BRIDGE REPLACEMENT FEASIBILITY REPORT

SR A1A over the Sebastian Inlet Bridge (88-0005)

Indian River County, Florida

FM# 445618-1-22-01

Prepared for
Florida Department of Transportation – District Four
Fort Lauderdale, Florida

Prepared by:

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April 2020

ENGINEER'S CERTIFICATION

I, hereby certify that I am a registered professional engineer in the State of Florida, practicing with ASA Consultants Inc., a Florida Corporation under Section 471.023, Florida Statutes, to offer engineering services to the public through a Professional Engineer, duly licensed under Chapter 471, Florida Statues, Certificate of Authorization Number 30932, by the State of Florida, Department of Professional Regulation, Board of Professional Engineers, and that I have prepared or approved the evaluation, findings, opinions, conclusions, or technical advice hereby reported for:

Project:	Bridge Replacement Feasibility Report for SR A1A over the Sebastian Inlet Bridge (88-0005) (FM# 445618-1-22-01 | Roadway ID: 88070000)
Location:	Indian River County, Florida
Client:	Florida Department of Transportation, District 4 3400 W. Commercial Blvd. Fort Lauderdale, FL 33309
FDOT Project Manager:	Binod Basnet, P.E.
Report Prepared by:	ASA Consultants, Inc. 510 Shotgun Road, Suite 402 Sunrise, Florida 33326 Contract No. C-A354, Task Work Order 3 Certificate of Authorization No. 30932 Vendor No. F46551262

I acknowledge that the procedures and references used to develop the results contained in this report are standard to the professional practice of transportation engineering as applied through professional judgment and experience.

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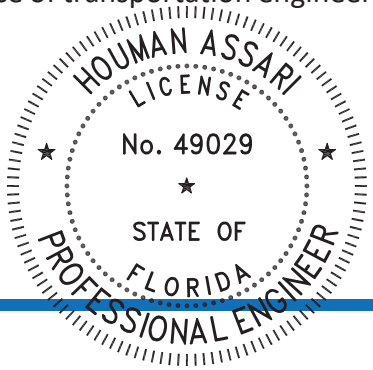

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1.0 BACKGROUND

The Florida Department of Transportation (FDOT), District Four, is performing an assessment to evaluate the feasibility of replacing the existing bridge on State Road A1A (Bridge 880005) spanning across the Sebastian inlet. This Feasibility Report presents the results of the evaluation performed to determine Right-of-Way requirements, as well as the feasibility of phased construction of the proposed bridge and the approach to maintenance of traffic. The report also considers the feasibility of the construction of the proposed bridge in close proximity to the existing bridge from geometric, both horizontally and vertically, and geotechnical perspectives.

1.1 Purpose and Need

An inspection of Bridge 880005, performed by Volkert, Inc. on November 14, 2018, determined the bridge to be structurally deficient, indicating a sufficiency rating of 51.6 and a health index of 79.8. The bridge is also determined to be functionally obsolete which means the bridge section and the geometric alignments do not meet the latest road design standards or the needs of the corridor.

The FDOT is planning to perform a Project Development and Environmental (PD&E) Study to evaluate the social, economic, and environmental effects of the replacement of the Bridge 880005. This report was commissioned to determine the feasibility and to evaluate potential constructability of the bridge replacement. The findings of this report are to assist the Department in planning for critical items, such as right-of-way acquisition, through the planning and design phases required for the completion of this bridge replacement.

1.2 Evaluation Methodology

The focus of this report was to establish the following:

- Preliminary horizontal and vertical geometry for alignment of the proposed bridge, as well as the approaching roadways
- Determine feasibility of phased construction for the bridge
- Maintenance of traffic approach needed to reduce operational impacts on the facility
- Determine any requirements for right of way acquisition or temporary construction needs
- Evaluate constructible alternatives for the construction of the new bridge

The basis of the horizontal geometric analysis was the proposed typical section information as noted in the current approved scope shown on Project Suite (PSEE). The proposed typical section consists of two 12-ft travel lanes, two 8-ft shoulders, a barrier separated 12-ft shared use path on the west side of the roadway, and a barrier separated 8-ft sidewalk on the east side. The basis of the vertical geometric analysis was the requirement for a low member vertical clearance of 65 feet above Mean Sea Level (MSL) (El. 0.00) across the main channel.

