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

Draft
Geotechnical Technical Memorandum

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

June 2012

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Prepared for:

Florida Department of Transportation
District Seven

Prepared by:

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Kirk Bogen, P.E.

FDOT Project Manager

June 2012

TIERRA

June 14, 2012

American Consulting Professionals, LLC
2818 Cypress Ridge Blvd., Suite 200
Wesley Chapel, FL 33544

Attn: Mr. Jeffery Novotny, P.E.
Mr. Larry R. Weatherby, P.E.

RE: Draft Geotechnical Technical Memorandum
Howard Frankland Bridge Project Development & Environment (PD&E) Study
I-275/SR 93 Replacement of the Northbound Howard Frankland Bridge
Pinellas and Hillsborough Counties, Florida
FPN: 422799-1-12-04
Tierra Project No.: 6511-10-261

Gentlemen:

Pursuant to your authorization, Tierra, Inc. has completed the enclosed Geotechnical Technical Memorandum for the above referenced project. The results of the study are provided herein.

Tierra appreciates the opportunity to provide our services to American Consulting Professionals, LLC (ACP) and the Florida Department of Transportation (FDOT) on this project.

If you have any questions regarding this report, please contact us at (813) 989-1354.

Respectfully Submitted,

TIERRA, INC.

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EXECUTIVE SUMMARY

The Florida Department of Transportation (FDOT) is conducting a Project Development and Environment (PD&E) Study to evaluate alternatives for the replacement of the northbound Howard Frankland Bridge (Bridge No. 150107) on Interstate 275 (I-275/SR 93) 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 bridge to include portions of the existing causeway. The study is designed to assist the FDOT and the Federal Highway Administration (FHWA) in reaching a decision on the type, location, and conceptual design of the necessary improvements for the replacement of the northbound bridge. A simultaneous Regional Transit Corridor Evaluation is underway to evaluate premium transit alternatives within the bridge corridor to link the Gateway area in Pinellas County to the Westshore area in Hillsborough County. This PD&E Study will evaluate options for inclusion of a future exclusive transit envelope within the Howard Frankland Bridge corridor.

Location concepts for constructing the new bridge include the west side of the southbound bridge, between the two existing bridges, or east of the existing northbound bridge. Demolition of the existing northbound bridge is included as part of all alternatives. The future transit envelope could either be a separate structure or included as part of the new bridge. In addition to the bridge replacement options, the Department is presently considering adding additional lanes as *managed lanes*, which would be variable-price tolled and could also be used by express bus and Bus Rapid Transit (BRT) vehicles. In addition to the various Build Alternatives, the No-Build or Rehabilitation option will also be considered as part of the study process. However, based on a life-cycle cost analysis conducted by T.Y. Lin for 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 analysis, with a present-worth savings of approximately $65 million in today's dollars.

This Draft Geotechnical Technical Memorandum has been prepared as part of this PD&E Study.

The design of the new northbound bridge will require geotechnical subsurface explorations. A review of pile driving records from the construction records of the southbound Howard Frankland Bridge indicate considerable variability in pile lengths across the bridge site and within pile groups indicating variability in the subsurface soil/limestone surface and limestone competency. Additional test borings will be required as part of the new bridge design along with foundation load testing during construction. Variations in the soil/limestone will play a role in the selection of the foundation system.

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SECTION 1 INTRODUCTION

1.1 PD&E STUDY PURPOSE

The objective of this Project Development and Environment (PD&E) Study is to assist the FDOT and the Federal Highway Administration (FHWA) in reaching a decision on the type, location, and conceptual design of the necessary improvements for the replacement of the northbound Howard Frankland Bridge on Interstate 275 (I-275/SR 93) due to its structurally-deficient condition. The PD&E Study satisfies all applicable requirements, including the National Environmental Policy Act (NEPA), in order for this project to qualify for federal-aid funding of subsequent development phases (design, right of way [ROW] acquisition, and construction). A simultaneous Regional Transit Corridor Evaluation is underway to evaluate premium transit alternatives within the bridge corridor to link the Gateway area in Pinellas County to the Westshore area in Hillsborough County. This PD&E Study will evaluate options for inclusion of a future transit envelope within the Howard Frankland Bridge corridor.

