DRAFT
NOISE TECHNICAL MEMORANDUM
Florida Department of Transportation
District 6
VENETIAN CAUSEWAY
(Venetian Way)
Project Development and Environment (PD&E) Study
from North Bayshore Drive to Purdy Avenue
Miami-Dade County, Florida
FM No. 422713-2-22-01
Efficient Transportation Decision Making (ETDM): 12756

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by FDOT pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated December 14, 2016 and executed by FHWA and FDOT.

December 14, 2018

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1.0 PROJECT SUMMARY

The Florida Department of Transportation (FDOT) District Six has conducted a Project Development & Environment (PD&E) Study to address identified structural and functional deficiencies of the 12 existing bridges that comprise the Venetian Causeway, which is owned by Miami-Dade County (County). Potential build alternatives included replacement or rehabilitation of the bridges. The limits of this PD&E Study extend along the Venetian Causeway from North Bayshore Drive in the City of Miami to Purdy Avenue in the City of Miami Beach, a distance of approximately 2.5 miles.

The purpose of this Noise Technical Memorandum is to present the findings of an assessment of traffic noise for the proposed project. This assessment was conducted in accordance with 23 *Code of Federal Regulations* (CFR) 772 and Chapter 18 *Noise* of Part 2 of the FDOT PD&E Manual (dated June 14, 2017).

1.1 Project Background

The Venetian Causeway is classified as an urban minor arterial road in Miami-Dade County, and is a significant transportation route connecting the City of Miami with the City of Miami Beach in Miami-Dade County, Florida. The current Causeway follows the original route of the Collins Bridge, a wooden structure built in 1913. The bridges along the causeway were originally built in 1926 with an anticipated design life of 50 years.

Between 1996 and 1999, the twelve causeway bridges underwent major rehabilitation that included the concrete arched beams, decks, foundations and the full replacement of all sidewalks and railings. The rehabilitation and repairs to the concrete elements were anticipated to last for ten years. As part of the rehabilitation, the east bascule bridge (Bridge 10) movable span and machinery was replaced. Spans 17 through 41 of the west bascule bridge (Bridge 1), including the bascule span, were replaced with a higher profile and wider channel to accommodate navigational traffic.

As a result of the continued deterioration of the bridges, in 2004 the FDOT authorized Miami-Dade County to post load restrictions on the bridges. Between 2009 and 2011, the County conducted another major rehabilitation project to repair the causeway's bridges. The scope of work for this rehabilitation included major repairs to the bridge support beams, diaphragms, deck undersides, and support piers. In 2011 FDOT in partnership with Miami-Dade County initiated the PD&E Study. Between 2015 and 2016 the Venetian Causeway underwent an Emergency Repair to replace the remaining original spans of Bridge 1 (spans 1 to 16). The bridges are continuously being repaired to maintain them operational.

The deteriorated condition of the bridges, deck geometry, and load carrying capacity of the bridges, affects the ability of the bridges to adequately serve traffic demand; as such, Bridges 2 thru 12 have been classified as functionally obsolete. Bridge 1 has been replaced in phases and is not considered to be functionally obsolete.

Due to the accelerated state of deterioration, inspection dates were increased from biennial inspections (every other year) required by Federal Highway Administration (FHWA) to biannual inspections (every 6 months).

1.2 Project Description

The Venetian Causeway is approximately 2.5 miles long and is primarily a two-lane undivided facility that provides a major link between the City of Miami and the City of Miami Beach in Miami-Dade County, Florida. The causeway includes ten fixed span bridges and two bascule leaf span bridges over the Intracoastal Waterway (bridge numbers 874459, 874460, 874461, 874463, 874465, 874466, 874471, 874472, 874473, 874474, 874477, and 874481) extending from North Bayshore Drive (City of Miami) to Purdy Avenue (City of Miami Beach). The purpose of the proposed project is to address identified structural and functional deficiencies of the twelve existing bridges through potential alternatives such as replacement or rehabilitation.

The bridges were originally built in 1926 and have been designated as historic landmarks by the City of Miami and City of Miami Beach; they are also listed on the National Register of Historic Places (NRHP). The project will take this historic designation into consideration and ensure that any decisions on improvements are coordinated through the County and a Task Force of representatives that reflect the local, state and federal interests of historic preservation. Given the historicity of the bridge, rehabilitation options will also be explored as part of the potential alternatives during the PD&E study.

The causeway bridges are mainly short span reinforced concrete arch beam bridges. Each bridge section consists of two 12-foot travel lanes with 4-foot bike lanes and 4-foot sidewalks on each side. In 1996, the bridges underwent a major rehabilitation consisting of gunite repairs to the superstructure arch beams and full replacement of all sidewalks and railings. The western bascule bridge (Bridge 1) and its spans 17 through 41 were also replaced. Presently, the bridges exhibit severe deterioration because of their proximity to the very aggressive marine environment. Due to new design codes, these bridges do not meet current design and safety requirements.

The corridor is tolled, and is owned and operated by Miami-Dade County. A Project Location Map is included as **Figure 1-1.**

1.3 Purpose and Need

The purpose of the proposed project is to address identified structural and functional deficiencies of the twelve existing bridges (ten low-level fixed spans and two movable bascules) through potential alternatives such as replacement or rehabilitation. The improvements are anticipated to meet the following identified needs:

