	7
Beam Dead Weight (lb/lf) - Each	43	43	43	43	43	43	43	43
Beam Dead Weight (kip/ft) - Total	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Slab Dead Weight (kip/ft)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Total Dead Weight (kip/ft)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Resisting Moment (kft/ft)	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6
Resisting Vertical Force (kip/ft)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

100-YEAR FORCE-MOMENT VALUES								
Maximum Vertical Force (kips/span)	60.4	65.6	67.5	67.2	60.7	58.0	54.9	54.9
Maximum Vertical Force (kips/ft)	3.0	3.3	3.4	3.4	3.0	2.9	2.7	2.7
Maximum Horizontal Force (kips/span)	9.9	6.5	6.3	6.2	8.2	9.2	9.6	10.0
Maximum Horizontal Force (kips/ft)	0.5	0.3	0.3	0.3	0.4	0.5	0.5	0.5
Maximum Moment (k-ft)	1,064	1,118	1,130	1,138	1,082	982	911	911
Maximum Moment (k-ft/ft)	53	56	57	57	54	49	46	46

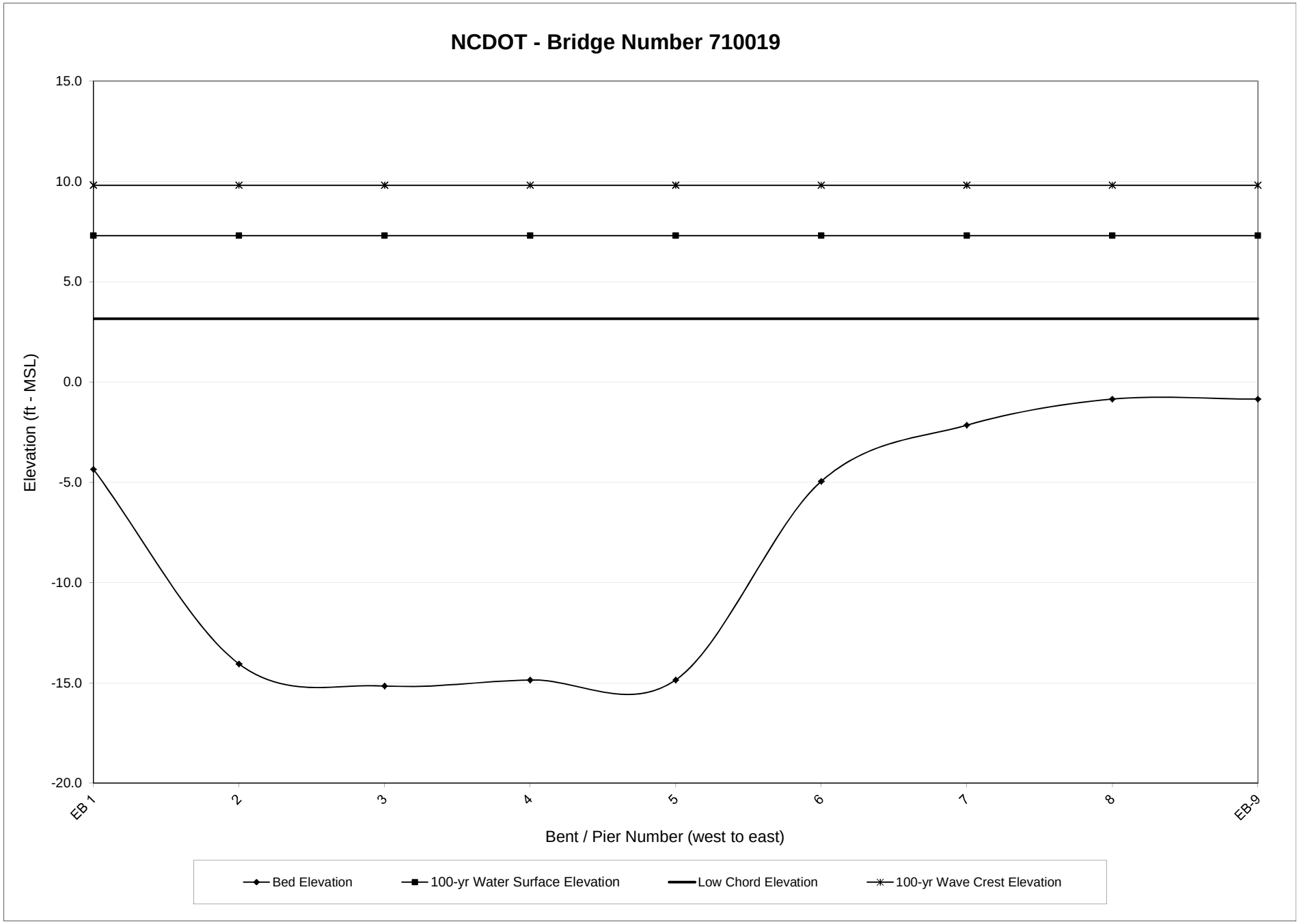
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

Notes:

1 - Bridge spans 1-8 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)


NCDOT - Bridge Number 710019
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
EB-9
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 710080

PERQUIMANS RIVER

US17 NBL

PERQUIMANS COUNTY

DRAFT

NCDOT BRIDGE NO. 710080

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.9**	**1.8**	**1.8**	**1.7**	**1.6**	**1.6**	**1.3**	**1.2**	**0.9**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Bed Elevation (ft - MSL)	-8	-13	-14	-16	-17	-17	-21	-22	-23	-24	-25	-27	-29	-31	-33	-34
Low Chord Elevation (ft - MSL)	4.6	4.6	4.6	4.7	5.1	5.5	6.2	7.1	8.1	9.3	10.7	12.2	13.9	15.7	17.5	19.3
100-yr Max Wave Crest Elevation (ft - MSL)	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
100-yr Wave Height (ft)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
100-yr Wave Period (seconds)	6.2	5.5	5.4	5.2	5.1	5.1	4.8	4.7	4.7	4.6	4.5	4.5	4.4	4.3	4.2	4.2

SPAN PROPERITES																
Span Length (ft)	60.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Total Dead Weight (kip/ft)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
Resisting Moment (kft/ft)	202.8	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3
Resisting Vertical Force (kip/ft)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	316.2	659.4	643.2	674.4	673.9	803.1	677.0	472.4	289.8	135.3	3.5	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	5.3	11.2	10.9	11.4	11.4	13.6	11.5	8.0	4.9	2.3	0.1	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	128.8	102.1	92.6	85.5	76.4	68.7	63.1	47.2	32.5	17.3	3.1	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	2.1	1.7	1.6	1.4	1.3	1.2	1.1	0.8	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	6436.2	12219.2	11938.0	11570.6	10731.0	10997.7	9046.6	7979.1	5721.1	2564.2	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	107.3	207.1	202.3	196.1	181.9	186.4	153.3	135.2	97.0	43.5	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-11 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 710080

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Bed Elevation (ft - MSL)	-35	-37	-39	-41	-43	-45	-46	-47	-48	-49	-51	-52	-53	-53	-53	-53
Low Chord Elevation (ft - MSL)	21.1	22.9	24.7	26.5	28.1	29.6	30.9	32.0	32.6	32.6	33.6	34.6	34.6	33.6	32.6	31.6
100-yr Max Wave Crest Elevation (ft - MSL)	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
100-yr Wave Height (ft)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
100-yr Wave Period (seconds)	4.1	4.1	4.0	4.0	3.9	3.9	3.9	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8

SPAN PROPERITES																
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	99.0	119.0	99.0	59.0	59.0
Span Width (ft)	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Total Dead Weight (kip/ft)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
Resisting Moment (kft/ft)	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	337.7	406.9	337.7	199.3	199.3
Resisting Vertical Force (kip/ft)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are not subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 710080

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY														
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES														
100-yr Water Surface Elevation (ft - MSL)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Bed Elevation (ft - MSL)	-51	-50	-50	-47	-44	-43	-41	-39	-37	-34	-32	-27	-20	-20
Low Chord Elevation (ft - MSL)	30.6	29.6	27.6	26.6	26.0	24.2	22.4	20.6	18.8	17.0	15.2	13.4	11.6	11.6
100-yr Max Wave Crest Elevation (ft - MSL)	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
100-yr Wave Height (ft)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
100-yr Wave Period (seconds)	3.8	3.8	3.8	3.8	3.9	3.9	4.0	4.0	4.1	4.2	4.3	4.4	4.8	4.8

SPAN PROPERITES														
Span Length (ft)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Span Width (ft)	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9	38.9
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Number of Beams	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Beam Dead Weight (lb/lf) - Each	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Beam Dead Weight (kip/ft) - Total	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Slab Dead Weight (kip/ft)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Total Dead Weight (kip/ft)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
Resisting Moment (kft/ft)	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3
Resisting Vertical Force (kip/ft)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9

100-YEAR FORCE-MOMENT VALUES														
Maximum Vertical Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	31.6
Maximum Vertical Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Maximum Horizontal Force (kips/span)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.0
Maximum Horizontal Force (kips/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	568.5
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6