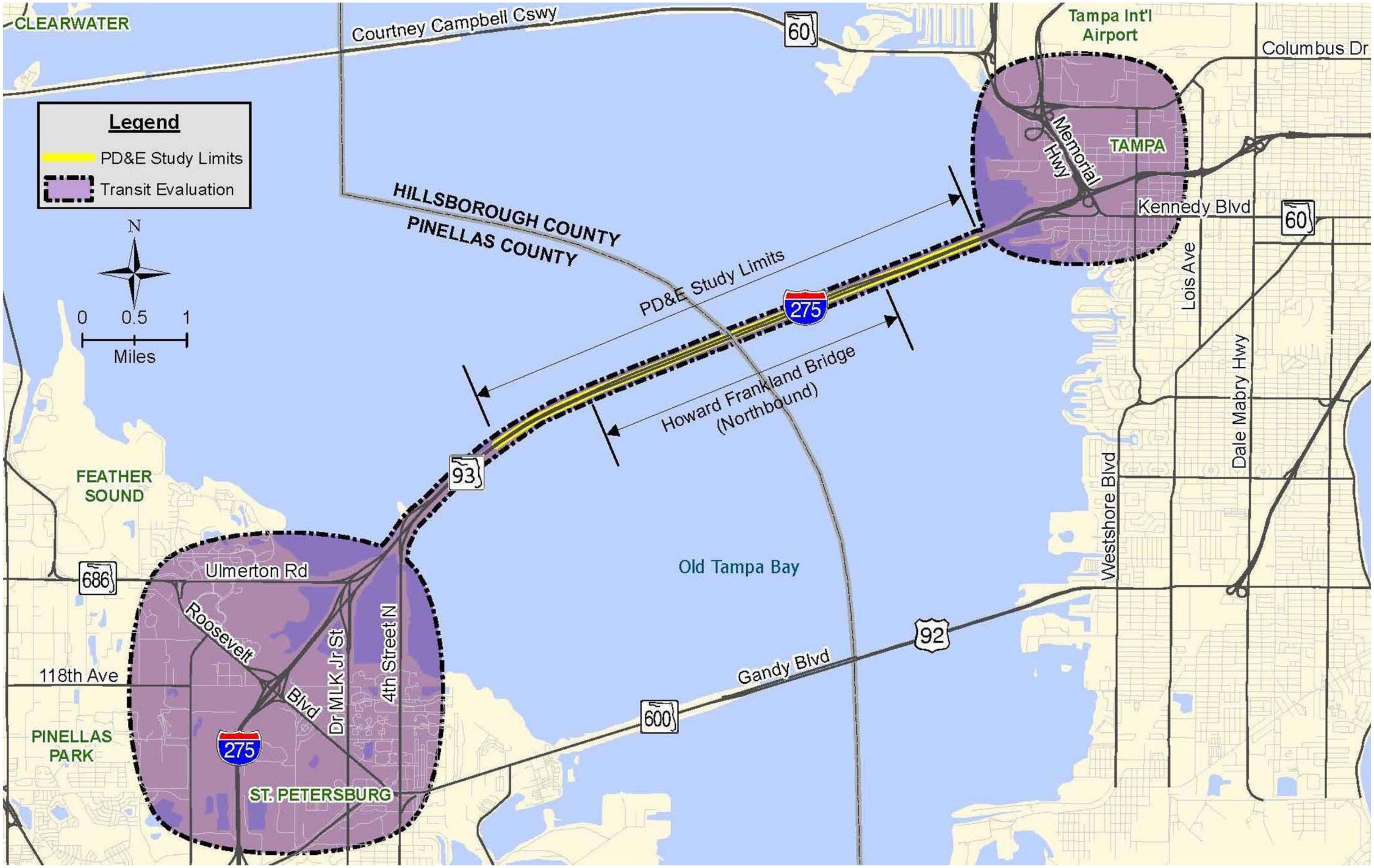
This project was evaluated through the FDOT's Efficient Transportation Decision Making (ETDM) program. Based on the Environmental Technical Advisory Team's review comments, it is expected that the FHWA will determine that this project qualifies as a Type 2 Categorical Exclusion (CE).

1.2 PROJECT DESCRIPTION

The proposed project involves the replacement of the four-lane northbound I-275 Howard Frankland Bridge (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 bridge to include portions of the existing causeway. In addition to the proposed bridge replacement, this study also considers 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. A project location map is shown in **Figure 1-1**. The project limits fall within Township 29S, Range 17E, sections 24 thru 28 and 32 thru 34.