There was no topographic survey or geotechnical investigation conducted to support the analyses performed for this assessment. The information used in developing the horizontal and vertical geometry was obtained from the existing roadway and bridge as-built plans. The existing boring logs from the as-built bridge plans were used in the geotechnical evaluations performed.

1.3 Project Location

Figure 1-1 Project Location Map

2.0 EXISTING CONDITIONS

2.1 ROADWAY CHARACTERISTICS

2.1.1 Functional Classification

SR A1A is a two-lane undivided facility on the approaches to Bridge 880005 and is classified as a Rural Minor Arterial. It also serves as an evacuation route, based on Indian River County's Evacuation Routes and Zones Map; however, it is not a part of the National Highway System (NHS) or the Strategic Intermodal System (SIS) highway network.

The straight-line diagram for SR A1A is provided in Appendix E.

2.1.2 Design and Posted Speed

SR A1A has a design speed of 55 mph and a posted speed of 45 mph.

2.1.3 Typical Sections

Within the limits of this study, SR A1A (Roadway ID: 88070000) is a two-lane, undivided, rural arterial with open shoulders. The existing travel lanes are 12-ft wide with 8-ft shoulders, 4-ft. paved, in each direction. On the approaches to the bridge, the full width of the shoulders is paved. Barrier curb and Guardrail, flush with the face of curb extending to the existing bridge section, are provided on the outside. The shoulders on the bridge are 2-ft wide. An existing 8-ft sidewalk is located to the west side of the roadway, terminating at access roads into the Sebastian Inlet State Park on the north and south sides of the bridge.

2.1.4 Right of Way

Based on the existing RW Maps, dated June 1960 (88070-2501), the existing right of way along SR A1A is 100-ft wide at the roadway approaches to the existing bridge, extending 50 ft to the east and west sides of the SR A1A Baseline of Survey. The right of way widens to the west by 45-ft at Station 668+00, approximately, providing for 145-ft of available width. The right of way widens 20 ft to the east at Station 673+50, (approx.) to provide for a total right of way width of 165-ft. At Station 678+50 (approx.) the right of way widens on both sides to provide a total width of 240 feet. To the north of the inlet, at Station 697+50 (approx.), the right of way narrows to 100 ft.

The team approached the FDOT D4 Survey and Mapping office, who provided the baseline and RW lines that were recovered for the programmed PD&E project, which have been presented in the Preliminary Roadway Plans included in this report.

2.1.5 Horizontal Alignment

The existing horizontal geometry for SR A1A was reviewed in preparation for the development of the proposed bridge and the associated roadway improvements needed to accommodate the replacement of the structure. The existing alignment along SR A1A is tangential through the study segment.

2.1.6 Vertical Alignment

The existing vertical geometry for SR A1A was reviewed in preparation for the development of the proposed bridge and the associated roadway improvements needed to accommodate the replacement of the structure. The evaluation of the existing vertical geometry focused on the following critical design elements:

1. Existing Grades
2. Bridge Low Member Vertical Clearance Requirements
3. Access Road Intersections with Mainline Profile

The review of the as-built plans revealed that the approach and departure slopes at the crest vertical curve of the profile across Sebastian inlet are at 5%. The current Bridge Low Member Vertical Clearance provided at the inlet is 39-ft above MSL. The connections to the Mainline Profile at Access Road Intersections are outside the limits of the sag vertical curves on either approach to the bridge.

2.2 PEDESTRIAN AND BICYCLE FACILITIES

An 8-ft sidewalk is provided on the west side of the SR A1A. Heading north, the sidewalk terminates at the access road into the Sebastian Inlet State Park on the south side of the inlet and begins again at the access road on the north side of the bridge.

Designated bicycle lanes terminating at the access road into the Sebastian Inlet State Park were observed on the south side of the inlet. There are no bicycle lanes along SR A1A on the north side of the bridge.