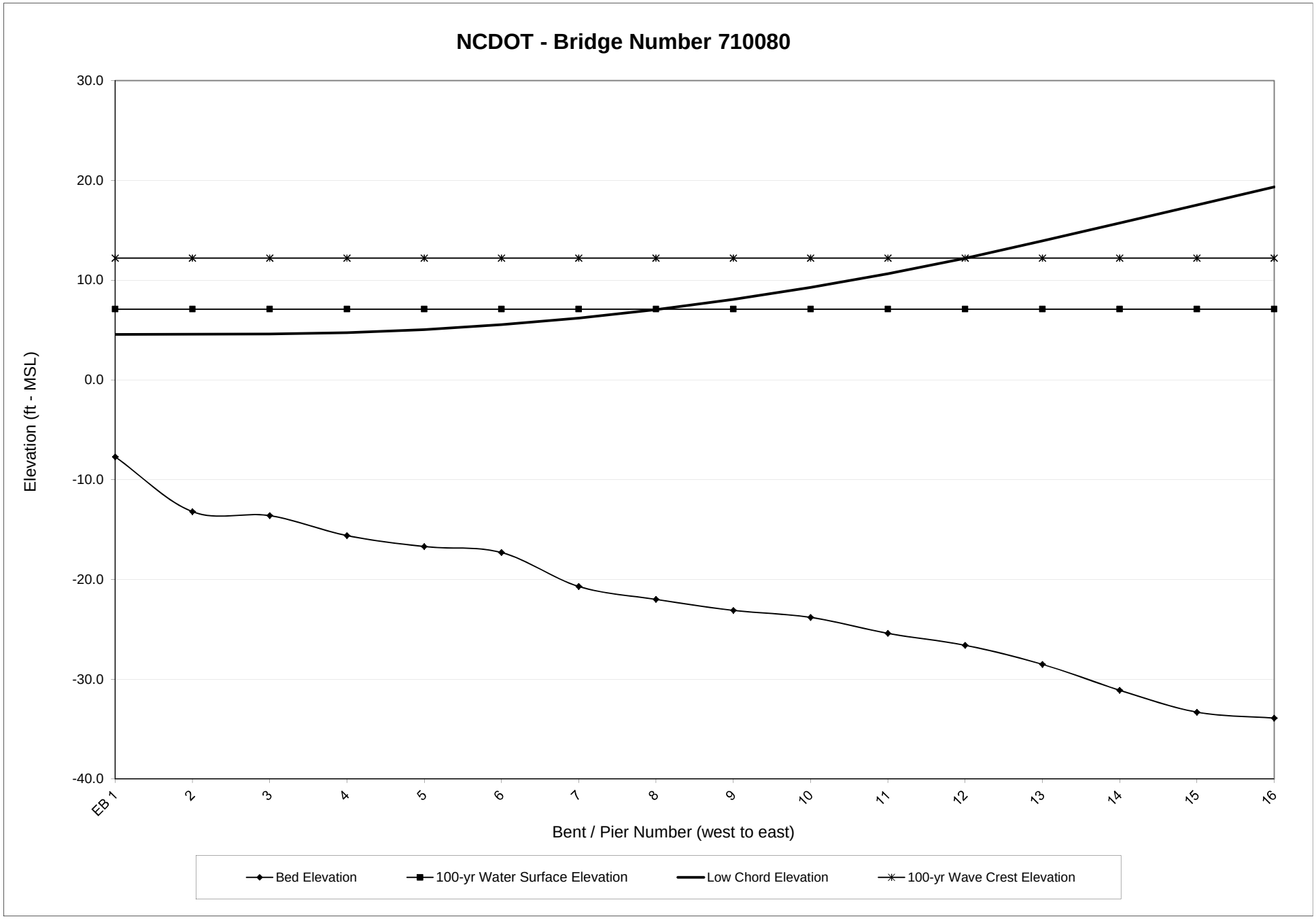
Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

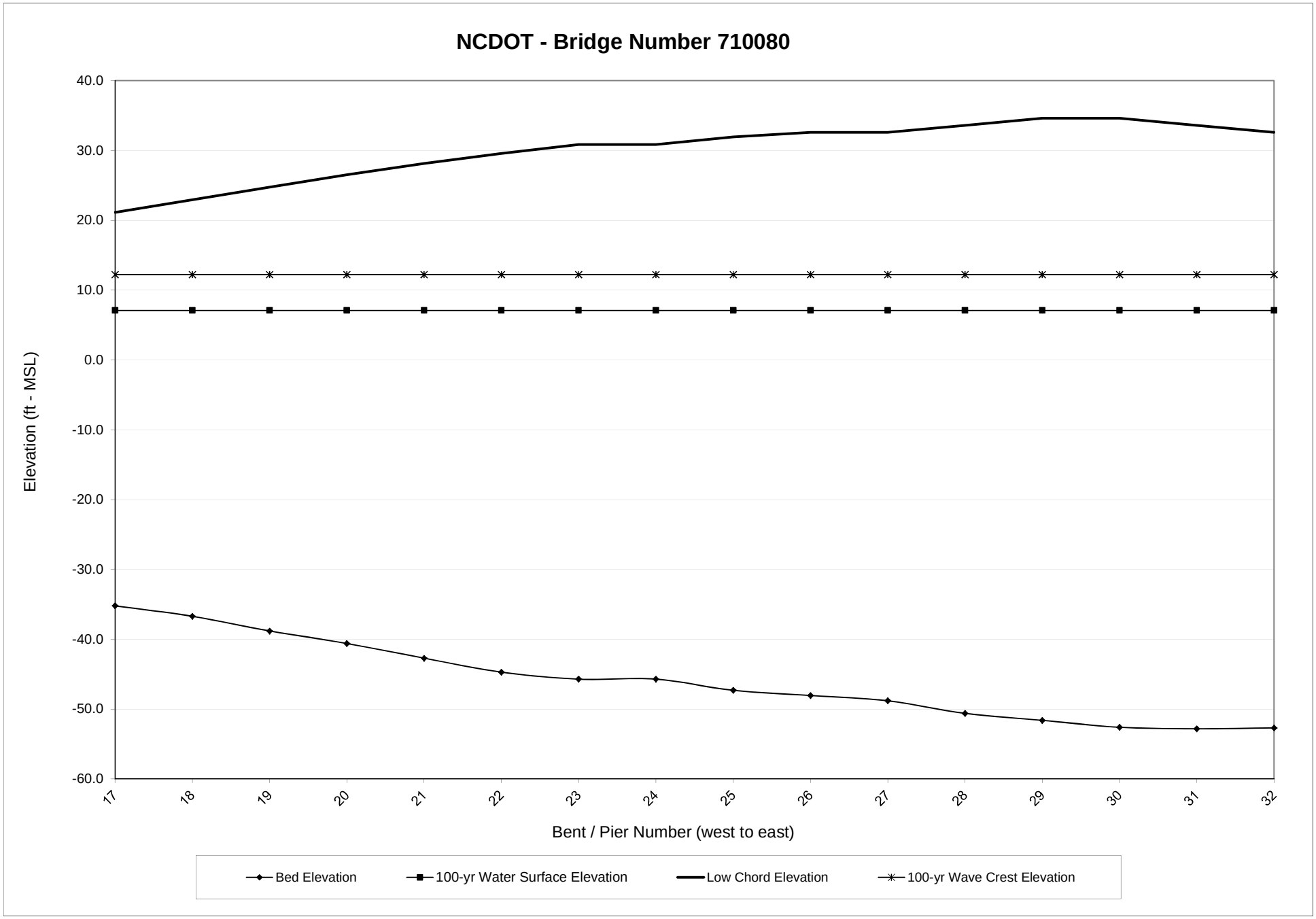
Notes:

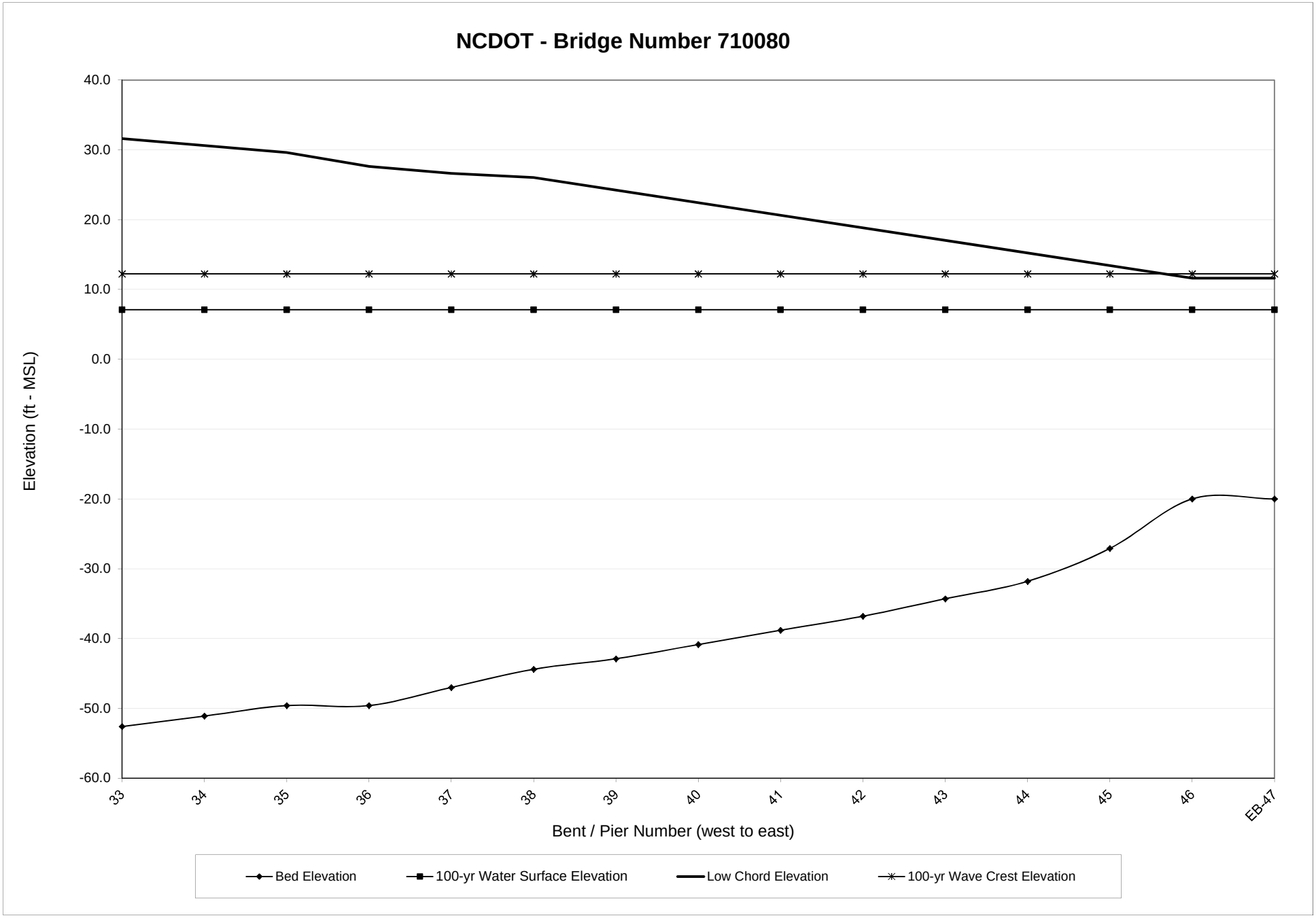
1 - Bridge spans 45-46 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)