Existing Structure - The existing northbound span of the Howard Frankland Bridge (Bridge No. 150107) is a mostly low-level, pre-stressed concrete stringer/girder structure. The bridge is 3.01 miles long and 62.3 feet wide, with a maximum (center) span of 98.1 feet. The existing bridge typical section (**Figure 1-2**) is four lanes with the older (1959) structure serving northbound traffic and the newer (1991) bridge serving southbound traffic. The navigational clearances for the northbound bridge are 42.9 feet vertical and 72.1 feet horizontal. The existing limited access (LA) right-of-way (ROW) is 800 feet wide in most areas. The bridge includes both 11 and 12-foot lane widths (as shown in the figure) in addition to a 4-foot inside shoulder and a 10-foot outside shoulder.

Figure 1-1 Study Area Map



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

Study Area Map

Figure 1-1

Roadway Approaches – The roadway approaches include four 12-foot lanes, 10-foot paved inside and outside shoulders, and concrete barrier walls within the 22-foot median. 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 1-2. Both causeway ends include emergency access roadways which run underneath the bridge ends.

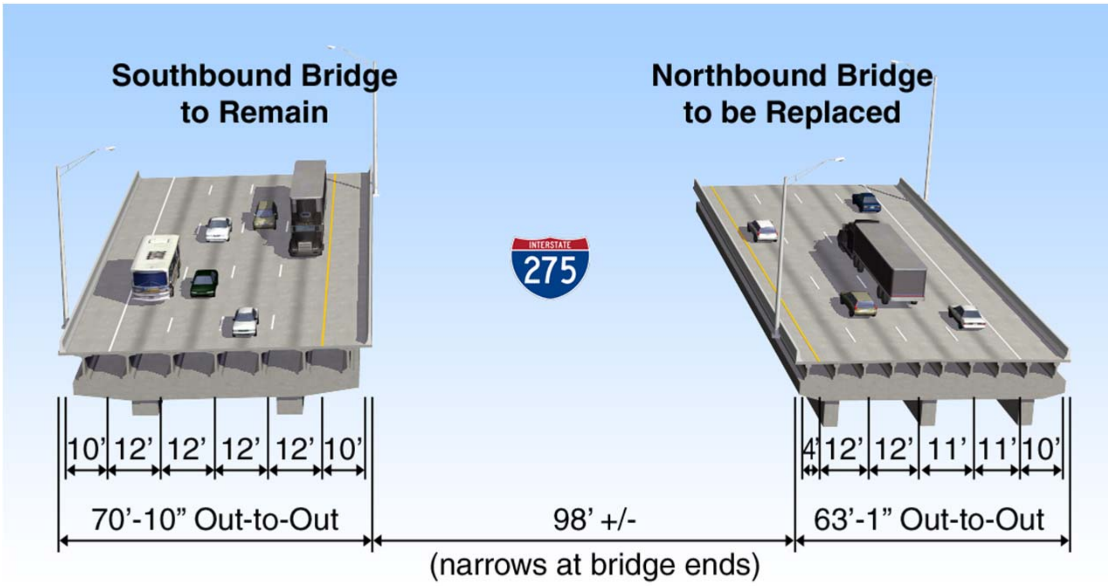
Proposed Improvements – Location concepts for constructing the new Howard Frankland Bridge include the west side of the southbound bridge, between the two existing bridges, or east of the existing northbound bridge. Demolition of the existing northbound bridge is included as part of all alternatives. In addition, all alternatives include provisions for a future transit envelope, which could either be a separate structure or included as part of the new Howard Frankland Bridge. Basic conceptual alternatives are shown in **Figure 1-3**. In addition to these basic options, the Department is presently considering adding additional lanes as *managed lanes*, which would be variable-price tolled and could also be used by express bus and Bus Rapid Transit (BRT) vehicles. For the center-construction option, if managed lanes were to be included with the new bridge, it would require staged construction, with the later stage to occur after the existing northbound bridge is removed. In addition to the various Build Alternatives, the No-Build or Rehabilitation option will also be considered as part of the study process.

