BRIDGE DEVELOPMENT REPORT

TOWN OF BAY HARBOR ISLANDS

BROAD CAUSEWAY BRIDGE REPLACEMENT
DRAFT BRIDGE DEVELOPMENT REPORT (BDR)

BROAD CAUSEWAY BRIDGE REPLACEMENT

Town of Bay Harbor Islands

Prepared for:

Town of Bay Harbor Islands, Florida

April 02, 2024

BAY HARBOR ISLANDS

Financial Management Number:	452428-1-21-01
Federal Project Number:	**N/A**
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Town of Bay Harbor Islands Project Number:	BC-160

Draft Bridge Development Report

April 02, 2024

Prepared for:
Town of Bay Harbor Islands

Prepared by:
AtkinsRéalis

PROFESSIONAL ENGINEER CERTIFICATE

I hereby certify that I am a registered professional engineer in the State of Florida practicing with Atkins, and that I have supervised the preparation of, and approved the analysis, findings, opinions, conclusions, and technical advice reported in:

REPORT:	Bridge Development Report
PROJECT:	Broad Causeway Bridge Replacement PD&E Study
LOCATION:	Miami-Dade County, Florida
FINANCIAL MANAGEMENT NO.:	452428-1-21-01
FEDERAL PROJECT NO.:	**N/A**
FDOT ETDM NO.:	14520

The following duly authorized engineering business performed the engineering work represented by this report:

AtkinsRéalis
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This Bridge Development Report (BDR) contains detailed engineering information that fulfils the purpose and need for the Broad Causeway Bridge Replacement PD&E Study from Broad Causeway Island to East of West Broadview Drive in Miami-Dade County, Florida.

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 design standards and criteria set for by the federal, state, and local regulatory agencies as well as professional judgment and experience.

This item has been digitally signed and sealed by *David Konz* on the date adjacent to the seal.

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies

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1.0 INTRODUCTION

1.1 Bridge Location

The Broad Causeway Bridge (State Route SR 922/Kane Concourse) over Biscayne Bay is located in Miami-Dade County, Florida approximately 1.4 miles east of US Route 1 and 1.2 miles west of SR A1A. A project location map is shown in Figure 1-1.

1.2 Project Description

The project involves the potential replacement of the Broad Causeway Bridge connecting the Town of Bay Harbor Islands (Town) with the City of North Miami, within Miami-Dade County. The bridge is part of Broad Causeway, a roadway classified as “Urban Minor Arterial”. This arterial also begins in Bal Harbour/Surfside and connects those commuters to the mainland. The specific limits of the project extend from the Broad Causeway Island (25°53'19.41"N, 80° 8'54.52"W) on the west side and (25°53'11.30"N, 80° 8'18.93"W) to east of West Broadview Drive. The Florida Department of Transportation (FDOT) Bridge Identification (ID) Number (No.) is 875101. The project is approximately 0.77 mile in length.

The existing Broad Causeway Bridge is a low-level bascule structure constructed in 1951 and is considered structurally deficient. The Florida Department of Transportation (FDOT), in coordination with the United States Coast Guard (USCG), the lead federal agency, identified the replacement structure to be a high-level fixed bridge. The recommendation was based on the engineering and environmental analysis, agency coordination, and public comments as part of the 2023 Project Development and Engineering (PD&E) Study.

The new high-level fixed-bridge will be constructed to the south of the existing bridge and provide a minimum 65-feet of vertical navigational clearance and 90-feet of horizontal clearance perpendicular between fenders. The existing Broad Causeway Bridge will be demolished following construction of the replacement bridge.

Figure 1-1 Project Location Map

Project Location

2.0 EXISTING CONDITIONS

2.1 Existing Roadway Conditions

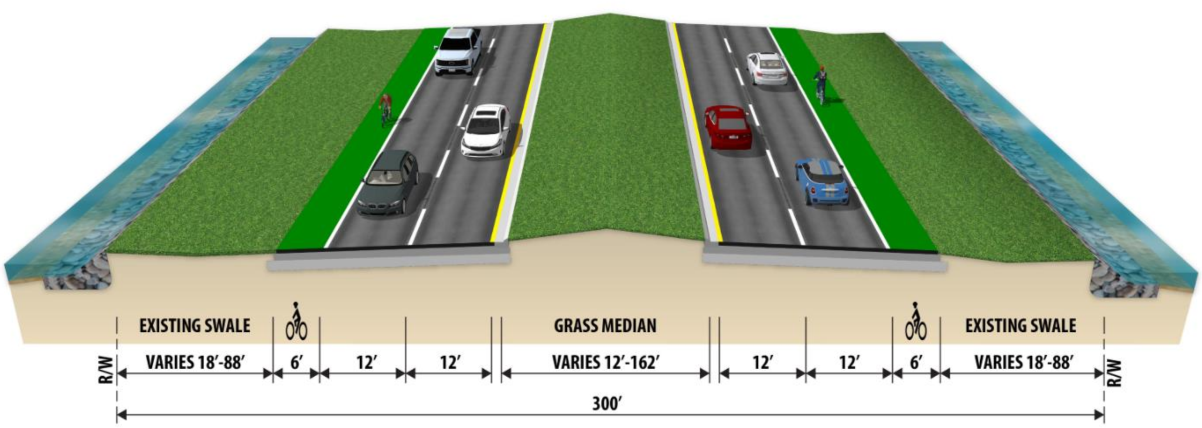
2.1.1 Functional Classification

As shown in the approved typical section package, SR 922 is classified as an urban minor arterial.

2.1.2 Roadway Typical Section

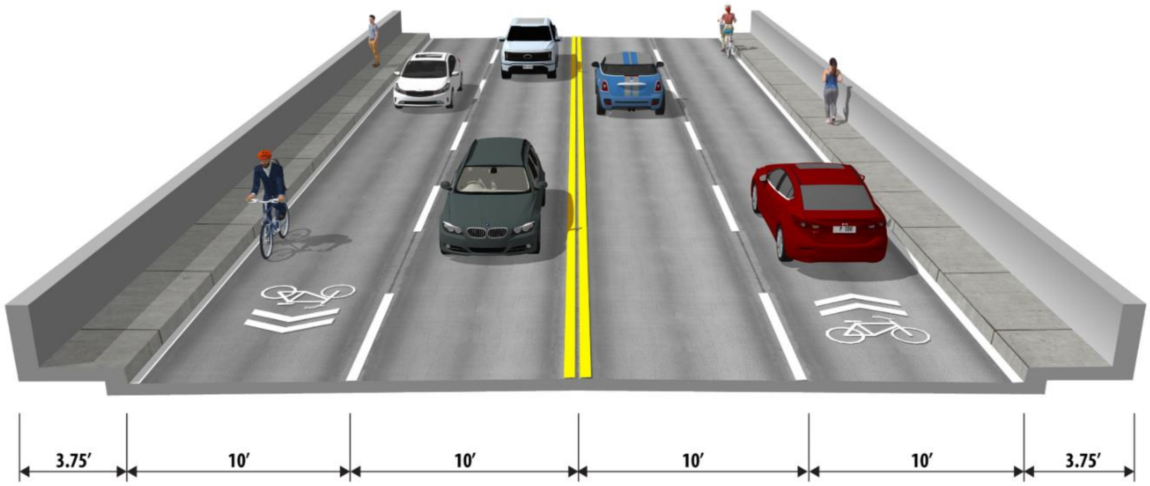
There are three existing typical sections within the project limits. The first typical is the existing roadway on the man-made causeway island from Sta. 105+21.37 to Sta. 123+85.28. The typical includes four, 12 ft. travel lanes and 6 ft. shoulders/bike lanes in both directions and no sidewalks. There is a grassed median that varies in width and inside curbs of 2 ft. On the outside of the shoulder there are grassed swales that vary in width and tie to an existing seawall/rip rap. The entire typical fits within the existing ROW owned by the Town (Figure 2-1).

