



Agenda Report

2725 Judge Fran Jamieson
Way
Viera, FL 32940

New Business - Development and Environmental Services Group

J.2.

10/22/2019

Subject:

Discussion Re: Sea Ray Drive Bridge over Sykes Creek - District 2

Fiscal Impact:

Fiscal Year 2019-2020: \$4,000,000.00 is budgeted in Constitutional Gas Tax 1170/265300. The County is investigating an appeal regarding Federal Emergency Management Agency (FEMA) Public Assistance funding eligibility. Fiscal Impact will be determined on Board direction.

Dept/Office:

Public Works Department/Finance and Contracts Administration

Requested Action:

It is requested the Board of County Commissioners discuss and direct staff on alternatives (repair or replacement) pertaining to the Sea Ray Drive Bridge Over Sykes Creek. Additionally, staff is seeking Board direction on the FEMA Public Assistance Determination of ineligibility for the repair or replacement of the bridge. It is further requested the Board approve any necessary Budget Change Requests associated with this action.

Summary Explanation and Background:

After the Hurricane Irma declaration date (September 4, 2017), the Board of County Commissioners, in special session on September 28, 2017, adopted Emergency Resolution No. 17-191E Regarding Rehabilitation and Restoration Work to Sea Ray Drive Bridge over Sykes Creek upon Completion of the U.S. Army Corps of Engineers Direct Federal Assistance Mission. In the months following the storm, the U.S. Army Corps of Engineers (A.C.O.E.) commenced with emergency stabilization work on the Sea Ray Drive Bridge. The Direct Federal Assistance (D.F.A.) Mission was completed by the A.C.O.E. in April 2018.

In accordance with the attached Resolution 17-191E, the County commenced with preparations for the preliminary survey, investigation and design work upon completion of the D.F.A. Mission as required in the Resolution (4a). The County determined that a Design-Build approach would be utilized for the permanent work. The County successfully entered into the Professional Services Contract with Kisinger Campo and Associates, Corp. (K.C.A.) to prepare the Design Criteria Package. The County issued a task order to K.C.A. to prepare a Feasibility Report which included Alternatives Analysis.

On September 23, 2019, Brevard County received the FEMA Public Assistance Eligibility Determination letter in which FEMA determined the bridge work (repair or replacement) is ineligible for Public Assistance funding. The FEMA denial is based on their assessment the damage claimed cannot be demonstrated to be the direct result of the major disaster but was pre-existing. As such, the County's request for Public Assistance support for \$2,000,000 to repair the bridge, or alternatively \$4,000,000 to replace the bridge was denied by FEMA.

990

Staff seeks Board Direction regarding appealing the FEMA determination. The appeal must contain documented justification supporting the County’s position and be submitted to the State within sixty days of receipt of the determination. Ultimately the appeal may be rejected in which case FEMA will make no repair reimbursement to the County. In that event the Board would bare the full cost of the bridge work to repair or replace the Sea Ray Drive Bridge. The repairs to the bridge should be considered separately from any potential FEMA reimbursement. It is FEMA’s directive for each applicant to proceed with repairs as if FEMA funding was not available. As such, the appeal options should not be a consideration for this funding decision.

In light of the pending need to expedite the bridge repair, staff seeks Board Direction choosing which repair alternative to use as outlined below.

Alternative 1 - Bridge Repair

- Crutch Bents - Includes new piling and reinforced concrete caps supporting transverse beams to carry the entire bridge loading
- Shoreline Protection - Includes rubble riprap and filter fabric to restrict erosion of the bridge abutments and approach roadways
- Other repairs - Include concrete restoration, fence replacement, deck sealing, and joint repair to improve existing service life

Alternative 2A - Bridge Replacement In-Kind Florida Slab Beam

- Entire removal of existing bridge structure
- Reconstruction of bridge utilizing a developmental design standard and requires Florida Department of Transportation (F.D.O.T.) approval
- Keeps the current span arrangement and similar clearances of existing bridge
- Keeps the current approach roadway transition into the bridge structure

Alternative 2B - Bridge Replacement Florida I-Beam

- Entire removal of existing bridge structure
- Reconstruction of bridge in accordance with current design standards
- Match span length and clearances of the adjacent proposed State Road 528 bridges
- Some approach roadway reconstruction to transition the existing roadway profile into the bridge structure

Alternative	Estimated Cost *	Permitting	Construction	Design Life
Repair	\$2,792,046	3 Months	12 Months	21 Years
Replacement (In-Kind)	\$4,990,776	12 Months	18 Months	75 Years
Replacement (Florida I-Beam)	\$4,967,631	12 Months	18 Months	75 Years

* Note: Utility costs not included

Clerk to the Board Instructions:



Tammy Rowe, Clerk to the Board, 400 South Street • P.O. Box 999, Titusville, Florida 32781-0999

Telephone: (321) 637-2001
Fax: (321) 264-6972
Tammy.Rowe@brevardclerk.us

October 23, 2019

MEMORANDUM

TO: Corrina Gumm, Interim Public Works Director

RE: Item J.2., Sea Ray Drive Bridge Over Sykes Creek

The Board of County Commissioners, in regular session on October 22, 2019, tabled discussion regarding alternatives (repair or replacement) pertaining to the Sea Ray Drive Bridge over Sykes Creek, to a future Board meeting.

Your continued cooperation is always appreciated.

Sincerely,

BOARD OF COUNTY COMMISSIONERS
SCOTT ELLIS, CLERK

Tammy Rowe

Tammy Rowe, Deputy Clerk

cc: County Manager



FEMA

Region IV - Recovery

September 7, 2019

Mr. Jared Moskowitz, Director
Director
Florida Division of Emergency Management
2555 Shumard Oak Boulevard
Tallahassee, FL 32399-2100

RECEIVED

SEP 23 2019

BUDGET OFFICE

Ms. Jane Toliver
Administrative Assistant
Brevard County
2725 Judge Fran Jamieson Way, Building C-303
Viera, Florida 32940

Re: FEMA Public Assistance Eligibility Determination - Brevard County, PA ID 009-99009-00,
FEMA-4337-DR-FL, Project 20858

Dear Mr. Moskowitz and Ms. Toliver:

The Department of Homeland Security's Federal Emergency Management Agency (FEMA) has determined that the work is ineligible for Public Assistance funding. Please see the enclosed FEMA Public Assistance Determination Memorandum for detailed information.

Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act and applicable regulations, the Brevard County (Applicant) is entitled to appeal this eligibility determination. The Applicant may appeal this determination to the FEMA Region 4 Regional Administrator pursuant to Title 44 Code of Federal Regulations § 206.206. The appeal must: (1) contain documented justification supporting the Applicant's position, (2) specify the monetary figure in dispute, and (3) cite the provisions in federal law, regulation, or policy with which the Applicant believes the initial action was inconsistent. The Applicant should also include a current email address to receive electronic correspondence. The Applicant must submit the appeal to the Florida Division of Emergency Management (Recipient) within 60 days of the Applicant's receipt of this determination. The Recipient must then transmit the appeal, with a written recommendation, to Region 4 within 60 days of receiving the Applicant's appeal.

Lastly, the Applicant must submit all relevant supporting information with its first appeal. For reference, a current index of documents relevant to this determination is enclosed.

Mr. Moskowitz and Ms. Toliver
September 7, 2019
Page 2

If you have any questions, please contact Allison McLeary, Florida Division of Emergency Management Appeals Officer, 850-815-4417 or email Allison.Mcleary@em.myflorida.com.

Sincerely,

ANGELA D
GILLMAN

Digitally signed by
ANGELA D GILLMAN
Date: 2019.09.18
09:56:07 -0400

Angela Gillman Green
Infrastructure Branch Director
Federal Emergency Management Agency
FEMA 4337-DR-FL

Enclosures:
FEMA PA Eligibility Determination Memorandum
Index of Documents

ELIGIBILITY DETERMINATION MEMORANDUM

Brevard County

FEMA-4337-DR-FL

PA ID 009-99009-00

Applicant Type		<input type="checkbox"/> State Agency <input checked="" type="checkbox"/> Local Government <input type="checkbox"/> Tribe <input type="checkbox"/> Private Nonprofit	
Grants Manager: <i>Only fill out this section if the project is in Grants Manager.</i>		EMMIE: <i>Only fill out this section if the project worksheet is in EMMIE.</i>	
Project No.	20858	EMMIE Project Worksheet No.	
Version No.	0	Version No.	
Damage Inventory No.	align="center">68015	EMMIE Project Cost	
		Total Amount Obligated	
Project Title		Searay Bridge	
Project Size	<input checked="" type="checkbox"/> Large <input type="checkbox"/> Small <i>(Potentially subject to Net Small Project Overrun appeal)</i>	Category of Work	C. Roads and Bridges

Issue(s): Are the costs of replacement or repair of the County's bridge eligible for FEMA Public Assistance support?

Amount at Issue	\$4,000,000	Eligibility Issue Type(s)	<input type="checkbox"/> Applicant Eligibility
Amount Denied	\$4,000,000		<input type="checkbox"/> Facility Eligibility
			<input checked="" type="checkbox"/> Work Eligibility
			<input type="checkbox"/> Cost Eligibility
Issue Keyword(s)	Deferred Maintenance Direct Result of Disaster		

Project Description:

Hurricane Irma caused strong winds, torrential rain and tidal surge which resulted in extensive damage throughout Florida. The incident period for this disaster is September 04, 2017, through October 18, 2017. The widespread damage resulted in a major disaster declaration (FEMA-4337-DR-FL) on September 10, 2017. This disaster declaration, as amended, authorized Public Assistance (PA) in all Florida counties.

Brevard County, Fl. owns and operates the Sea Ray Bridge over Sykes Creek connecting the City of Cocoa to a barrier island - Merrick Island, Fl. According to documentation provided by the County, Sea Ray Bridge is a "scour critical" bridge.¹ The major disaster caused scouring around 28 bridge pilings up to 10.3 feet (ft) on the south side of and 8.3 ft on the north side of Bent 4, which threatened the stability of the Bridge.² The Bridge had an attached water main to

¹ A scour critical bridge is a bridge that is predicted to fail from a certain magnitude flood either from analysis or observation. U.S. DOT Federal Highway Administration Publication No. FHWA-HF-12.003, Hydraulic Engineering Circular No. 18. April 2012, p2.15.

² WO 6415 DR4337FL SI Field Notes

provide water from the City to customers on the Island. The United States Army Corps of Engineers performed temporary repairs to fill scour holes and stabilize the water main pending the County's completion of permanent repairs to the Bridge.³

An inspection conducted after the disaster determined the Bridge to be "structurally deficient" and it was closed to all traffic between the City of Cocoa and the barrier island.⁴ The County has announced plans for a Design-Build project to either repair or replace the Bridge. The County reports the replacement option would be approximately \$4 million while a repair option would be about \$2 million. The County has requested FEMA Public Assistance (PA) for whichever option the County chooses.⁵

To be eligible for FEMA PA for these costs, applicants must demonstrate work is required as a direct result of the major disaster, not the responsibility of another Federal agency and is not the result of deferred maintenance.⁶

Issue:

Are the costs of replacement or repair of the County's bridge eligible for FEMA Public Assistance support?

Applicable Statutes, Regulations, and Policies in Effect as of the Declaration of the Emergency or Disaster:

- **The Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988, Pub. L. No. 93-288.**

§ 102. Definitions (42 U.S.C. 1522)

As used in this Act:

(10) PUBLIC FACILITY – "Public Facility" means the following facilities owned by a State or local government:

(B) Any non-Federal-aid street, road or highway.

§ 406, 42 U.S.C. § 5172, - Repair, Restoration, Replacement

- (a) Contributions –
- (1) In General. –
- (A) to a State or local government for the repair, restoration, reconstruction, or replacement of a public facility damaged or destroyed by a major disaster and for associated expenses incurred by the government.

³ [20858] Sea Ray Bridge News Release 8-28-18.

⁴ Searay Bridge Inspection Report 2017 Post Irma.

⁵ 20828 Sea Ray Bridge Email Cost Estimate, June 14, 2019.

⁶ 44 C.F.R. § 206.223 (a)(1); 44 C.F.R. § 206.226 (a); PAPPG II, p19.

- **Title 44 of the Code of Federal Regulations (C.F.R.):**

§ 206.201 Definitions Used in this Subpart

(c) *Facility* means any publicly or privately-owned building, works, system, or equipment, built or manufactured, or an improved and maintained natural feature. Land used for agricultural purposes is not a facility.

(i) *Permanent work* means restorative work that must be performed through repairs or replacement, to restore an eligible facility on the basis of its pre-disaster design and current applicable standards.

§ 206.223 General Work Eligibility

(a) General. To be eligible for financial assistance, an item of work must:

- (1) Be required as a result of the emergency or major disaster event;
- (2) Be located within the designated area of a major disaster
- (3) Be the legal responsibility of an eligible applicant.

§ 206.226 Restoration of Damaged Facilities

Work to restore eligible facilities on the basis of the design of such facilities as they existed immediately prior to the disaster and in conformity with the following is eligible:

- a) *Assistance under other Federal agency (OFA) program.* (1) Generally, disaster assistance will not be made available under the Stafford Act when another Federal agency has specific authority to restore facilities damaged or destroyed by an event which is caused by a major disaster.

- **FEMA Public Assistance Program and Policy Guide, FP 104-019-2 (April 2018)(PAPPG):**

CHAPTER 2: Public Assistance Policy

Section III: Facility Eligibility (A) Public Facility

An eligible public facility is one that a State, Territorial, Tribal, or local government owns or has legal responsibility for maintaining, including any:

- Flood control, navigation, irrigation, reclamation, public power, sewage treatment and collection, water supply and distribution, watershed development or airport facility
- Non-federal-aid street, road or highway;
- Other public building, structure, or system, including those used for educational, recreational, or cultural purposes; and,
- Park.

Section IV: General Work Eligibility (B) Minimum Work Eligibility Criteria

1. Result of the Declared Incident

For temporary repairs, mold remediation, and Permanent Work, the Applicant must demonstrate that damage was caused directly by the declared incident, FEMA does not provide PA funding for repair of damage by:

- Deterioration
- Deferred maintenance
- The Applicant's failure to take measures to protect a facility for further damage
- Negligence. (PAPPG II, pp19-20)

Section VII: Permanent Work Eligibility

1. Road and Bridges (Category C)

Permanent Work to restore roads and bridges is eligible unless restoration is eligible under the specific authority of another Federal Agency such as FHWA.

FHWA has authority to restore public roads under the Emergency Relief (ER) Program. Roads that are eligible for ER assistance are identified as Federal-aid Routes, which include highways on the Federal-aid highway system and all other public roads not classified as local roads or rural minor collectors. The ER program is activated separately from Presidential declarations under the Stafford Act and may not be activated for all incidents. Federal-aid roads are not eligible for Permanent Work even if the ER program is not activated or if the program is activated but FHWA does not provide funding for the work. (page 116)

Analysis:

FEMA, pursuant to its delegated authority, may make contributions to a local government for the repair, restoration, reconstruction, or replacement of a public facility damaged or destroyed by a major disaster and for associated expenses incurred by that government.⁷ FEMA has determined the County is an eligible applicant that may receive contributions for the repairs to damage caused by the major disaster only in accordance with all Federal regulations and policy.

FEMA policies establish specific criteria for determining the eligibility of facilities, such as bridges, for Public Assistance. The Stafford Act prohibits Public Assistance for an ineligible public facility.⁸ If FEMA determines such facilities are the statutory authority of another Federal agency, FEMA cannot provide assistance for either temporary or permanent work. In this

⁷ Stafford Act § 406(a)(1)

⁸ Stafford Act § 102 (10)(B)

instance, the Recipient provided documentation to substantiate this bridge is not the responsibility of another Federal agency.⁹

The County's Bridge is a double "T" beam style bridge, constructed in 1991, has five spans and is approximately 201.5 feet (ft) long and 45.5 ft wide. It carries two lanes and the superstructure is a simple span concrete slab.¹⁰ Federal Highway Administration (FHWA) regulations recommend frequent inspections for scour critical bridges and the formulation of a Plan of Action (POA) is required. A POA identifies scour countermeasures to be taken in the event flooding conditions that could threaten the stability of the scour critical bridge are identified.¹¹

The County provided copies of Bridge Inspection Reports prepared for the Florida Department of Transportation in 2014 and 2016. The 2014 Inspection recorded scour dishes up to 18 inches (in) around several of the pilings in Bents 3 and 4 extending out from the pilings up to 4 ft. The report's "Recommended Feasible Action: Do Nothing."¹²

The 2016 Report noted bank protection needed minor repairs and that "minor stream bed movement may be evident, or debris may be present." The Report also repeated the 2014 observation about 18 in. scour dishes around the piles in Bents 3 and 4 extending out up to 4 ft.¹³

In contrast to the 2014 Report, the 2016 Report included a Plan of Action.¹⁴ This POA scored the Scour Vulnerability as a 113 Code 3 and that "Profile measurements taken between 1991 and 2010 show degradation of up to 5.6 feet and scour dishes have been noted at Bents 3 and 4."¹⁵ A Bridge report summary based on the 2016 Inspection Report concluded

- Channel Protection: Bank protection is being eroded. River control devices and/or embankment have major damage. Trees and rush (sic) restrict the channel.
- Scour condition: Bridge is scour critical; bridge foundations determined to be unstable.¹⁶

The 2016 Inspection Report also recommended the implementation of a Flood Monitoring Program and consideration of structural/hydraulic countermeasures; specifically, "Crutch Bent" or "Replace Bridge."¹⁷ The POA included costing estimates of the proposed countermeasures.

From the issuance of the 2016 POA with the recommended countermeasures, there is no indication in documentation provided by the County that any actions were taken to investigate implementation of the POA recommended countermeasures. On April 30, 2019, FEMA issued a

⁹ Email confirm not FHWA for Brevard County's Searay Bridge.

¹⁰ Searay Bridge Inspection Report, 2016, p38.

¹¹ US Department of Transportation, Federal Highway Administration, **Evaluating Scour at Bridges, Fifth Edition**, Publication No. FHWA-HF-12-003, April 2012, pp10.2-10.3

¹² Searay Bridge Inspection Report 2014, p33.

¹³ Searay Bridge Inspection Report, 2016, p8.

¹⁴ Ibid. p38.

¹⁵ Ibid. pp38-39.

¹⁶ Bridge report – Searay Drive Bridge Sykes Creek, p2.

¹⁷ Searay Bridge Inspection Report, 2016, p40. A crutch bent is a rigid frame commonly made of reinforced concrete or steel that supports a vertical load and is placed transverse to the length of a structure. Bents are commonly used to support beams and girders. An end bent is the supporting frame forming part of an abutment. <https://www.contractortalk.com/f4/what-crutch-bents-58523/>

Request for Information to the County seeking documentation that the County had taken measures to repair the erosion and scour conditions noted in the 2016 Inspection Report.¹⁸

The County provided an updated timeline of inspection dates beginning after the passage of Tropical Storm Colin in June 2016 and Hurricane Mathew in October 2017 as well as an updated version of the POA.¹⁹ The County provided no documentation to indicate the conditions noted on the 2016 Inspection Report had been mitigated prior to the major disaster in September 2017.

As noted above, the 2016 Inspection had determined the Bridge's foundations were "unstable"²⁰ Despite this finding, the County could provide no documentation that it had taken any steps to repair the channel protection, erosion or scour conditions identified in that report.

In an email dated June 25, 2019, the County acknowledged its design firm was considering two options to address the disaster damage: bridge replacement or bridge repair using crutch bents and slope protection.²¹ These options had previously been recommended to the County to address the issues identified in the 2016 Inspection Report.²² The County provided no explanation as to why it delayed implementation of the mitigation countermeasures put forth in the 2016 Inspection Report.

FEMA policy is clear that PA funding may not be provided for repair of damage caused by:

- Deterioration
- Deferred maintenance
- The Applicant's failure to take measures to protect a facility from further damage
- Negligence²³

Remedy

To be eligible for Federal assistance, applicants must adequately document these costs were incurred in the performance of work resulting directly from the major disaster. The County provided no explanation as to why it failed to address the channel protection, erosion and scour conditions identified more than a year before the major disaster.

If a Non-Federal Entity, like the County, fails to comply with Federal statutes, regulations or the terms and conditions of a Federal award, the Federal awarding agency or pass-through may impose additional conditions. These additional conditions permit FEMA to disallow (that is, deny both the use of funds and any applicable matching credit for) all or part of the cost of the activity or action not in compliance.²⁴ That remedy is appropriate here.

¹⁸ FEMA, RFI-PRJ-12460, April 30, 2019.

¹⁹ Bridge 704144 Inspection Log; Bridge 704144 POA Update.

²⁰ Bridge report – Searay Drive Bridge Sykes Creek, p2

²¹ 20858 Searay Bridge Email Cost Estimate

²² Searay Bridge Inspection Report, 2016

²³ PAPPG II, pp19-20.

²⁴ 2 C.F.R § 200.338(d).

Eligibility Determination: Partially Approved Denied

The County was informed more than a year prior to the disaster that the Sea Ray Bridge foundations had been determined to be "unstable." A POA identified a set of prudent countermeasures for the County to implement to mitigate the threat of further damage. The County provided no documentation in the form of maintenance records or contract work orders to show that it implemented any of these measures. Consequently, the damage claimed cannot be demonstrated to be the direct result of the major disaster but was pre-existing and identified to the County more than one year prior to the disaster. The County deferred maintenance on the bank protection, erosion and scour conditions until these were exacerbated by the major disaster. FEMA cannot provide PA funding for work caused by deferred maintenance. Therefore, the County request for PA support for \$4,000,000 to replace this bridge or, alternatively, \$2,000,000 to repair the Sea Ray Bridge is denied.

Notice of Right to Appeal:

The Applicant may appeal this determination to the Regional Administrator, pursuant to Title 44 of the Code of Federal Regulations § 206.206, Appeals. If the Applicant elects to file an appeal, the appeal must:

- 1) Contain documented justification supporting the Applicant's position;
- 2) Specify the monetary figure in dispute; and
- 3) Cite the provisions in federal law, regulation, and/or policy with which the Applicant believes the initial action was inconsistent.

The appeal must be submitted to the State by the Applicant within 60 days of its receipt of this determination. The State's transmittal of that appeal, with the State's recommendation, is required to be submitted to The FEMA Regional Administrator's office within 60 days of the receipt of the Applicant's letter.

Preparation and Review:

Preparer: Notra Trulock, III PA Policy Advisor

Signature:  Digitally signed by AARON M LACHAPELLE
Date: 2019.09.19 08:50:28 -04'00'

Date: _____

Office of Chief Counsel Reviewer: David Russo, Attorney Advisor

Signature: DAVID A RUSSO Digitally signed by DAVID A RUSSO
Date: 2019.09.16 12:14:41 -04'00'

Date: _____

Approval:

PA Management: Angela Gillman, Infrastructure Branch Director

Signature: ANGELA D GILLMAN Digitally signed by ANGELA D GILLMAN
Date: 2019.09.16 12:14:41 -04'00'

Date: _____

Feasibility Report

**SEA RAY DRIVE (LAMBERT DRIVE) BRIDGE
OVER SYKES CREEK**

BRIDGE NO. 704144

PREPARED FOR:



PREPARED BY:

**KISINGER CAMPO & ASSOCIATES CORP.
201 NORTH FRANKLIN STREET, SUITE 400
TAMPA, FL 33602
FLORIDA CERTIFICATE OF AUTHORIZATION No. 02317**

**ENGINEER OF RECORD:
DAVID B. THOMPSON, PE
FL. P.E. No. 45403**

OCTOBER 2019

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EXECUTIVE SUMMARY

In September 2017, Hurricane Irma caused a severe scour condition at the bridge carrying Sea Ray Drive over Sykes Creek (Bridge Number 704144) in Brevard County, Florida, resulting in bridge closure. Brevard County (the County) requested assistance from the U.S. Army Corps of Engineers (USACE) to stabilize the bridge and the vital utilities it supports. USACE initiated emergency, temporary repairs that included filling the eroded creek bed with stone and rubble riprap.

At the request of Brevard County, Kisinger Campo & Associates Corp. (KCA) has assembled this feasibility study to evaluate the Sea Ray Drive Bridge over Sykes Creek and analyze alternatives for bridge repair and bridge replacement as provided below.

Option 1, construction of crutch bents and superstructure repairs of the existing bridge, is based upon original conceptual plans to return the bridge to service. Unknown costs associated with accommodating the rubble riprap within Sykes Creek during construction may escalate the estimated cost of **\$2,792,046** nearer to the expense of the bridge replacement alternatives. This alternative considers continued use of the existing bridge superstructure and its remaining design life of 21 years. There is construction risk and difficulty associated with pile driving near the bridge mounted utilities, constructing temporary supports for the utilities during construction, and addressing the obstruction to pile driving from existing rubble that could significantly increase cost. The reduction in horizontal bridge clearance may impede marine navigation.