1.3 PROJECT PURPOSE AND NEED

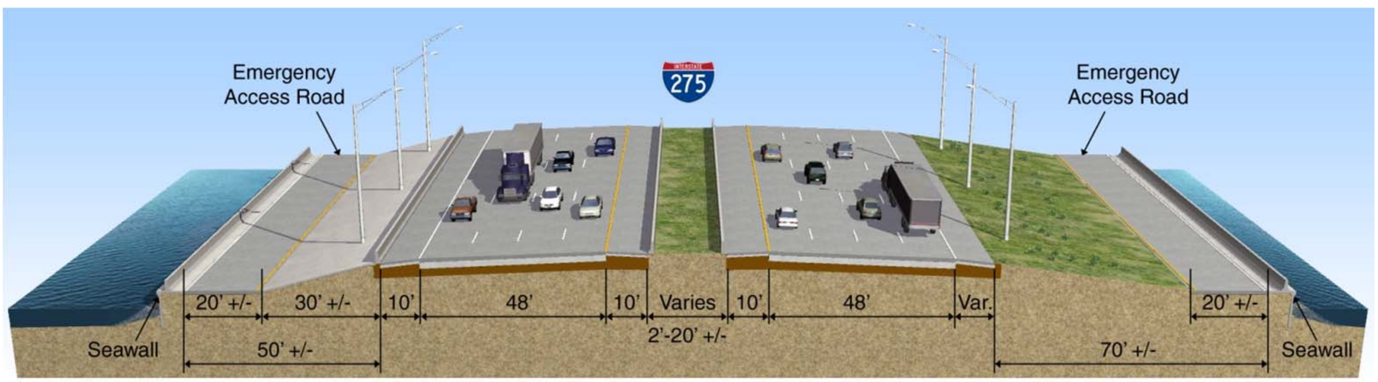
I-275 is a vital link in the local and regional transportation network as well as a critical emergency evacuation route for portions of Pinellas County. In addition to being an Interstate highway and part of the National Highway System, I-275 is part of the Florida Intrastate Highway System (FIHS) that provides for the high-speed movement of people and goods at high traffic volumes. The FIHS is the highway component of the Strategic Intermodal System (SIS), a statewide network of highways, railways, waterways and transportation hubs that handle the bulk of Florida's passenger and freight traffic.

The replacement of the 4-lane northbound Howard Frankland Bridge is consistent with the Pinellas County MPO's Cost Feasible Long Range Transportation Plan (LRTP), since it is primarily related to preservation of the facility rather than expansion. The transit envelope along I-275 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 Tampa Bay Area Regional Transportation Authority's (TBARTA) Mid-Term Regional Network (2035) and Long-Term Regional Network (2050) which shows "short distance rail" in the bridge corridor.