NCDOT - Bridge Number 710080
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 710080
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Elevation (ft - MSL)
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 710080
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Elevation (ft - MSL)
33
34
35
36
37
38
39
40
41
42
43
44
45
46
EB-47
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

BRIDGE NUMBER 880007

ALLIGATOR RIVER

US64-US65-US66

TYRRELL COUNTY

DRAFT

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.5**	**1.0**	**2.2**	**2.2**	**2.1**	**2.2**	**1.9**	**2.2**	**2.1**	**1.9**	**1.4**	**1.0**	**1.0**	**0.8**	**0.6**	**0.2**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-5	-5	-6	-7	-8	-9	-9	-10	-10	-11	-10	-10	-10	-11	-11	-11
Low Chord Elevation (ft - MSL)	1.3	2.3	2.8	2.8	3.3	3.8	4.3	4.3	4.8	5.3	6.3	6.8	7.3	7.8	8.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	7.5	7.5	7.9	8.4	8.8	9.3	9.3	9.7	9.8	9.8	9.8	9.7	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	5.4	5.4	6.0	6.7	7.3	8.0	8.0	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.7	7.5	7.4	7.5	7.7	7.5	7.4	7.4	7.4
SPAN PROPERITES																
Span Length (ft)	49.5	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	70.7	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	192.2	260.7	414.1	471.8	450.0	427.6	358.7	413.0	371.7	307.0	198.2	163.0	139.9	111.1	87.3	39.2
Maximum Vertical Force (kips/ft)	3.9	5.3	8.5	9.6	9.2	8.7	7.3	8.4	7.6	6.3	4.0	3.3	2.9	2.3	1.8	0.8
Maximum Horizontal Force (kips/span)	101.8	92.7	105.0	127.9	136.1	153.4	141.2	168.8	141.7	122.9	143.0	145.7	104.9	82.4	68.7	34.4
Maximum Horizontal Force (kips/ft)	2.1	1.9	2.1	2.6	2.8	3.1	2.9	3.4	2.9	2.5	2.9	3.0	2.1	1.7	1.4	0.7
Maximum Moment (k-ft)	2909.9	1947.9	4313.4	4284.0	4083.5	4277.3	3644.1	4343.1	4084.1	3668.9	2728.6	2027.4	1893.6	1614.2	1204.9	303.9
Maximum Moment (k-ft/ft)	58.8	39.8	88.0	87.4	83.3	87.3	74.4	88.6	83.3	74.9	55.7	41.4	38.6	32.9	24.6	6.2

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 1-16 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-12	-12	-12	-13	-13	-13	-13	-13	-13	-13	-13	-14	-13	-13	-13	-13
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	7.2	7.2	7.2	7.0	7.0	7.0	7.0	7.0	6.9	6.9	6.9	6.8	6.9	6.9	6.9	7.0

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	26.6	26.6	26.6	24.9	24.9	24.9	24.9	24.9	17.9	17.9	17.9	12.6	17.9	17.9	17.9	24.9
Maximum Vertical Force (kips/ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.4	0.4	0.4	0.5
Maximum Horizontal Force (kips/span)	21.8	21.8	21.8	15.6	15.6	15.6	15.6	15.6	12.4	12.4	12.4	10.5	12.4	12.4	12.4	15.6
Maximum Horizontal Force (kips/ft)	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3
Maximum Moment (k-ft)	21.2	21.2	21.2	94.4	94.4	94.4	94.4	94.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.4
Maximum Moment (k-ft/ft)	0.4	0.4	0.4	1.9	1.9	1.9	1.9	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 17-32 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-13	-13	-13	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	6.9	6.9	6.9	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	17.9	17.9	17.9	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Maximum Vertical Force (kips/ft)	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Maximum Horizontal Force (kips/span)	12.4	12.4	12.4	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Maximum Horizontal Force (kips/ft)	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 33-48 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES																
HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-14	-14	-14	-14	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	6.8	6.8	6.8	6.8	6.9	6.9	6.9	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	12.6	12.6	12.6	12.6	17.9	17.9	17.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9
Maximum Vertical Force (kips/ft)	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum Horizontal Force (kips/span)	10.5	10.5	10.5	10.5	12.4	12.4	12.4	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
Maximum Horizontal Force (kips/ft)	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 49-64 are potentiallysubject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-13	-13	-13	-14	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	6.9	6.9	6.9	6.8	6.9	6.9	6.9	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	17.9	17.9	17.9	12.6	17.9	17.9	17.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9
Maximum Vertical Force (kips/ft)	0.4	0.4	0.4	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum Horizontal Force (kips/span)	12.4	12.4	12.4	10.5	12.4	12.4	12.4	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
Maximum Horizontal Force (kips/ft)	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 65-80 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9
Maximum Vertical Force (kips/ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum Horizontal Force (kips/span)	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
Maximum Horizontal Force (kips/ft)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Maximum Moment (k-ft)	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4
Maximum Moment (k-ft/ft)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 81-96 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-14	-14	-14	-14	-14
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.9	6.9	6.9	6.8	6.8	6.8	6.8	6.8

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	17.9	17.9	17.9	12.6	12.6	12.6	12.6	12.6
Maximum Vertical Force (kips/ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3
Maximum Horizontal Force (kips/span)	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	12.4	12.4	12.4	10.5	10.5	10.5	10.5	10.5
Maximum Horizontal Force (kips/ft)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
Maximum Moment (k-ft)	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 97-112 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**113**	**114**	**Swing 1**	**Swing 2**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.4**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13
Low Chord Elevation (ft - MSL)	9.3	9.3	7.3	7.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.9

SPAN PROPERITES																
Span Length (ft)	49.0	49.5	134.0	134.0	49.5	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	70.7	194.7	194.7	70.7	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	24.9	25.1	425.5	425.5	25.1	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	17.9
Maximum Vertical Force (kips/ft)	0.5	0.5	3.2	3.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4
Maximum Horizontal Force (kips/span)	15.6	15.7	131.7	131.7	15.7	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	12.4
Maximum Horizontal Force (kips/ft)	0.3	0.3	1.0	1.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Maximum Moment (k-ft)	94.4	95.5	5358.5	5358.5	95.5	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	0.0
Maximum Moment (k-ft/ft)	1.9	1.9	40.0	40.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 113-126 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**	**142**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-13	-13	-13	-13	-13	-13	-13	-13	-14	-14	-14	-14	-14	-15	-15	-15
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.8	6.7	6.7	6.7	6.7	6.7	6.7	6.7

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9	12.6	10.7	10.7	10.7	10.7	6.3	6.3	6.3
Maximum Vertical Force (kips/ft)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1
Maximum Horizontal Force (kips/span)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	10.5	8.9	8.9	8.9	8.9	6.4	6.4	6.4
Maximum Horizontal Force (kips/ft)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 127-142 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**143**	**144**	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**	**153**	**154**	**155**	**156**	**157**	**158**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-15	-15	-15	-15	-15	-15	-15	-16	-16	-16	-16	-16	-17	-17	-17	-17
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	6.7	6.7	6.7	6.6	6.6	6.6	6.6	6.5	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	6.3	6.3	6.3	4.6	4.6	4.6	4.6	6.6	4.0	4.0	4.0	4.0	3.7	3.7	3.7	3.7
Maximum Vertical Force (kips/ft)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Maximum Horizontal Force (kips/span)	6.4	6.4	6.4	5.3	5.3	5.3	5.3	5.0	3.5	3.5	3.5	3.5	3.6	3.6	3.6	3.6
Maximum Horizontal Force (kips/ft)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 143-158 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**159**	**160**	**161**	**162**	**163**	**164**	**165**	**166**	**167**	**168**	**169**	**170**	**171**	**172**	**173**	**174**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-16	-16	-16	-16
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	4.0	4.0	4.0	4.0
Maximum Vertical Force (kips/ft)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Maximum Horizontal Force (kips/span)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.5	3.5	3.5	3.5
Maximum Horizontal Force (kips/ft)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 159-174 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**175**	**176**	**177**	**178**	**179**	**180**	**181**	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**	**190**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-16	-16	-16	-16	-16	-16	-15	-15	-15	-15	-15	-15	-15	-15	-15	-15
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	6.5	6.5	6.5	6.5	6.5	6.5	6.6	6.6	6.6	6.6	6.7	6.7	6.7	6.7	6.7	6.7

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	6.6	6.6	6.6	6.6	6.6	6.6	4.6	4.6	4.6	4.6	6.3	6.3	6.3	6.3	6.3	6.3
Maximum Vertical Force (kips/ft)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Maximum Horizontal Force (kips/span)	5.0	5.0	5.0	5.0	5.0	5.0	5.3	5.3	5.3	5.3	6.4	6.4	6.4	6.4	6.4	6.4
Maximum Horizontal Force (kips/ft)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 175-190 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**191**	**192**	**193**	**194**	**195**	**196**	**197**	**198**	**199**	**200**	**201**	**202**	**203**	**204**	**205**	**206**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-14	-14	-14	-14	-14	-14	-14	-14	-14	-14	-13	-13	-13	-13	-13	-13
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	6.7	6.7	6.7	6.7	6.8	6.8	6.8	6.8	6.8	6.8	6.9	6.9	6.9	6.9	7.0	7.0

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	10.7	10.7	10.7	10.7	12.6	12.6	12.6	12.6	12.6	12.6	17.9	17.9	17.9	17.9	24.9	24.9
Maximum Vertical Force (kips/ft)	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5
Maximum Horizontal Force (kips/span)	8.9	8.9	8.9	8.9	10.5	10.5	10.5	10.5	10.5	10.5	12.4	12.4	12.4	12.4	15.6	15.6
Maximum Horizontal Force (kips/ft)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Maximum Moment (k-ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.4	94.4
Maximum Moment (k-ft/ft)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.9

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 191-206 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**207**	**208**	**209**	**210**	**211**	**212**	**213**	**214**	**215**	**216**	**217**	**218**	**219**	**220**	**221**	**222**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9
Maximum Vertical Force (kips/ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum Horizontal Force (kips/span)	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
Maximum Horizontal Force (kips/ft)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Maximum Moment (k-ft)	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4
Maximum Moment (k-ft/ft)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 207-222 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**223**	**224**	**225**	**226**	**227**	**228**	**229**	**230**	**231**	**232**	**233**	**234**	**235**	**236**	**237**	**238**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.2**	**0.4**	**0.5**	**0.6**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-12	-12	-12
Low Chord Elevation (ft - MSL)	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.2	9.0	8.8	8.7	8.5
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.1