Option 2A, replacement of the bridge to roughly match the geometric criteria of the existing bridge, provides the least economical bridge replacement alternative and additional obstruction to marine navigation. This option is estimated at a cost of **\$4,990,776**, should funding be available for bridge replacement. It would incorporate a 75-year design life and be built to current design standards.

Option 2B, replacement of the bridge to match the geometric criteria of the proposed FDOT bridge replacements at the adjacent SR 528, provides the most economical bridge replacement alternative of the two replacement alternatives considered. This option is estimated at a cost of **\$4,967,631**, should funding be available for bridge replacement. It would incorporate a 75-year design life and provide the most value in terms of annualized cost to have a functioning, reliable bridge at the site, built to current design standards.

These total costs do not include fees for permitting, utility relocation, or other items not specifically shown in the cost estimation calculations in Appendix B.

Table 1: Estimated Cost Summary

Element	Description	Construction Cost	Design (15%)	CEI (10%)	Total Estimated Cost	Permitting Time	Construction Time	Design Life
Rehabilitation Option 1	Crutch Bent & Superstructure Repairs	\$2,233,637	\$335,045	\$223,364	\$2,792,046	3 Months	12 Months	21 years
Replacement Option 2A	In-Kind FSB Superstructure	\$3,992,621	\$598,893	\$399,262	\$4,990,776	12 Months	18 Months	75 years
Replacement Option 2B	Florida I-Beam Superstructure	\$3,974,105	\$596,116	\$397,410	\$4,967,631	12 Months	18 Months	75 years

1 INTRODUCTION

In September 2017, Hurricane Irma caused a severe scour condition at the bridge carrying Sea Ray Drive (previously known as Lambert Drive) over Sykes Creek (Bridge Number 704144) in Brevard County, Florida. The resulting lack of structural stability, caused by limited pile embedment, forced the bridge closure.

Working with the State Emergency Response Team, Brevard County requested assistance from the U.S. Army Corps of Engineers to stabilize the bridge and the vital utilities it supports. USACE initiated emergency, temporary repairs that included filling the eroded creek bed with stone and rubble riprap. In accordance with Brevard County Resolution No. 2017-191E, the County is now working to “restore or rehabilitate the Bridge to its pre-disaster function” and “address damages or deterioration to the bridge not caused by a disaster.”

At the request of Brevard County, Kisinger Campo & Associates Corp. (KCA) has assembled this feasibility study to evaluate the Sea Ray Drive Bridge over Sykes Creek Bridge and analyze alternatives for bridge replacement and bridge repair.



Figure 1-1: Elevation View of Bridge, Looking North

1.1 Project Description

Primary topics included within this report describe:

- The condition of the existing bridge
- Alternatives for replacement or repair and the viability of each
- Potential construction issues and considerations
- Existing utilities
- Permitting of construction
- Other opportunities (reef creation, recycling, use of existing material)
- Costs associated with the alternatives provided

Built in 1991, the Sea Ray Drive Bridge is 200'-0" long, 45'-0" wide and carries two 12' traffic lanes with approximately 9' shoulders. The bridge superstructure is comprised of five 40'-0" long spans of precast channel beams that are 2'-2" in height and approximately 5' in width. A 5½" thick reinforced concrete deck is cast atop the beams and supports 1'-3" wide reinforced concrete traffic barriers. Fencing is attached to the inside face of the traffic barriers. The bridge superstructure is supported by 18" prestressed concrete pile bents with reinforced concrete caps. The bridge has 20' long reinforced concrete approach slabs and the abutments are layered with sand-cement riprap for erosion protection.

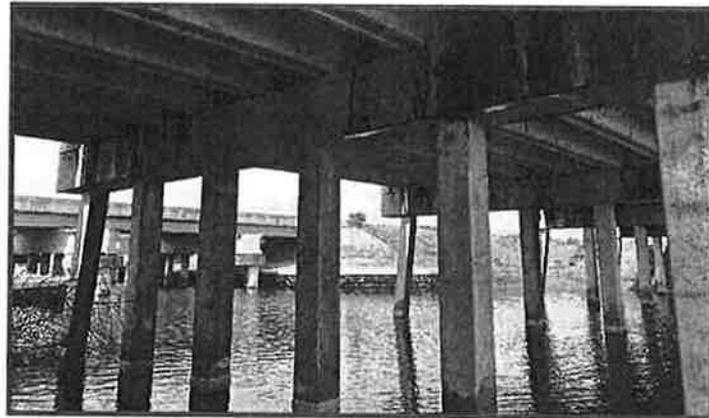


Figure 1-2: View of Existing Bridge Substructure

1.2 Project Location

Sea Ray Drive is a two-lane road that runs parallel to and immediately north of SR 528 between North Courtenay Parkway (SR 3) to the west and North Banana River Drive to the east, providing access to the businesses and properties immediately to the north.

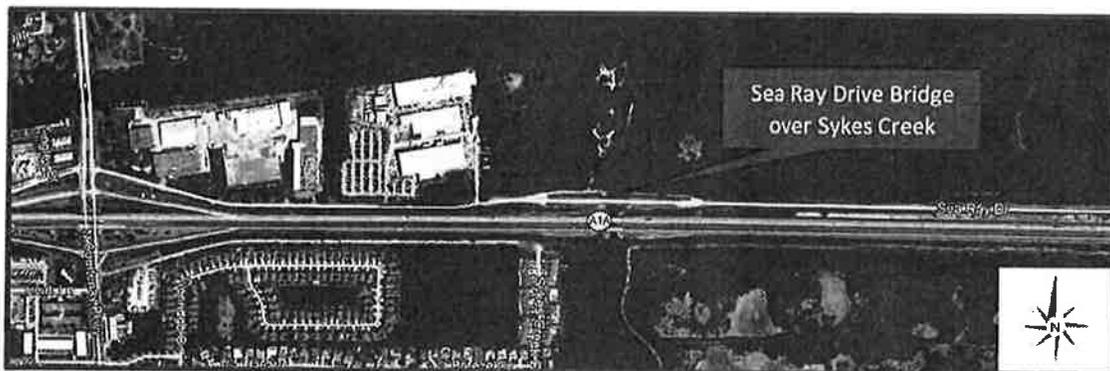


Figure 1-3: Project Location

2 CONDITION EVALUATION

2.1 Existing Channel

The existing channel, Sykes Creek, has been monitored for scour during past FDOT bridge inspections. In the most recent FDOT routine inspection report of February 2016, the bridge was rated "scour critical". At that time, comparison to groundline measurements dating back to 2006 showed degradation of the channel bottom up to 5.2' deep at Pile Bents 3 and 4. The report documents events related to Hurricane Katrina in August 2005 as a possible impact.

More recently, in the FDOT special inspection after Hurricane Irma in September 2017, measurements indicated that an additional 10.3' of scour had occurred on the south side of Pile Bent 4 and 8.3' of scour had occurred on the north side of Pile Bent 4. Pile embedment below the channel bottom was determined to be as little as 3.7', therefore the bridge was closed.

Recent remedial work carried out by the USACE on the channel at the bridge location attempted to mitigate the scour and stabilize the bridge with the installation of a revetment system, consisting of various layers of bedding stone and rubble riprap. The purpose of the remedial work was for the continued use of attached utilities.

The bridge has been closed since 2017, and no additional FDOT inspections have been conducted on the structure. The following Figures 2-1 and 2-2 provide a profile of the channel over time, as produced within the FDOT report. The graphs clearly show the severity of the scoured condition caused by Hurricane Irma.

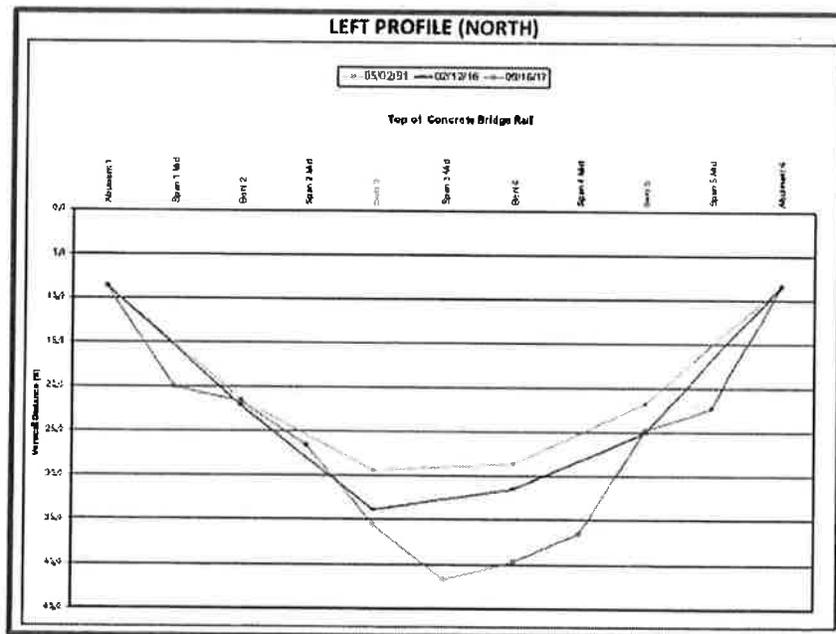


Figure 2-1: Channel Profile Change – North of Bridge

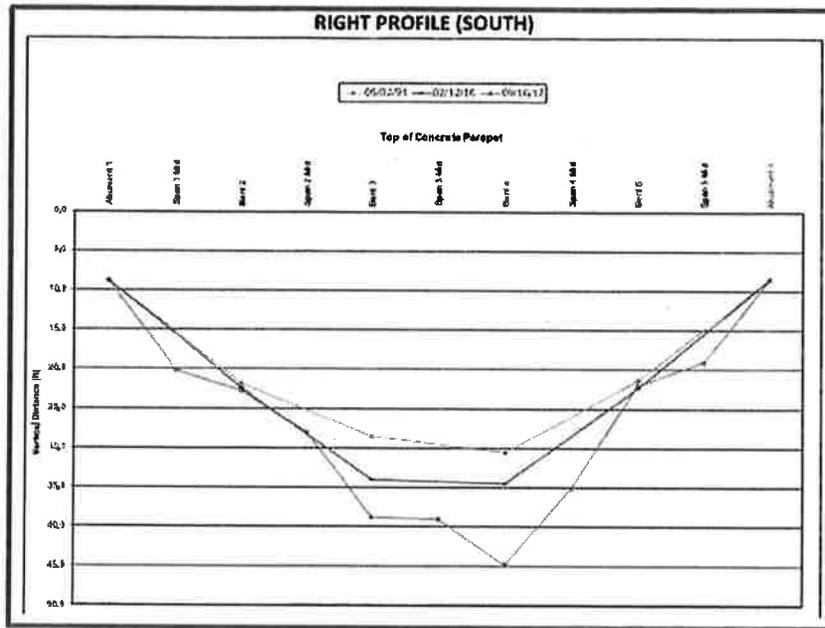


Figure 2-2: Channel Profile Change - South of Bridge

Sand-cement riprap protects the abutment of the bridge, but it is aging and covered with vegetation initiated from within the joint areas between the individual sand-cement bags. Some areas of settlement and deterioration exist within the riprap, both beneath the bridge and wrapping around the sides of the bridge, extending back to approximately the ends of the bridge approach slabs. On the west bank (Figure 2-3), settlement and deterioration are occurring at the base of the embankment slope along the creek.

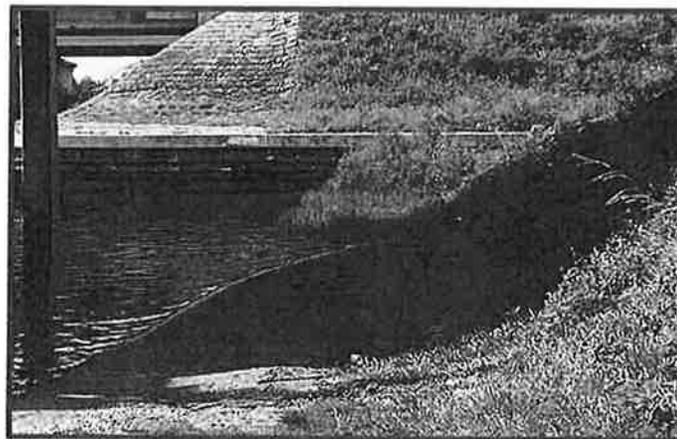


Figure 2-3 : West Embankment

On the east embankment, the creek bank has eroded up to the sand-cement riprap and has undermined some areas, resulting in displaced sections of riprap (Figure 2-4).



Figure 2-4: East Embankment

2.2 Existing Bridge

KCA has visited the bridge site on numerous occasions, most recently on July 9th, 2019. The scour condition resulting from Hurricane Irma resulted in closure of the bridge. Overall conditions of other specific bridge elements observed during our site visit generally correspond with those described in the 2016 inspection report. Figures 2-5 and 2-6 provide images of the current conditions of the superstructure and substructure.

Superstructure deficiencies include some areas of spalling and corrosion in the channel beams, deck joint deterioration, cracking within the concrete deck topping, localized areas of concrete cracking and spalling within the traffic barriers, and corrosion and deterioration of the chain link fencing.

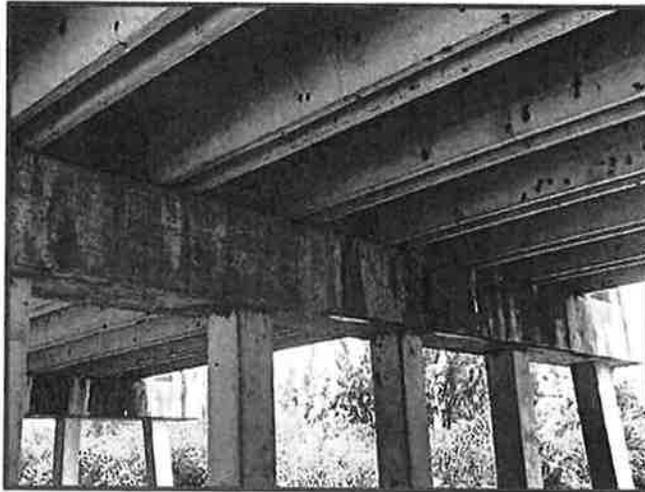


Figure 2-5: Superstructure

Substructure deficiencies include isolated areas of concrete spalls, cracking, and exposed reinforcing steel. Painted over graffiti exists throughout. The most critical deficiency is the inadequate pile embedment due to scour conditions that has resulted in structural instability of the bridge and its closure.



Figure 2-6: Substructure

The localized deficiencies found in the elements of the superstructure and substructure are to be expected in a bridge nearing 30 years of age.

2.3 Existing Utilities

The utilities of critical concern to bridge repair or reconstruction are the 6" force main and 36" water main ductile iron pipes (Figures 2-7 and 2-8 respectively). Both utilities service the population and businesses of the coastal areas and are, therefore, of critical importance. The force main is attached to the north side of the bridge and the water line is attached to the south side of the bridge. Both are supported by the bridge pile bent caps, which extend beyond the limits of the bridge deck. The pipes are seated on the caps and secured with bolted clamps.

Due to the time frame requirements of this report, utility information from each Utility Agency/Owner (UAO) is currently being assembled and coordination is ongoing. Securing utilities during and after rehabilitation or new construction activities will be a key design consideration.

Previous investigation, during the USACE emergency response, evaluated several alternatives to address the critical 36" water main. A subaqueous relocation below the existing channel with directional drilling at a cost of \$2.1 million and a time frame of 3 months was one alternative. An independent structure to support the utility was considered but abandoned due to the costly substructure that would be necessary to resist future scour events. Temporary support of the water main during construction of a crutch bent system for rehabilitation of the existing bridge was also discussed, but the process of installing temporary supports, such as added piles, would simply create the risk of additional vibration or impact to the vulnerable pipeline. Rubble currently in place below the bridge would further complicate the installation of temporary supports.

Additional investigation of utilities at the site and need for their adjustment or relocation will be further addressed as information becomes available.

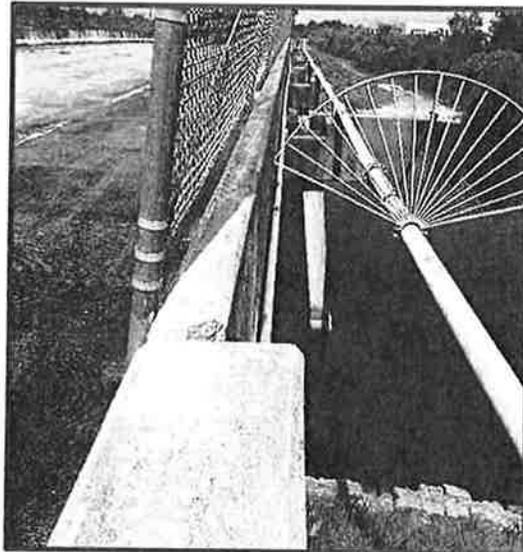


Figure 2-7: View of Existing 6" Force Main



Figure 2-8: View of Existing 36" Water Main

2.4 Existing Roadway

The existing roadway carries one lane of traffic in each direction with no shoulders. The overall roadway width widens at the bridge approaches, transitioning to approximately 9'-0" shoulders. Figure 2-9 provides an aerial photo showing this transition.

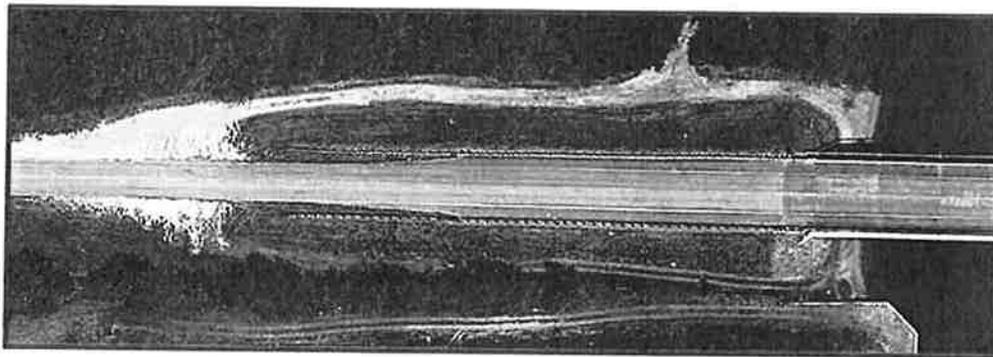


Figure 2-9: Roadway Transition at Bridge Approach (West Shown, East Similar)

The existing roadway section is assumed to remain unchanged for future bridge alternatives for the purposes of this report. The bridge approaches would require modification for the option of full bridge replacement with Florida I-Beams, as this option would raise the required approach roadway profile due to both the increased bridge superstructure depth and the increase in minimum vertical clearance for vessels (to match the proposed vertical clearances of the FDOT planned replacement of the adjacent SR 528 bridges). Minor roadway reconstruction is assumed for the in-kind replacement to ensure a smooth transition at the begin and end bridge locations. Estimated costs for roadway reconstruction have been included in the bridge replacement alternatives.

3 DESIGN CRITERIA

3.1 Horizontal and Vertical Clearances

The horizontal and vertical clearances of Sykes Creek would be affected with construction alternatives for both bridge replacement and repair alternatives.

The in-kind replacement option would slightly increase the vertical clearance, due to the use of a beam with a lower profile, Florida Slab Beams (FSBs), while keeping the existing vertical profile elevations (see sketches in Appendix A). The FSBs would be used for this alternative in place of the existing channel beams, as they are currently not a standard concrete beam shape. However, the horizontal clearance would decrease slightly by 6" from 38'-6" to 38'-0" due to the use of 24" square piles in place of the 18" square piles.

The bridge replacement option in which the design is established to be similar to the proposed adjacent SR 528 bridges at Sykes Creek is the only construction option in which both the vertical and horizontal clearances would increase. The vertical clearance would be increased to be equal to or greater than the proposed SR 528 bridges, a minimum height of 18'-9½", as shown in the BDR documents for SR 528. The horizontal clearance would also be made equal to or greater than those of the adjacent, proposed bridges, at 89'-6".

A reduced horizontal clearance is to be expected with the crutch bent repair alternative that would assume full structural support of the existing bridge superstructure for the compromised, existing foundation. The construction of a new crutch bent foundation at each pile bent, comprised of new prestressed concrete piling and reinforced concrete cap supporting new cross beams, would reduce the horizontal clearance by approximately 10'-0" from its current clearance of 38'-6". This reduction is approximated and may change with final design if this repair alternative is chosen. Vertical clearance would remain unaffected.

3.2 Construction Methods and Phasing

The existing bridge is currently closed to traffic. Therefore, phased construction for maintenance of vehicular traffic (e.g., constructing portions of bridge repair or replacement one half at a time) will not be necessary. Access to the bridge site from land can be achieved from either the west or east approaches, after exiting the main highway that is SR 528.

Barge construction may be necessary to construct the center spans of the replacement alternatives or the substructure and foundations of the crutch bent alternatives. Barge access to the project site may be possible depending on the size of the barge. The barge may be able to reach the project site from the north, but it would be more difficult to approach the site from the south due to restrictions in horizontal and vertical clearances of the existing SR 528 bridges and their existing crutch bents.

The use of a temporary trestle is also a viable option for the contractor, with the use of appropriate permits.

Overall, access from land or water is not greatly impeded and the absence of traffic due to the bridge closure will only help the construction process.

Marine traffic should be maintained throughout construction, as has been done during past construction projects within Sykes Creek. There are some potential periods of closure during major construction tasks such as rubble removal, beam placement, or other operations that could encroach upon marine navigation within the main channel.

Regardless of the solution chosen for the Sea Ray Drive Bridge over Sykes Creek, the utilities attached to the existing bridge will necessitate careful planning during demolition and/or construction activities. Temporary supports may be required should the crutch bent alternative be selected but may also present additional construction risks. Relocation, with directional boring or separate utility bridges being possible solutions, would be required in the case of a bridge replacement. Reference Section 2.3 Existing Utilities for a more detailed discussion of the options available for the existing utilities.

3.3 Removal of Existing Bridge

The removal of the existing bridge No. 714144 will occur in the replacement alternatives and require the removal of bridge debris.

Methods of demolition must be specified to minimize impact to adjacent structures, the marine environment, interference with future construction, and usage of the site and navigation channel. Alternatives for reuse of the bridge debris include recycling, artificial reef programs, and specific use, such as slope protection along embankments. These alternatives are generally selected by the construction team based on cost and availability but can be initiated by the County within the construction contract if there are specific preferences.

Detours for Sea Ray Drive will be required during demolition and construction activities. The Sea Ray Drive Bridge is not on a hurricane evacuation route and is not the sole means of access to a neighborhood or business. Access to the businesses located to the east and west of the existing bridge can be detoured (approximately 2 miles) around the bridge through the use of SR 528. Exits from SR 528 are available near the entrances to these businesses. See Figure 3-1 for a view of these alternate routes.

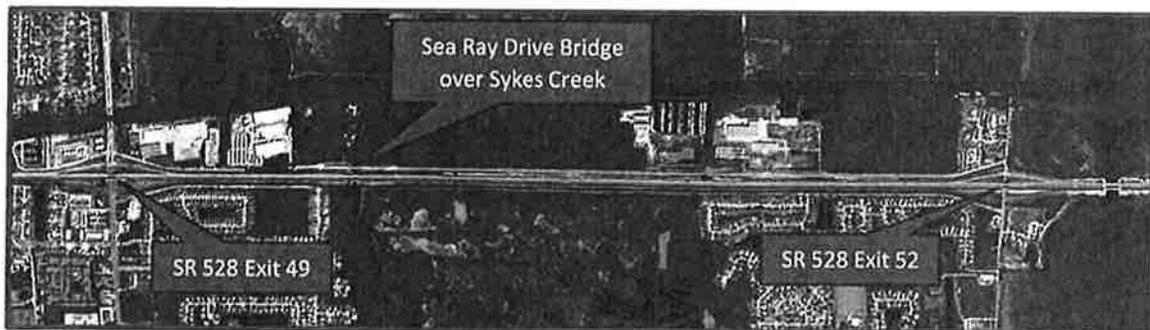


Figure 3-1: Alternate Routes for Access to Businesses

3.4 Life Expectancies

The bridge, constructed in 1991, was designed at a time when the theoretical design life of a bridge was 50 years. Based on that 50-year design life, the bridge would be planned for replacement in approximately 2041, had no other major incidents occurred that would impact the function of the bridge. The actual service life of a bridge can be extended beyond the design life with techniques such as aggressive maintenance, major renovations, cathodic protection, and strengthening. Coastal bridges are subjected to more corrosive environments than inland bridges, but typically have stricter design criteria, such as additional concrete cover and concrete admixtures to combat corrosion. In each case, consideration should be given to the controlling bridge elements, their continued function, and if that function meets current standards and operational needs.

