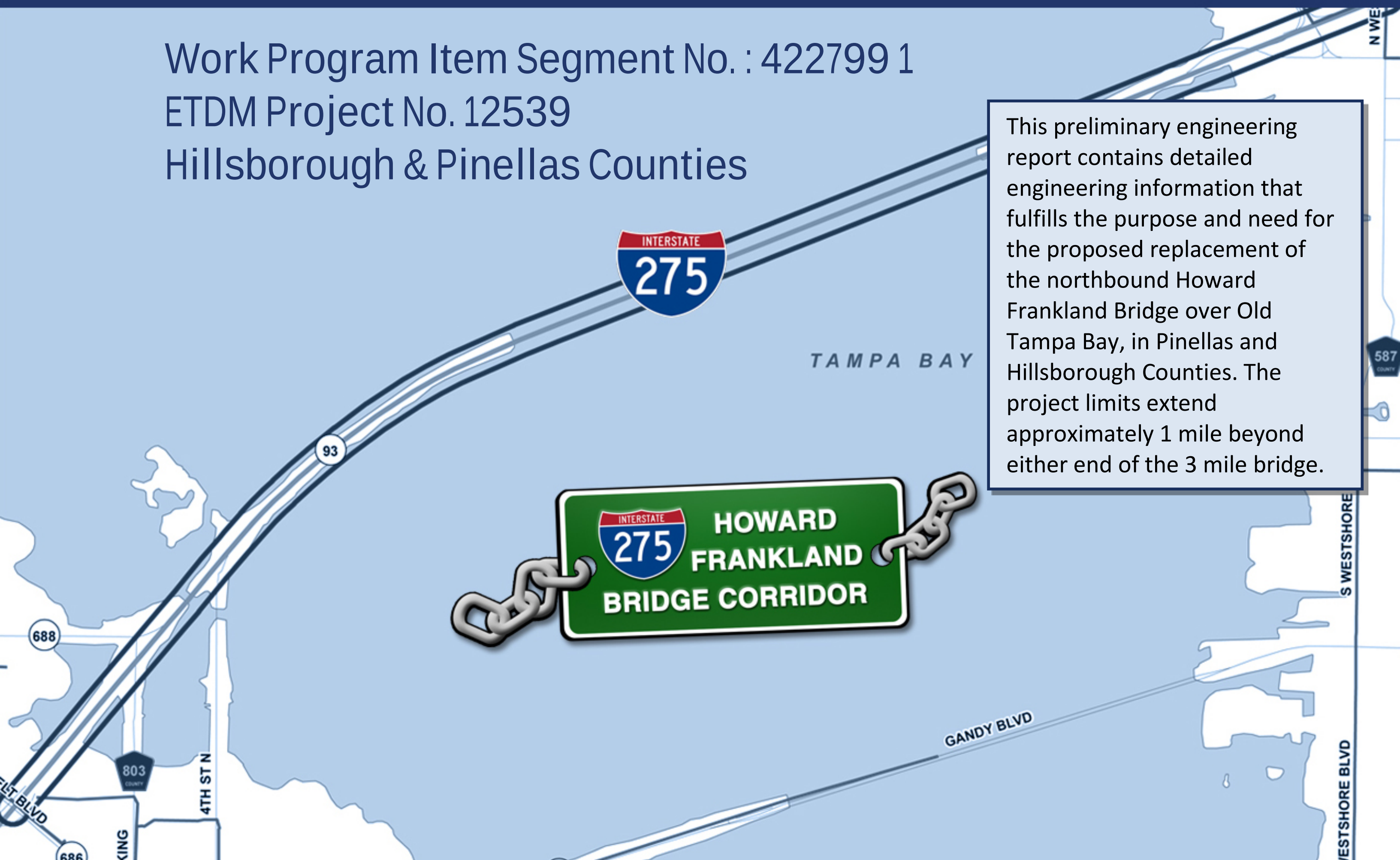
Project Development & Environment (PD&E) Study for Replacement of the Northbound Howard Frankland Bridge (I-275/SR 93)

Preliminary Engineering Report

Work Program Item Segment No. : 422799 1
ETDM Project No. 12539
Hillsborough & Pinellas Counties



This preliminary engineering report contains detailed engineering information that fulfills the purpose and need for the proposed replacement of the northbound Howard Frankland Bridge over Old Tampa Bay, in Pinellas and Hillsborough Counties. The project limits extend approximately 1 mile beyond either end of the 3 mile bridge.

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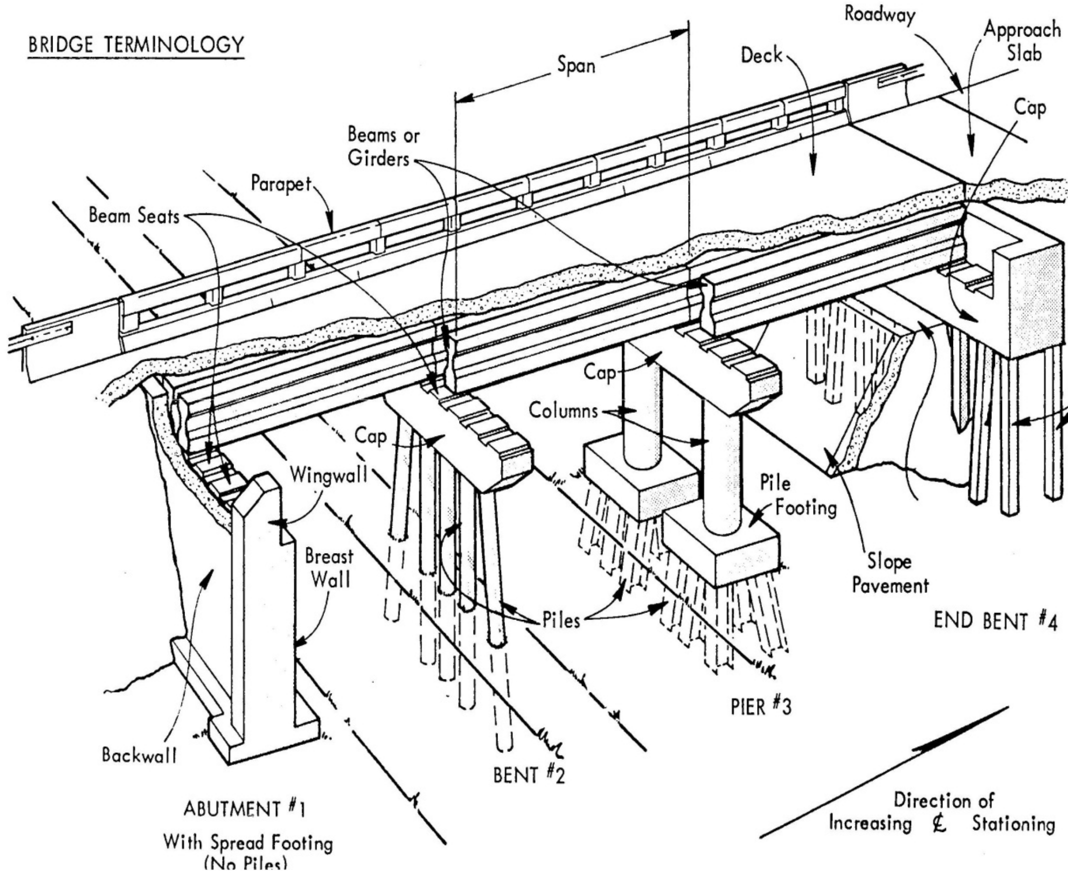
December 2013

State of Florida Department of Transportation
TBARTA
Tampa Bay Area Regional Transportation Authority
MPO
PSTA

BRIDGE TERMINOLOGY



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Prepared for:

Florida Department of Transportation
District Seven

This preliminary engineering report contains detailed engineering information that fulfills the purpose and need for the proposed replacement of the northbound Howard Frankland Bridge over Old Tampa Bay, in Pinellas and Hillsborough Counties. The project limits extend approximately 1 mile beyond either end of the 3 mile bridge.

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December 2013

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SECTION 1 SUMMARY OF PROJECT

1.1 SUMMARY STATEMENT

This preliminary engineering report contains detailed engineering information that fulfills the purpose and need for the proposed replacement of the northbound Howard Frankland Bridge (HFB), Bridge No. 150107, over Old Tampa Bay, in Pinellas and Hillsborough Counties. The PD&E Study limits extend approximately 1 mile beyond either end of the 3-mile long bridge (**Figure 1-1**).

1.2 COMMITMENTS & RECOMMENDATIONS

In order to assure that adverse impacts to listed species and suitable habitat within the vicinity of the project corridor will not occur, the Florida Department of Transportation (FDOT) will abide by standard protection measures in addition to the following commitments:

- The FDOT will conduct a seagrass survey during the growing season (June-August), and estimate impacts to seagrasses and submerged aquatic vegetation (SAV) within no more than two years of the construction start date.
- Informal Endangered Species Action Section 7 consultation will be conducted with the National Marine Fisheries Service (NMFS) for smalltooth sawfish and swimming sea turtles during future project phases.
- The FDOT will adhere to the NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions* during construction of the project.
- The FDOT is conducting a hydroacoustic analysis of pile driving at the Bayway Bridge (256903-1) in southern Tampa Bay and at the western portion of the SR 60 (Courtney Campbell Causeway) Pedestrian/Bicycle Trail (424561-3) within Old Tampa Bay to evaluate potential impacts to smalltooth sawfish, sea turtles and other marine wildlife. The results of this analysis will be evaluated and coordinated with NMFS. Once final design, materials and construction methods are available, it will be determined whether further analysis is needed for the construction of the northbound Howard Frankland Bridge. The results of the analysis will also help determine whether noise attenuation measures or other mitigation will be necessary for the smalltooth sawfish and sea turtles. Further coordination with NMFS will be required during future project phases.
- Informal Endangered Species Action Section 7 consultation will be conducted with the U.S. Fish & Wildlife Service (USFWS) for the Gulf Sturgeon during future project phases.
- The FDOT will commit to watching for Gulf Sturgeon during construction of the proposed bridge. FDOT will incorporate the *Construction Special Conditions for the protection of the Gulf Sturgeon*.
- To assure the protection of wildlife during construction, the FDOT will implement a Marine Wildlife Watch Plan (MWWP), which includes the Florida Fish and Wildlife Conservation

Commission (FFWCC) *Standard Manatee Conditions for In-Water Work*. The FDOT will require the construction contractor to abide by these guidelines during construction.

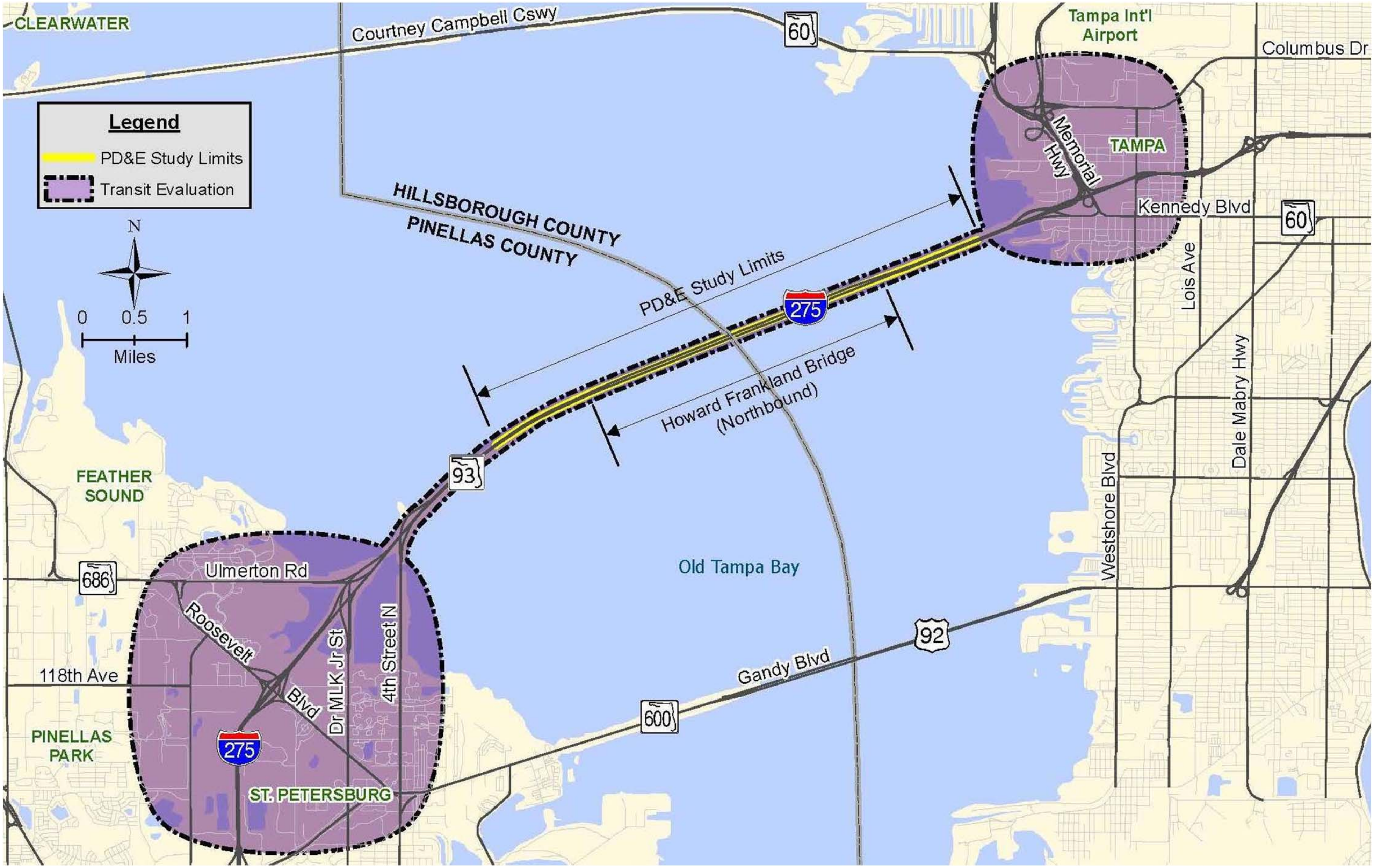
- Per direction from USFWS, special conditions for manatees will need to be addressed during construction and include the following:
    - No nighttime in water work in areas with high manatee use will be performed. In-water work can be conducted from official sunrise until official sunset times;
    - Two dedicated, experienced manatee observers will be present when in-water work is performed. Primary observers should have experience observing manatees in the wild on construction projects similar to this one;
    - All siltation barriers or coffer dams should be checked at least twice a day, in the morning and in the evening, for manatees that may become entangled or entrapped at the site.
    - Barges will be equipped with fender systems that provide a minimum standoff distance of four feet between wharves, bulkheads and vessels moored together to prevent crushing manatees. All existing slow speed or no wake zones will apply to all work boats and barges associated with construction;
    - Although culverts are unlikely for this project, any culverts larger than eight inches and less than eight feet in diameter should be grated to prevent manatee entrapment. The spacing between the bridge pilings will be at least 60 inches to allow for manatee movement in between the pilings; and
- The FDOT will coordinate with the appropriate regulatory and permitting agencies during the design phase of the project. Permits will be obtained prior to commencement of construction and the contractor will adhere to all conditions set forth in the permits. Staging areas should be in disturbed areas to avoid impacts to fish and wildlife habitat resources and should be approved during permitting.
- If blasting is required, formal consultation will be undertaken with USFWS for the manatee and with NMFS for sea turtle and the smalltooth sawfish. Blasting should be performed during specific times of the year, if possible. An extensive blast plan and MWWP would need to be developed and submitted to the USFWS, NMFS and FFWCC for approval as early as possible prior to construction.

1.3 DESCRIPTION OF PROPOSED ACTION

The proposed project involves the replacement of the four-lane northbound I-275 HFB (Bridge No. 150107) over Old Tampa Bay, in Pinellas and Hillsborough Counties. The limits of the PD&E Study extend approximately one-mile beyond either end of the 3-mile long bridge to include portions of the existing causeway. In addition to the proposed bridge replacement, this study also considered reserving space for a future transit envelope within the existing bridge corridor. The proposed transit improvements will be consistent with the Tampa Bay Area Regional Transportation Authority (TBARTA) Master Plan, adopted in May 2009. Potential accommodations for express lanes and premium transit are discussed in **Section 8.6**. The project limits fall within Township 29S, Range 17E, Section 32; Township 29S, Range 18E and Section 19; and Township 31S, Range 19E, and Section 21.

The Recommended Alternative consists of replacing the existing four-lane (three general through lanes and one auxiliary lane) northbound bridge with a wider four-lane (three general through lanes and one auxiliary lane that may be converted to an express lane in the future) bridge to be constructed in a centered alignment, located between the two existing bridges. Stage construction of the new bridge (including construction of temporary bridge) would be required at either end where the existing separation between the two existing bridges is much narrower. The existing northbound bridge would be removed following completion of the new northbound bridge.

The new bridge is proposed to be constructed several feet higher than the existing southbound bridge in order to clear the predicted 100-year wave crest elevation. The new northbound replacement bridge would include an extra four feet of width which could be used as a buffer area in the future should the Department decide to convert an existing auxiliary lane to an express lane. The estimated cost of the improvements, including the roadway transitions at either end of the bridge, is approximately $415 million in today's dollars. The cost estimate includes a contingency of $25 million to strengthen the new bridge to be able to accommodate a potential future light-rail transit system.



Northbound Howard Frankland Bridge (I-275/SR 93) Replacement PD&E Study
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Study Area Map

Figure 1-1

SECTION 2 INTRODUCTION

2.1 PROJECT DEVELOPMENT & ENVIRONMENT STUDY PROCESS

Prior to the beginning of the Project Development and Environment (PD&E) Study phase, the project was entered into the Florida Department of Transportation's (FDOT or Department) Efficient Transportation Decision Making (ETDM) system. An ETDM *Programming Screen Summary Report* was published on June 4, 2012 as ETDM Project number 12539. Two separate projects were run in the ETDM Environmental Screening Tool (EST) Planning Screen under project numbers 12256 (Gateway to Hillsborough County Line) and 12736 (Westshore to Pinellas Rail Corridor) for the transit evaluation. A Type 2 Categorical Exclusion class of action was assigned by the Federal Highway Administration (FHWA) during the programming screen phase of the ETDM process for the bridge replacement PD&E Study.

The objective of the PD&E Study was to help the FDOT and the FHWA reach a decision on the type, location, and conceptual design of the necessary improvements to or replacement of the northbound Howard Frankland Bridge (HFB) to safely and efficiently accommodate future travel demand. Factors considered included transportation needs, socioeconomic and environmental impacts, engineering requirements and cost estimates. In general terms, the process involved the following steps:

(1) Verifying the project purpose and need developed during the ETDM screening process
(2) the gathering and analysis of detailed information regarding the natural and cultural features of the study area in addition to engineering data
(3) the development and evaluation of alternatives for meeting the project need
(4) the selection of a Preferred Alternative, and
(5) documenting the entire process in a series of reports

During the process, communication with the affected public was accomplished directly, through public information meetings and a hearing, and indirectly, through interaction with elected officials and agency representatives. The PD&E Study process is designed to satisfy all applicable state and federal requirements, including the National Environmental Policy Act (NEPA), in order for this project to qualify for federal-aid funding of subsequent project phases (design and construction). In addition to the various Build Alternatives, the No-Build or Bridge Rehabilitation/Repair Alternative was also considered as part of the study process.

2.2 PROJECT HISTORY AND BACKGROUND

The original HFB was opened to traffic in early 1960. The original bridge carried four lanes of traffic, two lanes in each direction, with only a 4-foot traffic separator between oncoming traffic lanes. By 1978, planning had begun for increasing the capacity of this section of I-275. As traffic projections increased for the HFB it became clear that a total of at least eight lanes (four in each direction) of capacity would be required instead of the six lanes originally proposed. In 1987, it was determined that a parallel, four-lane span would be built, and construction began in 1988. The new southbound span was opened to traffic in 1991, and the older bridge was closed to traffic, rehabilitated and reopened in 1992 as the northbound span. One of the four lanes in each direction serves as an auxiliary lane as they do not extend beyond the SR 686/Roosevelt Boulevard/118th Avenue interchange in Pinellas County or beyond the SR 60 interchange in Hillsborough County.

A simultaneous Regional Transit Corridor Evaluation is underway to evaluate premium transit enhancements within the HFB corridor for linkage between the Gateway area in Pinellas County and the Westshore area in Hillsborough County. This evaluation is consistent with the Tampa Bay Area Regional Transportation Authority (TBARTA) Master Plan update adopted in June 2011. Potential accommodations for express lanes and premium transit are discussed in **Section 8.6**.

Two separate projects were run in the ETDM Environmental Screening Tool (EST) Planning Screen under project numbers 12256 (Gateway to Hillsborough County Line) and 12736 (Westshore to Pinellas Rail Corridor) for the transit evaluation.

2.3 PURPOSE OF REPORT

The PD&E study evaluated various design and operational concepts for replacing the bridge, as well as assessed the environmental effects of the bridge replacement and related causeway approaches. The PD&E study also presented an opportunity to explore various design options to accommodate transit within an “envelope” on the new bridge or on a separate parallel bridge structure; the type of premium transit service to be accommodated will be determined by the transit evaluation. Potential accommodations for express lanes and premium transit are discussed in **Section 8.6**.

The purpose of this report was to document all of the engineering-related aspects associated with the proposed replacement of the northbound HFB. Separate reports were prepared to document environmental effects and public involvement efforts (see **Section 10** for list).

SECTION 3 PURPOSE & NEED FOR PROJECT

3.1 SYSTEM LINKAGE

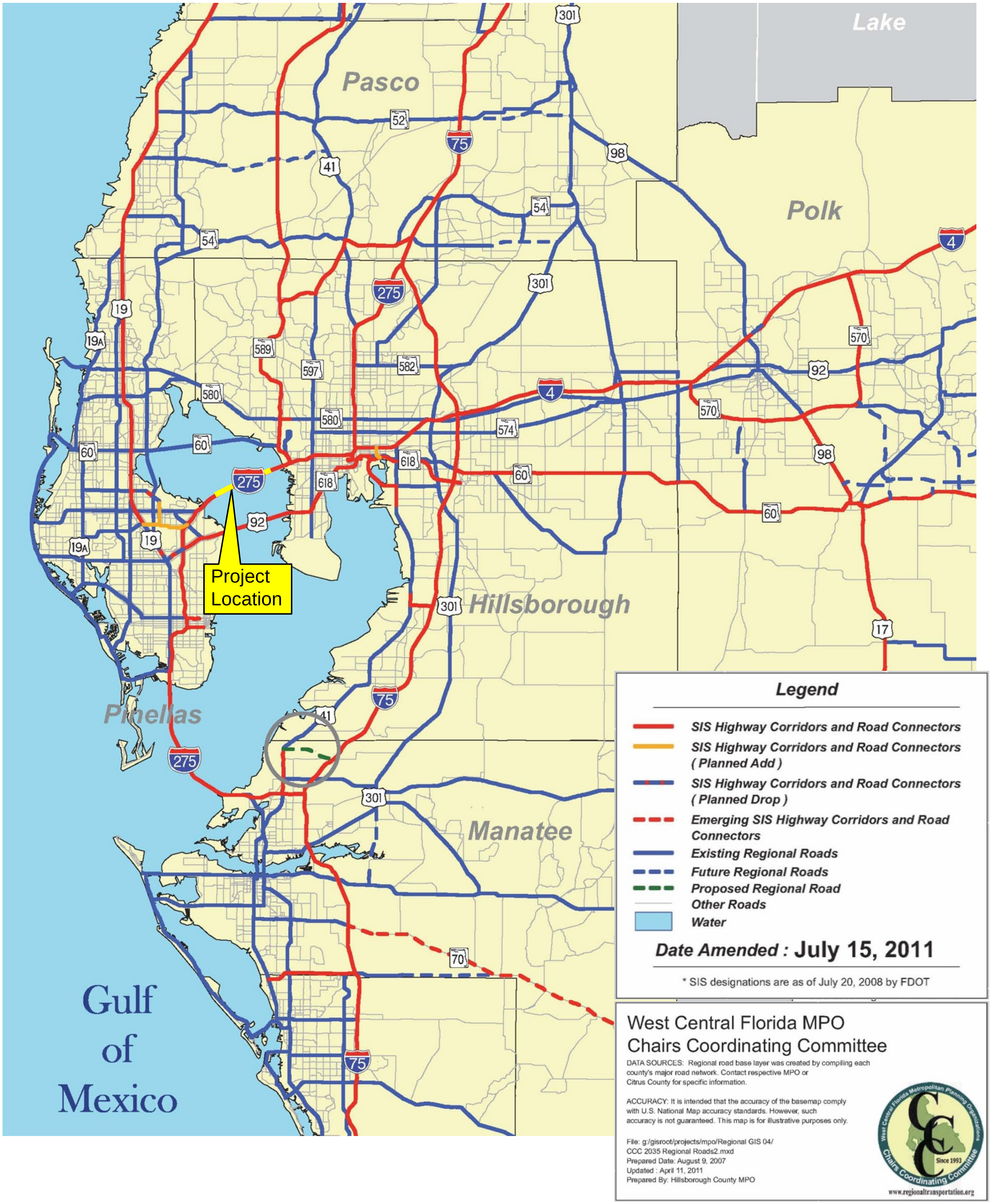
I-275 at the HFB is a vital link in the local and regional transportation network as well as a critical emergency evacuation route for portions of Pinellas County. **Figure 3-1** shows the relationship of the project location to the regional roads in west central Florida. In addition to being an Interstate highway and part of the National Highway System (**Figure 3-2**), I-275 is part of the Florida Intrastate Highway System (FIHS), which is comprised of interconnected limited and controlled access roadways including Interstate highways, Florida's Turnpike, selected urban expressways and major arterial highways. The FIHS is the *highway component* of the Strategic Intermodal System (SIS; **Figure 3-3**), which is a statewide network of highways, railways, waterways and transportation hubs that handle the bulk of Florida's passenger and freight traffic.

3.2 TRANSPORTATION & SOCIOECONOMIC DEMAND

The HFB is one of only three crossings between Pinellas and Hillsborough Counties over Old Tampa Bay and the crossing which carries the most traffic. In 2012, the Annual Average Daily Traffic (AADT) was 142,500 vehicles per day (VPD). The Tampa Bay Regional Transit Model for Managed Lanes (TBRTM-ML) indicates that the bi-directional AADT in 2035 is expected to increase to 219,600 VPD. The design year 2040 AADT has been estimated to be 236,400 VPD. The existing peak-hour level of service (LOS) is estimated to be "D/C" (AM/PM). Based on the latest traffic projections, the design year 2040 LOS is projected to be LOS "F" if the new northbound bridge remains four lanes as called for in the future long-range transportation plans. Because of this projected future LOS, the Department is studying the feasibility of adding additional highway capacity as express lanes within this bridge corridor. In addition, various exclusive transit options are also being evaluated in concert with this PD&E Study.

3.3 CONSISTENCY WITH TRANSPORTATION PLANS

The replacement of the northbound HFB is included in the Pinellas County MPO's Cost Feasible Long Range Transportation Plan (LRTP) (adopted December 9, 2009, amended on April 11, 2012). The construction phase is shown in the LRTP for the year 2026-2030 time period. Although the bridge replacement project is also included in the Hillsborough County MPO's LRTP for the same time period, FDOT has designated the project as a "Pinellas County project" for work program purposes. The proposed transit envelope within the HFB corridor is consistent with the Hillsborough County MPO's Cost Affordable LRTP and the Pinellas County MPO's Cost Feasible (2015-2035) LRTP. The transit envelope is also consistent with the TBARTA's Mid-Term Regional Network (2035) and Long-Term Regional Network (2050) which shows "short distance rail" in the bridge corridor (**Figure 3-4**). The potential implementation of express lanes along I-275, I-4 and I-75 in the Tampa Bay area is under study and will be presented to these MPO's in 2013 for programming consideration.



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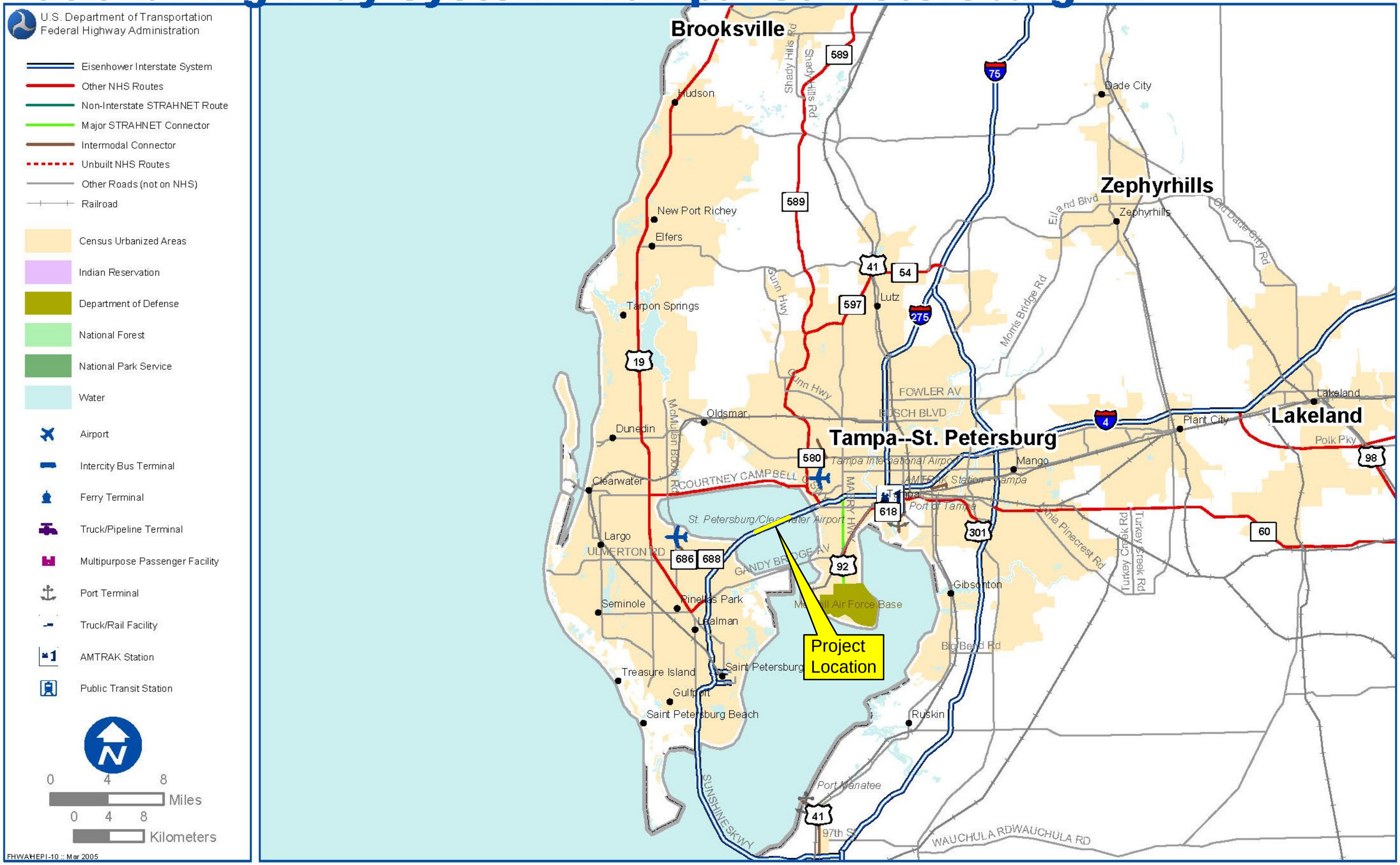
Relationship of the Project to the Region

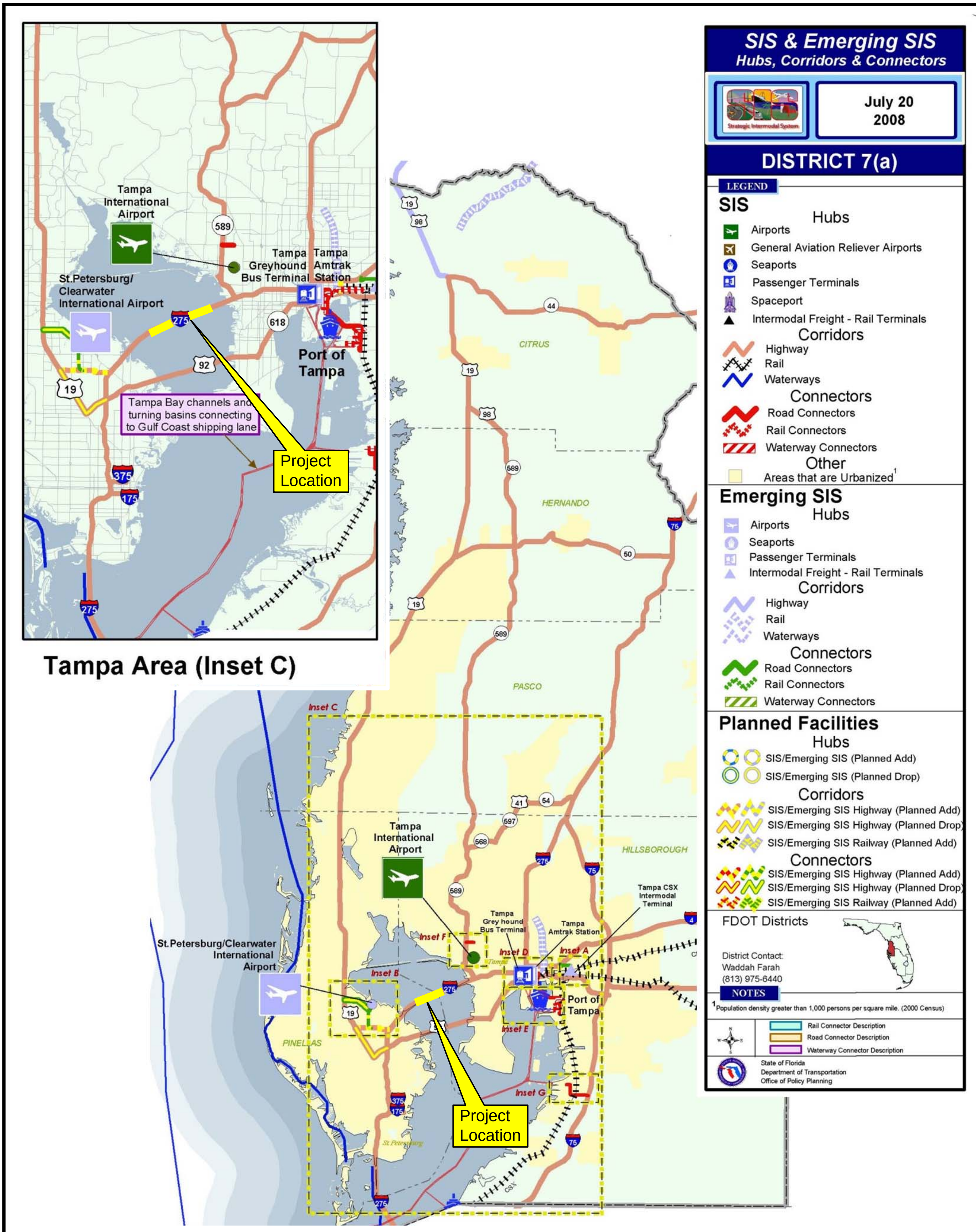
Figure 3-1

National Highway System: Tampa--St. Petersburg FL



National Highway System

Figure 3-2



Northbound Howard Frankland Bridge (I-275/SR 93) Replacement PD&E Study
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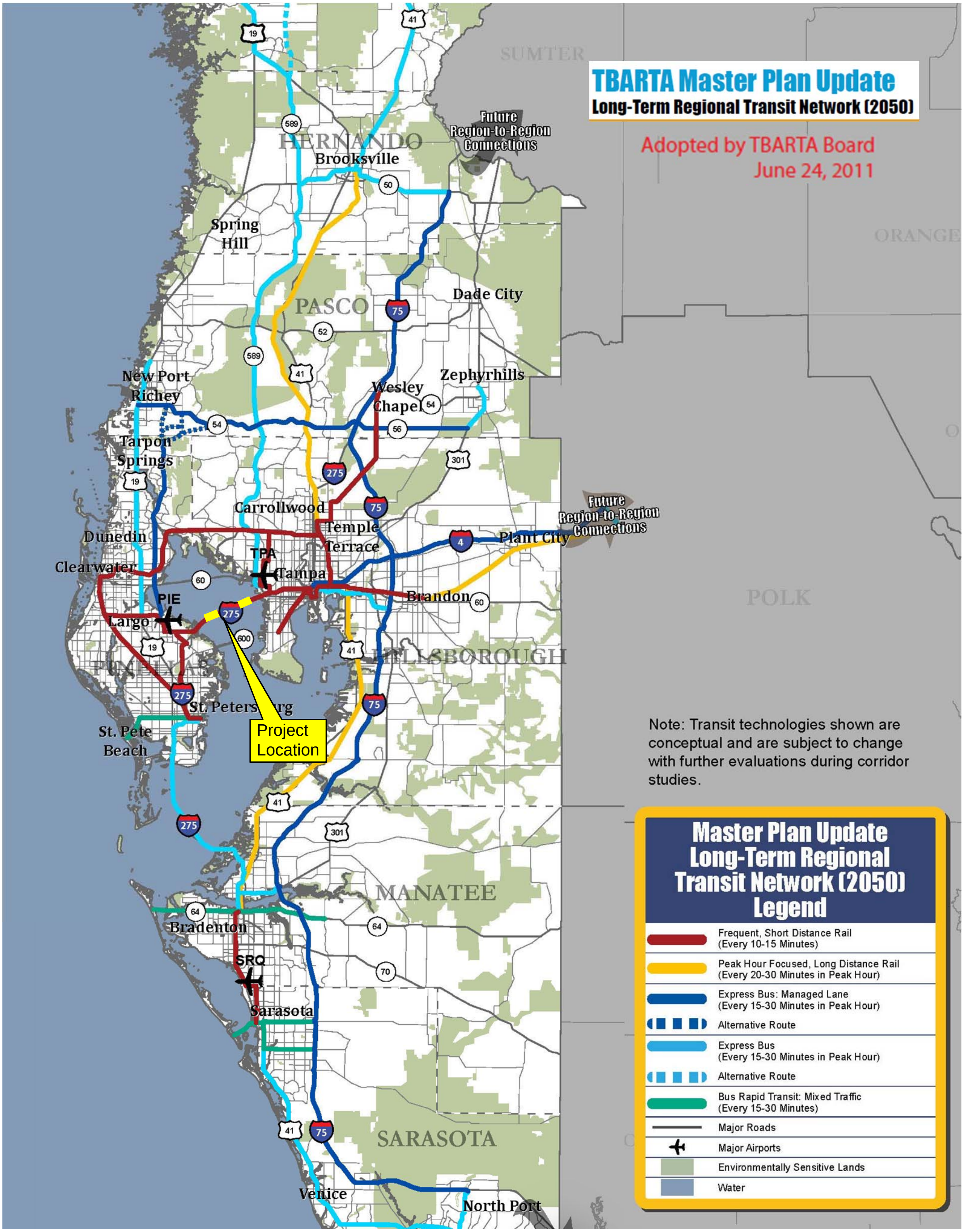
FDOT Strategic Intermodal System Map

Figure 3-3



Northbound Howard Frankland Bridge (I-275/SR 93) Replacement PD&E Study WPI Segment No. 422799 1 Pinellas & Hillsborough Counties	TBARTA Long-Term Regional Transit Network	Figure 3-4

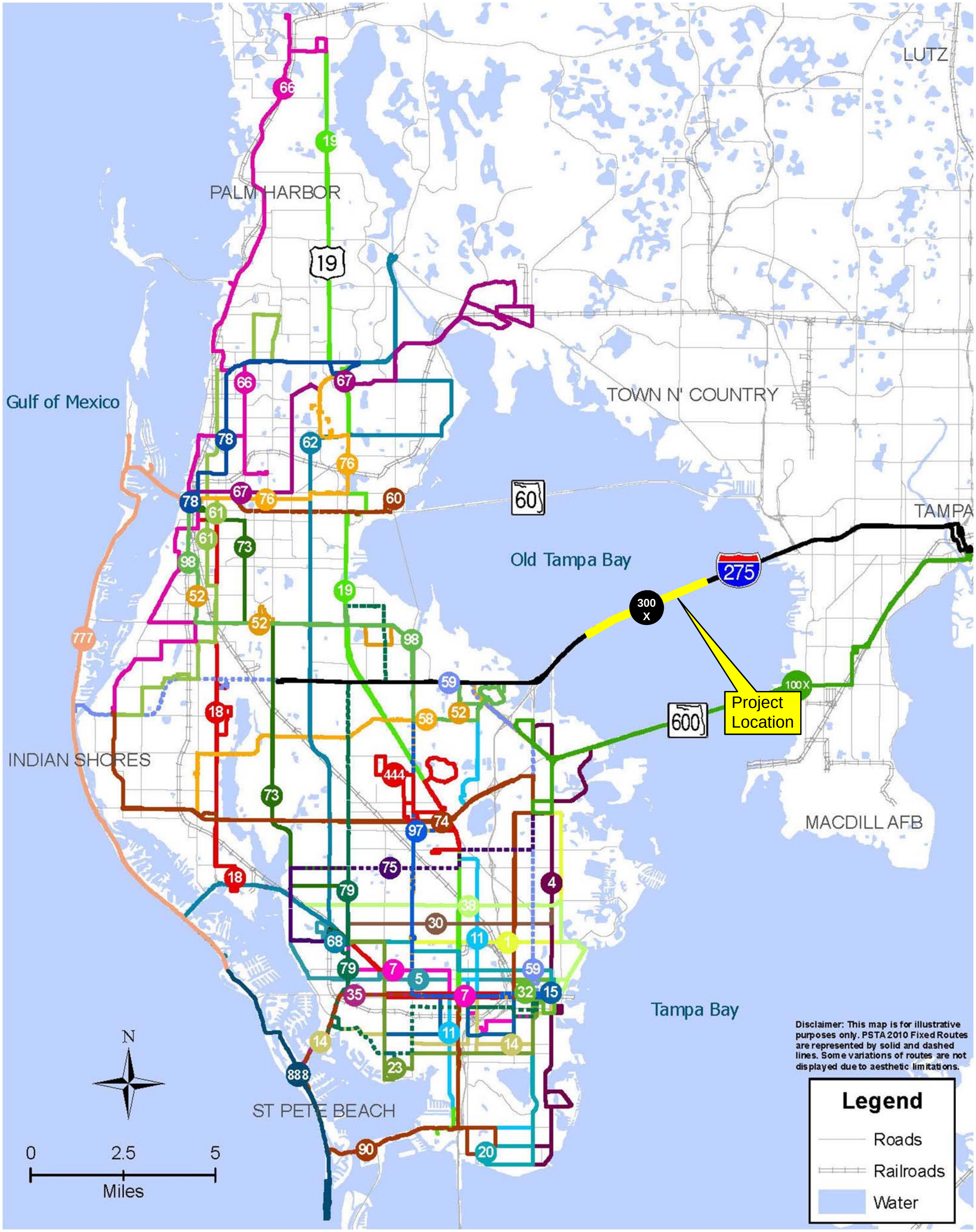
3.4 MODAL RELATIONSHIPS

The Pinellas Suncoast Transit Authority (PSTA) operates one express bus route which utilizes the HFB in providing service between Pinellas and Hillsborough Counties. Route 300X provides a connection between the Ulmerton Road Park-N-Ride in Largo and downtown Tampa, with service primarily in the peak periods and with limited intermediate stops (**Figure 3-5**). The Hillsborough Area Regional Transit Authority (HART) does not currently operate any buses on the HFB. The HFB/I-275 also provides a connection to Tampa International Airport for Pinellas County residents. Various motorcoach services use HFB/I-275 as part of their regional network; for example, Amtrak's Thruway motorcoach service connects Tampa's Union Station to Pinellas Park-St. Petersburg, Bradenton, Sarasota, Port Charlotte, and Ft. Myers. HFB/I-275 is also part of TBARTA's regional freight network, which is considered the backbone of the goods movement system for the TBARTA region. Potential accommodations for express lanes and premium transit are discussed in **Section 8.6**.

3.5 SAFETY/BRIDGE DESIGN AND CONDITION

For the 5-year period 2005 through 2009, a total of 585 crashes were reported for the northbound direction within the 5-mile study limits. The resulting economic loss of these crashes is estimated to be approximately $ 14.4 million, based on 2006 National Safety Council unit costs. For just the 3-mile bridge limits, 212 crashes were reported on the northbound bridge compared to 168 crashes on the southbound bridge (for this same 5-year period). The crash rate was estimated to be about 26 percent higher on the northbound bridge compared to the newer southbound bridge. The difference in crash rates might be related to the differences in the designs of the older and newer bridges. The vertical alignment on the existing northbound bridge does not meet current design standards for an Interstate highway. Based on the as-built plans, the estimated design speed is between 50 and 55 miles per hour (mph), while the bridge is posted with 65 mph speed limit signs (current standards require 70 mph design speed). This lower design speed results in shorter stopping sight distances for motorists travelling over the "hump" near the center of the bridge, which could be a contributing factor in some of the reported rear-end collisions on the bridge. In addition, the shoulder widths and two of the lane widths do not meet current Interstate design standards.

The existing northbound HFB is no longer classified as *structurally deficient*; the latest sufficiency rating is 80.0 based on a October 2013 inspection. An earlier inspection conducted in September 2010 resulted in a sufficiency rating of 61.8. The FDOT performed repairs that improved the rating for the latest inspection. In the mid-fifties, when this bridge was originally designed, normal practice was to design for a 50-year life span. While that duration has now been exceeded and the bridge is located in a harsh saltwater environment, major past rehabilitation projects have helped to extend the life of the structure. Based on a life-cycle cost analysis conducted by FDOT in September 2011, it was determined that over an 80-year analysis period, replacing the existing bridge rather than rehabilitating and maintaining it would cost approximately 25 percent less, based on a present-worth economic analysis, with a present-worth savings of approximately $65 million in today's dollars. A copy of the economic analysis is included in **Appendix D** of this report.



Northbound Howard Frankland Bridge (I-275/SR 93) Replacement PD&E Study WPI Segment No. 422799 1 Pinellas & Hillsborough Counties	PSTA Fixed Bus Routes	Figure 3-5

SECTION 4 EXISTING CONDITIONS

4.1 EXISTING ROADWAY CHARACTERISTICS

4.1.1 Roadway Classification & Access Management

I-275 at the HFB is classified as an "urban principal arterial – Interstate". The Interstate System is a subset of the National Highway System. I-275 is also included in Florida's FIHS/SIS as mentioned in **Section 3.1**. The HFB corridor is also designated as an emergency evacuation route for portions of Pinellas County. The access management classification is Class 1, which consists exclusively of limited access facilities.

4.1.2 Typical Sections and Posted/Design Speeds

The roadway approaches on either side of the HFB include four 12-foot lanes, 10-foot paved inside and outside shoulders, and concrete barrier walls within the 22-foot median. As noted in Section 2.2, one of the lanes in each direction serves as an auxiliary lane. The causeways near the bridge ends include seawalls/barrier walls located approximately 40 feet from the outside edge of pavement. The existing roadway approach typical sections are illustrated in **Figure 4-1.** Both causeway ends include emergency access (turnaround) roadways which run underneath the bridge ends.

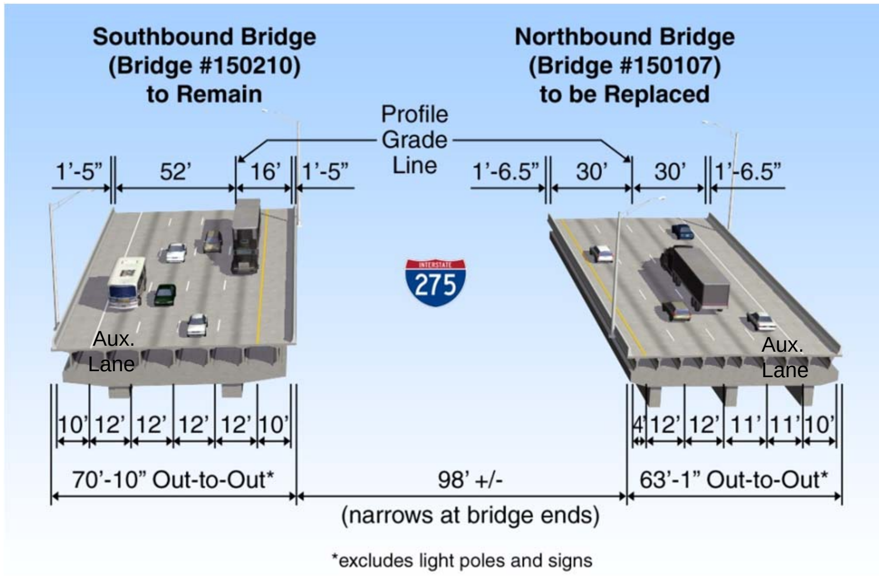
The northbound HFB typical section includes a 4-foot inside shoulder, a 10-foot outside shoulder, two 12-foot travel lanes and two 11-foot travel lanes. The lanes were restriped in early 1999 to provide a better refuge area on one side for disabled vehicles and crash investigations, etc. The posted speed limit is 65 miles per hour (mph) with 40 mph minimum. The original design speed is unknown, but based on the K values for the vertical curves, it would be between 50 and 55 mph, which is less than the standard Interstate design speed of 70 mph. The inside shoulder width and the two 11-foot lanes do not meet current design standards for an Interstate highway.

4.1.3 Pedestrian & Bicycle Facilities

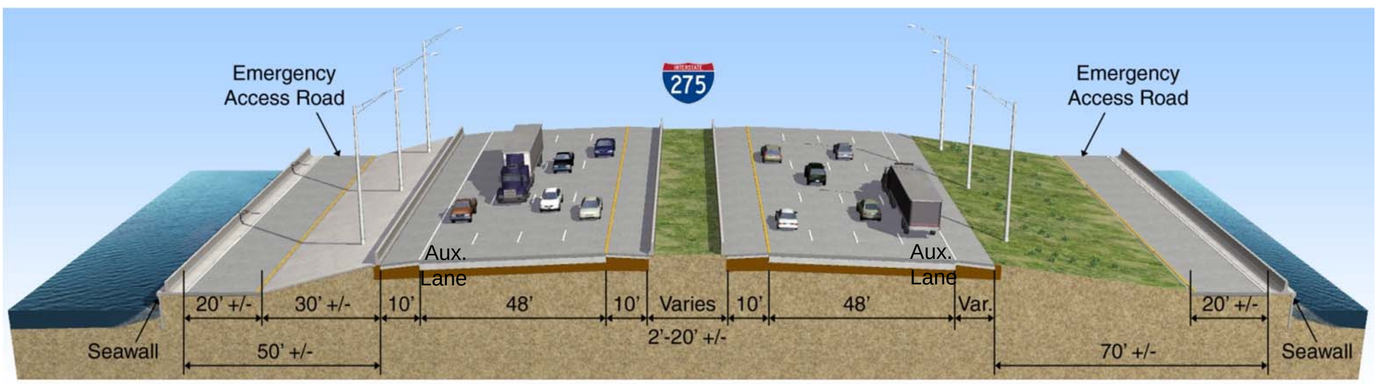
There are no provisions for pedestrians or bicyclists on the HFB (I-275) or its roadway approaches. Both user groups are prohibited by state law (Florida Statutes 316.091) to use this limited-access Interstate highway.

4.1.4 Right of Way

Existing (limited-access) right of way in the vicinity of the HFB is 800 feet in width, based on Trustees of the Internal Improvement Trust Fund (TIITF) deeds from 1958 that showed it as 800 feet in width.

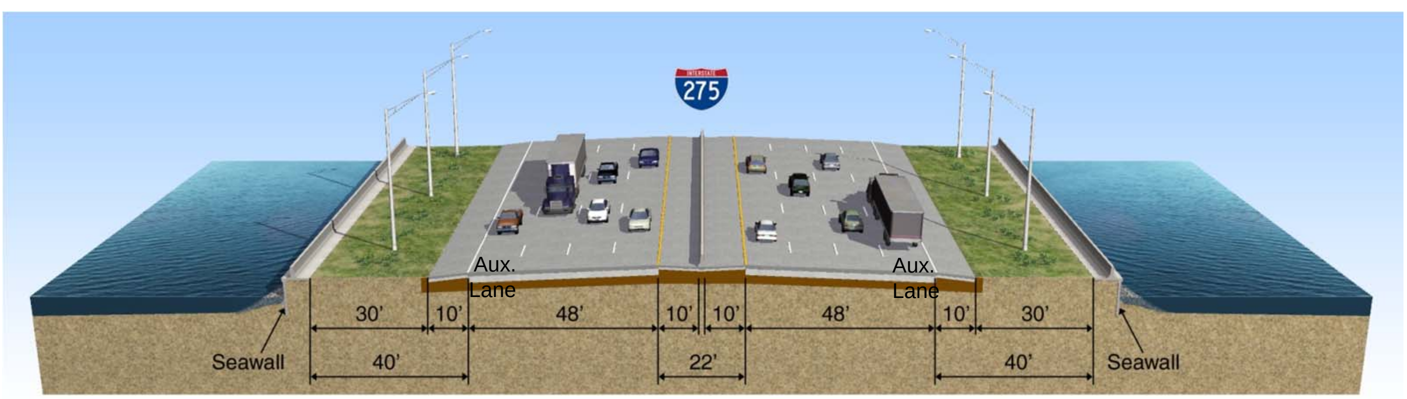


Existing Howard Frankland Bridges over Old Tampa Bay



Roadway Approaches Near Bridge Ends (Looking North)

(Applies for about 1400 ft near the south bridge end and a maximum of 1500 ft +/- near the north bridge end)



Roadway Approaches on the Causeway (Looking North)

Northbound Howard Frankland Bridge
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Existing Typical Sections

Figure 4-1

4.1.5 Horizontal Alignment

The existing horizontal alignment on the bridges and their approaches is illustrated in **Figure 4-2**. The northbound bridge is in a tangent section, including the roadway to the north, and a 0 degree-15 minute-7 second curve right ends at the south end of the northbound bridge.