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	34.1	44.9	56.3	65.6	77.5
Maximum Vertical Force (kips/ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.9	1.1	1.3	1.6
Maximum Horizontal Force (kips/span)	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	19.0	23.5	29.1	35.8	41.6
Maximum Horizontal Force (kips/ft)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.6	0.7	0.8
Maximum Moment (k-ft)	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	167.1	326.0	791.0	1024.8	1115.9
Maximum Moment (k-ft/ft)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	3.4	6.7	16.1	20.9	22.8

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 223-238 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**239**	**240**	**241**	**242**	**243**	**244**	**245**	**246**	**247**	**248**	**249**	**250**	**251**	**252**	**253**	**254**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**0.7**	**0.7**	**0.8**	**0.9**	**0.9**	**1.0**	**1.1**	**1.2**	**1.2**	**1.3**	**1.4**	**1.4**	**1.4**	**1.5**	**1.5**	**1.6**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-12	-12	-12	-12	-12	-12	-12	-11	-11	-11	-11	-11	-10	-10	-10	-10
Low Chord Elevation (ft - MSL)	8.3	8.2	8.0	7.8	7.7	7.5	7.3	7.2	7.0	6.8	6.7	6.5	6.3	6.2	6.0	5.8
100-yr Max Wave Crest Elevation (ft - MSL)	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
100-yr Wave Period (seconds)	7.1	7.2	7.2	7.2	7.2	7.2	7.2	7.3	7.3	7.3	7.3	7.4	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Slab Dead Weight (kip/ft)	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Total Dead Weight (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	87.6	97.2	110.2	118.9	125.8	131.1	143.0	153.1	160.7	168.1	180.7	187.3	198.2	210.8	224.4	235.3
Maximum Vertical Force (kips/ft)	1.8	2.0	2.2	2.4	2.6	2.7	2.9	3.1	3.3	3.4	3.7	3.8	4.0	4.3	4.6	4.8
Maximum Horizontal Force (kips/span)	44.7	58.6	62.8	66.5	67.5	72.1	75.8	72.5	77.5	84.0	90.1	127.8	143.0	151.3	148.9	147.7
Maximum Horizontal Force (kips/ft)	0.9	1.2	1.3	1.4	1.4	1.5	1.5	1.5	1.6	1.7	1.8	2.6	2.9	3.1	3.0	3.0
Maximum Moment (k-ft)	1275.0	1454.7	1658.7	1742.1	1795.3	1956.5	2085.1	2289.8	2410.2	2459.7	2644.2	2690.7	2728.6	2885.6	2960.4	3149.2
Maximum Moment (k-ft/ft)	26.0	29.7	33.9	35.6	36.6	39.9	42.6	46.7	49.2	50.2	54.0	54.9	55.7	58.9	60.4	64.3

Vulnerability Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 239-254 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**255**	**256**	**257**	**258**	**259**	**260**	**261**	**262**	**263**	**264**	**265**	**266**	**267**	**268**	**269**	**270**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.6**	**1.8**	**1.9**	**1.9**	**2.0**	**2.1**	**2.1**	**1.8**	**1.9**	**1.7**	**1.4**	**1.2**	**1.2**	**1.9**	**1.9**	**1.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-10	-10	-10	-10	-10	-11	-10	-9	-9	-8	-7	-6	-6	-6	-6	-5
Low Chord Elevation (ft - MSL)	5.7	5.5	5.3	5.2	5.0	4.8	4.7	4.5	4.3	4.3	4.3	4.3	4.3	3.3	3.3	3.3
100-yr Max Wave Crest Elevation (ft - MSL)	9.7	9.8	9.8	9.8	9.8	9.8	9.7	9.3	9.3	8.8	8.4	7.9	7.9	7.9	7.9	7.5
100-yr Wave Height (ft)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.0	8.0	7.3	6.7	6.0	6.0	6.0	6.0	5.4
100-yr Wave Period (seconds)	7.7	7.5	7.5	7.5	7.5	7.4	7.7	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Slab Dead Weight (kip/ft)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Total Dead Weight (kip/ft)	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Resisting Moment (kft/ft)	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	257.3	280.9	305.3	323.7	345.0	377.3	379.1	337.1	358.7	315.0	261.7	216.0	216.0	345.4	345.4	298.3
Maximum Vertical Force (kips/ft)	5.3	5.7	6.2	6.6	7.0	7.7	7.7	6.9	7.3	6.4	5.3	4.4	4.4	7.0	7.0	6.1
Maximum Horizontal Force (kips/span)	147.4	138.4	134.0	132.4	137.1	138.3	162.8	137.0	141.2	113.4	120.0	115.0	115.0	98.7	98.7	92.3
Maximum Horizontal Force (kips/ft)	3.0	2.8	2.7	2.7	2.8	2.8	3.3	2.8	2.9	2.3	2.4	2.3	2.3	2.0	2.0	1.9
Maximum Moment (k-ft)	3179.6	3452.4	3623.2	3700.3	3915.1	4168.5	4109.9	3494.3	3644.1	3288.1	2751.6	2444.8	2444.8	3712.5	3712.5	3747.5
Maximum Moment (k-ft/ft)	64.9	70.5	73.9	75.5	79.9	85.1	83.9	71.3	74.4	67.1	56.2	49.9	49.9	75.8	75.8	76.5

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 255-270 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**271**	**272**	**273**	**274**	**275**	**276**	**277**	**278**	**279**	**280**	**281**	**282**	**283**	**284**	**285**	**286**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.0**	**1.0**	**1.0**	**1.2**	**2.4**	**2.5**	**2.5**	**2.6**	**2.6**	**2.7**	**2.6**	**2.6**	**2.6**	**2.5**	**2.5**	**2.5**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
Low Chord Elevation (ft - MSL)	2.3	2.3	2.3	1.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
100-yr Max Wave Crest Elevation (ft - MSL)	7.2	7.2	7.2	7.0	7.1	7.2	7.2	7.3	7.3	7.4	7.3	7.3	7.3	7.2	7.2	7.2
100-yr Wave Height (ft)	5.1	5.1	5.1	4.7	4.9	5.0	5.1	5.1	5.2	5.3	5.2	5.1	5.1	5.1	5.1	5.0
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	49.0	49.0	49.0	49.5	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Slab Dead Weight (kip/ft)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Total Dead Weight (kip/ft)	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Resisting Moment (kft/ft)	69.9	69.9	69.9	70.7	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	248.4	248.4	248.4	155.8	23.9	24.8	26.2	26.9	27.1	27.9	27.1	26.9	26.9	26.2	26.2	24.8
Maximum Vertical Force (kips/ft)	5.1	5.1	5.1	3.1	1.8	1.9	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.0	2.0	1.9
Maximum Horizontal Force (kips/span)	82.5	82.5	82.5	85.7	20.2	20.3	20.7	22.8	22.6	23.7	22.6	22.8	22.8	20.7	20.7	20.3
Maximum Horizontal Force (kips/ft)	1.7	1.7	1.7	1.7	1.6	1.6	1.6	1.8	1.7	1.8	1.7	1.8	1.8	1.6	1.6	1.6
Maximum Moment (k-ft)	2001.9	2001.9	2001.9	2376.0	306.4	318.6	321.8	327.2	334.7	346.7	334.7	327.2	327.2	321.8	321.8	318.6
Maximum Moment (k-ft/ft)	40.9	40.9	40.9	48.0	23.6	24.5	24.8	25.2	25.7	26.7	25.7	25.2	25.2	24.8	24.8	24.5

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 271-286 potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**287**	**288**	**289**	**290**	**291**	**292**	**293**	**294**	**295**	**296**	**297**	**298**	**299**	**300**	**301**	**302**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**2.3**	**2.4**	**2.3**	**2.1**	**2.1**	**1.9**	**2.1**	**1.9**	**1.8**	**1.7**	**1.7**	**3.2**	**3.2**	**3.2**	**3.0**	**3.0**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-4	-4	-4	-4	-4	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Low Chord Elevation (ft - MSL)	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
100-yr Max Wave Crest Elevation (ft - MSL)	7.2	7.1	7.1	7.0	7.0	6.9	6.9	6.8	6.8	6.7	6.7	6.7	6.7	6.7	6.6	6.6
100-yr Wave Height (ft)	4.9	4.9	4.8	4.7	4.7	4.6	4.5	4.5	4.4	4.3	4.3	4.3	4.3	4.2	4.2	4.2
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Slab Dead Weight (kip/ft)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Total Dead Weight (kip/ft)	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Resisting Moment (kft/ft)	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	24.1	23.9	23.6	22.2	21.2	20.4	20.0	19.3	18.3	17.6	17.6	18.8	18.8	18.5	17.5	17.5
Maximum Vertical Force (kips/ft)	1.9	1.8	1.8	1.7	1.6	1.6	1.5	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.3
Maximum Horizontal Force (kips/span)	20.0	20.2	19.8	18.2	17.1	16.4	16.5	14.8	14.4	14.0	14.0	13.3	13.3	13.8	13.7	13.7
Maximum Horizontal Force (kips/ft)	1.5	1.6	1.5	1.4	1.3	1.3	1.3	1.1	1.1	1.1	1.1	1.0	1.0	1.1	1.1	1.1
Maximum Moment (k-ft)	289.7	306.4	292.1	265.8	272.0	247.9	264.9	247.9	234.0	213.5	213.5	405.1	405.1	408.1	386.1	386.1
Maximum Moment (k-ft/ft)	22.3	23.6	22.5	20.4	20.9	19.1	20.4	19.1	18.0	16.4	16.4	31.2	31.2	31.4	29.7	29.7

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 287-302 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**303**	**304**	**305**	**306**	**307**	**308**	**309**	**310**	**311**	**312**	**313**	**314**	**315**	**316**	**317**	**318**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
VULNERABILITY INDEX (defined below)	**3.0**	**3.0**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.4**	**2.2**	**2.2**	**2.2**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-2	-2	-2
Low Chord Elevation (ft - MSL)	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
100-yr Max Wave Crest Elevation (ft - MSL)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.5	6.5	6.5	6.5
100-yr Wave Height (ft)	4.2	4.2	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.0	4.0	4.0	4.0
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Slab Dead Weight (kip/ft)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Total Dead Weight (kip/ft)	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Resisting Moment (kft/ft)	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	17.5	17.5	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.2	14.3	14.3	14.3
Maximum Vertical Force (kips/ft)	1.3	1.3	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Maximum Horizontal Force (kips/span)	13.7	13.7	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	12.7	12.6	12.6	12.6
Maximum Horizontal Force (kips/ft)	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Maximum Moment (k-ft)	386.1	386.1	186.7	186.7	186.7	186.7	186.7	186.7	186.7	186.7	186.7	186.7	176.1	278.7	278.7	278.7
Maximum Moment (k-ft/ft)	29.7	29.7	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	13.5	21.4	21.4	21.4