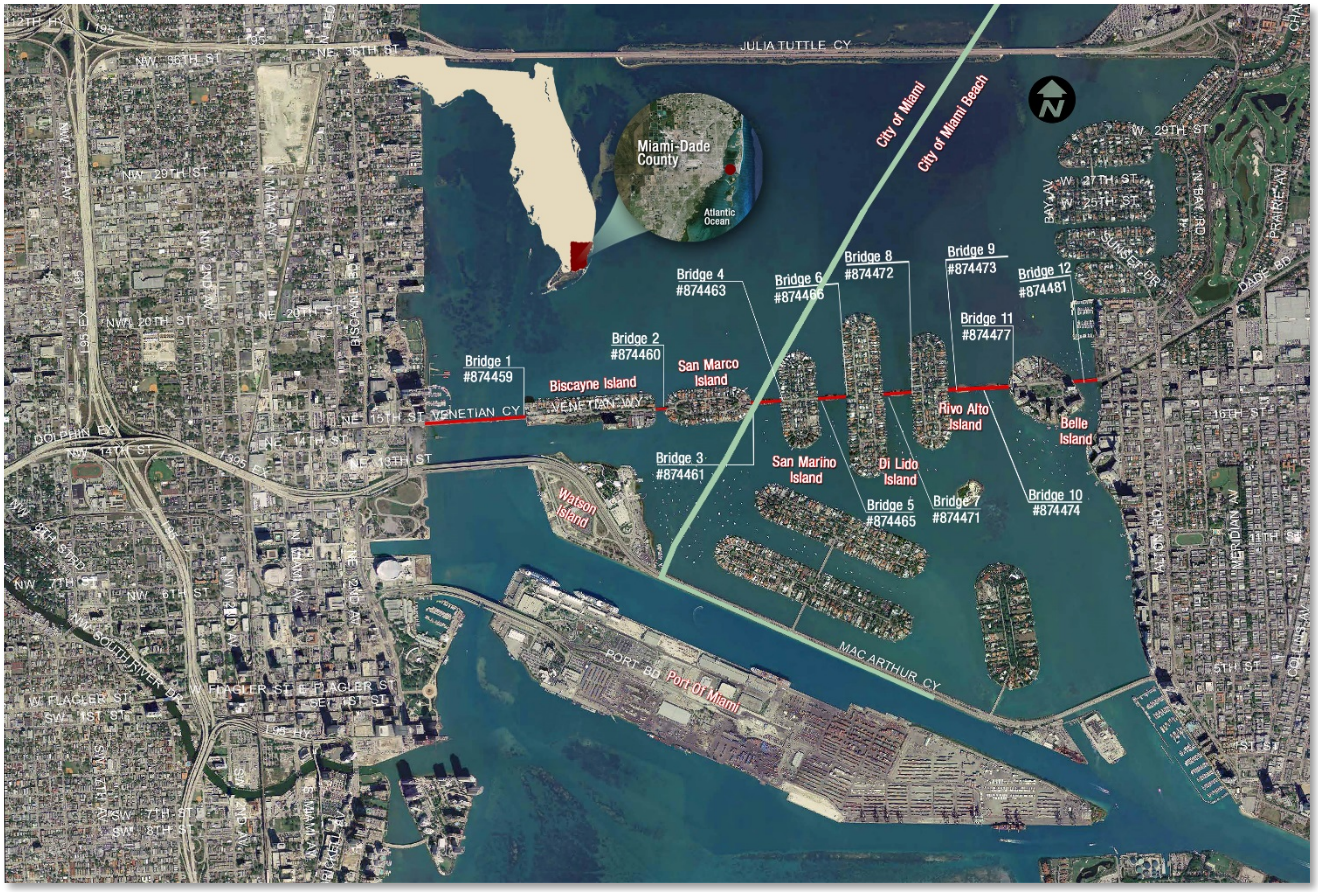


Figure 1-1 Project Location Map

1.3.1 Structural and Functional Deficiencies

The Venetian Causeway is classified as an urban minor arterial in Miami-Dade County and is a significant transportation route connecting the City of Miami with the City of Miami Beach. The bridges along the Venetian Causeway were originally built in 1926 with an anticipated design life of 50 years. The bridges have exceeded their design life by over 30 years and, in some cases, have been classified as functionally obsolete. A bridge is considered functionally obsolete if it has deck geometry, load carrying capacity, clearance or approach roadway alignment that no longer meet criteria for the system which the bridge is a part. Functionally obsolete bridges do not have adequate lane widths, shoulder widths or vertical clearances to serve the traffic demand, or may occasionally flood. Due to the accelerated state of deterioration, inspection dates were increased from the biennial minimum required by FHWA to biannual inspections. Bridge Inspection Reports (conducted in October 2018) yielded sufficiency ratings between 27.4 and 67.6 on a scale of 100.0 for the various bridges. According to the FHWA policy, bridges with a sufficiency rating of less than 50 are eligible for replacement. The sufficiency rating of each bridge is shown in **Table 1-1.**

The superstructure of each of these bridges displays advanced corrosion with section loss of several members that is significant enough to warrant supplemental supports and/or load restrictions. The bridge inspection reports also cite:

- Under-deck cracks,
- Failure of compression joints,
- Delamination and cracks on pier walls and abutments,
- Corrosion and section loss of substructure members,
- Major deficiencies in the bridge tender's facility,
- Major deck pavement deterioration,
- Substandard signing,
- Pavement marking and signalization, and
- Major Americans with Disabilities Act (ADA) deficiencies on both sidewalks along the bridges.

Once initiated, corrosion cannot be remedied and sufficiency ratings are only expected to decrease further over time.

Table 1-1 Venetian Causeway Bridge Inventory Ratings

Bridge No.	FDOT Bridge No.	2018 Sufficiency Rating	Deficiency
1	874459	67.6	
2	874460	50.0	Functionally Obsolete
3	874461	38.9	Functionally Obsolete
4	874463	38.9	Functionally Obsolete
5	874465	38.9	Functionally Obsolete
6	874466	40.1	Functionally Obsolete
7	874471	37.6	Functionally Obsolete
8	874472	23.6	Functionally Obsolete
9	874473	27.4	Functionally Obsolete
10	874474	32.2	Functionally Obsolete
11	874477	34.3	Functionally Obsolete
12	874481	34.7	Functionally Obsolete

1.3.2 Transportation Plan Consistency

The Venetian Causeway Bridge project is identified in the Miami-Dade Metropolitan Planning Organizations 2040 Long Range Transportation Plan (LRTP) as a Priority I Priority II project. In other words, the Planning and Design phases for this project will be funded in 2015-2020 (Priority I), and the Construction phase will be funded in 2021-2025 (Priority II). The project, described as a bridge replacement, is also shown on Table 6-7, Safety Projects of the LRTP. Additionally, the Adopted 2012-2016 FDOT Five-Year Work Program shows the Venetian Causeway Bridge project with funding in the amount of $1,770,000 for the PD&E/EMO Study in FY 2012.

1.3.3 Modal Interrelationships

Sidewalks and bicycle lanes exist on both sides of the Venetian Causeway along the entire corridor. Both the City of Miami and the City of Miami Beach Bicycle Master Plans identify Venetian Causeway as a significant bicycle corridor as it serves as one of the County's most well-traveled recreational and commuter bicycle routes. Pedestrian facilities will additionally be studied for opportunities to enhance safety and connectivity. Pedestrian and bicycle mobility is anticipated to be improved as a result of this project.

It should be noted that a Miami-Dade Transit bus route also operates along the causeway corridor, Route 101, Route A. This route connects the Omni Metromover/Bus Terminal adjacent to the Performing Arts Center to Lincoln Road in South Beach. Bus operation will be maintained on the corridor.

1.3.4 Emergency Evacuation

The Venetian Causeway not only serves west/east travel between the City of Miami and the City of Miami Beach, but it also serves regional travel as it is one of only two routes leading from south Miami Beach that provides hurricane evacuation capabilities.

1.4 Alternatives Considered

Alternatives evaluated during the PD&E Study include the No-Action Alternative, the Transportation Systems Management, and Operations (TSM&O) alternative, and two build alternatives as described below. Alternatives were developed and evaluated based on the ability to meet the project needs. The No-Action Alternatives will remain viable until after the Public Hearing. For additional information relating to the Alternatives Analysis, please see the Preliminary Engineering Report (PER) on file at the District.

1.4.1 No-Action Alternative

The No-Action Alternative maintains the existing bridges and roadway approaches in their current condition. No improvements would be made on the structures, except for routine maintenance. This alternative is used as a basis to evaluate the other project alternatives.

As a result of the bridge inspections dated October 26, 2017 through January 17, 2018, all the bridges in the causeway were classified as "functionally obsolete". Sufficiency ratings for bridges 2-12 are all at 50 or below out of a possible 100 based on the FHWA Sufficiency Rating Evaluation. According to the FHWA policy, bridges with a sufficiency rating of less than 50 are eligible for replacement.

The No-Action Alternative includes only routine maintenance performed as needed to keep the bridges open to traffic until safety issues, such as reduced capacity due to ongoing deterioration, would require them to be closed. Repair or replacement could be considered at a later date. This alternative does not include modification or improvements to the existing bridges or approach roadway. Existing geometric features and other deficiencies, including substandard lane width and curbs would remain. No changes to the existing horizontal and vertical navigational clearances would occur. The routine maintenance that would be performed on the structures would include:

- Spall repairs;
- Structural steel cleaning and painting;
- Steel repairs; and
- Mechanical and Electrical maintenance repairs.

The bridges are vulnerable to coastal storms and are below the 100-year Peak Storm Surge elevation of 11.6 feet NAVD88. Storm surge heights range from 7.7 feet (FEMA) to 11.6 feet for the 100-year storm. Wave crest is storm surge plus 70% of the maximum wave height. The Causeway fixed bridges would be inundated in the 100-year storm event. The bridges are also scour susceptible. The 100-year base flood event is predicted to result in scour to an elevation (-)20.9 feet, which is below average existing pile tip elevation of (-)19.0 feet. This would result in bridge failure.

The No-Action Alternative would preserve the historic character of the Venetian Causeway, and does not appear to be an adverse effect to the significant resources under Section 106. There are also no impacts to noise and air quality and no potential for contamination involvement with the no-action alternative. However, the alternative was deemed to be neither feasible nor prudent as it does not correct the bridges' structural and functional deficiencies. In addition, the lack of appropriate treatment of stormwater runoff will continue to degrade the natural habitat of Biscayne Bay. Over time, continued deterioration of structural elements will pose safety hazards to the public or place intolerable restrictions on travel.

1.4.2 Transportation Systems Management & Operations (TSM&O)

The objective of Transportation Systems Management & Operations (TSM&O) multi-modal improvements is to identify strategies that reduce existing traffic congestion and prevent its occurrence in areas that are currently not congested. These strategies are designed to modify travel behavior and increase system efficiency without costly infrastructure improvements. TSM&O strategies are implemented when one or more of the following occurs:

- Insufficient funds available to meet system improvement needs;
- Increased construction costs for new roadways and transit facilities;
- Increased need to improve operational efficiency; or
- Changes in travel patterns.