4.1.6 Vertical Alignment

The existing vertical alignment for the roadway and bridge is discussed in **Section 4.2.4**.

4.1.7 Drainage & Floodplains

There are currently no stormwater management facilities on the bridge or its causeway approaches within the Study limits. Stormwater runoff from the bridge drains directly into Old Tampa Bay via scuppers (vertical holes through the bridge deck) on the bridge. There are no areas on the causeway near the bridge ends which would allow sufficient space for ponds, even if it was economically feasible to capture and pipe the runoff from a 3-mile long bridge in the middle of the bay.

The causeway approaches to the HFB are located in Base Flood (100-year flood) Flood Zone VE (elevation 9 feet NAVD88) according to GIS data developed by the Federal Emergency Management Agency (FEMA) (**Figure 4-3**). Zone VE is defined as "Coastal flood zone with velocity hazard (wave action); base flood elevations determined." The following information is from the *Draft Location Hydraulic Technical Memorandum* prepared for this project, to document that the floodplain encroachment will be minimal.

1. History of Flooding: Infrequent flooding problems have been identified within the project area due to tropical storms and hurricanes. When Tropical Storm Debby passed through the bay area in June 2012, the Florida Highway Patrol closed the HFB in both directions on Monday June 25 (at about 6:30 p.m.) due to high winds, surf and flooding on the causeway approaches to the bridge. The southbound lanes reopened shortly after 8 p.m. according to news reports, and by 11 p.m. all lanes were open. In addition, local maintenance offices having jurisdiction in the project area were contacted to verify flooding problems in the project area. Anita Montjoy, Assistant Maintenance Engineer with the FDOT Tampa Maintenance Office, indicated that the service roads have been under water during major storm events at high tide.
2. Longitudinal or Transverse Encroachments: All of the floodplain encroachment is longitudinal encroachment of existing floodplain along the causeway approaches to the bridge. The bridge approaches will be located within the existing limits of the causeway fill. No significant change in the volume of fill on the roadway (causeway) approaches within the floodplain is expected as a result of the proposed northbound bridge replacement. In addition, since these bridge approaches are located in tidally influenced flood zones, there will be no adverse impacts.

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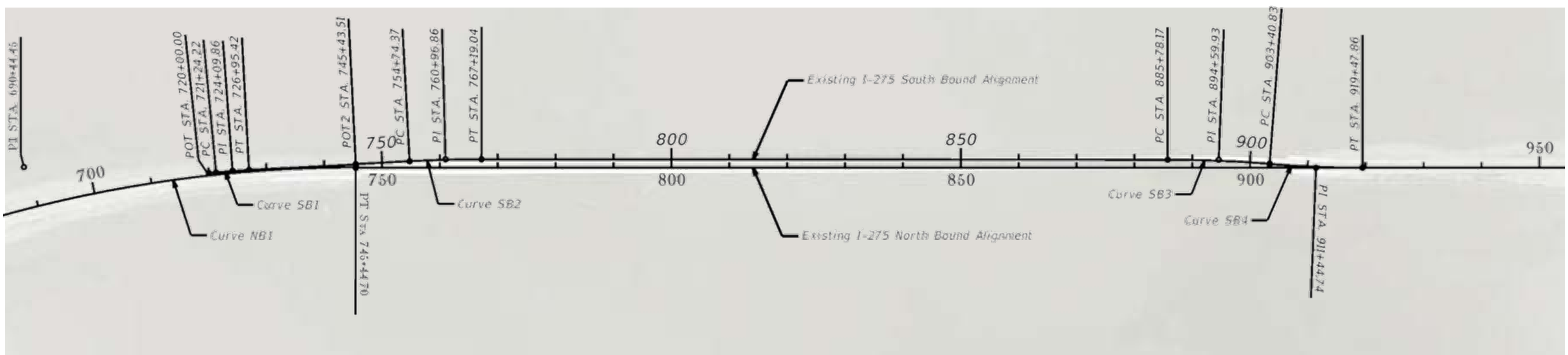

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PT STA.	= 745+44.70

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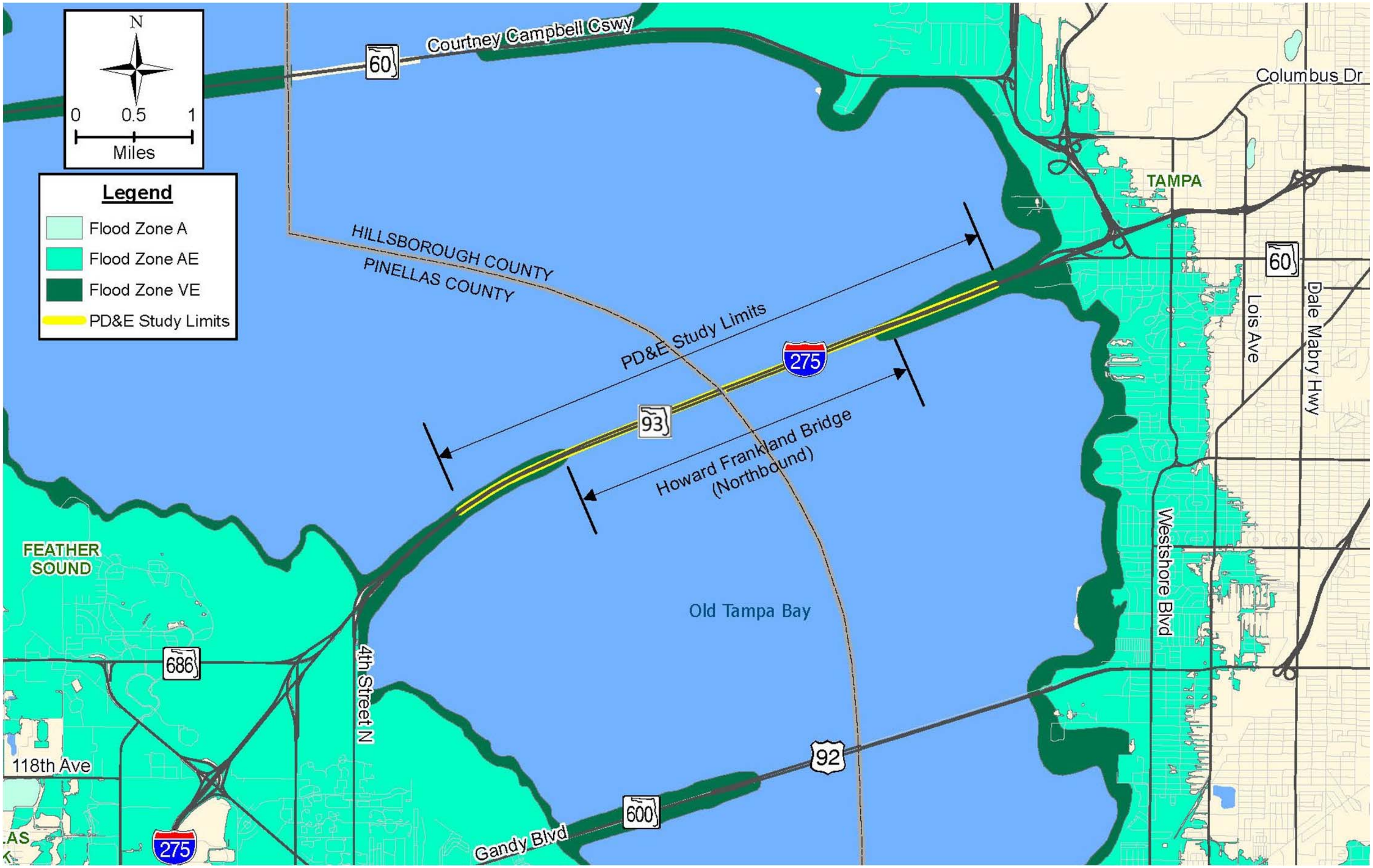
Existing Horizontal Alignment

Figure 4-2



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Floodplains in the Study Area

Figure 4-3

3. Avoidance Alternatives: There are no Build Alternatives available which would completely avoid any new floodplain encroachment since the majority of encroachment is associated with the causeway approaches to the bridge, and the new bridge is proposed to be constructed at a higher elevation to meet or exceed the elevation of the newer southbound HFB.

4. Emergency Services and Evacuations: No change in emergency services is expected due to construction of the proposed project. As mentioned above, interruption of traffic flow due to major storm events is very infrequent and unavoidable due to the low elevation of the roadway (causeway) approaches and the low mainland elevations on either side of the causeway. Therefore, no emergency services or evacuation opportunities will be adversely affected as a result of construction of the proposed project.

5. Base Flood Impacts: The project's drainage design will be consistent with local (FEMA), FDOT, and Southwest Florida Water Management District's (SWFWMD) design guidelines. Therefore, no significant changes in base flood elevations or limits will occur.

6. Regulatory Floodway: There are no regulatory floodways within the limits of this project.

7. Natural and Beneficial Floodplain Values: The proposed bridge replacement will follow the same general alignment as the existing bridge. Impacts to seagrasses and other natural areas are expected to be very minor; therefore, no natural and beneficial floodplain values will be significantly affected.

8. Floodplain Consistency and Development: The proposed bridge replacement is consistent with and included in the Pinellas County MPO's Cost Feasible Long Range Transportation Plan (LRTP) (adopted December 9, 2009, and last amended on April 11, 2012), since it is primarily related to preservation of the facility rather than expansion. The construction phase is shown in the LRTP for the year 2026-2030 time period. The proposed project will not encourage floodplain development due to local (FEMA) floodplain and SWFWMD regulations and local government site development regulations which prohibit construction of new development within Old Tampa Bay.

9. Floodplain/FIRM: The entire causeway is located within the FEMA-designated floodplain, which is tidally influenced. The project is located within FIRM maps 12103C0161G, 12103C0162G and 12103C0144G for Pinellas County and 12057C0333H, 12057C0337H, and 12057C0341H for Hillsborough County (maps dated August 2008). The project is located in Zone A (100-year floodplain with elevations undetermined) and Zone VE, a special flood hazard area inundated by 100-year flooding with velocity hazard (wave action) and where the base flood elevation has been determined to be 9 ft North American Vertical Datum (NAVD) of 1988. Mainland areas at either end of the causeway are classified as Zone AE, a special flood hazard area inundated by 100-year flooding where the base flood elevation has also been determined to be 9 ft NAVD88.

Risk Assessment: Based on the FDOT's floodplain categories, this project falls under Category 5: "projects on existing alignment involving replacement of drainage structures in heavily urbanized floodplains." Replacement drainage structures (in this case a major bridge) for this project are limited to hydraulically equivalent structures. The limitations to the hydraulic equivalency being proposed are basically due to restrictions imposed by the geometrics of design, existing development, cost feasibility, or practicability. An alternative encroachment location is not considered in this category since it defeats the project purpose or is economically unfeasible. Since flooding conditions in the project area are inherent in the topography or are a result of other outside contributing sources, and there is no practical alternative to totally eradicate flood impacts or even reduce them in any significant amount, existing flooding will continue, but not be increased. The proposed structure will be hydraulically equivalent to or greater than the existing structure, and backwater surface elevations are not expected to increase. As a result, the project will not affect existing flood heights or floodplain limits. This project will not result in any new or increased adverse environmental impacts. There will be no significant change in the potential for interruption or termination of emergency service or emergency evacuation routes. Therefore, it has been determined that *this encroachment is not significant*.

A *Bridge Hydraulic Report* (BHR) is not being developed as part of the PD&E study. A BHR will be developed during the design phase of this project. A new northbound replacement bridge is proposed as part of this PD&E study and will be located adjacent and parallel to the existing northbound HFB. Since a BHR is not being prepared as part of the PD&E study, the following items are discussed as part of this hydraulic analysis:

1. Conceptual Length: The conceptual length of proposed bridge is approximately 3.0 miles, the same as the bridge proposed to be replaced.

2. Conceptual Scour Considerations: The proposed bridge will be located within Old Tampa Bay, which is a tidally influenced waterbody. Some scour caused by tidal fluctuation is anticipated at the proposed bridge location. A hydraulic analysis will be conducted during the design phase of the project pursuant to *Section 4.8.2 – Tidal Crossings* of the *FDOT Drainage Manual*.

3. Preliminary Vertical Grade Requirements: The vertical clearances of the proposed northbound replacement bridge will be designed at a minimum to meet or exceed the vertical clearances of the existing southbound HFB, which is about 6 feet higher than the existing northbound bridge and is located about 98 feet west of and parallel to the northbound bridge. Currently the vertical clearance at the center span above mean high water is as follows:

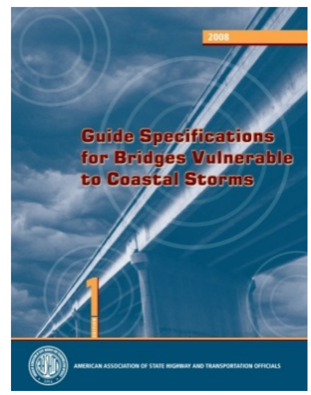
   - Northbound bridge = 43.5 ft +/-
   - Southbound bridge = 49.3 ft +/-

The roadway approaches on the causeway are at about elevation 7 feet (NAVD88) while the 100-year floodplain is at about 9 feet elevation. The low member on the approach spans of the existing northbound bridge is at about elevation 10 feet, which is above the 100-year flood elevation but below the estimated 100-year wave crest elevation, which ranges from about 12 to 17 feet (NAVD88).

In addition to potential damage to bridge piers due to scour, the main concern from a floodplain standpoint is the potential damage that could occur to a bridge crossing the bay due to wave action on top of a major storm surge.

<u>Need for Vulnerability Analysis for Coastal Bridges and Background Information</u>

In 2004, Hurricane Ivan caused significant damage to numerous structures along the northwest coast of Florida. A combination of elevated water level and wave heights trapped air between the girders increasing the buoyant force and imparted large vertical and horizontal forces dislodging most of the low lying spans of the I-10 Bridges over Escambia Bay. In the following year, Hurricanes Katrina and Rita did similar damage to bridges in Mississippi and Louisiana. In response to these events, the FHWA initiated a research project in cooperation with ten states which resulted in the development of the American Association of State Highway and Transportation Officials (*AASHTO) Guide Specifications for Bridges Vulnerable to Coastal Storms,* published in 2008.



Design wave forces acting on a bridge superstructure are typically large, so bridges designed to resist these wave forces are more costly. For bridges spanning waters subject to coastal storms, the AASHTO Guide Specification requires the superstructure to have a minimum vertical clearance of one foot above the 100-year design wave crest elevation, including the storm surge elevation and wind setup; this elevation is termed the *wave crest clearance*. If this clearance is not met, the bridge superstructure must be designed to resist storm wave forces. This requirement is also consistent with the latest editions of FDOT's *Drainage Manual* and *Structures Design Guidelines*.

The levels of analysis are defined according to the AASHTO Guide Specifications for Bridges Vulnerable to Coastal Storms, Article 6.2. The appropriate level of analysis for a bridge is dependent on the bridge length and importance. Long and/or significant bridges, such as the HFB, would be designed using a more accurate analysis (level III) and simulation. For all bridges spanning waters subject to coastal storms, the designer should consider simple and inexpensive measures that enhance a structure's capacity to resist storm forces, for example, the designer could place vents in all diaphragms for little or no cost. Venting all bays for all spans would reduce the effects of buoyancy forces on the structure. The designer should also consider anchoring the superstructure down to the substructure to reduce or prevent damage resulting from storms.

Results of 2010 Study Performed for FDOT District Seven

FDOT's Central Office conducted a pilot study on storm surge and wave loading on bridge superstructures. The objectives of the study were:

1. To develop a screening methodology that would identify those bridges potentially vulnerable to surge/wave loading,

2. To perform three different levels of analysis (Levels I, II and III) for determining the meteorological and oceanographic (met/ocean) parameters needed to compute surge/wave loads,

3. Establish design (100-year return interval) values for the met/ocean parameters based on the results from the Level III analysis,

4. Compute the design and storm of record loads on the vulnerable bridges in the pilot study area, and

5. Provide data, information, and a preliminary analysis for a wave modifier method, which will form the base for a FDOT follow-up study to develop methods for improving the accuracy of the Levels I and II results.

FDOT District Seven was chosen as the location for the pilot study. Fifty-two tidal bridges were included in the initial study group based on a conservative estimate of their location being susceptible to surge and waves. The screening procedure reduced the number to 34 requiring further analysis.

A Level I met/ocean analysis uses existing storm surge information for the site and analytical equations for estimating local wind setup and wave heights and periods. A Level II analysis is similar to the Level I but uses more refined methods for computing setup, wave heights and periods, and in some cases storm surge. The Level III analysis involved reconstruction of wind, water elevation and wave heights and periods produced by the hurricanes and tropical storms (hindcasting) that have impacted the pilot study area over the past 150 years. The number of actual storms experienced (30) was too small for the extremal analysis so additional storms were simulated by adjusting the storm paths and phasing with the astronomical tides of the actual storms to produce a total of 150 events. Extremal analyses on the results of the hindcasts produced the design (100-year) maximum water elevations and associated wave heights at each of the vulnerable bridge sites.

100-year wave crest elevations along the northbound HFB were obtained from the Level III analysis performed as part of the 2010 pilot study described above. The Level III analysis followed the methodology described in the AASHTO Guide Specifications for Bridges Vulnerable to Coastal Storms. The Level III results were extracted at each bent along the northbound bridge to determine the maximum wave crest elevation possible at that location. **Figure 4-4** shows the 100-year maximum wave crest elevation along the northbound HFB. The maximum wave crest elevations (in feet-NAVD88) are presented at each bent location along the existing northbound bridge. As shown in the figure, the north end of the bridge (Bent 145E) is subject to the highest maximum 100-year wave crest elevation, which reaches +17.3 ft-NAVD. The overall values range from 11.7 ft NAVD to 17.3 ft NAVD.

As mentioned previously, if this clearance cannot be met, the bridge superstructure must be designed to resist storm wave forces. During a later phase of the project development process, a benefit-cost analysis will be conducted to determine the most cost-effective design. As shown in **Figure 4-5**, for the existing northbound HFB, the vertical force on the superstructure under the design wave event exceeds the dead load of the superstructure, even with zero percent air entrapment between the beams. With 100 percent air entrapment, the vertical force increases to more than three times the weight of the superstructure.

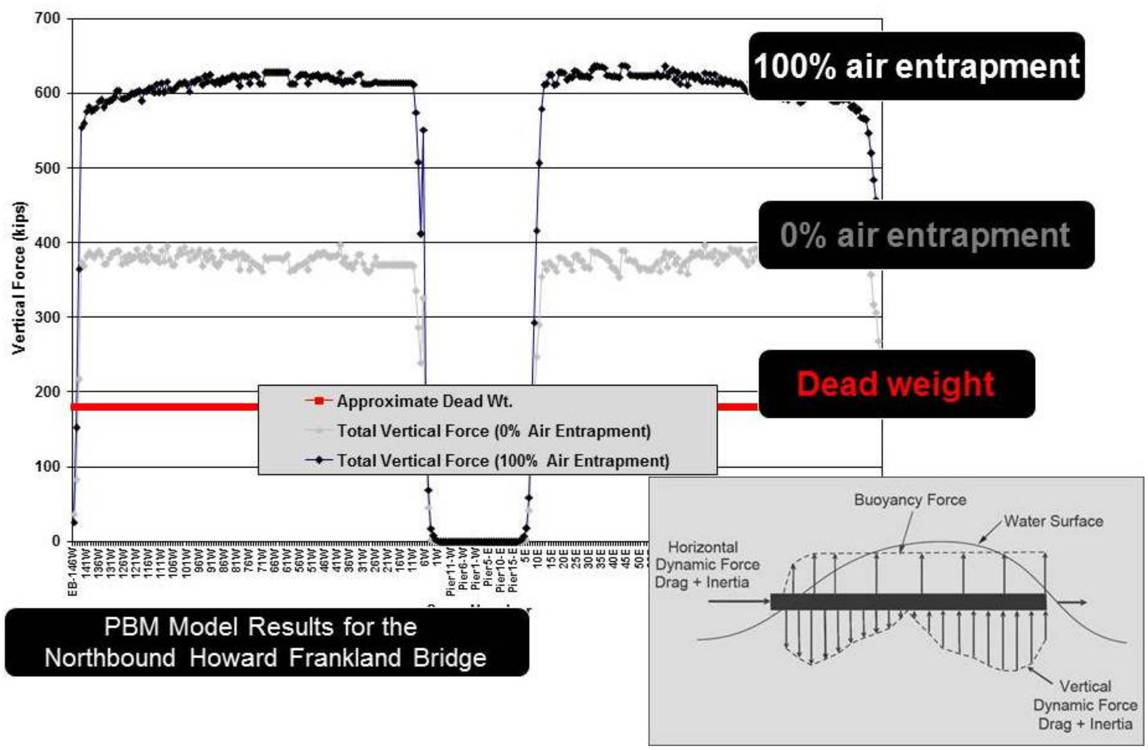
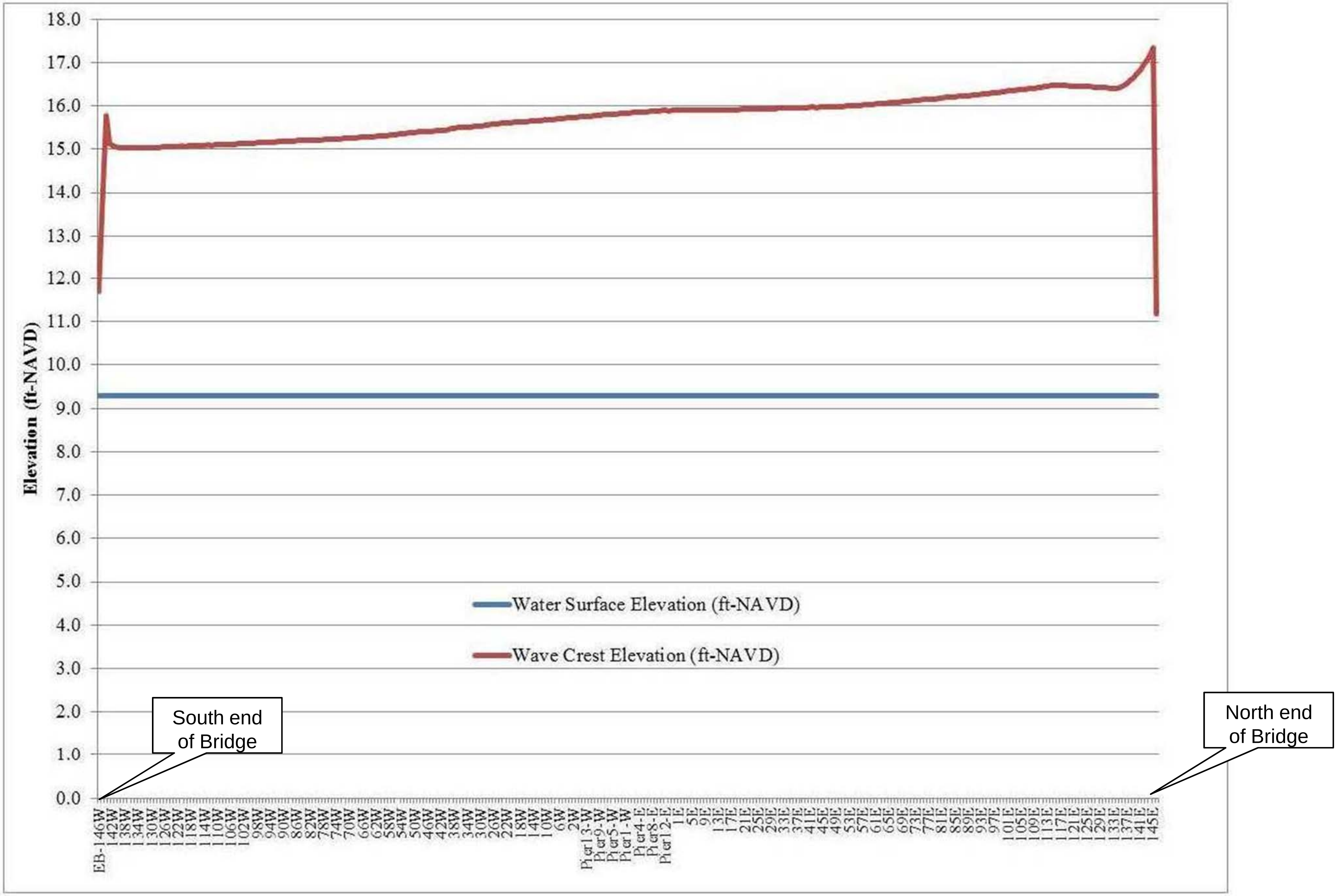


Figure 4-4 Comparison of Vertical Forces on the Northbound Bridge



Source: OEA, Inc., 2012 (from 2010 study)

Predicted 100-Year Water and Wave Crest Elevations at Northbound Bridge

Figure 4-5

The 100 year design wave crest elevation (elevation 17.3 feet) is about 7 feet higher than the 10.4-foot elevation of the low chord on most of the existing northbound bridge. To meet the required 1-foot clearance above the wave crest elevation, the low chord of the new bridge would need to be raised about 8 feet to elevation 18.3 feet. Preliminary calculations indicate that it may be acceptable to safely limit this increase to between 4 and 5 feet depending on the final dead load and configuration of the various superstructure alternatives. Based on a replacement configuration similar to the existing southbound bridge, a low chord elevation of 14.5 feet results in buoyancy just less than the counteracting dead load, assuming 100 percent air entrapment. Additional discussion is included in **Section 9.17** of this report.

4.1.8 Geotechnical Data

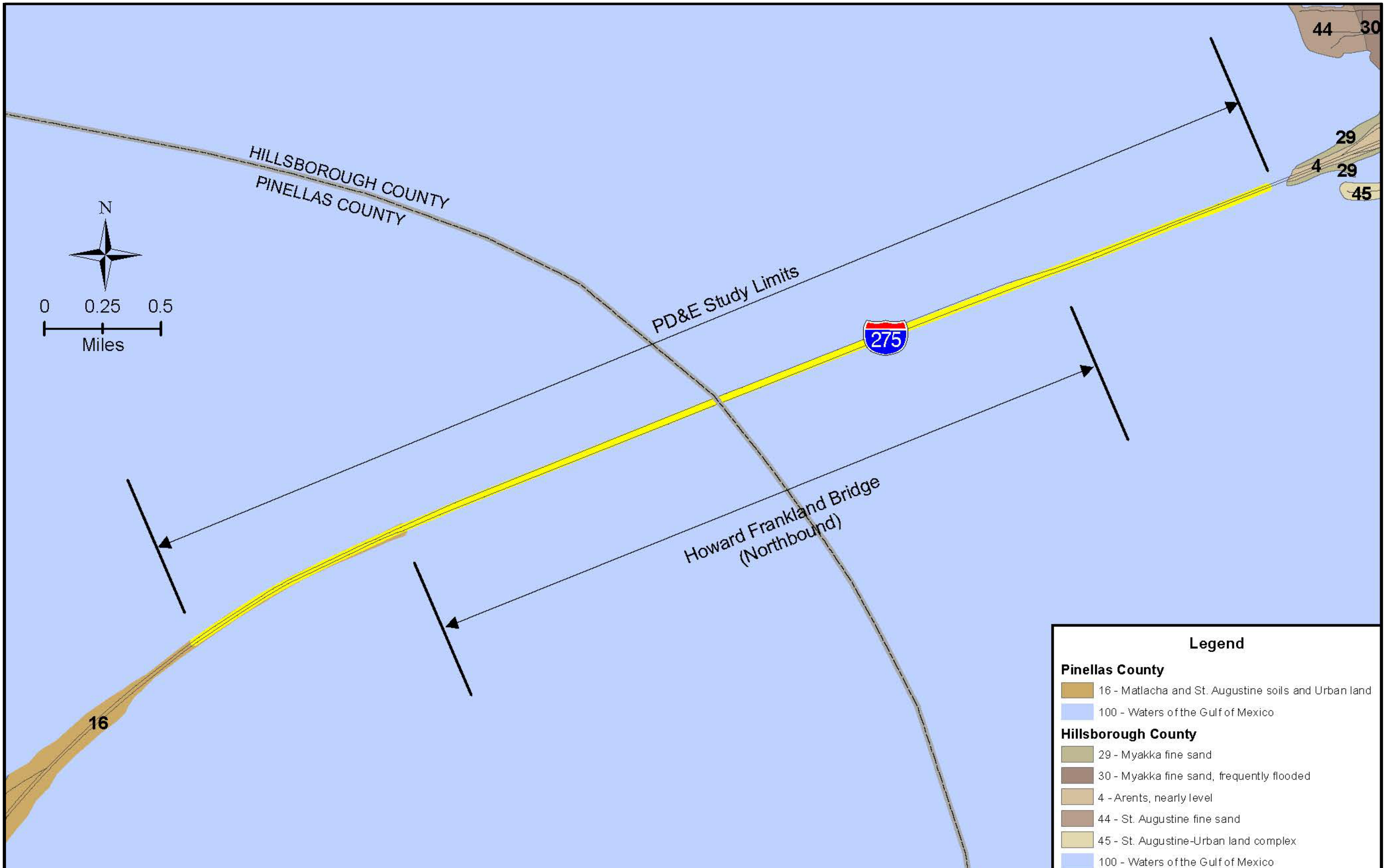
The following section presents information summarized from the Pinellas County Soil Survey and the Hillsborough County Soil Survey, as contained in the *Geotechnical Technical Memorandum* prepared for this study.

Pinellas County Soils - Based on a review of the Pinellas County Soil Survey published by USDA-Natural Resources Conservation Service (NRCS), it appears that there is one (1) soil-mapping unit included within the Pinellas County project limits (**Figure 4-6** and **Table 4-1**). The mapped soil unit along the Pinellas County side of the causeway is identified as Matlacha and St. Augustine Soils and Urban Land (map unit 16). The general soil descriptions are presented in the sub-sections below, as described in the Web Soil Survey. The table following the soil descriptions summarizes information on the soil mapping unit obtained from the Web Soil Survey.

<u>Matlacha and St. Augustine Soils and Urban Land (Unit 16)</u>

The Matlacha component makes up 32 percent of the map unit. Slopes are 0 to 2 percent. This component is on fills on ridges on marine terraces on coastal plains. The parent material consists of sandy mine spoil or earthy fill. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. This soil's seasonal zone of water saturation is at 30 inches.

The St. Augustine component makes up 32 percent of the map unit. Slopes are 0 to 2 percent. This component is on ridges on marine terraces on coastal plains. The parent material consists of sandy mine spoil or earthy fill. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded or ponded. This soil's seasonal zone of water saturation is at 27 inches.



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Soils Map of Study Area

Figure 4-6

Table 4-1 Pinellas County USDA-NRCS Soil Survey Information

USADA Map Unit and Soil Name	Depth (in)	Soil Classification		Permeability	Ph	Seasonal High Water	
		USCS	AASHTO			Depth (ft)	Months
(16) Matlacha-St. Augustine-Urban Land	0 – 42	SP, SP-SM	A-3	2.0 – 6.0	6.1 – 8.4	2.0 – 3.0	June - Oct
	42 – 80	SP, SP-SM	A-3	6.0 – 20.0	6.1 – 8.4		
	0 – 8	SP, SP-SM	A-3	6.0 – 20.0	6.1 – 8.4	1.5 – 3.0	June - Oct
	8 – 33	SP-SM	A-2-4	2.0 – 20.0	6.1 – 8.4		
	33 – 48	SP, SP-SM	A-3	6.0 – 20.0	6.1 – 8.4		
	48 – 63	SM, SP-SM	A-2-4	2.0 – 20.0	6.1 – 8.4		
	63 – 80	SP, SP-SM	A-3	6.0 – 20.0	6.1 – 8.4		
	--	--	--	--	--	--	--

In areas mapped as Urban Land, 85 percent or more of the surface is covered by streets, parking lots, buildings or other structures. Most areas of Urban Land are artificially drained by sewer systems, gutters, tile drains and surface ditches lower historic water tables. Specific soil information for the Urban Land mapping unit is not available in the Soil Survey. The soil unit presented above is part of the artificial causeway leading to the HFB.

Hillsborough County Soils - Based on a review of the Hillsborough County Soil Survey published by USDA-NRCS, it appears that there are two (2) soil-mapping units noted within the Hillsborough County project limits (**Figure 4-6** and **Table 4-2**). The mapped soil units along the Hillsborough County side of the causeway are identified as Arents, nearly level (map unit 4) and Myakka fine sand (map unit 29). The general soil descriptions are presented in the sub-sections below, as described in the Web Soil Survey. The table following the soil descriptions summarizes information on the soil mapping units obtained from the Web Soil Survey.

Arents, nearly level (Unit 4)

The Arents component makes up 100 percent of the map unit. Slopes are 0 to 5 percent. This component is on rises on marine terraces on coastal plains, fills. The parent material consists of altered marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. This soil's seasonal zone of water saturation is at 27 inches.

Myakka fine sand (Unit 29)

The Myakka component makes up 89 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. This soil's seasonal zone of water saturation is at 12 inches.

Table 4-2 Hillsborough County USDA-NRCS Soil Survey Information

USDA Map Unit and Soil Name	Depth (in)	Soil Classification		Permeability (in/hr)	Ph	Seasonal High Water Table	
		USCS	AASHTO			Depth (ft)	Months
(4) Arents	0 – 10	SP, SP-SM	A-1-b, A-2-4, A-3	6.0 – 20.0	6.6 – 8.4	1.5 – 3.0	June – Nov
	10 – 32	SP, SP-SM	A-2-4, A-3	6.0 – 20.0	5.6 – 8.4		
	32 – 60	SP, SP-SM	A-2-4, A-3	6.0 – 20.0	5.6 – 6.5		
(29) Myakka	0 – 5	SP, SP-SM	A-3	6.0 – 20.0	3.5 – 6.5	0.5 – 1.5	June – Sept
	5 – 20	SP, SP-SM	A-3	6.0 – 20.0	3.5 – 6.5		
	20 – 30	SM, SP-SM	A-2-4, A-3	0.6 – 6.0	3.5 – 6.5		
	30 – 80	SP, SP-SM	A-3	6.0 – 20.0	3.5 – 6.5		

Groundwater Conditions - The groundwater along the causeway alignment is anticipated to be consistent with sea level and will be tidally influenced. The groundwater table at the end bents and approaches to the HFB along the causeway will also be tidally influenced.

Poteniometric Surface Maps - Based on a review of the "Potentiometric Surface of the Upper Floridan Aquifer, West Central Florida" maps published by the U.S. Geological Survey, the potentiometric surface elevation across the bridge site is approximately +5 feet NGVD 29. As indicated in Section 2.1, the mudline elevations range from approximately -20 to -10 feet across Old Tampa Bay and +0 to +10 along the causeways. It should be noted that artesian conditions were not noted within test borings completed by others at the project site.

4.1.9 Crash Data & Safety Analysis

Traffic crash data for the HFB for years 2005 through 2009 for the Hillsborough and Pinellas County segments were obtained from the FDOT crash database. Information included the crash location, type of crash, road surface condition, time of day, influence of drug and alcohol, lighting condition, and other data. In this section, only the crashes for the northbound HFB structure are discussed since this study only considers the northbound bridge replacement. During the 5-year analysis period, a total of 585 crashes involving a total of 6 fatalities and 389 injuries were reported to occur along the northbound structure of the HFB. Traffic crashes per year are summarized in **Figure 4-7.**

The distribution of crash types was also investigated. It was found that about 53 percent were rear-end crashes. In addition, there were a high percentage of sideswipe crashes (17 percent) that occurred "due to improper lane changes". Many crashes were also reported as hit concrete barrier wall, hit utility/light pole, hit guard rails, and over-turned vehicles which have been categorized as "other" crash types (30 percent).

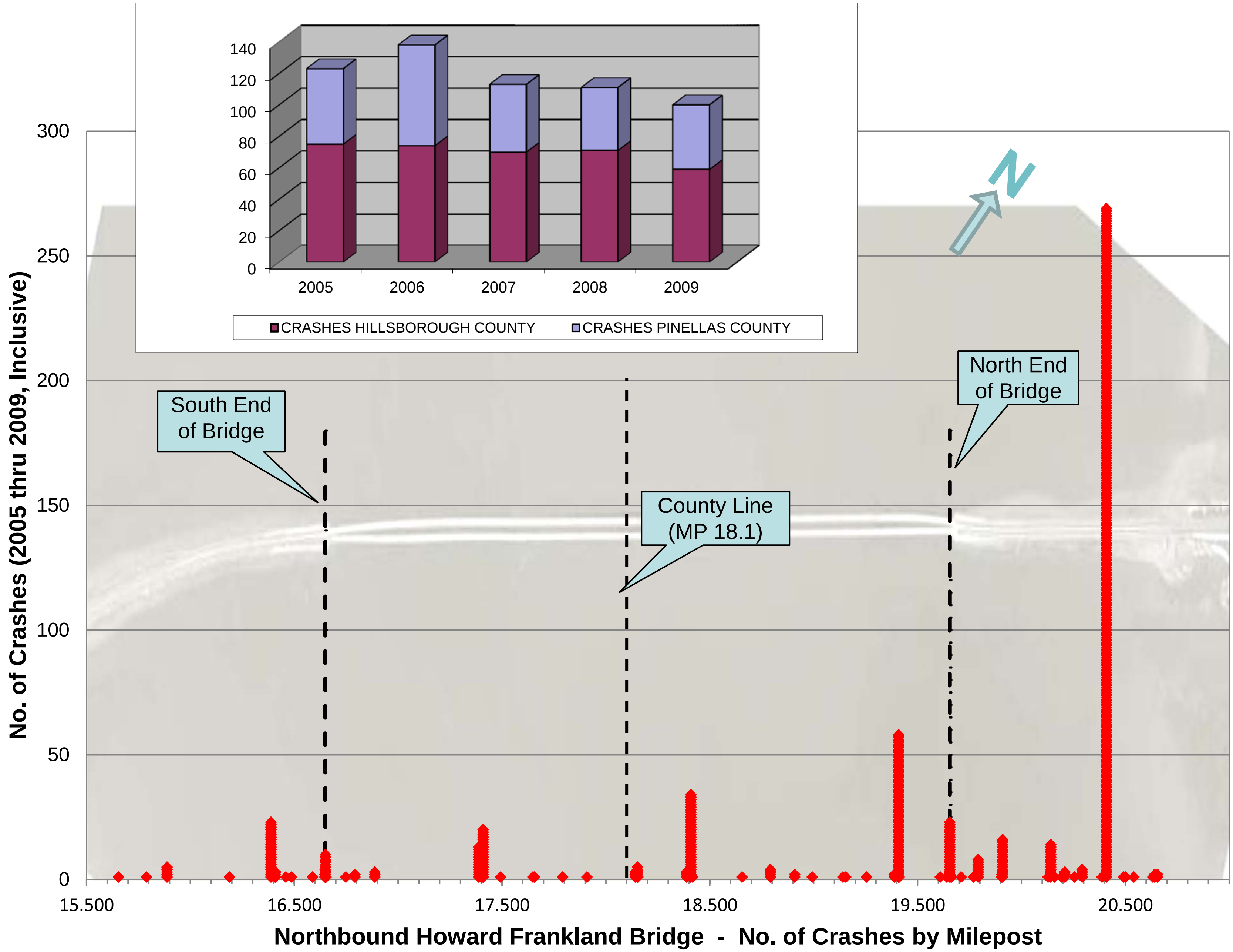
The estimated economic loss or the societal cost of these crashes is estimated to be approximately $14.4 million, as shown in **Table 4-3**, based on unit costs from the National Safety Council for 2006.

Table 4-3 Estimated Economic Loss for Crashes

Crash Type	Estimated 2006 Unit Cost*	Estimated Number of Crashes 2005 - 2009	Economic Loss ($millions)
Fatal	$1,210,000	6	$7.3
Non-fatal Disabling Injury	$55,000	53	$2.8
Property Damage Crash**	$8,200	526	$4.3
Totals			$14.4

*Unit costs based on National Safety Council costs for 2006.
**Includes non-disabling injuries

The location of the crashes on the bridges was also investigated. The location of reported crashes for the northbound bridge is also shown in **Figure 4-7**. A significant number of crashes reportedly occurred north of the bridge, within the study limits. These crashes are likely related to congestion occurring downstream, near the I-275 interchanges at Kennedy Boulevard and Memorial Highway.



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Traffic Crashes by Location

Figure 4-7

Traffic crash rates were also investigated for the southbound and northbound bridges, both with and without the roadway approach segments. These rates are summarized in **Table 4-4** below.

Table 4-4 Comparison of Crash Rates by Bridge and Segment Length

Bridge	5-Year Total Number of Crashes	AADT*	Segment Length (Mi)	Average Crash Rate over 5-Year Period	5-Year Average Statewide Crash Rate**	Ratio of Actual to Statewide Crash Rate
5-Mile Study Area						
SB Bridge & Approaches	292	70,150	5.006	0.46	0.53	0.85
NB Bridge & Approaches	585	70,150	5.006	0.91	0.53	1.71
3-Mile Bridge Only						
SB Bridge Only	168	70,150	3.006	0.44	0.53	0.82
NB Bridge Only	212	70,150	3.006	0.55	0.53	1.03
NB Compared to SB:	26% Higher			25% Higher		26% Higher

Crash rates expressed as crashes per million vehicle miles of travel
*Average AADT for years 2005 through 2009 from FTI 2011 DVD with Traffic Balanced by Direction
**Statewide crash rate for average of urban and rural Interstate segments: Urban = 0.691; rural = 0.378; Average = .535

To fairly compare the crash rates between the two HFB bridges, it is necessary to only consider crashes which occurred within the 3-mile milepost limits for the HFB, as summarized in the bottom half of **Table 4-4**. For the 5-year study period, the northbound bridge had approximately 26 percent more crashes reported than for the southbound bridge, and the crash rate was also 26 percent higher. In addition, the crash rate for the northbound bridge was slightly higher than the statewide average for similar facilities, based on an average of the rates for urban and rural Interstates (since the bridge is located in an urban area but the isolated causeway has rural characteristics). The difference in crash rates between the southbound and northbound bridges might be, in part, due to the "substandard" design features of the older northbound bridge, such as narrower lanes and shoulders and the shorter vertical curves (less stopping sight distance) located near the "hump" in the center of the bridge. In addition, the added congestion northbound due to Kennedy/Memorial ramp area of I-275 might be a factor as well.

4.1.10 Intersections & Signalization

Not applicable for this bridge replacement study.

4.1.11 Lighting

Both HFB structures have highway lighting. The lights on the northbound HFB are 250 watt high-pressure sodium, with poles on each side, staggered spacing, mounted at 45-foot heights. They are maintained for the FDOT by a private contractor.

4.1.12 Utilities ITS & Railroads

Numerous utilities are located within the Study Area, as listed in **Table 4-5**. A small house-like electric load center structure is located on the south side of the causeway, near each end of the bridge. In addition to the utilities mentioned listed in the table, there is currently full Intelligent Transportation Systems (ITS) coverage in the bridge corridor. This includes dynamic message signs (DMS), closed-circuit television (CCTV) and detectors, in addition to related conduit, fiber and power. CCTV's are installed at approximately one-mile intervals, DMS as required, usually before every interchange and detectors at ½-mile intervals. Additional ITS projects are planned near the Kennedy/Airport off ramp and the Memorial on-ramp and on I-275 southbound from Ashley (approximately) to the Airport interchange. In addition, "Highway advisory radio (HAR) is to be installed in the next two years or so", according to the ITS Operations Manager for FDOT District Seven.

Table 4-5 Existing Utilities in the Study Area

Utility Owner	Type of Utility	In Pinellas County?	In Hillsborough County?
Progress Energy – St. Petersburg	Underground Electric Power	Yes	
Verizon Florida	Cable/Fiber/Phone	Yes	Yes
Knology Broadband of Florida	Fiber optic	Yes	
Pinellas County South Water	Water and Sewer	Yes	
Fiberlight LLC	Fiber optic		Yes
TW Telecom Tampa	Fiber optic		Yes
AT&T	Fiber optic		Yes
Level 3 Communications	Fiber optic		Yes
MCI	Fiber optic		Yes
TECO Peoples Gas-Tampa	Gas		Yes
City of Tampa Transportation Div.	Traffic Sign and Signal Infrastructure		Yes
Tampa Electric Co.	Underground Electric Power		Yes
Bright House Networks	Cable TV		Yes
XO Communications – Tampa	Fiber optic		Yes

Source: Based on a Sunshine One Call ticket dated 5/11/2012.

4.1.13 Pavement Conditions

A flexible pavement condition survey was conducted by FDOT in 2012 for the project corridor. Each section of pavement is rated for cracking, ride and rutting on a 0-10 scale with 0 the worst and 10 the best. Any rating of 6.4 or less is considered deficient pavement and is marked by an asterisk. **Table 4-6** identifies the existing and projected pavement condition ratings for I-275 on either side of the northbound HFB. The existing pavement is in good condition and is projected to be acceptable through 2017 based on straight-line extrapolation. No ratings for rutting were provided.

Table 4-6 Pavement Condition Survey Results

Beginning Mile Post	Ending Mile Post	Last Year Resurfaced	Condition Category	Year 2012 Rating (0-10)	Year 2017 Projected Ratings (Based on Composite of Both Directions)
Pinellas County – Northbound I-275					
14.357	16.649	2006	Cracking	10.0	7.5
			Ride	9.0	7.8
Hillsborough County – Northbound I-275					
0.00	1.282	2003	Cracking	9.0	6.5
			Ride	8.7	7.3

Source: FDOT's Pavement Condition Forecast Reports for Pinellas and Hillsborough Counties, June 2012.

4.2 EXISTING STRUCTURES

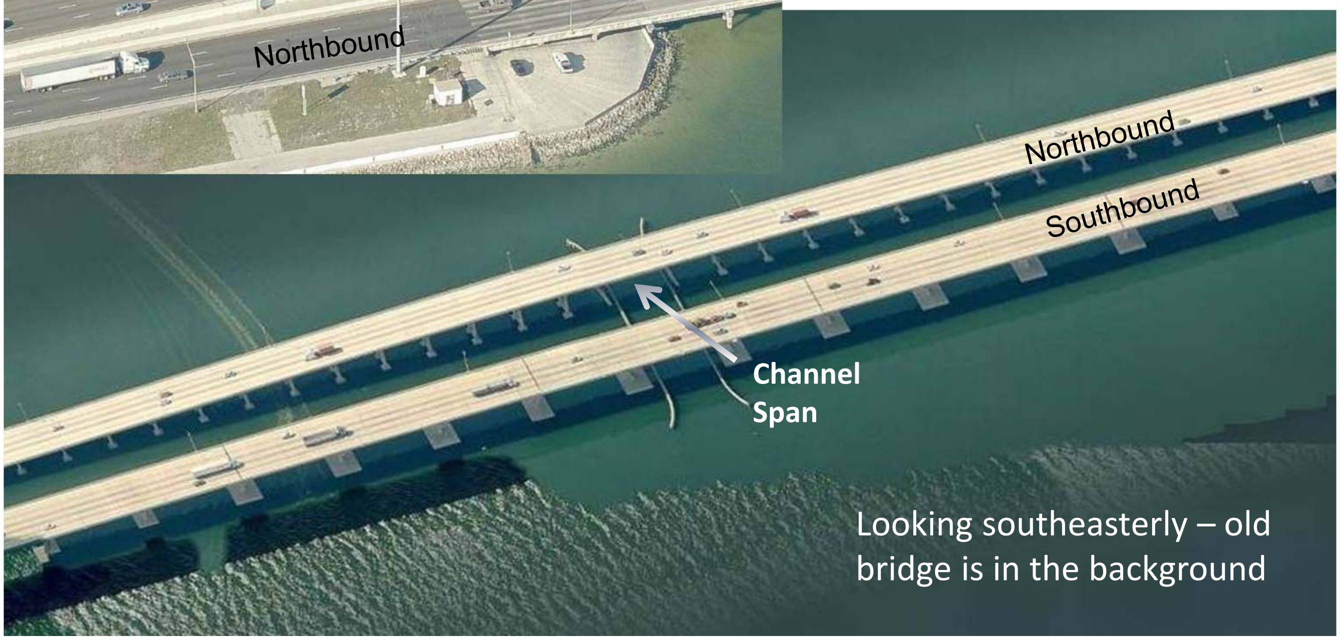
Photos of the existing bridge structures are included in **Figures 4-8** and **4-9**.

4.2.1 Type of Structure

The approximately 3 mile (15,872 feet or 3.006 miles) long northbound bridge (Bridge No. 150107) is a pre-stressed concrete stringer/girder structure with a reinforced concrete flat slab deck; the substructure consists of concrete pile bents and concrete footer piers. The typical bent contains eight pre-stressed concrete piles and ten similar piles in the tower bents. Each pier contains three support columns over square footers and two struts. There are a total of 288 bents and 30 piers. Except for seven bents (including end bents), all pile bents and piers are in direct contact with the water. The piles on the end-bents are embedded within the embankment and are not accessible for inspection. The bridge is symmetrical about the 98-foot long AASHTO Type IV concrete girder channel span. At each side of the channel span there are three 1-foot-7-inch thick simply-supported 33-foot long reinforced concrete flat slab approach spans, 143 48-foot long simply-supported AASHTO Type II prestressed concrete girder spans and 14 simply-supported 66-foot long AASHTO Type II prestressed concrete girder spans.

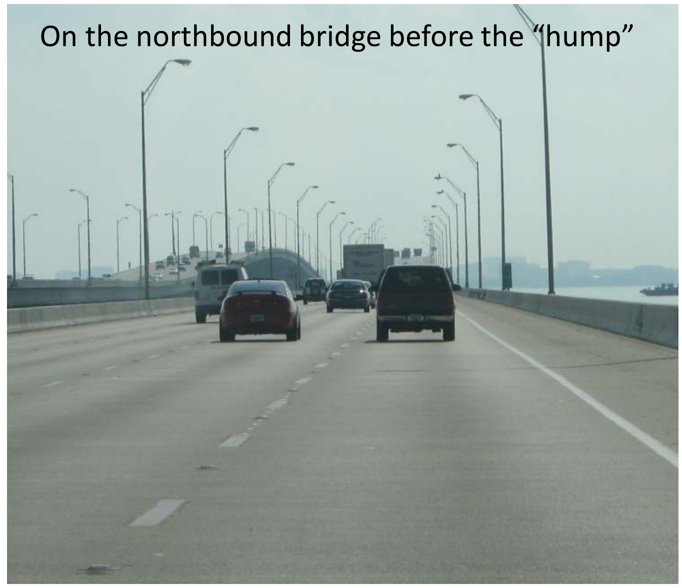
Aerial view of both bridges. looking northeasterly →

Bridge No. 150107 (northbound)
Bridge No. 150210 (southbound)

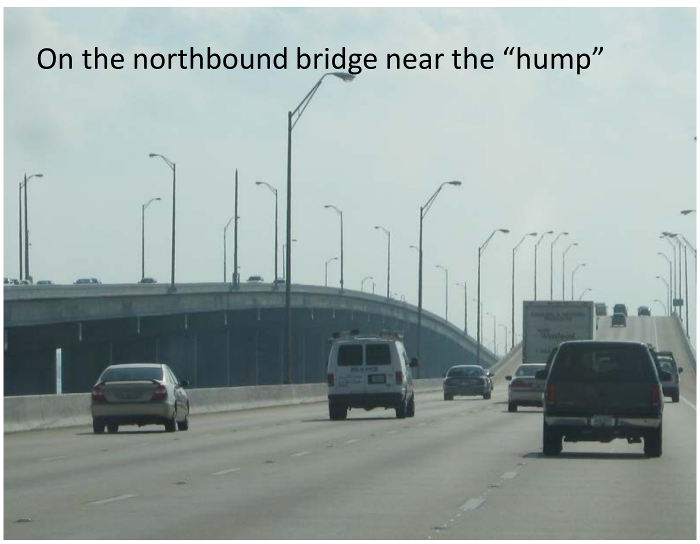


Northbound Howard Frankland Bridge (I-275/SR 93) Replacement PD&E Study WPI Segment No. 422799 1 Pinellas & Hillsborough Counties	Aerial Photos of the Existing Bridges	**Figure 4-8**

On the causeway approaching the northbound bridge

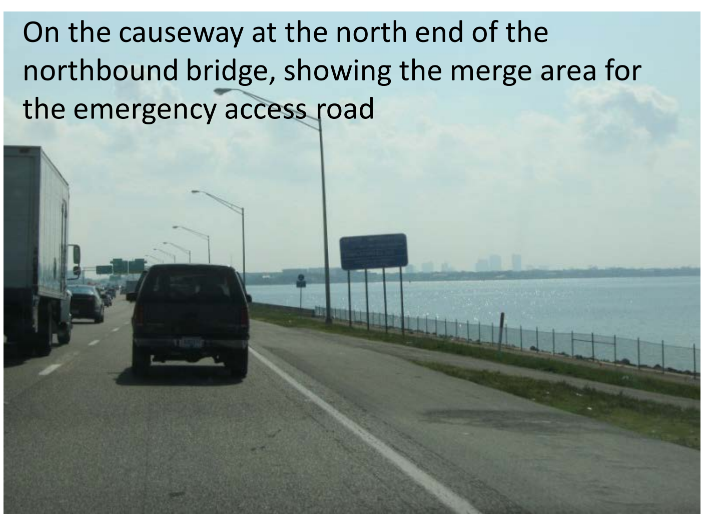


On the northbound bridge before the "hump"

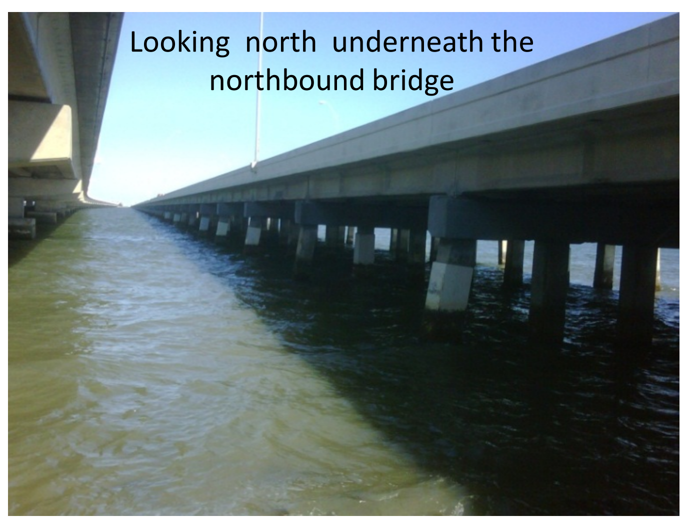


On the northbound bridge near the "hump"

On the northbound bridge after the "hump"



On the causeway at the north end of the northbound bridge, showing the merge area for the emergency access road



Looking north underneath the northbound bridge

STATE OF FLORIDA · DEPARTMENT OF TRANSPORTATION	**Northbound Howard Frankland Bridge (I-275/SR 93) Replacement PD&E Study** WPI Segment No. 422799 1 Pinellas & Hillsborough Counties	Ground-Level Photos of the Northbound Bridge (Bridge No. 150107)	**Figure 4-9**

The four-lane northbound bridge is 63'-1" wide measured from outside of the parapet walls, also considered "out-to-out". The existing typical sections for both the southbound and northbound structures are shown in **Figure 4-10**. The northbound bridge includes both 11 and 12-foot lane widths in addition to a 4-foot inside shoulder and a 10-foot outside shoulder. The outside travel lane in each direction serves as an auxiliary lane since it begins/ends at the SR 686/Roosevelt Blvd/118th Avenue interchange in Pinellas County to the south and begins/ends at the SR 60 interchange in Hillsborough County to the north(east). These lanes are marked "Aux. Lane" on Figure 4-10. In 1991 when it was converted for northbound only travel, it was rehabilitated for four 12-foot lanes and two 6-foot shoulders but was later restriped in 1999. Current standards require minimum 10-foot inside and outside shoulders for 6 or more lane freeways.