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 303-318 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007
SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY																
SPAN NUMBER	**319**	**320**	**321**	**322**	**323**	**324**	**325**	**326**	**327**	**328**	**329**	**330**	**331**	**332**	**333**	**334**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
VULNERABILITY INDEX (defined below)	**2.2**	**2.2**	**1.3**	**1.3**	**1.3**	**1.2**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.6**	**2.4**	**0.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES																
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Low Chord Elevation (ft - MSL)	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
100-yr Max Wave Crest Elevation (ft - MSL)	6.5	6.5	6.4	6.4	6.4	6.4	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.2	6.2	6.2
100-yr Wave Height (ft)	4.0	4.0	3.9	3.9	3.9	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.7	3.6	3.6	3.5
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES																
Span Length (ft)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Slab Dead Weight (kip/ft)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Total Dead Weight (kip/ft)	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Resisting Moment (kft/ft)	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES																
Maximum Vertical Force (kips/span)	14.3	14.3	13.3	13.3	13.3	12.8	13.8	13.8	13.8	13.8	13.8	13.8	13.4	13.3	12.4	10.2
Maximum Vertical Force (kips/ft)	1.1	1.1	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0	0.8
Maximum Horizontal Force (kips/span)	12.6	12.6	11.0	11.0	11.0	10.6	10.4	10.4	10.4	10.4	10.4	10.4	9.7	9.6	9.7	7.4
Maximum Horizontal Force (kips/ft)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.6
Maximum Moment (k-ft)	278.7	278.7	167.3	167.3	167.3	155.2	318.9	318.9	318.9	318.9	318.9	318.9	319.4	326.1	309.3	119.2
Maximum Moment (k-ft/ft)	21.4	21.4	12.9	12.9	12.9	11.9	24.5	24.5	24.5	24.5	24.5	24.5	24.6	25.1	23.8	9.2

Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

Notes:

1 - Bridge spans 319-334 are potentially subject to wave energy.

2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

NCDOT BRIDGE NO. 880007

SUPERSTRUCTURE WAVE ENERGY EXPOSURE

BRIDGE VULNERABILITY SUMMARY						
SPAN NUMBER	**335**	**336**	**337**	**338**	**339**	**340**
CRITICALITY INDEX (defined below)	**4**	**4**	**4**	**4**	**4**	**4**
VULNERABILITY INDEX (defined below)	**1.0**	**1.3**	**0.9**	**2.1**	**0.7**	**1.9**

SURGE/WAVE LOAD COMPUTATION INPUT VALUES

HYDRAULIC VALUES						
100-yr Water Surface Elevation (ft - MSL)	3.6	3.6	3.6	3.6	3.6	3.6
Bed Elevation (ft - MSL)	-2	-2	-1	-1	-1	-1
Low Chord Elevation (ft - MSL)	4.3	4.3	4.3	4.3	4.3	4.3
100-yr Max Wave Crest Elevation (ft - MSL)	6.1	6.1	6.0	5.9	5.8	5.8
100-yr Wave Height (ft)	3.4	3.4	3.2	3.1	3.0	3.0
100-yr Wave Period (seconds)	7.5	7.5	7.5	7.5	7.5	7.5

SPAN PROPERITES						
Span Length (ft)	13.0	13.0	13.0	13.0	13.0	13.0
Span Width (ft)	29.3	29.3	29.3	29.3	29.3	29.3
Deck Thickness (ft)	0.7	0.7	0.7	0.7	0.7	0.7
Overhang (ft)	2.6	2.6	2.6	2.6	2.6	2.6
Number of Beams	4	4	4	4	4	4
Beam Dead Weight (lb/lf) - Each	384	384	384	384	384	384
Beam Dead Weight (kip/ft) - Total	2	2	2	2	2	2
Slab Dead Weight (kip/ft)	3	3	3	3	3	3
Total Dead Weight (kip/ft)	4	4	4	4	4	4
Resisting Moment (kft/ft)	17.1	17.1	17.1	17.1	17.1	17.1
Resisting Vertical Force (kip/ft)	4.5	4.5	4.5	4.5	4.5	4.5

100-YEAR FORCE-MOMENT VALUES						
Maximum Vertical Force (kips/span)	9.9	9.5	9.0	9.2	3.4	8.3
Maximum Vertical Force (kips/ft)	0.8	0.7	0.7	0.7	0.3	0.6
Maximum Horizontal Force (kips/span)	8.3	8.1	6.0	3.8	2.3	2.3
Maximum Horizontal Force (kips/ft)	0.6	0.6	0.5	0.3	0.2	0.2
Maximum Moment (k-ft)	125.5	160.3	119.7	263.0	84.2	245.9
Maximum Moment (k-ft/ft)	9.7	12.3	9.2	20.2	6.5	18.9

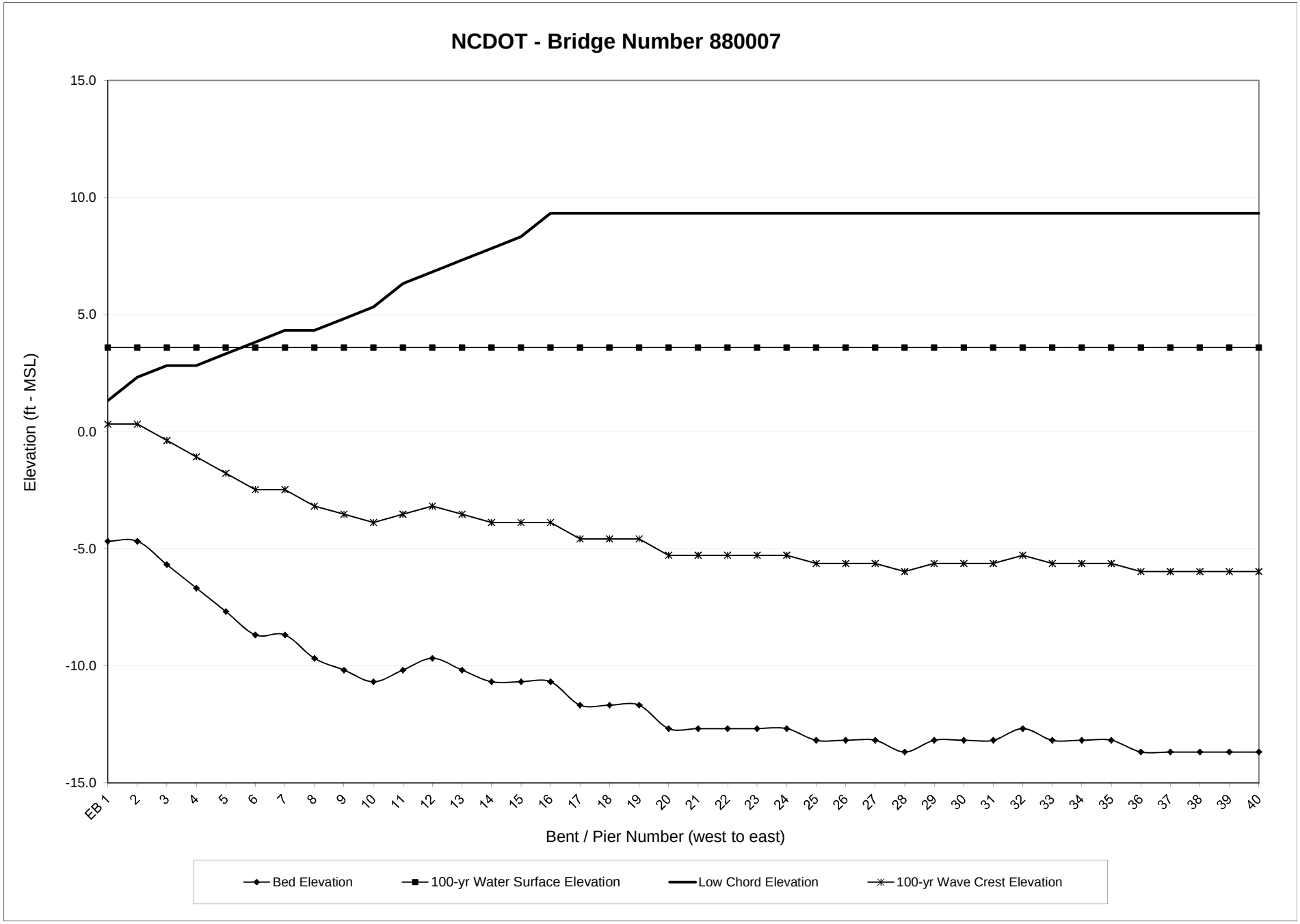
Vulerabilty Index Legend		
		Not Vulnerable
		Potentially Vulnerable

