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### 1.6.1 Title Sheet

## HYDRAULIC DESIGN AND RISK ASSESSMENT FOR BRIDGE / BRIDGE REPLACEMENT OVER

*(enter stream name here)*

ROUTE / ROAD NUMBER: US 21 (Sea Island Parkway)

FILE NO.:

PROJECT NO.: P026862

PIN:

COUNTY NAME: Beaufort

DATE: 02 / 15 / 2016

PREPARED BY:	<u>Brandon Stokes</u>
CHECKED BY:	<u>Michael Darby</u>

Hydraulic Design Reference for  
this study is the :

2009

Edition of SCDOT's  
"Requirements for Hydraulic  
Design Studies."

(Place stamp and signature  
in this space)

Signed and Sealed

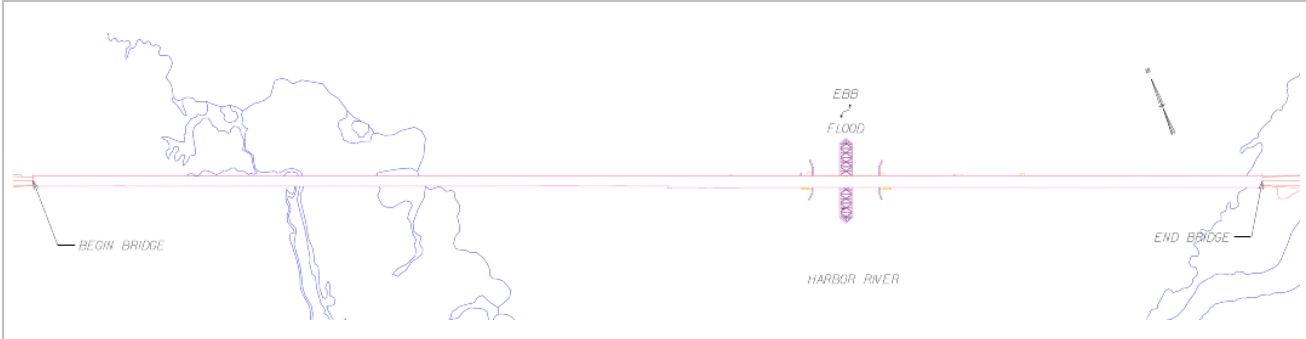
## 1.6.2 Comparative Data Sheet

COMPARATIVE DATA			
PROJECT DESCRIPTION			
County:	<u>Beaufort</u>	Rt. / Rd. No.:	<u>US 21</u>
Stream:	<u>Harbor River</u>	File No:	<u></u>
Project No:	<u>P026862</u>	PIN:	<u></u>
Charge Code:	<u></u>	Road Squad:	<u></u>
Project Engineer:	<u>Michael Darby</u>		

By: <u>Brandon Stokes</u>	Date: <u>02/15/2016</u>
Checked By: <u>Michael Darby</u>	Date: <u>02/15/2016</u>

	ROUTE/ROAD NO.'s				
DISTANCE FROM NEW BR. (mi.)					
DRAINAGE AREA (sq. mi.)					
ZONE					
Q <sub>10</sub> (cfs)					
Q <sub>25</sub> (cfs)					
Q <sub>50</sub> (cfs)					
Q <sub>100</sub> (cfs)					
Q <sub>500</sub> (cfs)					
BRIDGE LENGTH (ft.)					
AVG. FINISHED GRADE (ft.)					
OPENING FURNISHED (sq.ft.)					
VELOCITY (ft./sec)					
HIGHWATER ELEV. (ft.)					
HIGHWATER DATE					
HIGHWATER DEPTH (ft.)					
OBSERVED WATER ELEV. (ft.)					
OBSERVED WATER DATE					
OBSERVED WATER DEPTH (ft.)					
FILE/DOCKET/PROJECT NO.					
DATUM/DATUM TIE					