In the case of the alternative based on rehabilitation with installation of crutch bents, assumed for planning purposes to be within the next year, the remaining design life of the superstructure would be considered at approximately 21 years based on the controlling elements of the existing superstructure, unless new components were installed or other rehabilitation efforts were undertaken to extend the original design life.

For alternatives involving new bridges designed to current standards, with the evolution of newer design criteria now within the American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specifications, the design life is 75 years.

4 CONSTRUCTION ALTERNATIVES

In evaluating replacement, repair, and demolition of the existing bridge, KCA developed two alternatives: Option 1, the installation of additional crutch bents at the intermediate bents of the existing bridge (in order to provide a new foundation designed to accommodate the full bridge loading for controlling scour conditions); Option 2A, a replacement "in kind" matching the approximate geometry of the existing bridge but designed in accordance with current standards; and Option 2B, a replacement matching the conceptual geometric design criteria for required navigational clearances of the proposed adjacent replacement bridges, planned at SR 528 over Sykes Creek.

4.1 Assumed Bridge Typical Section

The assumed typical section for the replacement alternatives (Options 2A and 2B) consider a 42'-0" clear roadway width, along with 36" Single-Slope barriers. The Single-Slope barrier will have fencing mounted to its exterior, similar in height to the existing bridge fencing. The clear roadway width allows for two 12'-0" lanes with 9'-0" shoulders. The typical section assumed for replacement would require more extensive analysis from a roadway standpoint but can be considered a reasonable solution for this feasibility study.

4.2 Bridge Span Arrangements

The in-kind replacement (Option 2A) and the crutch bent repair (Option 1) do not propose any changes to the span arrangements of the existing bridge. Only the replacement with similar geometry to the planned SR 528 bridges (Option 2B) alters the existing span arrangement.

In order to match the proposed, adjacent SR 528 bridges, the Florida Department of Transportation (FDOT) provided KCA the recently submitted Bridge Development Report (BDR) for the improvements of roadway and bridges along SR 528. The horizontal and vertical clearances to be provided at the proposed SR 528 bridges are 89'-6" and 18'-11½", respectively. These horizontal and vertical clearances are matched for the cost estimation of the full replacement option (Option 2B) in order to have uniform clearances for marine traffic throughout the length of Sykes Creek should all bridges be replaced.

4.3 Rehabilitation Alternative

The rehabilitation option for the Sea Ray Drive Bridge over Sykes Creek bridge, Option 1, considers the stabilizing of the bridge substructure with crutch bents, and the optional repair of the deficiencies described in the latest bridge inspection report.

The proposed crutch bents in the rehabilitation alternative would be similar in configuration to those of the existing FDOT bridges at SR 528 bridges over Sykes Creek. Figure 4-1 shows the crutch bents supporting the superstructure of the SR 528 bridges. The proposed crutch bent for the Sea Ray Drive Bridge considers Florida I-54 Beams supporting the existing superstructure. The crutch bent cap would be supported by four 24" prestressed concrete piles. Four piles are conservatively proposed, as further

investigation and geotechnical assessment would be necessary to accurately design the foundation. This conservative approach also accounts for the extra stability necessary to prevent excessive deflection in the case of an extreme scour event. Reference Appendix A for preliminary sketches of a Plan & Elevation and Typical Section of the rehabilitation alternative.

A design consideration not taken into account for the estimated cost of the rehabilitation, due to lack of information and more detailed analysis, is the strengthening of the existing channel beams of the Sea Ray Drive Bridge. The bearing location of the channel beams will shift with the rehabilitation option due to the location of the crutch bent cap. Shear reinforcement typically decreases toward the midspan location of a simply supported beam and is likely the case for the existing channel beams. Strengthening of the existing channel beams by wrapping them in Carbon Fiber Reinforced Polymer (CFRP) material may be necessary at the proposed bearing location in order to prevent shear failure. Wrapping the beam ends in CFRP would add significant cost to the rehabilitation option and could be up to \$200,000 based on beam repair historical cost.

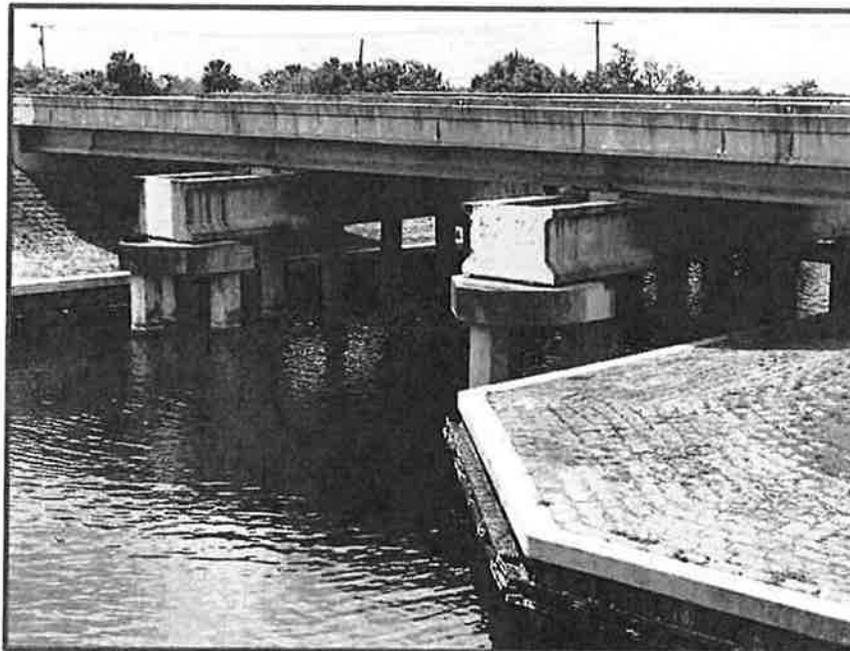


Figure 4-1: Existing Crutch Bents at Adjacent SR 528 Bridges

For the rehabilitation alternative, removal of the riprap would be difficult to accomplish with overhead constrictions from the existing bridge superstructure and extreme care would be required to avoid damage to the existing bridge foundation during this activity. Further, removal of the riprap would expose the bridge to a reduced level of stability until the crutch bent installation is complete. It is difficult to provide an accurate unit cost for this work, as it is heavily dependent upon the contractor's assessment

of risk and their willingness to be exposed to it. KCA is continuing discussions with geotechnical engineers and others on this matter and will keep the County apprised of our findings.

The County has the option of including the repair of other deficiencies found in the existing bridge as a County funded addition to planned construction. As noted in the Existing Bridge section of this report, the existing superstructure is in relatively good condition. However, repair of existing deficiencies is recommended to prevent further deterioration at the locations noted should the rehabilitation option be pursued.

Channel beams currently in use on the existing bridge are no longer a bridge standard in Florida due to common maintenance issues and deficiencies that develop as bridges age. These deficiencies can be difficult to repair if left unaddressed. One issue noted in the inspection report describes cracking in the bridge deck. This is likely due to differential deflection between beams from the limited ability of the relatively thin concrete deck to distribute the shear loads of traffic from beam to beam. This can result in harmful penetration of moisture and chlorides, and reduce the load carrying capacity of the bridge. A deck sealant system is one means to minimize potential damage.

The relatively narrow thickness of the existing channel beam legs typically provides minimal concrete coverage over the reinforcing steel and prestressing strand within. This can also cause added exposure to moisture and chlorides that can accelerate corrosion and result in spalling of the concrete as noted for several locations within the inspection report. Repairing any significant concrete deficiencies in a timely manner prevents added exposure and additional deterioration.

The bridge deck joints and bridge fencing need replacement due to deficiencies and age should the repair option be selected. Open deck joints allow runoff to flow onto the channel beams and substructure below. Moisture and chlorides deposited on these elements enhance potential for corrosion, deterioration of concrete, and a shortened service life. The existing bridge fencing is currently mounted on the interior face of the bridge railing, which is not standard and not recommended for vehicular safety. Significant areas of corrosion in fencing components add to the need for replacement with a proper installation. Figures 4-2 and 4-3 show the current condition of the deck joints and the existing bridge fencing.

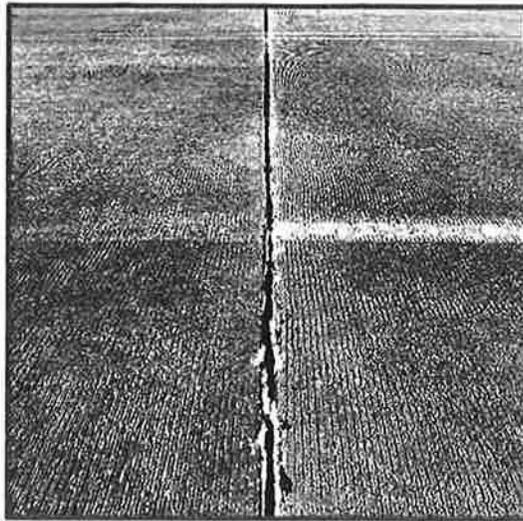


Figure 4-2: Typical Existing Deck Joint



Figure 4-3: Existing Bridge Fencing, Interior Mounting

Though the bridge inspection report does note some minor deficiencies in the substructure, no repairs would be proposed on the substructure if the crutch bent repair alternative is chosen. The proposed crutch bents would be designed to carry the full load of the superstructure with the embedment of the crutch bent foundations considering the potential scour of the channel, rendering the existing substructure unnecessary.

4.4 Replacement Alternatives

Two replacement options are considered in this report. The first is an in-kind replacement, Replacement Option 2A. The second is a replacement in which the structure matches the horizontal and vertical clearances of the future SR 528 bridges over Sykes Creek, which are immediately adjacent to the Sea Ray Drive bridge, and this option is referred to as Replacement Option 2B.

The in-kind replacement, Replacement Option 2A, proposes to keep the current span arrangement and similar clearances to the existing bridge. As such, a similar superstructure depth would be required. The existing bridge superstructure uses concrete channel beams with a reinforced concrete topping. The maximum superstructure depth for the existing bridge is approximately 2'-7½", based on the original construction plans. Figure 4-4 shows a partial section view from the original construction plans.

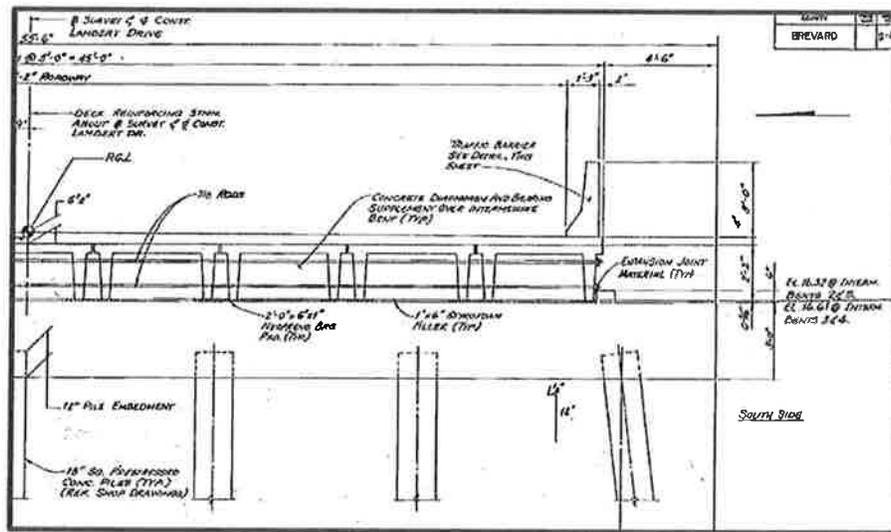


Figure 4-4: Partial Section View of Existing Bridge

As the channel beam used in the original construction of the bridge is no longer standard, it would not be economically efficient to propose the in-kind replacement using the same beam type. The Florida I-Beam with the lowest profile is 36" in height, exceeding the required 2'-7½" height for an in-kind replacement. Therefore, the beam proposed for the in-kind replacement is the Florida Slab Beam. The Florida Slab Beam is currently a developmental design standard for FDOT and is used on FDOT projects with approval. The Florida Slab Beam is a variation of prestressed slab units, modified for testing and research by FDOT. Figure 4-5 provides a typical section of the Florida Slab Beam standard.

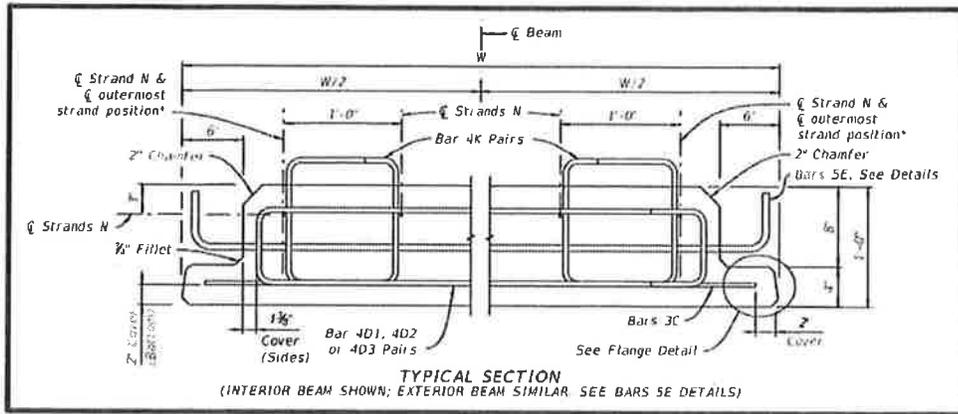


Figure 4-5: 12" Florida Slab Beam Typical Section

A Florida Slab Beam is a viable solution for replacing the existing channel beams at an equal span. It would require a 6½" topping, with the top ½" being sacrificial thickness for grooving and planing. The span lengths would remain unchanged from the existing, and the profile would not need to be raised, as the superstructure depth of the in-kind replacement option would be decreased. Appendix A can be referenced for a preliminary sketch of the Plan & Elevation and Typical Section of Replacement Option 2A.

Replacement Option 2B, in which the bridge is replaced with a bridge similar in horizontal and vertical clearances to the adjacent SR 528 bridges to be built in the future, is also explored. The BDR for the future SR 528 bridges proposes Florida I-45 Beams supporting an 8½" deck. The channel span is set to match the SR 528 channel span proposed in the BDR, with a length of 91'-6" and providing a horizontal and vertical clearance of 89'-6" and 18'-11½", respectively. A Florida I-45 Beam is set to support an 8½" deck for all three spans.

Replacement Option 2B considers an overall bridge length of 222'-0", which is estimated based on providing a 1:2 Slope from the existing toe of slope. The current slope protection is steeper than 1:2 and providing a flatter slope results in a longer bridge length. This bridge length is preliminary and can change with further hydraulic analysis. Reference Appendix A for preliminary sketches of the Plan & Elevation and Typical Section for Replacement Option 2B.

Table 4-1 summarizes the two replacement alternative superstructures, along with the resulting span lengths.

Option	Beam Type	Topping or Deck Thickness	Channel Span Length	Horizontal Clearance
Replacement Option 2A	12" FSB	6½"	40'-0"	38'-0"
Replacement Option 2B	45" FIB	8½"	91'-6"	89'-6"

The substructure proposed to support either of the superstructure options is a pile bent founded on 24" square prestressed concrete piles. For bridges with span lengths of those in this report, pile bents are typically the most economical. For the purpose of cost estimating, pile lengths are estimated using geotechnical information from the Bridge Development Report of the adjacent SR 528 bridges, and conservatively lengthened to account for future scour.

Replacement Option 2A poses a potential construction conflict between the proposed and existing pile foundations. The complete removal of the existing pile would be ideal to completely avoid a conflict when installing the proposed piles. The existing piles supporting Bents 3 and 4 are not significantly embedded due to the scour issue and it may be possible to completely remove them without too much difficulty. The existing piles at Bents 1, 2, 5, and 6 may be more problematic for removal. If complete extraction is not practical at these locations, the proposed pile locations may be staggered from the existing pile locations, thereby avoiding conflicts.

One critical issue for the alternatives identified during this investigation relates to the temporary repairs carried out by the USACE. The filling of the scour damage below the bridge resulting from the hurricane improved the existing bridge's stability and enabled continued operation of the bridge mounted utilities. It also averted possible catastrophic damage to the bridge and utilities from other future significant storms in the vicinity. However, the mat of rubble riprap now lining the Sykes Creek channel presents significant challenges and additional work effort for new construction alternatives. The top mat of rubble riprap, which may be approximately 5' thick, would prevent pile driving of intermediate bent foundations using conventional methods. Obtaining the required embedment of new piling, achieving placement within tolerance for the pile installations, and reaching reliable bearing and friction capacities without damage to the piling would all be made difficult by the presence of the added rubble and the properties of the added small stone. What appears to be the only viable option for pile installation for the new bridge alternatives is the complete removal of at least the layer of rubble riprap.

5 ENVIRONMENTAL AND PERMITTING REQUIREMENTS

5.1 Environmental Permits

A preliminary evaluation of potential environmental regulatory involvement associated with rehabilitation and replacement alternatives for the Sea Ray Bridge was performed. Environmental regulatory agencies potentially having jurisdiction over the identified project alternatives include: the St. Johns River Water Management District (SJRWMD), the Florida Department of Environmental Protection (FDEP), the U.S. Army Corps of Engineers (USACE), and the U.S. Coast Guard (USCG). Environmental regulatory coordination is recommended to be initiated early in the design build process, to identify any potential project permitting issues.

The water-related activities associated with rehabilitation and replacement alternatives presented in this report are envisioned to qualify for a General Permit (GP) from SJRWMD, under the Environmental Resource Permit regulations (Rule 62-330, F.A.C.), or qualify for an exemption from ERP. The USACE regulates discharge of fill under Section 404 of the Clean Water Act (CWA). Alternatives are envisioned to qualify for a Nationwide Permit (NWP) or result in a No Permit Required (NPR) finding by the USACE. The USCG regulates bridges crossing navigable waters of the United States. A USCG Bridge Permit will be required for the replacement of the Sea Ray Bridge, but not for rehabilitation work. A National Pollution Discharge Elimination System (NPDES) permit may be required from FDEP and is required for soil disturbance of one acre or more.

5.2 SJRWMD Environmental Resource Permit

The St. Johns River Water Management District (SJRWMD) will review the project under the Environmental Resource Permit (ERP) regulations, pursuant to Rule 62-330, F.A.C. The SJRWMD previously issued a Management and Storage of Surface Waters (MSSW) Individual Permit (Permit No.: 16513-1, issued May 8, 1990) for the original construction of Sea Ray Drive (previously, Lambert Drive Extension) and the Sea Ray Boats Bridge over Sykes Creek. An application for a Wetland Resource Management Permit (WRM Application No.: 12-009-0021AG) was reviewed by the SJRWMD concurrently with the MSSW Application (Application No.: 4-009-0371AG), under previous regulations, pursuant to Rule 40C-4, F.A.C.

Bridge repair and rehabilitation activities will likely qualify for an exemption to the ERP regulations in accordance with Rule 62-330.020(1)(a), F.A.C. (*non-regulated activity; as operation and routine custodial maintenance...*); and possibly Rule 62-330.051(4)(e), F.A.C. (*repair or replacement of vehicular bridges...*). Work associated with the bridge replacement may also qualify for an exemption under Rule 62-330.051(4)(e), F.A.C., subject to several conditions. This exemption is usually reserved for in-kind replacement and is generally not issued for bridge replacement projects which include additional work (extensive upgrades) to achieve current design standards (widening for shoulders, sidewalks, multi-use paths, etc.).

The bridge replacement project, as currently envisioned, would meet the criteria for a General ERP identified in Rule 62-330.443, F.A.C. (*General Permit to the FDOT, Counties, and Municipalities for Minor Bridge Alteration, Placement, Replacement, Removal, Maintenance and Operation*). This General Permit

is specific to the work associated with the bridge and would also cover demolition and removal of the existing bridge. Any roadway construction necessary for the bridge approaches, if not covered under a specific ERP Exemption, would likely qualify for a General ERP identified in Rule 62-330.447, F.A.C. (*General Permit to the FDOT, Counties, and Municipalities for Minor Activities within Existing Rights-of-Way or Easements*).

The SJRWMD may request that two (2) General ERP applications (one for the bridge replacement, and one for the roadway safety and operational improvements; as applicable) be submitted along with two separate review fees (\$250.00 each). A pre-application meeting with the SJRWMD, once a final repair/replacement solution is selected, is recommended to ascertain specific permitting requirements. The SJRWMD can process a *Notice of Intent to Use an Environmental Resource General Permit*, or a *Request for a Verification of an Exemption* within 30 days of receipt of a complete application.

5.3 USACE Dredge & Fill Permit

The U.S. Army Corps of Engineers (USACE; Cocoa Permits Section) will also review the project for dredge and fill impacts, pursuant to Section 404 of the Clean Water Act (CWA), and possibly navigation obstruction, under Section 10 of the Rivers and Harbors Act of 1899 (RHA). The USACE issued a Nationwide Permit 3, permit no. SAJ-2017-02693 (NWP-CMM) to Brevard County on October 23, 2017. This permit, which expires on March 18, 2022, covered placement of rock and rip rap in Sykes Creek as scour protection measures.

The USACE does not permit bridges, per se, but activities proposed for the bridge rehabilitation or replacement will be reviewed by the USACE to determine if a permit is required. Depending upon the final repair/replacement solutions, the project may be exempt from Section 404 (CWA) permitting, pursuant to Section 404(f)(1)(B) of the CWA.

Mr. Corey Maier, the USACE Project Manager for the current permit, was contacted to discuss the proposed project. Mr. Maier recommended a meeting once a selected repair/replacement alternative had been developed enough to determine permitting requirements. Mr. Maier indicated that he would be the point of contact for this project.

A meeting with the USACE, once a final repair/replacement solution is selected, is recommended to determine if a USACE permit will be required. Depending upon the activities proposed, the USACE may issue a new NWP for the work (maintaining the current permit number, as appropriate). If no USACE permit is required for the proposed work, then the USACE can issue a No Permit Required (NPR) letter as documentation. The bridge demolition and removal would also be covered under the NWP or NPR, depending on the construction techniques. If a USACE permit is required, then an application will be submitted on USACE ENG FORM 4345 and accompanied by a request for Corps Jurisdictional Determination (Form 2087). The USACE can general process an application for an NWP within approximately 60 days from receipt of a complete application.

5.4 U.S. Coast Guard Bridge Permit

The U.S. Coast Guard (USCG) has authority to approve the plans and locations of bridges and causeways across navigable waters of the United States, pursuant to Section 9 of the River and Harbors Act of 1899 (RHA), the General Bridge Act of 1946, as well as other enabling legislation.

Mr. Randall Overton, M.P.A., Chief, Permits Division, USCG Seventh District, Bridge Administration was contacted to determine if a USCG Bridge Permit would be required for the project. Mr. Overton indicated that if repair or maintenance work was proposed (including installation of crutch bents), then a USCG Bridge Permit, or Bridge Permit Amendment, would not be required. The demolition and removal would also likely not require formal USCG bridge permitting. However, the replacement of the Sea Ray Bridge would require a USCG Bridge Permit. A USCG Bridge Permit can generally be issued within approximately six to nine months from receipt of a complete application.

If the project involves in-water work, then the USCG Station Port Canaveral, Marine Safety Detachment, should be contacted a minimum of 60 days in advance of construction, to ensure that a Local Notice to Mariners (LNM) is published advising navigational interest of the proposed work.

Rehabilitation and replacement plans should also be sent to the Bridge Operation Section at USCG District Seven Headquarters in Miami. The USCG may also require a pre-construction conference with the contractor and Brevard County.

Proposed modifications to the structure that affect the existing navigational envelope (horizontal and vertical clearances) should be coordinated with the USCG as soon as practicable. Also, any plan to limit navigational access at the bridge location due to construction operations will need to be coordinated with the USCG, prior to construction.

According to the Space Coast Daily, the previous USACE project for scour repairs, planned the closing of the Sykes Creek waterway to boat traffic from the barge canal to the SR 528 bridge, Monday through Friday, from a half-hour after sunrise to a half-hour before sunset. The waterway was planned to be open from noon to 1 p.m. Monday through Friday and open nights and weekends. A similar closure schedule may be required for construction of other alternatives – rehabilitation, replacement, or demolition.