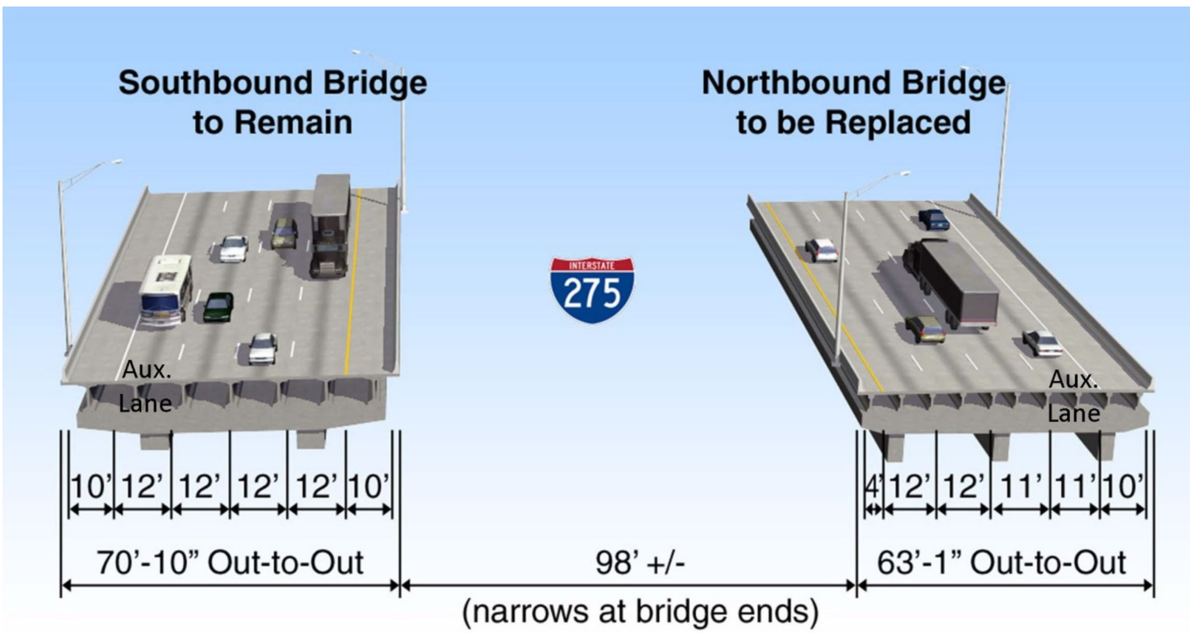


Figure 4-10 Existing Bridge Typical Sections

A comparison between the two HFB structures is included in **Table 4-7**. The older structure (Bridge No. 150107) serves northbound traffic while the newer bridge (Bridge No. 150210) serves southbound traffic.

Table 4-7 Comparison of Two Howard Frankland Bridge Structures

Bridge Element	Southbound Bridge #150210	Northbound Bridge #150107
Year Opened to Traffic	1991	1960
Type of Construction	Florida Bulb T Superstructure	AASHTO Type II & IV concrete girders
Number of Spans	111 spans @ 143' = 15,873'	321 spans = 15,872' 6 @ 33'; 286 @ 48'; 28 @ 66' & 1 @ 98'
Length of Center Channel Span	143 feet	98 feet
Number of Piers and Bents	110 piers and 2 end pile bents	290 pile bents, 30 piers & 2 end bents
Overall Bridge Width (out-to-out)	70 feet – 10 inches	63 feet – 1 inch
Horizontal Navigational Clearance	75 feet	75 feet
Vertical Clearance at Center	49.3 feet	43.5 feet +/-
Profile Grade Elevation of Approach Spans	21.3 feet NGVD29	16 feet +/- NGVD29
Sufficiency Rating*	94.7	80.0
Health Index*	99.39	87.2
Design Speed	70 mph	Estimated to be 50-55 mph

*Source: FDOT 2013 Inspection Reports

4.2.2 Condition & Year of Construction

The existing northbound HFB (Bridge No. 150107) was designed in 1956 and opened to bidirectional traffic on January 15, 1960. Since then, four different rehabilitation projects have been undertaken.

In 1987, repairs included the installation of a cathodic protection system at pier numbers 160 and 163 and restoration of spalled concrete areas. In 1991, after completion of the new southbound bridge, a bridge rehabilitation project was undertaken including various superstructure repairs such as removal of the center and exterior barrier walls, construction of new barrier walls on the exterior, placement of a concrete overlay, and replacement of the flat slab spans at each end and a precast span at the east end. Substructure repairs included the installation of a cathodic protection system with metalizing and pile jackets as well as cleaning and repainting of the steel bearing assemblies.

In 1992, a bridge rehabilitation test project was undertaken to include a cathodic protection system, pile jackets, and beam repairs with zinc masking. In 2004, a bridge rehabilitation project was undertaken to include the installation of cathodic protection integral structural and nonstructural pile jackets, zinc metalizing, restoration of spalled areas, and beam repairs. In 2009, a project was begun to repair corrosion on the bridge bearings (that allow for expansion and contraction of certain bridge components due to temperature changes). It was completed in 2011. Additional rehab/repair work has been ongoing since then.

Bridge Condition Terminology

The term "**structurally deficient**" means that the department believes a bridge should undergo a series of repairs or replacement within the next six years. The department's policy is to repair or replace all the structurally deficient state-owned bridges during that time.

The term "**functionally obsolete**" means that a bridge does not meet current road design standards. For example, some bridges are "functionally obsolete" because they were built at a time when lane or shoulder widths were narrower than the current standard.

The "**health index**" is a tool that measures the overall condition of a bridge. The health index typically includes about 10 to 12 different elements that are evaluated by the department. A lower health index means that more work would be required to improve the bridge to an ideal condition. A health index below 85 generally indicates that some repairs are needed, although it doesn't mean the bridge is unsafe. A low health index may also indicate that it would be more economical to replace the bridge than to repair it.

The "**sufficiency rating**" is a tool to help determine whether a bridge that is structurally deficient or functionally obsolete should be repaired or just replaced. The sufficiency rating considers a number of factors, about half of which relate to the condition of the bridge itself. The sufficiency ratings for bridges are part of a formula used by the Federal Highway Administration when it allocates federal funds to the states for bridge replacement.

Based on the bridge inspection performed in September 2009, the bridge was previously classified as *structurally deficient* with a sufficiency rating of 61.8 and a Health Index of 83.10. The most recent bridge inspection report, completed in October 2013, resulted in the bridge's sufficiency rating being raised to 80.0, due to the completed and ongoing rehabilitation projects. In addition, the Health Index was increased to 87.2.

Recent condition and appraisal ratings are summarized below in **Table 4-8**, from the Comprehensive Inspection & Bridge Profile Reports prepared for FDOT. The September 2012 inspection report included the following recommendations for corrective action:

Deck: repair spalls and delaminated areas

Superstructure: repair major beam diaphragm spalls, strut deficiencies, delaminations, cracks

Substructure: clean plugged vent holes in pilings, repair piling cracks, spalls and delaminations; repair footer delaminations, repair corrosion in bent caps, repair spalls and delaminations on bent caps, repair cracks in pile jackets (and continue the ongoing repairs to bearings)

In addition to the above data, the Design Load is HS 20, the Operating Rating is 79.3 tons, and the Inventory Rating is 48.5 tons. The bridge is not posted for weight restrictions as none are needed based on the most recent load analysis.

Table 4-8 Summary of Northbound Bridge Condition Ratings

	Ratings with Definitions	
National Bridge Inventory (NBI) Condition Ratings	**9/30/2010 Inspection above Water**	**9/29/12 Inspection Above Water**
Channel	7 Minor Damage	7 Minor Damage
Deck	6 Satisfactory	6 Satisfactory
Superstructure	4 Poor	**5 Fair**
Substructure	5 Fair	5 Fair
Waterway	8 Equal Desirable	8 Equal Desirable
Appraisal Ratings		
Structural Evaluation	4 Minimum Tolerable	**5 Above Minimum Tolerable**
Deficiency	"structurally deficient"	**Not Deficient**
Deck Geometry	4 Tolerable	4 Tolerable
Pier Protection	2 In-Place, Functioning	2 In-Place, Functioning
Scour Critical Bridges	5 Stable within footing	5 Stable within footing
Overall Sufficiency Rating	61.8	**81.3 (80.0 10/31/13)**
Health Index	85.03	99.00 (87.2 10/31/13)

*Repair/replacement of bridge bearings was still ongoing at the time of this inspection under FPN 423478-1-52-01. The inspection cycle was changed back to 24 months due to the improved superstructure rating. Changes are shaded in light blue. The sufficiency rating and Health Index were revised again based on a newer inspection completed on 10/31/13.

4.2.3 Historical Significance

According to the *Cultural Resource Assessment Survey Report* completed for this PD&E Study, the HFB is neither distinguished by its significant historical associations nor by its engineering or architectural design. As a result, it is considered ineligible for listing in the *National Register of Historic Places (concurrence will be added after coordination with SHPO through FHWA)*.

4.2.4 Horizontal & Vertical Alignment and Clearances

The horizontal alignment of the roadway approaches and both HFB structures was previously discussed in Section 4.1.5. The horizontal alignment of the northbound bridge is tangent for the entire length of the 3-mile long structure. The horizontal separation between the two bridges reduces to less than 20 feet near either end of the bridges, where they tie in to the causeway approaches.

The existing profile for both HFB structures is shown in **Figure 4-11**. The top of deck elevation for most of the 3-mile northbound bridge is at about 16 feet. The newer southbound bridge was built about 5 feet higher and approximately 98 feet to the north. Using the K values shown for the vertical curves of the northbound bridge (from the as-built plans), the estimated design speed based the current FDOT's Plans Preparation Manual (PPM) would be between 50 and 55 mph, lower than today's 70 mph standard for Interstate highways. In addition, the vertical curves do not meet the current minimum length required by the PPM. Vertical curve values are given in **Table 4-9**. The K values for the newer southbound bridge meet or exceed the PPM requirements for a 70 mph design speed. The maximum grade on the older northbound bridge is 3.0 percent, while the maximum grade on the newer southbound bridge is 2.0 percent.

Table 4-9 Summary of Vertical Curves on the Existing NB Bridge

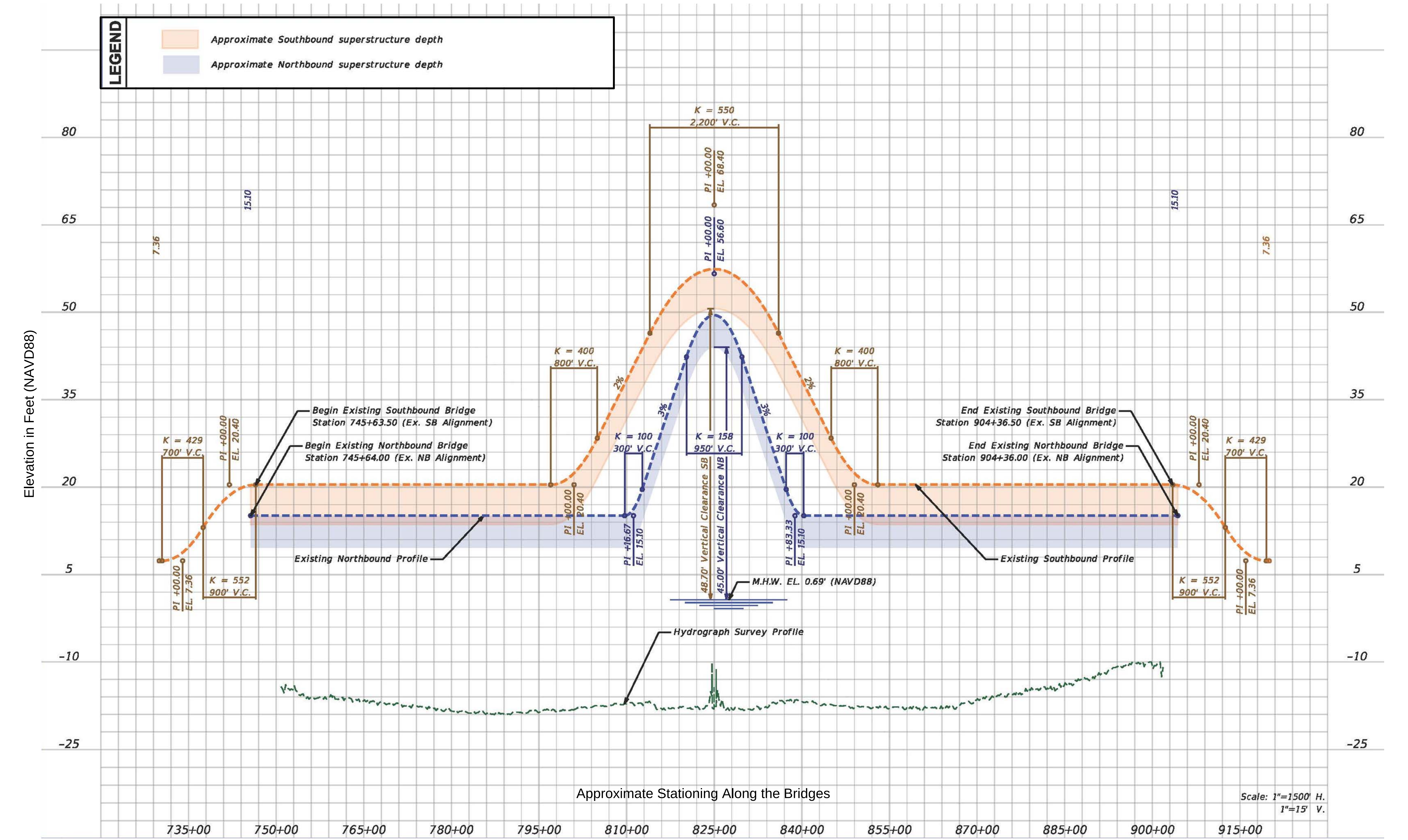
Curve(s)	Actual Length (L)	Minimum Length Required for Interstates[1]	Algebraic Difference in Grades (A)	Existing K Factor (K=L/A)	Minimum Required K for 70 mph design speed[2]
Crest Vertical Curve at the Center Span	950 ft	1000 ft	+3% - (-3%) = 6	158	506
2 Sag Vertical Curves on either side of Center	300 ft	800 ft	3 % - 0 % = 3	100	206

Notes:
[1] PPM Table 2.8.5 gives minimum values for crest vertical curves based on stopping sight distance (SSD) and Table 2.8.6 gives minimum values for sag vertical curves based on SSD and headlight sight distance
[2] PPM Table 1.9.2 shows 70 mph min. design speed required for rural/urban Interstates. Minimum K values are shown on PPM Tables 2.8.5 and 2.8.6 for crest and sag vertical curves, respectively.

The navigational clearances for the existing northbound bridge are 42.9 feet vertical and 72.1 feet horizontal, as shown in **Figure 4-12**. The mean high water (MHW) elevation reported is based on a previous study done by the Florida Department of Environmental Protection (FDEP) Bureau of Surveying and Mapping. Any references to MHW are based on the tide interpolation point #652 (located near the north end of the HFB) from the FDEP's Land Boundary Information System (LABINS) Mean High Water Interactive Map (http://data.labins.org/imf3/IMHW3/imfStyle2.jsp). According to the 2006 Structural Condition Assessment Report, the mean tidal change at the site is 2.8 feet with a maximum change of 3.5 feet.

4.2.5 Span Arrangement

The bridge has 314 continuous concrete spans and 6 approach spans, with a 98-foot long channel span, for a total of 321 spans. **Figure 4-13** shows the span arrangement on the original bridge plan and elevation sheet. On each side of the 98-foot channel span, from the outside to the center, are three 33-foot spans, 143 @ 48-foot spans and 14 @ 66-foot spans.



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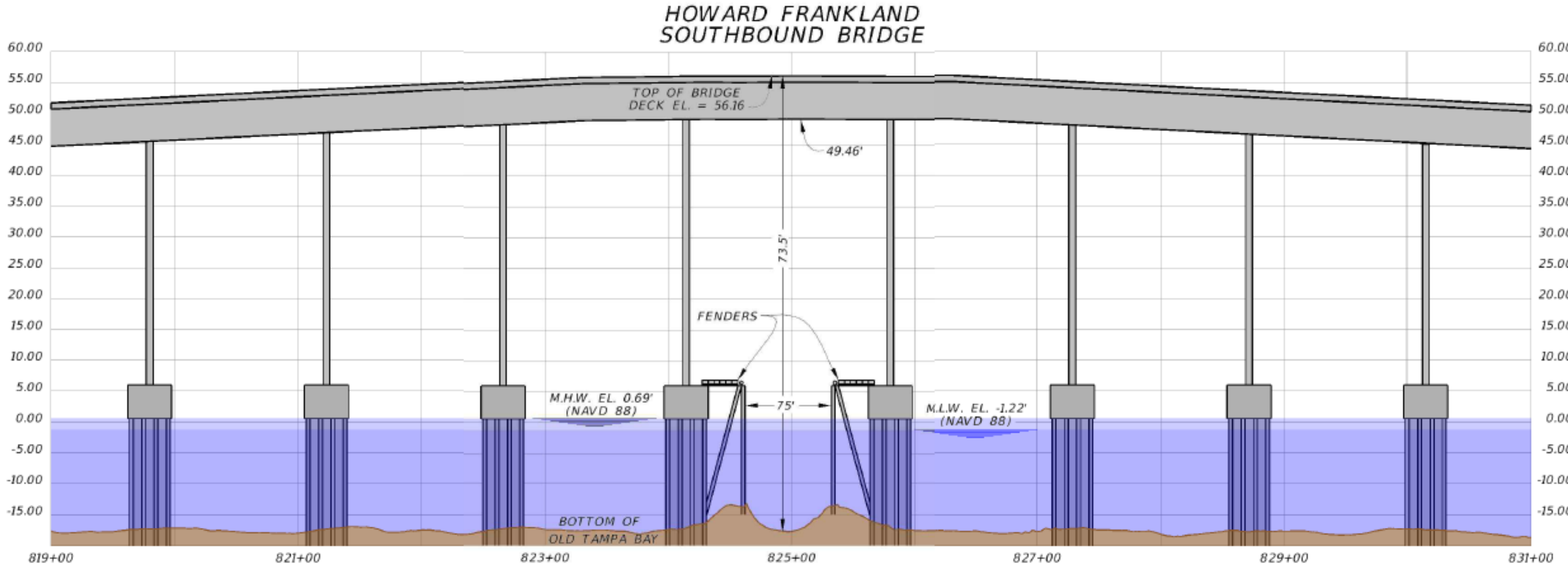
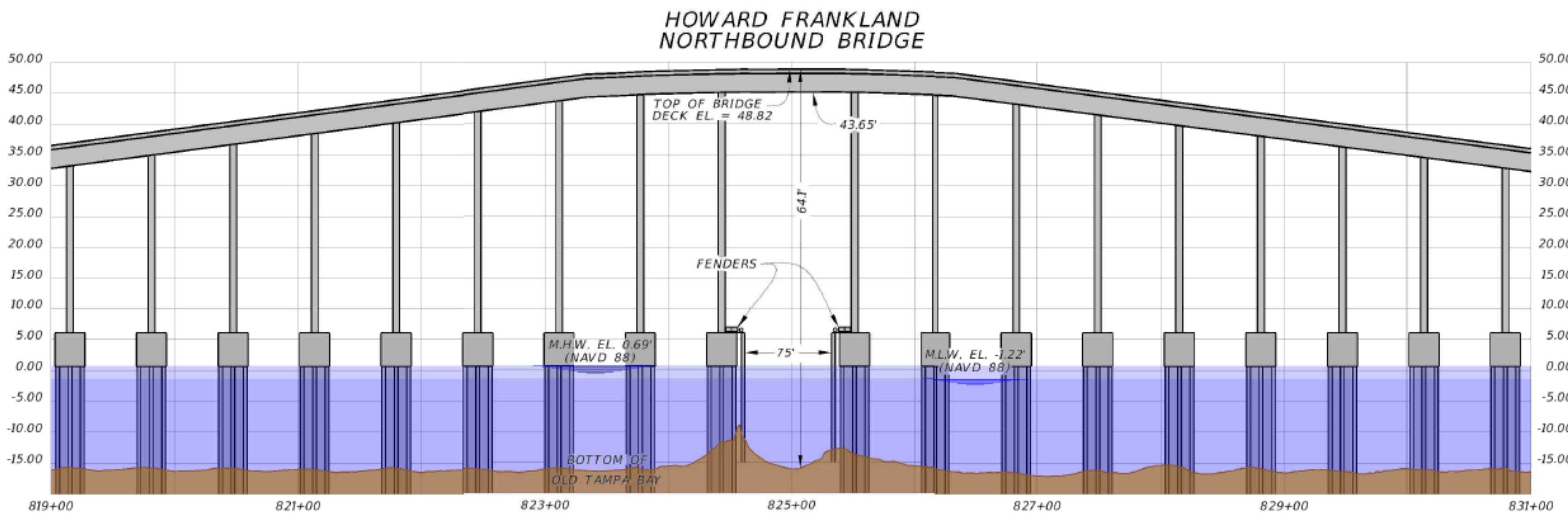
Existing Bridge Profiles

Figure 4-11





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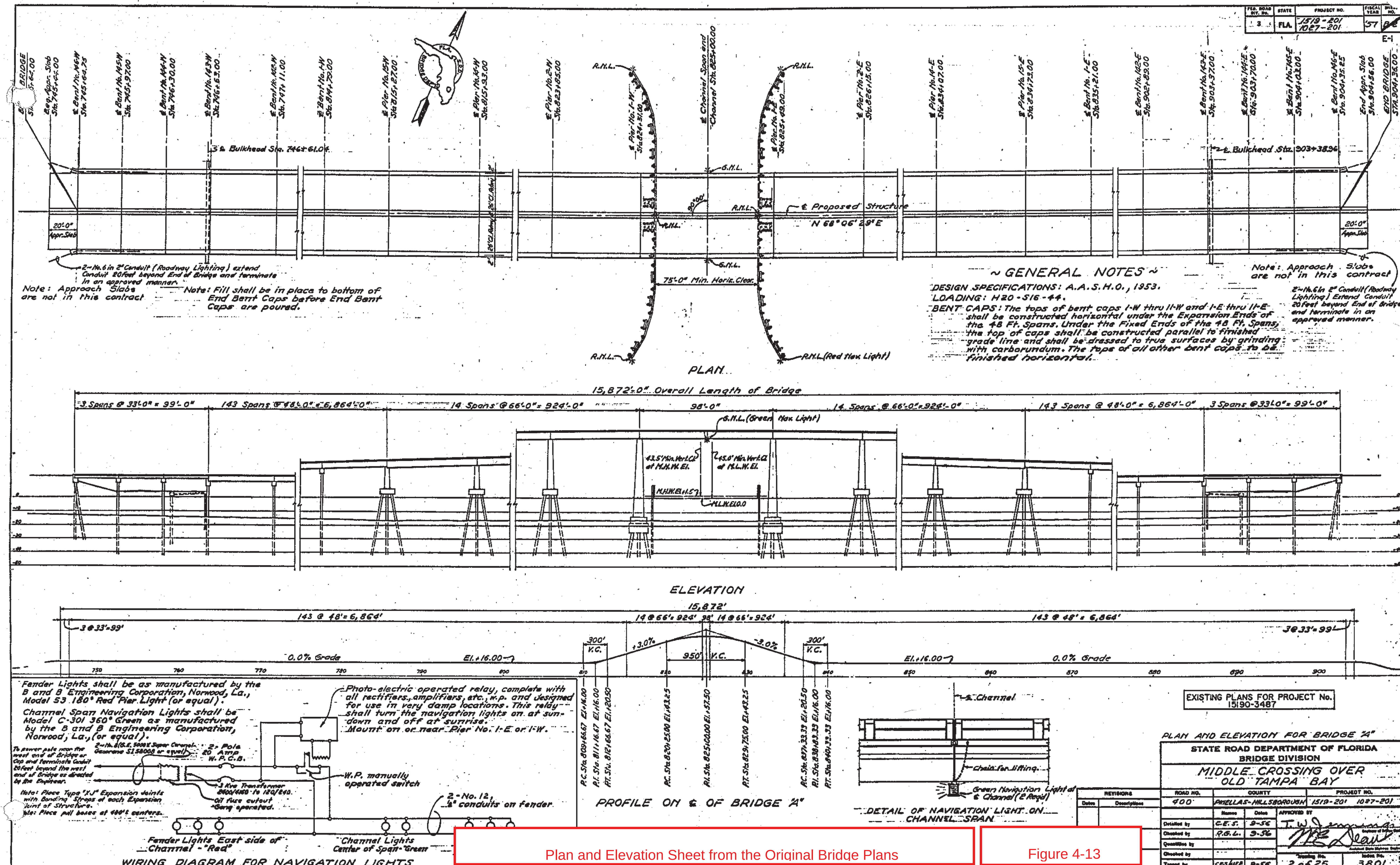
Elevation Views of Bridge Center Spans

Figure 4-12



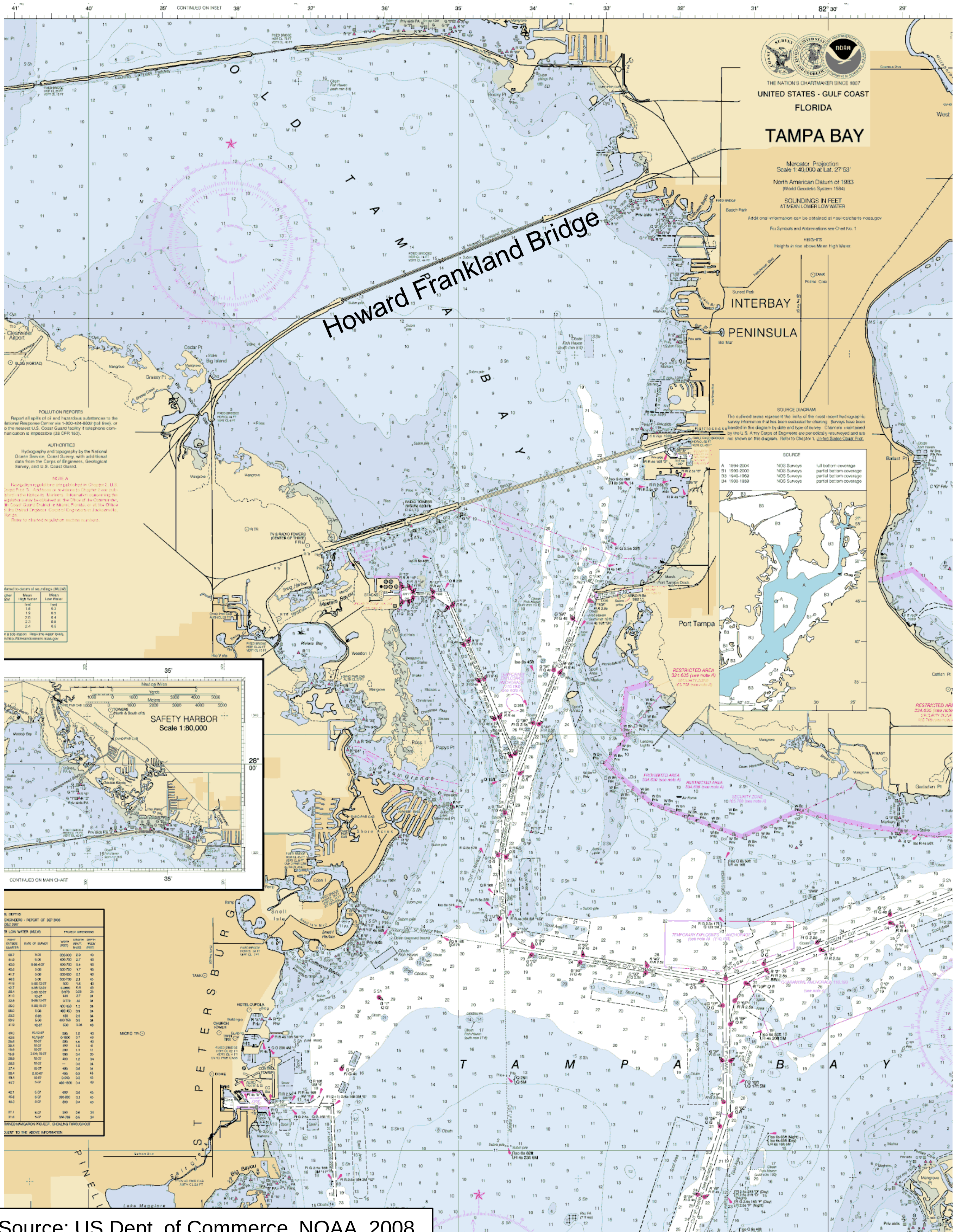
Plan and Elevation Sheet from the Original Bridge Plans

Figure 4-13

4.2.6 Channel Data

As shown in the navigational chart for Old Tampa Bay (**Figure 4-14**), there is no maintained navigational channel at the HFB. All channels maintained by the US Army Corps of Engineers end south of the Gandy Bridge. Based on a hydrographic survey conducted for the PD&E Study, the depth of the "channel" is approximately minus 15 feet NAVD88.

According to the *Cultural Resource Assessment Survey (CRAS) Report* prepared for this PD&E Study, "In general, the navigational charts from 1930 to 1988 show few significant changes to the depth and contour of Tampa Bay in the area of the HFB. Based on the navigational charts, it appears that the channel span was located to span the deepest portion of the bay. This channel has retained its basic flow pattern since the 1930s and, based on the navigation charts, has not been dredged (U.S. Department of Commerce 1928, 1930, 1935, 1943, 1959, 1969, 1978, 1988)." **Figure 4-15** is a channel profile plot showing minor changes in the Bay bottom profile along the bridge alignment between years 2000 and 2010



Source: US Dept. of Commerce, NOAA, 2008

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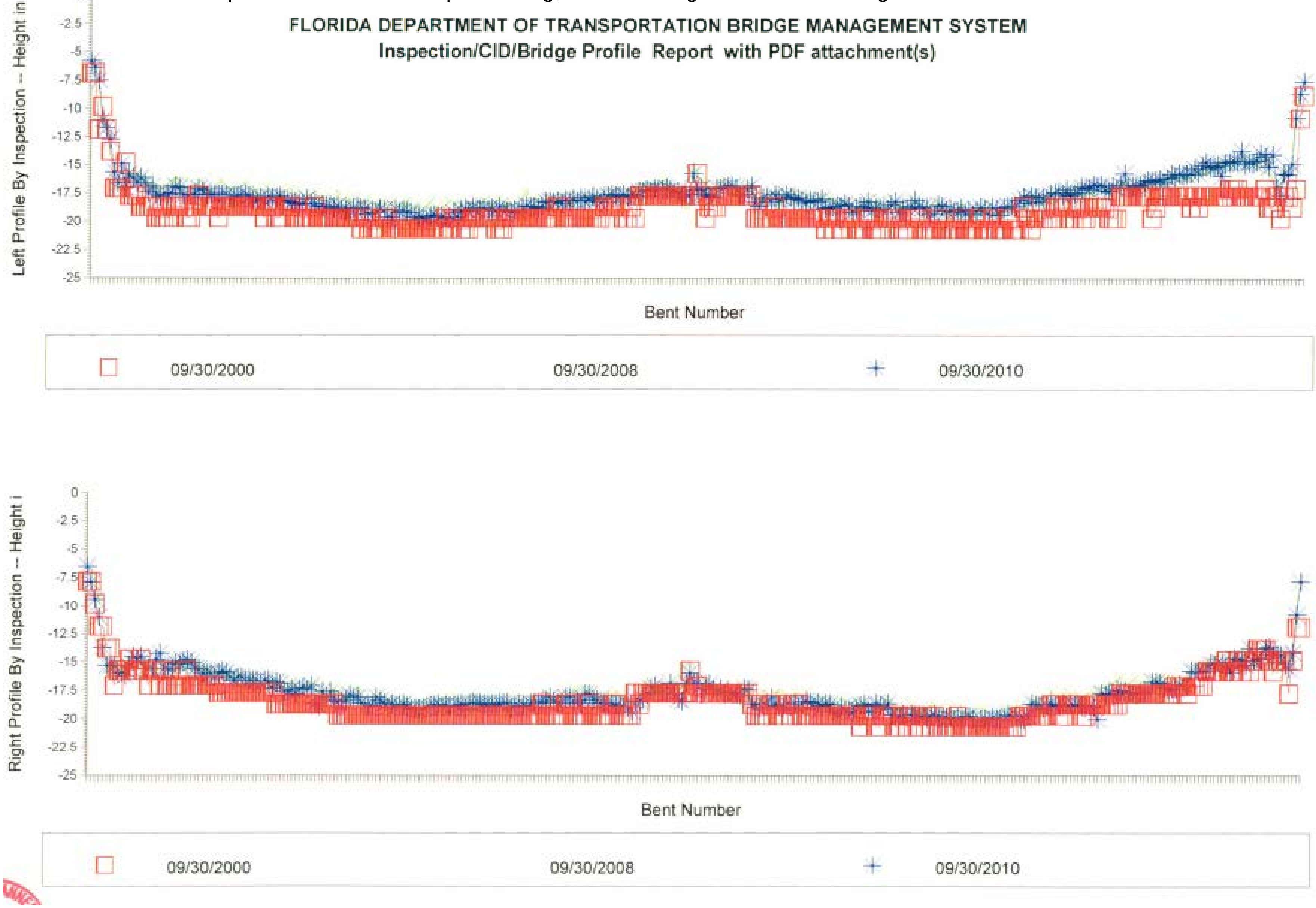
Navigational Chart for the Study Area

Figure 4-14

Depths measured from top of footing, on left and right sides of the bridge. **Source**:



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Northbound Bridge Channel Profile Plot for Years 2000 and 2010

Figure 4-15

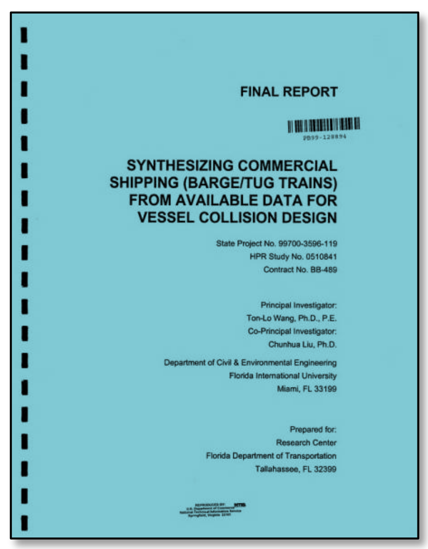
4.2.7 Ship Impact Data

Background Information and FDOT's Research

Accounting for potential waterway vessel collision is an integral component of structural design for any bridge spanning navigable waters. The 1980 collapse of the Sunshine Skyway Bridge marked a major turning point in increased concern for the safety of bridges crossing navigable waterways. In 1994, AASHTO adopted the Load and Resistance Factor Design (LRFD) Bridge Design Specifications, which incorporate the vessel collision provisions developed as part of a 1988 FHWA-sponsored research project. Current highway bridge design practice in Florida follows the AASHTO specifications. In bridge design, the probability of bridge collapse is currently estimated using procedures prescribed by the AASHTO specifications. However, due to the relative rarity of bridge collapses from vessel collision, the AASHTO expression was developed based on ship-to-ship collision data, rather than barge-to-bridge data.

The AASHTO guide specification for protection from vessel collisions provides three vessel impact design methods (I, II, and III).

- Method I is a semi-deterministic procedure that allows the designer to select a design vessel for collision impact.
- Method II is a probability-based technique in which the design vessel is selected based on accurate vessel traffic data.
- Method III employs a cost-effective analysis procedure to select the design vessel for collision impact and closely parallels techniques used in Method II.



FINAL REPORT

PB99-128894

SYNTHESIZING COMMERCIAL SHIPPING (BARGE/TUG TRAINS) FROM AVAILABLE DATA FOR VESSEL COLLISION DESIGN

State Project No. 99700-3596-119
HPR Study No. 0510841
Contract No. BB-489

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Prepared for:
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Florida Department of Transportation
Tallahassee, FL 32399

Although more difficult to apply than Method I, the AASHTO *Guide* strongly recommends using Method II for most bridges; however this requires statewide data, and the application of Method II for barge traffic is much more difficult than for ship traffic because of the many possible combinations of barge trains and lack of published barge accident data.

In the late 1990's, FDOT sponsored a research project (*Synthesizing Commercial Shipping [Barge/Tug Trains] from Available Data for Vessel Collision Design*, January 1999) to establish the commercial shipping traffic for all bridges located over navigable waterways in Florida. Knowing the commercial shipping traffic, a risk analysis can be performed which optimizes the vessel collision design. This data was developed statewide so that the commercial vessel traffic can be provided to design teams to reduce bridge design and construction costs by the use of consistent data and a uniform risk analysis approach. It was estimated that 401 bridge sites were qualified for this synthesization process at that time.

The U.S. Army Corps of Engineers Water Resources Support Center's Navigation Data Center (NDC) is responsible for establishing and maintaining a variety of navigation-oriented databases, including waterborne commerce, domestic commercial vessels, port facilities, lock facilities and lock operations, and navigation dredging projects. These databases are operated and maintained by the NDC's Waterborne Commerce Statistics Center (WCSC) in New Orleans. The data and information are available to all government agencies, organizations, and individuals.

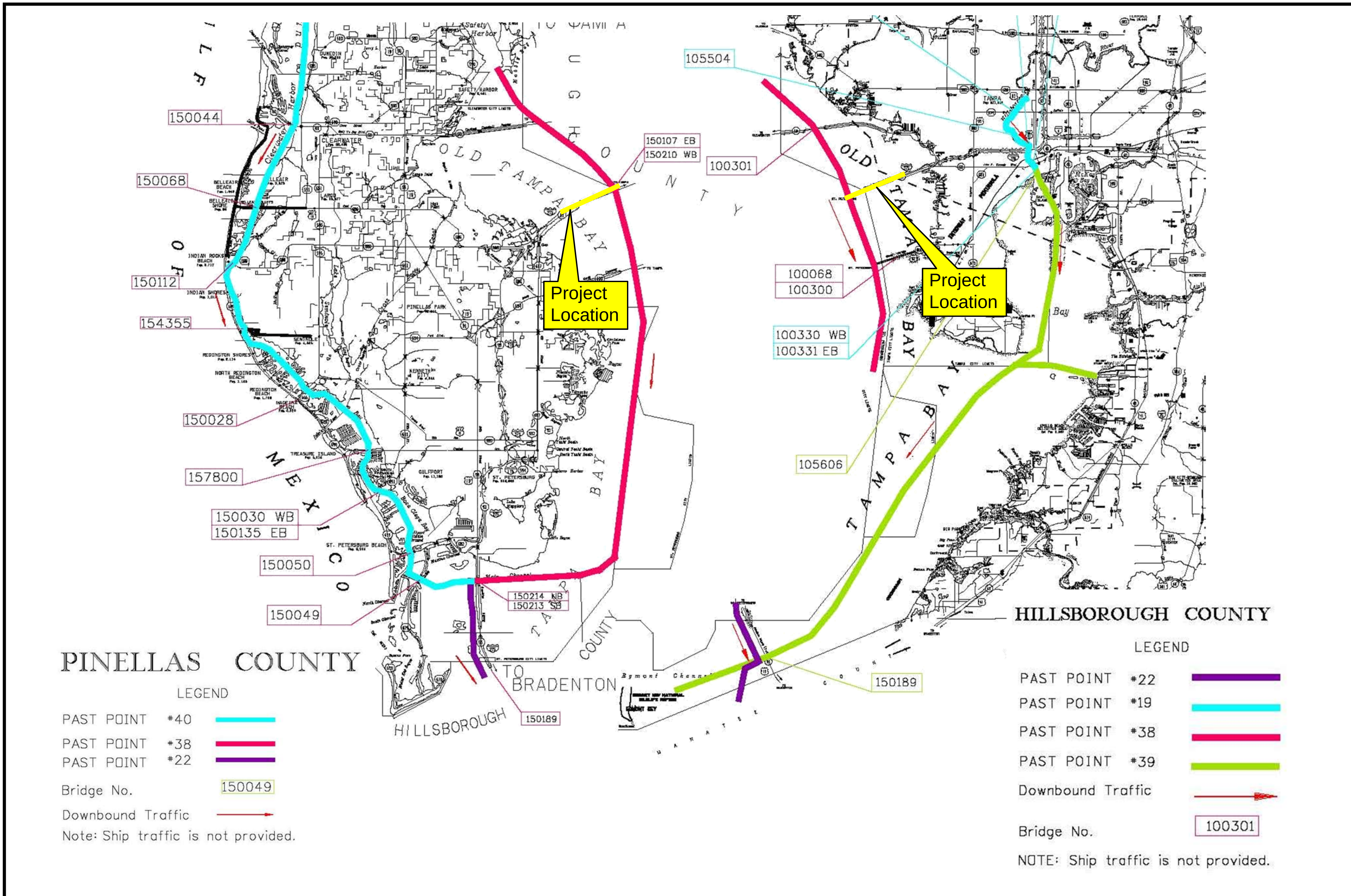
Various data sources were used in the FDOT-sponsored research to establish "past points". These are specific bridge locations which are selected as being representative of a stretch of waterway with similar navigational traffic. The selection of past points was primarily based on the following two principles: basically each major river/canal of every county possesses one past point, and a bridge site at a moveable structure is an optional past point.

Vessel Data for Howard Frankland Bridge

When these points were approved by FDOT, a total of 52 bridge locations were chosen as past points to represent 540 bridges with navigation control throughout Florida. A map showing the past points for Pinellas and Hillsborough Counties is included in **Figure 4-16**. The WCSC provided data for all 52 past points; however, Point #38 (applicable to the HFB) was found to be "a waterway that was a dead-end and probably has no through traffic", according to the research study.

Proposed Ship Impact Design Criteria

The existing southbound HFB was designed in the late 1980s for ship impact forces on the piers ranging from 200 kips to 2000 kips depending on the distance from the navigation channel. Using this force and FDOT's *Structure Design Guidelines*, a 200-foot channel span and continuous girder superstructure over the channel piers would be required. A review of data from multiple sources associated with past point #38 indicates that such high ship impact forces may not be warranted or cost effective for the new northbound bridge. According to a former bridge engineer who worked for HDR Engineering (the firm that designed the southbound bridge), the ship impact criteria was based on barges that brought fuel (oil or coal) to the now demolished A. W. Higgins Oldsmar Power Plant at the north end of the bay. Built in the early 1950's, it was last used in 1993 and demolished in 2006, according to an article in the St. Petersburg Times dated May 4, 2006. According to Progress Energy/Duke Energy, the site currently contains the smaller Higgins Combustion Turbine Station, a 4-unit, 105 megawatt station fueled by oil or natural gas (http://www.duke-energy.com/power-plants/oil-gas-fired/other.asp). With the former power plant gone, the need for a higher ship impact design load may no longer be justified. Recommended ship impact design criteria should consider the probability of future industrial development within Old Tampa Bay north of this bridge. Neither future land use maps for Pinellas or Hillsborough Counties show any proposed industrial areas north of the bridge; the only similar use shown is for "transportation/utility" at the site of the small Oldsmar power plant mentioned above.



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Navigational Past Points for Ship Impact Analysis

Figure 4-16

In consultation with the department, a preliminary risk assessment was conducted using an oversize tank barge (600 tons traveling at 1 knot) shown in the AASHTO guide specification, which is the typical vessel for the nearby past points, #'s 39 and 40. Although slightly larger than the vessels at past point #38, which is closest to the HFB, the larger oversize tank barge would cover the risk of any vessel from the nearby past points drifting up to the bridge. It is slightly larger than the standard hopper barge; however it is typical of the barges in the vicinity and is considered appropriate design criteria.

A preliminary risk analysis was conducted considering past point #38 with ½ of the traffic applied to the northbound bridge (due to shielding by the parallel bridge) with 200 kips as the strength for the piers. This analysis yields a return of about 9,000 years (meaning the chance of a direct hit would be once every 9,000 years) because of the low number of trips. For this scenario, 200 kips would satisfy past point #38 data.

4.2.8 Geotechnical Information

Soils on the Roadway Approaches - Based upon the USDA-NRSC Soil Survey for Pinellas and Hillsborough Counties, the soils at the end bents and approaches to the HFB (along the causeway) consist of man-made fills containing altered marine deposits and mine spoils. These materials are inherently variable due to the unknown nature of the deposition methods and unknown sources of the original burrow sites. The USDA Soil Surveys do indicate that a majority of these deposited materials consist of sandy soils. It is recommended that soil test borings be completed during final design activities to evaluate the soil at the site to determine soil suitability for the proposed improvements.

Geotechnical Bridge Considerations - The northbound HFB structure consists of over 300 spans supported by 24-inch driven concrete square piles and steel H piles. The steel HP 14x73 piles support the center piers. The design load for both types of piles was reported in the plans to be 60 tons.

The southbound bridge is supported by both 24-inch and 30-inch square concrete piles. According to the 1987 design plans, the design capacity of the 24-inch piles was 200 tons and the design capacity for the 30-inch piles was 300 tons. Pile driving records indicate that the piles were driven to a required bearing of 400 tons and 600 tons for the 24-inch and 30-inch piles, respectively. **Table 4-10** summarizes the pile configurations for the end bents and piers for the existing southbound bridge.

Table 4-10 Southbound Bridge Pile Cap Configuration at Each Pier/Bent

Pier/Bent	Pile Size	Pile Cap Configuration
END BENT 1W	24" X 24"	1 CAP X 12 PILES
PIER 2W to 40W	24" X 24"	2 CAPS X 5 PILES
PIER 41W to 46W	30" X 30"	1 CAP X 8 PILES
PIER 47W to 51W	30" X 30"	1 CAP X 20 PILES
PIER 52W to 56W	30" X 30"	1 CAP X 35 PILES
PIER 56E to 52E	30" X 30"	1 CAP X 35 PILES
PIER 51E to 47E	30" X 30"	1 CAP X 20 PILES
PIER 46E to 41E	30" X 30"	1 CAP X 8 PILES
PIER 40E to 2E	24" X 24"	2 CAPS X 5 PILES
END BENT 1E	24" X 24"	1 CAP X 12 PILES

Soil boring information and pile driving records utilized during the design and construction of the southbound HFB were reviewed to evaluate conditions that could be anticipated during the design of the replacement of the northbound HFB.

A total of 47 Standard Penetration Test (SPT) borings performed during the design phase for the southbound HFB were reviewed. The soil boring information generally indicated a mixture of loose/soft to dense/stiff sands and clays from the mudline (elevations of approximately -10 to -20 feet) for depths varying from approximately 30 to 90 feet underlain by weathered limestone (elevations of -30 to -100 feet, NGVD29). The depth to the top of the weathered limestone or a "bearing layer" varied across the borings.

Pile driving records for the southbound HFB were also reviewed. A total of 1460 piles were driven between 1988 and 1989, including 112 test piles. These test piles were dynamically tested with a Pile Driving Analyzer (PDA). The pile driving records indicated variability among the pile tip elevation (pile lengths) both across the bridge site and within pier groups. Splicing was common. In addition, set checks were utilized on piles that did not reach the pile driving criteria and over 100 production piles were PDA tested to verify pile capacity. At some locations, individual piles after splicing and set-check operations still did not achieve the required capacity; however, the total capacity of the pile group was established to have met the design requirements and thus the individual pile was accepted.

After review of this information, the boring data and the final production tip values were separated into three (3) sections to illustrate the pile length variations across the bridge in order to assist in future pile estimates and for variability assessment.

Section 1 extends from Bent/Pier 1E to 26E. This is an area of the eastern portion of the bridge where 24-inch pile tip elevations were relatively consistent ranging from approximately -25 to -50 feet.

Section 2 consists of the remaining 24-inch piles across the bridge with variations in the pile tip elevations ranging from approximately -40 to -175.

Section 3 consists of the piers along the bridge with 30-inch piles with variations in pile elevations ranging from approximately -35 to -130.

A graphic summary of the average, minimum, and maximum pile elevation across the bridge site is included in **Figure 4-17**. These three sections with the pile design load are shown in **Table 4-11**.

Table 4-11 Southbound Bridge Pile Information by Section

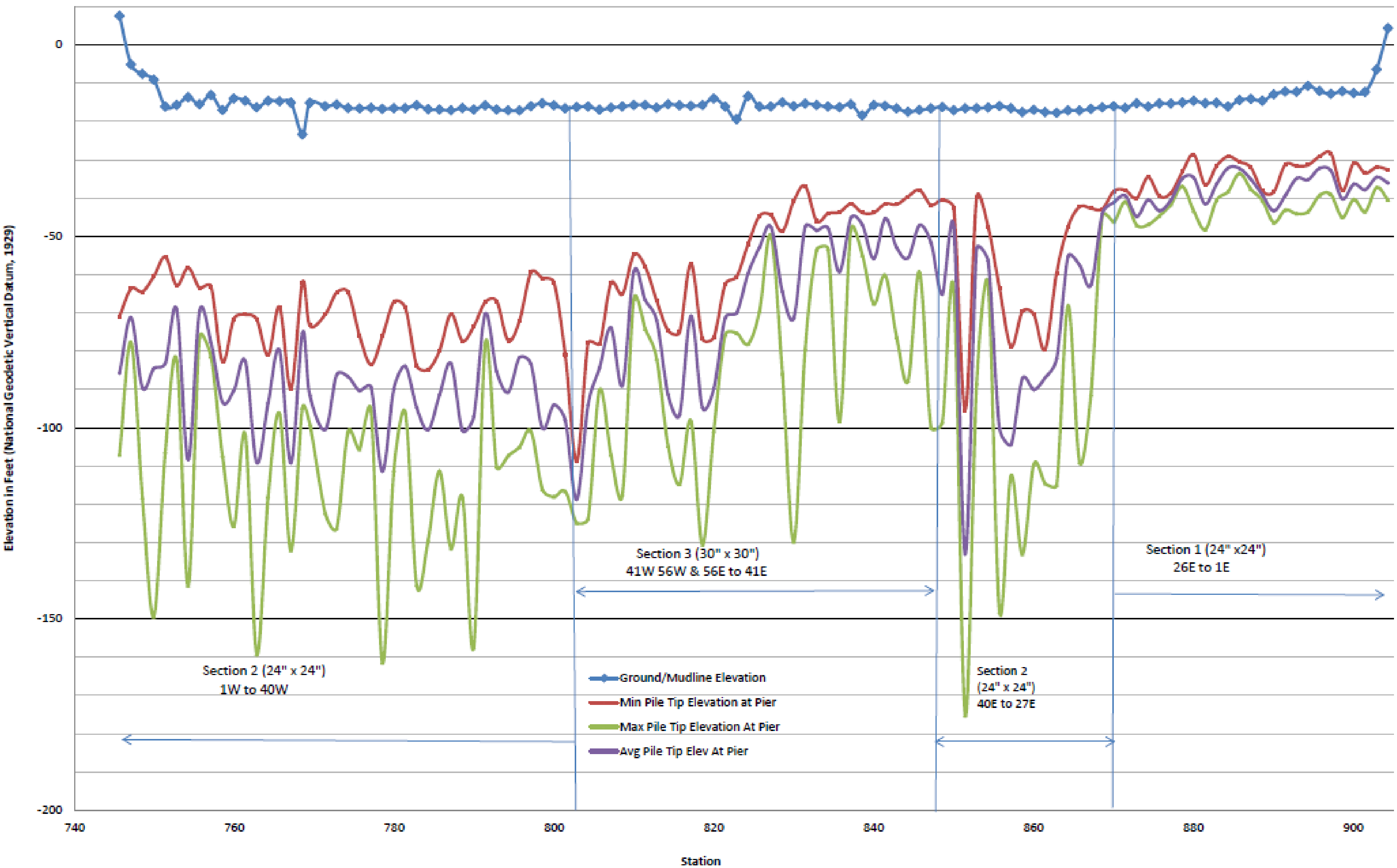
Section	Bent/Pier	Pile Size	Pile Design Load (ton)
1	1E to 26E	24” x 24”	200
2	27E to 40E;40W to 1W	24” x 24”	200
3	41E to 56E;56W to 41W	30” x 30”	300

Source: 1988 Bridge Plans

A table showing the actual tip elevation ranges that occurred within each section is included in **Appendix E**. In addition to the variations in pile lengths across the bridge site, in some cases, considerable variability occurred even among the piles within each pier; the above referenced Appendix includes additional data in this regard.

The soil boring data, pile sizes, and design loads were analyzed in FB-Deep Version 2.03 to evaluate what current pile capacity analysis would predict when a new northbound HFB is constructed. The analysis did not consider scour effects. The predicted driven pile tip elevations for each section based solely on the FB-Deep analysis are included in **Appendix E**.