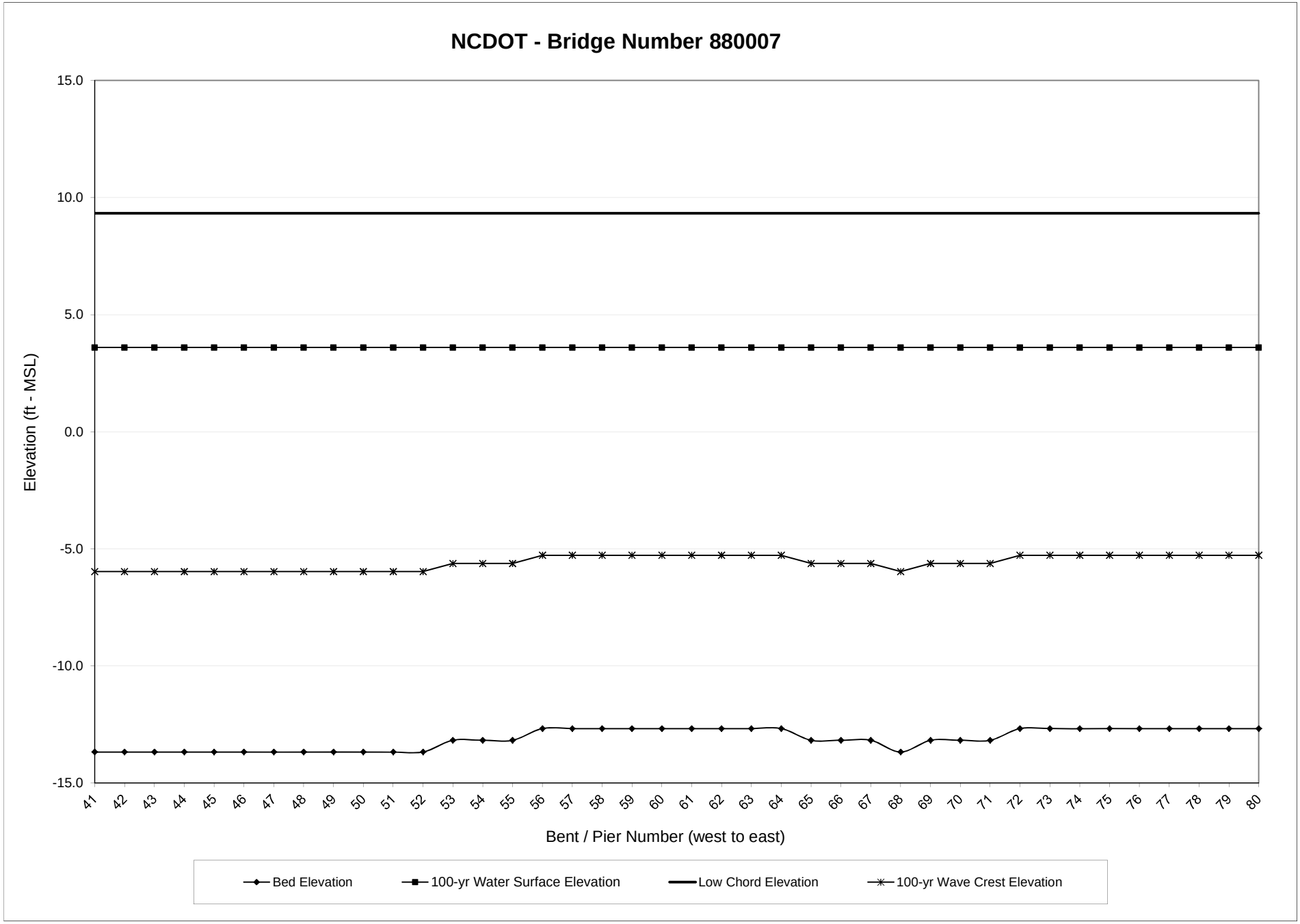
Notes:

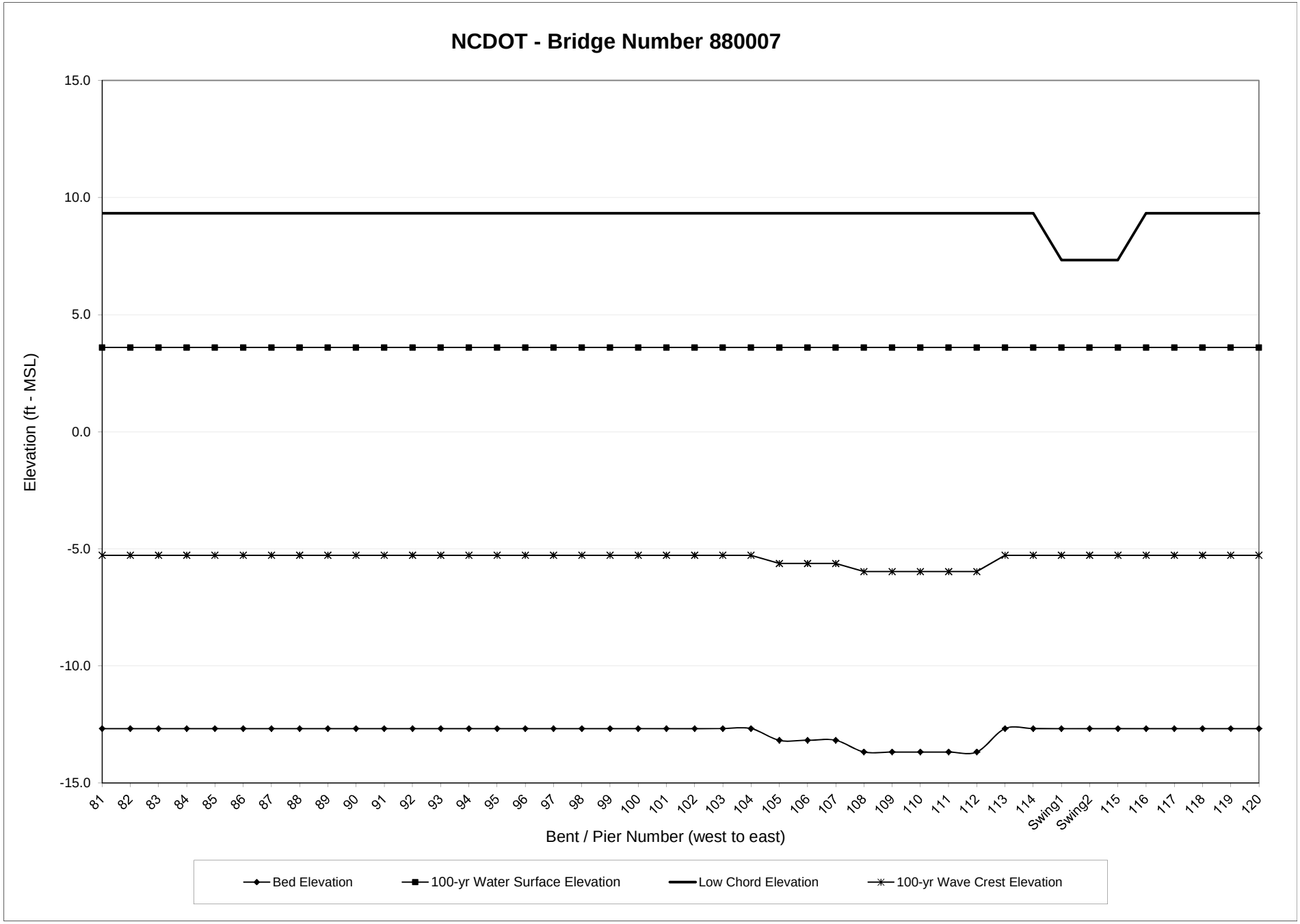
1 - Bridge spans 335-340 are potentially subject to wave energy.

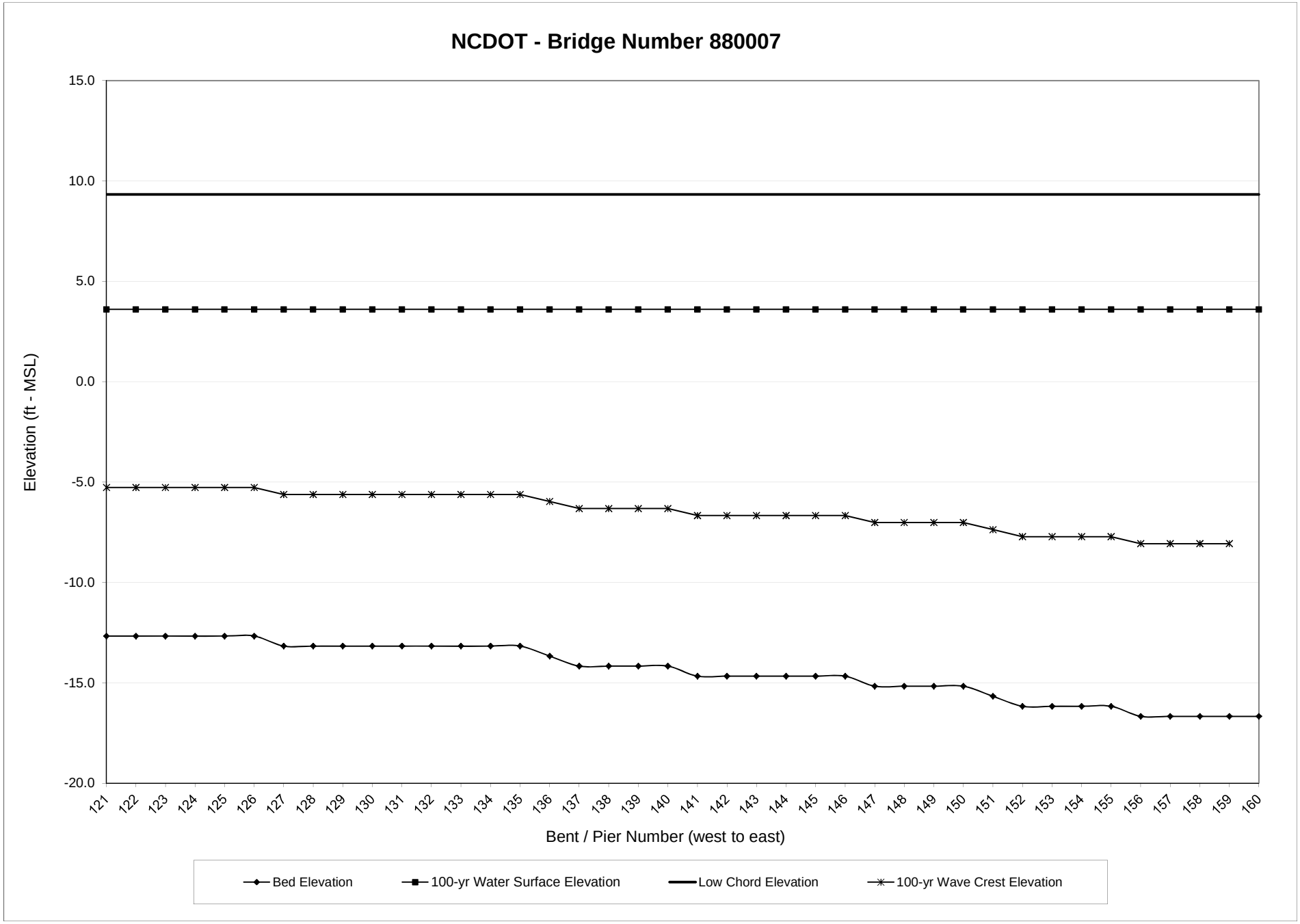
2 - Bridge Vulnerability Rating is defined as the greater value between the Ratio (Max Vertical Force / Resisting Vertical Force) and Ratio (Max Moment / Resisting Moment)