5.5 Florida Fish and Wildlife Conservation Commission (FWC)

The FWC, Division of Marine Fisheries Management, administers the state artificial reef program, and issues permit to local government and nonprofit corporations to construct artificial reefs. Brevard County holds an FWC reef permit, and there are currently over 60 permitted artificial reef sites within federal waters off the coast of Brevard County. The closest of these artificial reefs is approximately 17 miles offshore of Port Canaveral. The Brevard County Artificial Reef Program is administered by the Brevard County Natural Resource Management Department. Material generated from demolition of the existing bridge may present an opportunity for disposal at artificial reef site(s). The project is located very close to Port Canaveral, facilitating access to the Atlantic Ocean.

5.6 National Pollution Discharge Elimination System (NPDES)

The project may require filing a Notice of Intent to Use NPDES Generic Permit for Stormwater Discharge from Large and Small Construction Activities under the National Pollution Discharge Elimination System (NPDES), administered by the Florida Department of Environmental Protection (FDEP), pursuant to the provisions of Section 403.0885, F.S. A NPDES permit from FDEP and is required for soil disturbance of one acre or more. This permit application is generally acquired by the construction contractor, as part of the project mobilization.

5.7 Sovereignty Submerged Lands (SSL) Easement

The State of Florida holds title to sovereign submerged lands, and these lands are administered through the Board of Trustees of the Internal Improvement Trust Fund (TIITF). Brevard County was issued SSL Easement No. 00191-4028-05 on August 20, 1990, within which to construct the "Sea Ray Boats Bridge", in accordance with the SJRWMD Wetland Resource Management Permit. This 20-year easement expired on August 28, 2010 and has been renewed for 50 years (expires August 28, 2060). Should the selected team require additional sovereign submerged lands in order to accomplish the rehabilitation work or replacement of the existing bridge, then the existing SSL easement may need to be modified. This can sometimes take a substantial amount of time to prepare a complete submittal and receive approval. Due to possible time constraints, the modification of the SSL easement should be avoided unless necessary.

5.8 Federal Emergency Management Agency (FEMA)

FEMA provides federal disaster assistance through numerous programs under their purview. These programs include the Public Assistance Program and the Hazard Mitigation Grant Program. The Public Assistance Program provides grant assistance for disaster relief including the repair, replacement or restoration of disaster-damaged, public facilities and infrastructure. The FEMA Hazard Mitigation Grant Program provides funding for actions to lessen impacts to coastal infrastructure and facilities and to minimize future damage to coastal public resources. Brevard County has applied to FEMA, through the State of Florida, for a grant (Project No. 20858) for repairs to the Sea Ray Bridge. This feasibility study is intended to develop repair and replacement alternatives, as well as associated costs, to facilitate grant coordination with FEMA.

5.9 Federal Aviation Administration (FAA)

Construction, obstruction or alteration of more than 200 feet in height or exceeding prescribed heights within 20,000 feet of an airport, or 5,000 feet of a heliport, require coordination with the FAA by filing FAA Form 7460-1. The nearest airport is Merritt Island Airport (COI), which is located 22,740 feet south of the existing bridge. While Merritt Island Airport is located outside of the 20,000-foot buffer, FAA coordination is recommended if the proposed work involves cranes, due to the complex airspace surrounding the project. The project is located within proximity to areas of restricted airspace, including the Kennedy Space Center.

5.10 Protected Species

The waters of Sykes Creek are contiguous with the Indian and Banana rivers via the Canaveral Barge Canal and are intermittently connected to the Atlantic Ocean by the Canaveral Lock at Port Canaveral. These waters surrounding the project are accessible to fish and wildlife, including species afforded special protection by state and federal law. These regulations are administered by the U.S. Fish & Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and the Florida Fish and Wildlife Conservation Commission (FWC). The waters surrounding the project site are accessible to the West Indian manatee, swimming sea turtles, and the smalltooth sawfish.

5.10.1 Smalltooth Sawfish (*Pristis pectinata*)

The smalltooth sawfish is a large, cartilaginous fish with a long, flattened, toothed rostrum that extends outward from its flattened head resembling a saw. This species is listed as **endangered** by the National Marine Fisheries Service (NMFS). While the study area contains suitable habitat there have been no documented observations of this species within one (1) mile of the project area. Additionally, this species was not observed during the field reviews of the study area. To minimize potential adverse impacts to the smalltooth sawfish, Brevard County will implement the NMFS-approved *Sea Turtle and Smalltooth Sawfish Construction Conditions* (revised March 2006) during the proposed construction.

5.10.2 Sea Turtles

- Loggerhead Sea Turtle (*Caretta caretta*)
- Green Sea Turtle (*Chelonia mydas*)
- Leatherback Sea Turtle (*Dermochelys coriacea*)
- Hawksbill Sea Turtle (*Eretmochelys imbricata*)
- Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)

The loggerhead sea turtle and green sea turtle are listed as **threatened** and the leatherback sea turtle, hawksbill sea turtle, and Kemp's Ridley sea turtle are listed as **endangered** by the USFWS. While each species is distinct, sea turtles are discussed collectively since they occupy similar habitats and have similar nesting patterns. These sea turtles are all known to nest on sandy beaches of the Florida coastline. Additionally, they will occasionally utilize the waters of bays and inlet waters for swimming and foraging habitat. Sea turtles, particularly juvenile sea turtles, may utilize waters within and adjacent to the project area.

The primary concern for impacts to these species is the loss of nesting habitat (sandy beaches). Sea turtle nesting habitat is not present within the project area and there have been no documented occurrences within one (1) mile of the project study area. However, sea turtle observations have been made in the nearby Banana River.

To minimize potential adverse impacts to the loggerhead sea turtle, green sea turtle, leatherback sea turtle, hawksbill sea turtle, and Kemp's Ridley sea turtle, Brevard County will implement the NMFS-approved *Sea Turtle and Smalltooth Sawfish Construction Conditions* (revised March 2006) during the proposed bridge work.

5.10.3 Wood Stork (*Mycteria americana*)

The wood stork is listed as **threatened** by the **USFWS** due to a sharp decline in its breeding populations. The wood stork utilizes both fresh and saltwater habitats such as fresh and saltwater marshes, tidal flats, wet prairies, cypress swamps, and agricultural environments. Within the project area, suitable foraging habitat for the wood stork is available along the margins of Sykes Creek. The USFWS has defined a core foraging area (CFA) in Brevard County for the wood stork as a 15-mile radius from breeding colonies. The project area is located within the CFA of two (2) documented wood stork colonies, the closest of which is the Brevard County Maintenance Shop colony, located 6.3 miles south of the existing bridge. No wood storks were observed within the project vicinity during field reviews. The project may result in minor surface water involvement along Sykes Creek, which is not expected to substantially affect wood stork foraging habitat in the project vicinity.

5.10.4 Bald Eagle (*Haliaeetus leucocephalus*)

The bald eagle is a large raptor with a distinctive white head and yellow bill. This species has been delisted from the Endangered Species Act by the **USFWS**. However, it remains federally protected under the Bald and Golden Eagle Protection Act (BGEPA) in accordance with 16 United States code 668 and the Migratory Bird Treaty Act of 1918. The bald eagle tends to utilize riparian habitats associated with coastal areas, lake shorelines, and riverbanks. Nests are generally located near water bodies that provide a dependable food source. Nests within Florida are closely monitored by the FWC, and the FWC Center for Biostatics and Modeling maintains a website of known bald eagle nest locations. According to this database, the closest bald eagle nesting locality to the project is nest BE007 which is located approximately 0.99 miles (5,250 feet) east of the project. This nesting locality was last surveyed in 2016 but has not been reported as active since 2001. The project is located outside of the primary (330 feet) and secondary (660 feet) buffer zones of this bald eagle nest. No bald eagles or their nests were observed during field reviews. During the project design and permitting phase, Brevard County will review the project area for active bald eagle nests. If an active nest is identified within 660 feet of the proposed area, Brevard County will coordinate with the USFWS to secure all necessary approvals prior to initiating of construction.

5.10.5 West Indian Manatee (*Trichechus manatus*)

The West Indian Manatee is a large, aquatic mammal that is listed as **threatened** by the **USFWS**. This species is found in marine, brackish, and freshwater systems in coastal and riverine areas throughout Florida. Preferred habitats include areas near the shore featuring underwater vegetation like seagrass and algae. Due to their eating habits, the manatee is nicknamed “sea cow” because they eat seagrasses and other aquatic plants. The project is located within the USFWS West Indian Manatee Consultation Area and is federally designated Critical Habitat for the West Indian manatee. No visual observations of manatees were made during field reviews. However, there have been in excess of 50 manatee carcasses recovered within 1 mile of the project location. The Canaveral Barge Canal provides a conduit for manatees to traverse between the Banana and Indian rivers, as well as Sykes Creek. To minimize potential adverse impacts to the West Indian manatee, Brevard County will implement the USFWS-approved *Standard Manatee Conditions for In-Water Work (updated 2011)* during the proposed bridge work. The project area is an important manatee travel area, and the use of manatee observers during construction may be required by the environmental resource agencies, as it was for the USACE scour protection project.

5.11 Wetland Resources

5.11.1 Estuarine Vegetation

The margins of Sykes Creek at the project location are colonized by estuarine wetland vegetation typical of the Indian River Lagoon system. Conspicuous vegetation observed included red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*) white mangrove (*Laguncularia racemosa*), buttonwood (*Conocarpus erectus*), seashore paspalum (*Paspalum vaginatum*), seaside oxeye daisy (*Borrchia frutescens*), Australian pine (*Casuarina* sp.) and Brazilian pepper (*Schinus terebinthifolius*). Work in wetlands will require approval and permits from environmental regulatory and resource agencies.

5.11.2 Submerged Vegetation

Submerged vegetation, which includes seagrasses and rhizophytic algae, provides important habitat for many developmental stages of estuarine dependent species, including numerous commercially important finfish species and crustaceans. The current velocities, erosive bed movement, as well as the rubble placed within Sykes Creek at the project location, preclude colonization by submerged vegetation at the project site. However, *Caulerpa prolifera*, a rhizophytic green alga, was observed colonizing a shallow area, located northeast of the existing bridge. A single long shoot of widgeon grass (*Ruppia maritima*) was also observed rooted in this area. Observations were difficult due to poor water clarity. The project should not affect this area, as it is shallow and located outside of the SSL easement. If any impact is proposed to this submerged estuarine area, a submerged macrophyte survey will likely be required by the environmental regulatory agencies during the permitting process. Seagrass surveys are required to be performed between June and September.

6 CONCLUSIONS AND RECOMMENDATIONS

The cost estimates for each alternative are presented in Table 6-1 and are based on preliminary quantity estimates for the respective design alternatives detailed in Appendix B. Unit prices are estimated using the historical data provided by the Florida Department of Transportation on their website. These values provide a comparison of alternatives for planning purposes but may not reflect the actual construction cost at the time of project letting due to market prices, contractor availability, design modifications, and other considerations beyond the scope of this report.

Option 1, construction of crutch bents and superstructure repairs of the existing bridge, is based upon original conceptual plans to return the bridge to service. However, unknown costs associated with accommodating the rubble riprap within Sykes Creek during construction may escalate the estimated cost of **\$2,792,046** nearer to the bridge replacement alternatives. This alternative provides an estimated design life of 21 years considering continued use of the existing bridge superstructure and its remaining design life.

Option 2A, replacement of the bridge to roughly match the geometric criteria of the existing bridge, provides the least economical bridge replacement alternative and additional obstruction to marine navigation. This option is estimated at a cost of **\$4,990,776**, should funding be available for bridge replacement. It would incorporate a 75-year design life and be built to current design standards.

Option 2B, replacement of the bridge to match the geometric criteria of the conceptual FDOT bridge replacements at the adjacent SR 528, provides the most economical bridge replacement alternative at a cost of **\$4,967,631** should funding be available for bridge replacement. It would incorporate a 75-year design life and provides the most value in terms of annualized cost to have a functioning, reliable bridge at the site built to current design standards.

These total costs do not include fees for permitting, utility relocation, or other items not specifically shown in the cost estimation calculations in Appendix B.

It should be noted that the significant cost of addressing existing utilities will impact all alternatives. The rehabilitation option may enable leaving the water main in place, but methods to secure the utility prior to construction of the crutch bents will be complex.

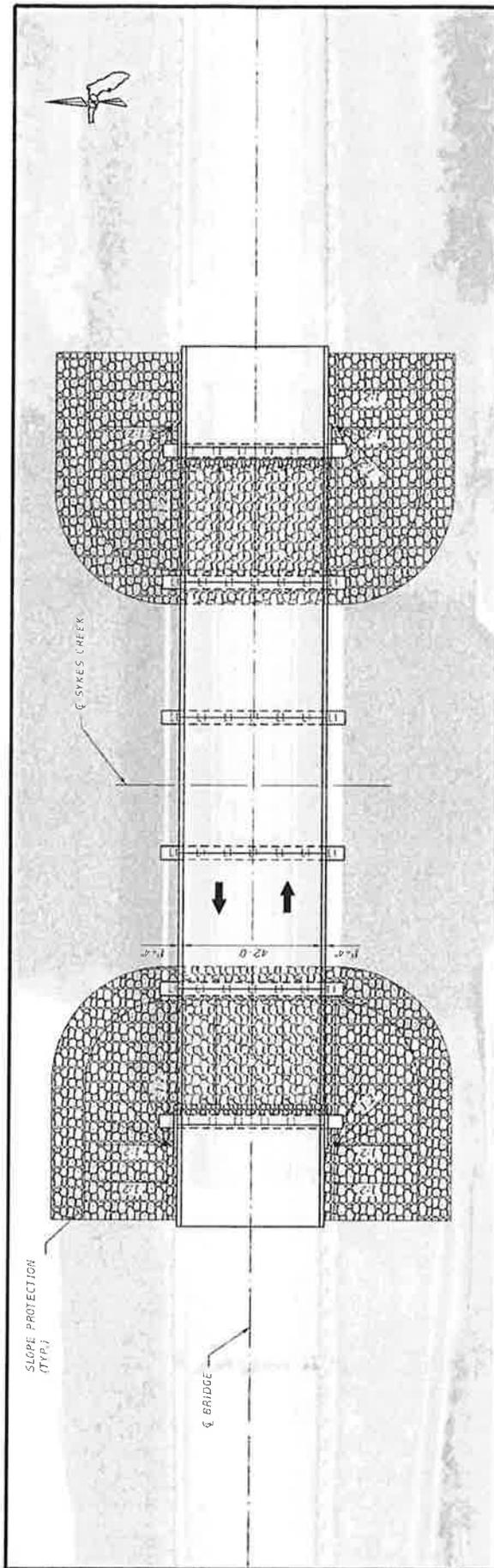
Lastly, the rubble riprap currently lining the channel must be addressed for all new construction alternatives. Additional alternatives for spanning the area of rubble installation can be explored further during the design phase, with detailed costs for associated construction items. This may include retaining walls and roadway approach work that can be explored once more detailed concepts are developed.

Table 6-1: Estimated Cost Summary

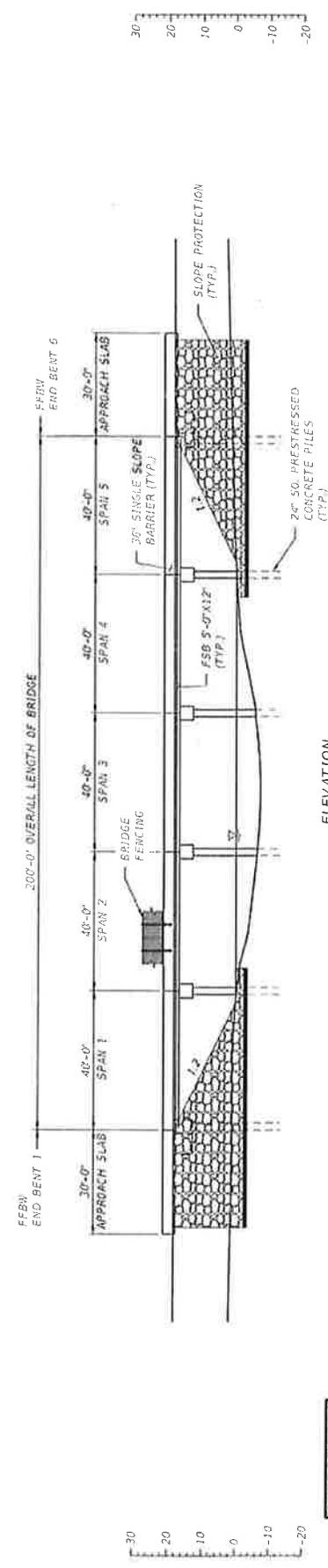
Element	Description	Construction Cost	Design (15%)	CEI (10%)	Total Estimated Cost	Permitting Time	Construction Time	Design Life
Rehabilitation Option 1	Crutch Bent & Superstructure Repairs	\$2,233,637	\$335,045	\$223,364	\$2,792,046	3 Months	12 Months	21 years
Replacement Option 2A	In-Kind FSB Superstructure	\$3,992,621	\$598,893	\$399,262	\$4,990,776	12 Months	18 Months	75 years
Replacement Option 2B	Florida I-Beam Superstructure	\$3,974,105	\$596,116	\$397,410	\$4,967,631	12 Months	18 Months	75 years

Appendix A

PRELIMINARY BRIDGE SKETCHES

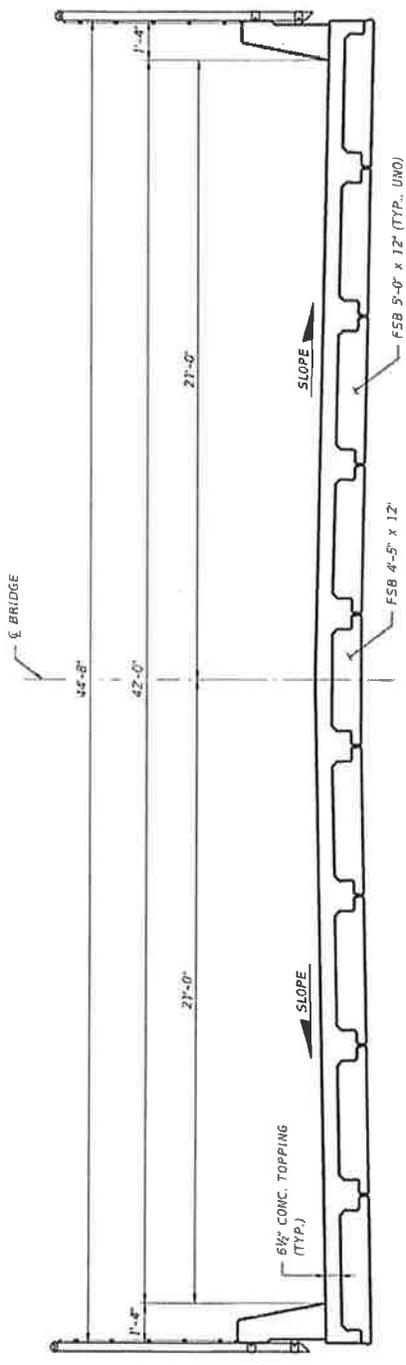


PLAN



ELEVATION

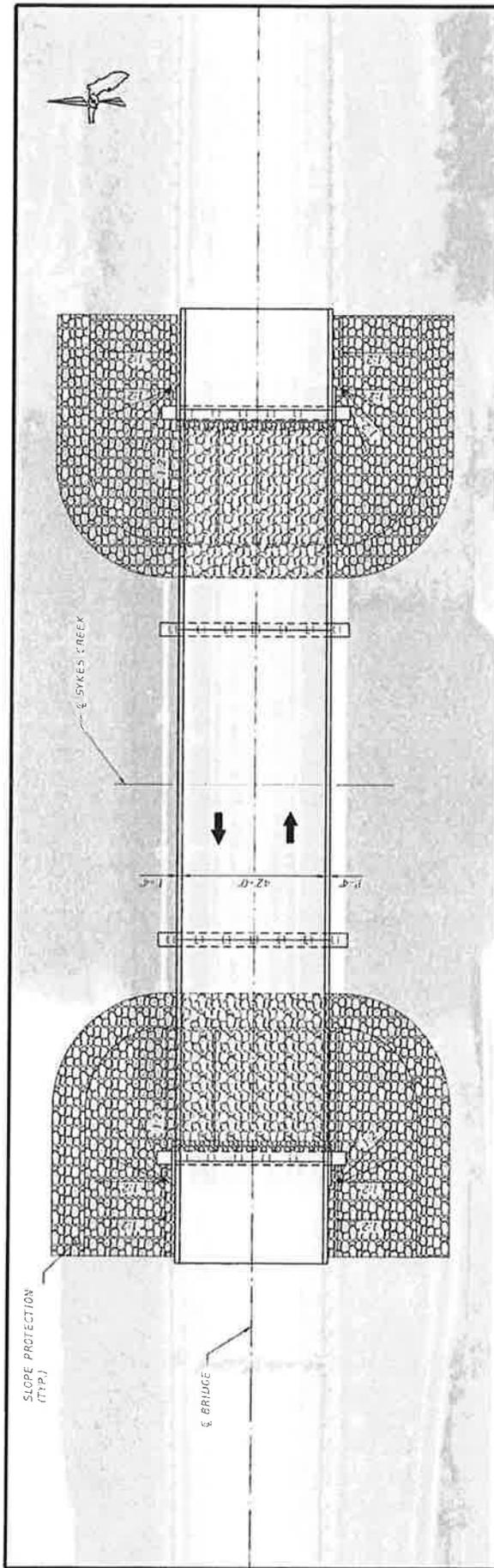
DATE		DESIGNED	CHECKED	APPROVED	DESCRIPTION	PROJECT	DATE
						SEA RAY DRIVE BRIDGE OVER SYKES CREEK	2-2-7
ENGINEER: CHANG & ASSOCIATES, CDP 3015 S. GARDNER STREET TAMPA, FL 33603 PHONE: 813-942-1111 FAX: 813-942-1112 DRIVEN & THOMPSON, PE No. 45163						DRAWN BY: [Name] CHECKED BY: [Name] PROJECT NO.: [Number]	SHEET NO.: [Number] TOTAL SHEETS: [Number]
PLAN & ELEVATION IN-KIND REPLACEMENT - OPTION 2A							



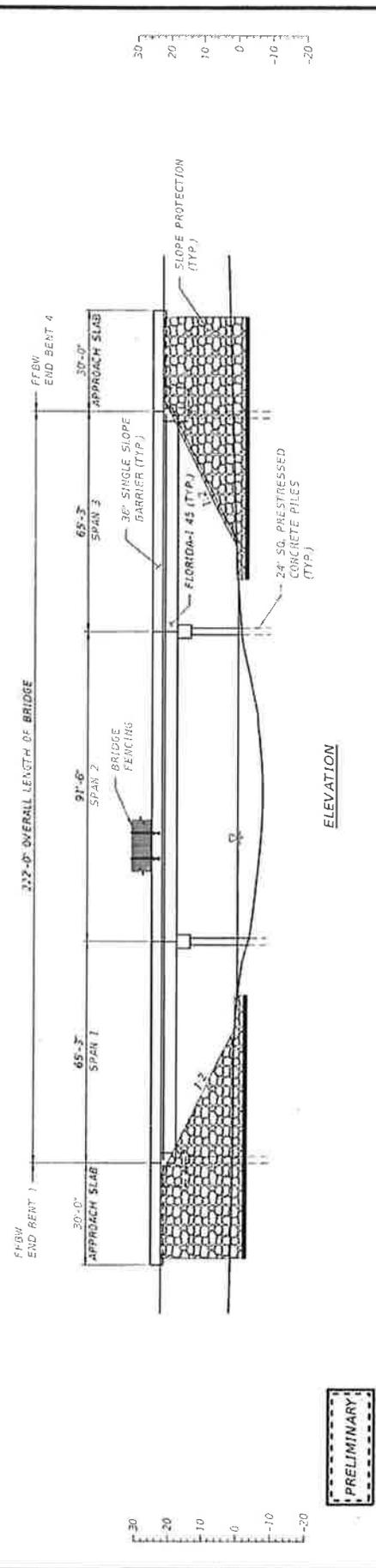
TYPICAL SECTION
IN-KIND REPLACEMENT

PRELIMINARY

DATE	BY	REVISIONS	DESIGNED	CHECKED	DATE	PROJECT	DATE	BY	BY	DATE	BY
		01									
Klinger Camp & Associates Corp. 201 S. Franklin Street Tallahassee, FL 32302 Florida C.O.A. No. 02317 David B. Thompson, PE No. 45403							PROJECT NO. SHEET NO.		TYPICAL SECTION IN-KIND REPLACEMENT - OPTION 2A SEA RAY DRIVE BRIDGE OVER SYKES CREEK		SHEET NO. 2A-2