Geotechnical Bridge Recommendations - Additional soil borings will be required during the design phase for the new bridge. The variability observed with the pile lengths across the new bridge and within pile groups, the variability of the depth and consistency of the limestone among the SPT borings, and the variability in pile lengths with current pile prediction software will be considered during the future Bridge Development design phase of the proposed project.



Source: Geotechnical Technical Memorandum, 2012

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Review of Pile Driving Records for Southbound Bridge

Figure 4-17

The following evaluations of foundation alternatives for a bridge replacement were based on the results of subsurface conditions encountered in the borings performed during the design of the existing southbound HFB and review of the pile driving records. Initial foundation alternatives considered included:

- Shallow Foundations
- Steel Piles, including Pipe and H Sections
- Pre-stressed Square Concrete (PSC) Piles (24 and 30 inch square)
- Drilled Shafts

Each of these is discussed briefly below.

With **shallow foundation systems**, the structure loads are supported by the bearing capacity of the foundation soils. The design of shallow foundations is typically governed by the soil bearing capacity and total and differential settlement criteria. The soils at the proposed end bents consist of man-made deposits, which are inherently variable. The surficial soils at the proposed end bents would likely require soil improvement to achieve an adequate bearing resistance and minimize the potential for differential settlements. In addition, shallow foundation sizes may be required to be very large to accommodate bridge loads of the magnitude of the HFB. Shallow foundations can also be undermined by scour unless the foundations are protected and/or constructed at depths that typically are too deep to be practical. Therefore, considering scour effects, impacts of the soil improvement operations and associated costs, shallow foundations were not considered further for this preliminary geotechnical evaluation.

Steel pile types include pipe and H-piles. Previous experience has shown that steel piles are generally more expensive per lineal foot than prestressed concrete (PSC) piles. Steel piles may more easily penetrate dense layers to achieve a desired penetration depth. In addition, steel piles are well suited to conditions with high variability in anticipated penetration depths where frequent splicing is expected. Typical sizes of pipe piles range from 18 to 24 inches in diameter. Steel pipe piles do not develop as much capacity for similar penetration depths as PSC piles. Steel H-piles often provide lower capacities than pipe piles at similar costs. Steel piles although structurally viable, are susceptible to corrosion in aggressive, high-chloride content environments as is present at this site. Steel piles are therefore not typically considered appropriate for a bridge replacement project in an extremely aggressive saltwater environment and are not permitted by the *Structures Design Guidelines.*

Drilled shafts - Drilled cast-in-place straight-sided concrete shafts have the ability to develop high axial and lateral capacities. One drilled shaft could potentially take the place of several driven piles. The quality control of drilled shaft installation requires more attention and precaution compared with driven piles to ensure that the construction is in accordance with the specifications. This type of foundation system is often the chosen alternative for sites where competent limestone or very dense bearing strata are present at a relatively shallow depth with a sufficient thickness. Drilled shafts are also considered for sites where limiting vibrations and noise are important. Depending on the proximity of the proposed new bridge with the existing bridge, vibration concerns would be considered. Drilled shafts would be evaluated as part of the Bridge Development phase of the project. It should be noted that the potential potentiometric head pressure (potential artesian head) is reported in *Potentiometric Surface of the Upper Floridan Aquifer, West Central Florida* maps published by the USGS at an elevation +5 NGVD 29. The potential for artesian conditions will need to be evaluated as part of the planned design of the bridge substructure. Drilled shaft cut-off elevations would ideally be set above the potential artesian head elevation to avoid construction problems with artesian flow.

The variations in the depth and consistency of competent limestone (as evidence by the variable pile lengths) are a concern for the project. Limestone strength testing and soil boring/rock cores will have to be analyzed in further detail during project design to evaluate feasibility of drilled shaft foundations.

Prestressed concrete (PSC) pile foundations are a feasible foundation alternative. They are a widely used and proven foundation system in central Florida. PSC pile foundations are readily available and generally have a lower cost per ton of capacity than other pile types. Based on the saltwater environment of Old Tampa Bay, the environment of the substructure at the bridge site is classified as *extremely aggressive* due to the chlorides content of the water. As a result, it is recommended that the minimum size for PSC pile foundations be 24 inches square as required by the FDOT *Structures Design Guidelines*.

<u>Additional Geotechnical Recommendations</u>

Protection of Existing Structures - FDOT, SSRBC Section 455-1 will be followed for the protection of existing structures during foundation construction operations. It should be noted that, depending on the bridge alternative alignment, some of the proposed bridge pier foundation locations may be situated in close proximity (distances less than 100 feet) to the existing southbound bridge. The design of the new bridge foundations and construction phasing will need to be configured to avoid impacts to the existing northbound and southbound foundations which contain battered piles.

Dynamic load testing for driven pile foundations - In the event a driven pile foundation is considered for the project, a test pile program would be conducted for the proposed bridge construction including testing of at least 10 percent of the total piles, and the test piles would be monitored dynamically utilizing the Pile Driving Analyzer (PDA). The monitoring would provide estimates of pile capacity versus pile penetration, stresses in the pile, and other relevant parameters used to evaluate the pile driving process. A Case Pile Wave Analysis Program (CAPWAP) analyses would be performed on selected conditions for evaluation of the PDA results. The results of the CAPWAP analyses would provide information for developing production pile length and driving criteria recommendations. The installation of the piles will be carried out in accordance with the FDOT SSRBC Section 455.

Drilled Shaft Construction - In the event a drilled shaft foundation is considered for the project, FDOT requires that non-production test-hole shafts be installed to determine if the Contractor's methods and equipment are sufficient for the project. It is recommended that the Contractor perform a minimum of one test hole for each shaft size proposed to be completed. The test hole would be installed in accordance with the FDOT SSRBC Section 455. In addition, due to the variable limestone conditions, a pilot hole at each shaft location is recommended. To verify the integrity of drilled shafts, Cross-hole Sonic Logging tubes would be installed in all drilled shafts in accordance with the FDOT SSRBC Section 455. It is expected that Cross-hole Sonic Logging testing would be performed on all test-hole shafts and at selected production shafts on the project. Recommended general notes for drilled shaft construction would be prepared during project final design.

4.2.9 Security Issues

No security issues associated with the HFB have been identified to date.

SECTION 5 PLANNING PHASE/CORRIDOR ANALYSIS

No planning screen was run for this proposed project in FDOT's Efficient Transportation Decision Making (ETDM) system. In addition, alternative corridors are not applicable for this proposed bridge replacement project. A separate but related premium transit evaluation is ongoing to determine what type of, if any, premium transit accommodations should be included on or near the HFB. Current options under consideration include either a separate transit bridge for light-rail transit (LRT) or bus rapid transit (BRT) in managed lanes, such as tolled express lanes on a new replacement bridge structure. Potential accommodations for express lanes and premium transit are discussed in **Section 8.6**.

SECTION 6 DESIGN CONTROLS & STANDARDS

6.1 DESIGN CONTROLS

Project design control information is included in **Table 6-1**.

6.2 PROJECT DESIGN STANDARDS

Project design standards are included in **Table 6-2**. In addition, **Table 6-3** includes standards for managed/express lanes.

Table 6-1 Project Design Controls

Design Element	I-275 Mainline/NB HFB	Reference
Functional Classification	Urban Principal Arterial Interstate and Strategic Intrastate System (SIS)	RCI database and Straight Line Diagram Inventory
Speed: -Posted -Design	65 mph, Min. 40 mph 70 mph	 PPM Table 1.9.2
Design Vehicle	WB-62FL	PPM Figure 1.12.1
Level of Service	Not Applicable: Bridge Replacement with same number (4) of lanes	
Design Traffic Volumes	2035 AADT is 119, 000 VPD	
Pedestrian and Bicycle Requirements	Not applicable for a limited-access facility	
Existing ROW Constraints	Existing ROW = 800 ft +/-	
Type of Stormwater Management Facilities	Not applicable: No existing or proposed facilities	
Navigational Requirements	Exceed or Maintain Existing Clearances: Vertical: 48.8 feet Horizontal: 75 feet	Vertical: at center span relative to mean high water, based on 2011 instrument survey
Mean High Water	0.69 ft NAVD88	Based on FDEP's LABINS published data
Design Wave Height	100-yr wave crest el. 17.3 ft NAVD88	From 2010 Study by OEA, Inc for FDOT D7
Access Classification -Interchange Spacing	Not Applicable to this Study	
Design Life	75 Years	FHWA Policy

Table 6-2 Project Design Standards

Design Element	I-275 Mainline/NB HFB	Reference
Horizontal Alignment		
- Max curvature	3° 00’ 00"	PPM Table 2.8.3
- Max curvature with NC	0° 15’ 00"	PPM Table 2.8.4
- Max superelevation	0.10 ft/ft	PPM Table 2.8.3
- Slope rates	1:200, 100’ min. (for only 6-lane)	PPM Table 2.9.3
- Min curve length in full super.	200’	PPM Table 2.8.2a
- Max deflection w/o curve	0° 45’ 00"	PPM Table 2.8.1a
- Length of curve	2,100’ (1,050’ min)	PPM Table 2.8.2a
Vertical Alignment		
- Max Grade	3%	PPM Table 2.6.1
- Max change in grade w/o curve	0.2%	PPM Table 2.6.2
- Min. stopping sight distance (1)	820’	PPM Table 2.7.1
- Min. "K" for crest curve	506	PPM Table 2.8.5
- Min. "K" for sag curve	206	PPM Table 2.8.6
- Min. crest curve length	1,000’ open highway	PPM Table 2.8.5
- Min sag curve length	800’	PPM Table 2.8.6
Cross Section Elements		
- Travel lane width	12’	PPM Table 2.1.1
- Auxiliary lane	12’	PPM Table 2.1.1
- Outside shoulder width (mainline)	12’ (10’ paved)	PPM Table 2.3.1
- Outside shoulder width (bridge)	10’	PPM Figure 2.0.1
- Inside shoulder width (mainline)	12’ (10’ paved)	PPM Table 2.3.1
- Inside shoulder width (bridge)	10’	PPM Figure 2.0.1
- Median width w/o barrier wall	64’	PPM Table 2.2.1
- Median width w/ barrier wall	26’	PPM Table 2.2.1
- Travel lane cross slope	2.0% (3.0% max)	PPM Figure 2.1.1
- Outside shoulder cross slope	6.0%	PPM Table 2.3.1
- Inside shoulder cross slope	5.0%	PPM Table 2.3.1
- Max rollover at ramp terminal	5.0%	PPM Table 2.1.4
- Max rollover between travel lanes	4.0%	PPM Table 2.1.1
Roadside Slopes		
- Front slopes	1:6 for 0-5’ height	PPM Table 2.4.1
	1:6 to CZ then 1:4 for 5-10’ ht.	PPM Table 2.4.1
	1:6 to CZ then 1:3 for 10-20’ ht.	PPM Table 2.4.1
	1:2 with guardrail for ht. over 20’	PPM Table 2.4.1
- Back slopes	1:4 desir. (1:3 min w/1:6 front slope)	PPM Table 2.4.1
- Transverse slopes	1:10	PPM Table 2.4.1

Table 6-2 Project Design Standards (continued)

Design Element	I-275 Mainline/NB HFB	Reference
Border Width	Standard 94' not achievable on the Causeway, Therefore a **Design Exception & Variation will be Required**	PPM Table 2.5.3
Clear Zone/Horizontal Clearance - Travel lane - Auxiliary lane	 36' 24'	 PPM Table 2.11.11
Vertical Clearance - Overhead signs [(2)] - Dynamic message sign [(2)] - Roadway over roadway	 17.5' 19.5' 16.5'	 PPM Table 2.10.2 PPM Table 2.10.4 PPM Table 2.10.1
Structural Loading Capacity	HL 93 [(3)]	AASHTO LRFD (Load and Resistance Factor Design) Specifications

[(1)] Lengths to be adjusted for grades of 2.0% or less (PPM, Table 2.7.1)
[(2)] Clearance over the entire width of pavement and shoulder to the lowest sign component
[(3)] Includes a combination of the design truck or design tandem, and the design lane load

Table 6-3 District Seven Design Standards for Express Lanes

Managed Lanes (Express Lanes)
Minimum Design Speed (Mainline): 50 mph Design Vehicle: SU-30 / BUS-45 Managed Lanes Mainline (Soft Separation from General Lanes) • Minimum lane width – 11’ (all lanes) • Minimum left shoulder width – 6’ • Minimum buffer from general lanes – 2’ Managed Lanes Mainline (Hard Separation from General Lanes) & 2-Lane Ramp • Minimum lane width – 11’ (all lanes) • Minimum left shoulder width – 6’ • Minimum right shoulder – 10’ Managed Lanes Single-Lane Ramp • Minimum lane width – 15’ • Minimum left shoulder width – 4’ • Minimum right shoulder width – 4’
General Lanes
Design Vehicle: WB-62FL General Lanes Mainline (Soft Separation from Managed Lanes) • Minimum lane width – 11’ (one lane must be 12’) • Minimum buffer from general lanes – 2’ • Minimum right shoulder width – 10’ General Lanes Mainline (Hard Separation from Managed Lanes) & 2-Lane Ramp • Minimum lane width – 11’ (one lane must be 12’) • Minimum left shoulder width – 4’ • Minimum right shoulder width – 10’ General Lanes Single-Lane Ramp • Minimum lane width – 15’ • Minimum left shoulder width – 4’ • Minimum right shoulder width – 4’
General Criteria
• Stopping sight distance (horizontal at barriers): Consider headlight sight distance • Vertical Clearance – Roadway Over Transit Envelope: 24’-3” • Use of existing profile is acceptable for soft separation

SECTION 7 TRAFFIC DATA

7.1 EXISTING TRAFFIC VOLUMES & TRAFFIC CHARACTERISTICS

HFB (I-275/SR 93) is currently an eight-lane facility, with separate four-lane bridges serving each direction. The 2012 annual average daily traffic (AADT) on the bridge is 142,500 vehicles per day (VPD) based on the most recent FTI CD, with approximately half of this in each direction. The existing traffic pattern on the bridge reflects that the traffic split in both directions is essentially balanced, as shown in **Figure 7-1**. Based on the existing daily traffic volume, the existing level of service (LOS) is “D” according to the 2009 FDOT Quality/Level of Service Handbook.

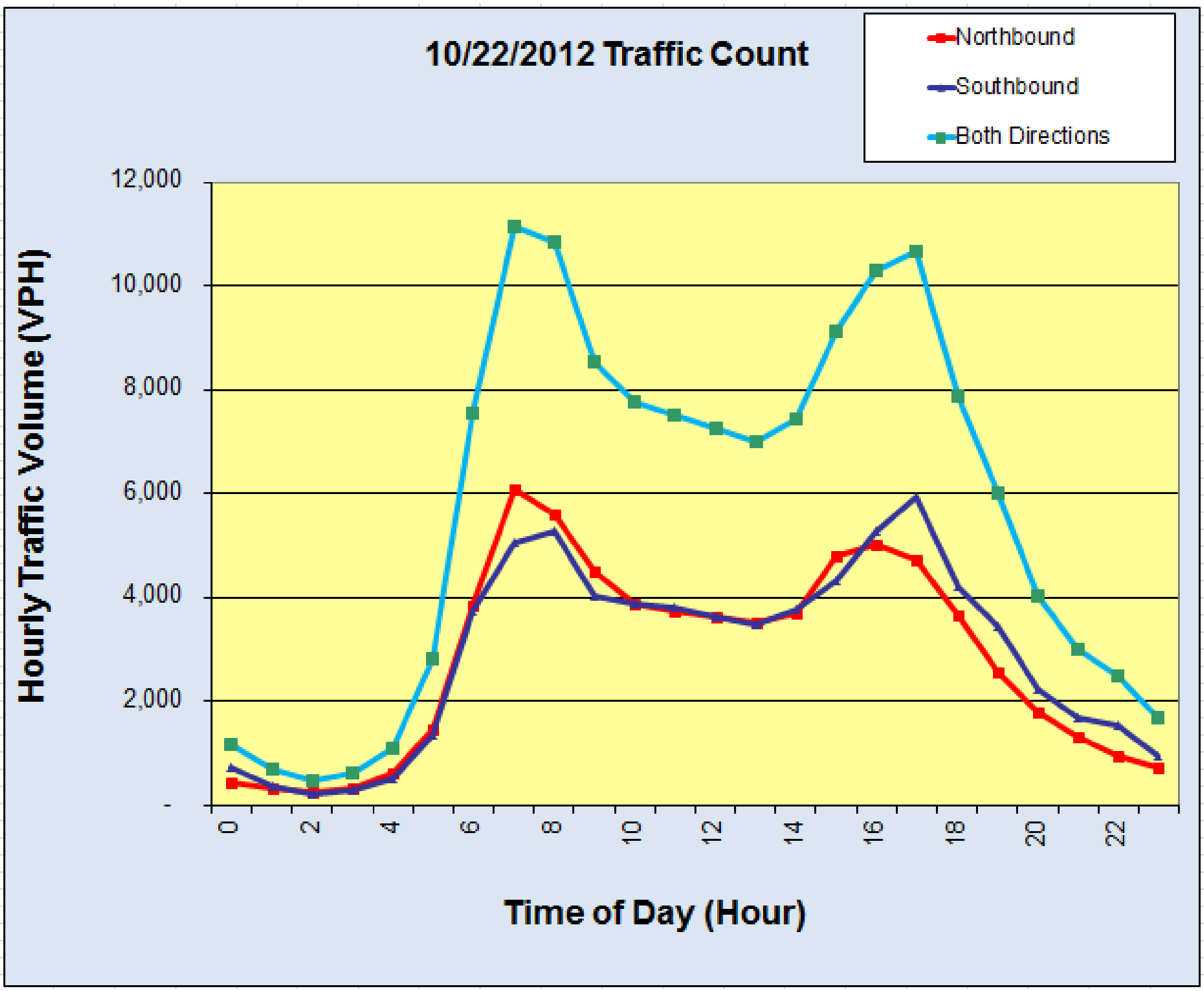


Figure 7-1 Existing Traffic Time-of-Day Pattern

Based on actual peak hour counts, the existing peak-hour level of service (LOS) is estimated to be “D/C” (AM/PM) using Highway Capacity Software (HCS).

The K factor is reported to be 8.5 percent, the D factor as 57.0 percent, and the T factor as 5.8 percent as obtained from the 2012 Florida Transportation Information (FTI) CD.

7.2 MULTIMODAL TRANSPORTATION SYSTEMS

Multimodal considerations are discussed in **Section 3.4**.

7.3 FUTURE TRAFFIC PROJECTIONS AND LEVEL OF SERVICE

Future traffic projection was based on the Tampa Bay Regional Transit Model for Managed Lanes (TBRPM-ML). The information on the future AADT volumes has been obtained from FDOT's District Seven systems planning group. The future traffic projection was based on the existing 2012 AADT obtained from the 2012 Florida Transportation Information (FTI) DVD and the 2035 model AADT obtained from the TBRPM-ML. The future AADT volumes for the Opening (2020), Interim (2030) and Design (2040) years are presented in **Table 7-1** below. **Table 7-1** also includes the future model year 2035 AADT.

Table 7-1 Howard Frankland Bridge – Future Year AADTs

Future Years	Estimated AADT Projections
Opening Year - 2020	169,300
Mid-Design Year - 2030	202,800
2035	219,600[1]
Design Year - 2040	236,400

[1] Based on 2035 TBRPM-ML Model Output

The projected 2040 two-way AADT of 236,400 VPD would operate at LOS "F" without any additional traffic lanes being added to the bridge based on FDOT's 2009 Quality/Level of Service Handbook. With this estimated projection, the existing bridge is expected to operate at LOS "E" by 2014 and LOS "F" by 2020 depending on how fast economy continues to rebound following the recession which began in 2008.

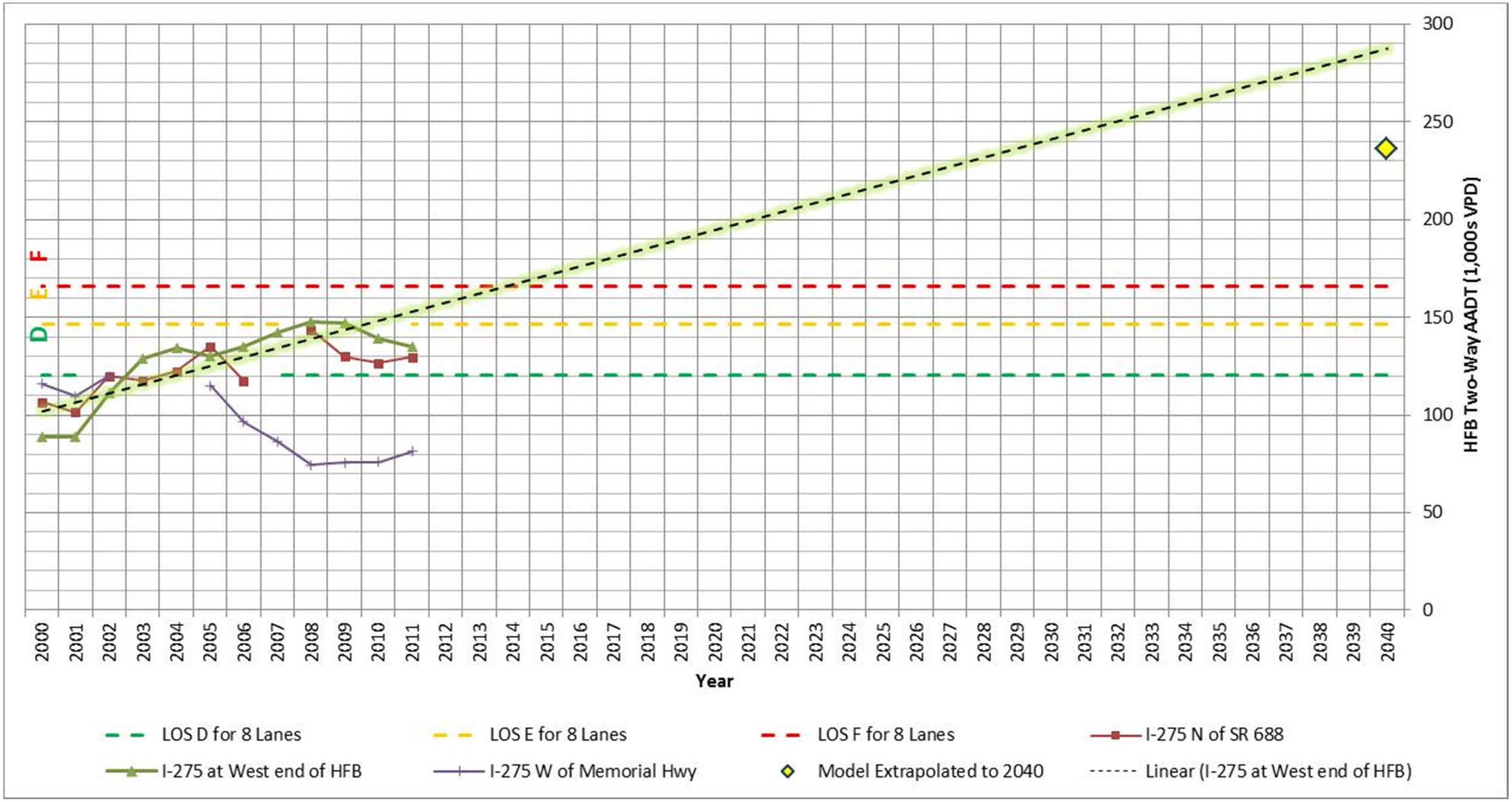
The level of service was estimated based on the AADT for all the future years using FDOT's 2009 Quality/Level of Service Handbook. In addition, peak hour peak direction level of service analysis was conducted for the future years using the basic freeway module of the Highway Capacity Software (HCS+, Version 5.4). The results are provided in **Table 7-2** below.

Table 7-2 Daily and Peak Hour Level of Service (LOS) for Future Years

Future Years	AADT (VPD)	Daily LOS[1]	Peak Hour Peak Directional Traffic	Peak hour Peak Directional LOS[2]
Opening Year - 2020	169,300	F	8,203	E
Mid-Year - 2030	202,800	F	9,826	F
Design Year - 2040	236,400	F	11,454	F

Figure 7-2 shows a comparison of future traffic on the HFB predicted from a linear trendline projection based on historical traffic counts with the year 2040 “traffic model projection” (based on the year 2035 model output extrapolated to 2040). The adjusted model projection shows a somewhat lower forecast of future traffic demand on the HFB compared to the linear trendline projection based on historical AADTs.

Due to the projected future traffic capacity deficiency, an investigation is ongoing regarding the feasibility of adding additional lanes as tolled express lanes on the new bridge, which could accommodate Bus Rapid Transit (BRT) in addition to private automobiles. In addition, the ongoing transit alternatives study could result in recommending a separate, parallel guideway for use of special transit vehicles such as Light-Rail Transit (LRT) or other exclusive modes. Additional traffic analysis is ongoing as part of the managed lanes (express lanes) master plan development currently underway.



LOS estimate based on FDOT's 2009 Generalized LOS table for urbanized areas

Northbound Howard Frankland Bridge (I-275/SR 93) Replacement PD&E Study WPI Segment No. 422799 1 Pinellas & Hillsborough Counties	**Historical and Projected Traffic and LOS for I-275 Near the HFB**	**Figure 7-2**

SECTION 8 ALTERNATIVES ANALYSIS

8.1 NO-BUILD/REHABILITATION/REPAIR ALTERNATIVE

In the mid-1950s, when this northbound bridge was originally designed, standard practice was to design for a 50-year life span. While that duration has now been exceeded and the bridge is located in a harsh saltwater environment, major past rehabilitation projects have helped to extend the life of the northbound structure.

As part of the alternatives analysis conducted for the northbound HFB replacement, the FDOT performed a "life-cycle cost analysis" (LCCA) in September 2011. LCCA is an engineering economic analysis tool that allows transportation officials to quantify the differential costs of alternative investment options for a given project. LCCA considers all agency expenditures and user costs throughout the life of an alternative, not only initial investments

A present-worth economic comparison was made between the Rehabilitation Alternative and the Replacement ("Build") Alternative. The actual calculations are included in **Appendix D**. An 80-year analysis period was used for the cost comparison, which is consistent with the FHWA-recommended service life of 75 years for major bridge structures. An interest ("discount") rate of 5 percent was used along with an annual inflation rate of 3 percent. Typical maintenance costs projected out for future years included repair/replacement of bearings, pile jackets with cathodic protection, painting, deck replacement, bridge rail repair/replacement, beam repairs, beam metalizing, cap repairs, footing repairs and fender system maintenance. Costs for the bridge replacement alternative did not include mobilization and maintenance of traffic, roadway approach work, or engineering design and inspection.

The conclusion and recommendation in the analysis was as follows: "The present worth cost comparison to rehabilitate and maintain this bridge is approximately $65 million greater than the replacement alternative. Therefore, based upon the life cycle costs analysis it is recommended to replace the bridge." Consistent with federal requirements, the Rehabilitation/Repair Alternative will be considered viable until FDOT has made its determination on a Preferred Alternative.

8.2 TRANSPORTATION SYSTEM MANAGEMENT & OPERATIONS (TSM&O)

The FDOT currently employs an Intelligent Transportation System (ITS) to monitor traffic conditions on the HFB and to facilitate quick responses to traffic incidents and crashes. Beyond that existing system, additional TSM&O measures aren't applicable for this bridge replacement study other than future planned upgrades to the existing ITS.

8.3 BUILD ALTERNATIVES

8.3.1 Typical Sections

A new northbound bridge typical section (**Figure 8-1**) would approximately match that of the existing southbound bridge, to include 10-foot shoulders and four 12-foot travel lanes (three general through lanes and one auxiliary lane). The total out-to-out dimension would be slightly different due to different bridge railing dimensions. The typical sections on the roadway approaches would match and tie into the existing typical sections.

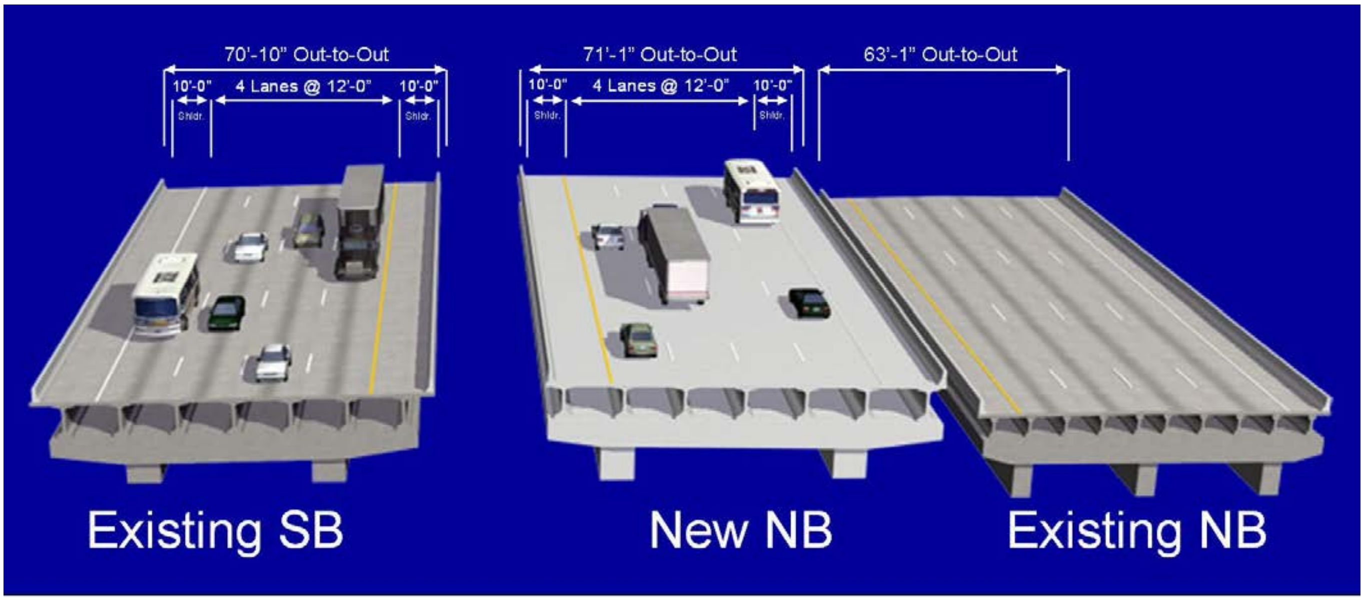


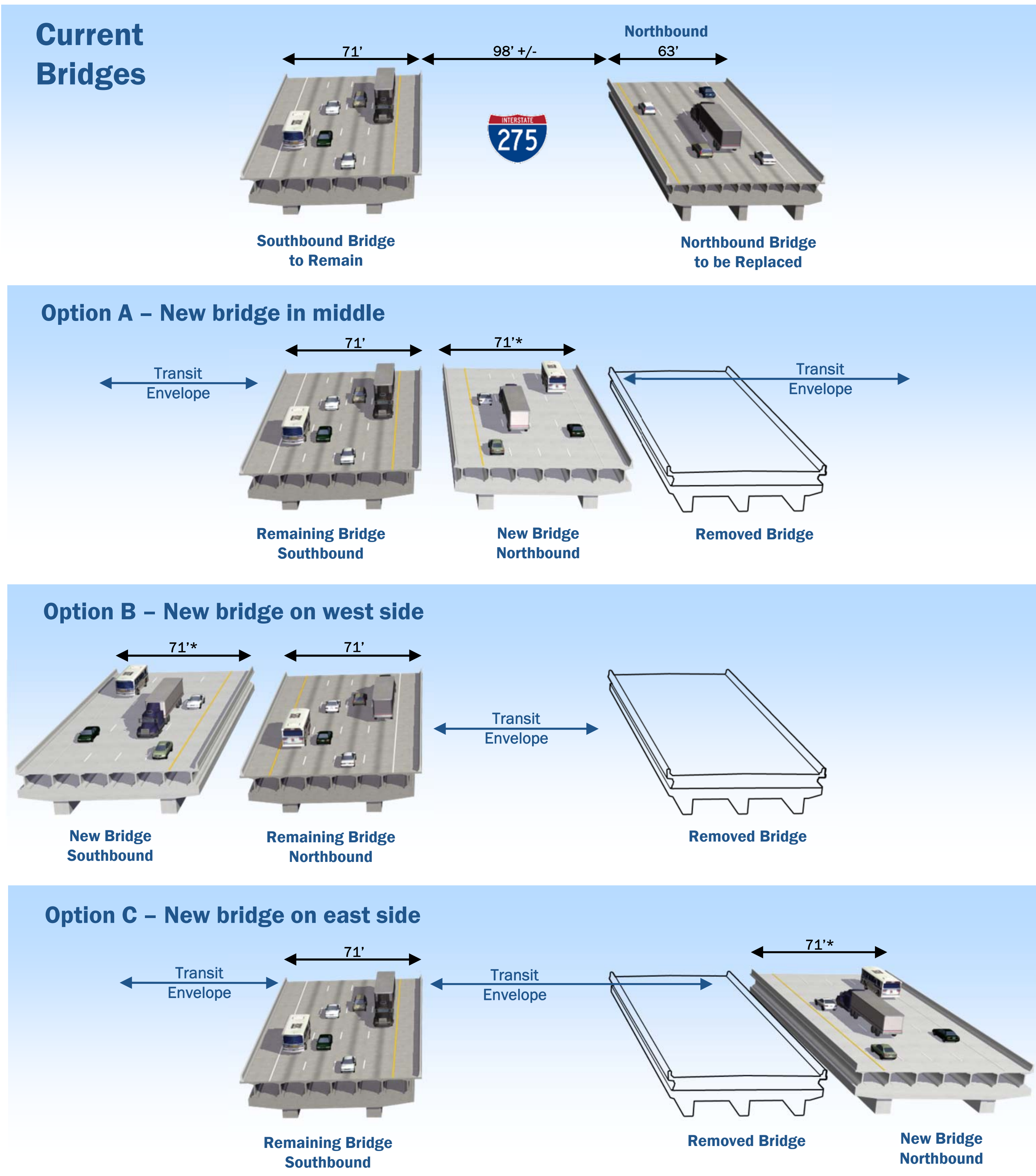
Figure 8-1 Original Proposed Typical Section for the Replacement Bridge Structure (Centered Option Shown)

8.3.2 Alternative Alignments

Current Build Alternatives being considered include replacement of the northbound bridge structure with a structure similar to the existing southbound bridge structure, on one of three alternative alignments, as shown in **Figure 8-2**:

- A centered alignment between the two existing bridges ("Option A")
- A new bridge on the west side of the existing southbound bridge ("Option B"), and
- A new bridge on the east side of the existing northbound bridge ("Option C")

All three of these options would reserve space for a future "transit envelope" to accommodate premium exclusive transit service within this bridge corridor connecting Pinellas and Hillsborough Counties. Transit alignments could be accommodated on either side of the highway bridges.



Notes: All dimensions are rounded to the nearest foot. *Additional width would be required if express lanes were to be added to the new bridge.

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Northbound Howard Frankland Bridge (I-275/SR 93) Replacement PD&E Study WPI Segment No. 422799 1 Pinellas & Hillsborough Counties	**Bridge Replacement Options**	**Figure 8-2**

Preliminary conceptual design plans for each of the three alternatives are included in **Appendix A**. The centered alignment option would require stage construction of the new bridge, as conceptually shown in **Figure 8-3**. More detailed plans for the centered alignment option are included in **Appendix B**. Detailed traffic control plans for each of the three alignment options are included in **Appendix C**. Preliminary capital cost estimates are provided in **Table 8-1**. All costs are based on the department's Long-Range Estimates (LRE) System. Cost estimates for the Recommended Alternative are included in **Section 9** based on additional refinements.

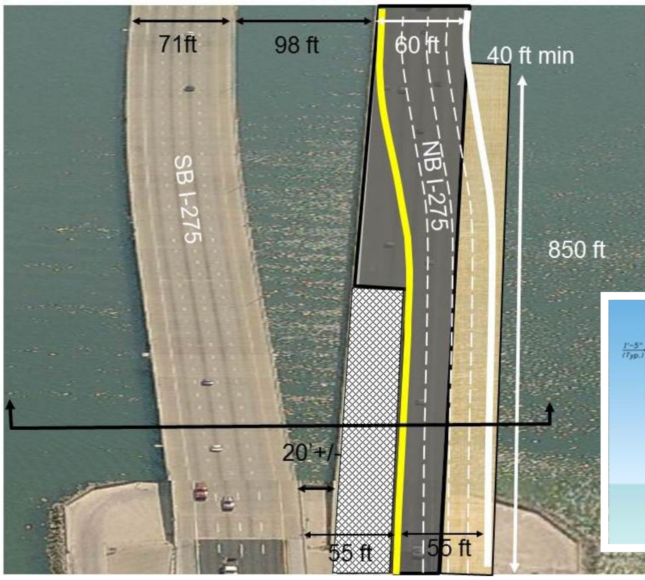
Table 8-1 NB HFB Replacement Capital Cost Estimates by Alignment Alternative

			West Alignment		Center Alignment		East Alignment	
Component	Unit	Approx Unit Cost	Quantities	Cost	Quantities	Cost[1]	Quantities	Cost
NB New Bridge	SF	$ 143	1,192,125	$ 170,318,710	1,192,125	$ 170,318,710	1,192,125	$ 170,318,710
Temporary NB Bridge Widening	SF	$ 141	0	$ -	60,000	$ 8,458,724	0	$ -
NB Bridge Removal[1]	SF	$ 30	1,001,259	$ 30,089,969	1,061,259	$ 31,895,370	1,001,259	$ 30,089,969
Roadway Transitions	LF	$ 2,100	6,350	$ 13,335,000	2,800	$ 6,007,178	4,950	$ 10,395,000
Seawall	LF	$ 3,000	6,130	$ 18,390,000	0	$ -	5,300	$ 15,900,000
Access Rd Rebuild	LF	$ 1,000	3,900	$ 3,900,000	0	$ -	3,900	$ 3,900,000
Mitigation Costs	AC	$ 1,000,000	4.00	$ 4,000,000	0	$ -	3.25	$ 3,250,000
Signing/Lighting				$ 1,345,000		$ 1,052,594		$ 1,320,000
Added Costs for Const Staging				$ -		$ 8,000,000		$ -
Maintenance of Traffic (MOT)		10%		$ 24,137,868		$ 22,573,258		$ 23,517,368
Mobilization		10%		$ 26,551,655		$ 24,830,583		$ 25,869,105
Construction Subtotal				$ 292,068,202		$ 273,136,416		$ 284,560,152
Contingencies		25%		$ 73,067,051		$ 68,484,104		$ 71,340,038
Construction Total				**$ 365,135,253**		**$ 341,620,520**		**$ 355,900,190**
Design for DB (8%)		8%		$ 23,365,456		$ 21,850,913		$ 22,764,812
CEI (7%)		7%		$ 27,195,050		$ 25,443,000		$ 26,506,550
Design, Const. & CEI				$ 415,695,759		$ 388,914,434		$ 405,171,552
			(say	$420 million)	(say	$390 million)	(say	$410 million)

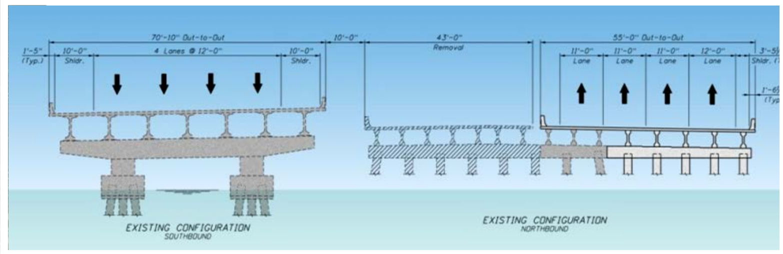
[1]Includes cost for removal of temporary bridge widening

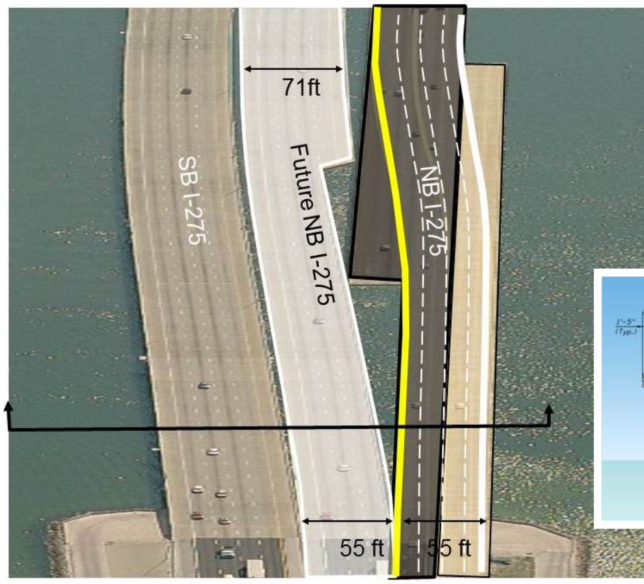
8.4 EVALUATION MATRIX

The three alignment options described above were compared in an evaluation matrix as shown in **Table 8-2**. The primary difference in the alignment options, aside from costs, is the difference in impacts to seagrasses, which can be difficult to mitigate for. In addition, the centered option would require stage construction at the ends of the new bridge as noted above.

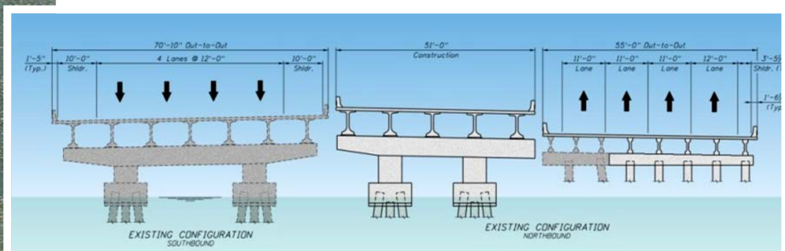


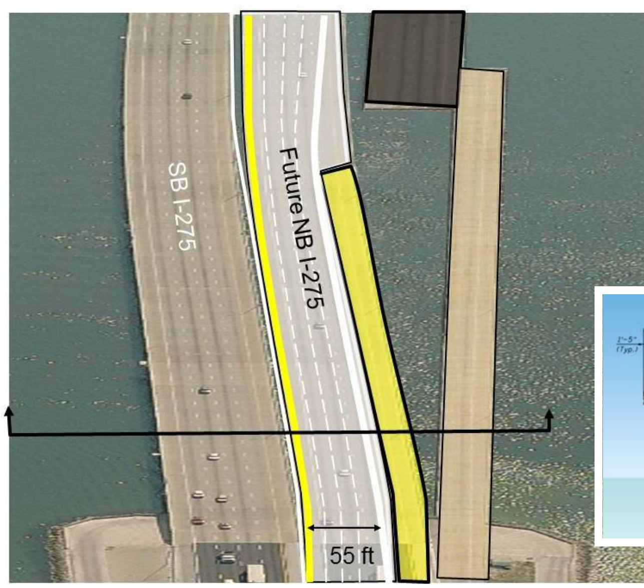
Stage 1: Construct temporary bridge structure
Stage 2: Realign traffic and remove portion of existing structure



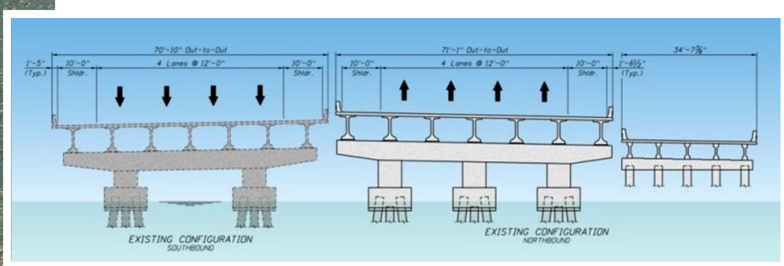


Stage 3: Construct most of the new structure





Stage 4: Shift traffic onto new structure, remove old structure and complete construction of new bridge



Northbound Howard Frankland Bridge (I-275/SR 93) Replacement PD&E Study WPI Segment No. 422799 1 Pinellas & Hillsborough Counties	Conceptual Construction Staging Plan for Centered Alternative	**Figure 8-3**

Table 8-2 Alternatives Evaluation Matrix for Northbound HFB Replacement

Evaluation Criteria	Bridge "Repair/ Rehab"	Alignment Alternatives		
		Western (Option B)	Centered (Option A)	Eastern (Option C)
Potential Relocations				
Number of Businesses and Residences	0	0	0	0
Potential Right-of-Way (ROW) Impacts				
Additional ROW Needed (acres)	0	0	0	0
Potential Net Environmental Effects				
Archaeological/Historical Sites	0	0	0	0
Noise-Sensitive Sites [1]	0	0	0	0
Seagrasses (acres)	0	3.7	0.0	3.1
Mangroves (acres)	0	0	0	0
Pinellas Aquatic Preserve/OFW Encroachment by Fill (acres)	0	0	0	0
Threatened and Endangered Species, Potential Involvement with	low	moderate	low	moderate
Petroleum Contamination & Hazardous Material Sites	0	0	0	0
Estimated Project Costs [2]		**(Costs in $ millions, rounded)**		
Right of Way Acquisition		$0	$0	$0
Construction Costs	See separate comparison of life-cycle costs of Build vs Rehab Alternatives			
New Northbound (NB) Bridge		*$170*	*$170*	*$170*
Temporary Widening of NB Bridge		-	*$8*	-
Demolition of Existing NB Bridge		*$30*	*$32*	*$30*
Roadway Transitions		*$13*	*$6*	*$16*
Seawall		*$18*	-	*$16*
Access Road Reconstruction		*$4*	-	*$4*
Seagrass/Wetlands Mitigation [3]		*$4*	-	*$3*
Signing/Lighting		*$1*	*$1*	*$1*
Added Construction Staging Costs		-	*$8*	-
Maintenance of Traffic (10%)		*$24*	*$23*	*$24*
Mobilization (10%)		*$27*	*$25*	*$26*
Additional Contingencies (25%+/-)		*$73*	*$68*	*$71*
Engineering Design-Build/CE&I [4] (8%/7%)		$57	$47	$49
Prelim. Estimate of Total Project Costs [5]		**$420**	**$390**	**$410**

Notes: 1) Sites located within 66dBA noise contour. Rev. 9/24/2013

2) Present day costs in millions of dollars., Construction Costs based on FDOT's LRE system costs.

3) Estimated at $500,000 per acre of impact, for preliminary budgeting purposes.

4) CE&I = construction engineering and inspection.

5) Rounded to 2 significant figures - Costs are rounded above and may not add up to exact total shown

8.5 RECOMMENDED ALTERNATIVE

The Recommended Alternative consists of a modified version of "Option A" - replacing the existing four-lane northbound bridge with a wider four-lane bridge to be constructed in a centered alignment, between the two existing bridges, as shown in **Figure 8-5**. This proposed centered alignment would have the least impacts to sea grasses and other environmental elements. Stage construction of the new bridge (including construction of temporary bridge) would be required at either end where the existing separation between the two existing bridges is much narrower than the typical 98 feet. The existing northbound bridge would be removed following completion of the new northbound bridge.

The new northbound replacement bridge is proposed to include an extra four feet of width which would be used as a buffer area in the future should the Department decide to convert the existing auxiliary lane to an express lane. **Figure 8-4** shows a possible bridge configuration with one express lane in each direction. Two of the lanes on the southbound bridge would be narrowed to 11 feet to yield a 2-foot buffer space for separation from the express lane. Potential accommodations for express lanes and premium transit are discussed in **Section 8.6**.

The new bridge is proposed to be constructed several feet higher than the existing southbound bridge in order to clear the predicted 100-year wave crest elevation, to minimize the chance of structural damage during an extreme weather event. A conceptual proposed roadway/bridge profile is shown in **Figure 8-6** along with the existing northbound and southbound bridge profiles. The proposed profile will be reevaluated in greater detail during the future design or design-build phase. Updated cost estimates for the "Preferred Alternative" are included in **Section 9**.

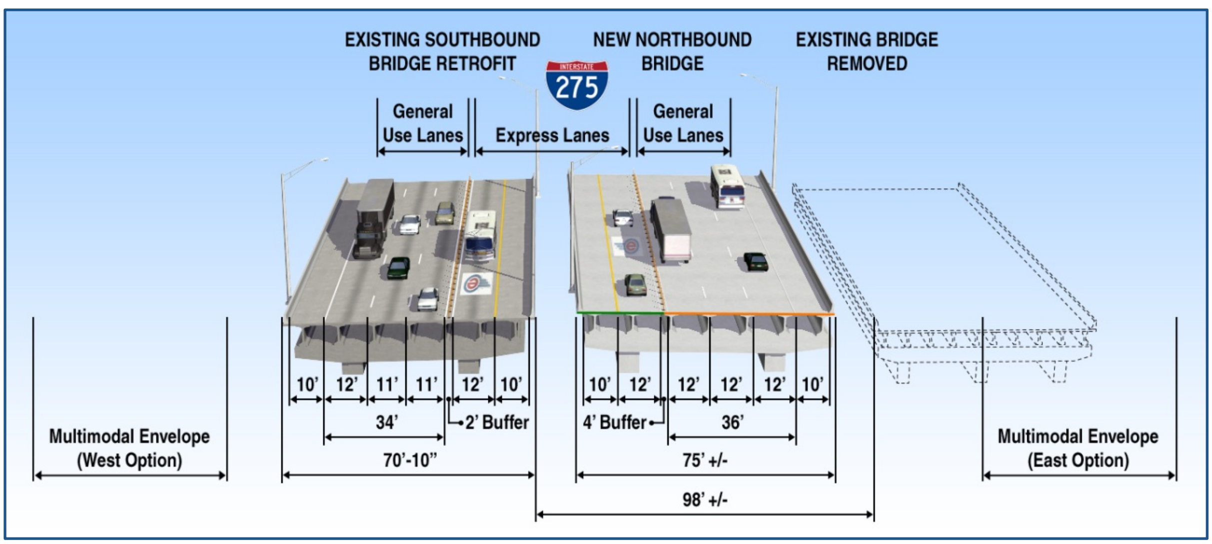
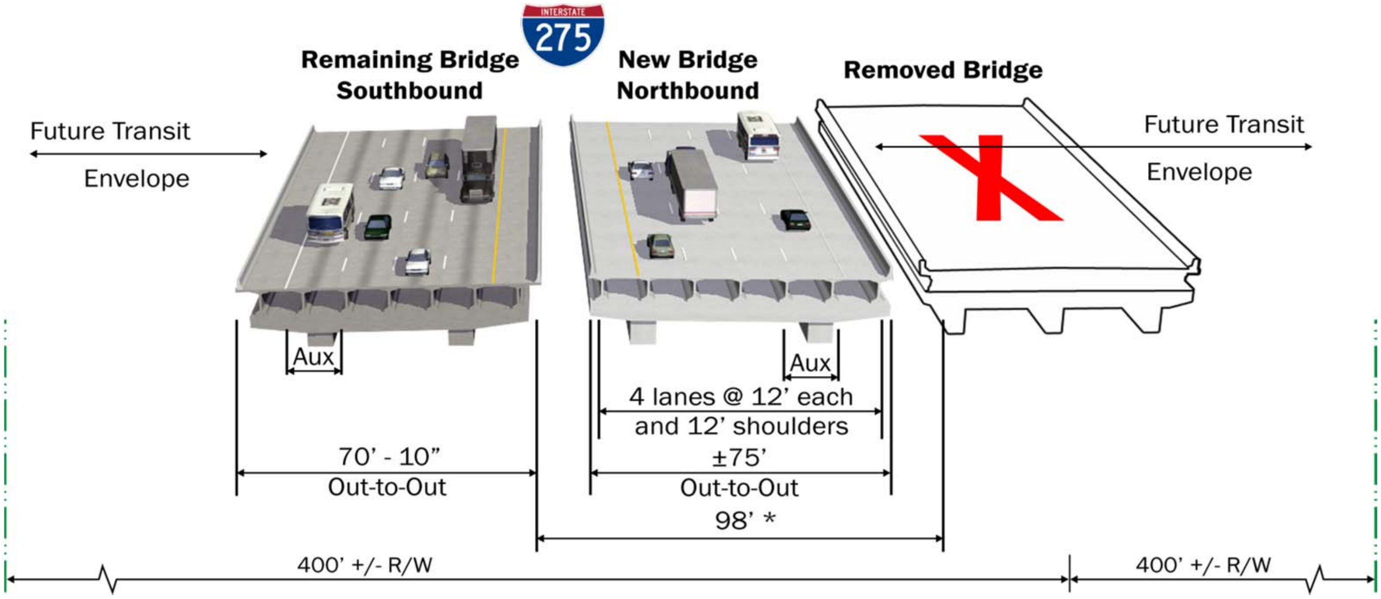


Figure 8-4 Express Lanes Starter Project Bridge Typical Section

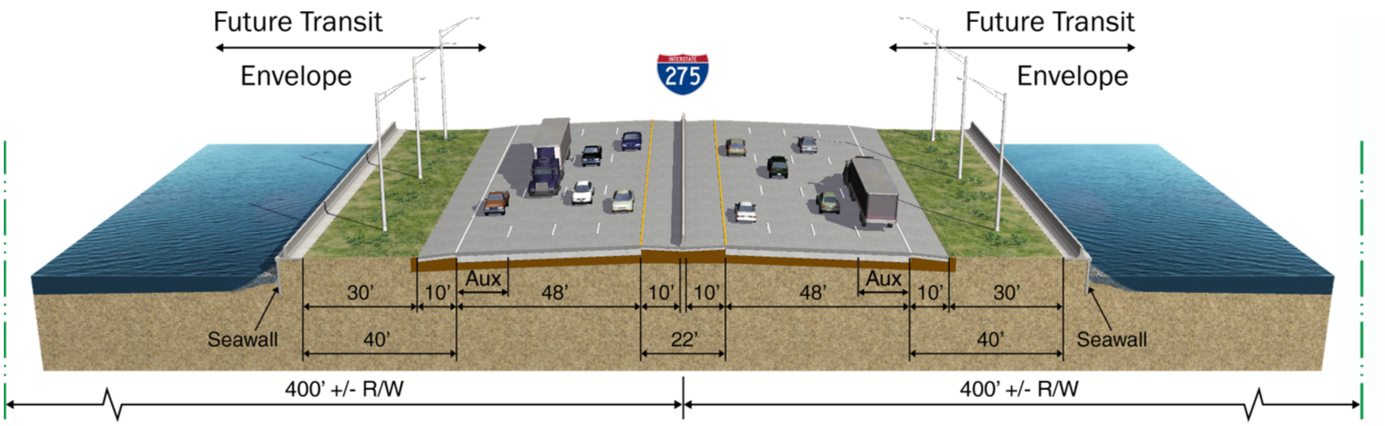


Recommended Alternative

Howard Frankland Bridge Northbound Replacement Bridge

*Distance between existing bridges narrows at bridge ends and excludes light poles and signs.