Figure 2-1 Existing Roadway Typical Section – Causeway Island



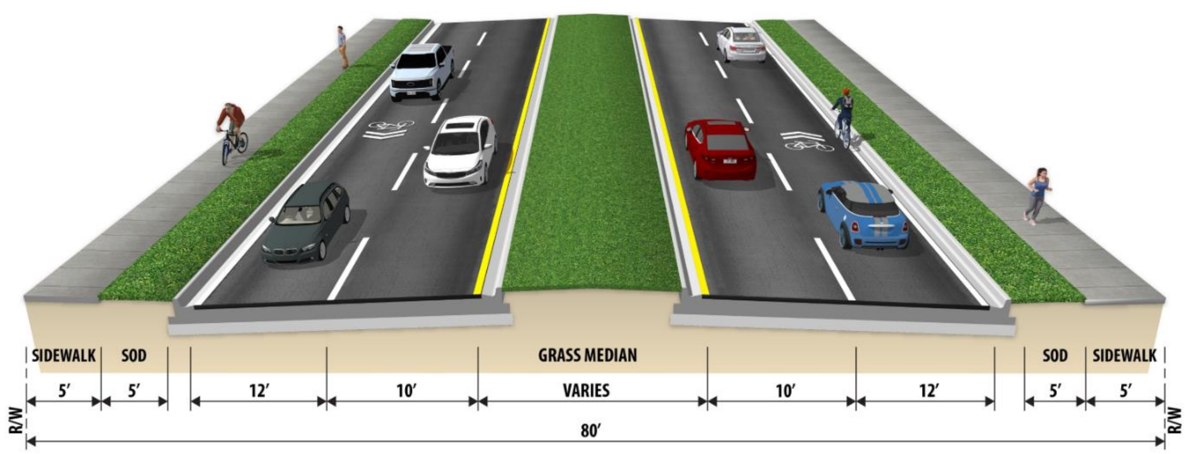
The second typical is the existing bridge with four 10 ft. travel lanes, no shoulders, and a raised 3.75 ft. maintenance section that includes 22 to 36 inches of walkable area and an outside barrier wall. This maintenance section is used as a path for pedestrians and includes a bridge railing. The outside lanes of the existing bridge typical are striped as sharrows for bicycle use (Figure 2-2).

Figure 2-2 Existing Typical Section – Bridge



The third typical is the approach roadway on the eastern end of the existing bridge on SR 922/Kane Concourse from Sta. 141+41.25 to Sta. 146+25.69 and consists of four travel lanes with widths of 10 ft. (inside) and 12 ft. (outside). The typical also includes a landscaped median varying in width and two 2 ft. curbs on both its sides. On the outside are 2 ft. curbs with 5 ft. sidewalks and 5 ft. of existing sod on each side. The outside lanes are striped as sharrows for bicycle use (Figure 2-3).

Figure 2-3 Existing Typical Section – SR 922/Kane Concourse



2.1.3 Right-of-way

The existing total ROW width varies from 80 ft. along Kane Concourse to 300 ft. on the causeway island as shown in Table 2-1.

Table 1-2 – Existing ROW Width

From Station	To Station	Width (ft)
Sta. 105+21.37	Sta. 123+85.28	300
Sta. 141+41.25	Sta. 146+25.69	80

Included in the Town Charter by the 1953 Senate Bill No. 865, the State of Florida surrendered and granted to the Town any claim or control over all tidewaters and other lands, and all bayous and bay bottoms, beaches, waters, waterways and water bottoms, and all riparian rights within and adjacent to the Town limits for municipal purposes only, a strip of 300 ft. wide from Kane Concourse, westwardly across Biscayne Bay to approximately 123rd Street in the City of North Miami. Therefore, the replacement bridge will be built within the 300 ft. area over Biscayne Bay under claim or control by the Town.

Within the existing Town owned Tot Lot at the eastern side of the existing bridge there is a 20 ft. utility easement for a 30-inch Miami Dade Water Main approximately 20 ft. north of the existing roadway.

There are no formal drainage easements within the project limits.

2.1.4 Existing Navigation

The channel is 80 feet wide between the existing fender system. The existing double-leaf bascule span can be opened; therefore, no vertical constraint exists.

2.1.5 Historical Significance Discussion

A Cultural Resource Assessment Survey (CRAS) report was conducted to locate, identify, and bound any prehistoric and historic period archaeological sites and historic structures within the project Area of Potential Effects (APE), and to assess the significance of these resources in terms of eligibility for listing in the National Register of Historic Places (NRHP). A field survey of the project APE conducted by AtkinsRéalis on September 6–September 8 of 2023 confirmed the location of nine (9) previously recorded resources identified during the historic resources' desktop analysis. The background research and field survey identified eight (8) historic resources eligible or potentially eligible for listing in the National Register of Historic Places (NRHP) within the historical APE.

The Broad Causeway (8DA10123) was determined NRHP-eligible by the Florida State Historic Preservation Officer (SHPO) under Criterion A for its association with the development of the Bay

Harbor Islands during the post-World War II Boom. Additionally, Broad Causeway is a contributing resource to the Bay Harbor Islands Historic District.

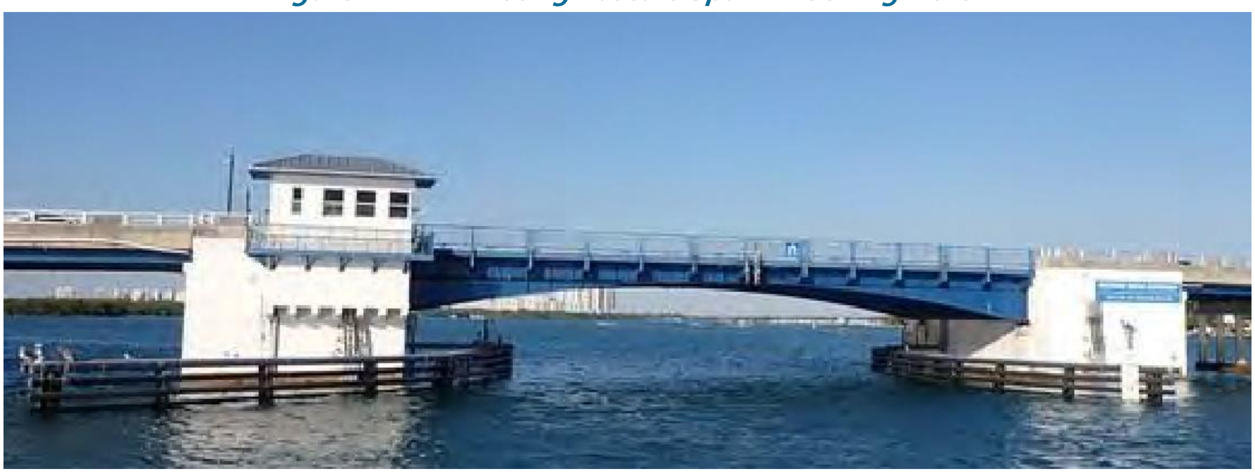
The Citgo (501 Broad Causeway [8DA10436]) historic structure is a Miami Modern (MiMo) masonry vernacular auto repair/gas station constructed on the manmade island that leads to the Broad Causeway. It is the only fueling station within the town of Bay Harbor Islands. It retains much of its original design integrity and is a contributing resource to the Bay Harbor Islands Historic District. The structure was determined NRHP-eligible by SHPO.

The results of this CRAS indicate that a Section 106 Case Study will be required to assess the impacts of the proposed Broad Causeway Bridge Replacement Alternatives on these identified resources.

2.2 Existing Bridge

The existing Broad Causeway Bridge (FDOT Bridge Number 875101) was constructed in 1951 and is a 1627'-4 3/16" long low-level bascule structure consisting of 30 spans including a 147'-0" long double leaf steel bascule span, two 65'-2" steel flanking spans and twenty-seven steel approach spans each 50'-0" long (eight approach spans on the western side of the bascule, nineteen on the eastern side of the bascule). The typical section provides 40'-0" of clear roadway, two 3'-0" sidewalks and a concrete barrier with steel railing along the bridge copings. The figure below shows the bascule span of the existing bridge looking north.