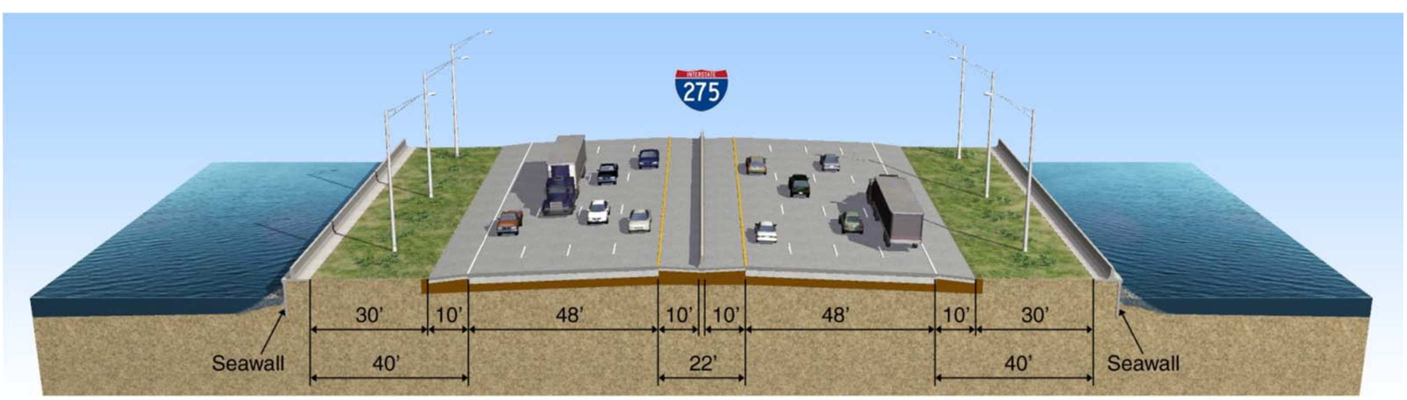
Figure 1-2 Existing Typical Sections



Existing Howard Frankland Bridges over Old Tampa Bay

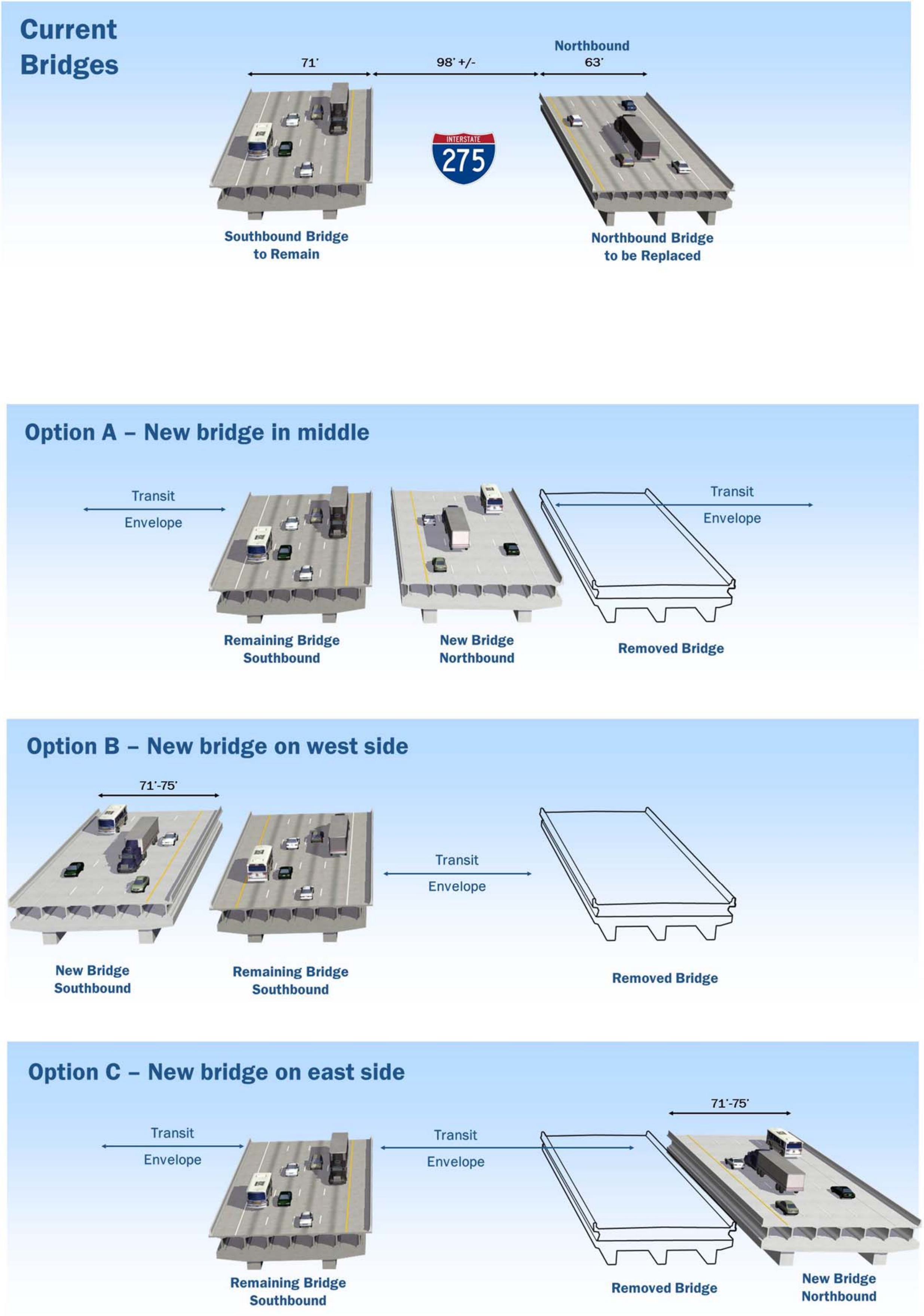


Roadway Approaches Near Bridge Ends (Looking North)



Roadway Approaches on the Causeway (Looking North)

Figure 1-3 Bridge Replacement Concepts



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

The Howard Frankland Bridge is one of only three crossings between Pinellas and Hillsborough Counties over Old Tampa Bay and the crossing which carries the most traffic. In 2010, the Annual Average Daily Traffic (AADT) was 139,000 vehicles per day (VPD) with each direction carrying 69,500 VPD. The Tampa Bay Regional Planning Model (TBRPM) Version 7.0 indicates that the AADT in 2035 is expected to increase to 123,400 VPD on the northbound bridge. 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 2035 LOS is projected to be LOS "F" if the new 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 lanes as *managed lanes* in this bridge corridor.

The existing northbound bridge is no longer classified as *structurally deficient*; the latest sufficiency rating is 78.9 based on a March 2011 inspection. The previous inspection conducted in September 2010 resulted in a sufficiency rating of 61.8. The FDOT performed repairs that improved the rating for the 2011 inspection. However, based on a life-cycle cost analysis conducted by T.Y. Lin for 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 analysis, with a present-worth savings of approximately $65 million in today's dollars.