2.3 TRAFFIC DATA

2.3.1 Existing Traffic Volumes

The Annual Average Daily Traffic (AADT) Data was obtained from the FDOT Traffic Monitoring Site 88-0291. **Table 2-1** shows the 2018 Traffic Data for SR A1A.

Table 2-1 2018 Traffic Data

Northbound AADT	Southbound AADT	Total AADT	K Factor	D Factor	T Factor
1531	1618	3149	9.5	52.8	7.3

2.3.2 Vehicle Classification

Vehicle classification data based on the information obtained from the FDOT Traffic Monitoring Site 88-0291 is summarized in **Table 2-2**.

Table 2-2 Vehicle Classification Summary

Location	Passenger Vehicles	Buses	Single Unit Trucks	Heavy Trucks
SR A1A	89.76%	0.10%	3.45%	6.69%

2.4 UTILITIES

Overhead Electric lines were observed running on the west side of the roadway on both approached to the bridge. The line on the southern side of the inlet extends into the parking area of the state park and appears to be serving the buildings in the surrounding area. The lines to the north of the inlet begin on the north side of the access road to the north of the bridge and appear to be distribution lines. A sunshine 811 ticket for underground facilities was not requested for this study.

2.5 GEOTECHNICAL

Refer to Appendix H for the Preliminary Geotechnical Evaluation.

2.6 EXISTING STRUCTURAL CHARACTERISTICS

The existing bridge on SR A1A spanning across the Sebastian Inlet (Bridge # 880005) is located in the Sebastian Inlet State Park. The bridge was built in 1964 and retrofitted in 1978 and 2003. The existing bridge consists of 19 spans with a total length of 1548'-0". There are 8 approach spans of 73'-0", a channel unit of 380 ft, and 8 end spans of 73'-0". The section of the bridge has two 12-ft lanes, one in each direction, 2 ft shoulders, and an out-to-out dimension of 34'-3". There are existing fishing piers at both ends, below the bridge.

The scope of the repair work performed in 1978 included providing Pile Jacket for piers No. 8 and 9.

The repair work in 2003 included the following:

- Partial demolition and reconstruction of pile caps at piers 6, 7, 8, 11 and 12 as well as installation of a cathodic protection system
- Repair of the Fender system
- Repair of spalls and sealing cracks in the concrete prestressed beams, bottom of deck, pier caps, diaphragms, pier columns, and footing caps
- Repair of the bridge superstructure bearing system (main spans 9, 10, and 11)
- Repair of the fishing pier stairs
- New pile jackets provided for piers 7 and 8
- Application of new silicon sealer at expansion joints located at end bents, piers 1 through 7, and 12 through 18
- Application of Class V finish to exterior surfaces
- Repair and replacement of the bridge handrails

2.6.1 Type of Structure

The approach and end spans are simply supported spans with their superstructure consisting of a cast-in-place (CIP) 7" deck supported on five (5) AASHTO Type III beam at 6'-6" spacing. The Channel unit consists of three (3) continuous spans 100'-180'-100' with 4 post-tensioned concrete Beams with special haunched sections at the supports. The substructure consists of multicolumn piers on pile caps supported by 24" composite steel and concrete piles and steel piling.

2.6.2 Condition of Existing Structures

FDOT performs bi-annual inspections and evaluations of all bridge structures under its jurisdiction, as part of the "National Bridge Inventory (NBI) and Structural Inventory and Appraisal Program" required by FHWA. The term structurally deficient means that the bridge should undergo a series of repairs. All structurally deficient bridge structures must be repaired or replaced within six years of being designated as a structurally deficient structure. The term functionally obsolete means that the bridge section does not meet the latest road design standards. The functionally obsolete rating is not associated with its structural capacity. Health index is a tool that measures the overall condition of a bridge; the lower the health index, the more work that is needed to bring the bridge to an ideal condition. Sufficiency Rating is a tool used to determine whether a bridge that is structurally deficient or functionally obsolete should be repaired or replaced. The Sufficiency Rating considers several factors with only about half of which relate to the condition of the bridge itself. The Sufficiency Rating is not a direct reflection of the bridges' ability to carry traffic loads. The Bridge Load Rating indicates the reserved capacity of the bridge to carry live loads. Bridges are rated at three different stress levels, referred to as Operating Rating, Inventory Rating, and Legal Rating.