TSM&O options generally include traffic signal and intersection improvements, access management and transit improvements. The TSM&O Alternative includes those types of activities designed to maximize the utilization and efficiency of the present system. The alternative components that were considered include the following:

- Traffic signal optimization;
- Traffic operational improvements to include signing and pavement marking improvements;
- Enhanced bus service;
- Facilitated pedestrian and bicyclist measures; and
- Limited repairs on the existing bridges to improve operation.

Similar to the No-Action Alternative, the TSM&O Alternative would preserve the historic character of the bridges and does not appear to be an adverse effect to the significant resources under Section 106, but maintains the existing bridges in their current condition. There are no impacts to noise and air quality and no potential for contamination involvement. The alternative provides some transportation operation improvements on the corridor, but was deemed to be neither feasible nor prudent as it does not correct the bridges' structural and functional deficiencies. In addition, the lack of appropriate treatment of stormwater runoff will continue to degrade the natural habitat of Biscayne Bay. Over time, continued deterioration of structural elements will pose safety hazards to the public or place restrictions on travel.

1.4.3 Build Alternative - Rehabilitation

Stormwater Management System

Existing stormwater management systems in the residential islands and proposed systems on the spoil islands will be utilized to collect runoff from the bridges since scuppers will be eliminated with the replacement of the existing bridge deck. These systems will provide water quality and attenuation. The stormwater management approach will be coordinated through pre-application meetings with DERM, the local-environmental agency, and SFWMD, the regional water management district as well as the maintaining agencies, such as the City of Miami and the City of Miami Beach.

For Bridge 12, half of the stormwater runoff will drain toward the City of Miami Beach's stormwater management system along Dade Boulevard and Sunset Harbour Drive. Dade boulevard has completed reconstruction and the proposed stormwater management approach will be coordinated with the City of Miami Beach to ensure there is sufficient capacity to handle the stormwater runoff.

Rehabilitation Alternative 4: Fixed Bridge Rehabilitation with Beam Strengthening

Rehabilitation Alternative 4 would correct physical and design criteria deficiencies of the existing bridges to extend their service life. Considering the historical significance of the existing causeway, all efforts were made to protect and preserve the bridges as a historic resource. This rehabilitation alternative includes deck replacement, beam strengthening and foundation strengthening. This alternative was developed in order to maintain the existing bridges in their location without major changes, and to extend service life by 25 years.

This alternative achieves the established rehabilitation criteria and includes the following:

- Replace the existing 6.5-inch deck with a new higher strength concrete 8.5-inch deck;
- Strengthen the existing foundations by installing new drilled shafts (Figures 1-2 and 1-3);
- Foundations designed to resist wave force vulnerability;

- Encase existing and new footings to strengthen the foundations;
- Repair concrete spalls and cracks in the beams and diaphragms;
- Repair jacketed piles;
- Strengthen interior beams by widening by 8-inches on both sides and strengthening exterior beams by widening by 8-inches on the inside face.
- Strengthened beams, cast-in-place deck and strengthened foundation would provide adequate resistance to meet current FDOT/AASHTO live load requirements.
- Strengthened foundation to meet the standards for scour resistance, wave force resistance (classified as Extremely Critical) and vessel impact resistance (classified as Critical). Refer to the Bridge Hydraulics/ Design Scour Report dated May 27, 2016.
- Cathodic protection impressed current system for the beams and diaphragms. Refer to Conceptual Cathodic Protection Design for Bridge Superstructure and Substructure Components dated June 15, 2015.
- Bridges would be closed one at a time during construction, and detours would be provided.
- Utility services would be maintained on the bridge during its construction time.

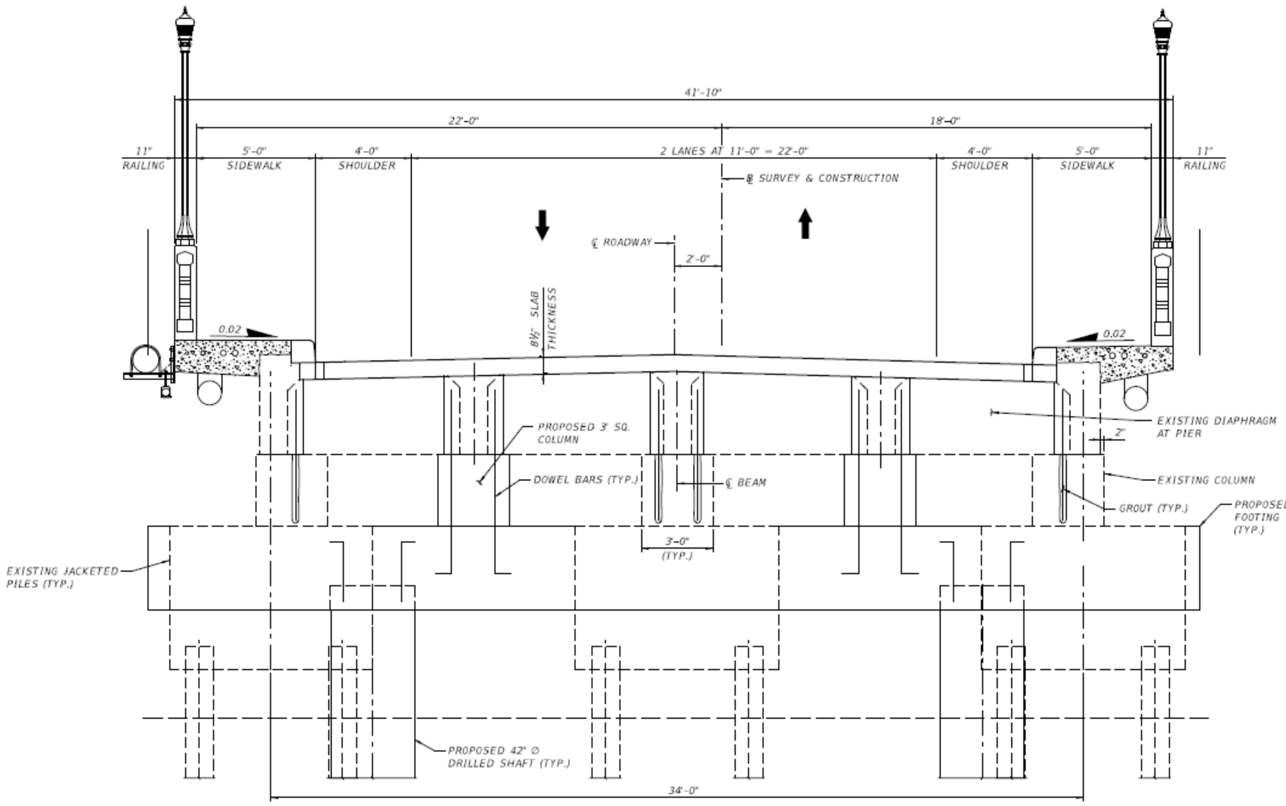


Figure 1-2 Rehabilitation Alternative 4: Beam and Foundation Strengthening Concept