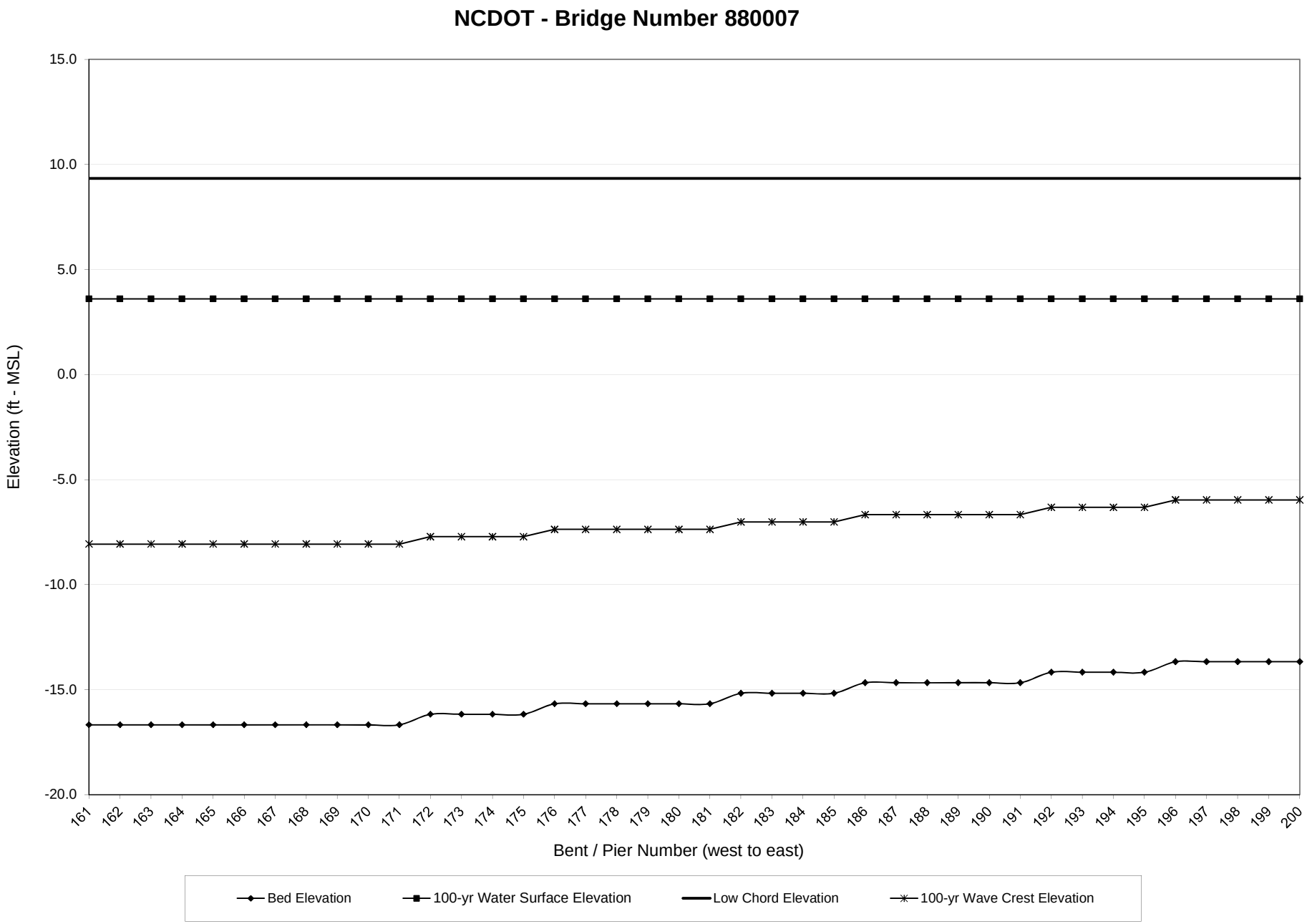
Criticality Index	Multiplier	Description
1	1	Minor impact to economy or emergency needs if closed (alternative routes exist)
2	1	Medium impact if closed - may lead to a barrier island but an alternative route exists
3	1.75	Major impact if closed - only road to a barrier island, evacuation route with no reasonable alternatives
4	1.75	Extreme impact if closed - Interstate or major economic connector (detour very long)

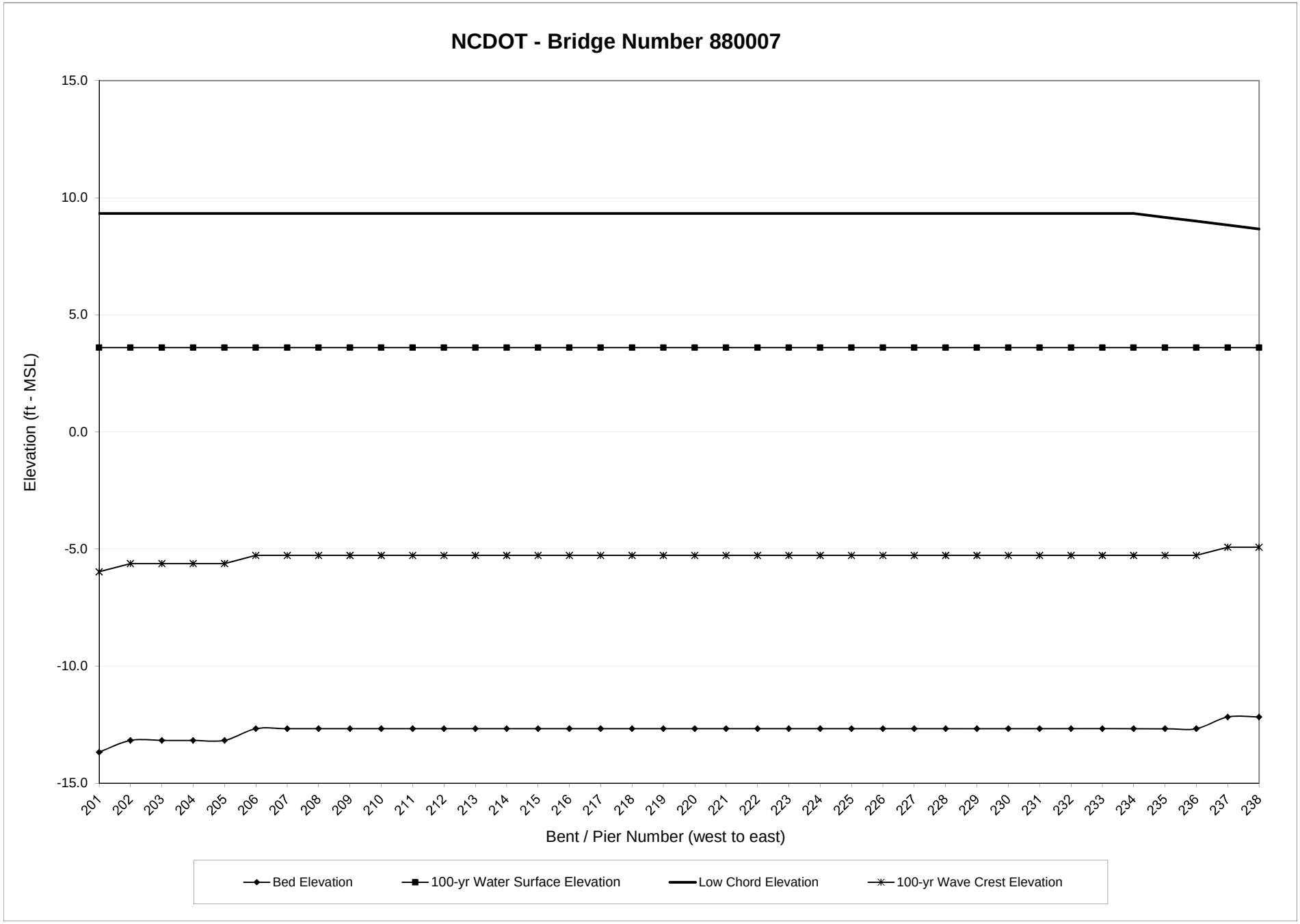

NCDOT - Bridge Number 880007
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
EB 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