The latest Bridge Load Rating Report was not available during the preparation of this report, but this bridge is programmed to undergo a PD&E Study in 2021, currently a candidate design project in 2022, and a candidate construction project in 2026.

2.6.3 Vertical Clearance

The existing bridge navigational channel main span has a 39-ft vertical clearance over the MSL. The Proposed high-level bridge main channel low member requirement is 65 ft over the MSL (EL 0.00).

2.6.4 Horizontal Clearance

The horizontal clearance underneath the existing bridge main channel unit is 120 ft, which is the lateral distance between the fender systems. This report evaluated a proposed bridge with a 200' Span and can accommodate a wider horizontal clearance, if necessary.

3.0 DESIGN CRITERIA

Several design standards and manuals were consulted to establish the design criteria for this Feasibility Study. The design criteria are based on design parameters outlined in the current editions of the following publications:

- A Policy on Geometric Design of Highways and Streets, American Association of State Highway Transportation Officials (AASHTO), 2018
- Florida Design Manual, FDOT, January 2020
- Standard Plans for Roadway and Bridge Construction, FDOT, 2020-21
- Manual of Uniform Traffic Control Devices (MUTCD), FHWA, 2012
- Roadside Design Guide, AASHTO, 2011
- Standard Specifications for Road and Bridge Construction, FDOT, 2020
- Structures Design Manual, FDOT, 2020
- AASHTO LRFD Bridge Design Specification 8th Edition, 2017

3.1 ARTERIAL ROADWAY DESIGN CRITERIA

Table 4-1 Design Criteria for Arterials		
Design Element	**Criteria**	**Source**
Functional Classification	Rural Minor Arterial	FDOT Straight Line Diagram
Design Speed/Posted Speed	55 mph/45 mph approaching the Bridge in both directions	As-Built Plans/Field Verification
Travel Lane	12 ft Minimum	FDM, Table 210.2.1
Auxiliary Lane	12 ft Minimum	FDM, Table 210.2.1
Sidewalk	Minimum 6-ft 8-ft West Sidewalk	FDM, Table 222.1.1 FDOT Proposed Typical Section
Shoulder Width	10 ft/5 ft Paved Minimum (Roadway) 8 ft Minimum (Bridge)	FDM, Table 210.4.1 FDM, Figure 260.1.2 FDOT Proposed Typical Section
Structural Capacity	HL-93 Design Load	AASHTO LRFD 2017
Grades	5% max (55 mph) based on C2T Context Classification	FDM, Table 210.10.1
Max. deflection without curve	0°45'00" (55 mph)	FDM 210.8.1
Max Change in Grade w/o Curve	0.5% (55 mph)	FDM, Table 210.10.2
Min. Length of Crest Curve	1,850 ft	FDM, Table 210.10.3
Minimum Length of Sag Curve	540.5 ft	FDM, Table 210.10.3
Stopping Sight Distance	541 ft Downgrade (55 mph) 456 ft Upgrade (55 mph)	FDM, Table 210.10.2
Clear Zone	30 ft	FDM, Table 215.2.1
Above ground fixed objects	Outside Clear Zone	FDM, Table 215.2.2
Drop-off and Canal Hazards	60 ft	FDM, Section 215.3.2
Border Width	40 ft (55 mph)	FDM Table 210.7-1

4.0 BRIDGE REPLACEMENT ALTERNATIVES

Feasibility of using phased construction to replace existing bridge was performed based on the available information listed below:

- Original existing bridge plans, dated 1963
- Bridge repair plans, dated 1978
- Bridge repair plans, dated 2003
- Right of Way Maps, dated 1960

The superstructure for Spans 1 - 8 and 9 - 12 have different beam type, beam spacing, and total number of beams from the main channel unit (spans 9 through 11). Therefore, the cut line will not be on the center of the beam at all spans, potentially requiring the use of temporary beams if two lanes of traffic (one each direction) are to be maintained during construction.