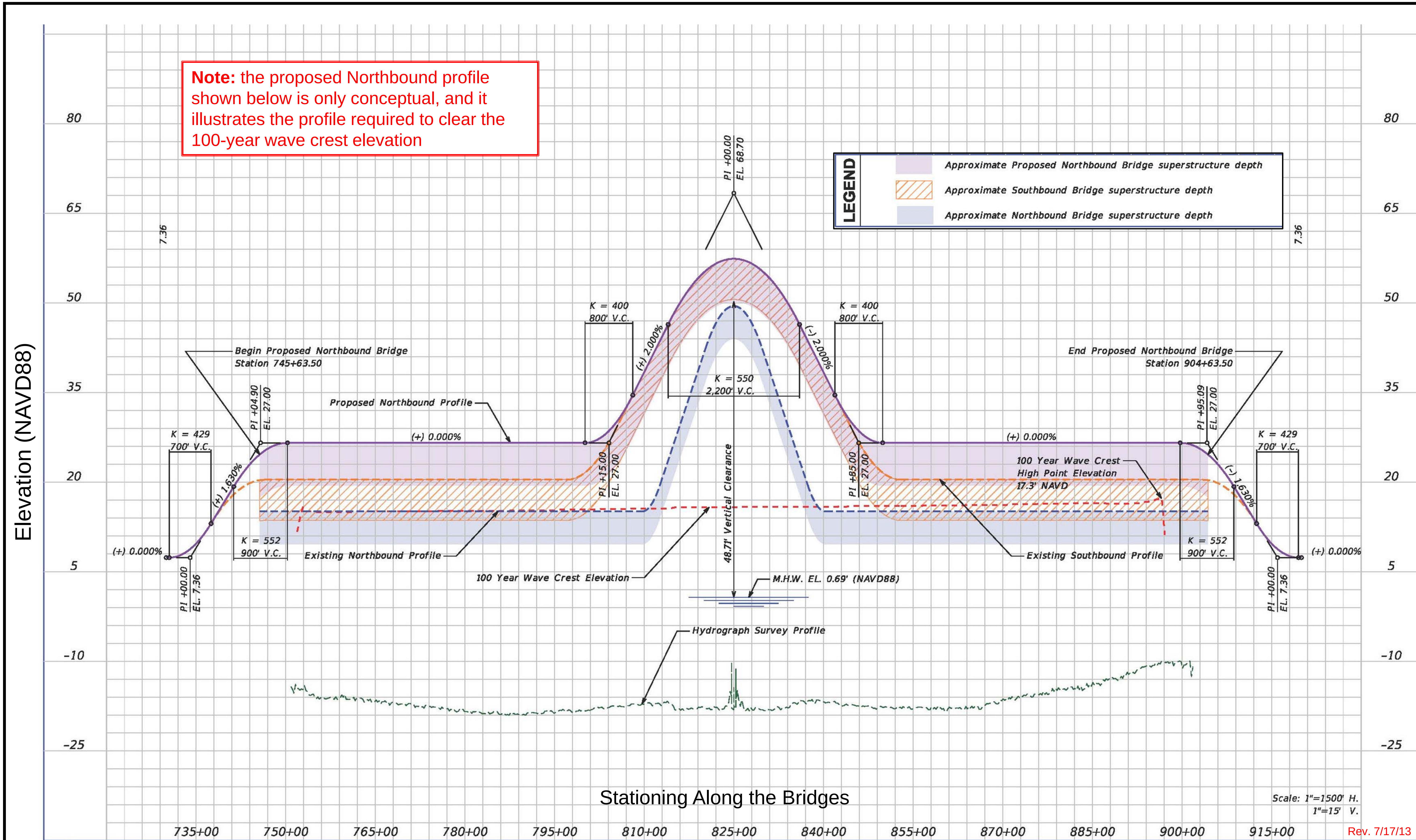
Configuration shown include four lanes in each direction (three general through lanes and one auxiliary lane). Should an express lane system be implemented for I-275, the auxiliary lane would be converted to an express lane and presumed to be situated as the inside lane. The 12' shoulder widths on the bridge would be reduced to the standard 10' widths and a 4' buffer area added separating the express lane and general lanes.



Recommended Alternative

Causeway Approaches to/from Howard Frankland Bridge Northbound Replacement

Rev. 12/12/13



Northbound Howard Frankland Bridge (I-275/SR 93) Replacement PD&E Study
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Existing and Proposed Roadway/Bridge Profiles

Figure 8-6

8.6 MULTIMODAL CONSIDERATIONS AND EXPRESS LANES

As previously mentioned, separate but related studies are ongoing to evaluate the feasibility of including accommodations for premium transit services within the HFB corridor in addition to accommodating express lanes. There are no plans to add any facilities for bicyclists or pedestrians on the bridge due to I-275 being a federal Interstate Highway on which they are prohibited.

The provision for additional transportation capacity along I-275 within the HFB corridor is being considered by two different, but related means. One is by setting aside an envelope for future premium transit, and the other is the establishment of tolled express lanes. Decisions on actual implementation of these strategies will be made outside the realm of this PD&E study by the FDOT in association with other local, state and federal agencies.

8.6.1 Premium Transit Accommodation

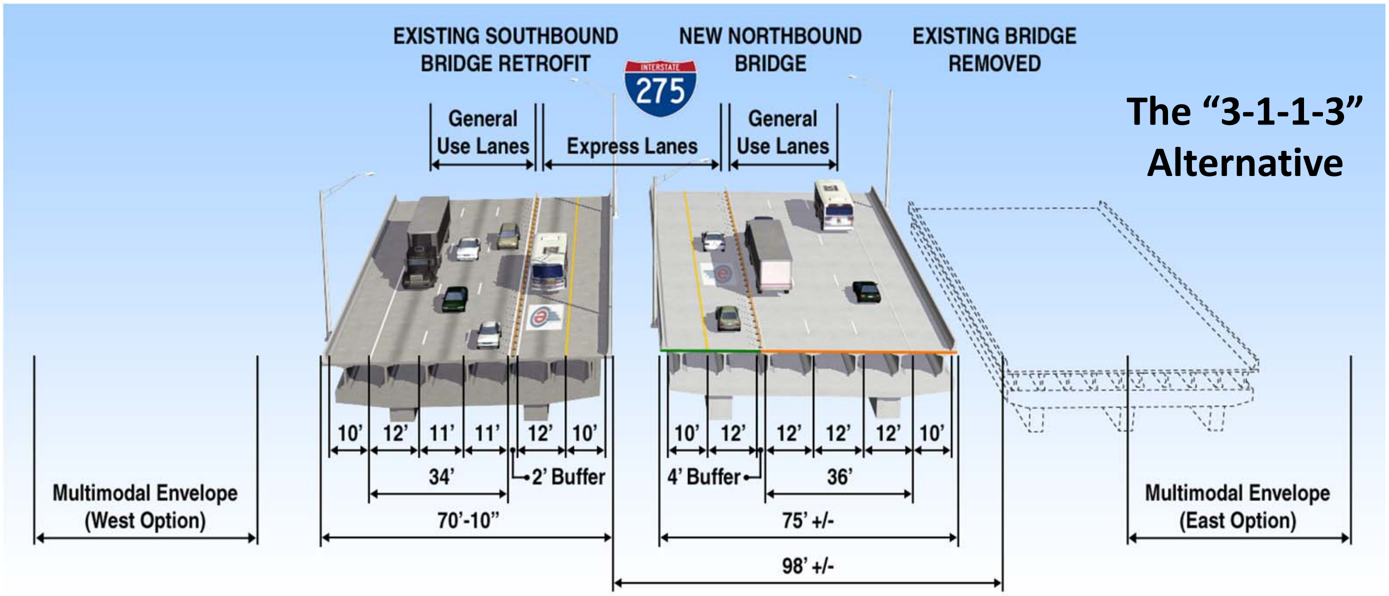
The Pinellas Alternatives Analysis (Pinellas AA) is an active transit study underway in Pinellas County. Currently, the Locally Preferred Alternative (LPA) involves premium transit service connecting Clearwater with St. Petersburg. The LPA includes a primary transit station in the Gateway area of Pinellas County roughly in the location of SR 686/Roosevelt Boulevard and SR 688/Ulmerton Road approximately one-mile west of I-275. The premium transit modes under consideration include light rail transit (LRT) or bus rapid transit (BRT). Presently the Pinellas Suncoast Transit Authority (PSTA) operates an existing express bus (Route 300x) between Largo and downtown Tampa along I-275 across the HFB. The premium transit options across the HFB could involve LRT and the existing express bus route, or BRT and the existing express bus route. In order to accommodate LRT along the I-275 corridor, a rail line would need to be constructed; however given the high volume of highway traffic along I-275, this rail line would need to be safely separated from the roadway travel lanes. Considerations for locating a separated rail line, or fixed guideway, across Tampa Bay in the I-275 corridor include a separate guideway structure to the west or east of the Interstate Highway. There is also an option to construct a fixed guideway integrated with the new northbound bridge structure (discussed below). Along I-275 in Hillsborough County from SR 60 to downtown Tampa, the Tampa Interstate Study recommendations included setting aside a multimodal rail envelope in the median of I-275. BRT and express bus can be accommodated in two ways. A bus-only guideway could be constructed similar to the LRT fixed guideway with BRT/bus only lanes separated from the general-use I-275 travel lanes, or the BRT/express bus could share the travel lanes with other highway vehicles.

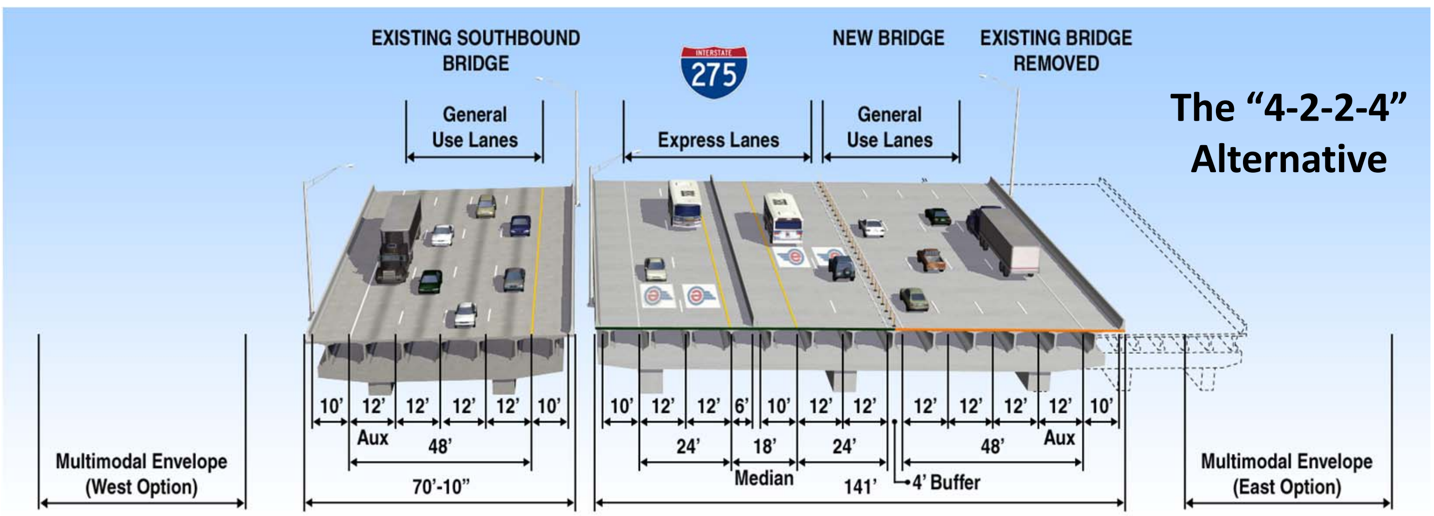
8.6.2 Express Lane Accommodation

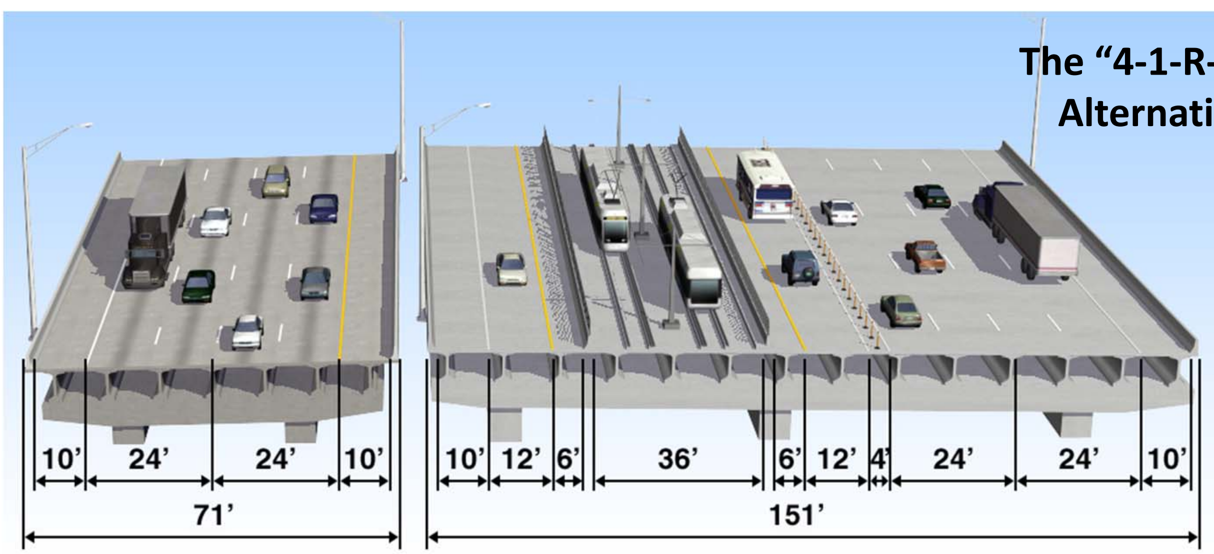
The FDOT is conducting a regional express lane master plan study. This study is evaluating a system of tolled express lanes in order to provide additional capacity for Interstate highways in the Tampa Bay area. This future system, presently named Tampa Bay Express, would likely include express lanes along I-275, I-4 and I-75. A key regional element is the I-275 link between Pinellas and Hillsborough Counties across the HFB. The Tampa Interstate Study recommendations included setting aside express lanes in the median of I-275 on either side of the aforementioned multimodal rail envelope. The Tampa Bay Express study is considering long-term master plan improvements as well as near-term starter projects. For the I-275/HFB crossing, the long-term master plan improvement includes a typical section on the HFB involving two express lanes in each direction in the middle of the highway flanked by four general purpose lanes (to match the current four-lanes of three through lanes and one auxiliary lane) in each direction. This has been referred to as a "4-2-2-4" configuration. The near-term concept for a starter express lane system includes converting the one auxiliary lane in each direction to an express lane leaving the remaining three lanes as general purpose lanes (the three existing through lanes) in each direction. This has been referred to as a "3-1-1-3" configuration, illustrated earlier in **Figure 8-4**. The starter project could be accommodated on the southbound HFB by narrowing two southbound lanes slightly to create a 2-foot buffer between the express lane and general purpose lanes. To avoid reducing lanes or shoulder widths on the new northbound bridge in the future, the new northbound bridge could be built with an additional four feet of width to accommodate a future conversion of one lane to an express lane with a 4-foot buffer separation between the express and general purpose lanes. The resulting bridge width would be approximately 75 feet wide. This would allow the express lane starter project to be implemented by changing the pavement markings on the structures. Furthermore, the new northbound bridge could be constructed such that it could be widened in the future should the express lane master plan scenario be implemented across the HFB. The new northbound bridge would then be retrofitted and widened to carry all four express lanes and the four general-purpose northbound lanes. The overall width of this widened structure would be approximately 151 feet. In either express lane configuration, BRT or express bus could be operated in the express lanes or in the general purpose lanes along I-275. **Figure 8-7** shows additional combinations of express lanes and transit accommodations.

8.6.3 Accommodating Both Premium Transit and Express Lanes

Should the express lane master plan option be implemented (4-2-2-4), and at a future time premium transit as LRT become a reality across I-275 connecting the Pinellas Gateway area to a transit station in Hillsborough County (assumed to be in the Westshore area), a separate fixed guideway could be built to the west or east of the highway bridge structures as noted above. Another option would be to presume that premium transit could reduce the highway traffic on the HFB and removing one of the express lanes would be an option. In this case, it is possible that the new northbound bridge could be retrofitted to carry the LRT fixed guideway on the structure. Given the median location for the multimodal envelope in the Tampa Interstate Study east of SR 60, a logical location would be in between the express lanes. In this configuration, referred to as a "4-1-R-1-4", the new northbound bridge would be approximately 10 feet wider (161 feet) than the 4-2-2-4 configuration to accommodate the necessary separation between the rail envelope and the express lanes. Additionally, inclusion of potential LRT vehicle loads on the new northbound bridge would







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Additional Multimodal Alternatives

Figure 8-7

need to be considered in the design of the structure. This could include constructing the bridge deck slightly thicker, aligning the beams supporting the bridge deck in a configuration to align with the future rail locations, and designing the new northbound substructure to carry additional rail loading. However, if local agencies cannot soon agree on a proposed transit technology then this will not be a viable option; they will need to provide direction to the FDOT early in the design phase for this option to remain viable.

8.6.4 Accommodations Made with the Recommended Alternative

In the case of future express lanes, or a future structure with an integrated fixed LRT guideway, the new northbound bridge should be designed with consideration of future widening to the east in terms of how the superstructure and substructure elements are designed and constructed. However, this PD&E study is only evaluating the replacement of the existing northbound bridge to carry four-lanes of highway traffic. Outside of considering an extra 4 feet of bridge width and provision to allow the structure to be widened in the future, this study is not considering the environmental impacts of a wider structure or of a separate fixed-guideway structure across Tampa Bay. A future PD&E study or reevaluation of this study would be needed to determine the impacts of those potential longer-range improvements.

SECTION 9 DESIGN DETAILS OF RECOMMENDED ALTERNATIVE

9.1 DESIGN TRAFFIC VOLUMES

As previously shown in **Table 7-2**, future traffic projections are shown below:

Future Years	Estimated AADT Projections
Opening Year - 2020	172,700
Mid-Design Year - 2030	214,600
2035	235,500[1]
Design Year - 2040	256,500

1 2035 TBRTMv23 Model Output PSWADT converted to AADT using Model Output Conversion Factor (MOCF) = 0.95.

The design-hour traffic is estimated to be 9 percent of the AADT traffic with 55.8 percent in the peak direction. As noted earlier in **Section 7**, additional traffic analysis is currently being done as part of the master plan development for managed/express lanes.

9.2 TYPICAL SECTIONS & DESIGN SPEED

The recommended bridge typical section was previously shown in **Figure 8-4**. The roadway approaches would transition to match the existing roadway approach typical sections, previously shown in **Figure 4-1**. The recommended design speed is 70 miles per hour.

9.3 INTERSECTION CONCEPTS & SIGNAL ANALYSIS

(Not applicable for this proposed project.)

9.4 ALIGNMENT & RIGHT OF WAY NEEDS

The proposed horizontal alignment follows the existing roadway alignment, previously shown in Figure 4-2, with the new bridge to be constructed between the two existing bridges, followed by the removal of the rest of the existing northbound bridge. The transitions on the ends will be designed for the 70-mile per hour design speed. No additional right of way is required for the proposed project. A plan view of the proposed improvements is shown in **Appendices A** and **B**. The proposed vertical alignment was previously shown in **Figure 8-5**.

9.5 RELOCATIONS

(Not applicable for this proposed project.)

9.6 COST ESTIMATES

A cost estimate for the Recommended Alternative was updated in September 2013, and the total cost in today's dollars is approximately $415 million, based on the FDOT's Long Range Estimates (LRE) system (**Table 9-1**). This estimate is based on a new bridge approximately 75 feet wide and includes the costs of the roadway approaches, removal of the existing northbound bridge, mitigation, design and construction inspection. The cost for engineering (final design) and the cost for Construction Engineering Inspection (CEI) were estimated at 6 percent and 7 percent, respectively, of the estimated total construction cost. Unknowns were estimated at 25 percent. In addition, $25 million was added to the cost to strengthen the new bridge for supporting a potential future light-rail transit system.

Table 9-1 Estimated Project Costs

Estimated Capital Costs[1]	(Cost in $ millions, rounded)
Right-of-Way Acquisition	$0
Construction Costs	
New Northbound (NB) Bridge	$170
Temporary Widening of NB Bridge	$8
Demolition of Existing NB Bridge	$32
Roadway Transitions	$6
Seawall	$0
Access Road Reconstruction	$0
Seagrass/Wetlands Mitigation	$0
Signing/Lighting	$1
Added Construction Staging Costs	$8
Maintenance of Traffic (10%)	$23
Mobilization (10%)	$25
Additional Contingencies (25%+/-)	$68
Engineering Design-Build/CE&I[2] (8%/7%)	$47
Additional contingency for strengthening structure for future light-rail transit	$25
Preliminary Estimate of Total Capital Costs[3]	**$415**

9.7 RECYCLING OF SALVAGEABLE MATERIALS

During construction of the project, recycling of reusable materials will occur to the greatest extent possible. Where possible, pavement material removed from the existing roadway can be recycled for use in the new pavement. This will help to reduce the volume of the materials that need to be hauled away and disposed of from the project and to reduce the cost of purchasing materials suitable for pavement construction. Other materials such as signs, drainage concrete pipes, etc., will also be salvaged and reused for regular maintenance operations if they are deemed to be in good condition. Concrete from the existing bridge can be reused as rip rap and roadway base material, etc.

9.8 USER BENEFITS (SAFETY, ETC.)

The primary benefit to the motoring public as a result of the proposed improvement will be a safer and more reliable transportation facility. As noted previously in Section 3.5, the vertical alignment on the existing northbound bridge does not meet current design standards for an Interstate highway. Based on the as-built plans, the estimated design speed is between 50 and 55 miles per hour (mph), while the bridge is posted with 65 mph speed limit signs (current standards require 70 mph design speed). This lower design speed results in shorter stopping sight distances for motorists travelling over the "hump" near the center of the bridge, which could be a contributing factor in some of the reported rear-end collisions on the bridge. In addition, the shoulder widths and two of the lane widths do not meet current Interstate design standards. The new bridge will meet all current design standards for a 70-mph design speed Interstate highway.

9.9 MULTIMODAL CONSIDERATIONS

As mentioned previously in this report, the Department is currently studying the feasibility of adding some combination of managed/express lanes and/or premium transit such as light-rail transit (LRT) or bus rapid transit (BRT) as part of the *ultimate* typical section. Coordination is ongoing with TBARTA, PSTA, HART, Pinellas and Hillsborough County MPOs and other local governments and agencies to determine the best long-range solution for increasing the capacity within the HFB corridor. Potential accommodations for express lanes and premium transit are discussed in **Section 8.6**.

9.10 ECONOMIC & COMMUNITY DEVELOPMENT

The proposed project would have little economic effects other than the temporary jobs that would be created during the construction phase along with the secondary benefits to service-related businesses. Based on the TIGER 3 FAQ's at the US DOT Application Resources website, the US DOT estimates that there are 13,000 job-years created per $1 billion dollars of government investment (or $76,900 per job-year; previous guidance had stated that every $92,000 of investment is equivalent to one job year). Based on a construction cost of $415 million, construction of this project would result in approximately 5,400 job years of employment for the local economy.

9.11 TEMPORARY TRAFFIC CONTROL PLAN

For most of the bridge crossing, the clear distance between the existing northbound and southbound bridges is approximately 98 feet. However, at both ends of the bridge this distance narrows to just a few feet creating construction and maintenance of traffic (MOT) challenges that will be integrated into the bridge analysis for the alternatives considered. **Appendix C** includes a preliminary traffic control plan for three alternatives, including the Recommended (Center Alignment) Alternative. In addition, a vessel maintenance of traffic plan will be developed during the project's final design phase.

9.12 PEDESTRIAN & BICYCLE FACILITIES

Consistent with federal and state policy, no facilities for bicyclists or pedestrians are planned on this limited access Interstate highway bridge.

9.13 UTILITY IMPACTS

The type, location, and ownership of existing and planned utilities are summarized in **Section 4.1.12** of this report. Depending on the location and depth of the utilities, implementation of the recommended improvements for the project may require adjustment of some of these facilities.

Costs for utility adjustments are not included in the total estimated project costs presented in Section 9.7, since they will be incurred by the utility owners. Since the project will require the relocation of some utilities, the project is expected to have minimal involvement with utilities.

9.14 RESULTS OF PUBLIC INVOLVEMENT PROGRAM

A *Public Involvement Plan* (PIP) was prepared for this study and approved in April 2011. The purpose of the plan was to describe the program that FDOT would implement to inform and solicit responses from interested parties, including local residents, public officials and agencies, and business owners. The plan included early agency coordination through the ETDM programming screen and the Advance Notification (AN) process; small group meetings with local residents and business owners; agency stakeholder meetings, and a public hearing. The results of the program are summarized in the *Comments and Coordination Report*. A brief summary of the program's activities follows.

EFFICIENT TRANSPORTATION DECISION MAKING (ETDM)

The PD&E study for the replacement of the northbound HFB (I-275/SR 93) was submitted to the Environmental Technical Advisory Team (ETAT) via the programming screen of the ETDM process in February 2012. The comment period lasted for a total of 45 days ending in April 2012. From the close of the comment period, FDOT had 60 days to submit a response to each comment. The initial Programming Screen Summary Report was published on June 6, 2012.

ADVANCE NOTIFICATION (AN)

FDOT, through the AN process, informed a number of federal, state, regional, and local agencies of this project and its scope of anticipated activities. The AN Package was distributed to the Florida State Clearinghouse in February 2012. The majority of comments received included requests for further coordination throughout the project, especially with regards to wetlands, essential fish habitat, and threatened and endangered species. The comments and corresponding responses are included in the *Comments and Coordination Report*.

INTERAGENCY COORDINATION

In April 2011, the Department distributed an electronic notification to elected officials informing them of the initiation of the HFB (I-275/SR 93) PD&E Study and Regional Transit Corridor Evaluation.

The notification consisted of a brief project description, overview of the project approach, and contact information. The notification was sent to representatives of the following governmental organizations:

- U.S. Senators
- U.S. Representatives (applicable districts)
- Florida State Senators (applicable districts)
- Florida House of Representatives (applicable districts)
- Hillsborough County Board of County Commissioners
- Pinellas County Board of County Commissioners
- City of Tampa City Council
- City of St. Petersburg City Council
- Hillsborough County Metropolitan Planning Organization
- Pinellas County Metropolitan Planning Organization

LOCAL AGENCY MEETINGS

Throughout the duration of the study, the Department met with various local agencies and organizations to keep them informed and to solicit feedback. These agencies include:

Agency/Organization	Dates
Hillsborough Area Regional Transit Authority (HART) / Hillsborough County MPO staff Joint Meeting	08/13/2012
Hillsborough County MPO Board	01/03/2012
Hillsborough County MPO Committees	12/14/2011 and 07/15/2013
Pinellas Alternative Analysis (AA) Project Advisory Committee (PAC)	10/11/2010; 04/11/2011; 06/13/2011; 07/11/2011: 09/12/2011;
Advisory Committee for Pinellas Transportation (ACPT)*	05/14/2012 and 04/08/2013
Pinellas Alternative Analysis (AA) Stakeholder Meetings	5/2011; 8/2011; 9/2011; 12/2011
Pinellas County MPO Board	07/09/2012 and 07/10/2013
Pinellas Suncoast Transit Authority (PSTA) Board	07/09/2012 and 08/22/2012
St. Petersburg Chamber of Commerce	07/18/2012
St. Petersburg Planning & Vision Commission	10/11/2011
Tampa Bay Applications Group	05/24/2012
Tampa Bay Regional Transportation Authority (TBARTA) Board	09/30/2011
Tampa Bay Regional Transportation Authority (TBARTA) CAC	09/21/2011
Tampa Bay Partnership	08/19/2011
Tampa International Airport / Westshore Alliance Joint Meeting	06/10/2013
Westshore Alliance Transportation Committee	11/16/2011 and 09/19/2012

**Evolved from the Pinellas AA PAC*

STAKEHOLDER MEETINGS

Two stakeholder meetings were conducted in May 2013. These meetings were held to help the Department collect information and gain consensus on issues related to the replacement of northbound HFB, including the importance of the bridge in municipal transportation plans, the location of the replacement bridge in relation to the existing structure, and the inclusion of a transit envelope.

The first meeting was held on Tuesday, May 7, 2013 at Pinellas Suncoast Transit Authority (PSTA) offices. There were approximately nine (9) attendees including representatives from Pinellas MPO, City of Pinellas Park, Hillsborough County, PSTA/TBARTA, City of St. Petersburg, and the Sierra Club. A total of six (6) questionnaire responses and two (2) written comments were received.

The second meeting was held on Thursday, May 9, 2013 at Hillsborough Community College – Dale Mabry Campus. Approximately twenty-one (21) attendees participated, included representatives from the City of Tampa, Westshore Alliance, Pinellas County, Tampa International Airport, Hillsborough County MPO, SWFWMD, HART, and TBARTA. A total of seven (7) questionnaire responses were received. No written comments were received at this meeting.

PUBLIC HEARING

A public hearing for this project was held from 5:00 p.m. to 7:00 p.m. in two sessions at two different locations. The first session was held in Pinellas County at the Pinellas Suncoast Transit Authority (PSTA) offices in St. Petersburg on Tuesday, October 8, 2013. The second session was held in Hillsborough County at the Tampa Marriott Westshore on Thursday, October 10, 2013.

The hearing was held to inform citizens and interested parties about the project and to provide them the opportunity to express their views concerning the proposed improvements. During both sessions, the hearing consisted of an open house from 5:00 p.m. to 6:00 p.m. and a formal presentation and public comment period beginning at 6:00 p.m. After the public comment period, the open house resumed until 7:00 p.m.

Draft Study documents were available for public review from September 4, 2013 through October 21, 2013 at the Pinellas Park Library in Pinellas County and at the West Tampa Library and FDOT District Seven offices in Hillsborough County.

Newsletters announcing the public hearing were sent via email to public officials and via direct mail to property owners located within 500 feet of the project, as well as current tenants, agencies, and interested parties. A legal display ad for the hearing was published in the *Tampa Bay Times* on September 21 and October 21, 2013. An advertisement was also placed in the *Florida Administrative Register* on October 1, 2013. The hearing was also publicized on the project's website.

FDOT staff and representatives were available at both hearing sessions to discuss the project and answer questions. A continuous-loop PowerPoint presentation describing the project and the recommended build alternative was shown during the open house portion of the hearing. Display boards were set up showing a plan view of the proposed improvements, typical sections, transit study information, and other project information.

The formal portion of each hearing session was moderated by Kirk Bogen, District Seven Project Development Engineer and recorded by a court reporter. Mr. Bogen welcomed the audience, discussed the purpose of the hearing, read various required statements and then accepted verbal statements from the audience.

A total of 66 people signed in at public hearing session 1 (Pinellas County), including: 5 elected officials and 9 representatives from 9 different agency/community groups. A total of 7 written comments were received and sixteen verbal statements were made during the formal public comment period.

A total of 94 people signed in at public hearing session 2 (Hillsborough County), including: 3 elected officials and representatives form 9 different agency/community groups. A total of 10 written comments were received and twenty verbal statements were made during the formal public comment period.

Copies of the legal display advertisement, the sign-in sheets, the speaker cards, and the public hearing transcript are included in the *Comments and Coordination Report*, while copies of the display graphics, the PowerPoint slides, and attendance rosters are included in the *Public Hearing Scrapbook* prepared for this study.

A total of 72 comments were received during the hearing and 10-day comment period: 17 written and 36 verbal comments. Most comments expressed support for the project. The following table summarizes the nature of comments received.

Table 9-2 Summary of Public Hearing Comments

	Supported	Did Not Support
Bridge Replacement (PD&E)		
Bridge Replacement in General	72	0
Express Lanes/Managed Lanes	37	0
"In-Kind" Replacement Only	1	0
Future Transportation Options		
Light Rail	27	25
Future Transit Envelope/Premium BRT	18	
Other	6	1

OTHER PUBLIC OUTREACH ACTIVITIES

Newsletters

To date, two newsletters have been distributed for this project to provide project updates, graphics, and FDOT contact information. The first, a kick-off newsletter, was developed to provide an introduction to the project, study graphics, and FDOT contact information. It was distributed in October 2011 and explained both the PD&E study and Regional Transit Corridor Evaluation processes. The second newsletter was distributed prior to the public hearing and describes the Recommended Alternative to be shown at the hearing. The newsletters were distributed to all property owners, federal, state, and local government agencies and other interested parties. Upon approval of the final environmental document, FDOT will distribute a final newsletter to inform the public of the Location Design and Concept Acceptance notification received from the Federal Highway Administration.

Fact Sheet

The Department and Tampa Bay Area Regional Transportation Authority (TBARTA) staff used the fact sheet to communicate with the general public and elected officials having jurisdiction in the project area. The fact sheet was a brief status report consisting of a brief project description, schedule, and contact information. The project fact sheet is typically distributed on-demand and at major project milestones.

Local Publications

During the course of the study, numerous project-related articles involving the project were published in the *Tampa Tribune*, the *Tampa Bay Times*, the Tampa Bay Newspapers or *TBNweekly.com*, and the *Tampa Bay Business Journal*. The articles often included project updates and informed the public of upcoming meetings.

Project Website

In an effort to fully engage and inform the public, a project website was developed. The site, http://hfbs.fdotd7studies.com/ contained a wide variety of project information. Visitors could read about why the project is needed in the project overview or find information related to public meetings, the project schedule, or contact information. Project documents and publications, including facts sheets and newsletters were also available for review. To date, approximately 11 interested parties submitted requests to be added to the project mailing list through the website. In addition to print ads and press releases, the Department used the project website to notify the public of upcoming meetings.

The Florida Department of Transportation was committed to working with the community, residents and property owners in dealing with the design options for the replacement of the northbound HFB and the associated improvements related to access and safety.

9.15 VALUE ENGINEERING RESULTS

The project is planned to be a future design-build project; therefore, value engineering was not required.

9.16 DRAINAGE & STORMWATER MANAGEMENT

As previously noted in Section 4.1.7, there are currently no stormwater management facilities on the bridge or its causeway approaches within the Study limits. Stormwater runoff from the bridge drains directly into Old Tampa Bay via scuppers (vertical holes through the bridge deck) on the bridge. There are no areas on the causeway near the bridge ends which would allow sufficient space for ponds, even if it was economically feasible to capture and pipe the runoff from a 3-mile long bridge in the middle of the bay. Therefore no provisions for stormwater treatment are proposed as part of the project.

9.17 STRUCTURES

In addition to the other information included within this section about the proposed replacement bridge structure, two additional items are addressed below:

Scour – a preliminary scour analysis will be conducted during the future design or design-build phase based on information and work already completed at this location, to allow a more accurate estimation of pile lengths.

Bridge type – three alternatives were bid for the existing SB Bridge including steel, Bulb T and segmental. While it is not vital at this stage to determine the precise bridge type, a bridge development report (BDR) is intended to be developed during the final design phase to further evaluate constructible alternative along with development of more accurate construction cost estimates.

Bridge Profile and Elevation - A preliminary analysis was completed to compare the costs related to increasing the vertical profile to 1 ft above the predicted 100-year wave crest elevation verses maintaining the existing southbound bridge profile and installing tie-downs in accordance with FDOT's *Structures Manual*, Section 2.5.

A maximum vertical wave force (un-factored) of 9.3 kips/ft was estimated, including quasi-static and slamming forces, and assuming 100 percent air entrapment (see **Appendix F**). In addition, a bridge weight of 16.4 kips per foot was estimated for calculation purposes. When comparing this to a *factored* vertical wave force, or 1.75 x 9.3 kips/ft = 16.27 kips/ft, the dead load (weight) of the bridge itself exceeds that of the factored vertical wave force; therefore tie-downs would not be required. This assumes a 7-beam typical section as shown in the conceptual plans in this PE Report. For the design-stage scope of services or design-build RFP, it should be stipulated that if the dead load of the bridge does not exceed this factored vertical wave force (e.g. should a beam be eliminated to lighten the bridge weight), tie-downs will be required if the low chord is not a minimum of 1 ft above the maximum wave crest elevation.

Calculations were also completed to estimate the incremental cost to raise the bridge profile 1 ft above the 100-year wave crest elevation; it is estimated to cost approximately $1.8 million more to raise the profile verses maintaining the same vertical profile as the existing southbound bridge. This incremental cost is based on the additional concrete, steel and MSE wall which would be required, using FDOT pay items/unit costs and contains no contingency factors.

For PD&E study/planning purposes, the proposed vertical profile is based on the new bridge's low chord member being at least 1 ft above the 100-year wave crest elevation, consistent with AASHTO and FDOT's recommended design standards. Considering a similar superstructure as the existing southbound bridge (e.g. similar beam depth, etc.) calculations show that a superstructure depth of about 8.5 ft would be required (**Table 9-3**).

Table 9-3 Preliminary Superstructure Depth Estimate

Element	Depth (ft)	Comments	New Bridge Width	71.08333 ft
Bridge Deck	0.708		Cross Slope	2%
Haunch	0.250		Coping to PGL	59.54167 ft
Beam	6.000	to match existing		
Cross Slope	1.191			
Total Depth	8.149	<-This value would be slightly different for a 75 ft wide bridge		
Rounded Value	8.50			

The resulting profile grade line (PGL) is about 17.3 ft (wave crest) + 1 ft (min low chord above wave crest) + 8.5 ft (superstructure) = Elevation (EL.) 26.8. Since this information is only conceptual at this PD&E study stage, the preliminary proposed PGL was rounded up to EL 27.0 as shown on the preliminary bridge profile drawing in **Figure 8-5** in **Section 7**.

9.18 SPECIAL FEATURES

No noise barriers or other special features are proposed.

9.19 ACCESS MANAGEMENT

(Not applicable for this proposed project.)

9.20 POTENTIAL CONSTRUCTION SEGMENTS & PHASING

A preliminary construction sequence plan is included in **Appendix B** for the Center Alignment alternative. Related to this is a preliminary traffic control plan included in **Appendix C**.

9.21 WORK PROGRAM SCHEDULE

Replacement of the northbound bridge is included in the Draft Tentative Work Program (Fiscal year 2014/15 to 2018/19) for Fiscal Year 2018/19 as a design/build project (FPN 422904-2). The total amount shown is about $458 million including $2.2 million for preliminary engineering costs. This tentative work program is expected to be approved by June 30, 2014.

SECTION 10 LIST OF TECHNICAL REPORTS

Engineering Items

- This Preliminary Engineering Report (PER) with Conceptual Design Plans
- Geotechnical Technical Memorandum
- Vertical Wave Force "Letter Report" (included in PER Appendix F)
- Location Hydraulic Technical Memorandum

Environmental Items

- Wetlands Evaluation & Biological Assessment Report (WEBAR)
- Essential Fish Habitat (EFH) Assessment (included in the WEBAR)
- Cultural Resource Assessment Survey (CRAS)
- Type 2 Categorical Exclusion

Public Involvement Items

- Public Hearing Transcript
- Public Hearing Scrapbook
- Comments and Coordination Report

Appendices

A Conceptual Design Plans

B Plan, Elevation & Bridge Sequencing

C Conceptual Traffic Control Plans

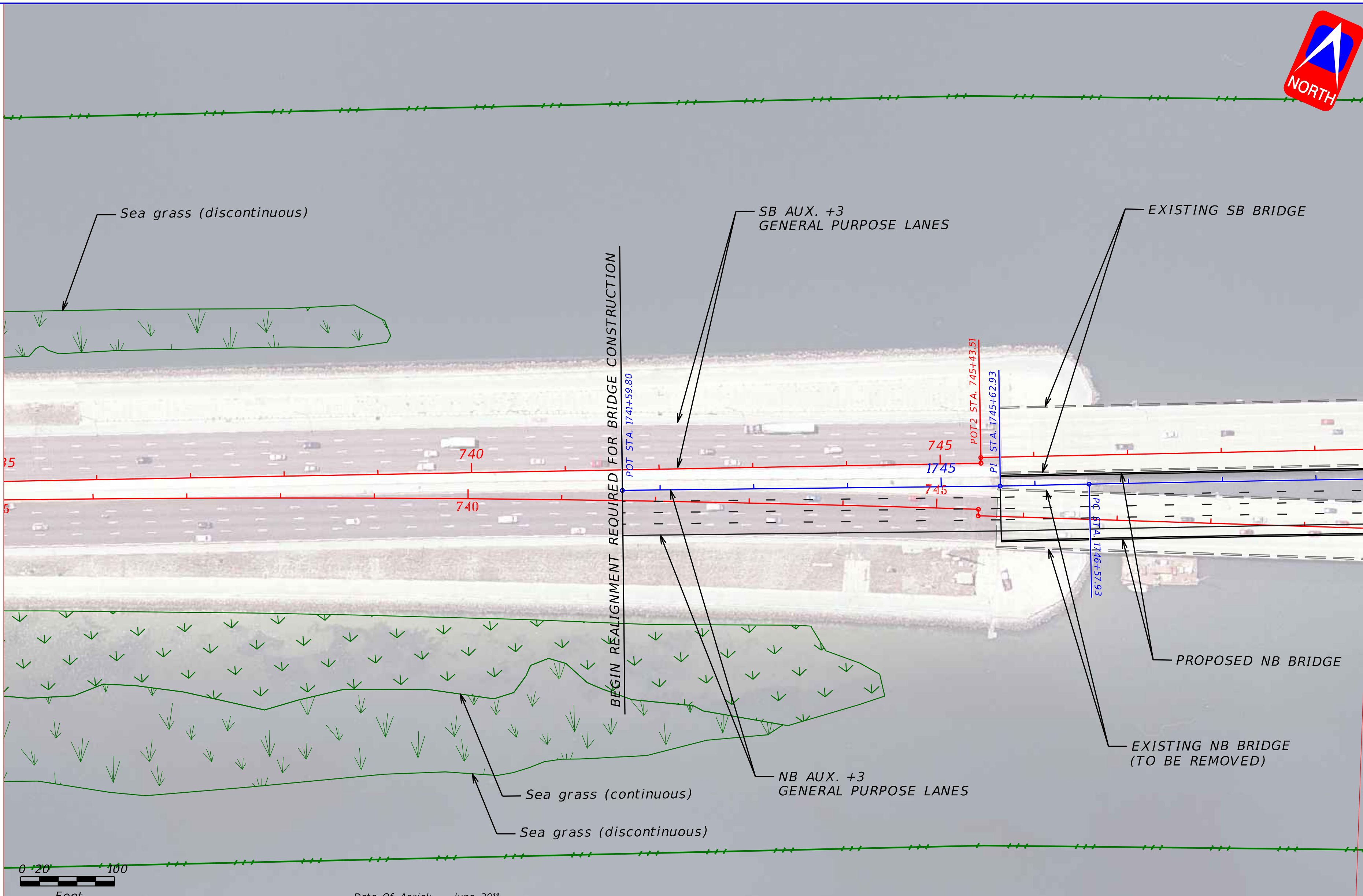
D Life-Cycle Cost Analysis

E Additional Geotechnical Information

F Vertical Wave Force Documentation

Appendix A

Conceptual Design Plans



LEGEND

Existing Right Of Way
Existing Limited Access Right Of Way

American Consulting Engineers of Florida, LLC.
2818 Cypress Ridge Blvd, Suite 200
Wesley Chapel, Florida 33544
Phone: (813) 435-2600 Fax: (813) 435-2601
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Jeffrey S. Novotny, P.E. No. 51083

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
I-275	PINELLAS HILLSBOROUGH	422799-1-12-04

Northbound Howard Frankland Bridge Replacement
(I-275/S.R. 93) PD&E Study

Bridge Replacement
(Only)
Center Option

SHEET NO.
RC-1-1

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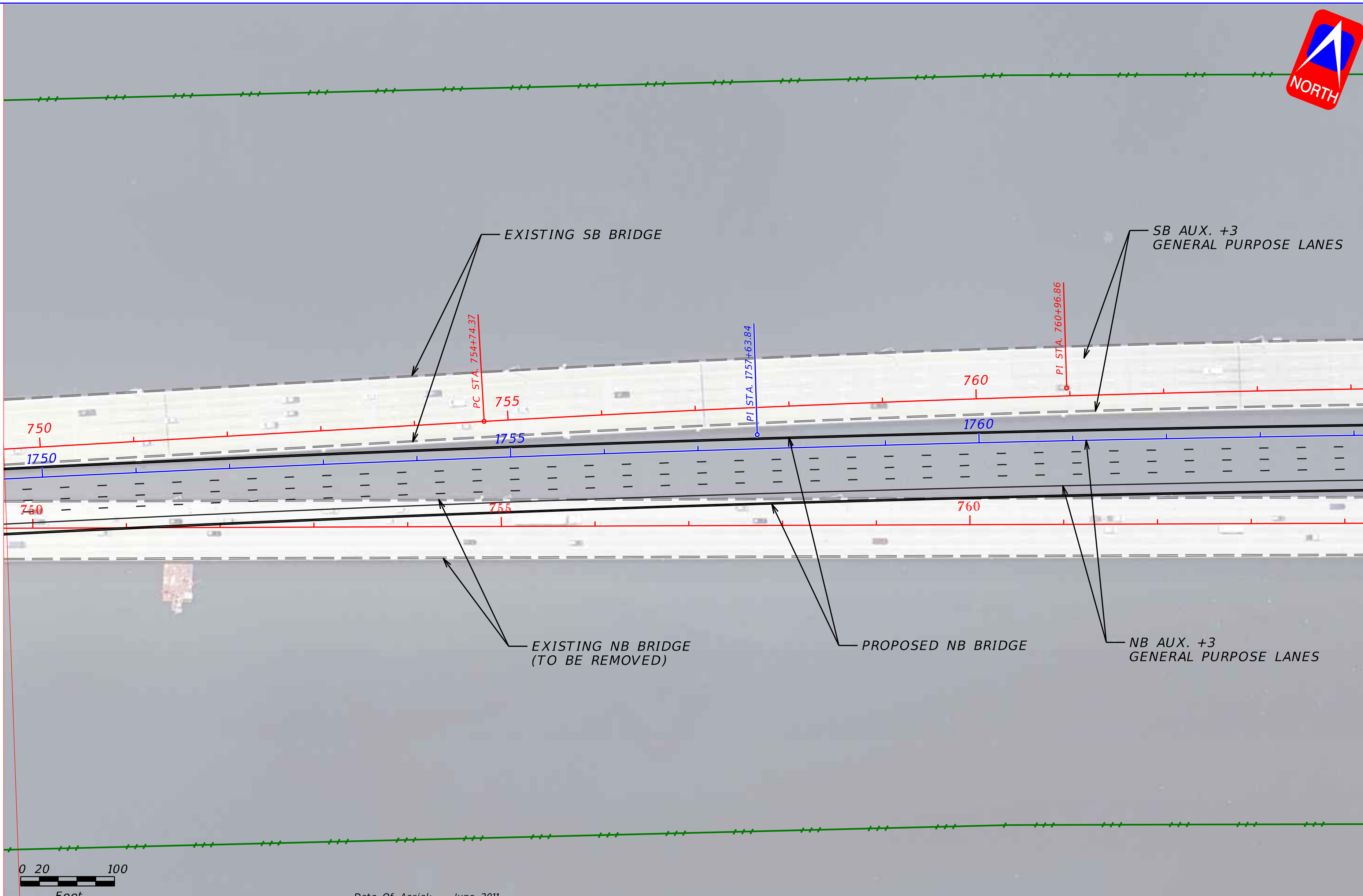

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(I-275/S.R. 93) PD&E Study

Bridge Replacement
(Only)
Center Option

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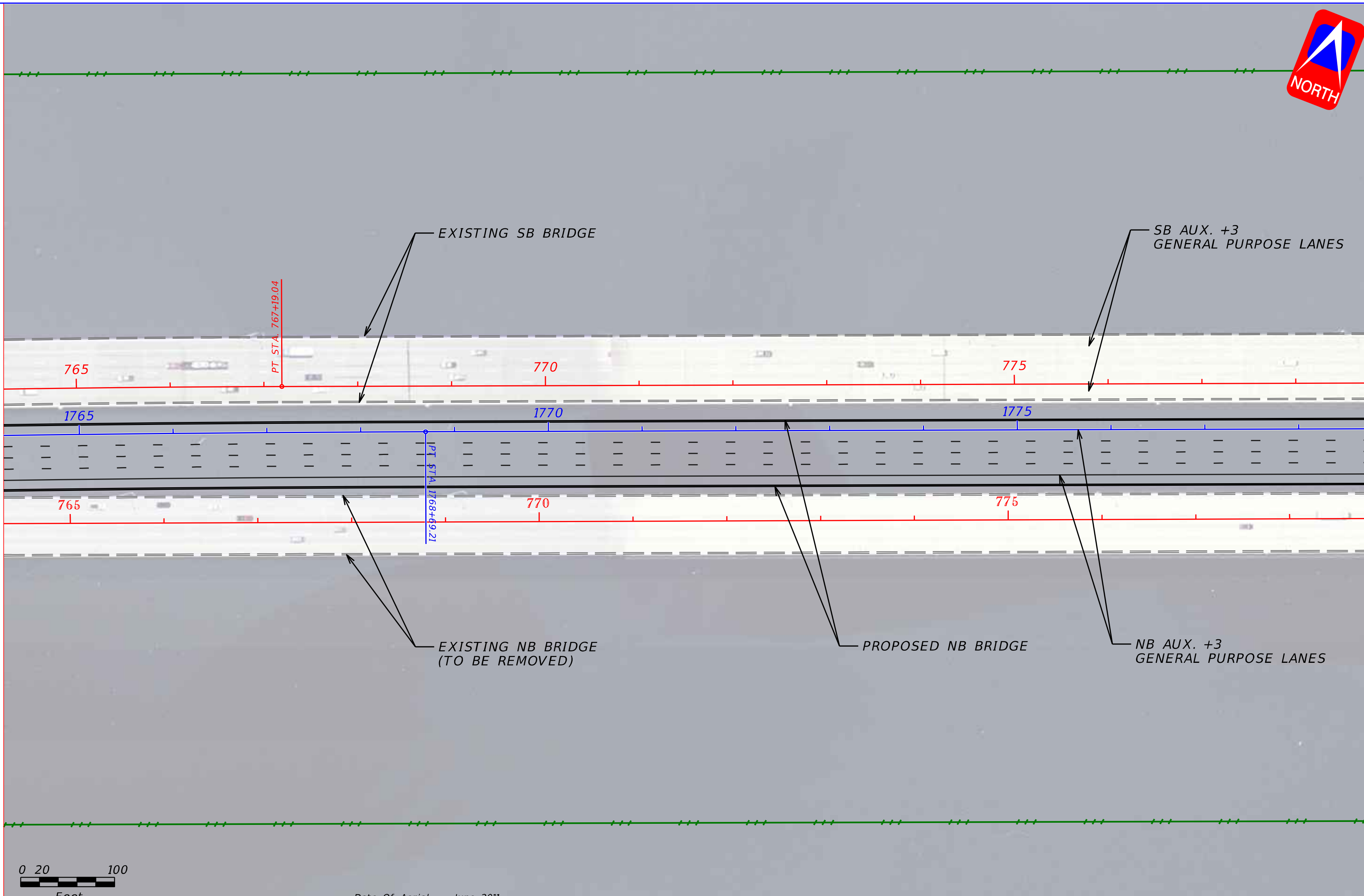
RC-1-2



LEGEND	Existing Right Of Way Existing Limited Access Right Of Way	American Consulting Engineers of Florida, LLC. 2818 Cypress Ridge Blvd, Suite 200 Wesley Chapel, Florida 33544 Phone: (813) 435-2600 Fax: (813) 435-2601 Certificate of Authorization No. 9302 Jeffrey S. Novotny, P.E. No. 51083	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION ROAD NO.: I-275 COUNTY: PINELLAS HILLSBOROUGH FINANCIAL PROJECT ID: 422799-1-12-04	Northbound Howard Frankland Bridge Replacement (I-275/S.R. 93) PD&E Study Bridge Replacement (Only) Center Option	SHEET NO. RC-1-3