Figure 2-4 Existing Bascule Span – Looking North



The steel fixed approach spans consist of a 7 ½" thick reinforced concrete deck supported by eight steel i-girder beams with steel diaphragms. The steel flanking spans also consist of a reinforced concrete deck supported by either steel i-girder beams. The sidewalk deck is partially cantilevered beyond the exterior beam. All approach and flanking spans are supported by concrete bents consisting of 18-inch driven prestressed concrete piles and cast-in-place reinforced concrete cap. The embankment at the eastern end bent is retained by a battered t-pile panel seawall and the embankment at the west end is retained by reinforced concrete wall panels supported by anchored t-piles with a reinforced concrete cap.

The bascule span consists of two leaves that rotate about a trunnion. The leaves consist of an open grid deck supported by a framework of steel stringers, floor-beams, and two main girders. Each leaf is balanced by a concrete counterweight at its tail end. The bascule span operating machinery consists of a frame-mounted hydraulic motor-driven gear train. A single-story control house located at the deck level on the north side of the west bascule pier houses the control desk and tender to operate the bridge.

In 2017, major structural repairs were performed to the bridge at a construction cost of approximately $17 million. As a result of a 2020 inspection carried out by FDOT, a design to address additional repairs identified by the 2020 inspection was completed. Estimated costs to perform these repairs in the upcoming year amount to $3.0 million. As the structure continues to age, frequent costly repairs will be needed to prevent closure or severe damages.

The bridge has been determined to be structurally deficient and contains fracture critical components based on a Bridge Inspection Report prepared in January 2024 by the FDOT. The existing Broad Causeway Bridge does not meet current design standards for lane widths, shoulder widths, or serve current or future traffic demands. The deck was rated as poor, the superstructure was rated as fair, and the substructure was rated as serious. The current Sufficiency Rating is 11.1 with a health index of 88.95 (both out of a possible score of 100). Given the aggressive marine environment, bridge deterioration is expected to continue. According to the Federal Highway Administration (FHWA), a bridge receiving a sufficiency rating below 50.0 is considered to be a candidate for replacement funding.

The bridge drains directly to Biscayne Bay.

2.3 Utilities

As part of the Broad Causeway Bridge Project Development and Environmental Study (PD&E), FDOT requested information from utility companies pertaining to the type, location, and ownership of the existing utilities within the project area. Base maps were sent to utility providers listed on the Sunshine 811 ticket 09821214 in accordance with FDOT's PD&E Manual with a request to provide information on existing and planned utilities. The following utility providers have existing facilities within the project limits:

- Atlantic Broadband / Breezeline (Cable)
- Comcast Cable (CATV / Fiber)
- FP&L Dade / Subaqueous (Electric)
- Miami-Dade Water & Sewer (Water / Sewer)
- TECO / Peoples Gas South Florida (Gas)
- AT&T / Distribution (Telephone)

Formal location of existing utilities will occur during the design phase and will be used to determine actual impacts. Based on preliminary designations and coordination with utility owners, impacts will occur to the existing overhead cable subsurface potable water piping and electrical facilities. At this stage, the only known proposed utility on the new structure will be new street lighting. Additional utilities could affect the new structure as the design stage progresses

2.4 Hazardous Material Assessment

As part of the PD&E, and in accordance with the FDOT policy and the FHWA requirements, a contamination screening evaluation has been performed to evaluate potential impacts from contaminated sites to the project. All sites were evaluated through examination of historical resources such as topographic maps and aerial photographs, regulatory sources at the State and local levels, and site inspections. In addition, Asbestos Containing Materials (ACM), Metal Based Coatings (MBC), and Polychlorinated Biphenyls (PCB) surveys of the bridge were performed. Potential sources of contamination were identified, and the sites were ranked with respect to their potential for contamination impacts.

The environmental screening evaluation has resulted in a “High” ranking for one site, a “Medium” ranking for one site, a “Low” ranking for two sites, and a “No” ranking for three sites.

Broad Causeway Bridge was tested for ACMs and MBCs. In addition, the bridge was observed for potential PCB-containing components. ACMs were not identified in the materials tested. However, based on the age of the bridge, ACMs and MBCs may be present in the faying surfaces (surfaces that are in contact at the joint) of splices and top flanges embedded in concrete decks and other surfaces. Since there is documented lead content in the painted surfaces at this site which will be impacted if the bridge is replaced, the contamination risk ranking for this site is “Medium”. The rating is also justified due to the potential for PCB-containing bascule machinery leaking oils into the equipment bay. Plans for handling, management, and removal of any MBCs on coatings or ACMs must be prepared before demolition, modification, or rehabilitation of the bridge. Potential PCB-containing components and stained areas should be tested and, if found to contain PCBs, properly disposed.

At Site 5 (Broad Causeway Bridge), lead was found in the painted coatings, so the lead-impacted coatings must be handled, managed, and disposed in compliance with United States Occupational Safety and Health Administration (OSHA) worker protection requirements and with USEPA requirements for disposal of hazardous waste (if found to be hazardous). Potential PCB-containing components and floor staining were observed at the area of the bascule machinery. Potential PCB-containing components should be tested. The stained areas near the machinery should be tested for PCBs and their disposal handled property.

Level II Contamination Assessment investigations will be completed during the design phase at any Medium or High rated sites, as identified in the Contamination Screening Evaluation Report (CSER), for any areas that have proposed dewatering, or subsurface work activities (e.g., pole foundations, drainage features) occurring adjacent to or at any of these sites.

3.0 DESIGN CONTROLS AND CONSIDERATIONS

3.1 Geotechnical Report and Environmental Classification

Geotechnical information has been provided by Arenha. Based on borings presented in the Preliminary Bridge Geotechnical Report Located in Appendix F.

The corrosivity test results of the soil samples and water samples found in the Report of Geotechnical Investigation provide an environmental classification for both the superstructure and substructures as Extremely Aggressive. The following items are noted:

- Marine Structure over Water
- pH ranging from 7.1 to 7.9
- Resistivity ranging from 26 to 690 Ohm-cm
- Chlorides ranging from 15 to 49,950 ppm
- Sulfates ranging from 300 to 330 ppm

3.2 Scour Information.

The BHR indicates the 100-year design scour values vary from -6.5 feet to -10.5 feet depending on the pier considered. The smallest scour occurs near the western/eastern end of the bridge while the larges scour occurs near the main channel. Due to the early stage of the project analysis and design considering scour effects will be incorporated in further submittals of this report.

3.3 Structures Design Criteria

3.3.1 Design Methodology

The Load Resistance Factor Design (LRFD) method using Strength and Service, Extreme Events to evaluate Vessel collision effects and Fatigue for the Steel Span will be used in future stages of the project. All units for the structure design for this project are English Units.

3.3.2 Design Specifications

The structure shall be designed in accordance with:

- FDOT Structures Manual, January 2024 edition (includes the Structures Design Guidelines referred to herein as SDG and the Structures Detailing Manual referred to herein as SDM).
- AASHTO LRFD Bridge Design Specifications, 9th Edition.
- FDOT Standard Specifications for Road and Bridge Construction, January 2024 edition.
- 2023 FDOT Design Manual (referred to herein as FDM).
- FDOT 2023-24 Standard Plans.

3.3.3 Concrete Materials

For all classes of concrete, the calculation for the Modulus of Elasticity (Ec), are in accordance with AASHTO LRFD 5.4.2.4. using a unit weight equal to 0.145 kcf, and an aggregate source correction factor (K1) of 1. Normal Weight concrete is used for the design of this project. The following concrete classifications and strengths are per SDG Section 1.4.3.