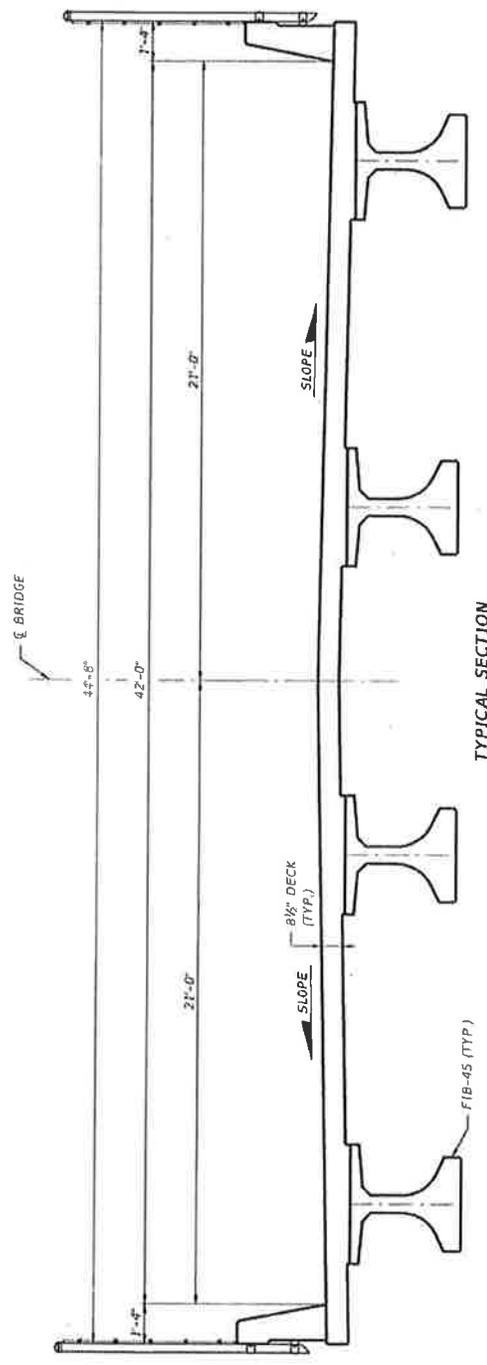
PLAN



ELEVATION

PRELIMINARY

REVISIONS NO. DATE BY DESCRIPTION		PROJECT NO. SHEET NO. 28-1
DESIGNER CHECKER		
PROJECT TITLE PLAN & ELEVATION NEW REPLACEMENT - OPTION 2B		
CLIENT SEA RAY DRIVE BRIDGE OVER SYKES CREEK		
CONTRACT NO. DATE		
DRAWN BY CHECKED BY APPROVED BY		
CONSULTANTS KIMLEY-HORN & ASSOCIATES, P.A. 200 N. FAYETTE ST., SUITE 400 FAYETTE, LA 70501 PHONE: (504) 782-2222 DAVID B. THOMPSON, P.E. No. 41503		



TYPICAL SECTION
NEW REPLACEMENT

PRELIMINARY

DATE		REVISIONS		PROJECT		SHEET NO.		SHEET TOTAL	
Designer: Kistinger Camp & Associates Corp 201 N. Franklin Street Suite 400, 35609 Fresno, CA 93701 David B. Thompson, P.E. No. 45403				Date: 11/11/11 Checked: 11/11/11 Drawn: 11/11/11		Project Name: TYPICAL SECTION NEW REPLACEMENT - OPTION 2B Project Location: SEA RAY DRIVE BRIDGE OVER SYKES CREEK			
Scale: AS SHOWN Drawing No.: 28-2								Revision: 28-2	

Appendix B

PRELIMINARY COST CALCULATIONS

CONSTRUCTION COST ESTIMATE

for
Option 1 - Crutch Bent Repair
Brevard County

Item Number	Item Description	Quantity	Unit	Unit Price	Total Amount Per Item
Sea Ray Drive Bridge over Sykes Creek Crutch Bent Repair					
0101 1	MOBILIZATION	1.0	LS	15%	\$238,636.38
0102 1	MAINTENANCE OF TRAFFIC	1.0	LS	2%	\$31,818.18
0104 1.1	FLOATING TURBIDITY BARRIER	822.0	LF	\$15.00	\$12,330.00
0110 4 1.0	REMOVAL OF EXIST CONC	785.0	SY	\$20.00	\$15,700.00
0120 5	CHANNEL EXCAVATION	2167.0	CY	\$175.00	\$379,225.00
0400 4 5	CONC CLASS IV, SUBSTRUCTURE	94.9	CY	\$1,100.00	\$104,390.00
0400147	COMPOSITE NEOPRENE PADS	36.5	CF	\$1,100.00	\$40,150.00
0401 70 4	RESTORE SPALLED AREAS, PORTLAND CEM GROUT	10.0	CF	\$740.00	\$7,400.00
0413151	METHACRYLATE MONOMER	102.0	GA	\$85.00	\$8,670.00
0413154	CLEAN & SEAL CONC - PENETR OR METHACR	10120.0	SF	\$1.00	\$10,120.00
0415 1 4	REINF STEEL- SUPERSTRUCTURE	60	LB	\$1.00	\$60.00
0415 1 5	REINF STEEL- SUBSTRUCTURE	13761	LB	\$1.00	\$13,761.00
0450 2 54	PREST BEAMS: FLORIDA-1 BEAM 54"	520	LF	\$300.00	\$156,000.00
0455 34 5	PRESTRESSED CONCRETE PILING, 24" SQ	3080	LF	\$120.00	\$369,600.00
0455143 5	TEST PILES- PREST CONCRETE, 24" SQ	500	LF	\$250.00	\$125,000.00
0458 1 21	BRIDGE DECK EXPANSION JNT, REHAB,POURED	264	LF	\$50.00	\$13,200.00
0530 1	RIPRAP, SAND-CEMENT	31.9	CY	\$540.00	\$17,205.00
0530 3 3	RIPRAP- RUBBLE, BANK AND SHORE	1559.7	TN	\$140.00	\$218,354.29
0530 74	BEDDING STONE	555.4	TN	\$100.00	\$55,543.93
0550 10325	FENCING, TYPE R, 5.1-6.0', VERTICAL	520.0	LF	\$85.00	\$44,200.00
	ROADWAY RECONSTRUCTION	1.0	LS	\$0.00	\$0.00
	CONTINGENCIES			20%	\$372,272.76
	DESIGN			15%	\$335,045.48
	CEI			10%	\$223,363.65
	TOTAL				\$2,792,045.68

NOTE: 1 Cost of repairing superstructure is based on most recent 2016 Bridge Inspection Report. Quantities will be adjusted with an updated inspection if Crutch Bent Alternative is selected.
2 The existing bridge is closed to traffic. A small percentage is allotted for MOT, accounting for control of boat traffic

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: *SAB* 07/19

Removal of Existing Structure

0110 4 10 REMOVAL OF EXISTING CONCRETE

Location	Area (SY)
END BENT 1	370.0
END BENT 6	415.0

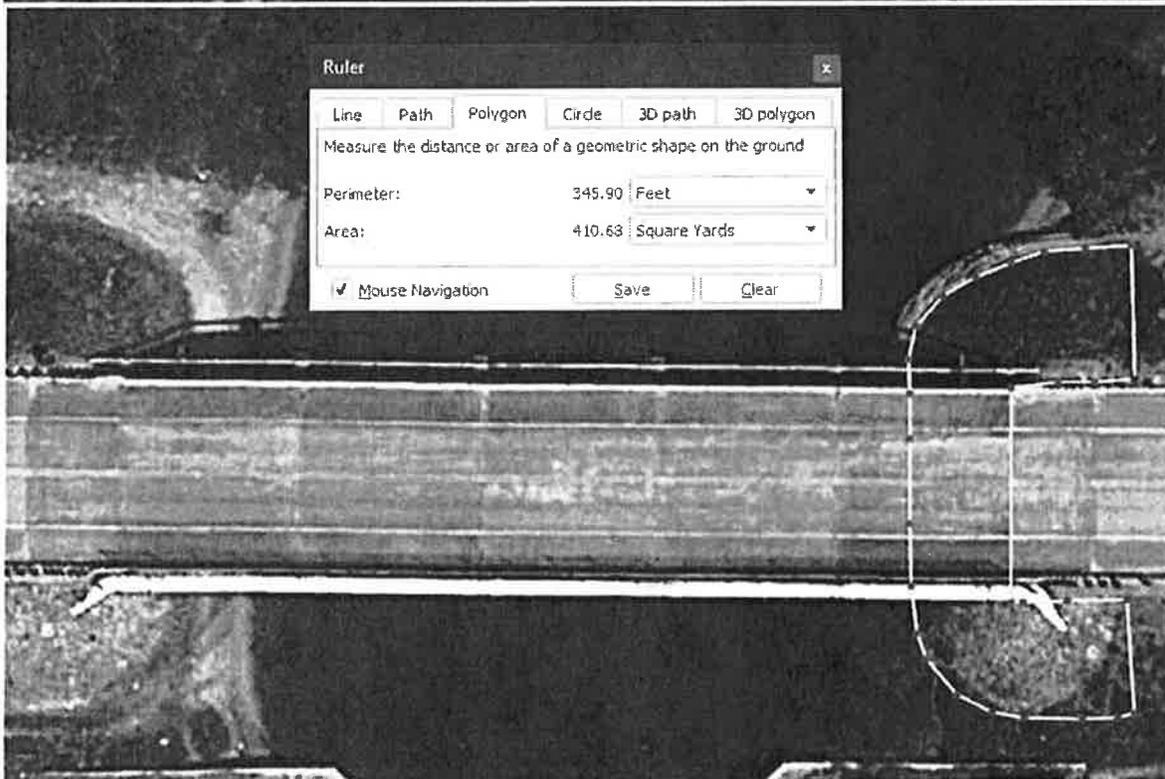
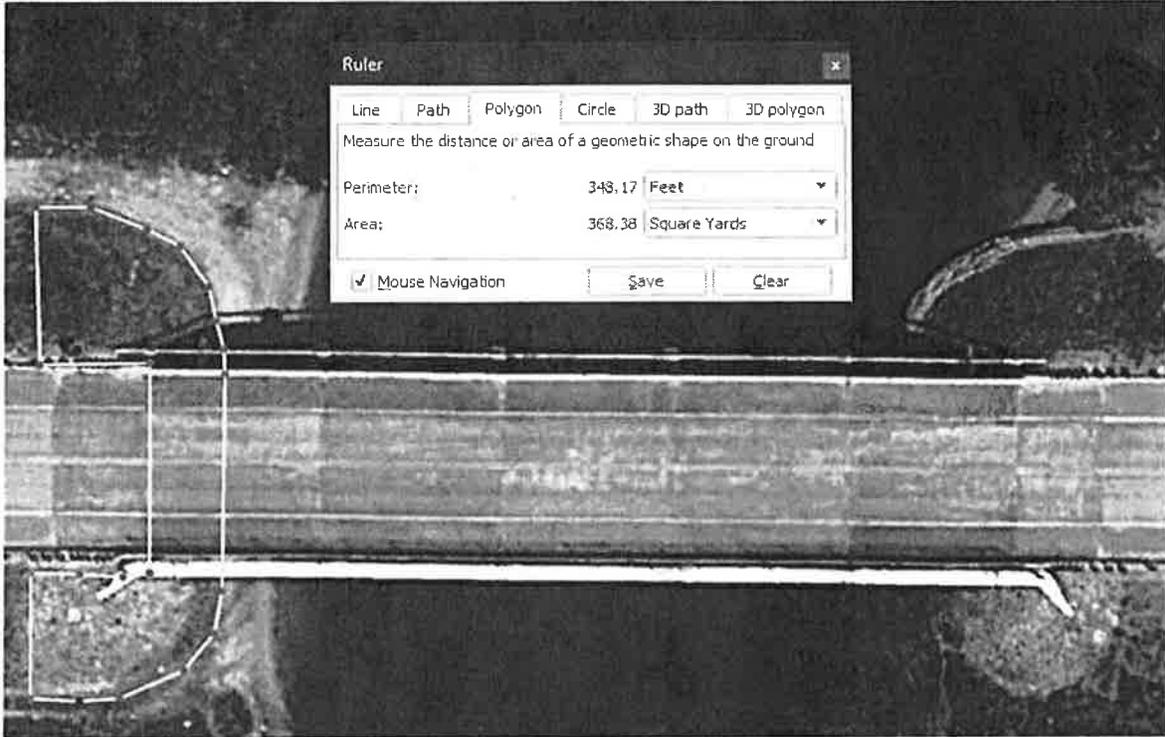
PAY ITEM TOTAL (SY)

785

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: SAB 07/19



1047

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: SAB 07/19

Foundation Quantities

0455 34 5 PRESTRESSED CONCRETE PILING, 24" SQ.

Location	No. Piles	Prod. Pile Length* (ft.)	Pile Length (ft.)
Int. Bent 2	7	110	770
Int. Bent 3	7	110	770
Int. Bent 4	7	110	770
Int. Bent 5	7	110	770

PAY ITEM TOTAL (LF) 3080

Applicable Equation: Pile Length = No. Piles x Production Pile Length

* Pile length is assumed similar to in-kind replacement option

0455143 5 TEST PILES - PRESTRESSED CONCRETE PILING, 24" SQ.

Location	No. Piles	Prod. Pile Length* (ft.)	Pile Length (ft.)
Int. Bent 2	1	125	125
Int. Bent 3	1	125	125
Int. Bent 4	1	125	125
Int. Bent 5	1	125	125

PAY ITEM TOTAL (LF) 500

Applicable Equation: Pile Length = No. Piles x Production Pile Length

0120 5 CHANNEL EXCAVATION

Location	Width (ft.)	Length (ft.)	Depth (ft.)	Volume (CY)
North	30	65	15	1083.33
South	30	65	15	1083.33

PAY ITEM TOTAL (CY) 2167

Applicable Equation: Volume = Width x Length x Depth / (27 ft³/CY)

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: *SAB 07/19*

Superstructure Quantities

0400147 COMPOSITE NEOPRENE PADS

Location	No. Piers	No. Pads per Bent	L (ft.)	W (ft.)	Thickness (in.)	Volume (CF)
Int. Bents 2-5	4	20	2.67	0.67	2.56	30.40
Crutch Beams	4	4	2.67	0.67	2.56	6.10

* See Index 400-510 for dimensions. Assume Type F.

PAY ITEM TOTAL (CF) 36.5

Applicable Equation:

$$\text{Volume} = \text{No. Pads} \times L \times W \times (\text{Thickness} / 12 \text{ in./ft})$$

0450 2 54 PREST BEAMS: FLORIDA-I BEAM 54"

NOTE: FIB-54 beams are conservatively assumed for the crutch bent caps, though FIB-45 beams may be possible with a more detailed structural analysis.

Location	Beam Length (ft.)	Quantity	Length (ft.)
Bent 2	65.00	2	130
Bent 3	65.00	2	130
Bent 4	65.00	2	130
Bent 5	65.00	2	130

PAY ITEM TOTAL (LF) 520

0458 1 11 BRIDGE DECK EXPANSION JOINT, REHAB, F&I POURED JOINT WITH BACKER ROD

Location	Width* (ft.)	Bridge Skew (deg.)	Length (ft.)
END BENT 1	42.17	0.00	44
BENT 2	42.17	0.00	44
BENT 3	42.17	0.00	44
BENT 4	42.17	0.00	44
BENT 5	42.17	0.00	44
END BENT 6	42.17	0.00	44

* Between inside face of rails/parapets.

PAY ITEM TOTAL (LF) 264

Applicable Equation:

$$\text{Length} = (\text{Width} / \cos(\text{skew})) + 2 \text{ in.} + \sqrt{[(6 \text{ in.})^2 + (6 \text{ in.})^2]}$$

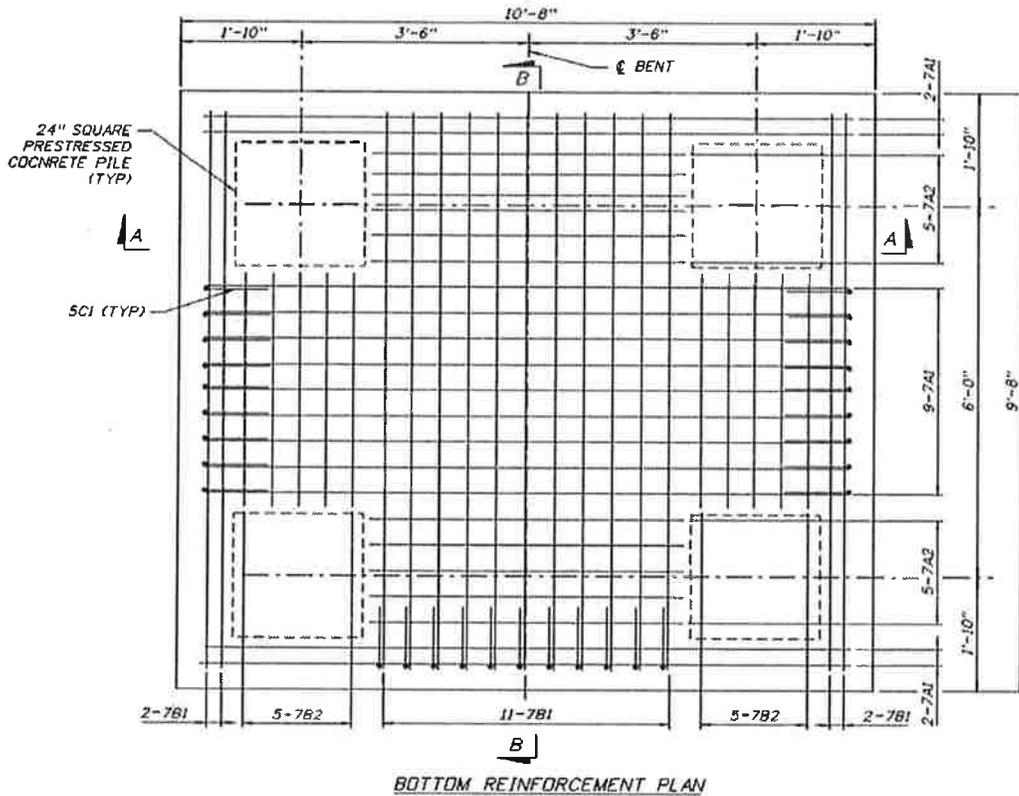
KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: SAB 07/19

Substructure Quantities

0400 4 5 CONCRETE CLASS IV, SUBSTRUCTURE



BOTTOM REINFORCEMENT PLAN

NOTE: The layout in the figure above is used for the purpose of quantity calculations.

Intermediate Bents					
Location	Length (ft.)	Width (ft.)	Height (ft.)	Quantity	Volume (CY)
Cap	10.67	9.67	2.50	8	76.38
Diaphragm*	5.00	1.00	4.50	8	6.67
Shear Blocks	4.00	2.00	3.00	16	14.22
Pile Void	2.00	2.00	1.00	-16	-2.37

* Assume a rectangular diaphragm between beams set 5' apart.

TOTAL (CY) **94.9**

Applicable Equation: $Volume = Quantity \times (Length \times Width \times Height) / (27 \text{ ft}^3/\text{CY})$

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: *SAB* 07/19

Substructure Quantities

0415 1 5 REINFORCING STEEL - BRIDGE SUBSTRUCTURE

Location	Volume (cy)	Reinforcing Weight (lb/cy)	Weight (lb.)
Intermediate Bents	94.9	145	13761

*Taken from FDOT BDR estimate for pile abutments and pile bents

PAY ITEM TOTAL (LB) 13761

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: *SAB* 07/19

RipRap Quantities

0530 3 3 RIPRAP - RUBBLE, BANK AND SHORE

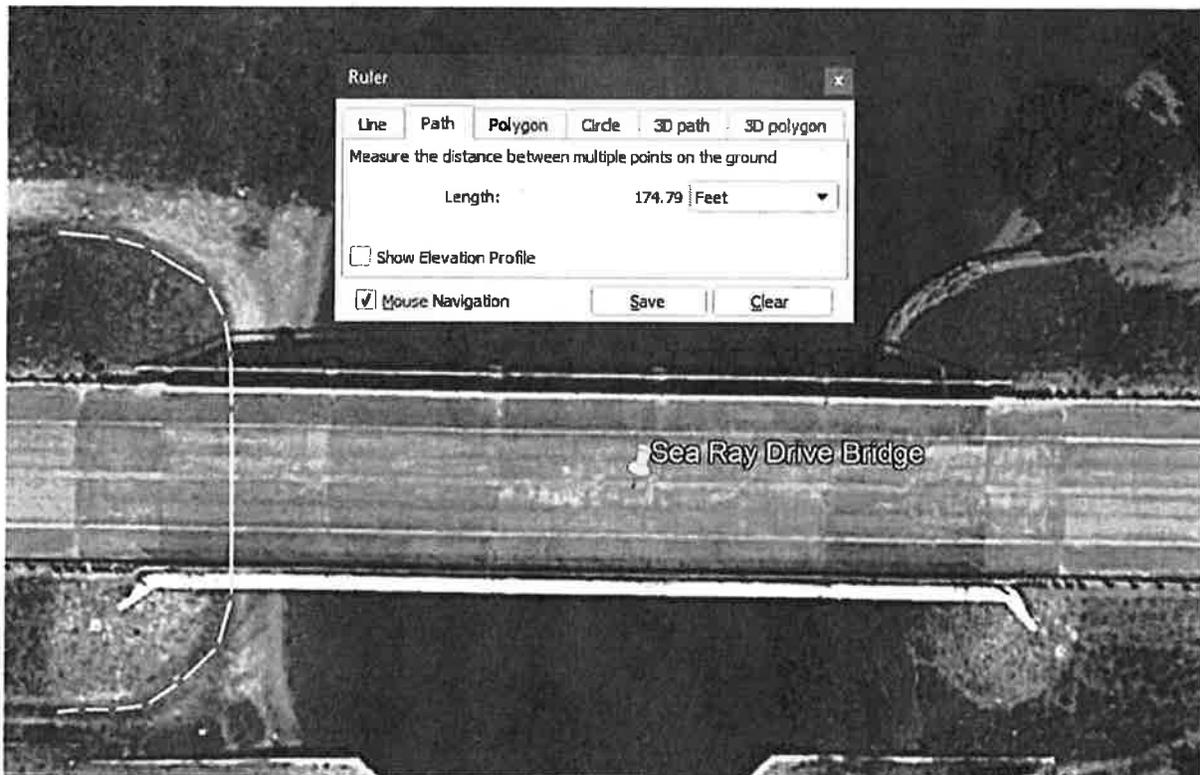
Location	Length* (ft.)	Width** (ft.)	Thickness (ft.)	Volume (ft ³)	S.G.	Ww (lb/ft ³)	Vf	Weight (Tons)
End Bents	180	26.83	2.5	12074.77	2.30	62.40	0.90	779.8