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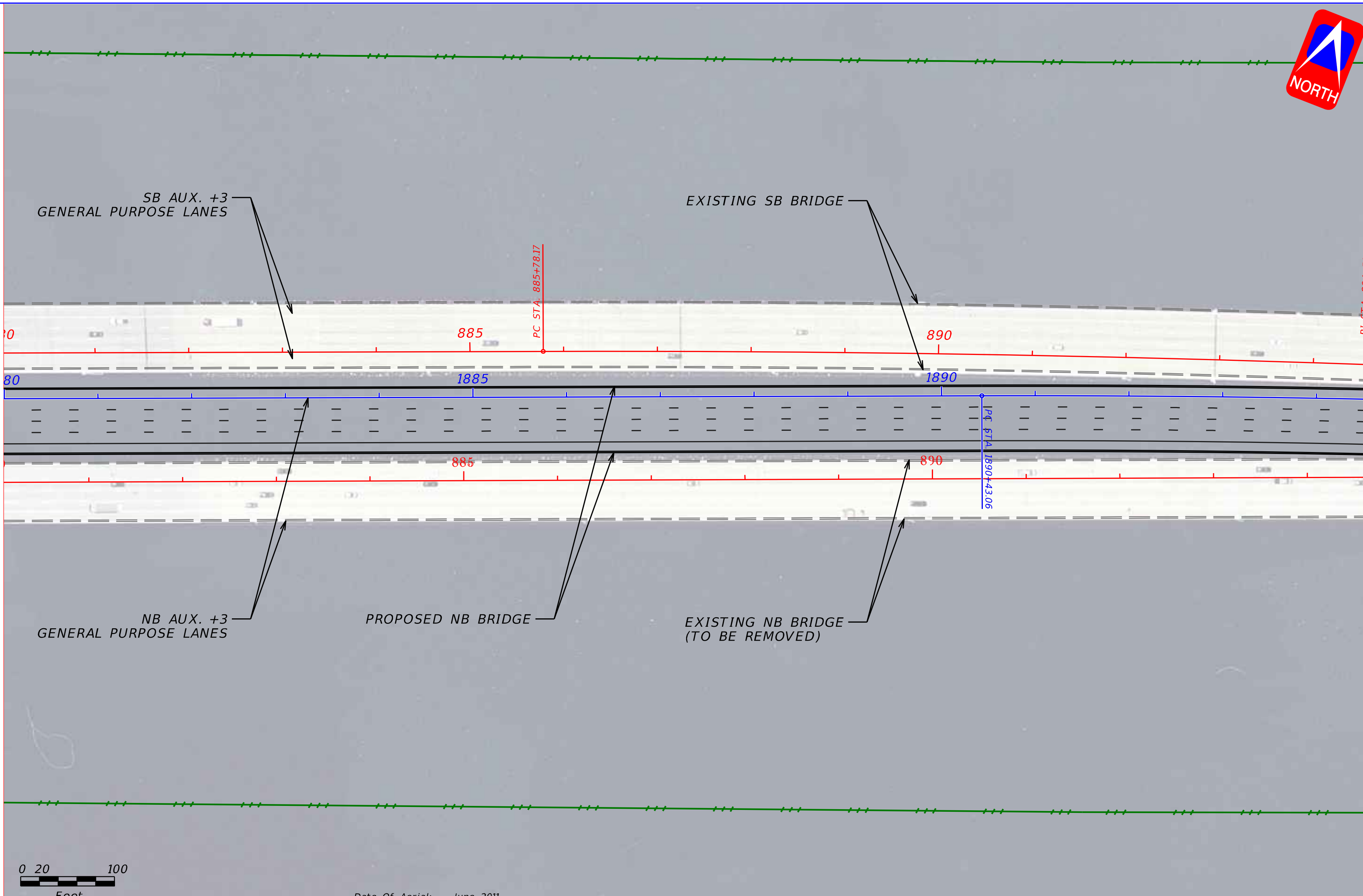

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STATE OF FLORIDA
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I-275	PINELLAS HILLSBOROUGH	422799-1-12-04

Northbound Howard Frankland Bridge Replacement
(I-275/S.R. 93) PD&E Study

Bridge Replacement
(Only)
Center Option

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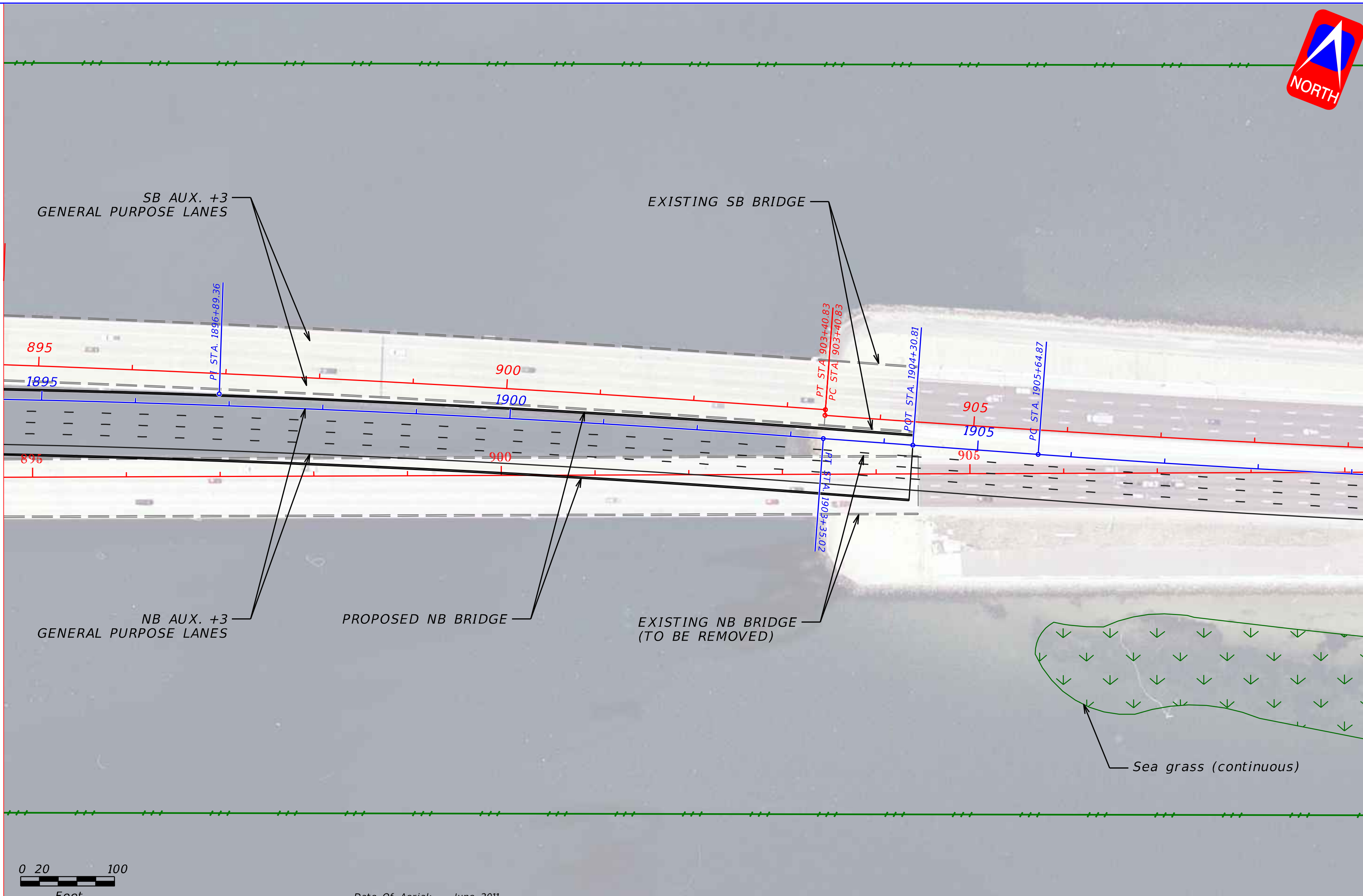

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ROAD NO.	COUNTY	FINANCIAL PROJECT ID
I-275	PINELLAS HILLSBOROUGH	422799-1-12-04

Northbound Howard Frankland Bridge Replacement
(I-275/S.R. 93) PD&E Study

Bridge Replacement
(Only)
Center Option

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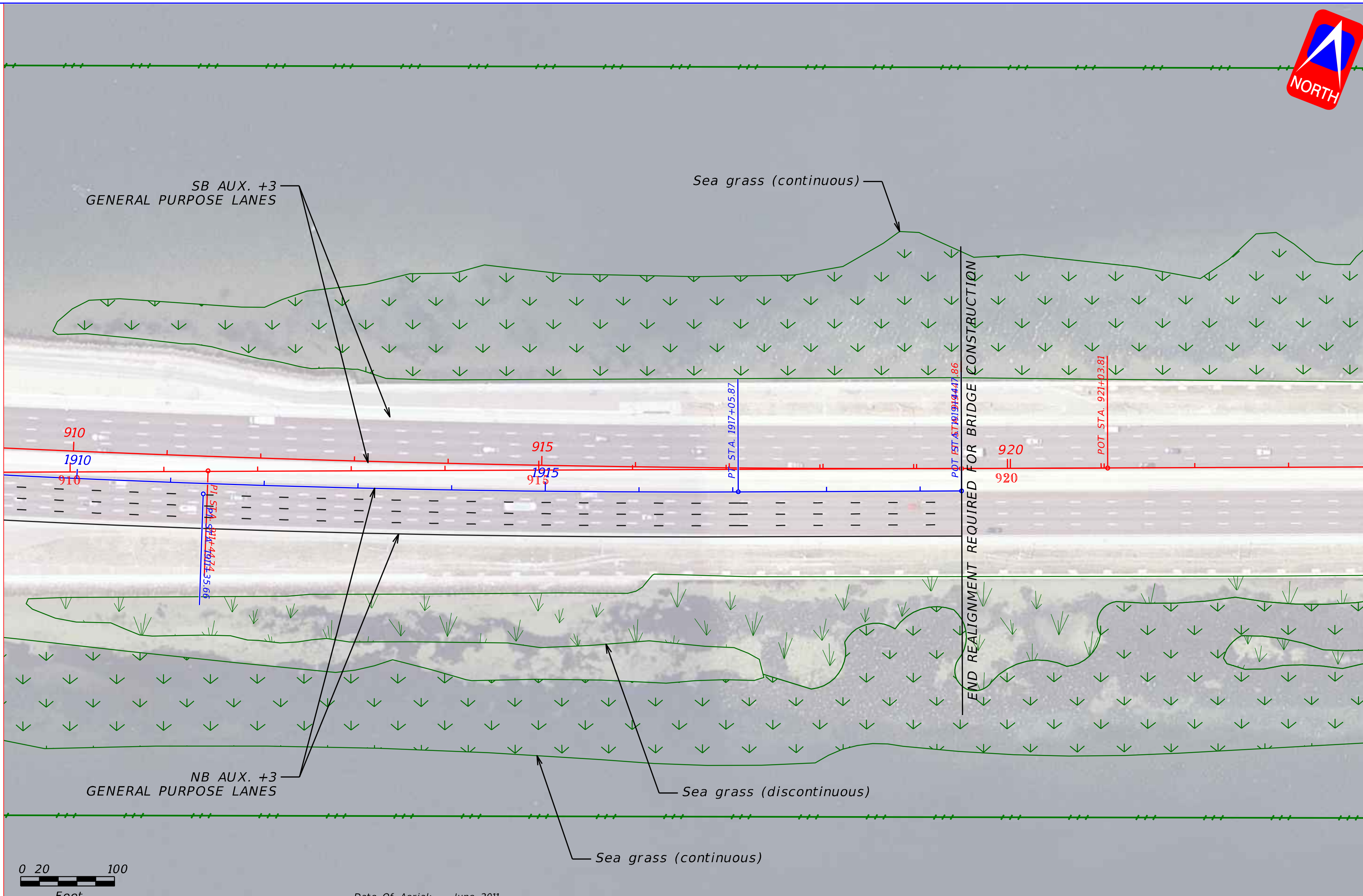

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Bridge Replacement
(Only)
Center Option

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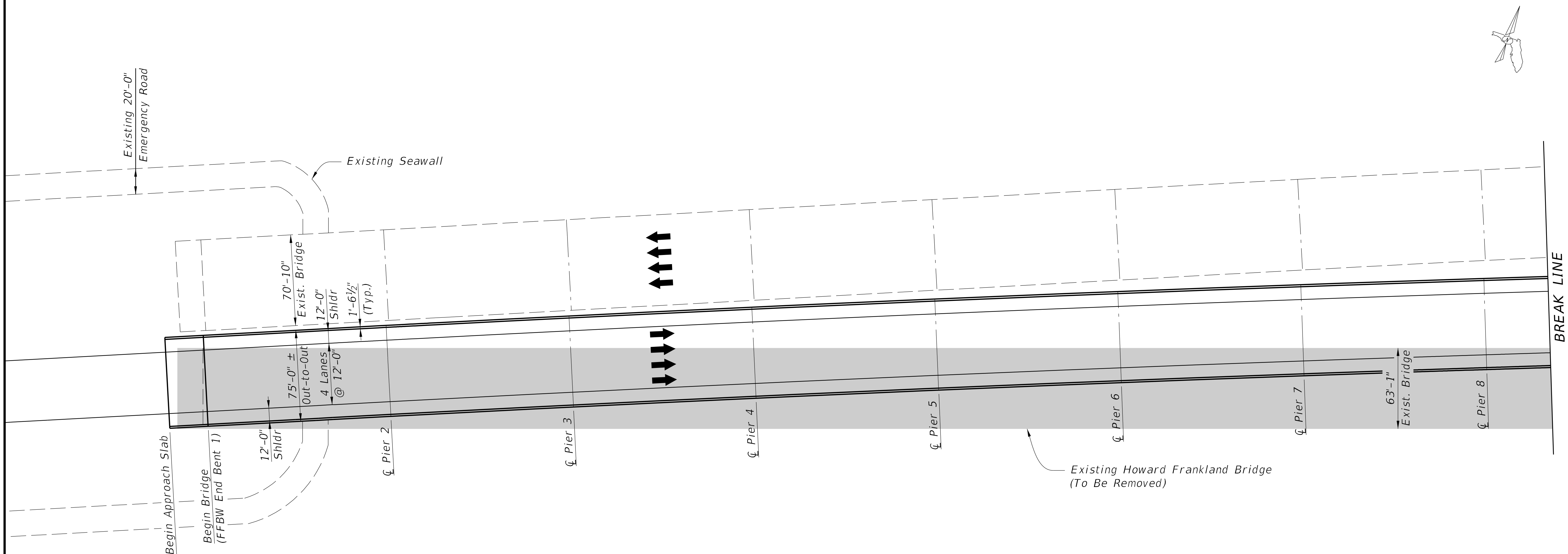
Appendix B

Plan, Elevation & Bridge Sequencing



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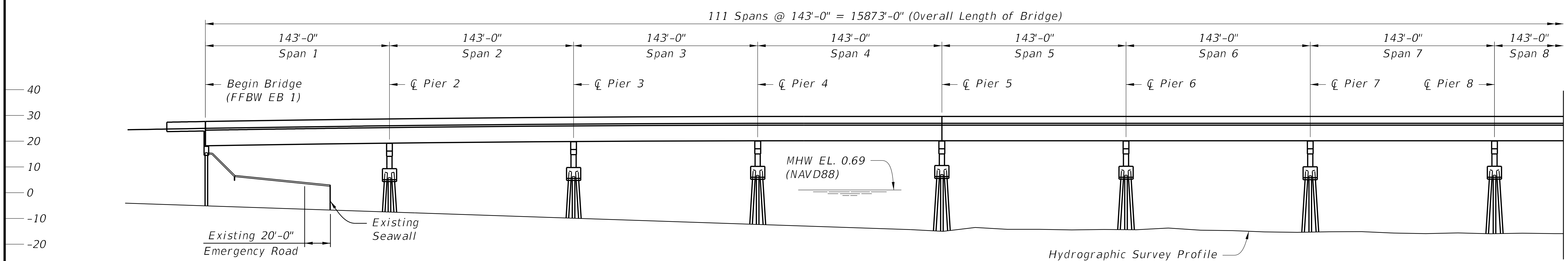

PARTIAL ELEVATION

REVISIONS					
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DESIGNED BY:	JLV 06-12
CHECKED BY:	SMK 06-12

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
275	HILLSBOROUGH PINELLAS	422799-1-12-04

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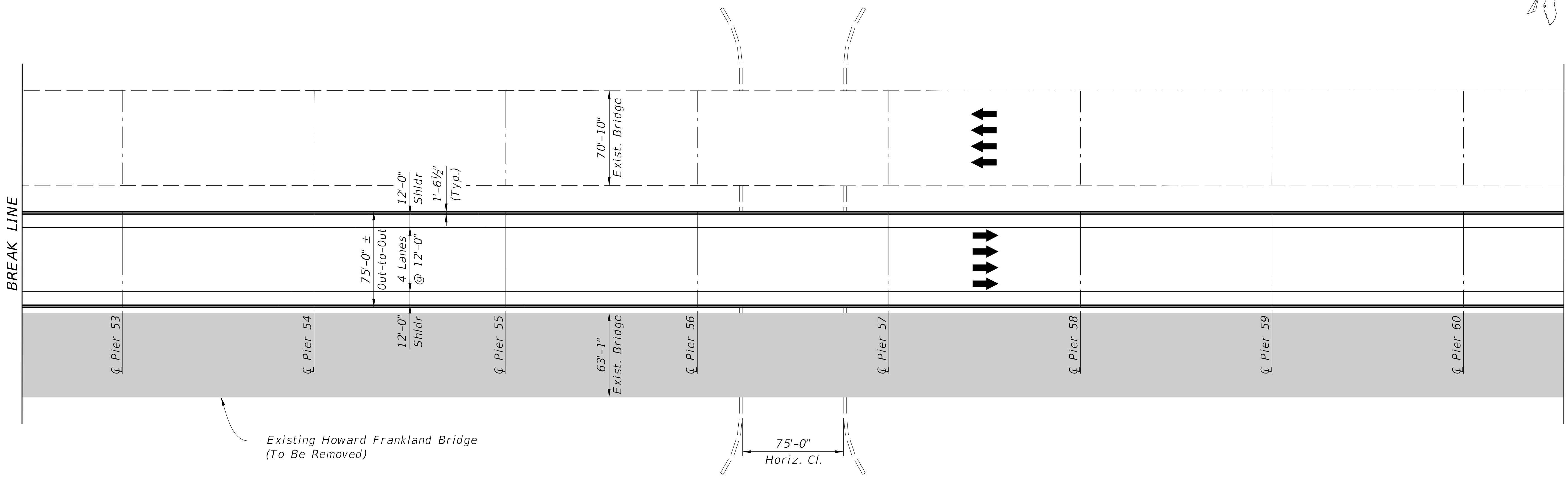

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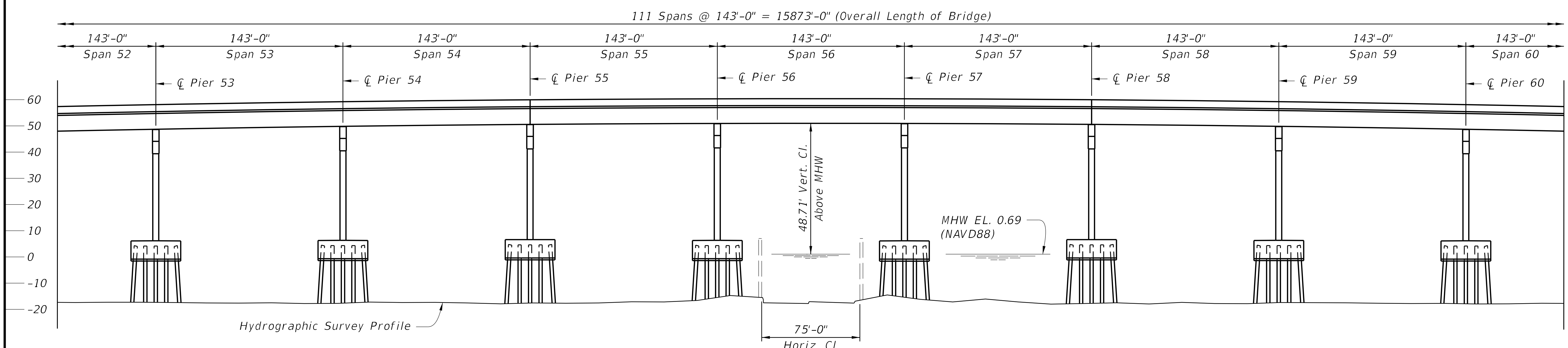

PARTIAL ELEVATION

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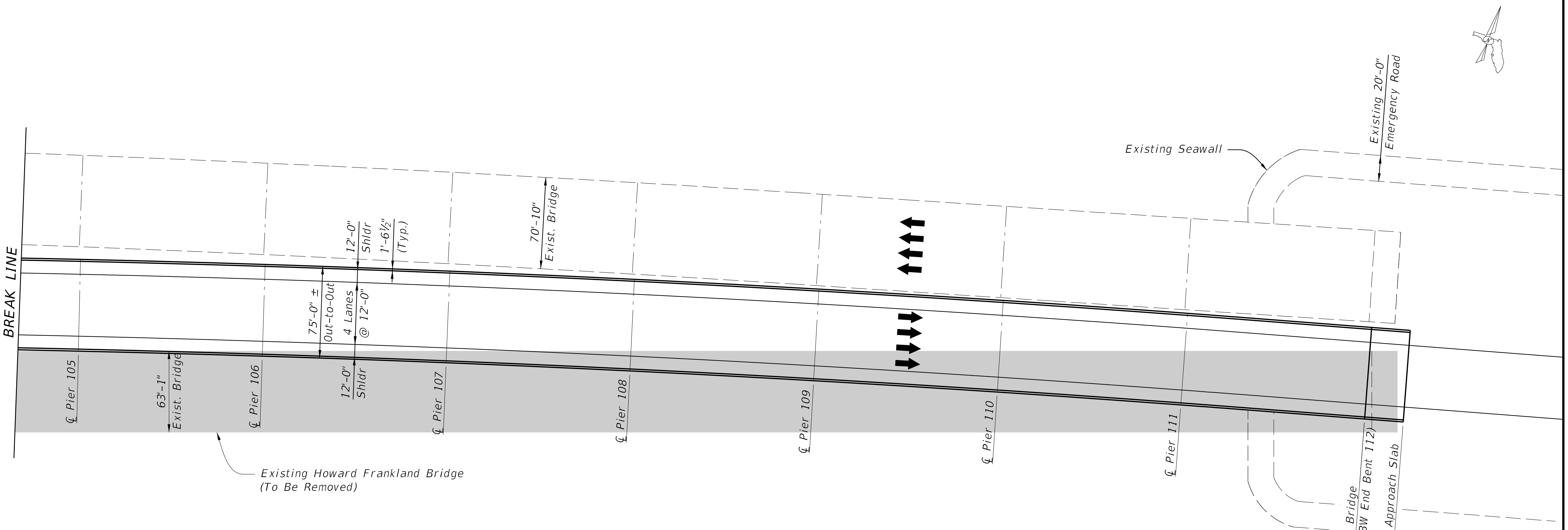

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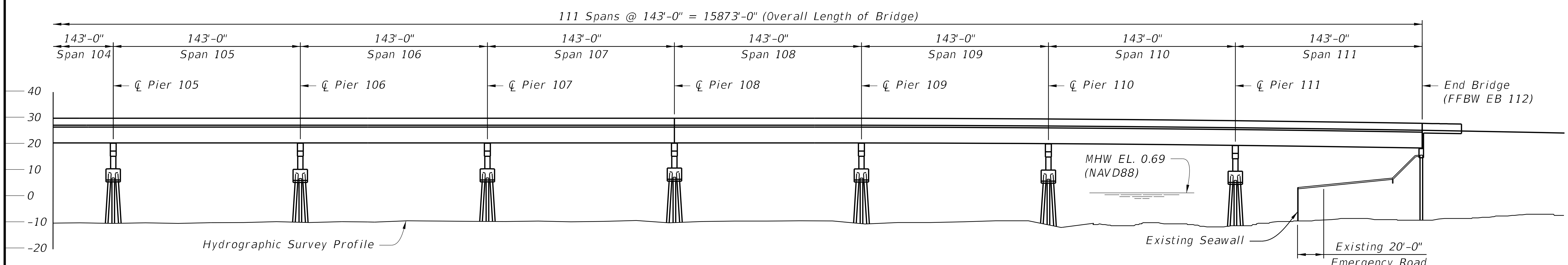

PARTIAL ELEVATION

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ROAD NO.	COUNTY	FINANCIAL PROJECT ID
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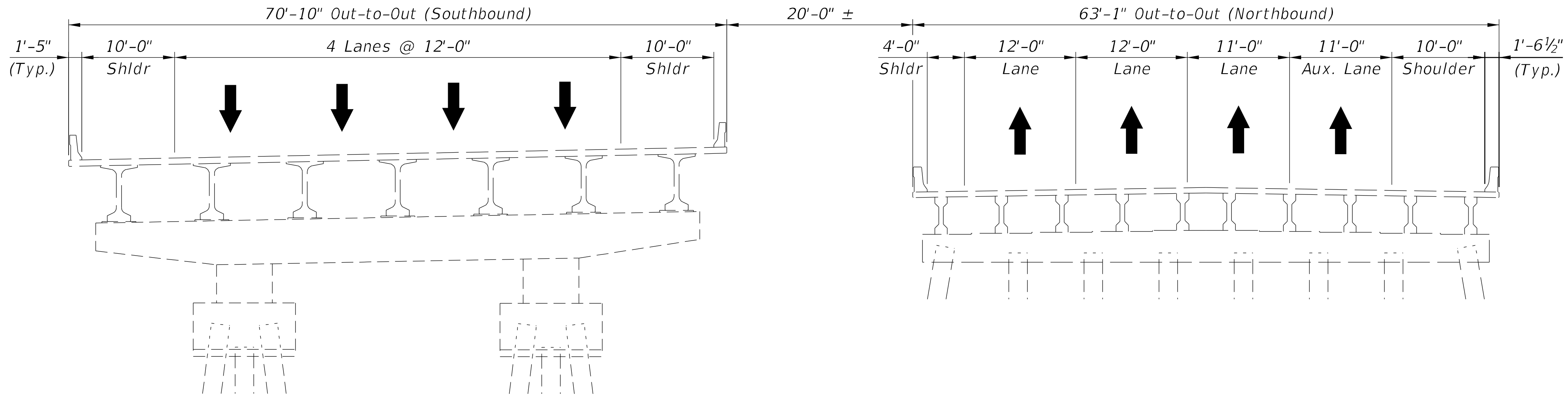

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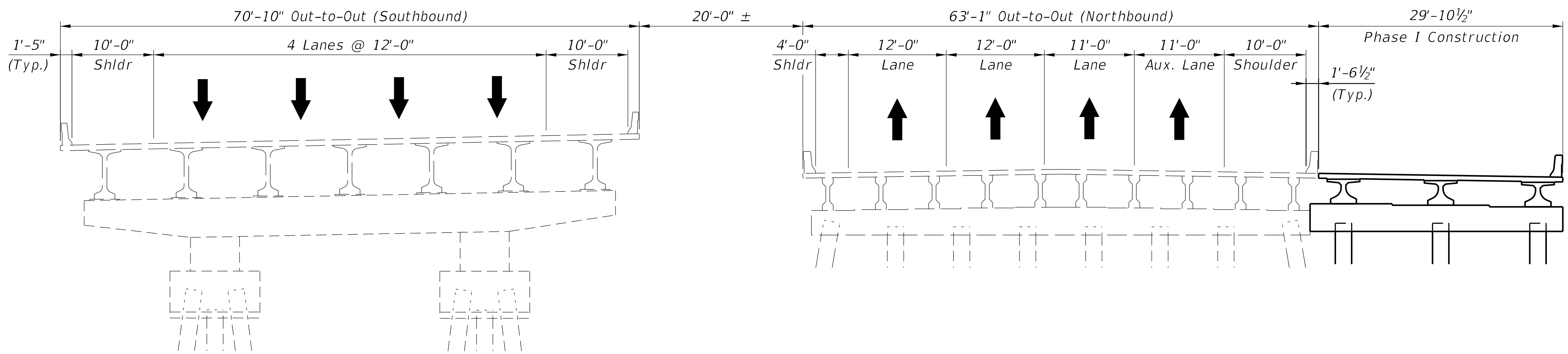

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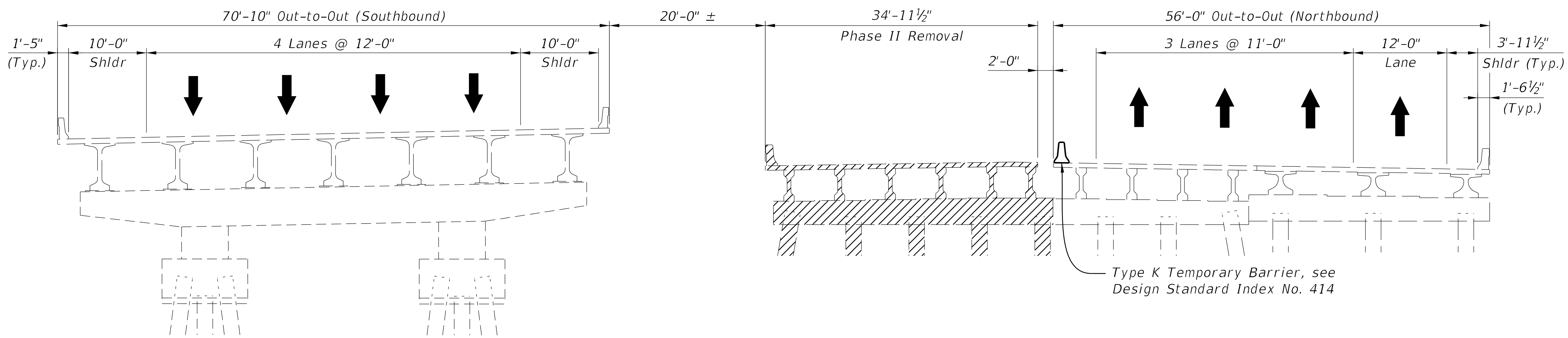

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ROAD NO.	COUNTY	FINANCIAL PROJECT ID
275	HILLSBOROUGH PINELLAS	422799-1-12-04

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PROJECT NAME: HOWARD FRANKLAND BRIDGE CORRIDOR

REF. DWG. NO.

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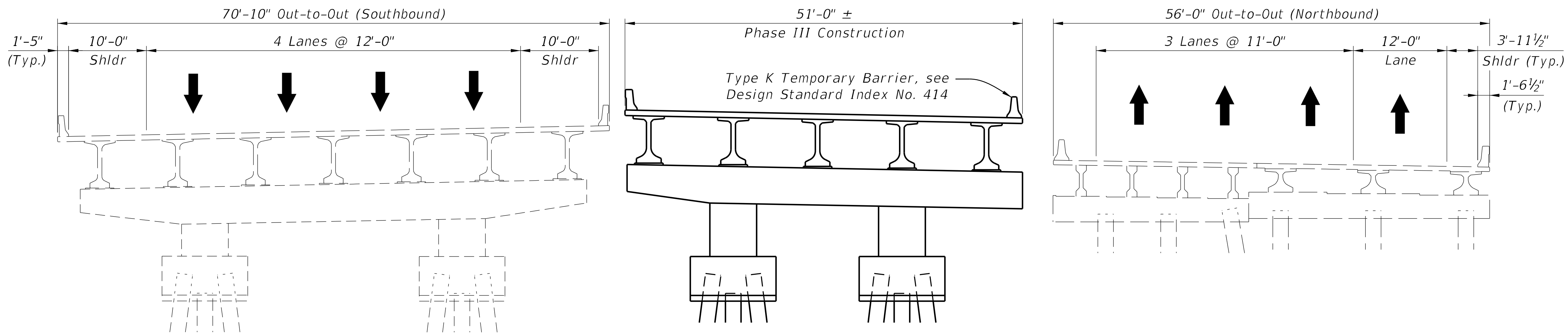

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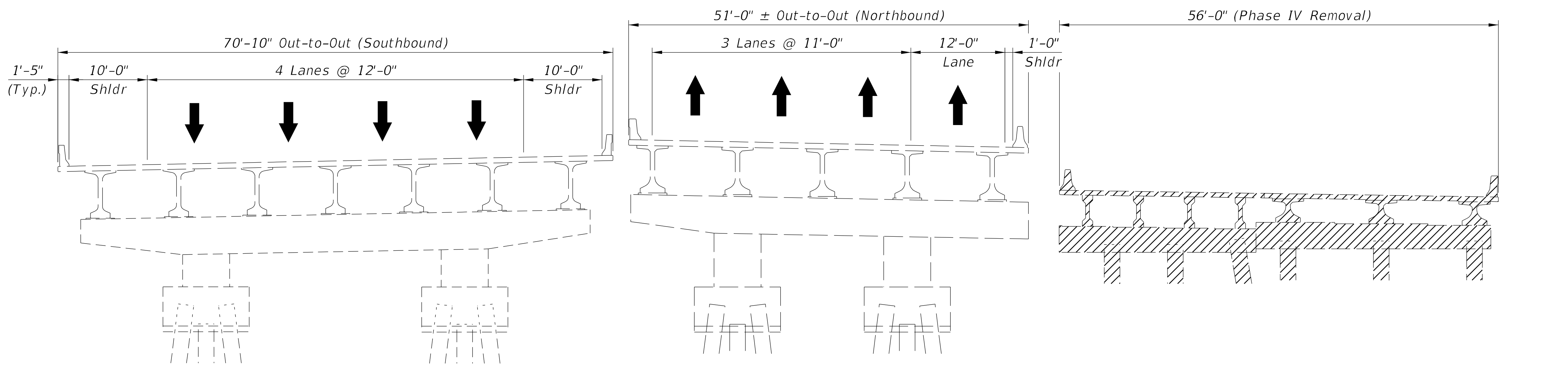

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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
275	HILLSBOROUGH PINELLAS	422799-1-12-04

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PROJECT NAME: HOWARD FRANKLAND BRIDGE CORRIDOR

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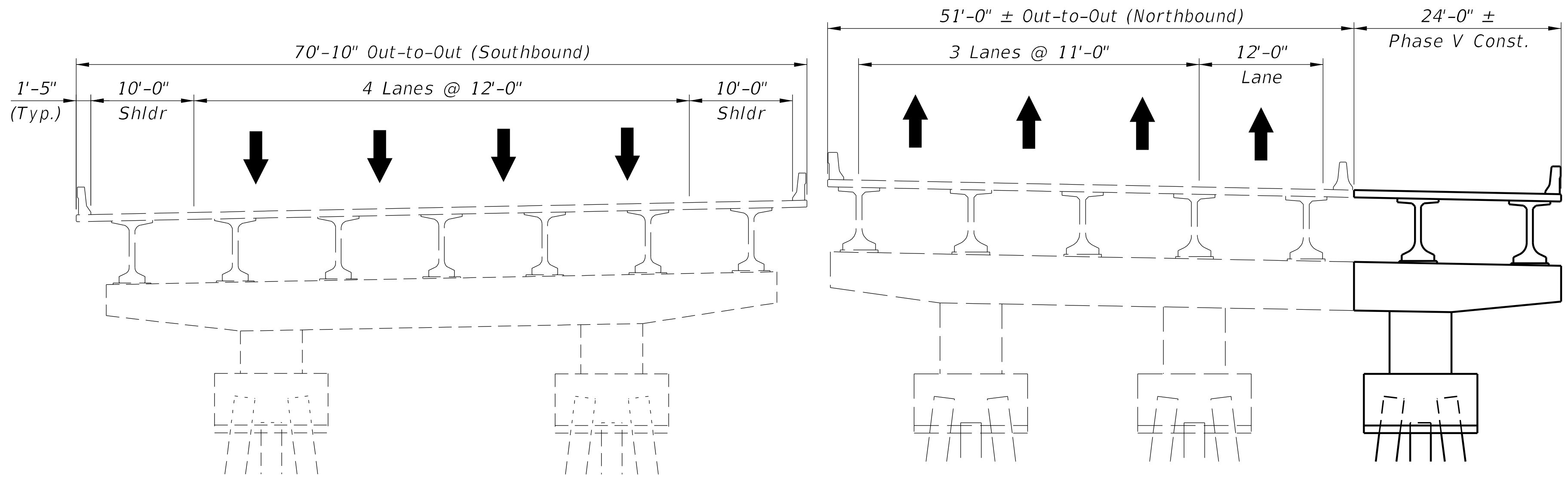

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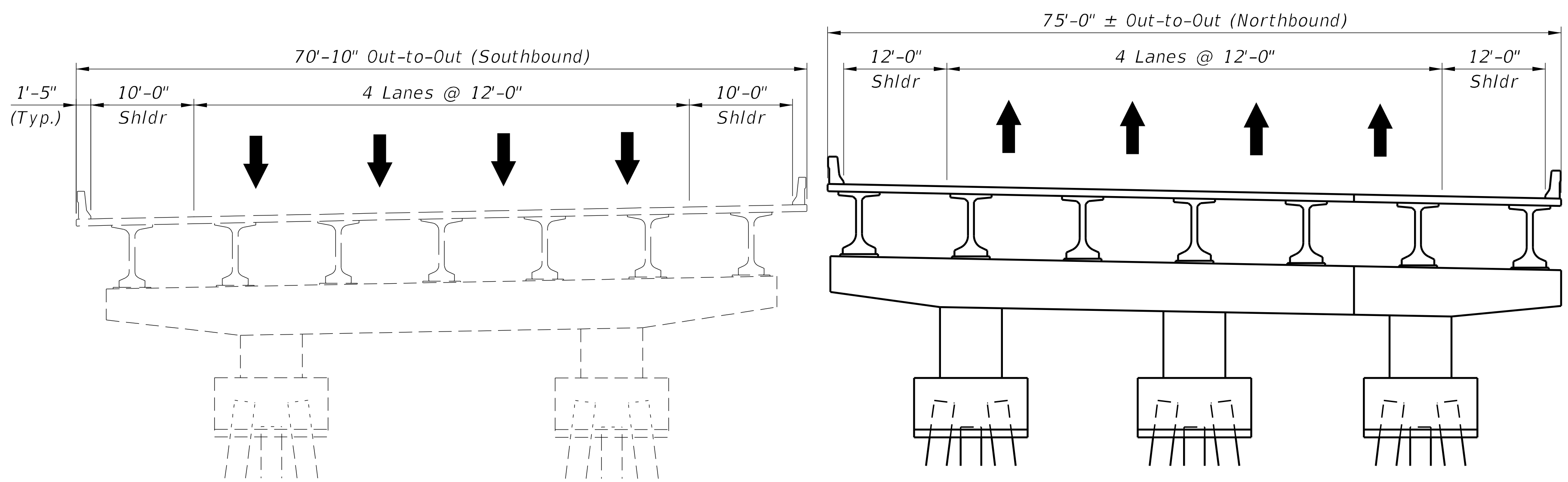

FINAL CONFIGURATION

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
275	HILLSBOROUGH PINELLAS	422799-1-12-04

SHEET TITLE: CONSTRUCTION SEQUENCE (3 OF 3) BEGIN/END BRIDGE

PROJECT NAME: HOWARD FRANKLAND BRIDGE CORRIDOR

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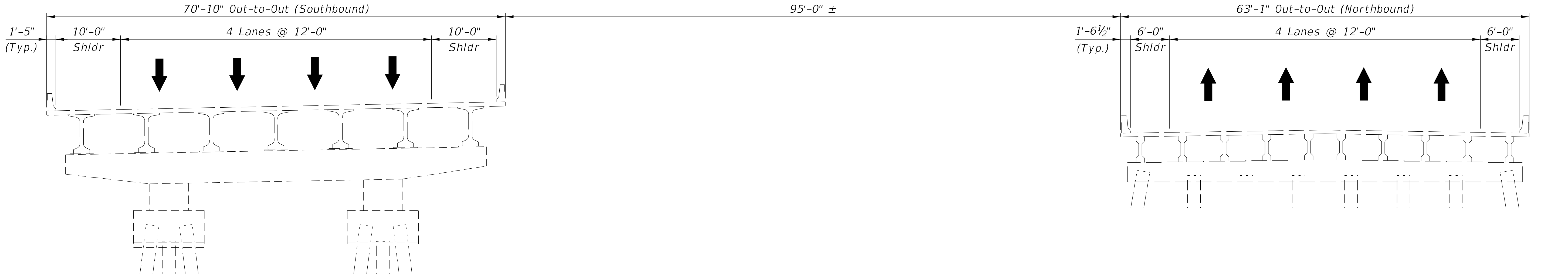

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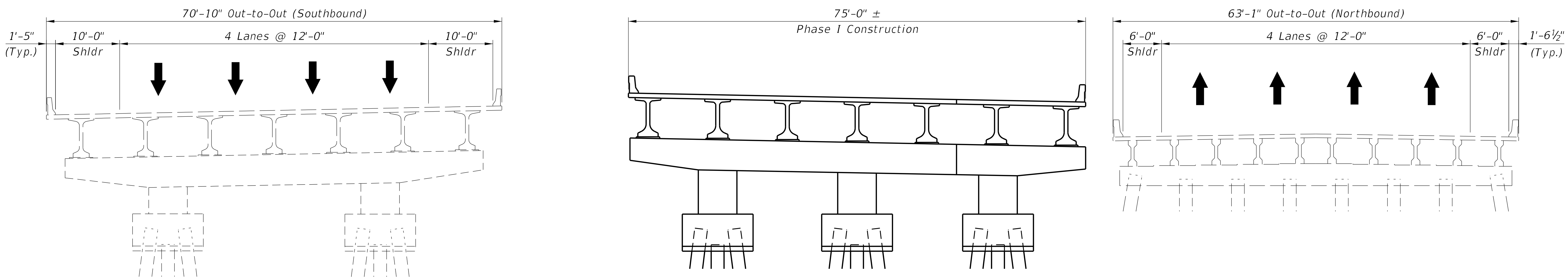

PHASE I CONSTRUCTION

REVISIONS					
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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
275	HILLSBOROUGH PINELLAS	422799-1-12-04

SHEET TITLE: CONSTRUCTION SEQUENCE (1 OF 2)
MID-BRIDGE

PROJECT NAME: HOWARD FRANKLAND BRIDGE CORRIDOR

REF. DWG. NO.

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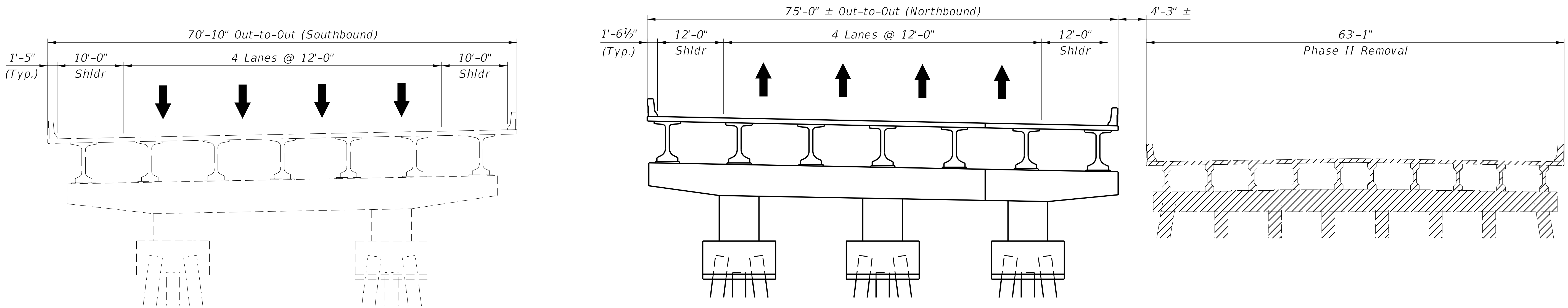

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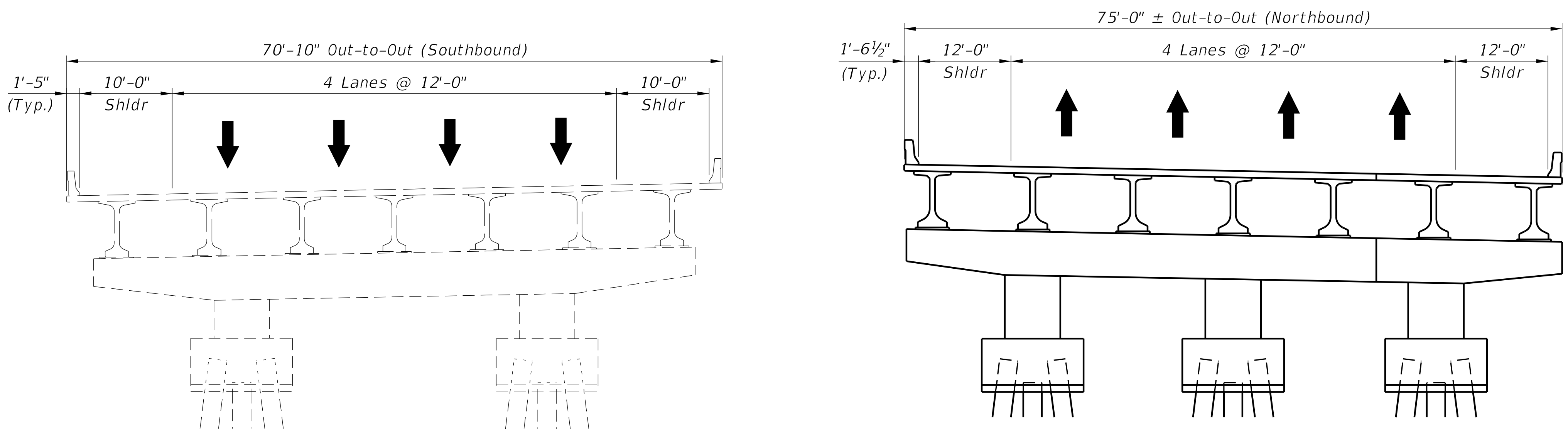

FINAL CONFIGURATION

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
275	HILLSBOROUGH PINELLAS	422799-1-12-04

SHEET TITLE: CONSTRUCTION SEQUENCE (2 OF 2)
MID-BRIDGE

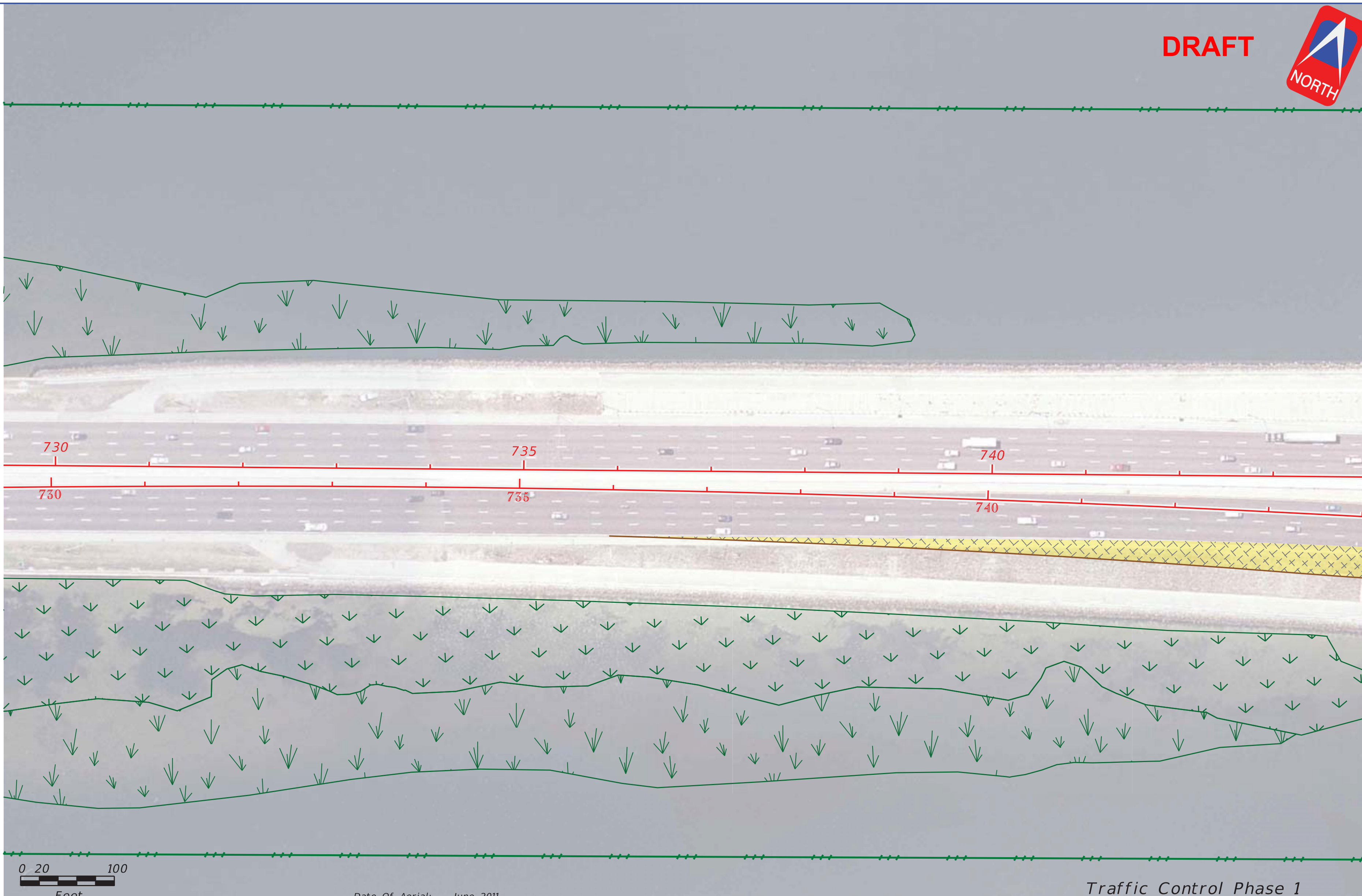
PROJECT NAME: HOWARD FRANKLAND BRIDGE CORRIDOR

REF. DWG. NO.

SHEET NO.