1.5 REPORT PURPOSE

This Geotechnical Technical Memorandum is one of several documents being prepared as part of this PD&E Study. The purpose of this report was to obtain and evaluate information on the existing subsurface conditions within the project limits along with evaluation of the existing southbound bridge foundation information to assist in the preparation of the PD&E Report for the project. The following services were provided for this summary:

- Reviewed published information on topographic, soils and groundwater conditions. Soil, groundwater and regional geology information was obtained from the Soil Surveys of Hillsborough and Pinellas Counties, Florida published by the United States Department of Agriculture (USDA) – Natural Resource Conservation Service (NRCS). Topographic information was obtained from appropriate topographic maps published by United States Geological Survey (USGS).

- Reviewed previous geotechnical soil explorations and pile driving records and summarized the collected data to support the PD&E study for the project.

- Prepared this Geotechnical Memorandum for the project.

SECTION 2 SUBSURFACE CONDITIONS

2.1 USGS TOPOGRAPHIC SURVEY

The USGS topographic survey map titled "Gandy Bridge, Florida" was reviewed. The natural ground surface elevations along the Howard Frankland causeway appear to range from approximately +0 to +5 feet National Geodetic Vertical Datum of 1929 (NGVD29) along the project alignment.

Based on a review of previous FDOT reports, the existing ground elevation along the causeway at the ends of the Howard Frankland Bridge ranges from elevation +0 feet to approximately +10 feet, NGVD29. The mudline across Old Tampa Bay is reported to range from approximately -10 feet, NGVD29 near the causeway at each end of the bridge down to approximately -20 feet, NGVD29 near the middle of Old Tampa Bay at the center span of the Howard Frankland Bridge. A reproduction of the USGS map is presented in **Appendix A.**

2.2 REGIONAL GEOLOGY

The following sections contain information on the regional geology for Hillsborough and Pinellas Counties as presented in the "Soil Survey of Pinellas County, Florida" and the "Soil Survey of Hillsborough County, Florida" published by the United States Department of Agriculture (USDA) Natural Resource Soil Conservation Service (NRCS).

2.2.1 Pinellas County

The two major geologic formations in Pinellas County are the Hawthorn Formation of the lower Miocene and Caloosahatchee Marl of the lower Pliocene. The border between these formations extends across the peninsula north of the Cross Bayou Canal through Safety Harbor and Oldsmar. The Hawthorn Formation underlies soils north of this line.

The Hawthorn Formation consists of interbedded sand, clay, marl, limestone, lenses of fuller's earth, and land-pebble phosphate. Soils that occur on the side slopes of depressions northeast of Clearwater and in cuts made by Curlew Creek north of Dunedin contain phosphatic material from this formation.

During the Pleistocene, marine deposits that formed four terraces covered these formations. A mantle of sand that ranges from two to 35 feet in thickness covered these terraces. These terraces are described below:

The Pamlico terrace occurs at an elevation of 0 to 25 feet above mean sea level. It is mainly sand, one to 15 feet thick. In areas near Oldsmar, St. Petersburg, and Pinellas Park, the sand is only one to 4 feet thick and is underlain by Caloosahatchee Marl.

Soils of the Oldsmar and Wabasso series that have acidic sand upper horizons and nonacidic, loamy subsoil formed on this terrace.

The Talbot terrace is 25 to 42 feet above mean sea level. It is fine sand not more than 16 feet thick. In a few places, the sand mantle is thin and soils have been affected by phosphatic material from underlying Hawthorn Formation. Most soils of the Talbot terrace are acidic. Soils of Astatula, Immokalee, Myakka, and Pomello series formed this terrace.

The Penholoway terrace is 42 to 70 feet above mean sea level. It is mostly fine sand as much as 28 feet thick. The Hawthorn Formation underlies it. On sides of depressions the sand mantle is thin, and materials from the Hawthorn Formation have affected the soils. Most soils on this terrace are acidic. A few nonacid soils occur in small isolated areas in depressions and along streams. Soils of the Astatula, Immokalee, Myakka, Paola, Pomello, and St. Lucie series formed this terrace.

The Wicomico terrace is 70 to 97 feet above mean sea level. It is mainly fine sand as much as 27 feet thick. The Hawthorn Formation underlies it. The soils on this terrace are dominantly acid sands of the Astatula, Immokalee, Paola, Pomello, and St. Lucie series.

A few pockets of recently deposited muck and freshwater marl occur in low areas. With few exceptions, individual soils are confined to a particular geologic formation or marine terrace. For example, Pinellas soil that formed in fresh-water alkaline deposits on upland terraces are very similar to Pinellas soil that formed in alkaline sediments of Caloosahatchee Marl. Though variations in characteristics of the parent material are apparent in the field, they do not affect soil classification.