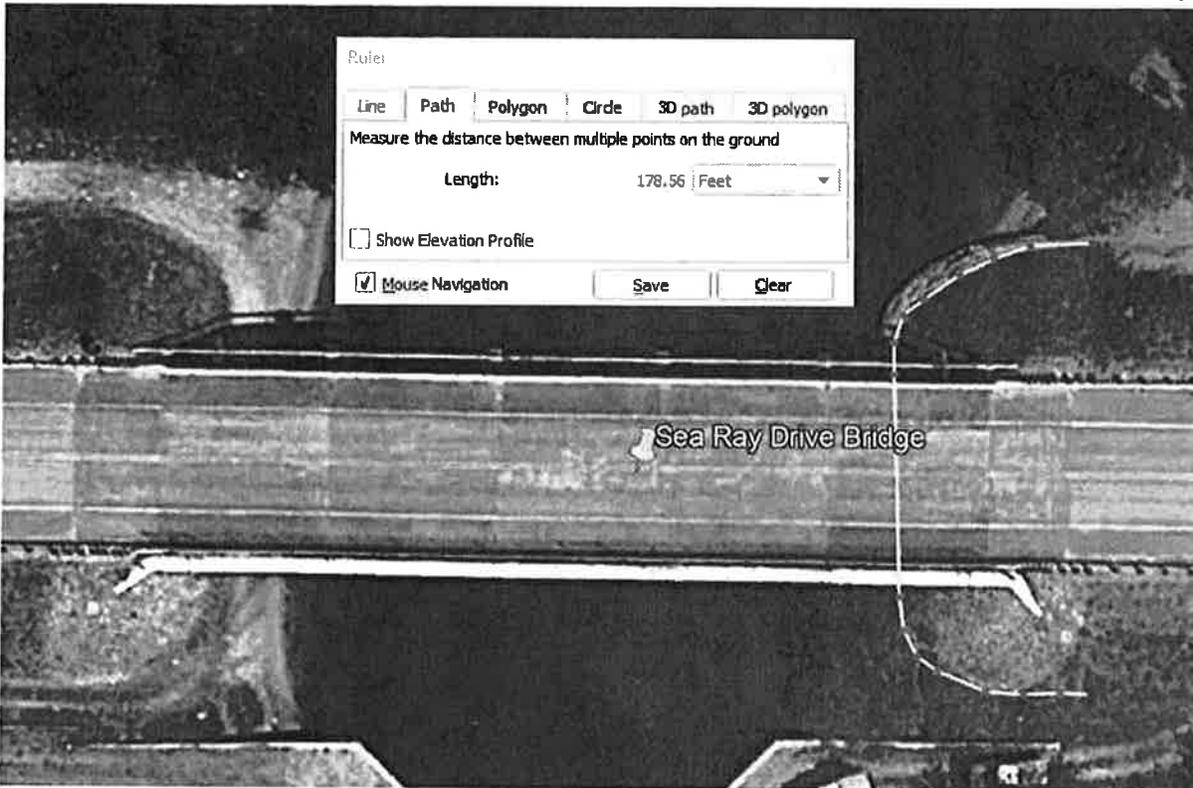
* Length is conservative measured at toe of slope

** Width includes slope.

TOTAL 1559.7 TON

Applicable Equation: $Weight = (Volume \times S.G. \times Ww + Vf) / 2000lb/ton \times 2 \text{ End Bents}$





0530 74 BEDDING STONE

Location	Length (ft.)	Width (ft.)	Thickness (ft.)	Volume (ft ³)	Unit Weight	Weight (Tons)
End Bents	180	26.83	1	4829.91	115.00	277.7

TOTAL 555.4 TON

Applicable Equation: Weight = (Volume x Unit Weight)/2000 x 2 End Bents

0530 1 RIPRAP, SAND-CEMENT

Location	Length (ft)	Volume (cy)
End Bent 1	95.58	15.93

TOTAL 31.9 CY

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

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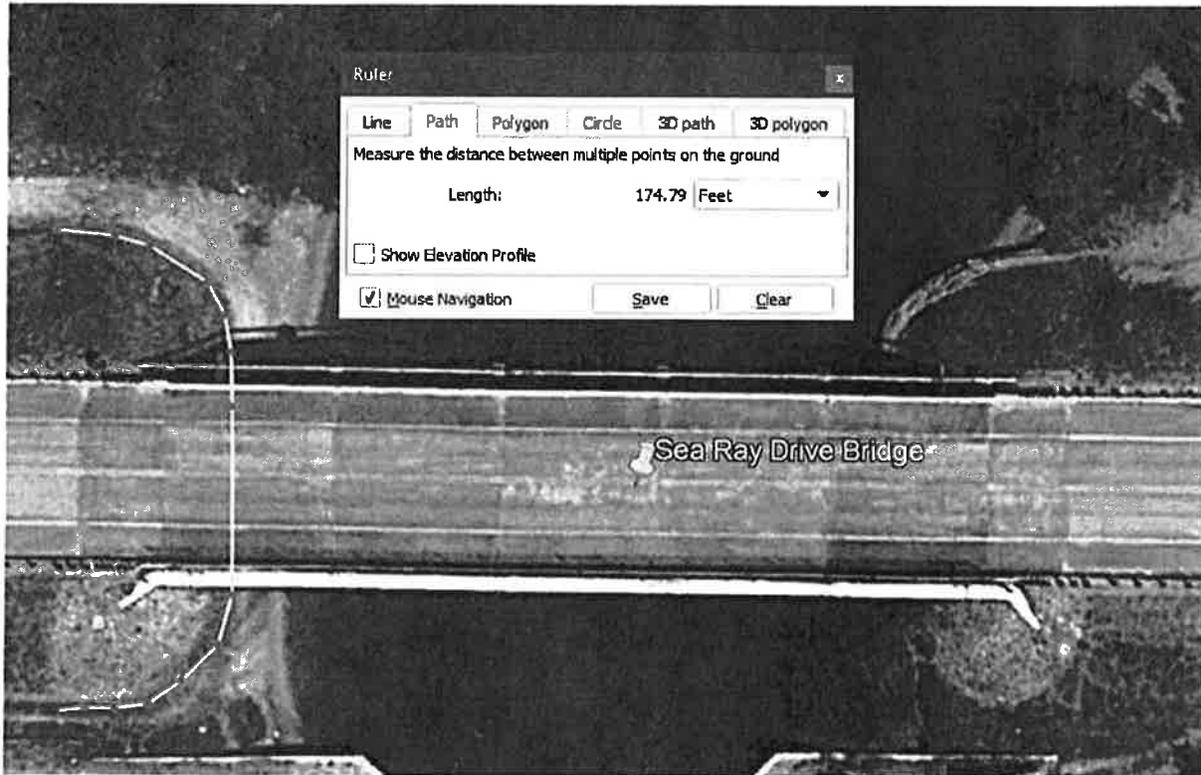
Erosion Control Quantities

0104 11 FLOATING TURBIDITY BARRIER

Location	Length (ft.)	Width (ft.)	No. (Ea.)	Total (ft.)
Ex. End Bents	200	0.00	2	400.00
Ex. Intermediate Bents	75.5	30.00	4	422.00

NOTE: Assume 10 ft offset from bents.

TOTAL 822.0 LF



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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: SAB 07/19

Repair Quantities

0401 70 4 RESTORE SPALLED AREAS, PORTLAND CEMENT GROUT

Location	Length (ft.)	Width (ft.)	Height (ft.)	Quantity	Adj. Factor	Volume (CF)
Railing	0.67	0.33	0.17	1	3	0.11
Railing	0.83	0.58	0.17	1	3	0.24
Beam 3-9	1.00	0.33	0.25	1	3	0.25
Beam 2-1	2.08	0.33	0.25	1	3	0.52
Beams	0.33	0.17	0.25	9	3	0.38
Abutment	0.33	0.33	0.25	1	3	0.08

NOTE: Adj. factor accounts for increased deterioration since last inspection.

TOTAL (CF) 10.0 Use 10.0 BOE minimum

Applicable Equation: Volume = Quantity x (Length x Width x Height) x Adjustment Factor

0413151 METHACRYLATE MONOMER

Location	Length (ft.)	Width (ft.)	Area (sf)	Volume* (sf/ga)	Volume (ga)
AS 1	20.00	42.17	843.33	100	8.43
Bridge Deck	200.00	42.17	8433.33	100	84.33
AS 2	20.00	42.17	843.33	100	8.43

* Assume 100 sf/ga as average per Specifications 413-3.4.3

TOTAL (GA) 102

Applicable Equation: Volume = Area / (100 ga/sf)

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: *SAB* 07/19

Repair Quantities

0413154 CLEANING & SEALING CONCRETE SURFACES - PENETRANT SEALER OR METHACRYLATES

Location	Length (ft.)	Width (ft.)	Area (sf)
AS 1	20.00	42.17	843.33
Bridge Deck	200.00	42.17	8433.33
AS 2	20.00	42.17	843.33

TOTAL (SF) 10,120

Applicable Equation: Area = Length x Width

0415 1 4 REINFORCING STEEL - BRIDGE SUPERSTRUCTURE

Location	Volume (cy)	Reinforcing Weight* (lb/cy)	Weight (lb.)
Intermediate Bents	0.4	150	60

*Estimate for concrete repairs

PAY ITEM TOTAL (LB) 60

0550 10325 FENCING, TYPE R, 5.1-6.0', VERTICAL

Location	Length (ft.)	No. Railings	Length (ft.)
APPROACH SLAB 1	30.00	2	60.00
BRIDGE	200.00	2	400.00
APPROACH SLAB 2	30.00	2	60.00

PAY ITEM TOTAL 520 LF

CONSTRUCTION COST ESTIMATE
for
Option 2A - In-Kind FSB Replacement
Brevard County

Item Number	Item Description	Quantity	Unit	Unit Price	Total Amount Per Item
0101.1	MOBILIZATION	1.0	LS	15%	\$426,562.08
0102.1	MAINTENANCE OF TRAFFIC	1.0	LS	2%	\$56,874.94
0104.11	FLOATING TURBIDITY BARRIER	1188.0	LF	\$15.00	\$17,820.00
0110.3	REMOVAL OF EXISTING STRUCTURES/BRIDGE	1.0	LS	\$30.00	\$324,000.00
0110.4.10	REMOVAL OF EXIST CONC	785.0	SY	\$20.00	\$15,700.00
0120.5	CHANNEL EXCAVATION	1889.0	CY	\$175.00	\$330,575.00
0400.2.10	CONC CLASS II, APPROACH SLABS	102.8	CY	\$440.00	\$45,232.00
0400.4.5	CONC CLASS IV, SUBSTRUCTURE	196.0	CY	\$900.00	\$176,400.00
0400.4.47	CONC CLASS IV, CIP TOP W/SR ADMIX	216.5	CY	\$1,000.00	\$216,500.00
0400.9	BRIDGE DECK GROOV & PLANING, DECK 8 5" GR	953	SY	\$10.00	\$9,530.00
04001.48	PLAIN NEOPRENE BEARING PADS	20.0	CF	\$1,100.00	\$22,000.00
0415.1.4	REINF STEEL- SUPERSTRUCTURE	44383	LB	\$1.00	\$44,383.00
0415.1.5	REINF STEEL- SUBSTRUCTURE	27734	LB	\$1.00	\$27,734.00
0415.1.9	REINF STEEL- APPROACH SLABS	20560	LB	\$1.00	\$20,560.00
0430.8.14	PRESTRESSED BEAM: FLORIDA SLAB BEAM, BEAM DEPTH 12", WIDTH 58-60"	1755	LF	\$300.00	\$526,500.00
0455.34.5	PRESTRESSED CONCRETE PILING, 24" SQ	3960	LF	\$120.00	\$475,200.00
0455143.5	TEST PILES-PREST CONCRETE,24" SQ	500	LF	\$250.00	\$125,000.00
0458.1.11	BRIDGE DECK EXPANSION JNT,NEW,POURED	258	LF	\$45.00	\$11,610.00
0525.5.13	CONC TRAF RAIL- BRIDGE, 36" SING SLOPE	520	LF	\$100.00	\$52,000.00
0530.1	RIPRAP, SAND-CEMENT	31.9	CY	\$540.00	\$17,205.00
0530.3.3	RIPRAP- RUBBLE, BANK AND SHORE	1539.7	TN	\$140.00	\$218,354.29
0530.74	BEDDING STONE	555.4	TN	\$100.00	\$55,543.93
0550.10325	FENCING, TYPE R, 5'-6.0', VERTICAL	520.0	LF	\$85.00	\$44,200.00
0630.2.16	CONDUIT, F&I EMBEDDED- BARR RAILINGS	1560	LF	\$10.00	\$15,600.00
0635.3.13	JUNCTION BOX, FURNISH & INSTALL, EMBED	6	EA	\$350.00	\$2,100.00
	ROADWAY RECONSTRUCTION	1.0	LS	\$50,000.00	\$50,000.00
	CONTINGENCIES			20%	\$665,436.85
	DESIGN			15%	\$398,893.16
	CEI			10%	\$399,262.11
	TOTAL				\$4,990,776.37

NOTE: 1. The existing bridge is closed to traffic. A small percentage is allotted for MOT, accounting for control of boat traffic.

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: SAB 07/19

Foundation Selection

Description: Estimate the appropriate pile number and size for in-kind replacement.
Assume 24" piles, as they are more common than 18" for new bridge construction.

Dead Load Per Span					
Element	Unit Weight	Unit	Dimension*	Unit	Weight (kip)
FSB	650	plf	351	ft	228.15
Topping	150	pcf	1169.1	cf	175.37
Railings	430	plf	80	ft	34.40
Pile Bent	150	pcf	864	cf	129.60
Water Pipe	166.7	plf	40	ft	6.67
Water**	579.1	plf	40	ft	23.16

* See quantity calculations for topping and pile bent volumes

** Inside diameter of 41.25 inches

Live Load Per Bent*					
Truck/Lane	No.	Distance from CL Bent	Length	MPF	Weight
(kip/klf)	(Ea.)	(ft.)	(ft)		(kip)
32	3	0	-	0.8	76.80
32	3	14	-	0.8	49.92
8	3	28	-	0.8	5.76
0.64	3	-	40	0.8	61.44

* Assume 3 lanes

Estimated Pile Factored Design Load				
Load Case	Load	Factor	Distribution	Total
Dead (except pipe)	567.5	1.25	7	101.3
Pipe	29.8	1.25	1	37.3
Live	193.9	1.75	7	48.5

Divide dead and live load equally among piles, except for the water main which is conservatively assumed to contribute half its weight to the exterior pile.

Using 7 piles provides an approximate spacing of 7'-3", similar to proposed SR 528 bridge replacement foundations.

TOTAL 187.1 kip

Assuming 0.75 phi factor, nominal bearing resistance = 125 TN

Conclusion: Use 7~24" piles for each bent foundation. The calculated NBR is much less than the SDG recommended resistance of 450 tons, but will also provide lateral deflection resistance in the case of a large unbraced length due to scour.

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: *SAB* 07/19

Foundation Quantities

0455 34 5 PRESTRESSED CONCRETE PILING, 24" SQ.

Location	No. Piles	Prod. Pile Length* (ft.)	Pile Length (ft.)
End Bent 1	5	110	550
Int. Bent 2	7	110	770
Int. Bent 3	6	110	660
Int. Bent 4	6	110	660
Int. Bent 5	7	110	770
End Bent 6	5	110	550

PAY ITEM TOTAL (LF) 3960

Applicable Equation: $\text{Pile Length} = \text{No. Piles} \times \text{Production Pile Length}$

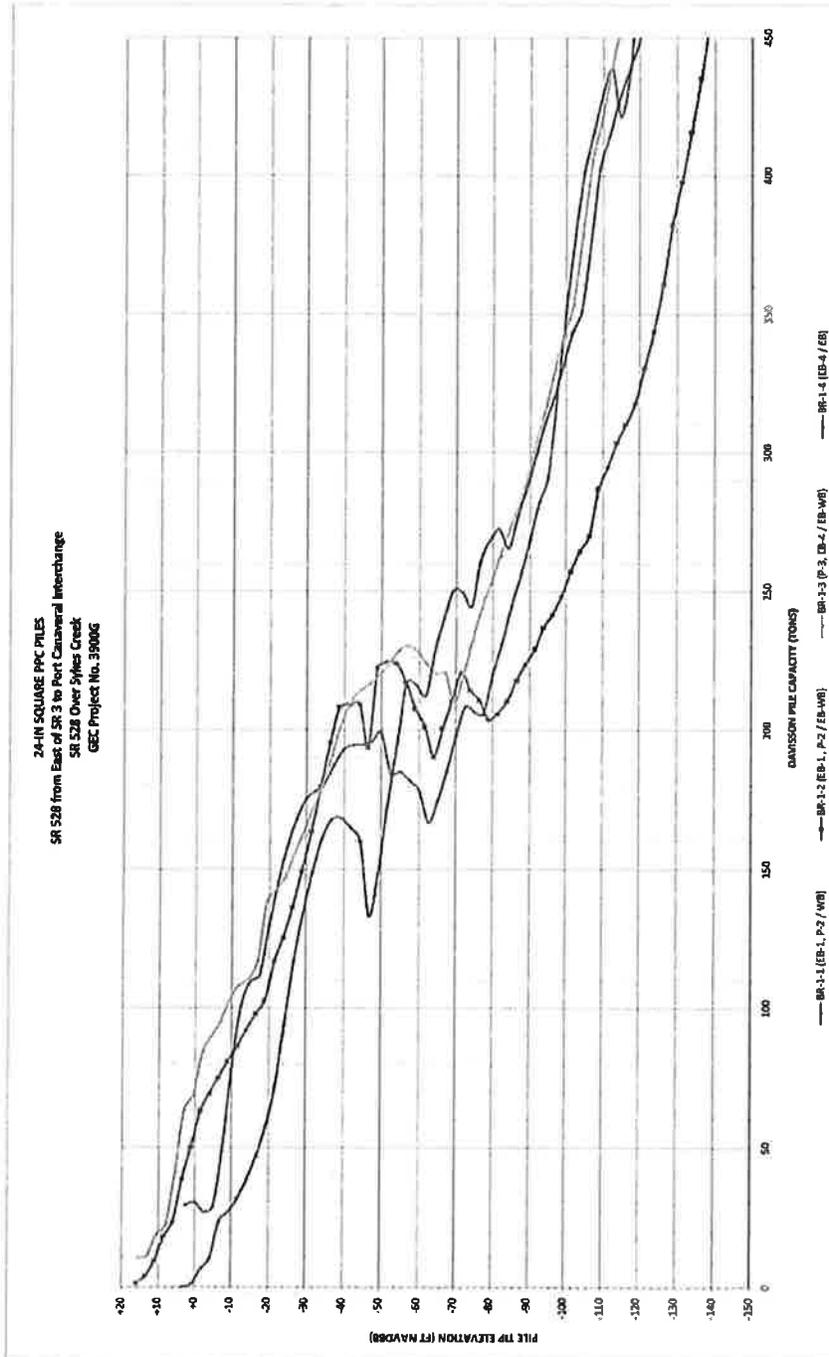
* Pile length is estimated with preliminary capacity curves for adjacent SR 528 bridge replacements

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
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Foundation Quantities



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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
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Foundation Quantities

0455143 5 TEST PILES - PRESTRESSED CONCRETE PILING, 24" SQ.

Location	No. Piles	Prod. Pile Length* (ft.)	Pile Length (ft.)
End Bent 1	1	125	125
Int. Bent 2	0	125	0
Int. Bent 3	1	125	125
Int. Bent 4	1	125	125
Int. Bent 5	0	125	0
End Bent 6	1	125	125

PAY ITEM TOTAL (LF) 500

Applicable Equation: Pile Length = No. Piles x Production Pile Length

0120 5 CHANNEL EXCAVATION

Location	Width (ft.)	Length (ft.)	Depth (ft.)	Volume (CY)
Int. Bent 3	30	65	10	722.22
Int. Bent 4	30	70	15	1166.67

PAY ITEM TOTAL (CY) 1889

Applicable Equation: Pile Length = No. Piles x Production Pile Length

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

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Superstructure Quantities

0400 4 47 CONCRETE CLASS IV, CIP TOPPING W/ SHRINKAGE REDUCING ADMIXTURE

BRIDGE DECK (PER SPAN)					
Location	Length (ft.)	Width* (ft.)	Deck Depth (ft.)	No. (Ea.)	Volume (CY)
Topping	40.00	44.67	0.50	1.00	33.09
Void Btwn. FSBs	39.00	1.04	0.67	8.00	1.00
Overhang Void	39.00	0.50	0.67	2.00	0.48
Void Btwn. Flange	39.00	1.00	0.04	8.00	0.06
FSB Ends	44.67	0.50	1.50	2.00	1.24

*Assume 1/2" gap between FSB flanges

TOTAL (CY) 35.87

BUILD-UP (PER SPAN)						
Spans	No. Beams	Beam Length (ft.)	Flange Width (ft.)	'B' & 'D' * (in.)	'C' * (in.)	Volume (CY)
1 to 5	1	40.00	44.67	2.000	1.00	7.35

* See SPI Index 450-199, Case 3.

TOTAL (CY) 7.35

Location	Volume (CY)
Bridge Deck	179.5
Build-Up	37.0

PAY ITEM TOTAL (CY) 216.5

Applicable Equations:

Bridge Deck Volume = (Length x Width x Depth) / (27 ft³/CY)

Build-Up Volume = (Beam Length x Flange Width x (C + ((B + D - 2C)/6))) / (27 ft³/CY)

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: SAB 07/19

Superstructure Quantities

0400 9 BRIDGE DECK GROOVING & PLANING, DECK 8.5" AND GREATER

Location	Length (ft.)	Width (ft.)	Area (SY)
Bridge	200.00	42.00	934
Approach Slabs	4.00	42.00	19

PAY ITEM TOTAL (SY) 953

Applicable Equation:

$$\text{Area} = \text{Length} \times \text{Width} / (9 \text{ ft}^2/\text{SY})$$

0400148 PLAIN NEOPRENE PADS

Location	No. Piers	No. Pads per Bent	L (ft.)	W (ft.)	Thickness (in.)	Volume (CF)
End Bent 1	1	9	4	0.67	1.00	2.00
Int. Bents 2-5	4	18	4	0.67	1.00	16.00
End Bent 6	1	9	4	0.67	1.00	2.00

* See Index 400-510 for dimensions.

PAY ITEM TOTAL (CF) 20.0

Applicable Equation:

$$\text{Volume} = \text{No. Pads} \times \text{L} \times \text{W} \times (\text{Thickness} / 12 \text{ in/ft})$$

0415 1 4 REINFORCING STEEL - BRIDGE SUPERSTRUCTURE

Location	Concrete Volume (cy)	Reinforcing Weight* (lb/cy)	Weight (lb.)
Bridge Deck	216.5	205	44383

*Taken from FDOT BDR estimate for standard decks

PAY ITEM TOTAL (LB) 44383

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: SAB 07/19

Superstructure Quantities

0450 8 14 PRESTRESSED BEAM: FLORIDA SLAB BEAM, BEAM DEPTH 12", WIDTH 58-60"

Table of Recommended Maximum Span Lengths (CL Bearing to CL Bearing)				
Beam Type	6" C.I.P. Topping w/ Future Wearing Surface (Short Bridge)		6½" C.I.P. Topping w/ ½" Sacrificial Thickness (Long Bridge)	
	Beam Width		Beam Width	
	4'-0"	5'-0"	4'-0"	5'-0"
12" FSB	40'-11"	43'-11"	41'-2"	44'-5"
15" FSB	52'-11"	56'-3"	53'-3"	56'-9"
18" FSB	62'-3"	64'-4"	62'-8"	64'-10"

Location	Beam Length (ft.)	Quantity	Length (ft.)
Span 1	39.00	9	351
Span 2	39.00	9	351
Span 3	39.00	9	351
Span 4	39.00	9	351
Span 5	39.00	9	351

PAY ITEM TOTAL (LF) 1755

0458 1 11 BRIDGE DECK EXPANSION JOINT, NEW CONSTRUCTION, F&I POURED JOINT WITH BACKER ROD

Location	Width* (ft.)	Bridge Skew (deg.)	Length (ft.)
END BENT 1	42.00	0.00	43
BENT 2	42.00	0.00	43
BENT 3	42.00	0.00	43
BENT 4	42.00	0.00	43
BENT 5	42.00	0.00	43
END BENT 6	42.00	0.00	43

* Between inside face of rails/parapets.