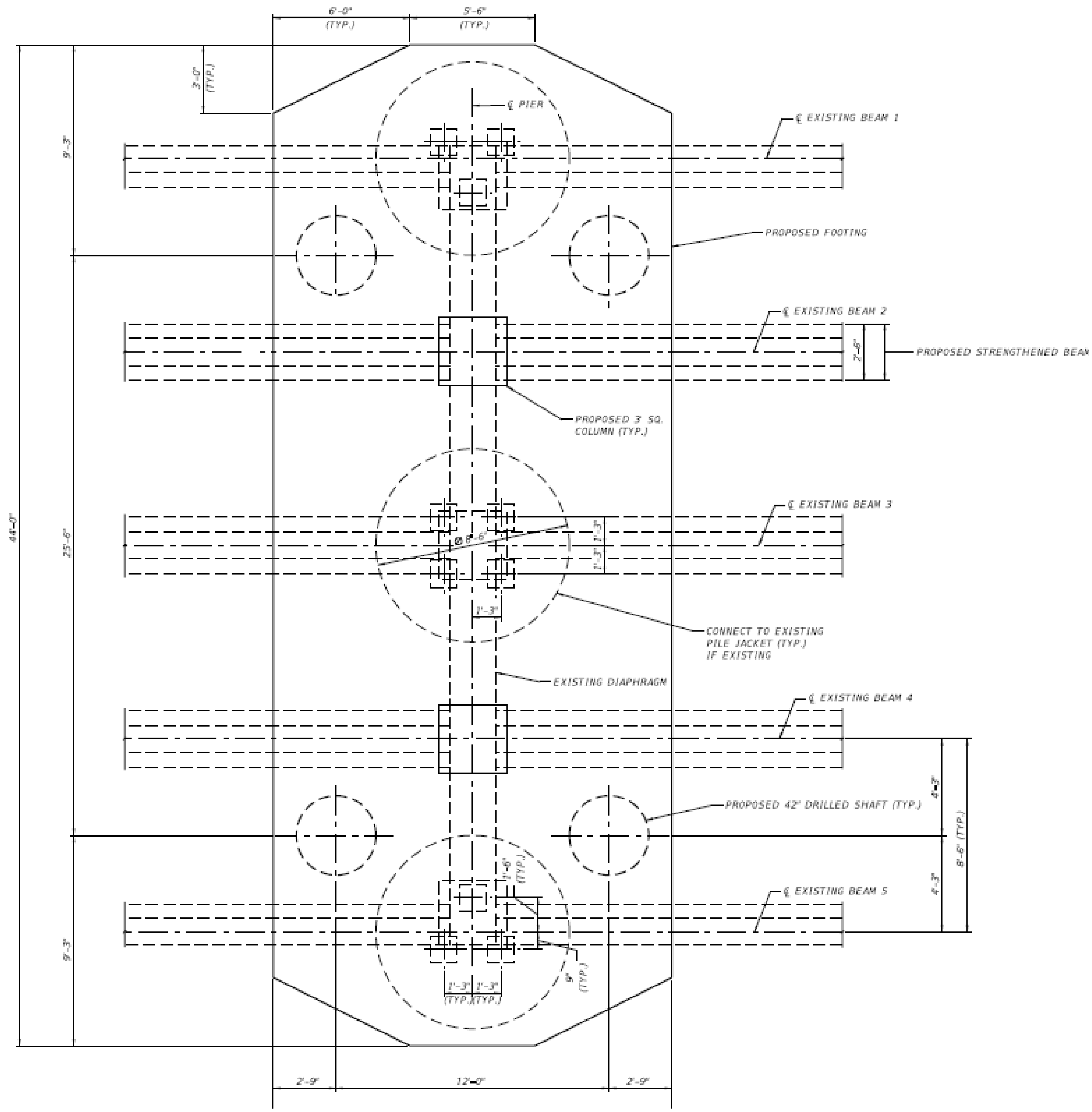


Figure 1-3 Rehabilitation Drilled Shaft Foundation Strengthening

Estimated ROW Acquisition: None

Anticipated Cost: $43 Million

Rehabilitation Alternative M1: Bascule Bridge Rehabilitation

The rehabilitation of the movable span bridge 10 includes modifications to the existing bridge to improve safety aspects and eliminate structural, mechanical and electrical deficiencies. The rehabilitation would be designed to extend the life of the bridge for a minimum of 25 years with routine maintenance and periodic repairs. This rehabilitation alternative would not include changes in the horizontal or vertical clearance. The bridge would not be widened; therefore, the existing sidewalks and lane configurations would remain the same.

The following scope of work is recommended for the Rehabilitation Alternatives:

Bridge 1 (West Bascule – 874459)

The easternmost spans of this bridge were partially replaced in 1999 and then the westernmost spans were replaced in 2016 in the Emergency Repair Project. As such, the bridge is in good condition. The following repairs should only be considered as part of any future rehabilitation to extend the life of the bridge. These costs were not included in the cost estimates for the project.

Structural:

- Recondition Bascule Span Superstructure (Reduce Maintenance):
    - Replace Steel Coating System
        - Use Metalized Primer for Enhanced Corrosion Resistance
    - Replace Bolts
        - Use Mechanically Galvanized Structural Bolts for Enhanced Corrosion Resistance
        - Use Stainless Steel (Type 316) Fasteners for Miscellaneous Components
- Modify Bascule Span Superstructure (Improve Functionality/Maintenance):
    - Replace Sidewalk Plates and Install New Curb Assembly (5-foot Wide Sidewalk)
    - Install Machinery Room Access Platforms
    - Modify Bridge Railing to Accept Railing Mounted Span Locks
- Repair Bascule Pier Concrete (Extend Concrete Service Life):
    - Clean and Seal Cracks
    - Replace Class 5 Applied Finish Coating
- Recondition Fender System (Reduce Maintenance):
    - Replace Timber Components with Plastic Marine Lumber
    - Replace Hardware with Stainless Steel (Type 316) Hardware
    - Replace Access Ladders and Cages

Mechanical:

- Recondition Hydraulic Cylinder Drive System (Improve Reliability/Reduce Maintenance):
    - Recondition Hydraulic Cylinders
        - New Seals, Rod Bearings
        - Clean and Polish Rods
        - Replace Lubrication Fittings
        - Flush and Clean Clevis Assemblies
        - Replace Flexible Hosing and Fittings
        - Recondition Hydraulic Power Units
        - Replace Motors and Pumps

            - Replace Seals
            - Replace Valves
            - Replace Electronic Controls
            - Replace Flexible Hosing and Fittings
            - Replace Fluid, Clean and Flush System
    - Recondition Trunnion Assemblies
        - Clean and Polish Journal Surfaces
        - Replace Lubrication Ports, Flush and Clean bearings
    - Properly Balance Spans
    - Adjust Live Load Shoes
        - Replace Shims and Hardware
    - Replace Span Lock Assemblies
        - Mount in Modified Bridge Railings with Access from Sidewalks

Electrical:

- Replace Electrical Power Distribution System (Improve Reliability/Reduce Maintenance):
    - New Conduit, Wiring, Junction Boxes, Receptacles, Pier Lighting
        - Use Improved Materials for Enhanced Corrosion Resistance
    - Recondition Motor Control Center
    - New Service Entrance
    - Recondition Standby Generator and Automatic Transfer Switch
    - New Grounding and Surge Suppression System
    - New Submarine Cable Installed in Permanent Duct
- Replace Electrical Control System (Improve Reliability/Reduce Maintenance):
    - Recondition Control Desk, Control Panels, Relays/PLC
    - New Limit Switches
- Replace Navigation Lighting (Improve Reliability/Reduce Maintenance)
- Replace Warning Gates and Signals (Improve Reliability/Reduce Maintenance)

Architectural:

- Renovate Control House
    - Replace Windows and Doors
    - Install Closed Circuit Television (CCTV) Camera System
    - Clean and Paint Interior
    - Replace Flooring

Bridge 10 (East Bascule – 874474)

This bridge was completely rehabilitated in 1999 to include new electrical and mechanical systems as well as new bascule leaves. In 2016, there was also a structural, mechanical, and electrical rehabilitation to improve existing conditions. This rehabilitation would extend the life of the bridge by 25 years.