Table 3-1 – Concrete Properties

Structural Component	Concrete Class	28-day Strength (Psi)	Modulus of Elasticity (Ksi)
Superstructure			
Approach Slabs	II (Bridge Deck)	4,500	4,145
Bridge Deck	IV	5,500	4,428
Traffic Barriers	IV	5,500	4,428
Prestressed Concrete Beams	VI	8,500	5,112
Substructure			
CIP Substructure	IV	5,500	4,428
CIP Columns and Caps below EL. 12.50	IV (1)	5,500	4,428
Seals	I (Seal)	3,000	3,626
Prestressed Concrete Piling	V	6,000	4,557
Drilled Shafts	IV (Drilled Shaft)	4,000	3987

(1) – Highly reactive pozzolans

The requirements for concrete cover over carbon-steel reinforcing are in accordance with SDG

3.3.4 Reinforcing Materials

The reinforcing materials to be used in the project are:

- Reinforcing Steel (SDG 1.4.1B) - ASTM A615, Grade 60 deformed carbon-steel bar
- Prestressing Strands (SDG 4.3.1) - ASTM A416, Grade 270, low-relaxation strands
- Stainless Steel (SDG 1.4.1B) - ASTM A955 Grade 60 or 75, or ASTM A276, UNS S31603 or S31803 deformed stainless steel bar

- Fiber Reinforced Polymer (FRP) Reinforcing bars are to be provided for the seawall cap due to environmental classification based on FDOT SDG requirements – Section 3.12.C.4.b.

Considering the harsh environmental conditions, the use of stainless reinforcing steel for the substructure emerges as a compelling option. This approach could balance the initial higher costs by lowering maintenance expenses and prolonging the substructure's lifespan. However, it is important to acknowledge that stainless reinforcing steel is four times more expensive than carbon reinforcing steel. Therefore, the practicality of this material for the proposed substructures might be limited due to the significant demand of reinforcing for this bridge.

3.3.5 Design Loads

The following loads have been considered in the project design:

Dead Loads (SDG 2.2 and LRFD 3.5.1)

- Compacted Soil: 115 lb/ft^3
- Reinforced Concrete (Structural) 150 lb/ft^3
- Reinforced Concrete 145 lb/ft^3 (for elasticity modulus only)
- Stay-in-Place (SIP) forms 20 lb/ft^3
- Future Wearing Surface 0 lb/ft^3
- Traffic Barrier (42” Single Slope) 580 lb/ft (1) (Index 521-428)
- Traffic Barrier (36” Median Barrier) 645 lb/ft (Index 521-426)
- Pedestrian/Bicycle Railing 245 lb/ft (Includes 2 bullets) (Index 521-820)

*Note 1: considering 42” Single slope traffic barrier is conservative. Any modification related to the typical section is to be refined in future submittals.

Live Loads (LRFD 3.6)

- Design Vehicular Live Load: HL-93 (LRFD 3.6.1.2.1)
- The multiple presence factor shall be considered, and the corresponding factors shall be applied in accordance with LRFD T3.6.1.1.2-1
- Dynamic Load Allowance shall be applied in accordance with LRFD 3.6.2.
- Bridge shall be load rated for the FL120 Permit Truck.
- Pedestrian load has not been considered for the analysis, conservatively the analysis has been developed used only Vehicular Live Loads.

Vehicular Collision Force (SDG 2.6 and LRFD 3.6.5)

Pier columns located within the setback distance shall be designed for a 600-kip equivalent static force.

Wind Loads

- Wind Loads are in accordance with AASHTO, Section 3.8 and SDG Section 2.4
- Design wind speed on completed structure shall be 170 mph (Miami-Dade County).

Seismic Effects (SDG 2.3 and LRFD 3.10)

Seismic Provisions are in accordance with Section 2.3 of the SDG.

Temperature Loads:

Movement of bridge structures shall be calculated assuming the following uniform temperature range:

Superstructure Material	Temperature Range (Degrees Fahrenheit)			
	Mean	High	Low	Range
Concrete Only	70	105	35	70

3.3.6 Vessel Impact (SDG 2.11)

Specific vessel information was taken from the report *Synthesizing Commercial Shipping (Barge/Tug Trains) from Available Data for Vessel Collision Design (1999)*. The Broad Causeway Bridge is located at Past Point #14. Although the Broad Causeway Bridge is not on the list of FDOT's critical bridges, the Bridge Development Report will use impact loads for an Importance Classification of "Critical", corresponding to an annual frequency of collapse of 0.0001, or a return period of 10,000 years. Similar projects suggest this can be achieved as a minimal cost since gravity loads control the design of the foundations outside of the two piers on either side of the main channel. Per SDG 2.11.4(H), pier strengths for the first two piers on each side of the channel shall be proportioned such that the Annual Frequency of Collapse (AFC) per pier shall be less than the Acceptable Risk of the Bridge Collapse divided by the total number of piers within a distance of six times the LOA of the longest vessel group. The bridge will be designed for the following vessel impact loads:

Table 3-2 – Vessel Impact Forces

Distance from Channel Centerline	Vessel Impact Load
≤70 feet	2,180 kip
71 feet to 360 feet	1,900 kip
361 feet to 670 feet	1,010 kip
>670 feet	80 kip

A fender system delineating the shipping channel beneath the bridge will be required and is necessary to serve as a navigational aid to vessel traffic, protect the bridge piers from minor collisions, and redirect errant and small vessels. For additional analysis Vessel Impact forces evaluation is located in Appendix E.

3.3.7 Vertical and Horizontal Clearance

Based upon the coordination performed as part of the PD&E, the USCG requires a minimum vertical clearance of 65 feet above the mean high water (MHW) elevation and 90 feet horizontal clearance between the inside faces of the fender system. In addition, understanding that the gas station's location is a critical consideration for the project, a horizontal and vertical clearance of 3 feet over the gas station will be provided. This will also facilitate the inspection of the bridge.

FDM 260.8.1 provides additional vertical clearance requirements for bridges over waterways. The "Environmental" criteria states that superstructures classified as moderately aggressive or extremely aggressive due to chloride content shall have material requirements based on the location within the splash zone. The splash zone applies to any marine structure between 4-feet below Mean Low Water (MLW) and 12-feet above MHW, and the Broad Causeway Bridge substructure and superstructure fall within this zone. The corrosion protection for all concrete components will follow SDG Table 1.4.3-3. "Drainage" criteria states that a minimum vertical clearance of 2-feet is required between the design flood stage and the low member of a bridge. The design flood elevation corresponds to the 50-year return period, which is an elevation of 5.8 feet. The bridge low member elevation cannot be lower than 7.8 feet. Finally, the "Navigation" criteria require the bridge low member elevation have a minimum vertical clearance of 6-feet above the mean high-water elevation. By inspection, the "Drainage" criterion governs over the "Navigation" criterion; therefore, to satisfy the first three requirements of FDM 260.8.1, the bridge low member elevation within the limits of the waterway cannot be lower than EL. 7.8 feet.

The fourth item presented in FDM 260.8.1 is for coastal bridges. The paragraph states, "A minimum vertical clearance of 1 foot above the 100-year design wave crest elevation including the storm surge elevation and wind setup is required for the superstructure." The wave crest elevation is wave crest at EL. 9.06 ft. The bridge low member elevation cannot be lower than 8.06 feet.

At the west end, the first span and eighth span of the proposed bridge spans over the Broad Causeway Underpass which facilitates traffic movement around the gas station. The minimum vertical clearance required is 16'-6" per FDM Table 260.6.1. Per FDM 260.6.3 and FDM 215.5.5, the minimum lateral offset for a curbed roadway with design speed less than or equal to 45 mph is 16 feet from the edge of the travel lane. The bridge superstructure provides adequate vertical clearance, and the substructure placement provides adequate horizontal clearance. The typical section of the Broad Causeway Underpass lanes can be seen in Appendix C.