PAY ITEM TOTAL (LF) 258

Applicable Equation: $Length = (Width / \cos(\text{skew})) + 2in. + \sqrt{[(6in.)^2 + (6in.)^2]}$

1065

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

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Substructure Quantities

0400 4 5 CONCRETE CLASS IV, SUBSTRUCTURE

End Bents							
Location	Length (ft.)	Width (ft.)	Max Height (ft.)	Min Height (ft.)	Average Height (ft.)	Quantity	Volume (CY)
Cap	55.58	4.00	4.00	4.00	4.00	2	65.88
Wingwalls	6.75	1.00	4.50	4.50	4.50	4	4.50
Pile Void	2.00	2.00	1.00	1.00	1.00	-12	-1.78

*Use cap length equal to existing bents

TOTAL (CY)

Intermediate Bents					
Location	Length* (ft.)	Width (ft.)	Height (ft.)	Quantity	Volume (CY)
Cap	55.50	4.00	4.00	4	131.56
Pile Void	2.00	2.00	1.00	-28	-4.15

*Use cap length equal to existing bents

TOTAL (CY)

Location	Volume (CY)
End Bents	68.6
Int. Bents	127.4

PAY ITEM TOTAL (CY)

Applicable Equation: Volume = Quantity x (Length x Width x Height) / (27 ft³/CY)

0415 1 5 REINFORCING STEEL - BRIDGE SUBSTRUCTURE

Location	Volume (cy)	Reinforcing Weight (lb/cy)	Weight (lb.)
End Bents	68.6	135	9261
Intermediate Bents	127.4	145	18473

*Taken from FDOT BDR estimate for pile abutments and pile bents

PAY ITEM TOTAL (LB)

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
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Approach Slab Quantities

0400 2 10 CLASS II CONCRETE, APPROACH SLABS

Location	Length (ft.)	Width (ft.)	Depth - Slab (ft.)	Depth - Topping (ft.)	Depth - To Backwall (ft.)	Volume (CY)
Approach Slab 1	30.00	44.67	1.00	0.17	0.58	51.4
Approach Slab 2	30.00	44.67	1.00	0.17	0.58	51.4

TOTAL 102.8 CY

Applicable Equation: Volume = (Length x Width x Depth Slab + 2-ft x Width x Depth Topping
+ Width x Depth To Backwall x (1-ft + 0.5 x Depth To Backwall)) / (27 ft³/CY)

0415 1 9 REINFORCING STEEL - APPROACH SLABS

Location	Volume (CY)	Reinforcing Weight (lb/cy)	Weight* (lb.)
Approach Slab 1	51.40	200	10280
Approach Slab 2	51.40	200	10280

*Taken from FDOT BDR estimate for approach slabs

PAY ITEM TOTAL (LB) 20560

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

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Barrier Quantities

0521 5 13 CONCRETE TRAFFIC RAILING - BRIDGE, 36" SINGLE-SLOPE

Location	Length (ft.)	No. Railings	Length (ft.)
APPROACH SLAB 1	30.00	2	60.00
BRIDGE	200.00	2	400.00
APPROACH SLAB 2	30.00	2	60.00

PAY ITEM TOTAL LF

0550 10325 FENCING, TYPE R, 5.1-6.0', VERTICAL

Location	Length (ft.)	No. Railings	Length (ft.)
APPROACH SLAB 1	30.00	2	60.00
BRIDGE	200.00	2	400.00
APPROACH SLAB 2	30.00	2	60.00

PAY ITEM TOTAL LF

0630 2 16 CONDUIT, FURNISH & INSTALL, EMBEDDED

Location	Length (ft.)	No. Railings	No. Conduits	Length (ft.)
APPROACH SLAB 1	30.00	2	3	180.00
BRIDGE	200.00	2	3	1200.00
APPROACH SLAB 2	30.00	2	3	180.00

PAY ITEM TOTAL LF

0635 3 13 JUNCTION BOX, FURNISH & INSTALL, EMBEDDED

Location	No. (EA)
APPROACH SLAB 1	2
MID-SPAN	2
APPROACH SLAB 2	2

PAY ITEM TOTAL EA

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: *SAB 07/19*

RipRap Quantities

0530 3 3 RIPRAP - RUBBLE, BANK AND SHORE

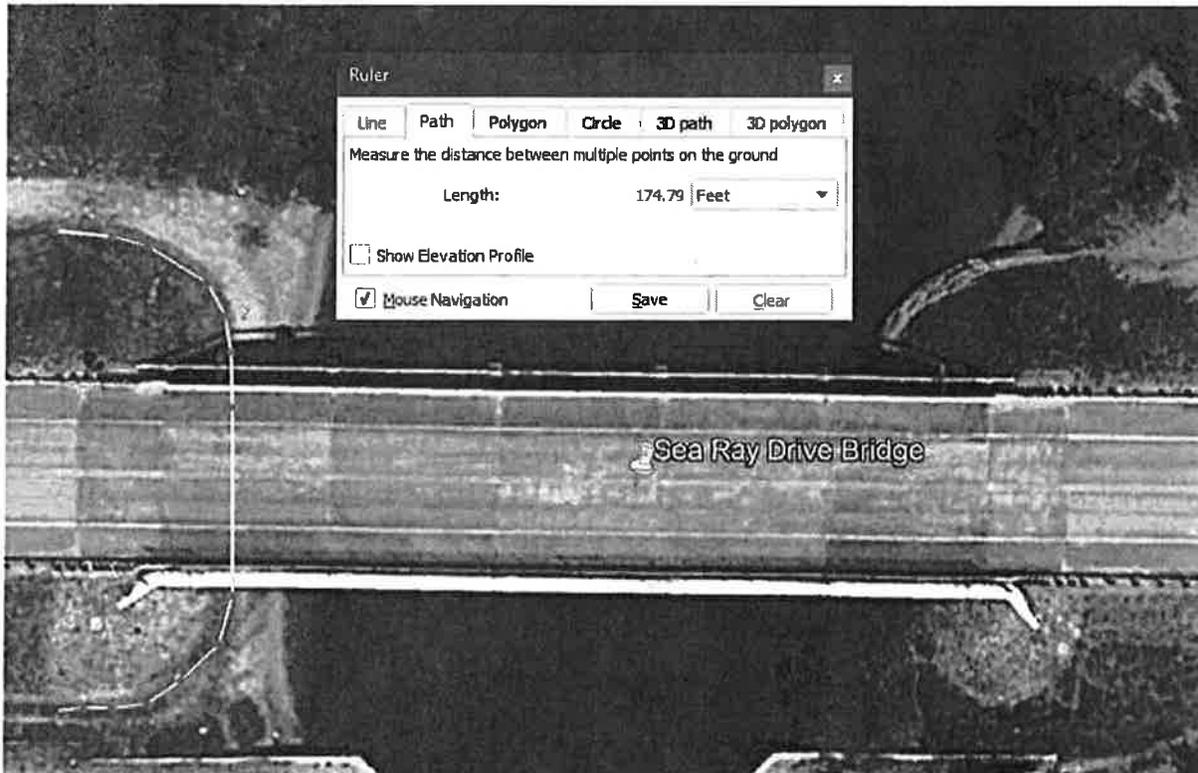
Location	Length* (ft.)	Width** (ft.)	Thickness (ft.)	Volume (ft ³)	S.G.	Ww (lb/ft ³)	Vf	Weight (Tons)
End Bents	180	26.83	2.5	12074.77	2.30	62.40	0.90	779.8

* Length is conservative measured at toe of slope

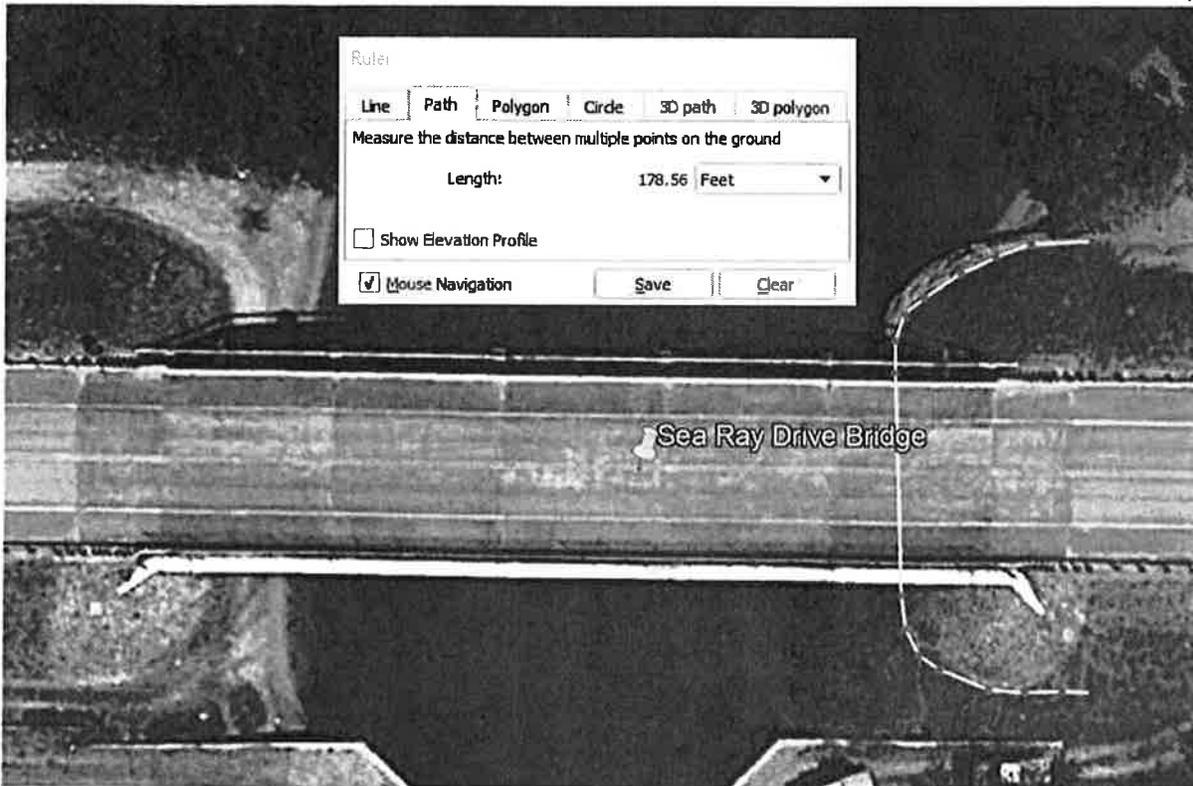
** Width includes slope.

TOTAL 1559.7 TON

Applicable Equation: $Weight = (Volume \times S.G. \times Ww + Vf) / 2000lb/ton \times 2 \text{ End Bents}$



SAB 07/19



0530 74 BEDDING STONE

Location	Length (ft.)	Width (ft.)	Thickness (ft.)	Volume (ft ³)	Unit Weight	Weight (Tons)
End Bents	180	26.83	1	4829.91	115.00	277.7

TOTAL 555.4 TON

Applicable Equation: Weight = (Volume x Unit Weight)/2000 x 2 End Bents

0530 1 RIPRAP, SAND-CEMENT

Location	Length (ft)	Volume (cy)
End Bent 1	95.58	15.93

TOTAL 31.9 CY

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
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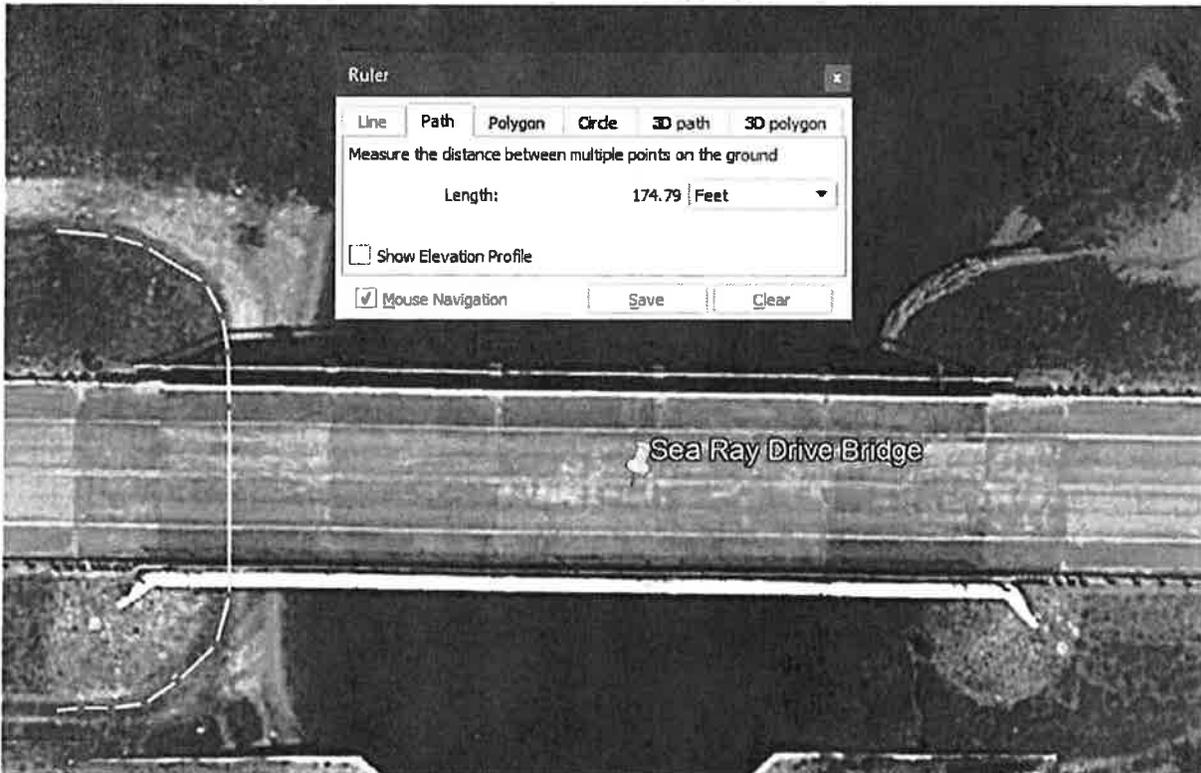
Erosion Control Quantities

0104 11 FLOATING TURBIDITY BARRIER

Location	Length (ft.)	Width (ft.)	No. (Ea.)	Total (ft.)
Ex. End Bents	200	0.00	2	400.00
Ex. Intermediate Bents	75.5	23.00	4	788.00

NOTE: Assume 10 ft offset from bents.

TOTAL **1188.0** LF



SAB 07/19



CONSTRUCTION COST ESTIMATE
for
Option 2B - FIB Replacement
Brevard County

Item Number	Item Description	Quantity	Unit	Unit Price	Total Amount Per Item
Sea Ray Drive Bridge over Sykes Creek New FIB Replacement					
0101 1	MOBILIZATION	1.0	LS	15%	\$428,583.86
0102 1	MAINTENANCE OF TRAFFIC	1.0	LS	2%	\$56,611.18
0104 11	FLOATING TURBIDITY BARRIER	794.0	LF	\$15.00	\$11,910.00
0110 3	REMOVAL OF EXISTING STRUCTURES/BRIDGI	10800 SF	LS	\$30.00	\$324,000.00
0110 4 10	REMOVAL OF EXIST CONC	785.0	SY	\$20.00	\$15,700.00
0120 5	CHANNEL EXCAVATION	1889.0	CY	\$175.00	\$330,575.00
0400 2 10	CONC CLASS II, APPROACH SLABS	102.8	CY	\$440.00	\$45,232.00
0400 4 4	CONC CLASS IV, SUPERSTRUCTURE	288.0	CY	\$1,200.00	\$345,600.00
0400 4 5	CONC CLASS IV, SUBSTRUCTURE	182.4	CY	\$1,100.00	\$200,640.00
0400 9	BRIDGE DECK GROOV & PLANING, DECK 8 5" GR	1055	SY	\$10.00	\$10,550.00
0400147	COMPOSITE NEOPRENE PADS	8.7	CF	\$1,100.00	\$9,570.00
0415 1 4	REINF STEEL- SUPERSTRUCTURE	59040	LB	\$1.00	\$59,040.00
0415 1 5	REINF STEEL- SUBSTRUCTURE	25303	LB	\$1.00	\$25,303.00
0415 1 9	REINF STEEL- APPROACH SLABS	20560	LB	\$1.00	\$20,560.00
0450 2 45	PREST BEAMS: FLORIDA-1 BEAM 45"	888	LF	\$325.00	\$288,600.00
0455 34 5	PRESTRESSED CONCRETE PILING, 24" SQ	2420	LF	\$120.00	\$290,400.00
0455143 5	TEST PILES- PREST CONCRETE, 24" SQ	500	LF	\$250.00	\$125,000.00
0458 1 11	BRIDGE DECK EXPANSION JNT, NEW, POURED	172	LF	\$45.00	\$7,740.00
0521 3 13	CONC TRAF RAIL- BRIDGE, 36" SING SLOPE	564	LF	\$100.00	\$56,400.00
0530 1	RIPRAP, SAND-CEMENT	38.5	CY	\$540.00	\$20,805.00
0530 3 3	RIPRAP- RUBBLE, BANK AND SHORE	2140.9	TN	\$1.40.00	\$299,730.13
0530 74	BEDDING STONE	762.4	TN	\$100.00	\$76,243.93
0550 10325	FENCING, TYPE R, 5.1-6.0', VERTICAL	564.0	LF	\$85.00	\$47,940.00
0630 2 16	CONDUIT, F&I, EMBEDDED- BARR/RAILINGS	1692	LF	\$10.00	\$16,920.00
0635 3 13	JUNCTION BOX, FURNISH & INSTALL, EMBED	6	EA	\$350.00	\$2,100.00
	ROADWAY RECONSTRUCTION	1.0	LS	\$200,000.00	\$200,000.00
	CONTINGENCIES			20%	\$662,350.82
	DESIGN			15%	\$596,115.74
	CFI			10%	\$397,410.49
	TOTAL				\$4,967,631.15

NOTE: 1 The existing bridge is closed to traffic. A small percentage is allotted for MDT, accounting for control of boat traffic.

KISINGER CAMPO & ASSOCIATES

BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: *SAB 07/19*

Bridge Replacement Length

Description: Determine approximate length of bridge if 1:1.5 slope is adjusted to 1:2.

Location	Top of Slope Elev. (ft.)	Bot. of Slope Elev. (ft.)	Elev. Difference (ft.)
Existing Bridge	12.74	0.80	11.94

Location	Toe of Slope Clear* (ft.)	Slope (1:H)	Slope Length (ft.)	Berm Width (ft.)	Front Face of End Bents Clear (ft.)	Assumed Front Face of End Bent to FFBW (ft.)	Proposed Bridge Length (ft.)
Proposed Bridge	160.00	2.00	23.88	3.00	213.76	3	219.76

*Taken from existing plans.

For proposed bridge length, use **222 ft.** Use three spans, with center span matching proposed adjacent SR 528 bridges (91'-6").

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
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Foundation Selection

Description: Estimate the appropriate pile number and size for new replacement.
Assume 24" piles, as they are more common than 18" for new bridge construction.

Dead Load Per Span					
Element	Unit Weight	Unit	Dimension*	Unit	Weight (kip)
FIB 45	906	plf	313.5	ft	284.03
Deck + BU	150	pcf	101.43	cy	410.77
Railings	430	plf	157	ft	67.40
Pile Bent	150	pcf	864	cf	129.60
Water Pipe	166.7	plf	78.375	ft	13.07
Water**	579.1	plf	78.375	ft	45.39

* See quantity calculations for topping and pile bent volumes

** Inside diameter of 41.25 inches

Live Load Per Bent*					
Truck/Lane	No.	Distance from CL Bent	Length	MPF	Weight
(kip/klf)	(Ea.)	(ft.)	(ft)		(kip)
32	3	0	-	0.8	76.80
32	3	14	-	0.8	62.27
8	3	28	-	0.8	11.94
0.64	3	-	78.375	0.8	120.38

* Assume 3 lanes

Estimated Pile Factored Design Load				
Load Case	Load	Factor	Distribution	Total
Dead (except pipe)	891.8	1.25	7	159.3
Pipe	58.5	1.25	2	36.5
Live	271.4	1.75	7	67.8

Divide dead and live load equally among piles, except for the water main which is conservatively assumed to contribute half its weight to the exterior pile.

Using 7 piles provides an approximate spacing of 7'-3", similar to proposed SR 528 bridge replacement foundations.

TOTAL 263.6 kip

Assuming 0.75 phi factor, nominal bearing resistance = 176 TN

Conclusion: Use 7~24" piles for each bent foundation. The calculated NBR is much less than the SDG recommended resistance of 450 tons, but will also provide lateral deflection resistance in the case of a large unbraced length due to scour.

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: SAB 07/19

Removal of Existing Structure

0110 3 Removal of Existing Structure

Location	Length (ft.)	Area (sf)	Slope (1:H)	Width (ft.)	Area (SF)
Bridge	200.00	-	-	45	9000.0
Approach Slabs	40.00			45	1800.0

PAY ITEM TOTAL (SF) 10800

0110 4 10 REMOVAL OF EXISTING CONCRETE

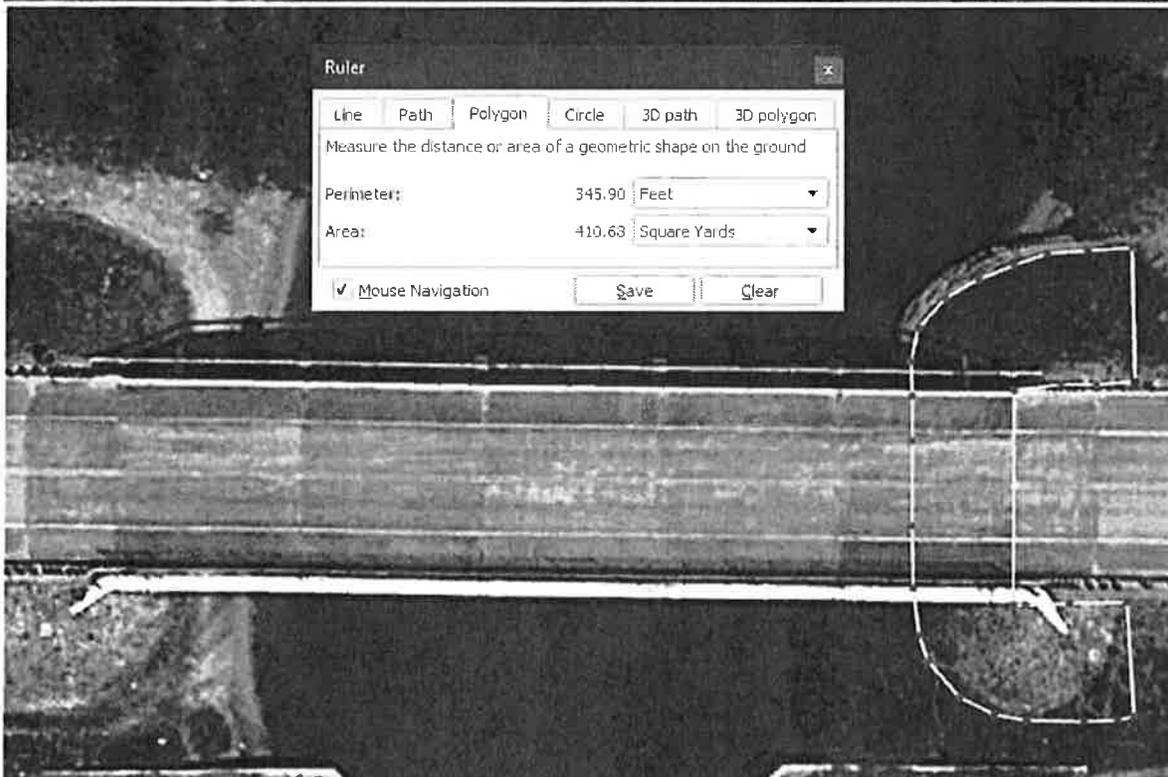
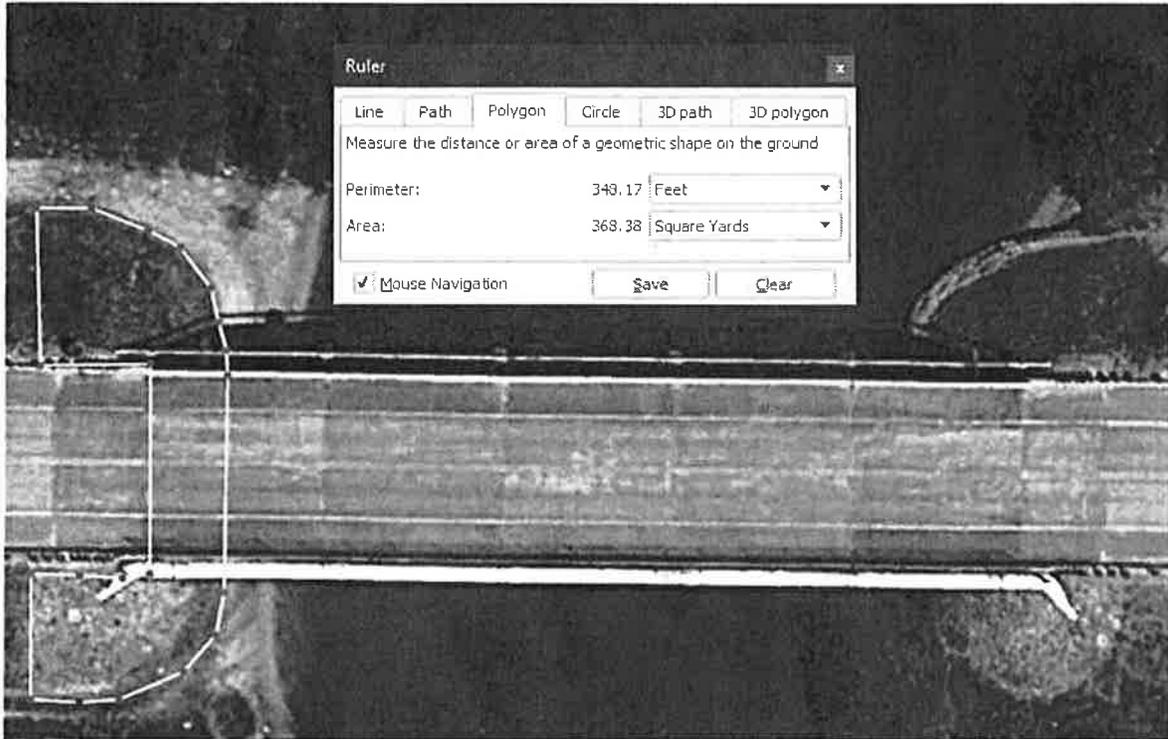
Location	Area (SY)
END BENT 1	370.0
END BENT 6	415.0

PAY ITEM TOTAL (SY) 785

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SEA RAY DRIVE OVER SYKES CREEK

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SEA RAY DRIVE OVER SYKES CREEK

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Foundation Quantities

0455 34 5 PRESTRESSED CONCRETE PILING, 24" SQ.