Structural:

- Recondition Bascule Span Superstructure (Reduce Maintenance):
    - Replace Bolts. Use Mechanically Galvanized Structural Bolts for Enhanced Corrosion Resistance
    - Use Stainless Steel (Type 316) Fasteners for Miscellaneous Components
- Modify Bascule Span Superstructure (Improve Functionality/Maintenance):
    - Replace Sidewalk Plates and Install New Curb Assembly (5-foot Wide Sidewalk)
    - Install Machinery Room Access Platforms
- Repair Bascule Pier Concrete (Extend Concrete Service Life):
    - Remove Surface Concrete to Depth of Reinforcing
        - Removes Unsound and Contaminated Material
    - Supplement Deteriorated Reinforcing Steel (as Required)
    - Install Cathodic Protection System
    - Use Corrosion Resistant concrete
    - Replace Class 5 Applied Finish Coating
- Strengthen Bascule Pier Foundations (Resist Wave Loading):
    - Remove Bascule Pier Deck and Deck Joints between Curbs
    - Remove Live Load Support Beams and Concrete Brackets
    - Temporarily Remove Bascule Leaves
        - Float-out on Barges
    - Install Drilled Shafts or Driven Concrete Piles between Footings
    - Install Steel Sheet Pile Cofferdam with Tremie Concrete Seal and Dewater
        - Facilitates Construction in the Dry
    - Install Reinforcing Steel and Anchor to Pier Footings
    - Form and Pour Concrete Strut between Pier Footings
    - Cut-off or Remove Steel Sheet Piles
- Construct Counterweight Enclosure (Prevent Submersion of Counterweight/Improve Protection)
    - Construct Precast Enclosure Slab/Walls
    - Install Precast between Pier Columns and Seal with Supplemental Forms
    - Install Tremie Concrete Seal and Dewater
        - Facilitates Construction in the Dry
    - Install Reinforcing Steel and Anchor to Pier Columns, Beams and Diaphragms
    - Form and Pour Concrete Slab and Walls
    - Reinstall Bascule Leaves
        - Float-in on Barges
    - Reconstruct Live Load Shoe Support Beams and Concrete Bracket
- Reconstruct Bascule Pier Deck between Curbs
- Install Galvanized Steel Screen and Gate along Front Wall (Prevent Unauthorized Access)
- Recondition Fender System (Reduce Maintenance):
    - Replace Timber Components with Plastic Marine Lumber
    - Replace Hardware with Stainless Steel (Type 316) Hardware
    - Replace Access Ladders

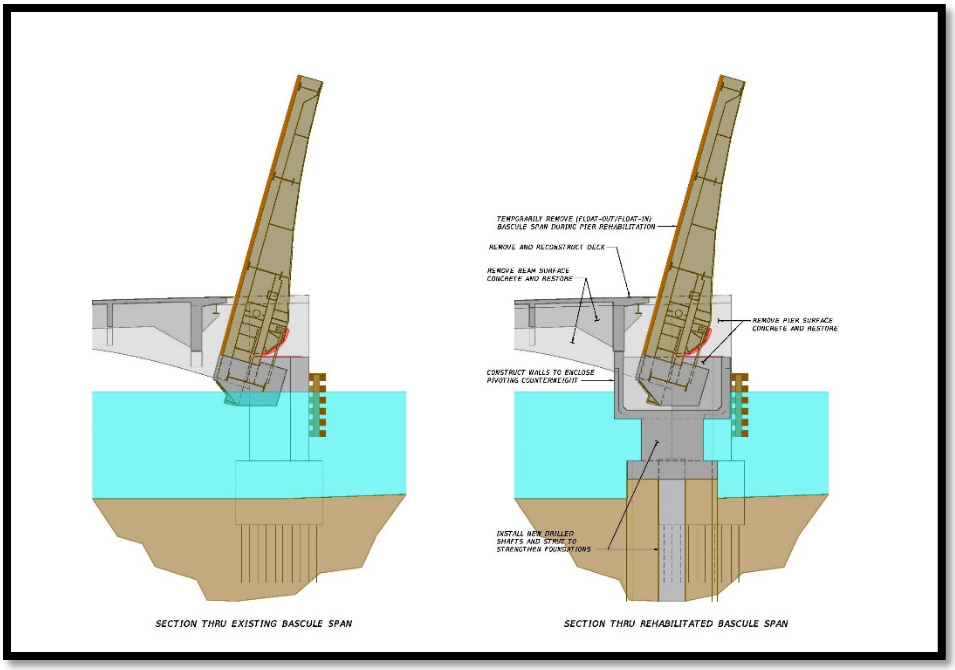


Figure 1-4 Bridge 10 Bascule Leaf Rehabilitation Concept

Mechanical:

- Recondition Drive Train (Improve Reliability/Reduce Maintenance):
    - Replace Steel Coating System
        - Use Metalized Primer for Enhanced Corrosion Resistance
    - Recondition Gear Boxes
        - Replace Gaskets, Breathers, and Sight Glasses
    - Recondition Bearings
        - Clean and Polish Surfaces
        - Replace Lubrication Ports, Flush and Clean

Electrical:

- Replace Electrical Power Distribution System (Improve Reliability and Reduce Maintenance):
    - New Conduit, Wiring, Junction Boxes, Receptacles, Pier Lighting
        - Use Improved Materials for Enhanced Corrosion Resistance
    - New Motor Control Center
    - New Service Entrance
    - New Standby Generator and Automatic Transfer Switch
    - New Grounding and Surge Suppression System
    - New Submarine Cable Installed in Permanent Duct
- Replace Navigation Lighting (Improve Reliability/Reduce Maintenance)
- Replace Warning Gates and Signals (Improve Reliability/Reduce Maintenance)

Architectural:

- Renovate Control House
  - Replace Windows and Doors
  - Install CCTV Camera System
  - Clean and Paint Interior
  - Replace Flooring

Anticipated Cost: $9 Million

1.4.4 Build Alternative - Replacement

Stormwater Management System

Similar to the rehabilitation approach, the existing stormwater management systems in the residential islands and proposed systems on the spoil islands will be utilized to collect runoff from the bridges since scuppers will be eliminated. These systems will provide water quality and attenuation. The stormwater management approach will be coordinated through pre-application meetings with DERM, the local environmental agency, and SFWMD, the regional water management district as well as the maintaining agencies, such as the City of Miami and the City of Miami Beach.

For Bridge 12, half of the stormwater runoff will drain toward the City of Miami Beach's stormwater management system along Dade Boulevard and Sunset Harbour Drive. Dade Boulevard has completed reconstruction and the proposed stormwater management approach will be coordinated with the City of Miami Beach to ensure there is sufficient capacity to handle the stormwater runoff.

Replacement Alternative T1: Venetian Railing

Bridge railings are required for the protection of traffic and pedestrians from drop offs and other obstacles and must function to contain and redirect errant vehicles using the structure. Bridge railings are designed to satisfy requirements provided by AASHTO's Guide Specification for Bridge Railings. AASHTO requires railings to have performance characteristics based on a number of factors such as: roadway classification, design speed, average daily traffic, percentage of truck traffic, alignments and bridge conditions.

The T1 alternative maintains the existing Venetian Railing at the coping, and maintains the historical character of the causeway (Figure 1-5). The existing Venetian Railing is different from the original Venetian Railing. During the 1996 to 1999 Rehabilitation Project, the original railings were replaced with heavier railings designed for vehicular impact consistent with the AASHTO requirements at the time, but not the geometric requirements. The provision of a curbed sidewalk in front of the railing was introduced on both sides of the bridge to mitigate for any geometric deficiencies. The existing Venetian Railing was also used in the 2016 Emergency Repair Project for Bridge 1. The existing Venetian Railing maintains the historic appearance of the causeway. The railing will not comply with all the geometric requirements of AASHTO's Guide Specification for Bridge Railings, so a variation or exception will be required.

Figure 1-5 Replacement Alternative T1: Typical Section

Replacement Alternative 7: Arched Beams

The Arched Beam superstructure replacement alternative supports the required AASHTO HL-93 load. The HL-93 truck consists of a “design truck plus design lane load” or “design tandem plus design lane load”, whichever is the worst case. The design truck is a 3-axel HS20 truck with weight limit of 36 tons, the design tandem is a military truck with twin axles of 12.5 tons each, and the design lane load consists of a 9.3KN/m uniformly distributed in the longitudinal direction. The structural system mimics the dimensions and appearance of the original structure. The superstructure consists of variable depth arched beams. The variable depth beams are approximately 2 feet deep at midspan and 4 feet deep at beam ends (See Figure 1-6).

Figure 1-6 Replacement Alternative 7: Arched Beam Elevation View

The proposed approach span bridge section would be increased 16 feet from the existing 41-foot 10-inch wide section. The 57-foot 10-inch-wide bridge section includes two 8-foot sidewalks, two 1-foot 6-inch shoulders, two 7-foot buffered bicycle lanes and two 11-foot travel lanes (See Figure 1-7).