3.3.8 Bicycle and Pedestrian Facilities

There is a 14-foot shared use path on the southern side of the bridge. The American with Disabilities Act (ADA) requirements limit the maximum grade to 5% without the use of landing areas. The proposed high-level profile along SR 922 has a roadway grade of 5.78% from the high point to the east end of the bridge. Since the proposed roadway grade does not meet the ADA requirements, landings along the shared use path will be required. The proposed mid-level profile along SR 922 has a roadway grade of 4.15% which does meet the ADA requirements. Any open expansion joints will utilize cover plates.

3.3.9 Aesthetics

The project should be designed so that it is in harmony with the community and preserves and/or enhances the natural, environmental, scenic, and aesthetic values of the area.

Context Sensitive Design or "Thinking Beyond the Pavement" is a vital aspect to the Town. The existing bridge is the main artery into the Town and the community has voiced concerns of the positive and negative impacts a 65 ft. High-Level Fixed Bridge will have during construction and after the new bridge is opened. The proposed option was refined down thru various alternative meetings with the Town officials and community to provide a product that will address more than the Towns transportation needs. Currently, the Town owns and maintains just one park within the project limits (Tot Lot). The Preferred Alternative accommodates extra greenspace along the causeway island and provides that needed space the Town is looking for to potentially develop a park or a fitness destination.

The improvements are intended to enhance the physical use and appeal of the bridge/corridor for pedestrians and bicyclists with the potential provision of 14' shared use path and overlooks at the top of the bridge. Also, lighting, and aesthetic treatments will be evaluated. Concrete form liners will be used on the substructure for added curb appeal. Context sensitive solutions will be considered to ensure that the project matches local aesthetics and accounts for the community's input on design preferences However, the width and height profiles of the new bridge may alter viewsheds of the area from both the bridge and from the residents and recreational areas along the shoreline.

3.3.10 Lighting

The existing causeway island lighting will be replaced with new decorative LED luminaires mounted on new aluminum poles. The decorative LED luminaire will be coordinated with the Town. A USCG compliant navigation lighting system will be provided over the Intracoastal Waterway. The existing underground conduit and conductors on the causeway island will be replaced with new conduit installed underground and new copper conductors. The lighting poles on the proposed bridge will be mounted on pilasters. Lighting calculations will include the shared-use path and the outside shoulders.

Color changing LED luminaires will be provided to illuminate the bridge beams and piers. Up to seven color themes will be proposed. Fenders and navigational lighting will be per Standard Plans 510-001.

3.3.11 Bridge Drainage

The bridge deck can be drained to the end of the structure without placing scuppers on the bridge, except for the sag in the bridge profile from STA. 112+27 to STA. 115+66. At this location, 4" scuppers, spaced 10-ft apart, will be used along the westbound and eastbound Broad Causeway Bridge barrier walls and will drain without piping into the pond underneath the bridge. No Bridge inlets or pipes will be needed. Otherwise, drainage will be collected by roadway inlets off of the ends of the bridge on all four quadrants. Depending on the stormwater capture of those roadway inlets, bridge inlets may be needed to discharge internally through the piers over land.

3.3.12 Construction Methods

While traffic is maintained on the existing bridge, the new bridge will be constructed to the south of the existing bridge with conventional ground-up methods using a combination of trestles and barges. The portion of the bridge over the channel can be constructed from crane-mounted barges. In areas where the water is too shallow to allow for barge access, temporary work trestles will need to be constructed for crane access. For purposes of determining approximate temporary work trestle limits, it has been assumed the water depth must be a minimum of 6 feet relative to the mean low water elevation. The MLW is EL. -1.938; therefore, work trestle is assumed to be necessary where the existing channel bottom is higher than EL. -7.938. Using this criterion, the work trestle is not expected to be required on this project. The contractor will be required to coordinate with the USCG and obtain prior approval before implementing any marine traffic restrictions during construction.

Within the waterway, seal slabs will be used to facilitate footing construction.

The portion of the bridge structure over land will be constructed with traditional methods while avoiding the gas station.

3.3.13 Removal of Existing Bridge

The existing bridge will be removed once traffic has been shifted to the new bridge. The Contractor is responsible to choose their preferred means and methods for removal adhering to any permit restrictions subject to the removal. It is The Contractors' responsibility the operation and maintenance of the existing bascule bridge until its removal is successfully completed. There is no intention to preserve any portion of the existing bridge for recreational purposes. All existing piles will be removed in accordance with District Construction's guidelines.

As outlined in the FDOT Structures Design Guidelines Section 9.4, an estimate of the debris volume generated by the existing bridge demolition in the Bridge Development Report shall be provided. The estimated debris volume will be estimated in the next steps of the project.

3.3.14 Bridge Security

Per FDM 121.9.6, a refined evaluation of all new Category 2 bridges identified in a PD&E study as critical, landmark or signature bridges is to be performed to determine if anti-terrorist countermeasures are to be included as part of the design. The PD&E was approved, and the document does not identify the proposed structure as a critical, landmark or signature structure; therefore, no further action is required to satisfy the FDM 121.9.6 requirements.

3.3.15 Bridge Permitting

The following permits are anticipated for this project:

- USCG Bridge Permit
- USACE Nationwide 15 Permit (including Section 408 review)
- FDEP National Pollutant Discharge Elimination System (NPDES) Permit
- FDEP Contamination Stormwater Permit

- SFWMD Environmental Resource Permit (ERP)
- Miami-Dade County Class I Coastal Construction Permit
- Miami-Dade County Tree Permit

Included in the Town Charter by the 1953 Senate Bill No. 865, the State of Florida surrendered and granted to the Town any claim or control over all tidewaters and other lands, and all bayous and bay bottoms, beaches, waters, waterways and water bottoms, and all riparian rights within and adjacent to the Town limits for municipal purposes only, a strip of 300 ft. wide from Kane Concourse, westwardly across Biscayne Bay to approximately 123rd Street in the City of North Miami. This information with be included in the SFWMD ERP and Miami-Dade County Class I Permit applications to explain how the sovereign submerged lands are granted to the Town.

Section 24-48 of the Miami-Dade County Code requires that a Miami-Dade Class I Permit be obtained prior to performing any work in, on, over or upon tidal waters or coastal wetlands of Miami-Dade County or of any of the municipalities located within Miami-Dade County.

Since there are no sovereign submerged lands within the project area, an easement will be not required.

Coordination has occurred with environmental regulatory agencies for the proposed geotechnical survey work associated with the PD&E phase of the Broad Causeway Bridge project. The Town is seeking authorization from Miami-Dade County's Department of Regulatory and Economic Resources - Division of Environmental Resource Management via an Expedited Administrative Authorization (EAA) and the USACE via Nationwide Permit 6. The proposed geotechnical survey work is exempt from permitting with the FDEP/SFWMD under 62-330.051(11)(d), F.A.C. The EAA was issued on July 31, 2023, and the USACE Nationwide Permit 6 was received on November 2, 2023.

If dewatering occurs within 500 ft. of the service station, a special "Contamination" stormwater Permit will be required from FDEP. The contractor will be held responsible for ensuring compliance with any necessary dewatering permit(s). Any dewatering operations in the vicinity of potentially contaminated areas shall be limited to low-flow and short-term. A dewatering plan may be necessary to avoid potential contamination plume exacerbation. All permits will be obtained in accordance with Federal, State, and local regulations.

3.3.16 Fire Protection Requirements

Fire protection rating based on life safety requirements to be determined.

4.0 ALTERNATIVE ANALYSIS

Various superstructure alternatives were considered for the replacement structure including Florida I-Beams (FIB), Florida U-Beams (FUB), Steel Plate Girders (SPG), Steel Box Girders (SBG), and Segmental Concrete (SC). The steel alternatives and the segmental concrete alternatives were eliminated from initial consideration due to their higher cost, increased future maintenance requirements and minimum vertical clearance issues. The Florida U-Beam alternatives had a higher cost than the Florida I-Beam alternatives for the same span lengths; therefore, were eliminated from further consideration.