2.2.2 Hillsborough County

The Suwannee Limestone occurs in the subsurface throughout Hillsborough County and is the oldest geologic formation that is exposed at the surface in the county. The Suwannee is found near the ground surface in the northeastern part of the county and is exposed in the Hillsborough River bed. In all other parts of the county, the Suwannee is overlain by the Tampa Member of the Arcadia Formation. The Suwannee dips to the south and southwest and thickens to the southwest. The thickness of the Suwannee, within Hillsborough County, ranges from just under 100 feet to more than 300 feet. The top of the Suwannee Limestone is encountered at about 50 feet above mean sea level in northeastern Hillsborough County and dips to about 300 feet below mean sea level at the southern border.

The Arcadia Formation, Nocatee Member consists of the “lower Tampa” or “Tampa sand and clay unit” of Wilson (1977). The updip limits of the Nocatee are not well-defined at this time; however, the unit extends into southern and eastern Hillsborough County where it is believed to be present as a thin (several feet) clay layer often described in the past at the base of the Tampa Limestone. The Arcadia Formation, Tampa Member is a white to tan-colored, quartz sandy limestone with a carbonate mud matrix. Varying amounts of clay are usually disseminated throughout the rock (King and Wright, 1979). The Tampa Member is present in the subsurface over most of the county and is exposed in many areas, especially within the Hillsborough River Valley. The Tampa Member has been removed by erosion in a band along the eastern part of northernmost Hillsborough County. In this area, the Suwannee Limestone is the first formation encountered beneath the surficial sands (Wright and MacGill, 1974). The Tampa Member dips generally to the southwest and thickens in the downdip direction. The top of the Tampa Member is encountered at just above mean sea level in northern Hillsborough County to approximately 260 feet below mean sea level in the southwestern corner of the county (King, 1979). The uppermost (unnamed) member of the Arcadia Formation includes those sediments which in the past have been referred to as the “Hawthorn carbonate unit” (Scott, 1984, personal communication). Lithologically, these sediments consist of white to yellowish-gray, quartz sandy, phosphatic, sometimes clayey, dolomites and limestones (uncommon). In portions of northwest Hillsborough County and the Hillsborough River Valley, limestones of the Tampa Member of the Arcadia Formation are overlain by irregular thicknesses of sandy calcareous clays. In the past these sediments have been assigned to the Tampa, Hawthorn, Bone Valley, Alachua and Pleistocene by various authors.

The Peace River Formation proposed by Scott (1984) includes two members: a downdip, unnamed member and the updip Bone Valley Member. The unnamed member consists of interbedded sands, clays and dolomite with variable phosphate content which, in the past, have been described as “upper Hawthorn clastics.” In many parts of Hillsborough County, the Peace River Formation is difficult to differentiate from the uppermost Arcadia due to the gradational nature of the contact and the northward thinning of the Peace River Formation. Both the upper member of the Arcadia Formation and the Peace River Formation pinch out in northern Hillsborough County; however, the Peace River pinches out farther to the south than the upper member of the Arcadia Formation. Bone Valley sediments are present only in the eastern part of Hillsborough County. Bone Valley deposition was restricted to the north by the presence of the Hillsborough High and to the west by the ancestral Valrico Ridge. The Bone Valley Member consists of a series of sands and clays which contain abundant quantities of phosphorite sand and gravel.

Pleistocene terrace sands, deposited during higher sea level stands, blanket most of Hillsborough County. These sands are very fine to medium grained quartz sands with a minor amount of heavy minerals. Generally, the sands are clean and white in color; however, locally they may contain some organic matter and may be iron stained. Thickness of the terrace sands ranges from a few inches to more than 50 feet in the Plant City area (Wright and MacGill, 1974). The Pleistocene terrace sands overlie the clayey residuum of the Hawthorn Group in the northern part of the county. In the southwestern portion of the county, a thin veneer of Pleistocene sand overlies the Pleistocene shell deposits.

Holocene sediments within the county consist of fluvial, lacustrine, mangrove and swamp deposits. Lakes are most prevalent in northwest Hillsborough County. Lacustrine deposits consist of sand, silt and clay washed into lakes by storm water runoff, as well as organic material derived from the decay of aquatic plants within the lakes. Fluvial deposits consist of sand, silt, clay and organic material deposited in the stream beds and flood plains of rivers and streams. The majority of such deposits occur along the Hillsborough, Alafia and Little Manatee Rivers and their tributaries. Mangrove and swamp sediments consist of variable amounts of organic matter and sand, silt and clay.