The Proposed Bridge characteristics include the following:

- Proposed piers lines should be staggered between the existing pier lines to avoid conflicts and avoid undermining the existing foundation. It must be noted that both sets of piers, existing and proposed, will be in place during construction. Scour Analysis must be performed for this period to evaluate the conditions and ensure mitigating measures are in place to avoid adverse conditions.
- The existing navigational channel is on a 20° skew with the existing bridge; therefore, a main span of 200 ft or larger will be required to provide a larger navigational opening than the existing.
- Florida I-Beams (FIB-96) may be utilized if the main span is to be 200 ft or less and provide continuity using full depth diaphragm. Otherwise, for the main spans larger than 200 ft, the following may be used:
    - Post-tensioned concrete beams with special haunched sections at the supports
    - Segmental box girder
    - Steel Box girder (Per SDG 5.1.1.C, Box Girders are preferred compared to plate girders when located in extremely aggressive environments)

FIB-96 was assumed for this feasibility study.

Two options were evaluated for the phased construction and Construction Sequence Sheets are provided in Appendix B.

- Option 1: Provide a 1 lane, two-way configuration, using temporary signals in Phase I
- Option 2: Provide 2 lanes of traffic at all times

4.1 OPTION 1 – 1 lane, two-way configuration, using temporary signals in Phase I

In order to provide adequate width to accommodate 1 lane of traffic, the following phasing of construction is required:

- Phase I:
    - Partial removal of the existing bridge and the southbound raised sidewalk for a total demolition width of 10'-1½".
    - Maintain one lane two-way traffic for northbound and southbound on existing bridge using a temporary traffic signal (SPI 102-603)
    - 37'-10" of the proposed bridge will be constructed to the west of the existing bridge (6'-6" offset from the Existing Bridge Centerline to the Proposed Crown of the bridge).
    - Estimated construction duration of 3 months is anticipated for this Phase.
- Phase II:
    - All traffic will be shifted onto the newly constructed bridge. The construction completed in Phase I will allow for one 12'-0" Travel Lane and 4'-6" Shoulder in each direction.
    - The remainder of the existing bridge will be demolished.
    - The remainder of the proposed bridge will be constructed.
    - Estimated construction duration of 16 months is anticipated for this Phase.

A lane closure analysis was performed to evaluate potential operational impacts to the facility with the use of a one-lane, two-way approach to the maintenance of traffic during construction. The results indicated no restrictions on lane closures based on the low AADT volumes. However, it should be noted that wait time duration on either side of the bridge may be in the excess of 15-20 minutes due to the length between the signals. The preliminary Lane Closure Analysis is included in Appendix C.

4.2 OPTION 2 - Phase I: Provide 2 Lanes of Traffic at All Times

In order to provide adequate width to accommodate 2 lanes of traffic, the following phasing of construction is required:

- Phase I:
    - Partial removal of the existing bridge and the southbound raised sidewalk for a total demolition width of 3'-1½".
    - 27'-3" of the proposed bridge will be constructed to the west of the existing bridge (6'-6" offset from the Existing Bridge Centerline to the Proposed Crown of the bridge).
    - Estimated construction duration of 2 months is anticipated for this Phase.
- Phase II:
    - The southbound traffic will be shifted onto the newly constructed bridge, while the northbound traffic will be maintained on the existing bridge. The use of a temporary beam may be required.
    - An additional 9'-9" of existing bridge will be demolished in this phase.
    - An additional 9'-9" of the proposed bridge will be constructed to the west of the existing bridge.
    - Estimated construction duration of 15 months is anticipated for this Phase.
- Phase III:
    - The northbound traffic will be shifted onto the newly constructed bridge section.
    - The remainder of the existing bridge will be demolished.
    - The remainder of the proposed bridge will be constructed.
    - Estimated construction duration of 9 months is anticipated for this Phase.

The overall construction duration for this phase is estimated to be 7 months loner that Option 1.