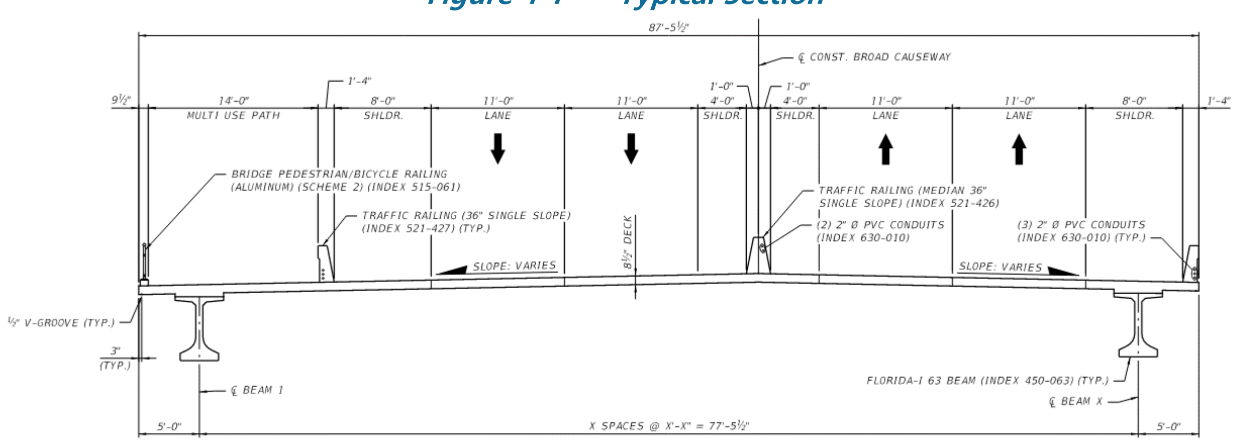
Based on aesthetic recommendations, the substructure for each alternative is a multi-column pier with rectangular columns and architecturally enhanced curved caps. Each alternative compared four foundation options consisting of 24-inch or 30-inch precast prestressed concrete (PPC) piles or 48-inch or 60-inch drilled shafts all on a waterline footing.

4.1 Typical Section

At the west end of the bridge, there are three vehicular ramps and one pedestrian ramp entering and exiting the bridge structure. Spans 1 through 3 have a constant bridge width of 72'-8", Spans 4 through 9 vary from 72'-8" (min.) to 141'-8 1/8" (Max.) to account for the varying lane arrangements. The bridge typical section over Biscayne Bay will consist of two 11ft lanes in each direction separated by 4 feet inside shoulders and a 36" single slope median barrier (FDOT 521-426). The outside shoulders are 8 feet and are adjacent to the 36" single-slope concrete barrier walls (FDOT Standard 521-427). A 14-foot shared use path is proposed along the north side of the bridge with a bridge pedestrian/bicycle railing (FDOT Standard 515-061). The overall bridge width will be 87'-5½" for Spans 9 through 19. The deck thickness will be 8.5-inch per SDG Table 4.2.5-1.

At the west end of the bridge, access ramps the annual average daily traffic (AADT) volume in 2023 was 25,100 vehicles per day and the posted speed is 30 mph. The approved typical section package is in Appendix C.

Figure 4-1 Typical Section



4.2 Construction Phasing

The traffic control plan for the construction consists of three main phases on the eastern end of the structure. A general description of each phase is as follows:

Phase I:

- Construct full-width bridge – Span 1 to Span 8 and Span 10 to Span 17.
- Construct partial width for shared use path on Span 9, and Spans 18 and 19.

Phase IA:

- Shift eastbound (EB) vehicular traffic to the new bridge (reduce to one lane at night).
- Maintain westbound (WB) vehicular traffic on the existing bridge along with all pedestrian traffic (detour pedestrians from south side to the north).
- Construct a partial new approach at the east end of the bridge using nighttime WB lane closures.

Phase IB:

- Restripe and set a temporary barrier wall (for drop-off) with crash attenuators.
- Shift all EB and WB traffic to the new bridge and maintain pedestrians on the existing bridge.

Phase II:

- Maintain traffic on the new bridge with pedestrians on the existing bridge.
- Partially demolish the East portion of the existing bridge.

Phase III:

- Maintain traffic on the new bridge with pedestrians on the existing bridge.
- Construct the remainder of the proposed bridge (Span 9 and Spans 18 and 19).
- Construct a circular pedestrian ramp on the island.

Phase IV:

- Maintain traffic on the new bridge and shift pedestrians to the new pedestrian bridge and ramps.
- Demolish the remainder of the existing bridge.

The vehicular traffic shift from the existing bridge to the new construction will occur outside of the hurricane season and during off-peak hours to allow for sufficient lane closure requirements.

4.3 Span Arrangement

Selecting an appropriate span arrangement is a key design issue for a new bridge. The location of the begin bridge, end bridge, gas station, and centerline of the channel influence many of the decisions related to span arrangement. The begin bridge is at Sta. 111+61.75. The end bridge is at

Sta. 140+80.50, which is directly west of West Broadview Drive. This will still allow access to West Broadview Drive. Per FDM Table 260.6.1, the minimum vertical clearance for new bridges over roadways is 16.5 feet. Per FDM Table 215.2.2, the minimum required horizontal offset from a pier to the edge of the travel lane for a curbed roadway is 16 feet where the design speed is less than or equal to 45 mph. In order to satisfy these requirements, Span 1 must have FIB-36 beams and Pier 2 is located so that it is short enough to use FIB-36 beams as well as long enough to provide enough horizontal clearance around the U-turn access road. Pier 5's location is governed by the placement of the crash cushion for the exit ramp which handles cars traveling westward wanting to exit the Broad Causeway Bridge for the gas station. Pier 6 is located at the kink point of the exit ramp. Pier 7 and Pier 8 are located to provide enough clearance between the girder and the rooftop barrier on the gas station as well as having footings placed 25'-0" from the gas station so that there are no construction disturbances to the gas facilities. Pier 9 is placed to avoid any potential conflict with the existing seawall tie-back. The centerline of the existing channel is at Sta. 129+01.27 and 90 feet of clearance is provided between the inside faces of the proposed fender system. Per SDG 3.14.2.B, a minimum offset of 10 feet is required between the back of the fender system to the near face of the footing. Channelside Pier 12 and Pier 13 are located accordingly. The end bridge abutment is placed to minimize potential conflicts with the existing seawall tiebacks.

The span arrangement that was developed satisfies the criteria presented above. The 19-span arrangement is summarized below. The main channel unit will satisfy the requirements of SDG 2.11.7.B since the channel pier strength requirements are greater than 1500 kips. The total bridge length is 2918'-9".

Table 4-1 – Preferred Span Arrangement

Span Length (ft)	Span Number	Stationing	Pier Number
		111+61.75	Begin Bridge
94.75	Span 1		
		112+56.50	Pier 2
141.17	Span 2		
		113+97.67	Pier 3
141.17	Span 3		
		115+38.83	Pier 4
106.17	Span 4		
		116+45.00	Pier 5
165.00	Span 5		
		118+10.00	Pier 6
169.00	Span 6		
		119+79.00	Pier 7
225.00	Span 7		
		122+04.00	Pier 8
146.00	Span 8		
		123+50.00	Pier 9
170.75	Span 9		
		125+20.75	Pier 10
170.75	Span 10		
		126+91.50	Pier 11
138.00	Span 11		
		128+29.50	Pier 12
143.00	Span 12	129+01.27	Channel CL
		129+72.50	Pier 13
139.00	Span 13		

		131+11.50	*Pier 14*
169.00	*Span 14*		
		132+80.50	*Pier 15*
165.00	*Span 15*		
		134+45.50	*Pier 16*
170.00	*Span 16*		
		136+15.50	*Pier 17*
170.00	*Span 17*		
		137+85.50	*Pier 18*
160.00	*Span 18*		
		139+45.50	*Pier 19*
135.00	*Span 19*		
		140+80.50	*End Bridge*

The plan and elevation views for this arrangement is shown in Appendix N.