### 1.6.3 Site Inspection Form

SITE INSPECTION FORM			
<b><u>PROJECT DESCRIPTION</u></b>			
County:	Beaufort	Rt. / Rd. No.:	US 21
Stream:	Harbor River	File No.:	
Project No.:	P026862	PIN:	
By:	Brandon Stokes	Date:	02 / 15 / 2016
Note: All references to left and right are looking in the direction of flow.			
<b><u>EXISTING BRIDGE</u></b>			
Length:	2,851 ft.	Width:	24 ft.      Max. Span Length: 85.2 ft.
Alignment:	Tangent <input checked="" type="checkbox"/> Curved <input type="checkbox"/>		
Bridge skewed?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Angle: _____		
End Abutment Type:	Concrete Cap		
Riprap on Fills?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Condition: Small quantity on west end.		
Superstructure Type:	Concrete deck.		
Substructure Type:	Steel girders on concrete caps and piles.		
Utilities Present?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Describe: DIP connected to north and south side of bridge, electrical conduit on south side. Power lines run parallel to bridge on south side		
Debris Accumulations on Bridge:	Percent Blocked (Horizontal): 0 % Percent Blocked (Vertical): 0 %		
Hydraulic Problems?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Describe: Shellfish (oysters/barnicles) are growing on bridge piles, slightly reducing the hydraulic opening under the bridge.		
Draw Sketch of Bridge and Stream Below: (Show north arrow and direction of flow)			
			

### 1.6.3.1 Site Characteristics Form

SITE CHARACTERISTICS FORM			
<b>General Topography</b> _____			
<b>Stream Type (circle one)</b>			
<div style="border: 1px solid black; padding: 2px; display: inline-block;">Straight</div>	Braided	Anabranched	Meandering
Are channel banks stable?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
If No, describe: _____			
_____			
Soil Type	Muddy, fine sands		
Exposed Rock?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	
If Yes, give description and location: N/A			
_____			
_____			
Describe potential for debris: There is little to no potential for debris accumulation.			
The Harbor River is surrounded by marshlands that will filter out most debris. Any debris that may accumulate should disperse after a tide change.			
_____			
Give description and location of any structures or other property that could be damaged by backwater: Due to the vast floodplains of the surrounding marshlands, backwater from the bridge should not affect any property or structures. However, nearby Saint Helena Island and Harbor Island contain structures located in flood zones. Power lines on concrete piles are present south of the existing bridge.			
_____			
Describe any other features that might affect or be affected by the hydraulic performance of the proposed bridge: The causeway stretching the marsh from Saint Helena Island to the bridge has the potential to be overtopped or damaged due to backwater.			
_____			
_____			

### 1.6.3.2 Manning's "n" Values – for Channels

MANNING’S “n” VALUES – FOR CHANNELS							
n = [(n <sub>b</sub> +n <sub>1</sub> + n <sub>2</sub> +n <sub>3</sub> +n <sub>4</sub> ) m]							
<b>Channel</b>		<b>n<sub>b</sub> -- Base n for soil</b>		<b>Channel</b>		<b>n<sub>1</sub> -- Degree of Irregularity</b>	
Earth		.020		Smooth		.000	
Rock Cut		.025		Minor		.001-.005	
Fine Gravel		.024		Moderate		.006-.010	
Course Gravel		.028		Severe		.011-.020	
		<b>n<sub>2</sub> -- Variations of Channel Cross Sections</b>				<b>n<sub>3</sub> -- Relative Effect of Obstructions</b>	
Gradual		.000		Negligible		.000-.004	
Alternating Occasionally		.001-.005		Minor		.010-.015	
Frequently		.010-.015		Appreciable		.020-.030	
				Severe		.040-.060	
		<b>n<sub>4</sub> -- Vegetation</b>				<b>m -- Degree of Meandering</b>	
Low		.002-.010		Minor		1.00	
Medium		.010-.025		Appreciable		1.15	
High		.025-.050		Severe		1.30	
Very High		.050-.100					
SITE OBSERVATIONS FOR CHANNELS							
Channel Depth	n <sub>b</sub>	n <sub>1</sub>	n <sub>2</sub>	n <sub>3</sub>	n <sub>4</sub>	m	<i>Computed n</i>

#### 1.6.4 Risk Assessment

### **SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION FLOODPLAIN AND RISK ASSESSMENT**

**Regulation 23 CFR 650 shall apply to all encroachment and to all actions which affect base floodplains, except for repairs made with emergency funds. (See HEC-17) Note: These studies shall be summarized in the environmental review document prepared pursuant to 23 CFR 771.**

**Project Description:** The proposed project involves the replacement of the existing US 21 bridge over the Harbor River in Beaufort County, SC. The proposed bridge will be constructed on new alignment and will tie back in to the existing road alignment outside of the bridge limits.