5.0 FEASIBILITY ANALYSIS

5.1 TYPICAL SECTIONS

The proposed typical Section of 2-12 ft lanes, 8-ft shoulders (10-ft within the roadway section), 12-ft barrier separated Shared Use Path on the west side, and a 8-ft barrier separated sidewalk on the east side can be accommodated within the RW.

5.2 HORIZONTAL ALIGNMENT

The proposed Crown/PGL line for the bridge and roadway has been shifted 6'-6" to the west of the SR A1A Baseline of Survey.

The horizontal geometry as presented in the preliminary plans is based on a right-of-way of 100 feet, which was established to be the most restrictive condition to ensure the bridge can be constructed in phases. The actual right-of-way, as provided by the Department, is 240 feet wide across the Sebastian inlet which allows for several alternative alignments to be evaluated for PD&E Phase of the project.

5.3 VERTICAL ALIGNMENT

The proposed vertical alignment required for accommodating the 65 ft MVC at the Main Channel Span has extended the tie down points by ~900 ft on both sides. Three vertical curves (2 sag and 1 crest curve) were provided. Because of the drastic change in grades, a Temporary Construction Easement (TCE) or additional RW will be required to harmonize with the existing access roads. See Appendix A for preliminary profiles.

5.4 TRAFFIC OPERATIONS

The recommendation is to maintain 2 lanes of traffic during construction due to following conditions:

- The existing bridge connects Indian River and Brevard County Recreational Parks.
- The ~4000' length of the work zone in which Construction will likely span at least 18 months
- The anticipated long wait times associated with the use of temporary signals at the bridge approaches in order to maintain 2-way traffic if only 1 lane is provided.

- The shortest detour route is about 55 miles in length (resulting in a ~2-hour detour) based on a trip from one side of the bridge to the other with no access across the bridge. The closest bridge crossing to the North and south of the project are ~25 miles apart. Please refer to Appendix D for the detour route. Further analysis of detour routes is to be performed as part of the PD&E study based on origin-destination survey data to more accurately define detour needs and route distances.

5.5 DRAINAGE

As per the requirements of the St. Johns River Water Management District a defined volume of stormwater runoff is to be collected and treated to remove pollutants prior to release to surface or ground water. The required treatment volume is generally the greater of the first one inch of runoff from the total project area, or 2.5 inches of runoff from the impervious area. The actual treatment volume may vary based on treatment approaches employed to provide treatment, such as wet detention, dry detention, or retention as well as offline and online configurations.

The Required Water Quality Treatment Volume:

Total Project area (RW to RW): **18.39 acres**

$$V = A_{Total} \times 1^{"} \times {}^{1'}/_{12"}$$

$$V = 18.39 \times 1^{"} \times {}^{1'}/_{12"}$$

$$\boldsymbol{V = 1.53\ Acft.}$$

Total Impervious Area: **8.19 acres**

Southern Impervious Area subtotal: **2.66 acres**

Bridge Area subtotal: **3.21 acres**

Northern Impervious Area subtotal: **2.32 acres**

$$V = A_{Impervious} \times 2.5^{"} \times {}^{1'}/_{12"}$$

$$V = 8.19 \times 2.5^{"} \times {}^{1'}/_{12"}$$

$$\boldsymbol{V = 1.71\ Acft.}$$

The Maximum Required Water Quality Treatment Volume for this project is 1.71 Acre feet.

5.6 BRIDGE ANALYSIS

Phase Construction of the proposed bridge along with phased demolition of the existing bridge is possible as discussed in Section 4.0 and 4.1. The proposed recommended bridge length is 2099 ft allowing the use of MSE walls (which have a 40' maximum height) to be maximized. Additionally, FIB 96 beams can be used for the Main Channel Span provided the length does not exceed 200 feet. Shallower beams can be used for the approach spans depending on the final design lengths.

5.7 ENVIRONMENTAL ANALYSIS

An evaluation of the potential impacts to the social, cultural, natural and physical environment associated with the proposed improvements will be performed as part of the PD&E study. The Sebastian Inlet State Park extends across Indian River and Brevard County within the project limits. This project is federally funded; therefore Section 4(f) is applicable.