4.4 Superstructure Alternative

Per the Bridge Development Report scope, the only superstructure material considered was prestressed concrete. Transversely post-tensioned slabs were originally examined to reduce the profile grade; however, were eliminated due to their challenge to construct and long-term maintenance issues as well as having limited span lengths to around 110 feet over the channel. Spliced, precast U-beams (FUBs) were an eliminated option since SDG 4.8.1 requires a minimum section depth of 72". This could cause vertical clearance issues over the channel. Steel superstructure and segmental concrete alternatives were not initially evaluated because traditionally where Florida I-Beams can be used they are more cost effective than steel plate and box girders or segmental box girders. Further, the town was not presented with various superstructure material options. All renderings provided showed Florida I-Beams (FIBs) on the approach spans. All beam depths to be used must be compatible with the vertical clearance per the FDM Table 260.6.1. Ultimately, all spans of the superstructure will be Florida I-Beams except for Span 7 which will be steel girders to satisfy vertical and horizontal clearance requirements from the gas station.

The following superstructure alternatives were further evaluated:

- **Alternative 1a** provides a high-level fixed simple span FIBs superstructure. There is no separate pedestrian bridge required for this option while still being ADA compliant. There will be a pedestrian ramp with variable slopes that includes ramp runs and landings. The maximum vertical profile grade is 5.78% while providing 65 feet of clearance over the mean high-water level in the channel. The high-level fixed bridge alternative meets the purpose and need of the project. This was the most cost-effective alternative presented.
- **Alternative 1b** is a high-level fixed spliced girder option which includes haunched FIBs which entails a three span post-tensioned unit over the channel. This decreases the superstructure depth by approximately 20% when compared to Alternative 1a. No separate pedestrian bridge is needed for this option while still being ADA compliant. There will be a pedestrian ramp with variable slopes that includes ramp runs and landings. The maximum vertical profile grade is 5.62% while providing 65 feet of clearance over the mean high water in the channel. The cost has been estimated to 10% higher than alternative 1a while also taking longer to construct.

- **Alternative 1c** presents a high-level fixed spliced girder with haunched FIBs with a three span post-tensioned unit over the channel. This decreases the superstructure depth by approximately 20% when compared to Alternative 1a. There is a separate pedestrian bridge needed at the eastern end of the structure with slopes less than 5% but requires a switchback at the eastern end of the structure. The maximum vertical profile grade is 5.62% while providing 65 feet clearance over the mean high-water level in the channel. The cost has been estimated to 10% higher than alternative 1a while also taking longer to construct.
- **Alternative 2** is a mid-level movable structure with both traffic and pedestrians on the same structure while still meeting ADA requirements. A movable structure increases the superstructure depth by approximately 39% when compared to Alternative 1a. Also, due to today's standards on bascule structures, the typical section is wider since the span locks are housed within the bridge barriers for ease of maintenance as well as requiring a maintenance walkway on both the northern and southern side of the structure. There will be standard simply supported FIBs on the approach spans with a steel movable bridge over the channel. The maximum vertical profile grade is 4.15% while providing 40 feet of clearance over the mean high-water level in the channel. This height would allow approximately 70 to 80 percent of the waterway users that currently require the bridge to open to pass without an opening. This alternative meets the purpose and need to the project but would have a high impact of essential fish habitats (EFH), seagrasses, and sovereign submerged lands due to the wider bridge footprint. It also has the highest construction cost of all the alternatives.

Based on the analysis of the viable alternatives presented above along with the public input received during the Hybrid Alternatives Public Workshop held in September 2023, Alternative 1a was recommended as the preferred alternative. This alternative was unanimously approved by the Town of Bay Harbor Island Town Council in November 2023.

4.4.1 Prestressed Concrete

For the prestressed concrete superstructure alternatives, both FIBs and FUBs were initially considered as viable options. In an extremely aggressive environment, the maximum span length for FUBs is 157'-0". The preferred span arrangement has a maximum span length of 170'-9", excluding the steel Span 7. Since the maximum beam span length of FUBs are not as long as FIBs, only FIBs will be considered for the prestressed concrete alternative. The FDOT Beam Tables (Standard Index SPI 450-010) were initially used to determine the beam type and spacing and later checked using Bentley's LEAP Bridge Concrete software. The superstructure consists of precast prestressed concrete FIBs of varying size throughout the length of the bridge. The simple span prestressed beams must be made continuous for live load for the three-span unit above the main channel per SDG 2.11.7.B.3.

4.4.2 Steel

In order to reduce vibration effects from the installation of prestressed concrete piles nearby the existing gas station, Pier 7 and Pier 8 have been strategically placed. This arrangement causes Span 7 to extend for a total length of 225 feet.

Additional bridge geometry alternatives were considered, including inserting another pier along Span 7 to reduce the lengths of spans. However, due to the clearance between the footing and the existing gas station structure, this option was not feasible. As an alternative for Span 7, the use of Spliced FIBs with post-tensioning was considered. This method would require a three-span continuous unit with constant edge distances. However, the flaring layout of the spans prevents the continuous use of FIBs with post-tensioning.

The final placement of Pier 7 and Pier 8 results in a span length that exceeds any length indicated in the FDOT Beam Tables (Standard Index SPI 450-010) for an extremely aggressive environment. Therefore, steel girders have been determined as the solution to span over the gas station due to vertical and horizontal geometry constraints. It is crucial to understand that, with the selection of steel girders under these environmental conditions, corrosion provisions must be considered. These provisions should be in accordance with FDOT SDG 5.12 – Corrosion Protection. Since Span 7 is located within a 4-mile range of Biscayne Bay, Provision 1.3.2.E.2 from the SDG also applies to this bridge. Therefore, additional coordination with the State Materials Office is necessary to determine if the use of uncoated weathering steel can be considered

4.5 Substructure Alternatives

During alternatives meetings, 4 pier alternatives were presented. Based on coordination with the owner, an aesthetically enhanced multi-column pier with cheek walls and a waterline footing will be used on this project. These piers will be used for all superstructure alternatives. Cheek walls are anticipated on piers with varying girder depths between bearing lines. All piers have been designed for the loads mentioned in Section 3.3.5. Water piers are evaluated for vessel collision and piers within the continuous channel span will include full depth continuity diaphragms monolithic with the bridge deck (SDG 4.1.7.C.2). Pier 8 will be evaluated for the 600-kip vehicular collision force per LRFD requirements. Bentley's LEAP Bridge Concrete software (RC-Pier) was used to determine preliminary pier cap, column, footing sizes, and pile loads.

The pier footings will utilize the "stadium" style consistent with SDG 2.11.11-1 since waterline footings adjacent to approaching vessels must have rounded faces. Two-column, three-column, and four-column piers will be utilized. All proposed columns will be rectangular with 1½" chamfers and aesthetic rustication detailing along the column and pier cap. Independent to the number of columns, the pier cap is arched with added rustication and lighting. The arched pier cap heights vary from 6 feet between columns to a maximum of 21 feet over the columns for piers in the water and 12 feet over the columns for piers on land. The piers on either side of the main channel require continuity diaphragms to ensure that the simple span prestressed beams are continuous for live load. Three piers were analyzed by the design team which include a typical land pier, a typical water pier, and a channel side pier. All were designed per AASHTO LRFD and checked the Service III stress check per SDG 3.10. The proposed pier geometries can be seen in Appendix N.

Figure 4-2 Aesthetically Enhanced Pier Rendering

4.6 Foundation Alternatives

A range of foundation alternatives was initially evaluated for the bridge project. These options included shallow foundations, steel H-Piles or Pipe Piles, Augered Cast-in-Place Piles, Drilled Shafts, and Prestressed Concrete Driven Piles. For a comprehensive understanding of these options, the preliminary geotechnical report, located in Appendix F, provides an in-depth discussion on each of these alternatives, highlighting their respective limitations and suitability for the project.