Appendix C

Traffic Control Plans



Traffic Control Phase 1

LEGEND

- Existing Right Of Way
- Existing Limited Access Right Of Way
- Bridge Construction
- Roadway Construction
- Temporary Road / Bridge
- Construction In Previous Phases
- Demolition

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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
I-275	PINELLAS HILLSBOROUGH	422799-1-12-04

Northbound Howard Frankland Bridge Replacement
(I-275/S.R. 93) PD&E Study

Bridge Replacement
(Only)
Center Option

SHEET NO.
RC-TC1-1

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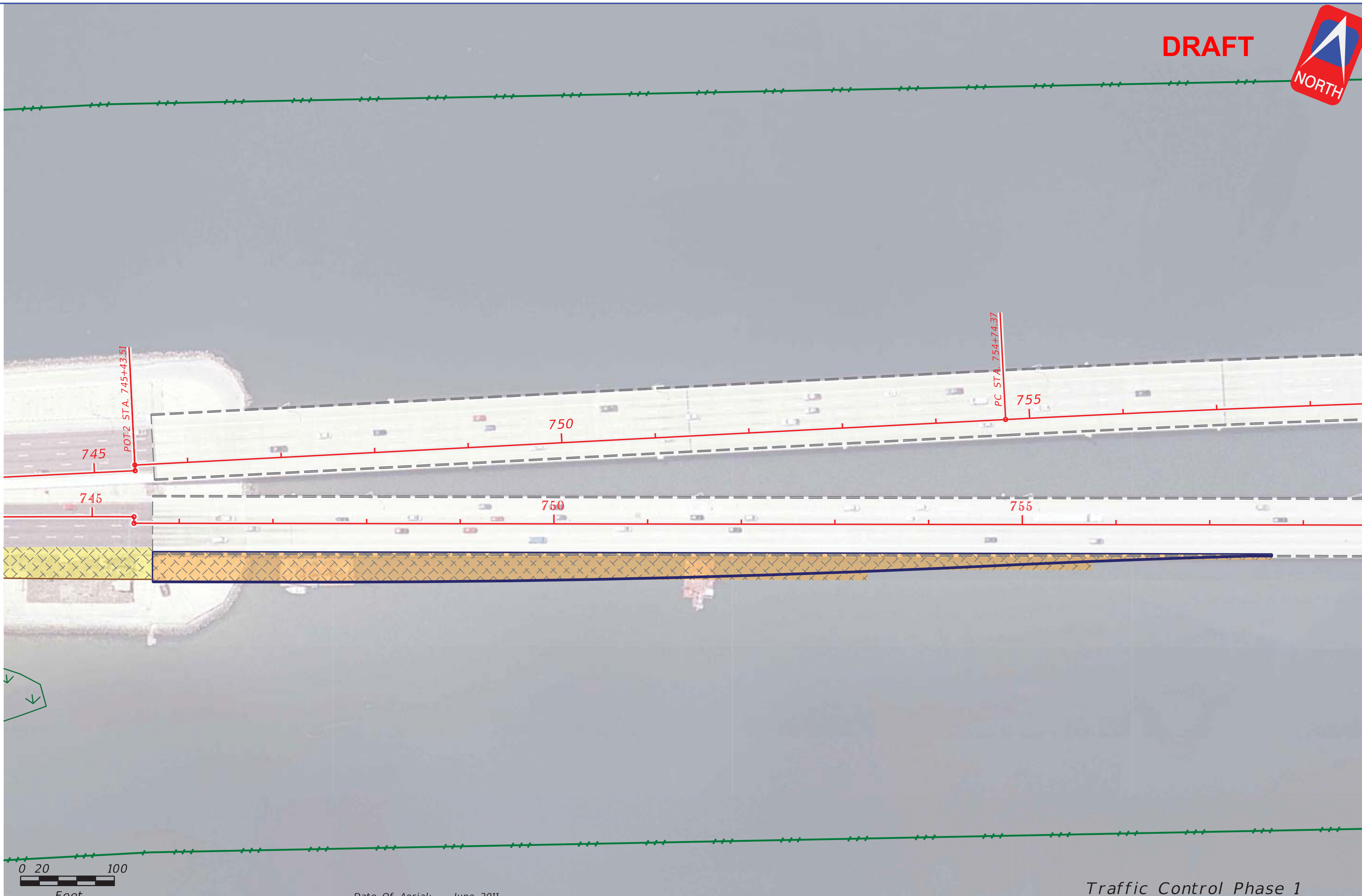

Date Of Aerial: June 2011

Traffic Control Phase 1

LEGEND

- Existing Right Of Way
- Existing Limited Access Right Of Way
- Bridge Construction
- Roadway Construction
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Northbound Howard Frankland Bridge Replacement
(I-275/S.R. 93) PD&E Study

Bridge Replacement
(Only)
Center Option

SHEET NO.
RC-TC1-2

Date Of Aerial: June 2011

Traffic Control Phase 1

LEGEND

- Existing Right Of Way
- Existing Limited Access Right Of Way
- Bridge Construction
- Roadway Construction
- Temporary Road / Bridge
- Construction In Previous Phases
- Demolition

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Jeffrey S. Novotny, P.E. No. 51083

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
I-275	PINELLAS HILLSBOROUGH	422799-1-12-04

Northbound Howard Frankland Bridge Replacement
(I-275/S.R. 93) PD&E Study

Bridge Replacement
(Only)
Center Option

SHEET NO.
RC-TC1-3

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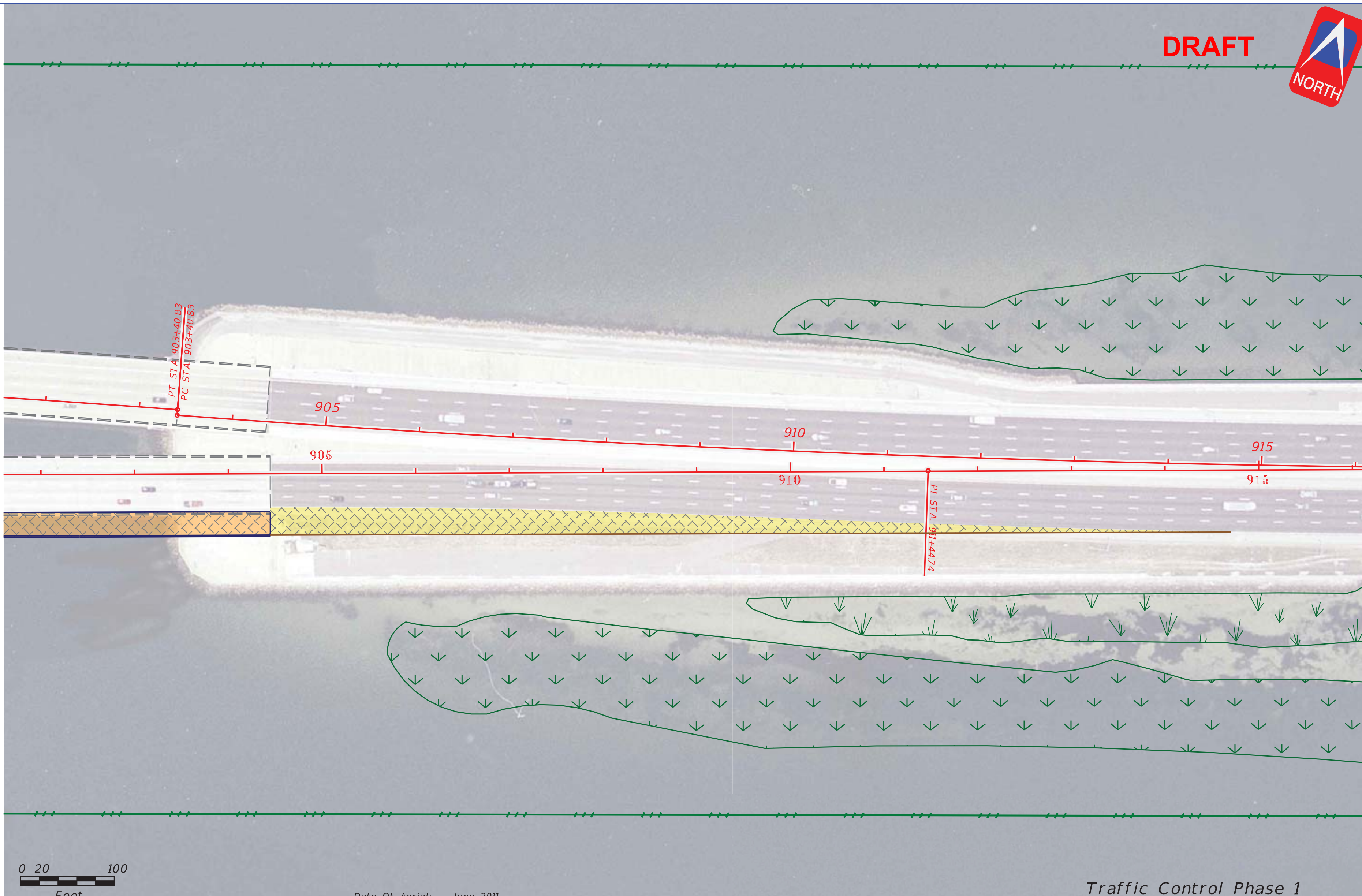

Date Of Aerial: June 2011

Traffic Control Phase 1

LEGEND

Existing Right Of Way	Bridge Construction
Existing Limited Access Right Of Way	Roadway Construction
	Temporary Road / Bridge
	Construction In Previous Phases
	Demolition

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Bridge Replacement
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SHEET NO.
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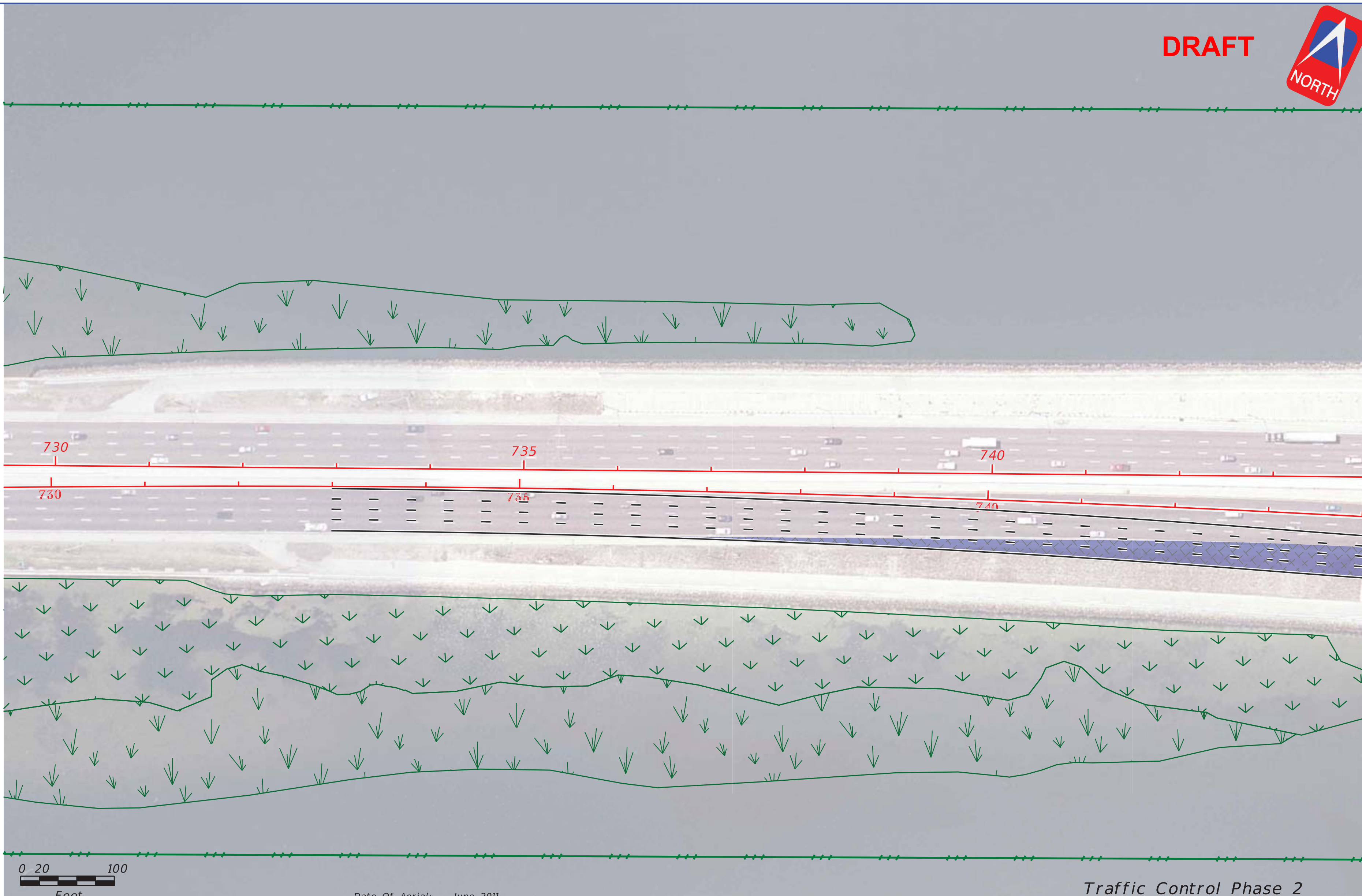

LEGEND

- Existing Right Of Way
- Existing Limited Access Right Of Way
- Bridge Construction
- Roadway Construction
- Temporary Road / Bridge
- Construction In Previous Phases
- Demolition

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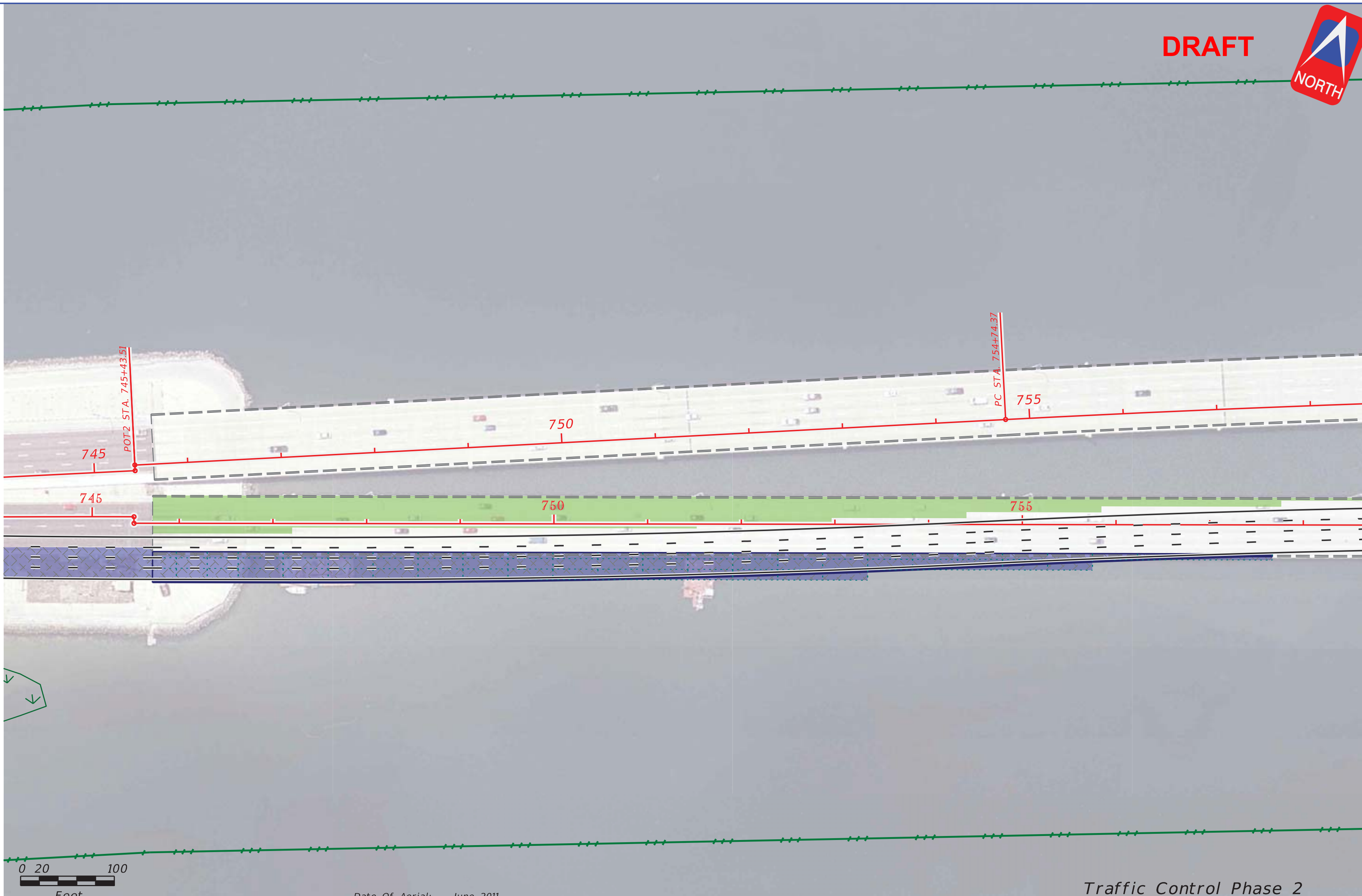

Date Of Aerial: June 2011

Traffic Control Phase 2

LEGEND

Existing Right Of Way	Bridge Construction
Existing Limited Access Right Of Way	Roadway Construction
	Temporary Road / Bridge
	Construction In Previous Phases
	Demolition

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(I-275/S.R. 93) PD&E Study

Bridge Replacement
(Only)
Center Option

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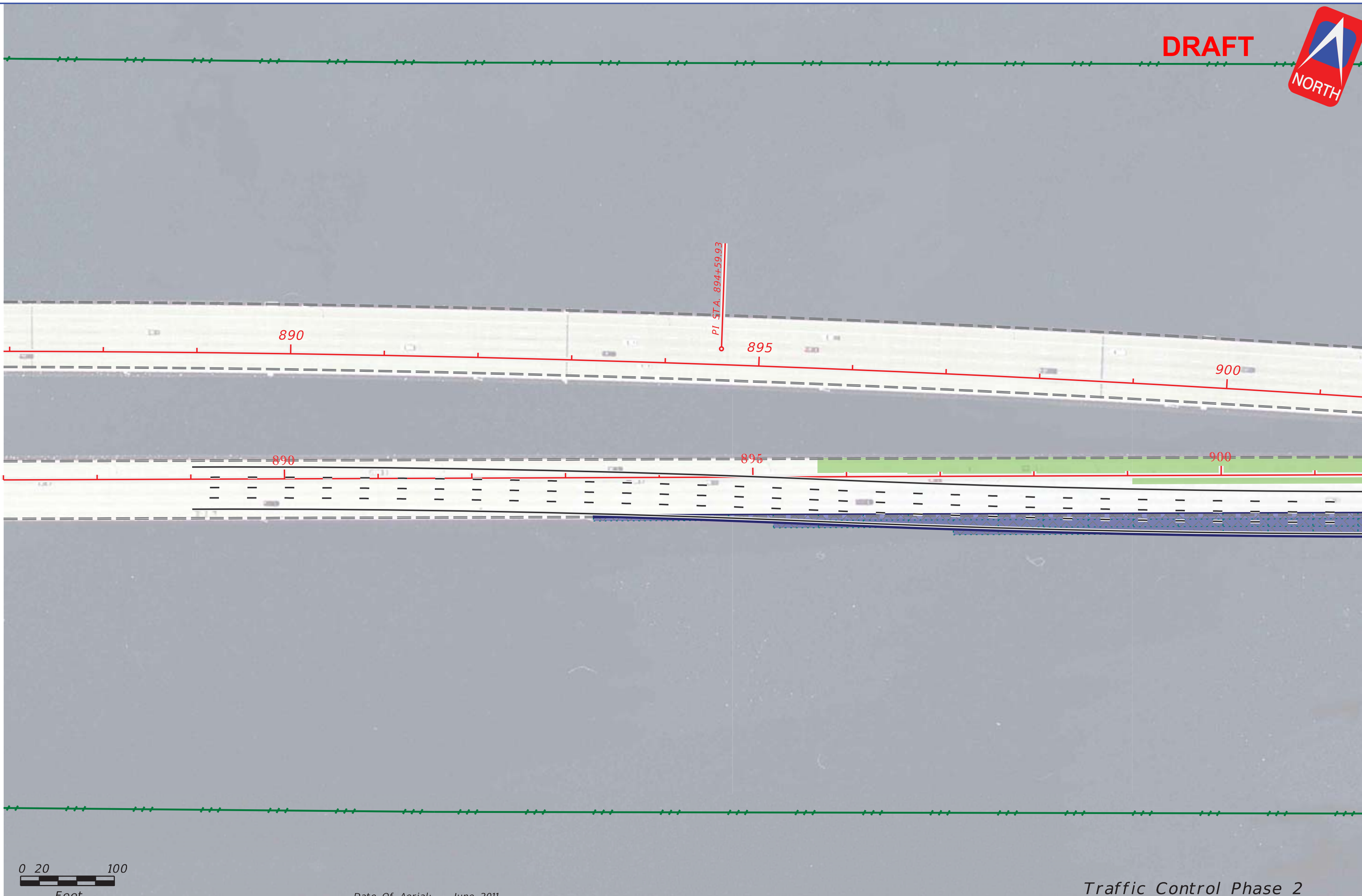

Date Of Aerial: June 2011

Traffic Control Phase 2

LEGEND

- Existing Right Of Way
- Existing Limited Access Right Of Way
- Bridge Construction
- Roadway Construction
- Temporary Road / Bridge
- Construction In Previous Phases
- Demolition

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Bridge Replacement
(Only)
Center Option

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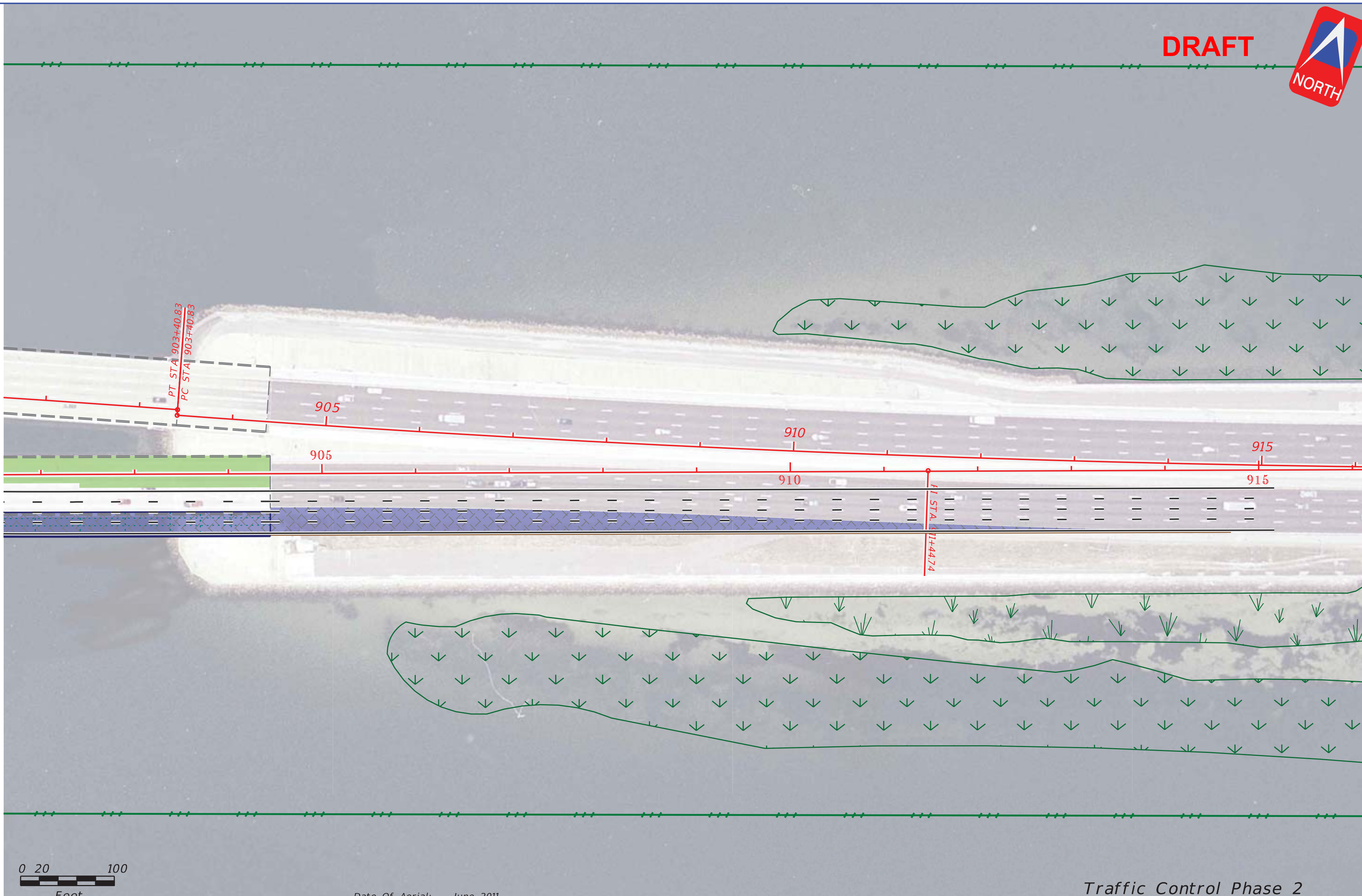

Date Of Aerial: June 2011

Traffic Control Phase 2

LEGEND

——— – –	Existing Right Of Way
—+—+—	Existing Limited Access Right Of Way
(red)	Bridge Construction
(yellow)	Roadway Construction
(hatched)	Temporary Road / Bridge
(purple)	Construction In Previous Phases
(green)	Demolition

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Bridge Replacement
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Center Option

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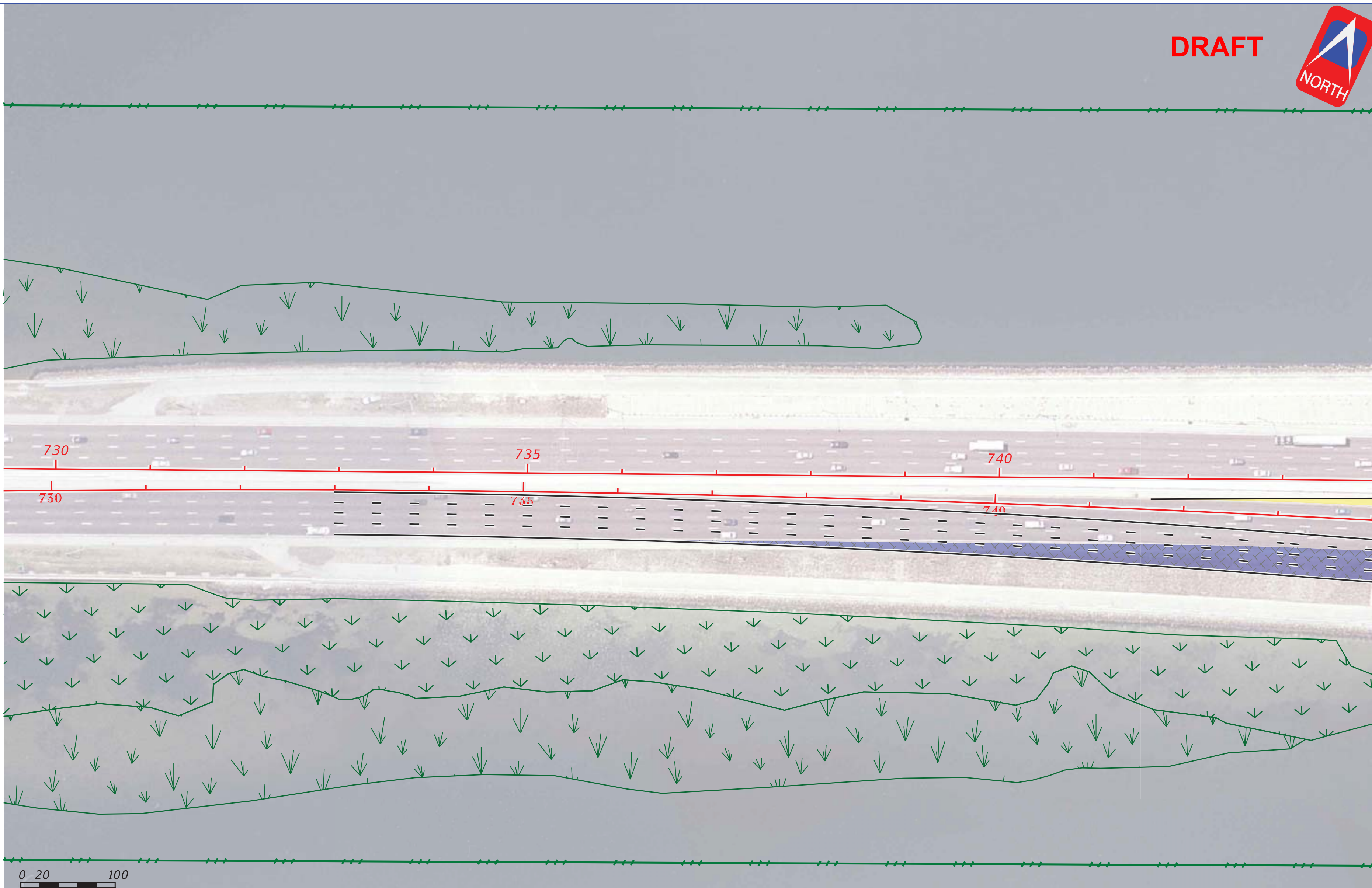

Date Of Aerial: June 2011

Traffic Control Phase 3

LEGEND

- Existing Right Of Way
- Existing Limited Access Right Of Way
- Bridge Construction
- Roadway Construction
- Temporary Road / Bridge
- Construction In Previous Phases
- Demolition

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Bridge Replacement
(Only)
Center Option

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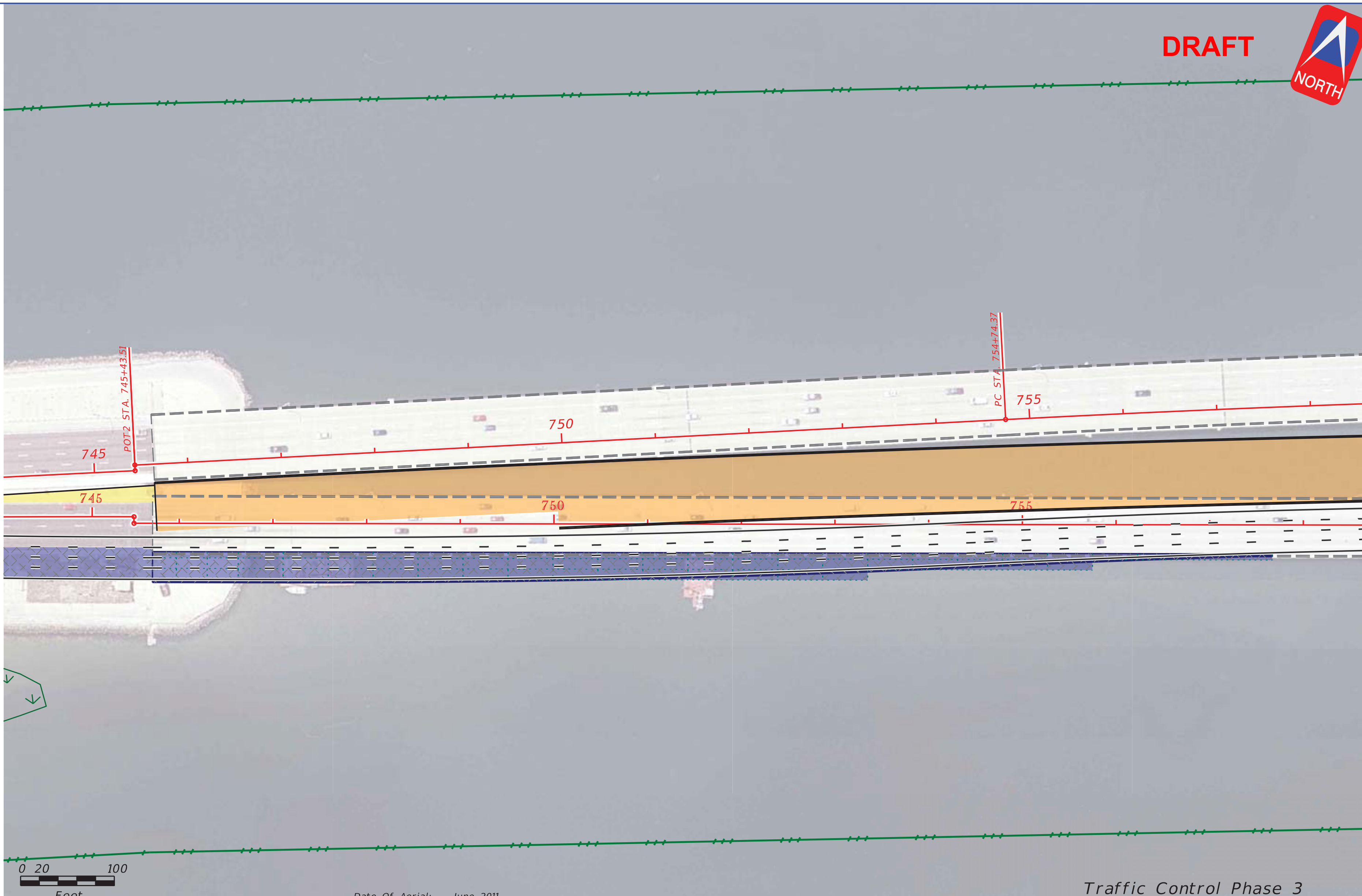

Traffic Control Phase 3

LEGEND

Existing Right Of Way	
Existing Limited Access Right Of Way	
Bridge Construction	
Roadway Construction	
Temporary Road / Bridge	
Construction In Previous Phases	
Demolition	

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Bridge Replacement
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Center Option

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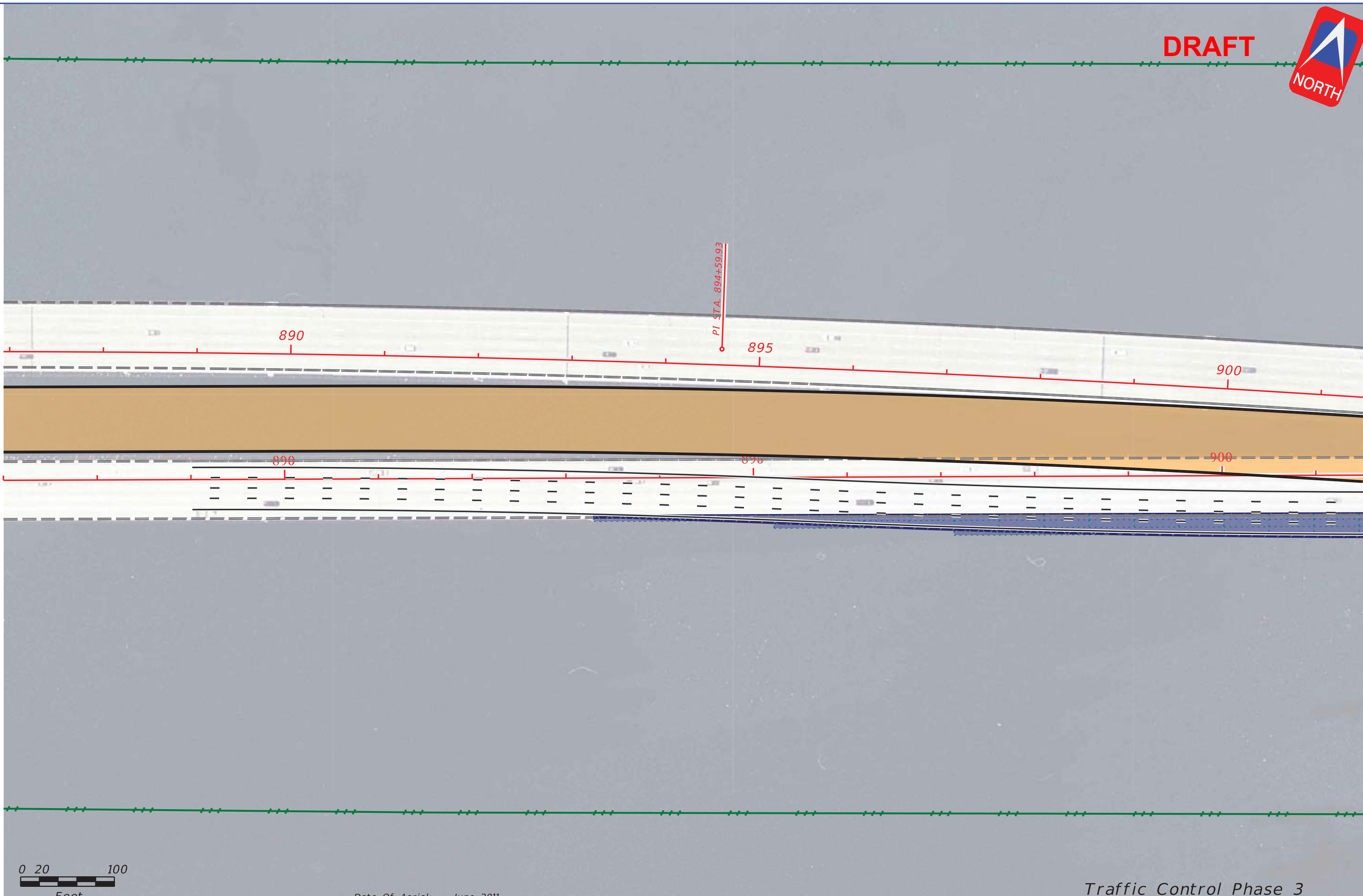

LEGEND

- Existing Right Of Way
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- Demolition

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Bridge Replacement
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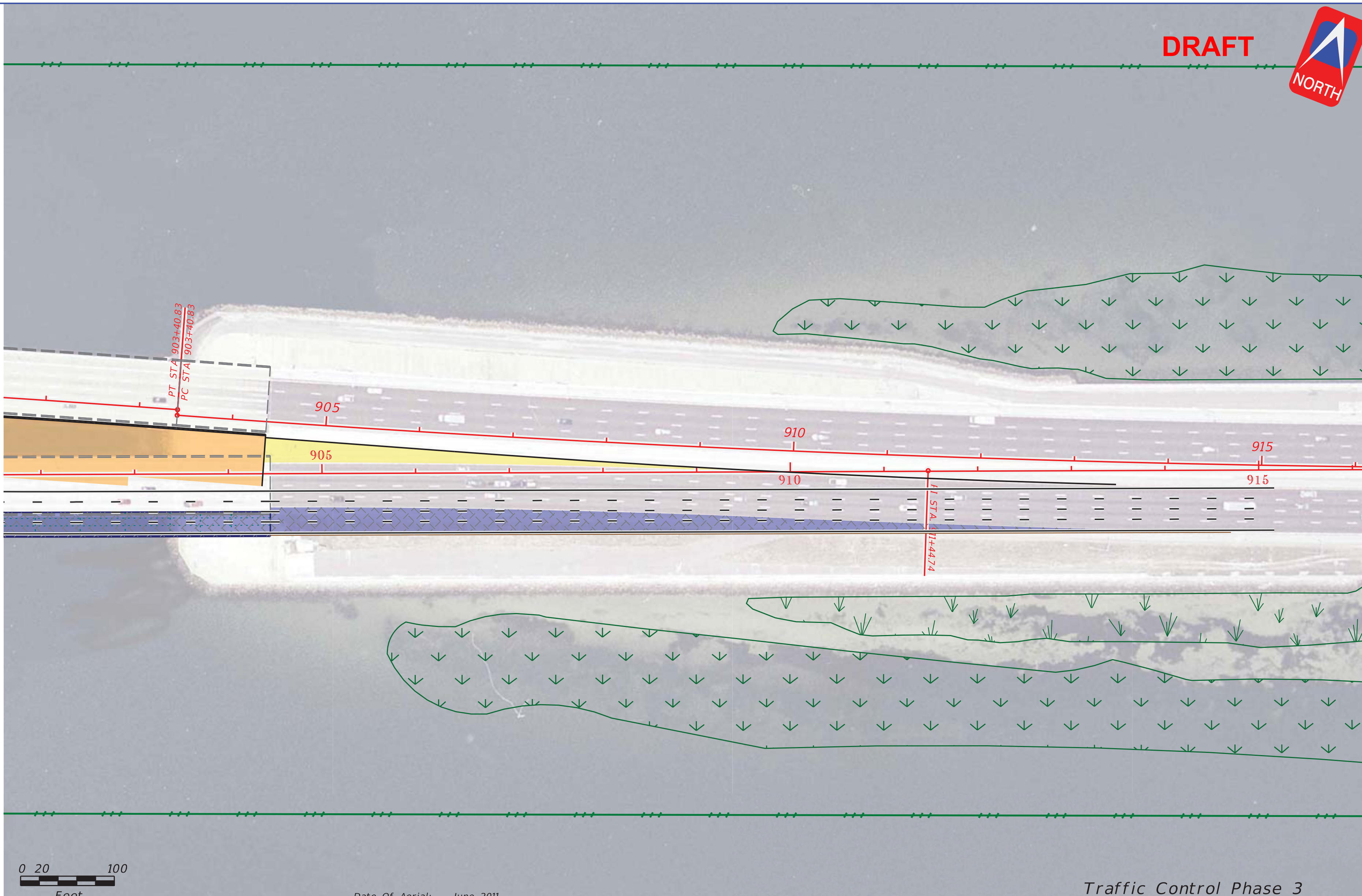

LEGEND

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Bridge Replacement
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Center Option

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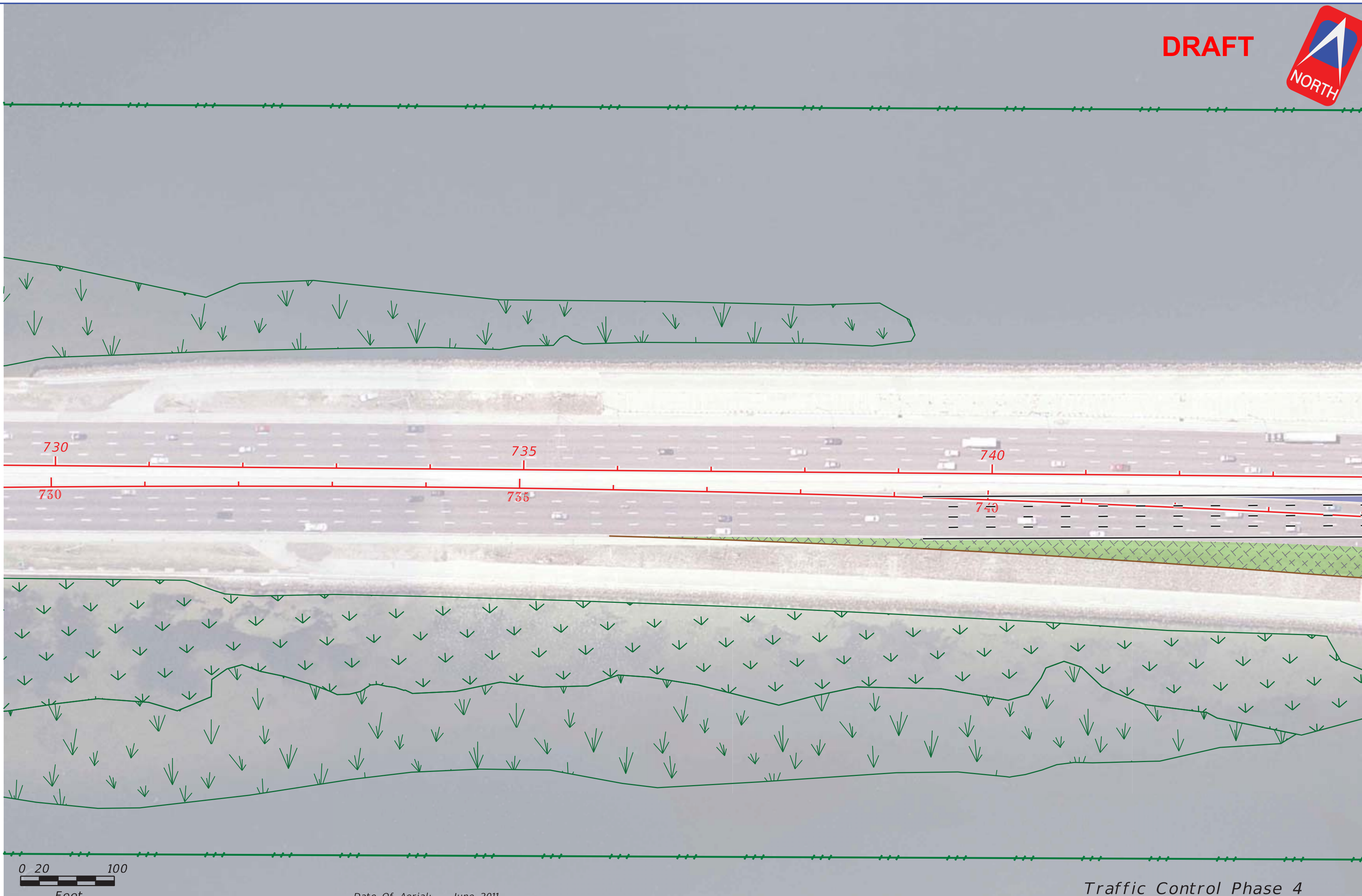

Traffic Control Phase 4

LEGEND		
Existing Right Of Way	Bridge Construction	
Existing Limited Access Right Of Way	Roadway Construction	
	Temporary Road / Bridge	
	Construction In Previous Phases	
	Demolition	

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Bridge Replacement
(Only)
Center Option

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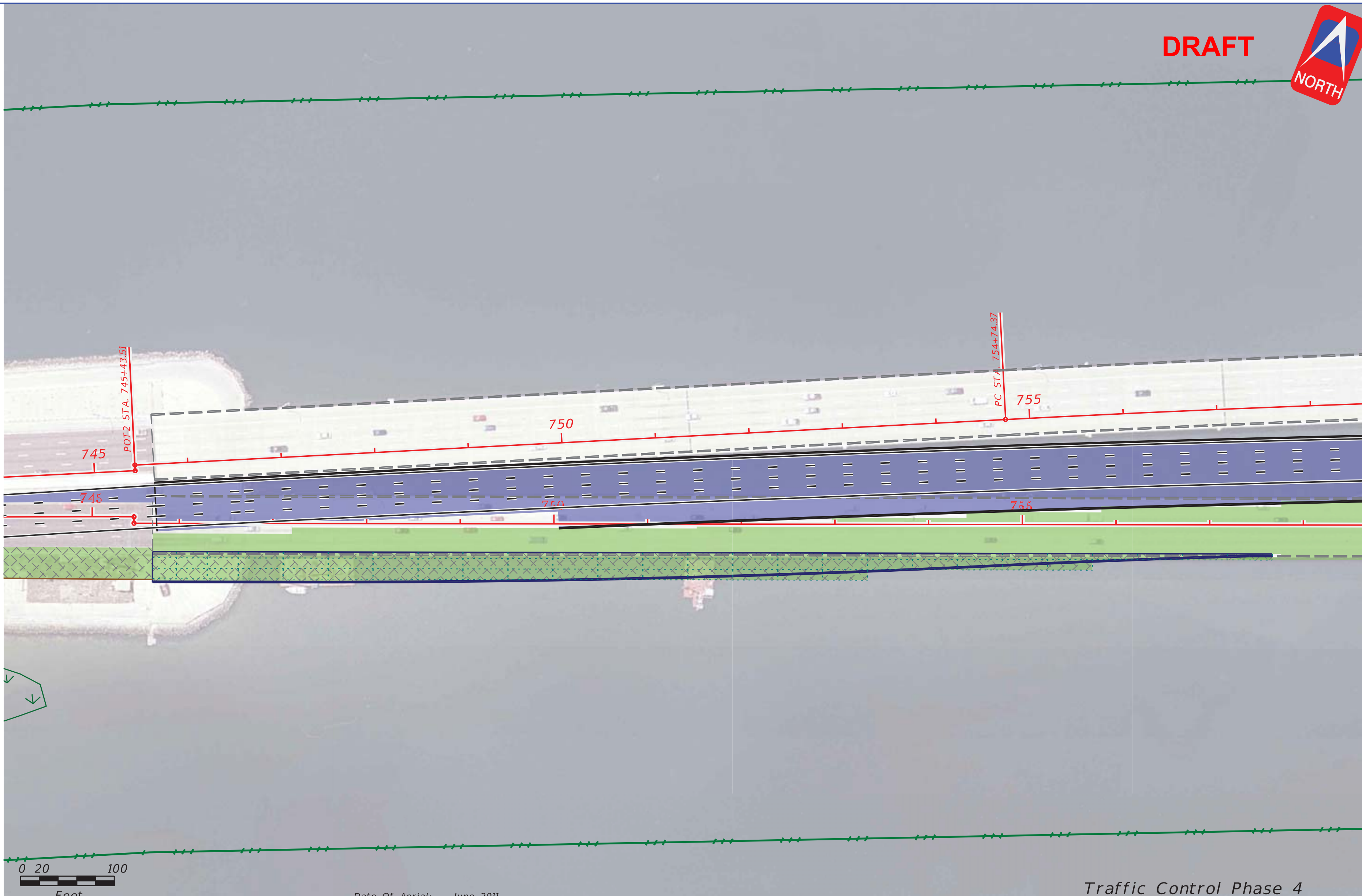

Traffic Control Phase 4

LEGEND

Existing Right Of Way	Bridge Construction
Existing Limited Access Right Of Way	Roadway Construction
	Temporary Road / Bridge
	Construction In Previous Phases
	Demolition

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(I-275/S.R. 93) PD&E Study

Bridge Replacement
(Only)
Center Option

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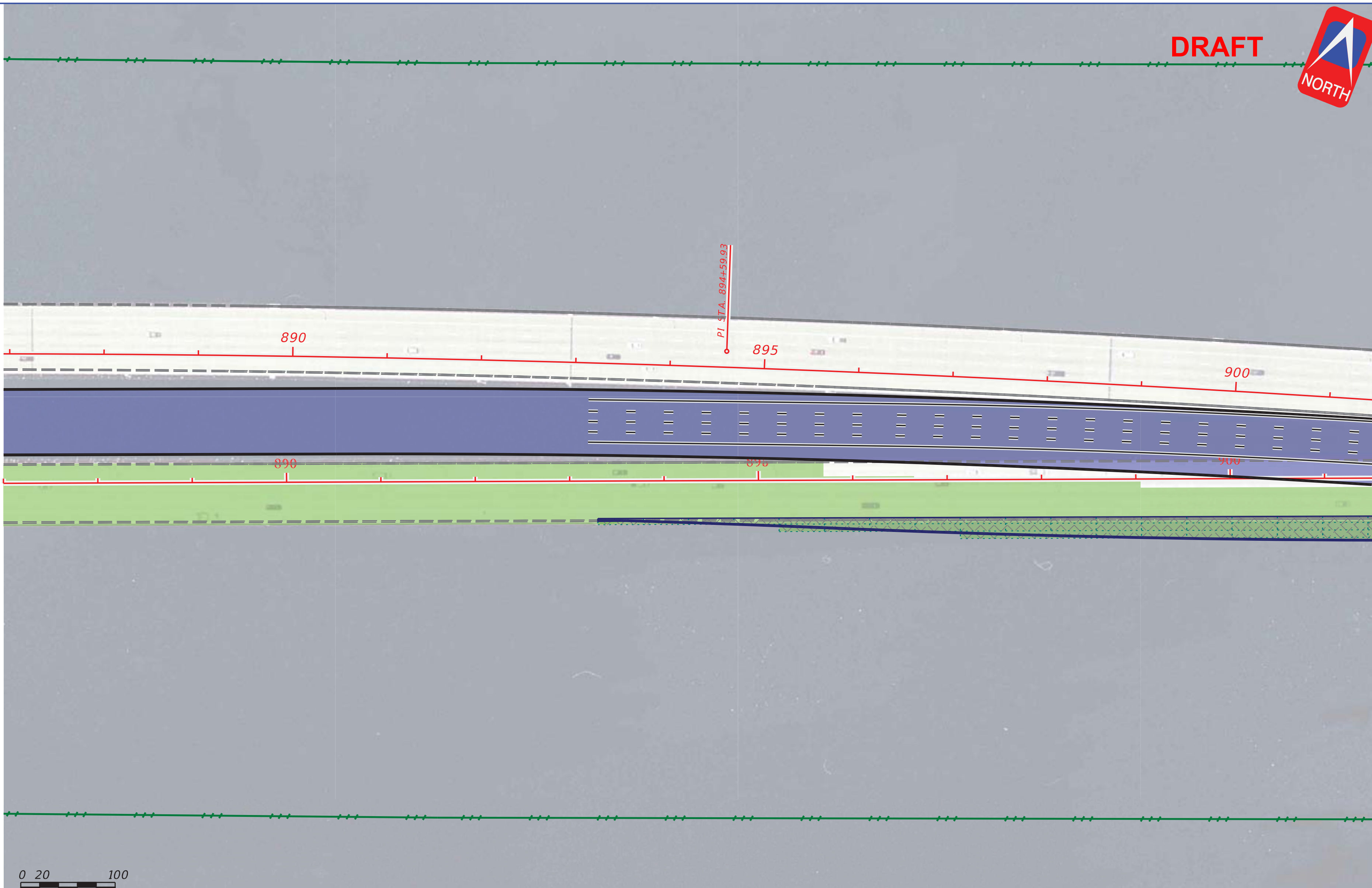

Date Of Aerial: June 2011

Traffic Control Phase 4

LEGEND

- Existing Right Of Way
- Existing Limited Access Right Of Way
- Bridge Construction
- Roadway Construction
- Temporary Road / Bridge
- Construction In Previous Phases
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Center Option

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RC-TC4-3

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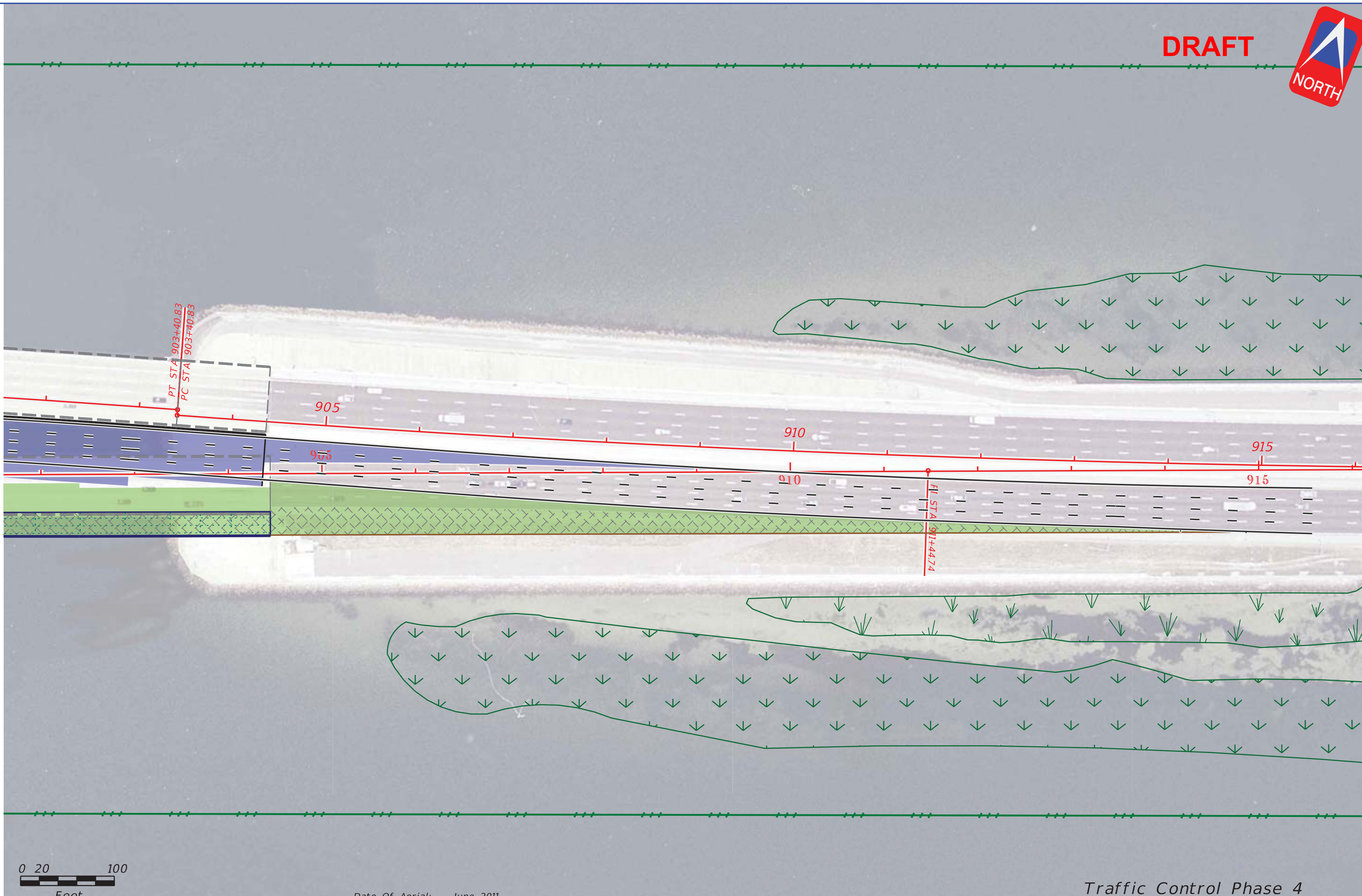

Date Of Aerial: June 2011

Traffic Control Phase 4

LEGEND

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- Existing Limited Access Right Of Way
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- Roadway Construction
- Temporary Road / Bridge
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Bridge Replacement
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Center Option

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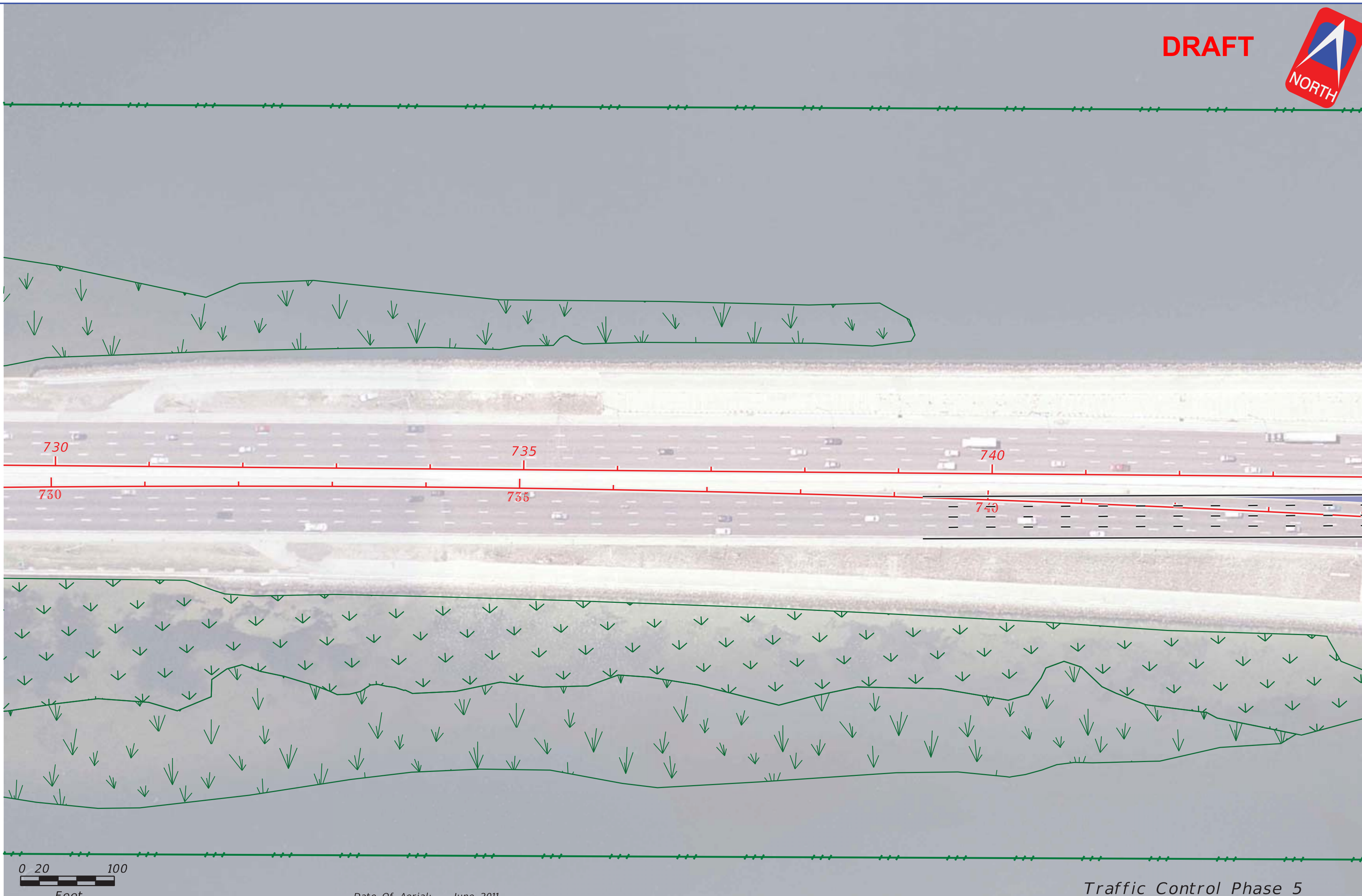