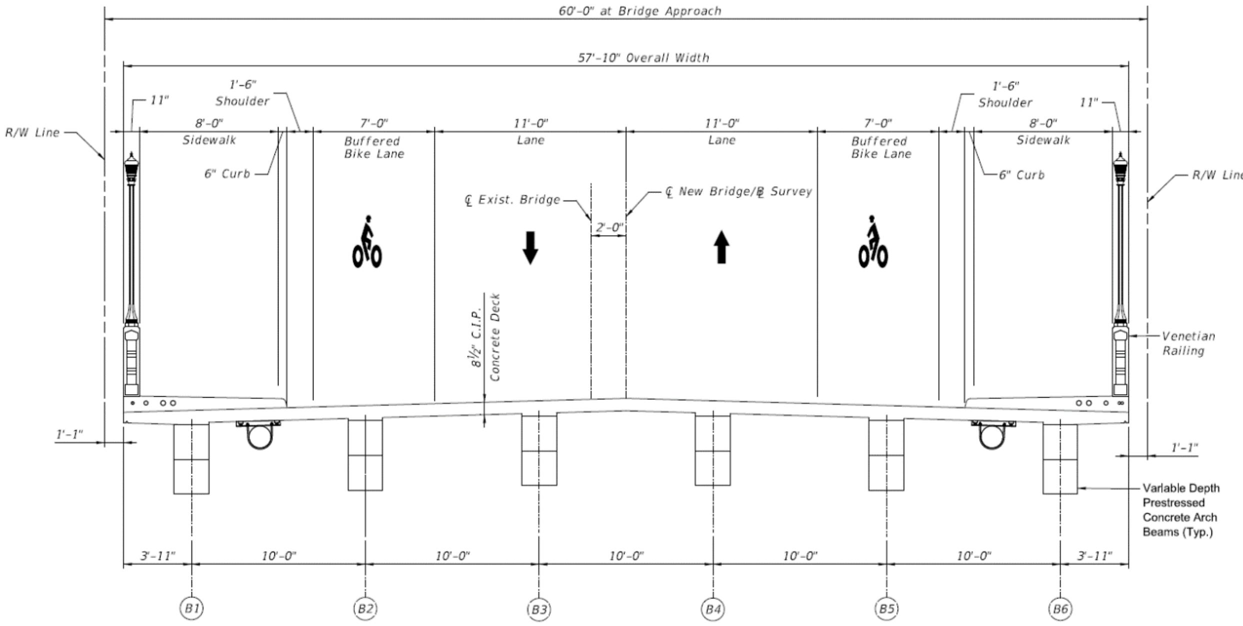


Figure 1-7 Replacement Alternative 7: Arched Beam Typical Section

Bridge height affects the extent of potential impacts to right-of-way and connecting streets. The vertical alignment of the new fixed bridges would be raised a minimum of 1 foot above the existing clearance to Biscayne Bay. The raised bridge profile will require modifications to the roadway approaches. (See Figure 1-8)

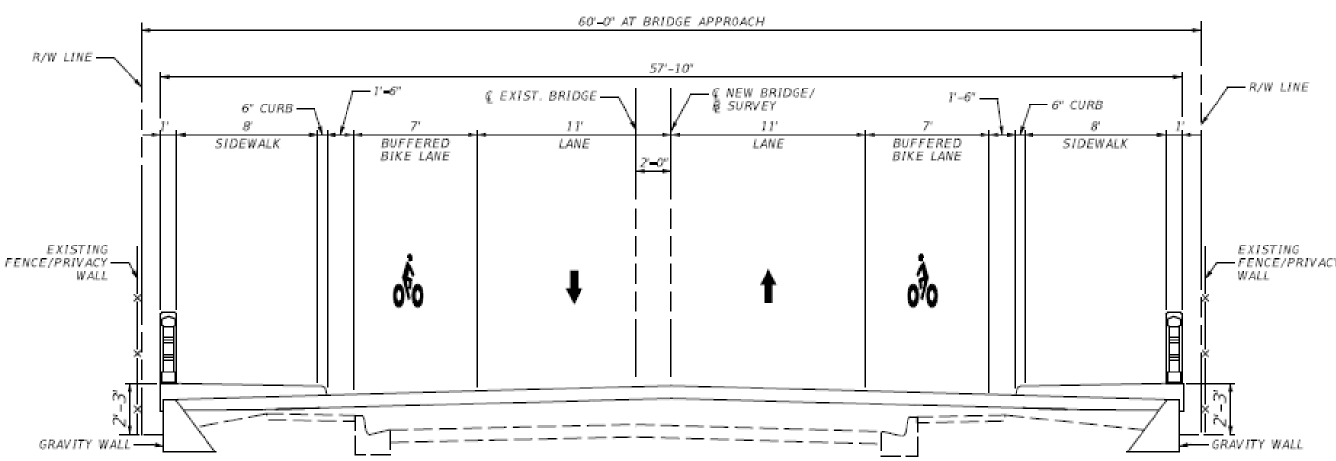


Figure 1-8 Replacement Alternative 7: Raised Bridge Profile

Substructure

Two foundation types were considered for the replacement alternatives:

- 24-inch Square Prestressed Concrete Piles

- 48-inch Drilled Shafts

Deep foundations with piles consist of a footing or pile cap supported by precast, prestressed concrete square piles. Piles are slender members that support the foundation loads when the soil is not capable of doing so. The piles resist and transfer the vertical and horizontal bridge loads to the soil or rock.

Advantages of piles include:

- Elimination of need for cofferdams and dewatering if pile caps are used;
- Fewer environmental impacts would be incurred; and
- Piles are less prone to scour and erosion.

Disadvantages of piles include:

- Driving piles may incur impacts to adjacent bridges and homes in close proximity;
- Piles are more susceptible to marine collision damage especially if they are exposed when pile caps are used; and
- Piles would require more specialized testing and inspection.

Deep foundations with drilled shafts are cast-in-place reinforced concrete piles. They are larger than driven piles, therefore they can take larger loads than piles as well as resist more vertical loads and moments. Drilled shafts are constructed by drilling to the required depth, cleaned, inspected, reinforced with a reinforcing steel cage, and concrete placed in the hole. The construction process is not environmentally friendly due to the drilling operation; however, noise impact would be greatly reduced for this alternative.

Despite the high cost of drilled shafts, they are recommended for this project to reduce noise impacts. Additionally, drilled shafts were proven to be effective during the partial Bridge 1 replacement in 1999 and 2016.

***Estimated ROW Acquisition*:** None

Anticipated Cost: $47 million

Replacement Alternative M4: Double Leaf Bascule Bridge

This alternative would replace the existing Bridge 10 movable bridge with a new double leaf bascule bridge 10. Advantages to the double leaf bascule bridges include:

- Unlimited vertical clearance in the raised position;
- The design can be laid out in a symmetrical arrangement which is an advantage when an “arched” look is desired; and
- They provide natural barriers to vehicular traffic when in the open position.

The existing bascule span provides 6 feet of minimum vertical clearance above mean high water at the face of fenders and 10 feet at the center of the navigation channel with the span lowered. The existing horizontal clearance is 56 feet between fenders. There are no established official US Coast Guard (USCG) vertical or horizontal guide clearances for this waterway crossing. However, a USCG Bridge Permit will be required for the replacement bridge and the USCG will make a determination concerning acceptable vertical and horizontal clearances for the proposed replacement bridge. For reference, the bridges at the east end of Julia Tuttle Causeway (I-195) to the north and MacArthur Causeway (SR A1A) to the south are high-level bridges with fixed spans over the navigation channel that provide 35 feet of minimum vertical clearance above mean high water. They both provide 75 feet of horizontal clearance between fenders.

A 75-foot horizontal clearance between fenders is proposed for the movable span replacement option. This provides improved safety at the Venetian Causeway site and is consistent with bridges located to the north and south of the causeway. In order to span the proposed 75-foot wide navigation channel, the bascule span will require a minimum overall structure depth (controlled by the depth of the main girders) at the face of fenders of approximately 10 feet (See Figure 1-9).