4.6.1 Foundations Type Evaluation

For the Broad Causeway Bridge Replacement, Shallow Foundations, Prestressed Concrete Piles, and Drilled Shaft foundations have been evaluated as potential foundation alternatives. The use of shallow foundations as spread footings supported on geosynthetic reinforced soil (GRS) posed too many challenges such as differential settlement, potential wet utility conflicts, and construction obstacles. Therefore, this foundation alternative was not further evaluated. A preliminary design encompassing the prestressed concrete piles and drilled shafts alternatives has been completed for piers that could support the bridge. This analysis is detailed in Appendix M.

The foundation alternatives considered include:

- Alternative 1: 24-inch Square Precast Concrete Piles
- Alternative 2: 30-inch Square Precast Concrete Piles
- Alternative 3: 48-inch Drilled Shafts

- Alternative 4: 60-inch Drilled Shafts

The preliminary geotechnical results indicated that the maximum pile driving resistances for the 24-inch and 30-inch piles are 360 tons and 480 tons, respectively. The preliminary geotechnical data also reveals that the minimum capacity for drilled shafts is 600 tons. It is important to note that this data is based solely on land drilled shaft boring, as no water drilled shaft boring data is available. Given the complexity of implementing drilled shafts and considering the early stage of soil exploration, square precast concrete piles are currently the preferred alternative

4.7 Retaining Walls

4.7.1 Temporary Walls

Temporary sheet pile walls are anticipated to be required for the construction of some pier foundations. However, these walls should be evaluated in the future when roadway cross-sections become further developed.

4.7.2 Permanent Walls

MSE Wall around the proposed bridge ends are anticipated for this project. MSE walls are generally the most economical of all wall types when the area of the retaining wall is greater than 1,000 square feet and the walls are greater than 5 feet in retained height. The retaining walls used for this project will exceed 1,000 square feet and will be greater than 5 feet in retained height; therefore, the use of MSE walls will be the most cost-effective wall alternative. Based on the FDOT SDG Section 3.12.C.3.e, the FDOT Wall Type 2F will be required where the wall is within 50 feet of the seasonal high-water line (SHWL) shoreline with a chloride content greater than 2,000 ppm. Wall Type 2E can be used where the wall is greater than 50 feet from the SHWL shoreline. The wall layout is provided in Appendix N

4.7.3 Permanent Seawalls

It is anticipated that the replacement of the existing seawall on both the west and east sides of the causeway will occur. On the west side, an extension of the seawall limits will also be considered to accommodate the drainage requirements while protecting environmental concerns of the project. Due to the early stage of the project, additional investigation is required to establish an accurate condition of the existing seawall. It is anticipated that some sections of the proposed wall will require an anchorage system. For the top of the wall, a concrete cap is to be installed. Given the extremely aggressive environment at the project location, the use of FRP for reinforcement is required by FDOT SDG 3.12.C.4.B. A concept of the construction phase for the seawall is shown in Appendix O.

4.8 Precast Feasibility Assessment

Per FDM Section 121.9.1(9), a precast feasibility assessment is to be included in the Bridge Development Report. Precast elements will be utilized for this project; however, every element is not conducive for using a precast alternate for this bridge. Precast Florida-I Beams are used for the recommended alternative for this project as are square precast prestressed concrete piling. These two elements are standard precast elements on FDOT projects and can be supplied from multiple precast manufacturers.

Several other elements could be considered for precasting. They include precast pier elements, such as the pier cap, columns, and pier footings, and a precast bridge deck. The precast feasibility assessment questions from FDM 121.19.1 are shown in the below table. The answers to the questionnaire suggest that precast concrete elements should be considered for this project.

Table 4-2 – Precast Feasibility Assessment Questions

Assessment Question	Yes	No
1) Will precasting reduce traffic impacts		*X*
2) Is the bridge on the critical path of construction?	*X*	
3) Is the bridge on a hurricane evacuation route?	*X*	
4) Is precasting practical given the project aesthetics and considering lifting weights?		*X*
5) Is precasting practical given project variability	*X*	
6) Is the project large enough to benefit from economy of scale?	*X*	
7) Is there adequate R/W to provide near-site casting yard?		*X*
8) Is there access from off-site precast yards	*X*	
9) Can connection details be developed that are durable, easily inspected and allow for fit up?	*X*	
10) Does the bridge have adequate barge access?	*X*	

The responses to the questions in the precast feasibility assessment questionnaire were determined based upon the following considerations:

1) Although using precast elements will not reduce traffic impacts since the traffic will be maintained on the existing bridge during construction, the overall construction duration would potentially be reduced by using precast elements. The bridge construction is on the critical path.
2) SR 922 is identified as an evacuation route.
3) The use of precast elements other than Florida-I Beams and precast prestressed concrete piles would require a larger crane.
4) The proposed structure has uniform beam lengths along most of the bridge and the substructure and footing geometry is uniform. Some structural element dimensions may vary along the length of the bridge; however, the changes do not constitute a major modification to the typical of the project.
5) With a total bridge length of 2918'-9", the number of precast elements is large enough to benefit from economy of scale.
6) There is not adequate FDOT R/W to set up a precast yard locally. R/W being purchased for the project is limited to what is required to accommodate the project footprint. The PD&E did not contemplate acquiring additional R/W for purposes of setting up a precast yard.
7) There are off-site precast yards near the project. The precast yard can ship the precast elements via land or via water using a barge.
8) Connection details have been used on past projects and could be implemented on this project.
9) The quality of connection details has improved in recent years as more State DOT's begin using precast elements.
10) All water pier and superstructure construction can be performed from barges.

FDM 121.19.2 provides a tool that can be used in documenting the decision-making process for evaluation of precast construction versus conventional cast-in-place construction. However, this assessment will not be developed as there is no need to evaluate an accelerated construction for other structural elements.

5.0 Alternative Evaluation

5.1 Preliminary Estimated Construction Costs

Construction costs are recognized as an important criterion for selection. An appropriate method for preparing preliminary estimated construction costs is essential to the cost-benefit analysis performed for Alternative 1a. The unit prices of $240/sf in determining estimates of probable construction costs are based on the 2022 Atkins Report prepared for FDOT District 2.

Table 5-1 – Estimated Construction Cost

Description	Subtotal (USD)	Maintenance of Traffic (20%)	Mobilization (15%)	Inflation (20%)	Project Unknowns (15%)	Total (USD)
Alternative 1a	*127,020,663.83*	*25,404,132.77*	*22,863,719.49*	*40,316,358.70*	*26,293,277.41*	**241,898,152.19**
Alternative 2	*199,471,113.83*	*39,894,222.77*	*35,904,800.49*	*63,312,131.53*	*41,290,520.56*	**379,872,789.17**

5.2 Construction Time

The mid-level moveable alternative has a more complex construction sequence than the high-level fixed bridge alternative so it is anticipated that the construction duration would be the greatest due to the bascule structure. The high-level fixed bridge will have the shortest overall construction duration of the analyzed alternatives.

6.0 CONCLUSIONS AND RECOMMENDATION

Based on the criteria and methodology outlined in the Bridge Development Report, the recommended alternative is the high-level simple span with 24-inch square prestressed concrete piles.

The selected alternative includes:

- An overall bridge length of 2918 feet 9 inches, consisting of 19 spans as detailed in Appendix N.
- A superstructure comprising prestressed Florida I-Beams (FIBs) ranging from FIB-36 to FIB-84 throughout the project, except for Span 7, which consists of steel I-girders. All spans are supported by an 8.5-inch-thick cast-in-place concrete deck, as shown in Appendix N.
- A substructure consisting of standard end bents and aesthetically enhanced multi-column piers, founded on precast prestressed concrete piles.

The estimated construction cost is $**241,898,152.19.**

Appendices can be found on the Bay Harbor Islands Website at: Broad Causeway Bridge Replacement PD&E Study | Bay Harbor Islands, FL (bayharborislands-fl.gov)

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