Location	No. Piles	Prod. Pile Length* (ft.)	Pile Length (ft.)
End Bent 1	5	110	550
Int. Bent 2	6	110	660
Int. Bent 3	6	110	660
End Bent 4	5	110	550

PAY ITEM TOTAL (LF) 2420

Applicable Equation: Pile Length = No. Piles x Production Pile Length

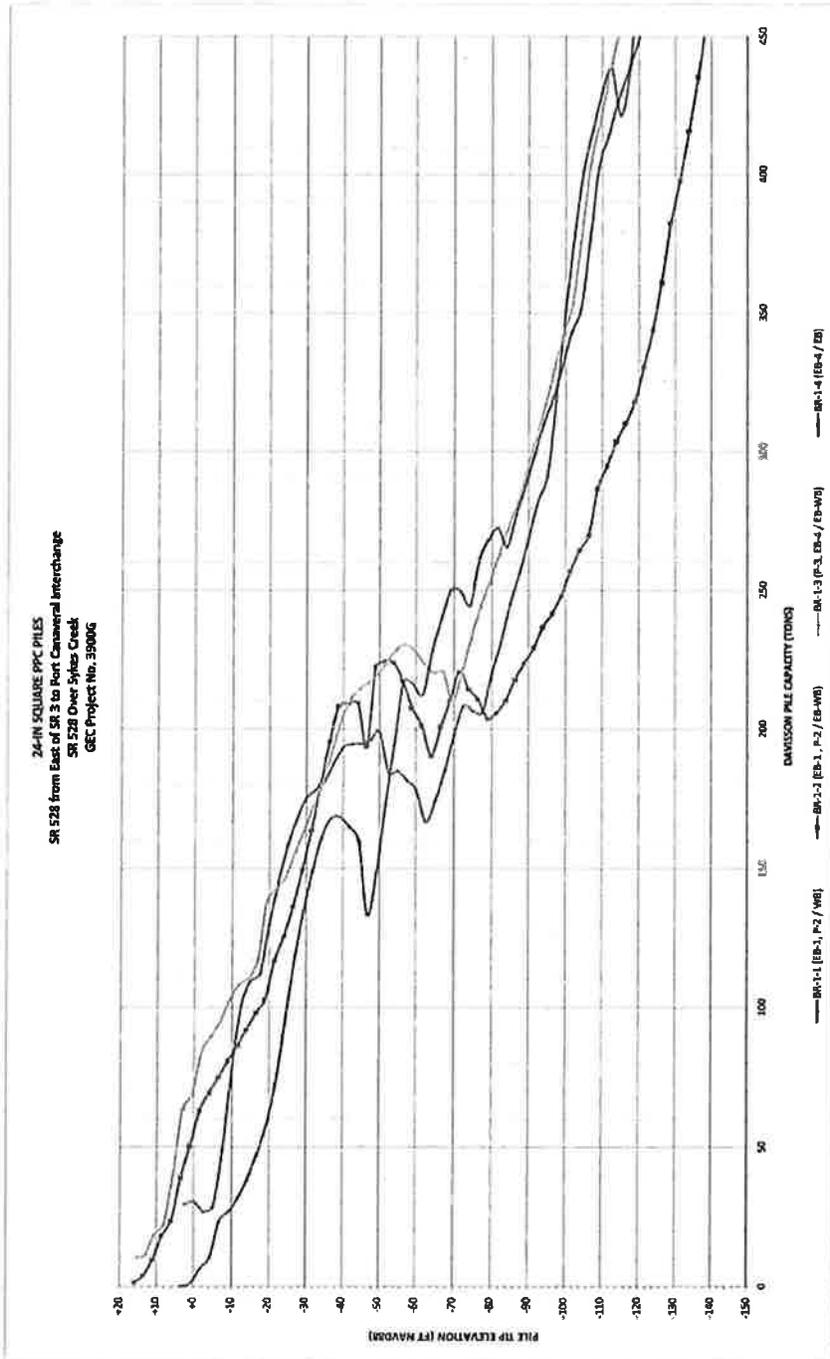
* Pile length is estimated with preliminary capacity curves for adjacent SR 528 bridge replacements

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: SAB 07/19

Foundation Quantities



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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: *SAB 07/19*

Foundation Quantities

0455143 5 TEST PILES - PRESTRESSED CONCRETE PILING, 24" SQ.

Location	No. Piles	Prod. Pile Length* (ft.)	Pile Length (ft.)
End Bent 1	1	125	125
Int. Bent 2	1	125	125
Int. Bent 3	1	125	125
End Bent 4	1	125	125

PAY ITEM TOTAL (LF) 500

Applicable Equation: Pile Length = No. Piles x Production Pile Length

0120 5 CHANNEL EXCAVATION

Location	Width (ft.)	Length (ft.)	Depth (ft.)	Volume (CY)
Int. Bent 3	30	65	10	722.22
Int. Bent 4	30	70	15	1166.67

PAY ITEM TOTAL (CY) 1889

Applicable Equation: Pile Length = No. Piles x Production Pile Length

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: SAB 07/19

Superstructure Quantities

0400 4 4 CONCRETE CLASS IV, BRIDGE SUPERSTRUCTURE

BRIDGE DECK					
Location	Length (ft.)	Width* (ft.)	Deck Depth (ft.)	No. (Ea.)	Volume (CY)
Deck - Span 1	65.25	44.67	0.71	1.00	76.47
Deck - Span 2	91.50	44.67	0.71	1.00	107.23
Deck - Span 3	65.25	44.67	0.71	1.00	76.47
Thickend Slab	44.67	2.67	0.50	6.00	13.25

TOTAL (CY) 273.41

BUILD-UP (PER SPAN)						
Spans	No. Beams	Beam Length (ft.)	Flange Width (ft.)	'B' & 'D' * (in.)	'C' * (in.)	Volume (CY)
1	4	65.25	4.00	2.00	1.00	4.30
2	4	91.50	4.00	2.00	1.00	6.02
3	4	65.25	4.00	2.00	1.00	4.30

* See SPI Index 450-199, Case 3.

TOTAL (CY) 14.62

Location	Volume (CY)
Bridge Deck	273.4
Build-Up	14.6

PAY ITEM TOTAL (CY) 288.0

Applicable Equations:

Bridge Deck Volume = (Length x Width x Depth) / (27 ft³/CY)

Build-Up Volume = (Beam Length x Flange Width x (C + ((B + D - 2C)/6))) / (27 ft³/CY)

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
CHECKED BY: SAB 07/19

Superstructure Quantities

0400 9 BRIDGE DECK GROOVING & PLANING, DECK 8.5" AND GREATER

Location	Length (ft.)	Width (ft.)	Area (SY)
Bridge	222.00	42.00	1036
Approach Slabs	4.00	42.00	19

PAY ITEM TOTAL (SY) 1055

Applicable Equation:

$$\text{Area} = \text{Length} \times \text{Width} / (9 \text{ ft}^2/\text{SY})$$

0400147 COMPOSITE NEOPRENE PADS

Location	No. Piers	No. Pads per Bent	L (ft.)	W (ft.)	Thickness (in.)	Volume (CF)
End Bent 1	1	4	0.833	2.67	1.91	1.50
Int. Bents 2-3	2	8	0.833	2.67	1.91	5.70
End Bent 4	1	4	0.833	2.67	1.91	1.50

* See Index 400-510 for dimensions.

PAY ITEM TOTAL (CF) 8.7

Applicable Equation:

$$\text{Volume} = \text{No. Pads} \times \text{L} \times \text{W} \times (\text{Thickness} / 12 \text{ in/ft})$$

0415 1 4 REINFORCING STEEL - BRIDGE SUPERSTRUCTURE

Location	Concrete Volume (cy)	Reinforcing Weight* (lb/cy)	Weight (lb.)
Bridge Deck	288.0	205	59040

*Taken from FDOT BDR estimate for standard decks

PAY ITEM TOTAL (LB) 59040

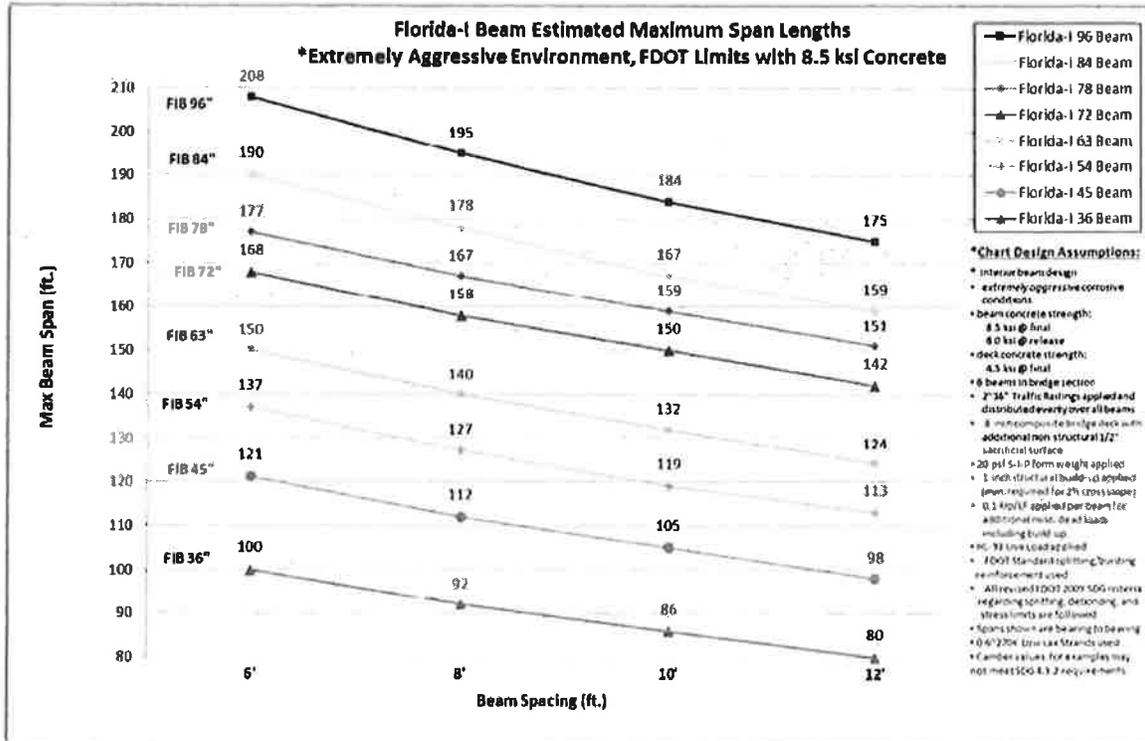
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SEA RAY DRIVE OVER SYKES CREEK

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Superstructure Quantities

0450 2 45 PRESTRESSED BEAMS: FLORIDA-I BEAM 45"



Location	Beam Length (ft.)	Quantity	Length (ft.)
Span 1	65.25	4	261
Span 2	91.50	4	366
Span 3	65.25	4	261

PAY ITEM TOTAL (LF) 888

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SEA RAY DRIVE OVER SYKES CREEK

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Superstructure Quantities

0458 1 11 BRIDGE DECK EXPANSION JOINT, NEW CONSTRUCTION, F&I POURED JOINT WITH BACKER ROD

Location	Width* (ft.)	Bridge Skew (deg.)	Length (ft.)
END BENT 1	42.00	0.00	43
BENT 2	42.00	0.00	43
BENT 3	42.00	0.00	43
END BENT 4	42.00	0.00	43

* Between inside face of rails/parapets.

PAY ITEM TOTAL (LF) 172

Applicable Equation:

$$\text{Length} = (\text{Width} / \cos(\text{skew})) + 2\text{in.} + \sqrt{[(6\text{in.})^2 + (6\text{in.})^2]}$$

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

DESIGNED BY: LM 07/19
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Substructure Quantities

0400 4 5 CONCRETE CLASS IV, SUBSTRUCTURE

End Bents							
Location	Length (ft.)	Width (ft.)	Max Height (ft.)	Min Height (ft.)	Average Height (ft.)	Quantity	Volume (CY)
Cap	55.58	4.00	4.00	4.00	4.00	2	65.88
Wingwalls	12.00	1.00	8.00	8.00	8.00	4	14.22
Backwall	55.58	1.00	8.82	8.82	8.82	2	36.31
Pile Void	2.00	2.00	1.00	1.00	1.00	-12	-1.78

*Use cap length equal to existing bents

TOTAL (CY) **114.6**

Intermediate Bents					
Location	Length* (ft.)	Width (ft.)	Height (ft.)	Quantity	Volume (CY)
Cap	55.50	4.00	4.00	2	65.78
Pile Void	2.00	2.00	1.00	-14	-2.07

*Use cap length equal to existing bents

TOTAL (CY) **63.7**

Pedestals					
Location	Length* (ft.)	Width (ft.)	Height (ft.)	Quantity	Volume (CY)
End Bents	4.00	3.00	0.50	8	1.78
Int. Bents	4.00	4.00	0.50	8	2.37

*Use cap length equal to existing bents

TOTAL (CY) **4.1**

Location	Volume (CY)
End Bents	114.6
Int. Bents	63.7
Pedestals	4.1

PAY ITEM TOTAL (CY) **182.4**

Applicable Equation: Volume = Quantity x (Length x Width x Height) / (27 ft³/CY)

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

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Substructure Quantities

0415 1 5 REINFORCING STEEL - BRIDGE SUBSTRUCTURE

Location	Volume (cy)	Reinforcing Weight (lb/cy)	Weight (lb.)
End Bents	114.6	135	15471
Intermediate Bents	63.7	145	9237
Intermediate Bents	4.1	145	595

*Taken from FDOT BDR estimate for pile abutments and pile bents

PAY ITEM TOTAL (LB) 25303

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SEA RAY DRIVE OVER SYKES CREEK

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Approach Slab Quantities

0400 2 10 CLASS II CONCRETE, APPROACH SLABS

Location	Length (ft.)	Width (ft.)	Depth - Slab (ft.)	Depth - Topping (ft.)	Depth - To Backwall (ft.)	Volume (CY)
Approach Slab 1	30.00	44.67	1.00	0.17	0.58	51.4
Approach Slab 2	30.00	44.67	1.00	0.17	0.58	51.4

TOTAL 102.8 CY

Applicable Equation: Volume = (Length x Width x Depth Slab + 2-ft x Width x Depth Topping
+ Width x Depth To Backwall x (1-ft + 0.5 x Depth To Backwall)) / (27 ft³/CY)

0415 1 9 REINFORCING STEEL - APPROACH SLABS

Location	Volume (CY)	Reinforcing Weight (lb/cy)	Weight* (lb.)
Approach Slab 1	51.40	200	10280
Approach Slab 2	51.40	200	10280

*Taken from FDOT BDR estimate for approach slabs

PAY ITEM TOTAL (LB) 20560

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SEA RAY DRIVE OVER SYKES CREEK

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Barrier Quantities

0521 5 13 CONCRETE TRAFFIC RAILING - BRIDGE, 36" SINGLE-SLOPE

Location	Length (ft.)	No. Railings	Length (ft.)
APPROACH SLAB 1	30.00	2	60.00
BRIDGE	222.00	2	444.00
APPROACH SLAB 2	30.00	2	60.00

PAY ITEM TOTAL 564 LF

0550 10325 FENCING, TYPE R, 5.1-6.0', VERTICAL

Location	Length (ft.)	No. Railings	Length (ft.)
APPROACH SLAB 1	30.00	2	60.00
BRIDGE	222.00	2	444.00
APPROACH SLAB 2	30.00	2	60.00

PAY ITEM TOTAL 564 LF

0630 2 16 CONDUIT, FURNISH & INSTALL, EMBEDDED

Location	Length (ft.)	No. Railings	No. Conduits	Length (ft.)
APPROACH SLAB 1	30.00	2	3	180.00
BRIDGE	222.00	2	3	1332.00
APPROACH SLAB 2	30.00	2	3	180.00

PAY ITEM TOTAL 1692 LF

0635 3 13 JUNCTION BOX, FURNISH & INSTALL, EMBEDDED

Location	No. (EA)
APPROACH SLAB 1	2
MID-SPAN	2
APPROACH SLAB 2	2

PAY ITEM TOTAL 6 EA

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

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RipRap Quantities

0530 3 3 RIPRAP - RUBBLE, BANK AND SHORE

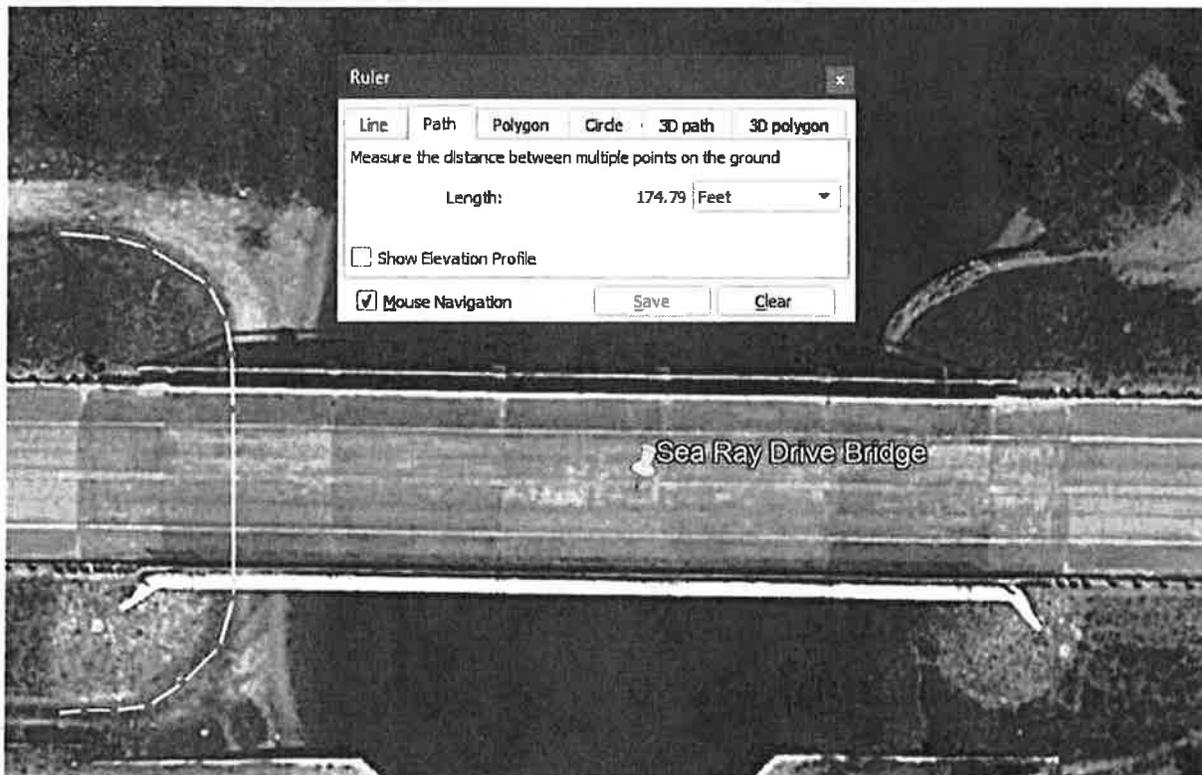
Location	Length* (ft.)	Width** (ft.)	Thickness (ft.)	Volume (ft ³)	S.G.	Ww (lb/ft ³)	Vf	Weight (Tons)
End Bents	180	36.83	2.5	16574.77	2.30	62.40	0.90	1070.5

* Length is conservative measured at toe of slope

** Width includes slope.

TOTAL 2140.9 TON

Applicable Equation: $Weight = (Volume \times S.G. \times Ww + Vf) / 2000lb/ton \times 2 \text{ End Bents}$



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0530 74 BEDDING STONE

Location	Length (ft.)	Width (ft.)	Thickness (ft.)	Volume (ft ³)	Unit Weight	Weight (Tons)
End Bents	180	36.83	1	6629.91	115.00	381.2

TOTAL 762.4 TON

Applicable Equation: Weight = (Volume x Unit Weight)/2000 x 2 End Bents

0530 1 RIPRAP, SAND-CEMENT

Location	Length (ft)	Volume (cy)
End Bent 1	115.58	19.26

TOTAL 38.5 CY

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BREVARD COUNTY
SEA RAY DRIVE OVER SYKES CREEK

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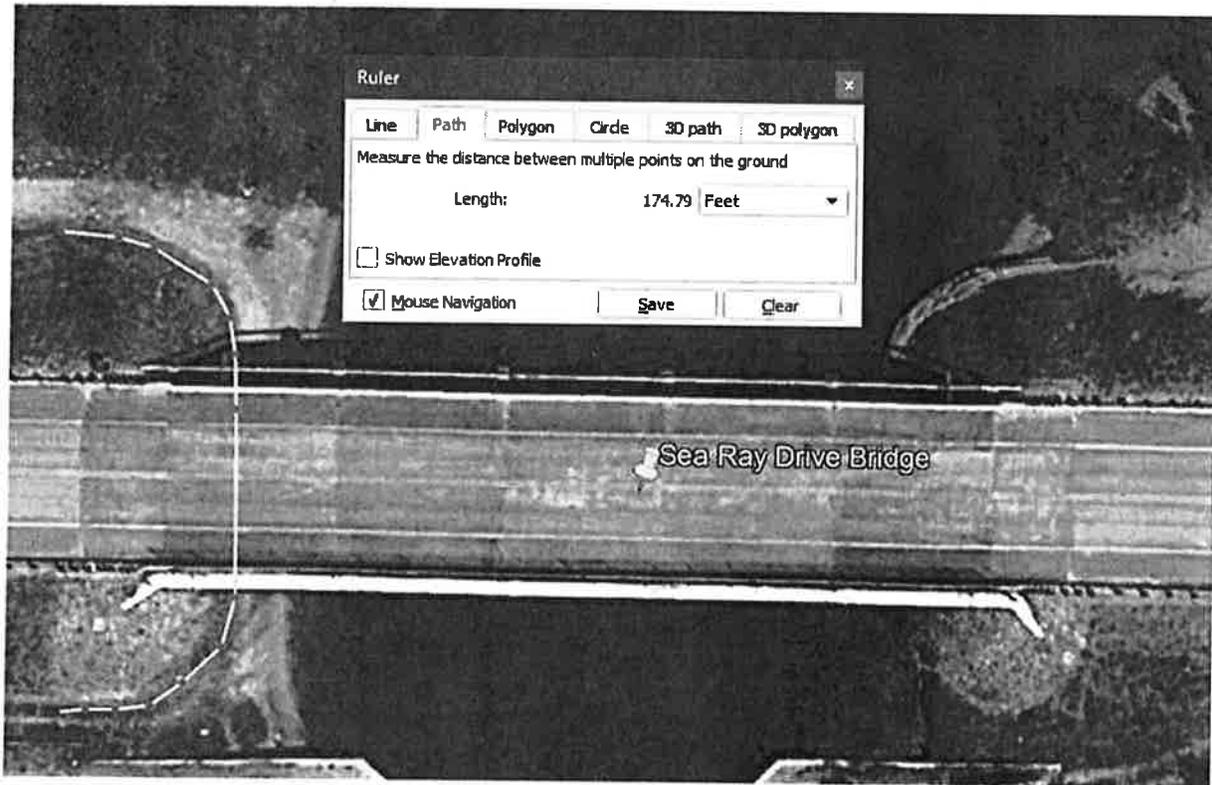
Erosion Control Quantities

0104 11 FLOATING TURBIDITY BARRIER

Location	Length (ft.)	Width (ft.)	No. (Ea.)	Total (ft.)
Ex. End Bents	200	0.00	2	400.00
Ex. Intermediate Bents	75.5	23.00	2	394.00

NOTE: Assume 10 ft offset from bents.

TOTAL **794.0** LF



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