Figure 1-9 Replacement Alternative M4: Double Leaf Bascule Bridge

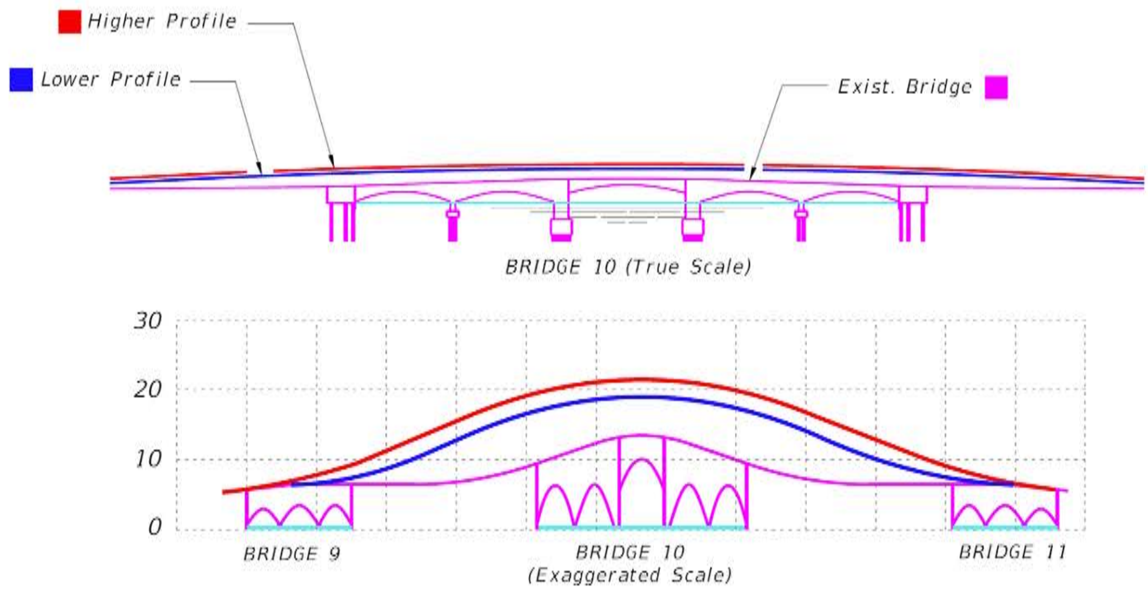
For a movable span bridge, the vertical clearance in the closed position affects the number of bridge openings and traffic flow. Higher vertical clearance in the closed position would require fewer bridge openings. The existing bridge provides only 6 feet of minimum vertical clearance at mean high water over the Intracoastal Waterway (ICWW) at the fenders in the closed position. Unlimited clearance is provided in the open position. The vessel height survey conducted on this bridge indicated the bridge would see less openings if the vertical clearance of the bridge was raised. The raising of the bridge must take into consideration the impacts to the spoil islands and residential islands as well as the historic appearance of the causeway. The bridge vertical clearance alternatives considered for Bridge 10 include:

- 10.5 feet of vertical clearance at the fender and 13.5 feet of vertical clearance at centerline of channel. This profile maintains the drive machinery above the 100-year flood elevation. Although the bascule piers will flood during a storm event, the mechanical and electrical systems of the bridge will remain above the flood elevation. The spoil islands will have retaining walls. A ramp could be provided for pedestrian access to the islands.

- 13.0 feet of vertical clearance at the fender and 16.0 feet of vertical clearance at centerline of channel. This profile would maximize the height of the bridge by raising the profile beginning at the point where bridges 9 and 11 connect to the residential islands. The spoil islands will have retaining walls. A ramp could be provided for pedestrian access to the islands.

The lower profile bridge with 10.5 feet of vertical clearance at the fender and 13.5 feet of vertical clearance at the centerline of the channel was requested by the public at the Alternatives Public Workshop, in order for the bridge to remain as low as possible and preserve its existing appearance.

Vertical profiles were prepared for the above alternatives to determine where each alternative would tie back into existing grade on the approach roadways. Both proposed profiles have a maximum vertical grade of five percent to meet ADA requirements for pedestrians (Figure 1-10).



NAVIGATION CLEARANCE POINT	VERT. CLEAR. (ABOVE MEAN HIGH WATER)		
	EXISTING	HIGHER	LOWER
at Fender	6.0'	13.0'	10.5'
at Center	10.0'	16.0'	13.5'
DECK ELEVATION AT PEAK	13.45'	21.45'	18.96'

BRIDGE 10 - VERTICAL PROFILE ALTERNATIVES

Figure 1-10 Bridge 10 Vertical Profile

A bridge profile with 10.5 feet of vertical clearance at the fender and 13.5 feet of vertical clearance at centerline of channel is proposed. This profile has the following benefits:

- Least impacts to the appearance of the causeway
- Reduces the need to raise bridges 9 and 11
- Minimizes the use of retaining walls
- Maintains pedestrian access to the spoil islands from the roadway

- Has the least impacts to the aesthetics and view shed of the causeway

Anticipated Cost: $43 Million

1.5 Recommended Alternative

(To be completed after the public hearing.)

2.0 LAND USE

The existing land uses within the project area were determined through the interpretation and review of the 2008 South Florida Water Management District (SFWMD) Florida Land Use and Cover Geographical Information Systems (GIS) layer, and the more detailed Miami-Dade County land use GIS layer. Land uses identified within the proposed right of way (ROW) limits and adjacent to the corridor are shown in **Figure 2-1**. The majority of land within and adjacent to the existing ROW is urban and built-up. The land use within the ROW is primarily transportation and exists as either roads or bridges. Within 500 feet of the existing ROW the land uses are predominantly medium density single family and high density multi-family residential. Commercial lodging exists adjacent to the east and west sides of the project corridor. Recreational land (public parks) and open space can be observed from the ROW.