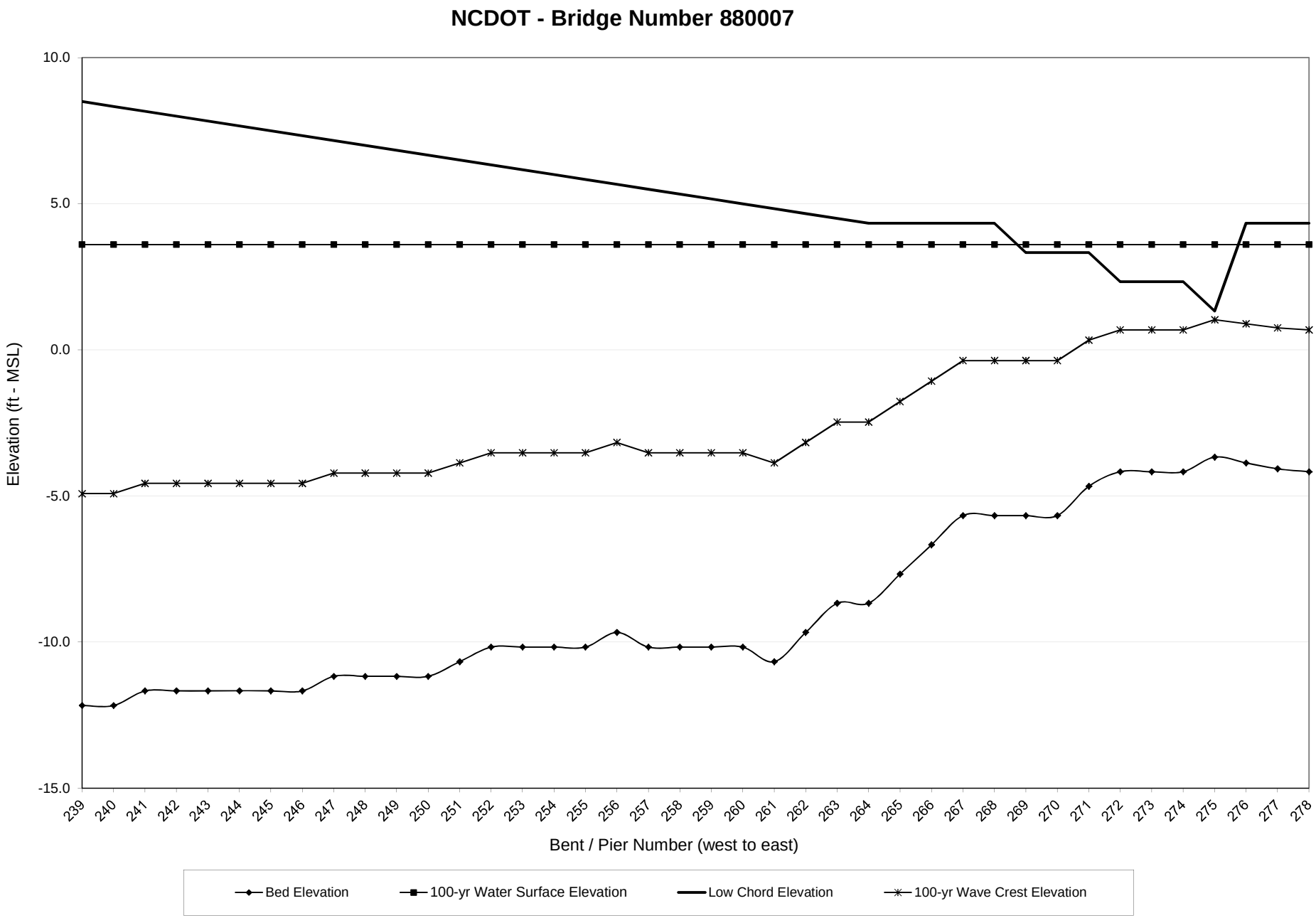

NCDOT - Bridge Number 880007
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

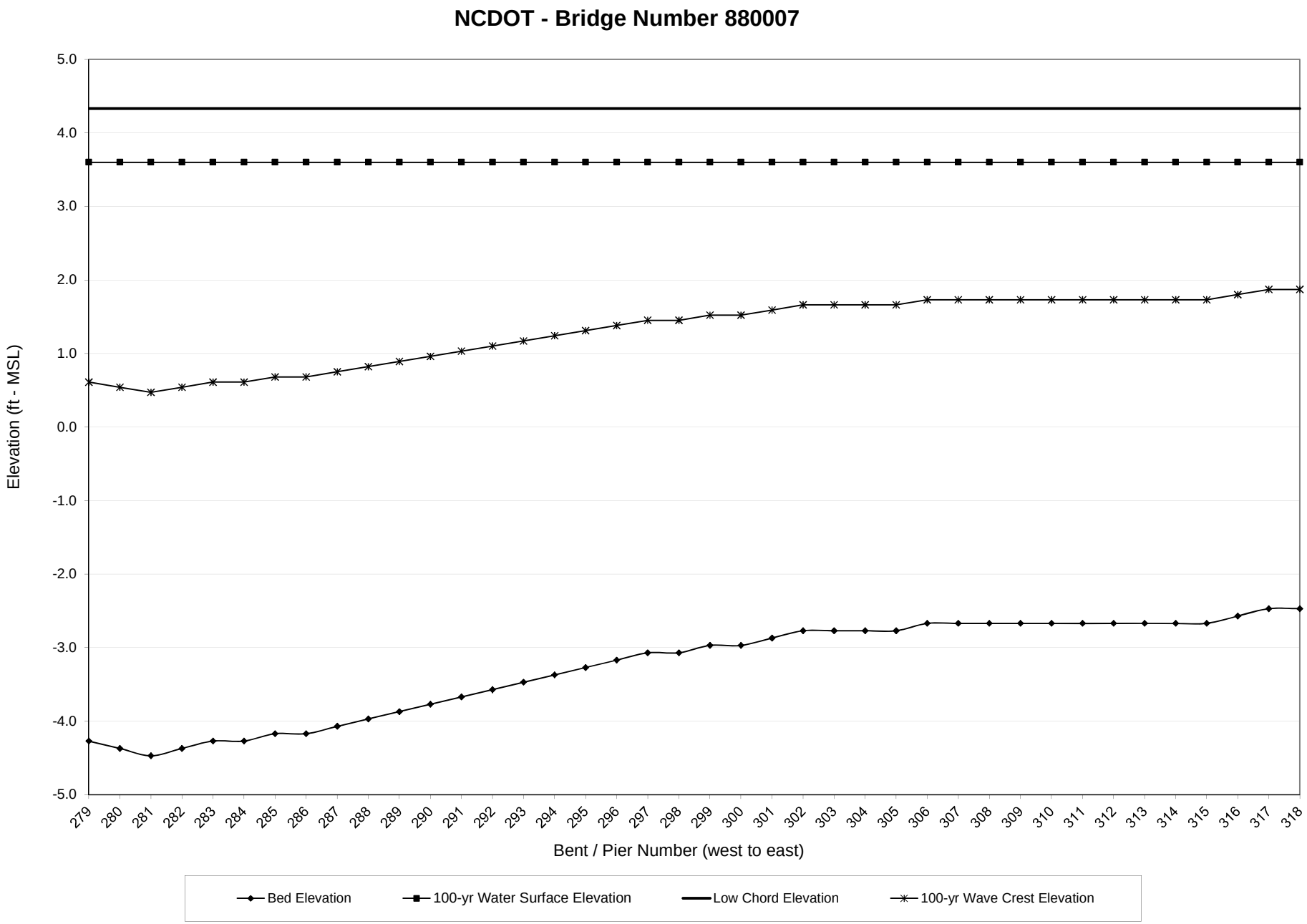

NCDOT - Bridge Number 880007
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 Swing1 Swing2 115 116 117 118 119 120
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation

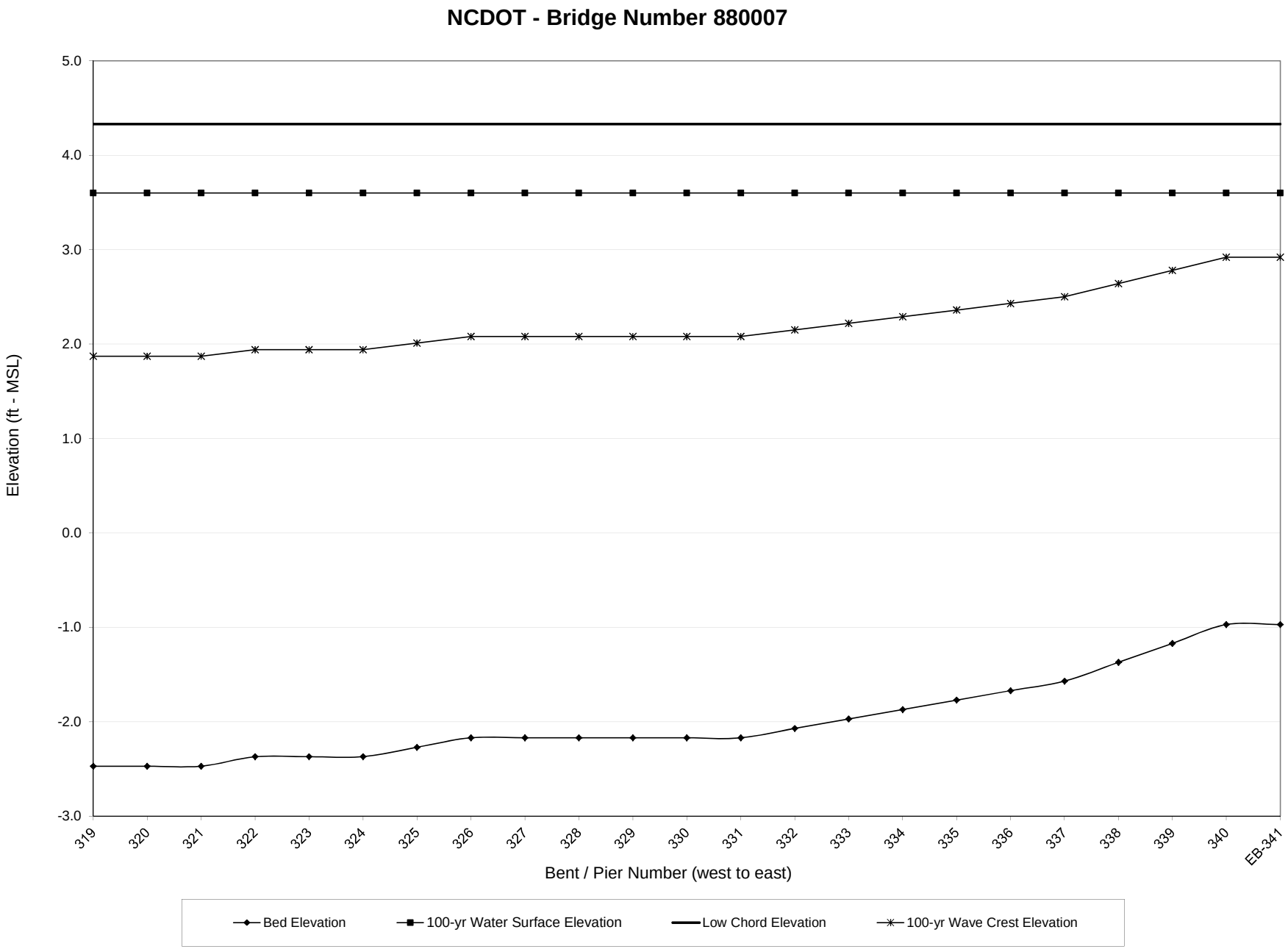

NCDOT - Bridge Number 880007
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 880007
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Elevation (ft - MSL)
161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 880007
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 880007
10.0
5.0
0.0
-5.0
-10.0
-15.0
Elevation (ft - MSL)
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 880007
Elevation (ft - MSL)
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation


NCDOT - Bridge Number 880007
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
Elevation (ft - MSL)
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
EB-341
Bent / Pier Number (west to east)
Bed Elevation
100-yr Water Surface Elevation
Low Chord Elevation
100-yr Wave Crest Elevation