**A. Narrative Describing Purpose and Need for Project:**

a. Relevant Project History: The existing bridge was constructed in the 1940s and is considered structurally and functionally obsolete.

b. Project Location (attach Location and Project Map):  
The project is located in Beaufort County, South Carolina. The bridge spans the Harbor River, connecting Saint Helena Island to Harbor Island. See attached map.

c. Major Issues and Concerns: The existing bridge provides the only vehicular access to and from the surrounding islands.

**B. Are there any floodplain(s) regulated by FEMA located in the project area?**

Yes ☒

No ☐

**C. Will fill be placed within a 100-year floodplain?**

Yes ☒

No ☐

D. Will the existing profile grade be raised within the floodplain?

Yes ☒

No ☐

E. If applicable, please discuss the practicability of alternatives to any longitudinal encroachments.

The proposed bridge will be longer than the existing bridge, which will reduce the amount of fill placed in the floodplain.

F. Please include a discussion of the following: commensurate with the significance of the risk or environmental impact for all alternatives containing encroachments and those actions which would support base floodplain development:

i. What are the flood-related risks associated with implementation of the action?

The proposed bridge opening will be increase from the existing bridge opening and, therefore, should reduce any flood-related risk.

ii. What are the impacts on the natural and beneficial floodplain values?

None.

iii. Will the bridge entice people to build in floodplains?

No.

iv. What measures were used to minimize floodplain impacts associated with the action?

The proposed bridge on new alignment will be longer than the existing bridge and will tie back to the existing roadway alignment as quick as possible to minimize filling the floodplain.

v. Were any measures used to restore and preserve the natural and beneficial floodplain values impacted by the action?

No.

G. Please discuss the practicability of alternatives to any significant encroachments or to support of incompatible floodplain development.

None.

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H. List local, state, and federal water resources and floodplain management agencies consulted to determine if the proposed highway action is consistent with existing watershed and floodplain management programs. Describe any information obtained on development and proposed actions in the affected area. Please include agency documentation.

None.

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### **I. BACKWATER DAMAGE FORM**

**Major flood damage applies to shopping centers, hospitals, industrial facilities, residential areas, schools, farming operations, etc.**

*1. Does the maximum flood cause major damage to upstream property?*

Yes - (Go to 2.)

No - (Go to 3.)

*2. Would this damage occur if the road were not there?*

Yes - (Go to 3.)

No - (Perform a limited Least Total Expected Cost (LTEC) (HEC-17) analysis to see if the bridge opening should be increased and/or grades raised to minimize the damage potential. Go to II.)

*3. Was this a bridge replacement? If so, was the bridge opening increased enough to increase the discharge passed through the bridge?*

Yes - (Go to 4.)

No - (Go to II.)

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**4. Does the increased flow cause major damage downstream?**

Yes - (Perform a limited LTEC analysis to determine if the bridge opening should be reduced, the floodway redefined, and flood easements purchased upstream or if flood easements should be purchased downstream. Go to II.)

No - (Go to II)

## **II. TRAFFIC RELATED LOSSES**

**1. Is the overtopping flood greater than the 100-year flood?**

Yes - (Go to III.)

No - (Go to 2.)

**2. Does the ADT exceed 50 vehicles per day?**

Yes - (Go to 3.)

No - (Go to III.)

**3. Does the duration of road closure in days, multiplied by the difference in length, in miles between the normal route and the detour, exceed 20?**

Yes - (Go to 4.)

No - (Go to III.)

**4. Does the annual risk cost for traffic related costs exceed 10% of the estimated annual capital costs?**

Yes - (Perform a limited LTEC analysis to compare the cost to raise the grades and if necessary increase the bridge length with the traffic related costs. Go to III.)

No - (Go to III.)

## **III. ROADWAY AND/OR STRUCTURE REPAIR COST**

**1. Is the overtopping flood less than the 100-year flood?**

Yes - (Go to 2)

No - (Go to 3)

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*2. Is the overtopping flood less than 0.5 foot over the low point on the roadway and duration no more than 1.0 hour?*

Yes - (Go to 3)

No - (perform a limited LTEC analysis to determine if the grades should be raised and/or the bridge opening increased or that the repair cost for embankment erosion are less significant. Traffic cost should be included in this evaluation.)

*3. Is the proposed bridge or culvert structure subject to potential damage due to debris?*

Yes - (Go to 4)

No - (Go to 5)

*4. Perform a limited LTEC analysis to determine if the structure should be modified. (Go to 5.)*

*5. The risk assessment has determined the most economical design for the crossing within the design constraints.*

Revised 3/16/09

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