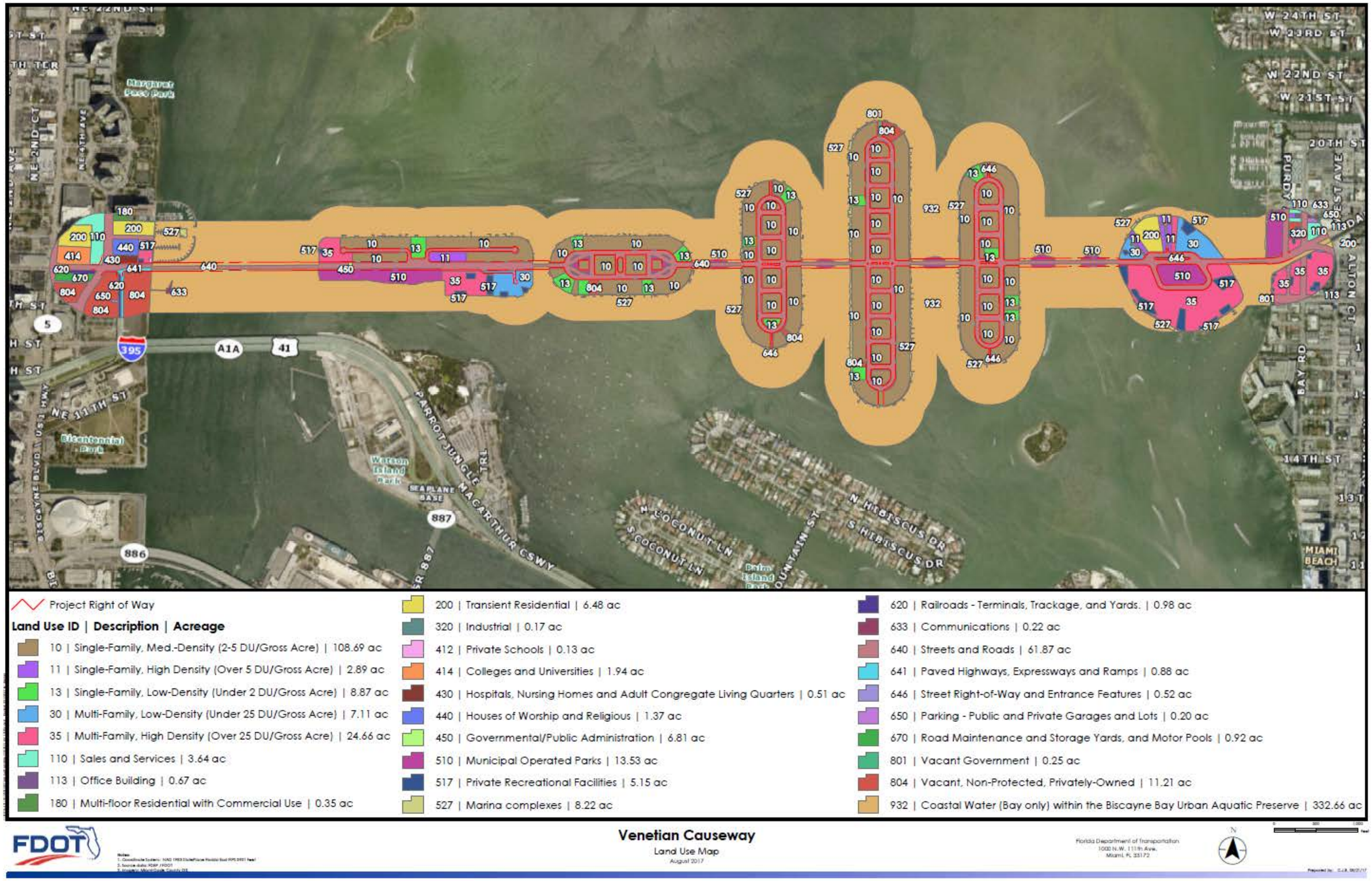


Figure 2-1 Land Use Map

3.0 TRAFFIC NOISE

This traffic noise assessment was conducted in accordance with current FHWA and FDOT guidelines, methodologies and criteria.

3.1 Noise Abatement Criteria

The FHWA has established Noise Abatement Criteria (NAC) for seven land use activity categories. These criteria determine when an impact occurs and when consideration of noise abatement is required. Maximum noise level thresholds or criteria levels, representing acceptable traffic noise level conditions, have been established for five of these activity categories. The FHWA's current NAC levels are presented in **Table 3-1**. Noise abatement measures must be considered when predicted noise levels approach or exceed the NAC levels or when a substantial noise increase occurs. The FDOT defines "approach" as within one dB(A) of the FHWA criteria. A substantial noise increase is defined as when the existing noise level is predicted to be exceeded by 15 dB(A) or more as a result of the transportation improvement project.

Table 3-1 Noise Abatement Criteria

[Hourly A-Weighted Sound Level-Decibels (dB(A))]

Activity Category	Activity Leq(h)[1]		Evaluation Location	Description Of Activity Category
	FHWA	FDOT		
A	57	56	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[2]	67	66	Exterior	Residential
C[2]	67	66	Exterior	Active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreational areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	51	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[2]	72	71	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	–	–	–	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	–	–	–	Undeveloped lands that are not permitted.

(Based on Table 1 of 23 CFR Part 772)

[1] The Leq(h) Activity Criteria values are for impact determination only, and are not a design standard for noise abatement measures.

[2] Includes undeveloped lands permitted for this activity category.

Note: FDOT defines that a substantial noise increase occurs when the existing noise level is predicted to be exceeded by 15 decibels or more as a result of the transportation improvement project. When this occurs, the requirement for abatement consideration will be followed.

3.2 Noise Sensitive Land Use

Most of the developed lands along the Venetian Causeway consist of noise sensitive use. Dense single-family home communities line most of the corridor; though large condominium complexes are found on the westernmost and easternmost islands (Biscayne Island and Belle Isle, respectively). However, since no substantial roadway improvements are planned on the islands, most of these residences are located outside of the area of proposed construction. The residences fall under Activity Category B and the NAC is 67 dB(A). Two (2) parks; Belle Isle Park and Maurice Gibb Park are also located along the corridor. However, Belle Isle Park is outside of the area of proposed construction; and Maurice Gibb Park is located at the eastern project terminus. The parks fall under Activity Category C, where the NAC is also 67 dB(A).

3.3 Existing Traffic Noise Levels

Noise levels along the corridor were measured in order to characterize the existing noise conditions within the limits of the project. All measurements were performed using procedures defined in the FHWA report *Measurement of Highway-Related Noise* (FHWA-PD-96-046). A Rion Model NL-21 Type-II integrating sound level meter was used to collect noise level data. The sound level meter was calibrated to 94 dB at 1000 Hertz using a Rion Model NC-73 acoustical calibrator. The ambient temperature during the measurements ranged from 89 to 94 degrees Fahrenheit, and the winds remained less than approximately 5 miles-per-hour throughout the measurements. The relative humidity ranged from approximately 50 to 70 percent and the cloud cover ranged from approximately 20 to 70 percent. All roadway surfaces remained clean and dry.

The field measurements were conducted on July 27, 2017 at sites representative of the nearby residences or parks. The locations of the field measurement sites are described in **Table 3-2** and depicted on **Figure 3-1**. All sites were located along the causeway and associated roadway, at distances of approximately 16 to 53 feet from the near travel lane. One 1-hour measurement was conducted for each site. No unusual noises at the monitoring sites were documented. The existing traffic noise levels were found to range from 57.8 to 65.0 dB(A).

Table 3-2 Field Measurement Data

Measurement Location	Start Time/Date	Measurement Duration	Distance From Roadway (Feet)	Measured Traffic Noise Level [dB(A)]
Toll Booth–along Eastbound Lanes (Approximate Station (Sta.) 135+00)	9:35AM/ 7-27-17	1 hour	16	62.5
Spoil Island between San Marco Island and San Marino Island–along Westbound Lanes (Approximate Sta. 177+00)	11:00AM/ 7-27-17	1 hour	21	65.0
Spoil Island between Di Lido Island and Rivo Alto Island–along Westbound Lanes (Approximate Sta. 203+00)	1:53PM/ 7-27-17	1 hour	26	63.6
Belle Isle Park–along Eastbound Lanes (Approximate Sta. 319+00)	3:06PM/ 7-27-17	1 hour	53	57.8

Figure 3-1 Noise Data Collection Site Location Map

3.4 Analysis

The portions of the project corridor located on the islands are lined with noise sensitive residences and parks. With the exception of one-way paired roadways on San Marco Island, the Venetian Causeway is an undivided two-lane facility. The posted speed limit along most of the corridor is 30 miles per hour. Existing measured noise levels did not approach or exceed the FHWA NAC.

The existing Annual Average Daily Traffic (AADT) of 12,230 vehicles per day is expected to increase to 16,600 vehicles per day during the design year regardless of the planned improvements. Neither build alternative will increase the number of travel lanes on the bridges and causeways, and no work is planned on the land-based roadway segments. Also, no significant horizontal or vertical realignments of the bridges or causeways are planned. Therefore, this project is not expected to result in increased traffic noise levels.

This project does not include any capacity improvements, substantial alignment modifications, or other improvements identified in Sections 18.1.3.1 - *Type I Projects* and 18.1.3.2 - *Type II Projects* of Chapter 18 of the PD&E Manual. Therefore, this is classified by FDOT as a Type III project and does not require a noise analysis or consideration of noise abatement.

4.0 SUMMARY

Although there are many noise sensitive sites located close to the causeway, the project will not add capacity or substantially change the alignment of the bridges or causeways. Also, no work is planned for the roadway segments on the islands where all of the nearby noise sensitive sites are located. Therefore, the project is not expected to result in increased traffic noise levels. In accordance with the PD&E Manual, Part 2, Chapter 18, the project does not require a detailed traffic noise analysis or consideration of noise abatement.

5.0 CONSTRUCTION

During construction of the project, there is the potential for noise impacts to be substantially greater than those resulting from normal traffic operations because heavy equipment is typically used to build roadways and bridges. In addition, construction activities may result in vibration impacts. Therefore, early identification of potential noise/vibration sensitive sites along the project corridor is important in minimizing noise and vibration impacts. The project area is lined with many noise sensitive residences and parks. Construction noise and vibration impacts to these sites will be minimized by adherence to the controls listed in the latest edition of the FDOT's *Standard Specifications for Road and Bridge Construction*.

A reassessment of the project corridor for additional sites particularly sensitive to construction noise and/or vibration will be performed during design to ensure that impacts to such sites are minimized. Coordination between the FDOT and the owners of any construction noise/vibration sensitive locations identified during design should occur and Technical Special Provisions should be developed for the project's contract package in order to ensure that impacts to such locations are minimized.