Traffic Control Phase 5

LEGEND

Existing Right Of Way	Bridge Construction
Existing Limited Access Right Of Way	Roadway Construction
	Temporary Road / Bridge
	Construction In Previous Phases
	Demolition

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Bridge Replacement
(Only)
Center Option

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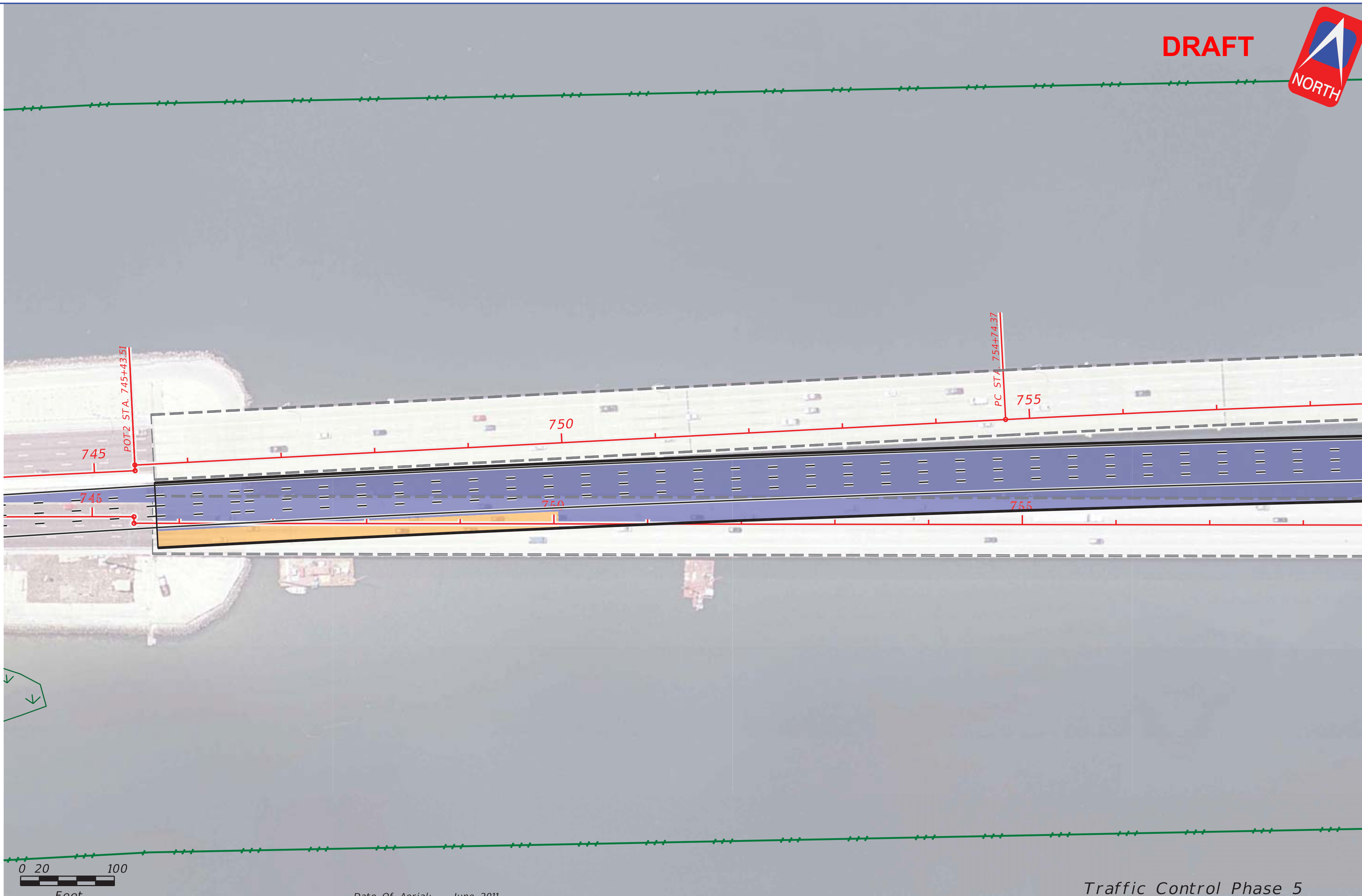

LEGEND

- Existing Right Of Way
- Existing Limited Access Right Of Way
- Bridge Construction
- Roadway Construction
- Temporary Road / Bridge
- Construction In Previous Phases
- Demolition

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Bridge Replacement
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Center Option

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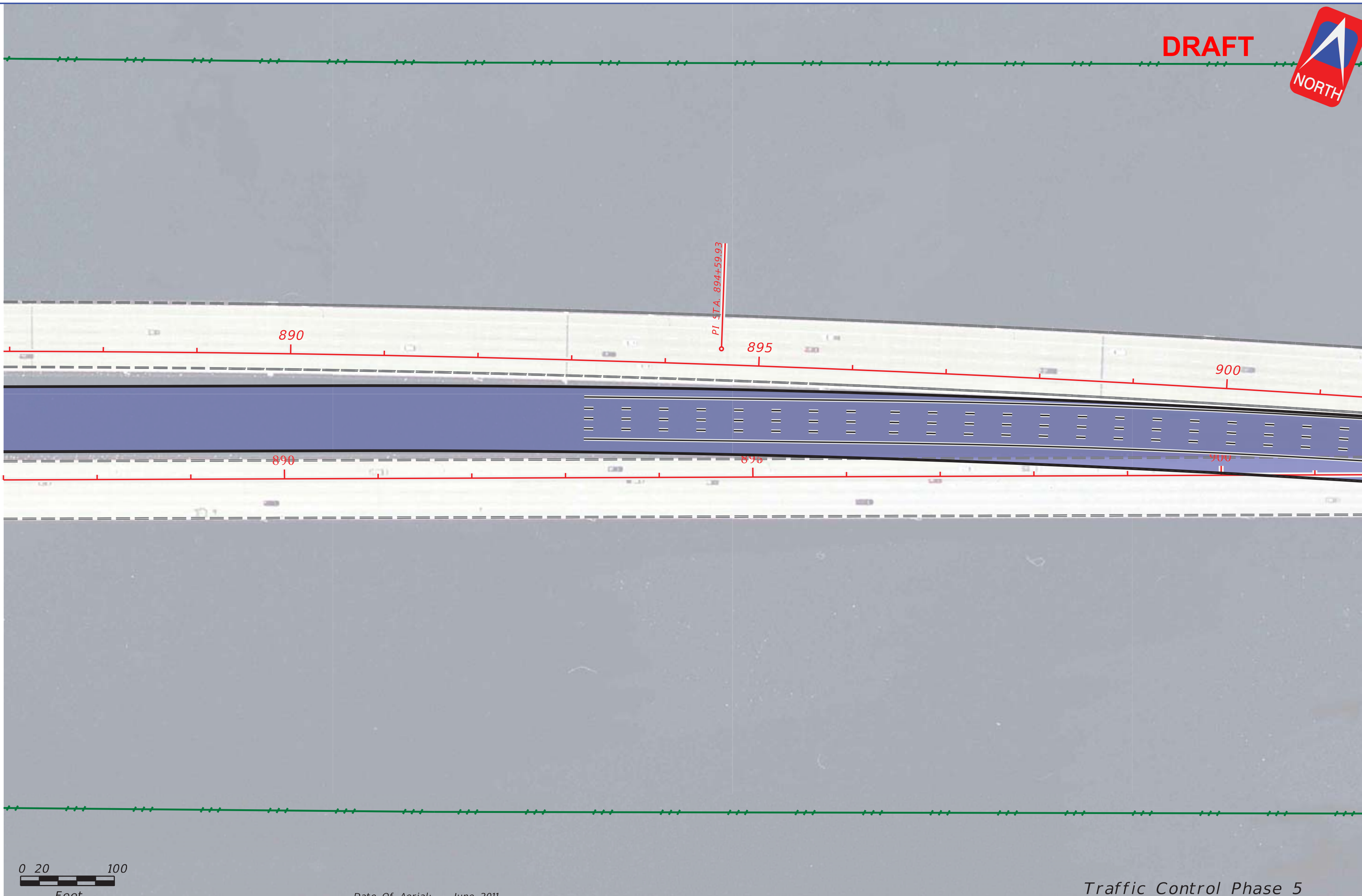

Date Of Aerial: June 2011

Traffic Control Phase 5

LEGEND

- Existing Right Of Way
- Existing Limited Access Right Of Way
- Bridge Construction
- Roadway Construction
- Temporary Road / Bridge
- Construction In Previous Phases
- Demolition

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Bridge Replacement
(Only)
Center Option

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RC-TC5-3

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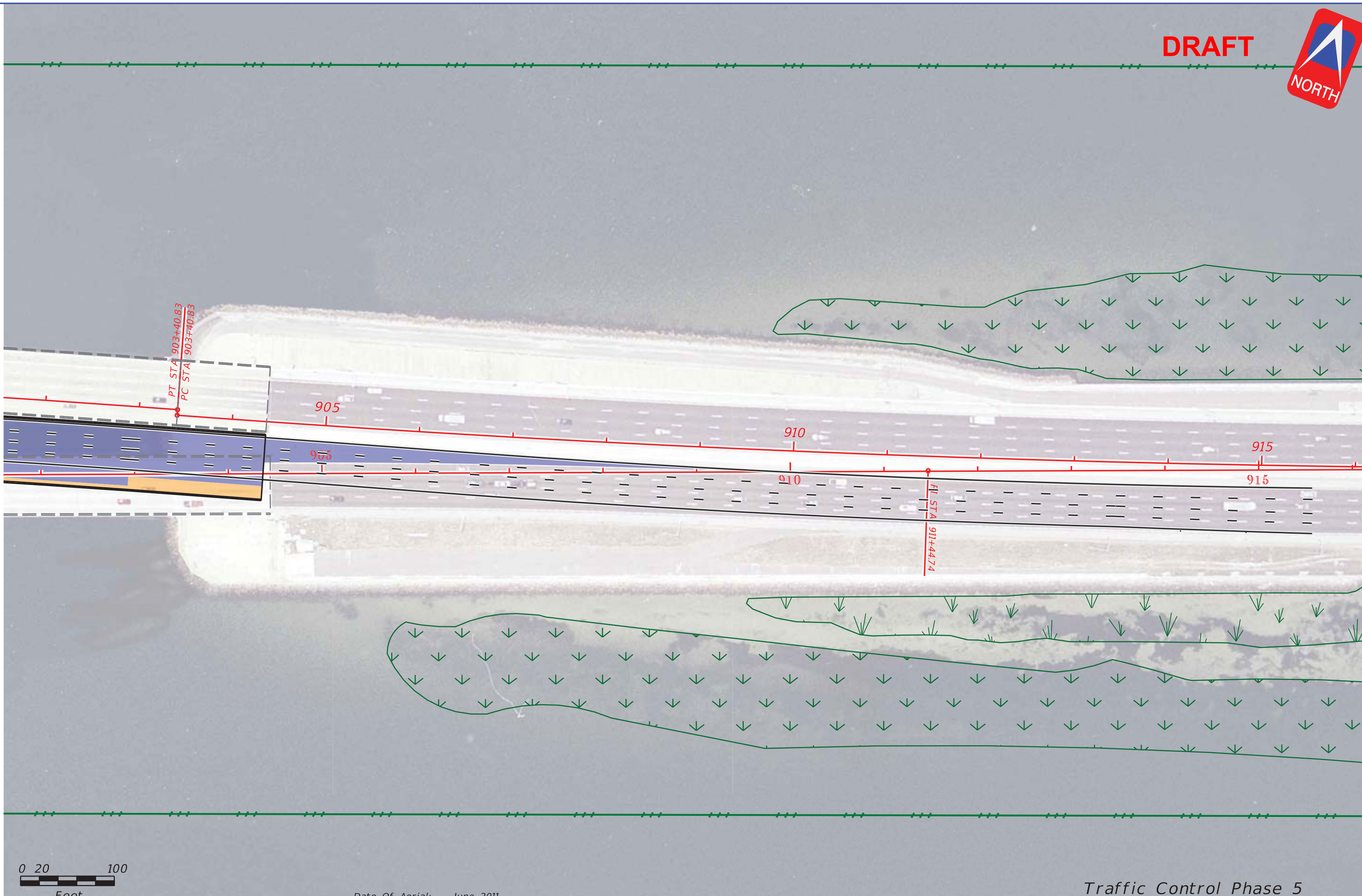

Date Of Aerial: June 2011

Traffic Control Phase 5

LEGEND

Existing Right Of Way	Bridge Construction
Existing Limited Access Right Of Way	Roadway Construction
	Temporary Road / Bridge
	Construction In Previous Phases
	Demolition

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(I-275/S.R. 93) PD&E Study

Bridge Replacement
(Only)
Center Option

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RC-TC5-4

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Appendix D

Life-Cycle Cost Analysis

Year	Rehabilitation Present Worth	Replacement Present Worth
0	$ 107,302,694	$ 191,682,194
10	$ 23,258,121	$ 32,607
20	$ 5,533,716	$ 47,079
30	$ 21,602,965	$ 38,842
40	$ 3,812,606	$ 45,781
50	$ 25,620,499	$ 37,772
60	$ 17,383,965	$ 46,745
70	$ 2,166,923	$ 38,567
80	$ 1,787,816	$ 31,820
Total Present Worths	**$ 260,476,312**	**$ 195,168,200**

Recommendation:

The present worth cost comparison to rehabilitate and maintain this bridge is approximately $65 million greater than the replacement alternative. Therefore, based upon the life cycle costs analysis it is TYLI's recommendation to replace the bridge.

NOTES:

1 The life cycle costs for both, the replacement and rehabilitation alternatives are taken from the footprint of the existing bridge and do not consider widening of the bridge.

2 Bridge replacement costs estimates were taken from the January 2011 FDOT Structures Design Guidelines, Chapter 9- BDR Cost Estimating.

3 Bridge rehabilitation costs were taken from a combination comprised of the FDOT's statewide averages and recently let construction projects.

4 Maintenance costs for the bridge replacement alternative were estimated at $0.04/SF for the first 10 years, $0.07/SF for the next 20 years, $0.10/SF for the next 20 years and $0.15/SF for the final 30 years.

5 Maintenance costs for the bridge rehabilitation alternative were estimated at $0.10/SF for the first 20 years, $0.15/SF for the next 20 years, $0.20/SF for the next 20 years and $0.30/SF for the final 20 years.

6 Replace bridge rails at $70/LF in Year 10 and repeat in Year 60.

7 Replace bridge deck at $500/CY in Current Year and repeat in Year 60.

8 Repair 10% Prestressed Concrete Beams with an estimate of 2 strand splices per beam in Year 0 and repeat in Years 30 and 60. Beam repair is estimated at $2000/beam.

9 Metalize all beams in Current Year at $24/SF and repeat every 10 years.

10 Perform bearing repair and replacement, 33% at $1.57 million in Current Year, 33% at $1.57 million in Year 10 and 100% at $4.71 million in Year 50.

11 Repair 50% of beam diaphragms at $500/CY in Current Year and repeat with in Years 30 and 60.

12 Repair 30% concrete bent caps at $500/CY in Current Year and repeat in Years 30 and 60.

13 Metalize 10% of the bent caps at $24/SF in the Current Year.

14 Metalize 100% of the bent caps at $24/SF in Year 10 and repeat every 10 years.

15 Install CP pile jackets at $1500/LF on all of the non-jacketed piles in Current Year and repeat with structural CP jackets at $2000/LF every 25 years.

16 Replace all non-CP jackets with structural CP pile jackets at $2000/LF in Current Year and repeat every 25 years

17 Replace existing CP and structural CP pile jackets with new structural CP jackets at $2000/LF. Replace 30% in Year 10, the3n replace 70% in Year 25, then in Year 50 replace all.

18 Repair 20% of footings at $500/CY in Current Year and repeat every 30 years.

19 Install ICCP on 10 footings at $500K/footing in Current Year and repeat in Year 75.

20 Perform concrete repairs on 50% of the struts at $500/CY in Current Year and repeat every 30 years.

21 Metalize all of the struts (except the two that currently have ICCP) at $24/SF in Current Year and repeat every 10 years.

150107 Preliminary Estimate Cost for Replacement

Existing Deck Area (sq ft)	988826	
Existing Length (ft):	15872	
Existing Width from plans (ft):	63.08333333	
Lane Width (ft):	12	
Number Lanes:	4	
Total Shoulder Width (ft):	12	
Total Barrier Width (ft):	3.083333333	
Additional Shoulder Width Req'd per PPM(ft):		Not Required for LCCA
Reconstructed Width per PPM (ft):	63.08333333	
Reconstructed Deck Area (sq ft):	1001258.667	
		Total Cost/SQ FT
New Const 2011 Cost Per Sq Ft Per SDG	147	$147,185,024
Demo Cost per SF	45	$44,497,170
Total Reconstructed Struture Cost:		*$191,682,194*

Done By: AHA Date: 08-30-11
Checked By: BFS Date: 09-02-11

BRIDGE REPLACEMENT LIFE CYCLE COSTS:				
PW=(1+f)^n/(1+i)^n				
	interest rate, i =	5	%	
	inflation rate, f =	3	%	
	n =	numer of years		
	PW =	present worth		
Year	**PW Factor**	**Replacement Cost**	**Annual Maintenance**	**Total Present Worth**
0	1.000	$191,682,194		$ 191,682,194
1	0.981		$ 39,521	$ 38,768
2	0.962		$ 39,521	$ 38,030
3	0.944		$ 39,521	$ 37,306
4	0.926		$ 39,521	$ 36,595
5	0.908		$ 39,521	$ 35,898
6	0.891		$ 39,521	$ 35,214
7	0.874		$ 39,521	$ 34,544
8	0.857		$ 39,521	$ 33,886
9	0.841		$ 39,521	$ 33,240
10	0.825		$ 39,521	$ 32,607
11	0.809		$ 69,162	$ 55,975
12	0.794		$ 69,162	$ 54,909
13	0.779		$ 69,162	$ 53,863
14	0.764		$ 69,162	$ 52,837
15	0.749		$ 69,162	$ 51,831
16	0.735		$ 69,162	$ 50,844
17	0.721		$ 69,162	$ 49,875
18	0.707		$ 69,162	$ 48,925
19	0.694		$ 69,162	$ 47,993
20	0.681		$ 69,162	$ 47,079
21	0.668		$ 69,162	$ 46,182
22	0.655		$ 69,162	$ 45,303
23	0.643		$ 69,162	$ 44,440
24	0.630		$ 69,162	$ 43,593
25	0.618		$ 69,162	$ 42,763
26	0.607		$ 69,162	$ 41,948
27	0.595		$ 69,162	$ 41,149
28	0.584		$ 69,162	$ 40,366
29	0.573		$ 69,162	$ 39,597
30	0.562		$ 69,162	$ 38,842
31	0.551		$ 98,803	$ 54,432
32	0.540		$ 98,803	$ 53,395
33	0.530		$ 98,803	$ 52,378
34	0.520		$ 98,803	$ 51,381
35	0.510		$ 98,803	$ 50,402
36	0.500		$ 98,803	$ 49,442
37	0.491		$ 98,803	$ 48,500
38	0.482		$ 98,803	$ 47,576
39	0.472		$ 98,803	$ 46,670
40	0.463		$ 98,803	$ 45,781
41	0.455		$ 98,803	$ 44,909
42	0.446		$ 98,803	$ 44,054
43	0.437		$ 98,803	$ 43,215
44	0.429		$ 98,803	$ 42,392
45	0.421		$ 98,803	$ 41,584
46	0.413		$ 98,803	$ 40,792
47	0.405		$ 98,803	$ 40,015
48	0.397		$ 98,803	$ 39,253
49	0.390		$ 98,803	$ 38,505
50	0.382		$ 98,803	$ 37,772
51	0.375		$ 148,205	$ 55,578
52	0.368		$ 148,205	$ 54,520
53	0.361		$ 148,205	$ 53,481
54	0.354		$ 148,205	$ 52,463
55	0.347		$ 148,205	$ 51,463
56	0.341		$ 148,205	$ 50,483
57	0.334		$ 148,205	$ 49,522
58	0.328		$ 148,205	$ 48,578
59	0.322		$ 148,205	$ 47,653
60	0.315		$ 148,205	$ 46,745
61	0.309		$ 148,205	$ 45,855
62	0.304		$ 148,205	$ 44,981
63	0.298		$ 148,205	$ 44,125
64	0.292		$ 148,205	$ 43,284
65	0.286		$ 148,205	$ 42,460
66	0.281		$ 148,205	$ 41,651
67	0.276		$ 148,205	$ 40,858
68	0.270		$ 148,205	$ 40,079
69	0.265		$ 148,205	$ 39,316
70	0.260		$ 148,205	$ 38,567
71	0.255		$ 148,205	$ 37,832
72	0.250		$ 148,205	$ 37,112
73	0.246		$ 148,205	$ 36,405
74	0.241		$ 148,205	$ 35,712
75	0.236		$ 148,205	$ 35,031
76	0.232		$ 148,205	$ 34,364
77	0.227		$ 148,205	$ 33,710
78	0.223		$ 148,205	$ 33,067
79	0.219		$ 148,205	$ 32,438
80	0.215		$ 148,205	$ 31,820
			Total PW	**195,168,200**

Done By: AHA Date: 08-30-11
Checked By: BFS Date: 09-02-11

BRIDGE REHABILITATION LIFE CYCLE COSTS:

Retain 50 year old bridge (BR#150107, constructed 1960):

PW=(1+f)^n/(1+i)^n

interest rate, i = 5 %

inflation rate, f = 3 %

Year	PW Factor		Deck Replacement	Partial Deck Repair	Bridge Rails	Beam Repair	Beam Metalizing	Diaphragm Repair	Bearing Repair/Replacement	Cap Repair	Cap Metalizing	CP Pile Jacket	CP Structural Jacket	Footing Repair	Footing ICCP	Strut Repair	Strut Metalizing	Fender System	Navigation Lights	Maintenance	Total Present Worth
0	1.000					$ 1,260,000	$ 34,176,895	$ 1,063,125	$ 1,569,925	$ 26,499,364	$ 565,320	$ 34,992,000	$ 1,264,000	$176,587	$ 5,000,000	$ 138,669	$ 373,007	$ 125,000		$ 98,803	$107,302,694
1	0.981																			$ 98,803	$ 96,921
2	0.962																			$ 98,803	$ 95,075
3	0.944																			$ 98,803	$ 93,264
4	0.926																			$ 98,803	$ 91,488
5	0.908																			$ 98,803	$ 89,745
6	0.891																			$ 98,803	$ 88,036
7	0.874																			$ 98,803	$ 86,359
8	0.857																			$ 98,803	$ 84,714
9	0.841																			$ 98,803	$ 83,100
10	0.825	0	$ 12,198,536		$ 4,444,160		$ 3,417,690		$ 1,569,925		$ 4,239,898		$ 1,848,000				$ 373,007			$ 98,803	$ 23,258,121
11	0.809																			$ 98,803	$ 79,965
12	0.794																			$ 98,803	$ 78,442
13	0.779																			$ 98,803	$ 76,947
14	0.764																			$ 98,803	$ 75,482
15	0.749																			$ 98,803	$ 74,044
16	0.735																			$ 98,803	$ 72,634
17	0.721																			$ 98,803	$ 71,250
18	0.707																			$ 98,803	$ 69,893
19	0.694																			$ 98,803	$ 68,562
20	0.681	0					$ 3,417,690				$ 4,239,898						$ 373,007			$ 98,803	$ 5,533,716
21	0.668																			$ 148,205	$ 98,962
22	0.655																			$ 148,205	$ 97,077
23	0.643																			$ 148,205	$ 95,228
24	0.630																			$ 148,205	$ 93,414
25	0.618												$ 52,232,000							$ 148,205	$ 32,386,598
26	0.607																			$ 148,205	$ 89,889
27	0.595																			$ 148,205	$ 88,177
28	0.584																			$ 148,205	$ 86,498
29	0.573																			$ 148,205	$ 84,850
30	0.562	0				$ 1,260,000	$ 3,417,690	$ 1,063,125		$ 26,499,364	$ 4,381,228			$176,587		$ 138,669	$ 373,007	$ 1,000,000	$ 8,000	$ 148,205	$ 21,602,965
31	0.551																			$ 148,205	$ 81,648
32	0.540																			$ 148,205	$ 80,093
33	0.530																			$ 148,205	$ 78,568
34	0.520																			$ 148,205	$ 77,071
35	0.510																			$ 148,205	$ 75,603
36	0.500																			$ 148,205	$ 74,163
37	0.491																			$ 148,205	$ 72,750
38	0.482																			$ 148,205	$ 71,365
39	0.472																			$ 148,205	$ 70,005
40	0.463	0					$ 3,417,690				$ 4,239,898						$ 373,007			$ 197,606	$ 3,812,606
41	0.455																			$ 197,606	$ 89,819
42	0.446																			$ 197,606	$ 88,108
43	0.437																			$ 197,606	$ 86,429
44	0.429																			$ 197,606	$ 84,783
45	0.421																			$ 197,606	$ 83,168
46	0.413																			$ 197,606	$ 81,584
47	0.405																			$ 197,606	$ 80,030
48	0.397																			$ 197,606	$ 78,506
49	0.390																			$ 197,606	$ 77,010
50	0.382	0					$ 3,417,690		$ 4,709,775		$ 4,239,898		$ 54,080,000				$ 373,007			$ 197,606	$ 25,620,499
51	0.375																			$ 197,606	$ 74,105
52	0.368																			$ 197,606	$ 72,693
53	0.361																			$ 197,606	$ 71,308
54	0.354																			$ 197,606	$ 69,950
55	0.347																			$ 197,606	$ 68,618
56	0.341																			$ 197,606	$ 67,311
57	0.334																			$ 197,606	$ 66,029
58	0.328																			$ 197,606	$ 64,771
59	0.322																			$ 197,606	$ 63,537
60	0.315	0	$ 12,198,536		$ 4,444,160	$ 1,260,000	$ 3,417,690	$ 1,063,125		$ 26,499,364	$ 4,239,898			$176,587		$ 138,669	$ 373,007	$ 1,000,000	$ 8,000	$ 296,410	$ 17,383,965
61	0.309																			$ 296,410	$ 91,710
62	0.304																			$ 296,410	$ 89,963
63	0.298																			$ 296,410	$ 88,249
64	0.292																			$ 296,410	$ 86,568
65	0.286																			$ 296,410	$ 84,920
66	0.281																			$ 296,410	$ 83,302
67	0.276																			$ 296,410	$ 81,715
68	0.270																			$ 296,410	$ 80,159
69	0.265																			$ 296,410	$ 78,632
70	0.260	0					$ 3,417,690				$ 4,239,898						$ 373,007			$ 296,410	$ 2,166,923
71	0.255																			$ 296,410	$ 75,665
72	0.250																			$ 296,410	$ 74,224
73	0.246																			$ 296,410	$ 72,810
74	0.241																			$ 296,410	$ 71,423
75	0.236												$ 54,080,000		$ 5,000,000					$ 296,410	$ 14,034,869
76	0.232																			$ 296,410	$ 68,728
77	0.227																			$ 296,410	$ 67,419
78	0.223																			$ 296,410	$ 66,135
79	0.219																			$ 296,410	$ 64,875
80	0.215	0					$ 3,417,690				$ 4,239,898						$ 373,007			$ 296,410	$ 1,787,816
																				Total Present Worth=	$260,476,312

Done By: AHA Date: 08-30-11
Checked By: BFS Date: 09-02-11

Bridge 150107 Northbound Howard Frankland Bridge

Items to Note:

*Project 420666-1-52 was final accepted in 7/2009. This project included 19 new cathodic (only) jackets. Only 3 new jackets were noted on the 2010 BIR
*Project 405757-1-52-01 was final accepted in 10/2005. This project included 129 new cathodic (structural and non-structural) jackets.
This amount, plus more, was picked up in the 2008 BIR.
Of the 129 jackets, 116 were existing jackets that were replaced. This amout, plus a few more, are reflected Element 299 in the 2008 BIR.
*The 2010 draft BIR has moved the majority of the steel bearings into CS =1. Both bearing elements, 311 and 313, use the painting system as one of the indicators.
However, even if the painting system is functioning properly it seems questionable to move elements in CS1 due to the underlying condition. Also, only 280 movable bearings are planned for replacement and 70 fixed (this is the new quantity). Furthermore, the BIR states another inspection will be required after the rehab project.
*2010 BIR lists an additional pile in Element 298. This doesn't seem correct since any new jacket would be reflected in Element 299 due to the CP requirements of jackets.

Element 207- P/S Conc Hollow Pile

	2010 BIR	2008 BIR	9/2006 BIR	2004 BIR
CS1	2744	2782	2782	2782
CS2	39	22	22	22
CS3	34	2	2	2
CS4	99	110	110	110
Total Qty:	2916	2916	2916	2916

Element 298/4 Pile Jacket Bare

	2010 BIR	2008 BIR	9/2006 BIR	2004 BIR
CS1	47	46	221	221
CS2	24	27	0	0
CS3	8	5	11	11
CS4	0	0	0	0
Total Qty:	79	78	232	232

Element 299/4 Pile Jkt/Cathodic Protection

	2010 BIR	2008 BIR	9/2006 BIR	2004 BIR
CS1	308	305	142	142
CS2	0	0	0	0
CS3	0	0	0	0
CS4	0	0	0	0
Total Qty:	308	305	142	142

Element 311 - Moveable Bearing

	2010 BIR	2009 BIR*	2008 BIR	2007 BIR*	9/2006 BIR	5/06 Insp*
CS1	951	0	0	980	0	0
CS2	159	1108	1108	200	1097	1117
CS3	0	2	2	0	3	3
CS4	0	0	0	0		+
Total Qty:	1110	1110	1110	1180	1100	1120

Element 313 - Fixed Bearing

	2010 BIR	2009 BIR*	2008 BIR	2007 BIR*	9/2006 BIR	5/06 Insp*
CS1	430	0	0	4620	347	0
CS2	110	540	540	620	107	44
CS3	0	0	0	0	0	0
Total Qty:	540	540	540	5240	454	44

*Special Bearing Inspection

BRIDGE COMPONENTS:

Bridge Length: 15872 Bridge Width (o-o): 62.25

Span No.	Span Length (ft)	Bridge Rail (ft)	Deck Area (ft^2)	Beams per Span	Beams Perimeter (ft)	Beams Perimeter Total Per Span(ft)	Exposed Beam Surface Area (ft^2)	Diaphragms (cf)	Bent/Pier No.	Type of Pile Bent	Type of Bearing	Bent Cap Volume (yd^3)	Bent Cap Exposed Area (ft^2)	Pier Cap Volume (yd^3)	Pier Cap Exposed Area (ft^2)	Pier Column Height (ft)	Pier Column Volume (ft^3)	Pier Columns Exposed Area (ft^2)	Footing Volume (yd^3)	Footing Exposed Area (yd^2)	Pier Strut Volume (yd^3)	Exposed Pier Strut Area (ft^2)	Number of Piles on Bent
Span 1	33	66	2054	Flat Slab	NA	NA		NA	Bent 1	EB	F	10.4	216	NA	NA	NA	NA	NA	NA	NA	NA	NA	12
Span 2	33	66	2054	Flat Slab	NA	NA		NA	Bent 2	Bent	EF	10	394	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 3	33	66	2054	Flat Slab	NA	NA		NA	Bent 3	Bent	EF	10	394	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 4	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 4	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 5	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 5	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 6	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 6	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 7	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 7	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 8	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 8	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 9	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 9	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 10	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 10	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 11	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 11	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 12	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 12	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 13	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 13	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 14	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 14	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 15	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 15	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 16	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 16	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 17	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 17	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 18	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 18	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 19	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 19	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 20	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 20	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 21	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 21	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 22	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 22	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 23	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 23	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 24	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 24	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 25	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 25	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 26	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 26	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 27	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 27	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 28	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 28	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 29	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 29	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 30	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 30	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 31	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 31	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 32	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 32	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 33	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 33	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 34	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 34	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 35	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 35	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 36	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 36	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 37	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 37	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 38	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 38	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 39	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 39	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 40	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 40	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 41	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 41	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 42	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 42	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 43	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 43	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 44	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 44	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 45	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 45	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 46	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 46	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 47	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 47	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 48	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 48	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 49	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 49	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 50	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 50	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 51	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 51	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 52	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 52	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 53	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 53	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 54	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 54	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 55	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 55	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 56	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 56	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 57	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 57	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 58	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 58	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 59	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 59	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 60	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 60	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 61	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 61	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 62	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 62	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 63	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 63	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 64	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 64	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 65	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 65	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 66	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 66	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 67	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 67	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 68	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 68	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8

Span No.	Span Length (ft)	Bridge Rail (ft)	Deck Area (ft^2)	Beams per Span	Beams Perimeter (ft)	Beams Perimeter Total Per Span(ft)	Exposed Beam Surface Area (ft^2)	Diaphragms (cf)	Bent/Pier No.	Type of Pile Bent	Type of Bearing	Bent Cap Volume (yd^3)	Bent Cap Exposed Area (ft^2)	Pier Cap Volume (yd^3)	Pier Cap Exposed Area (ft^2)	Pier Column Height (ft)	Pier Column Volume (ft^3)	Pier Columns Exposed Area (ft^2)	Footing Volume (yd^3)	Footing Exposed Area (yd^2)	Pier Strut Volume (yd^3)	Exposed Pier Strut Area (ft^2)	Number of Piles on Bent
Span 69	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 69	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 70	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 70	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 71	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 71	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 72	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 72	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 73	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 73	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 74	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 74	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 75	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 75	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 76	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 76	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 77	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 77	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 78	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 78	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 79	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 79	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 80	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 80	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 81	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 81	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 82	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 82	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 83	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 83	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 84	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 84	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 85	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 85	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 86	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 86	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 87	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 87	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 88	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 88	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 89	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 89	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 90	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 90	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 91	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 91	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 92	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 92	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 93	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 93	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 94	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 94	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 95	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 95	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 96	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 96	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 97	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 97	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 98	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 98	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 99	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 99	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 100	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 100	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 101	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 101	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 102	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 102	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 103	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 103	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 104	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 104	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 105	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 105	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 106	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 106	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 107	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 107	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 108	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 108	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 109	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 109	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 110	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 110	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 111	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 111	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 112	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 112	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 113	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 113	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 114	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 114	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 115	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 115	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 116	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 116	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 117	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 117	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 118	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 118	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 119	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 119	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 120	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 120	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 121	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 121	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 122	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 122	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 123	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 123	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 124	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 124	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 125	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 125	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 126	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 126	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 127	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 127	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 128	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 128	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 129	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 129	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 130	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 130	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 131	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 131	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 132	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 132	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 133	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 133	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 134	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 134	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 135	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 135	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 136	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 136	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 137	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 137	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 138	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 138	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 139	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 139	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8

Span No.	Span Length (ft)	Bridge Rail (ft)	Deck Area (ft^2)	Beams per Span	Beams Perimeter (ft)	Beams Perimeter Total Per Span(ft)	Exposed Beam Surface Area (ft^2)	Diaphragms (cf)	Bent/Pier No.	Type of Pile Bent	Type of Bearing	Bent Cap Volume (yd^3)	Bent Cap Exposed Area (ft^2)	Pier Cap Volume (yd^3)	Pier Cap Exposed Area (ft^2)	Pier Column Height (ft)	Pier Column Volume (ft^3)	Pier Columns Exposed Area (ft^2)	Footing Volume (yd^3)	Footing Exposed Area (yd^2)	Pier Strut Volume (yd^3)	Exposed Pier Strut Area (ft^2)	Number of Piles on Bent
Span 140	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 140	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 141	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 141	TB	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 142	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 142	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 143	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 143	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 144	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 144	Bent	EF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 145	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 145	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 146	48	96	2988	10	8.12	81.2	3897.6	13.5	Pier 146	Pier	EF	23	557	30.5	576	13.25	17.2	357.5	41.6	348	17.7	575.0	8
Span 147	66	132	4109	10	11.55	115.5	7623	13.5	Pier 147	Pier	FF	23	557	30.5	576	15.25	19.7	411.4	41.6	348	17.7	575.0	18
Span 148	66	132	4109	10	11.55	115.5	7623	13.5	Pier 148	Pier	EF	23	557	30.5	576	17.25	22.3	465.4	41.6	348	17.7	575.0	18
Span 149	66	132	4109	10	11.55	115.5	7623	13.5	Pier 149	Pier	FF	23	557	30.5	576	19.25	24.9	519.4	41.6	348	17.7	575.0	18
Span 150	66	132	4109	10	11.55	115.5	7623	13.5	Pier 150	Pier	EF	23	557	30.5	576	21.25	27.5	573.3	41.6	348	17.7	575.0	18
Span 151	66	132	4109	10	11.55	115.5	7623	13.5	Pier 151	Pier	FF	23	557	30.5	576	23.25	30.1	627.3	41.6	348	17.7	575.0	18
Span 152	66	132	4109	10	11.55	115.5	7623	13.5	Pier 152	Pier	EF	23	557	30.5	576	25.25	32.7	681.2	41.6	348	17.7	575.0	18
Span 153	66	132	4109	10	11.55	115.5	7623	13.5	Pier 153	Pier	FF	23	557	30.5	576	27.25	35.3	735.2	41.6	348	17.7	575.0	18
Span 154	66	132	4109	10	11.55	115.5	7623	13.5	Pier 154	Pier	EF	23	557	30.5	576	29.25	37.9	789.2	41.6	348	17.7	575.0	18
Span 155	66	132	4109	10	11.55	115.5	7623	13.5	Pier 155	Pier	FF	23	557	30.5	576	31.25	40.5	843.1	41.6	348	17.7	575.0	18
Span 156	66	132	4109	10	11.55	115.5	7623	13.5	Pier 156	Pier	EF	23	557	30.5	576	32.25	41.8	870.1	41.6	348	17.7	575.0	18
Span 157	66	132	4109	10	11.55	115.5	7623	13.5	Pier 157	Pier	FF	23	557	30.5	576	33.25	43.1	897.1	41.6	348	17.7	575.0	18
Span 158	66	132	4109	10	11.55	115.5	7623	13.5	Pier 158	Pier	EF	23	557	30.5	576	34.25	44.4	924.1	41.6	348	17.7	575.0	18
Span 159	66	132	4109	10	11.55	115.5	7623	13.5	Pier 159	Pier	FF	23	557	30.5	576	35.25	45.6	951.0	41.6	348	17.7	575.0	18
Span 160	66	132	4109	10	11.55	115.5	7623	13.5	Pier 160	Pier	EF	23	557	41.5	677	57.50	127.8	1955.0	154.0	952	28.9	1664.0	78
Span 161	98	196	6101	10	11.55	115.5	11319	13.5	Pier 161	Pier	FE	23	557	41.5	677	57.50	127.8	1955.0	154.0	952	28.9	1664.0	78
Span 162	66	132	4109	10	11.55	115.5	7623	13.5	Pier 162	Pier	FF	23	557	30.5	576	13.25	17.2	357.5	41.6	348	17.7	575.0	18
Span 163	66	132	4109	10	11.55	115.5	7623	13.5	Pier 163	Pier	FE	23	557	30.5	576	15.25	19.7	411.4	41.6	348	17.7	575.0	18
Span 164	66	132	4109	10	11.55	115.5	7623	13.5	Pier 164	Pier	FF	23	557	30.5	576	17.25	22.3	465.4	41.6	348	17.7	575.0	18
Span 165	66	132	4109	10	11.55	115.5	7623	13.5	Pier 165	Pier	FE	23	557	30.5	576	19.25	24.9	519.4	41.6	348	17.7	575.0	18
Span 166	66	132	4109	10	11.55	115.5	7623	13.5	Pier 166	Pier	FF	23	557	30.5	576	21.25	27.5	573.3	41.6	348	17.7	575.0	18
Span 167	66	132	4109	10	11.55	115.5	7623	13.5	Pier 167	Pier	FE	23	557	30.5	576	23.25	30.1	627.3	41.6	348	17.7	575.0	18
Span 168	66	132	4109	10	11.55	115.5	7623	13.5	Pier 168	Pier	FF	23	557	30.5	576	25.25	32.7	681.2	41.6	348	17.7	575.0	18
Span 169	66	132	4109	10	11.55	115.5	7623	13.5	Pier 169	Pier	FE	23	557	30.5	576	27.25	35.3	735.2	41.6	348	17.7	575.0	18
Span 170	66	132	4109	10	11.55	115.5	7623	13.5	Pier 170	Pier	FF	23	557	30.5	576	29.25	37.9	789.2	41.6	348	17.7	575.0	18
Span 171	66	132	4109	10	11.55	115.5	7623	13.5	Pier 171	Pier	FE	23	557	30.5	576	31.25	40.5	843.1	41.6	348	17.7	575.0	18
Span 172	66	132	4109	10	11.55	115.5	7623	13.5	Pier 172	Pier	FF	23	557	30.5	576	32.25	41.8	870.1	41.6	348	17.7	575.0	18
Span 173	66	132	4109	10	11.55	115.5	7623	13.5	Pier 173	Pier	EE	23	557	30.5	576	33.25	43.1	897.1	41.6	348	17.7	575.0	18
Span 174	66	132	4109	10	11.55	115.5	7623	13.5	Pier 174	Pier	FF	23	557	30.5	576	34.25	44.4	924.1	41.6	348	17.7	575.0	18
Span 175	66	132	4109	10	11.55	115.5	7623	13.5	Pier 175	Pier	FE	23	557	30.5	576	35.25	45.6	951.0	41.6	348	17.7	575.0	18
Span 176	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 176	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 177	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 177	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 178	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 178	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 179	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 179	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 180	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 180	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 181	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 181	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 182	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 182	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 183	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 183	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 184	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 184	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 185	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 185	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 186	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 186	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 187	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 187	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 188	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 188	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 189	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 189	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 190	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 190	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 191	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 191	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 192	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 192	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 193	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 193	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 194	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 194	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 195	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 195	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 196	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 196	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 197	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 197	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 198	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 198	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 199	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 199	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 200	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 200	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 201	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 201	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 202	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 202	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 203	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 203	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 204	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 204	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 205	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 205	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 206	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 206	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 207	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 207	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 208	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 208	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 209	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 209	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 210	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 210	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8

Done By: AHA Date: 08-30-11
Checked By: BFS Date: 09-02-11

Span No.	Span Length (ft)	Bridge Rail (ft)	Deck Area (ft^2)	Beams per Span	Beams Perimeter (ft)	Beams Perimeter Total Per Span(ft)	Exposed Beam Surface Area (ft^2)	Diaphragms (cf)	Bent/Pier No.	Type of Pile Bent	Type of Bearing	Bent Cap Volume (yd^3)	Bent Cap Exposed Area (ft^2)	Pier Cap Volume (yd^3)	Pier Cap Exposed Area (ft^2)	Pier Column Height (ft)	Pier Column Volume (ft^3)	Pier Columns Exposed Area (ft^2)	Footing Volume (yd^3)	Footing Exposed Area (yd^2)	Pier Strut Volume (yd^3)	Exposed Pier Strut Area (ft^2)	Number of Piles on Bent
Span 211	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 211	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 212	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 212	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 213	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 213	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 214	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 214	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 215	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 215	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 216	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 216	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 217	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 217	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 218	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 218	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 219	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 219	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 220	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 220	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 221	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 221	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 222	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 222	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 223	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 223	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 224	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 224	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 225	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 225	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 226	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 226	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 227	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 227	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 228	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 228	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 229	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 229	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 230	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 230	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 231	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 231	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 232	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 232	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 233	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 233	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 234	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 234	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 235	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 235	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 236	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 236	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 237	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 237	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 238	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 238	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 239	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 239	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 240	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 240	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 241	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 241	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 242	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 242	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 243	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 243	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 244	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 244	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 245	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 245	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 246	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 246	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 247	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 247	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 248	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 248	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 249	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 249	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 250	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 250	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 251	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 251	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 252	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 252	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 253	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 253	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 254	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 254	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 255	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 255	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 256	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 256	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 257	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 257	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 258	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 258	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 259	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 259	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 260	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 260	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 261	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 261	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 262	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 262	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 263	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 263	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 264	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 264	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 265	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 265	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 266	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 266	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 267	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 267	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 268	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 268	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 269	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 269	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 270	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 270	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 271	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 271	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 272	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 272	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 273	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 273	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 274	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 274	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 275	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 275	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 276	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 276	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 277	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 277	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 278	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 278	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 279	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 279	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 280	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 280	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 281	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 281	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8

Span No.	Span Length (ft)	Bridge Rail (ft)	Deck Area (ft^2)	Beams per Span	Beams Perimeter (ft)	Beams Perimeter Total Per Span(ft)	Exposed Beam Surface Area (ft^2)	Diaphragms (cf)	Bent/Pier No.	Type of Pile Bent	Type of Bearing	Bent Cap Volume (yd^3)	Bent Cap Exposed Area (ft^2)	Pier Cap Volume (yd^3)	Pier Cap Exposed Area (ft^2)	Pier Column Height (ft)	Pier Column Volume (ft^3)	Pier Columns Exposed Area (ft^2)	Footing Volume (yd^3)	Footing Exposed Area (yd^2)	Pier Strut Volume (yd^3)	Exposed Pier Strut Area (ft^2)	Number of Piles on Bent
Span 282	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 282	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 283	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 283	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 284	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 284	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 285	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 285	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 286	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 286	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 287	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 287	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 288	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 288	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 289	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 289	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 290	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 290	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 291	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 291	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 292	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 292	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 293	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 293	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 294	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 294	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 295	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 295	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 296	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 296	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 297	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 297	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 298	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 298	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 299	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 299	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 300	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 300	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 301	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 301	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 302	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 302	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 303	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 303	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 304	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 304	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 305	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 305	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 306	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 306	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 307	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 307	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 308	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 308	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 309	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 309	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 310	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 310	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 311	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 311	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 312	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 312	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 313	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 313	TB	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	10
Span 314	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 314	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 315	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 315	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 316	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 316	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 317	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 317	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 318	48	96	2988	10	8.12	81.2	3897.6	13.5	Bent 318	Bent	FF	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 319	33	66	2054	Flat Slab	NA	NA	NA	NA	Bent 319	Bent	FE	23	557	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 320	33	66	2054	Flat Slab	NA	NA	NA	NA	Bent 320	Bent	FE	10	394	NA	NA	NA	NA	NA	NA	NA	NA	NA	8
Span 321	33	66	2054	Flat Slab	NA	NA	NA	NA	Bent 321	EB	F	10.4	216	NA	NA	NA	NA	NA	NA	NA	NA	NA	12
Totals	15872	31744	988032	3150	2657.27	26572.7	1,068,028	4252.5				7152.52	176662.43	937.03	17482.5	830	1181.4806	23200.7	1471.56	11648	554.6741	19427.44	3054

Appendix E

Additional Geotechnical Information

Appendix E – Additional Geotechnical Information

(From the Draft Geotechnical Report, June 2012)

The following table provides information regarding the tip elevation ranges that occurred within each section for the southbound Howard Frankland Bridge, constructed in 1991.

Table 3-3: Pile Driving Tip Elevations

Section	Total Number of Piles	Number of Piles with a Tip Elevation within the Elevation Ranges Shown (% of Total Piles)							
		-28 to -40	-40 to -50	-50 to -70	-70 to -90	-90 to -110	-110 to -130	-130 to -150	-150 to -176
1	252	166 (~66%)	86 (~34%)	0	0	0	0	0	0
2	552	1 (<1%)	42 (~8%)	80 (~14%)	218 (~39%)	139 (~25%)	44 (~8%)	23 (~4%)	5 (~1%)
3	646	8 (~1%)	181 (~28%)	206 (~32%)	151 (~23%)	78 (~12%)	22 (~3%)	0	0

Table 3-3 provides an indication on the variations in pile lengths across the bridge site. However, in some cases, considerable variability occurred even among the piles within each pier. The following table provides an indication of the variability of the pile tip elevations *within* individual piers.

Table 3-4: Pile Driving Tip Variations within Individual Piers

Section	Number of Piers	Number of Piers where the Distance Between the Most Shallow and Deepest Tip Elevations Range, In Feet						
		<10	10 to 15	15 to 25	25 to 35	35 to 50	50 to 70	70 to 90
1	26	17 (~65%)	9 (~35%)	--	--	--	--	--
2	54	--	5 (~9%)	5 (~9%)	10 (~19%)	14 (~26%)	13 (~24%)	7 (~13%)
3	32	4 (~13%)	6 (~19%)	7 (~22%)	3 (~9%)	7 (~22%)	4 (~13%)	1 (~3%)

The soil boring data, pile sizes, and design loads were analyzed in FB-Deep Version 2.03 to evaluate what current pile capacity analysis would predict when the New Howard Frankland Bridge was constructed. The analysis did not consider scour effects. The predicted driven pile tip elevations for each section based solely on the FB-Deep analysis are as follows.

Table 3-5: Predicted Pile Driving Tip Elevations

Section	Pile Size	Pile Design Load (ton)	Required Bearing (ton) [1]	Total Number of Borings Analyzed	Predicted Pile Tip Elevation Ranges						
					-28 to -40	-40 to -50	-50 to -70	-70 to -90	-90 to -110	-110 to -130	< -130
1	24" x 24"	200	400	2	--	1 (50%)	1 (50%)	--	--	--	--
2	24" x 24"	200	400	18	--	--	4 (~22%)	10 (~56%)	3 (~17%)	--	1 (~6%)
3	30" x 30"	300	600	22	--	--	8 (~36%)	6 (~27%)	1 (~5%)	--	7 (~32%)

(1) Required bearing for the project was indicated on the pile driving records as 2 times the pile design load. The Davisson Capacity from FB-Deep analyses was compared to the required bearing loads.

Tables 3-3 and 3-5 can be compared to evaluate the difference between the actual and predicted pile tip elevations.

Appendix F

Vertical Wave Force Documentation

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November 27, 2012

Leahann Powell, P.E.
American Consulting Professionals, LLC
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Greenwood, IN 46143

Re: Northbound Replacement Howard Frankland Bridge – Vertical Wave Forces

Dear Ms. Powell,

This letter documents the maximum 100-year total vertical wave force (including quasi-static and slamming forces) on the superstructure of the proposed northbound replacement Howard Frankland Bridge over Old Tampa Bay. Wave-structure interaction is a critical facet inherent to the design of coastal structures, especially bridges. A physics-based numerical model served as the main tool for developing the forces on the bridge superstructure. This model forms the basis for the parametric wave force equations accepted by the American Association of State Highway and Transportation Officials (AASHTO) (2008) for coastal bridge design.

Model inputs include wave height and period, water depth, and bridge characteristics (vertical clearance of bridge low member above storm water level, span length, span width, deck height, girder type and number, and rail height). Wave heights and periods and water depths originated from a Level III analysis, (following the methodology described in AASHTO [2008]), performed by Ocean Engineering Associates, Inc. (OEA) for the Florida Department of Transportation (FDOT) in District 7 (OEA, 2010a and 2010b). The present analysis extracted the Level III results at each bent along the existing northbound bridge to determine the wave characteristics and water depths at that location. Wave heights and periods generally ranged from 9 – 11 ft and 5 – 7 seconds. Water depths, based on an assumed a storm tide elevation of +9.3 ft NAVD, generally ranged from 20 – 25 ft. American Consulting Professionals provided the below replacement bridge characteristics:

- Low member elevation: +13.6 ft NAVD
- Span length: 143 ft
- Span width: 71.083 ft
- Deck height: 8.5 inches
- Girder type and number: 72-inch Florida I-beam (7 beams)
- Rail height: 32 inches

The present analysis assumed the replacement bridge followed the profile of the existing southbound bridge. Although portions of the existing bridge profile lie above the specified low member elevation, OEA assumed a low member elevation of +13.6 ft NAVD to estimate wave forces over the entire bridge profile (with varying wave characteristics and water depths).

Modeling results revealed a maximum 100-year total vertical wave force (including quasi-static and slamming forces) of 9.30 kips/ft, located near the east side of the bridge.

Please let me know if you have any questions or require additional information.

Regards,

Michael R. Krecic, P.E.
Senior Engineer

<u>References</u>

American Association of State Highway and Transportation Officials (AASHTO). 2008. *Guide Specifications for Bridges Vulnerable to Coastal Storms.* Washington, DC.

Ocean Engineering Associates, Inc. (OEA). 2010a. *Volume A Wave Vulnerability Pilot Study FDOT District 7 Procedure and Results.* Gainesville, FL.

Ocean Engineering Associates, Inc. (OEA). 2010b. *Volume B Wave Vulnerability Pilot Study FDOT District 7 Procedure and Results.* Gainesville, FL.