The water table in the surficial aquifer generally follows the topographic relief and flow patterns are usually local in nature, following surface water basins. Based on topography and surface water features, the direction of groundwater flow would likely be to the south and west toward the

Hillsborough River. Direct measurement would be required to determine actual direction of groundwater flow and depth to groundwater on the corridor. Local water features include Cory Lake (located approximately 950 feet south of the corridor) and Basset Branch (located approximately 900 feet north-northeast) of the corridor.

Review of the Hillsborough County Soil Survey indicates that the soils within the project area consists of Mayakka fine sands (70.1%), Basinger, Holopaw, and Samsula soils (14.9%), Malabar fine sands (11.8%), Winder fine sands (2.3%) and other minor soil types. No major water bodies, creeks, or rivers were identified on the soil survey maps. No borrow pits, mining operations, or landfills were identified from the soil survey review. Several small ponds were depicted on the soil survey map for the project area. These ponds may be manmade as part of the development in the area or may be naturally occurring low areas.

2.3 SOIL SURVEY

The Soil Surveys for Pinellas County and Hillsborough County published by USDA-NRCS were reviewed for near-surface soil information. Both the Pinellas County and Hillsborough County ends of the Howard Frankland Bridge intersect an artificial causeway consisting of man-made deposited soils.

The following sections present the information contained within the Pinellas County Soil Survey and the Hillsborough County Soil Survey.

2.3.1 Pinellas County

Based on a review of the Pinellas County Soil Survey published by USDA-NRCS, it appears that there is one (1) soil-mapping unit noted within the Pinellas County project limits. 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). A detailed soil survey map is shown in **Appendix A.** 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. It is not ponded. This soil's seasonal zone of water saturation is at 27 inches.

Table 2-1: Pinellas 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
(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		
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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 units presented above are part of the artificial causeway leading to the Howard Frankland Bridge.

2.3.2 Hillsborough County

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. 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). A detailed soil survey map is shown in **Appendix A.** 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 2-2: 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		

2.4 GROUNDWATER CONDITIONS

The Howard Frankland Bridge crosses Old Tampa Bay. 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 Howard Frankland Bridge along the causeway will also be tidally influenced.

2.5 REVIEW OF POTENIOMETRIC SURFACE MAPS

Based on a review of the "Potentiometric Surface of the Upper Floridan Aquifer, West Central Florida" maps published by the USGS, 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.

SECTION 3 PRELIMINARY ENGINEERING EVALUATIONS

3.1 SHALLOW SOIL SUITABILITY

Based upon the USDA-NRSC Soil Survey for Pinellas and Hillsborough Counties, the soils at the end bents and approaches to the Howard Frankland Bridge (along the causeway) consist of man-made fills consisting of 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.

3.2 ROADWAY CONSTRUCTION

Site preparation should consist of normal clearing and grubbing followed by compaction of subgrade soils. Subgrade preparation will include the removal of plastic soils and top-soils and organic soils in accordance with FDOT Design Standard Index 500. Backfill embankment materials should consist of materials conforming to FDOT Design Standard Index 505.

The overall site preparation and mechanical densification work for the construction of the proposed roadway and approach embankments should be in accordance with the FDOT Standard Specifications for Road and Bridge Construction (SSRBC) and Standard Index requirements. In general, the reported sandy subsurface soils appear capable of supporting the construction of the proposed roadway improvements subject to the above geotechnical considerations and after proper subgrade preparation.

3.3 GEOTECHNICAL BRIDGE CONSIDERATIONS

3.3.1 Existing Northbound Howard Frankland Bridge Information:

The Howard Frankland Bridge was built in 1959. It was built as a concrete structure to carry two lanes of vehicular traffic in two directions across Old Tampa Bay. The 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. Since the opening of the “new” Howard Frankland bridge, the four lanes of travel have been converted entirely for northbound traffic.

3.3.2 Existing Southbound Howard Frankland Bridge Information:

The “new” southbound Howard Frankland Bridge was completed in 1991 to accommodate the increased traffic loads since the construction of the original Howard Frankland Bridge. The New Howard Frankland Bridge is approximately 15,000 feet long, consists of 110 spans (approximately 1/3 the number of spans of the original Howard Frankland Bridge) and carries four lanes of traffic.

The bridge is supported by both 24-inch and 30-inch square concrete piles. As provided in the 1987 plans, the design capacity of the 24-inch piles was 200 tons and the design capacity for the 30-inch piles was 300 tons, as reported in the design plans. 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.

The following table summarizes the pile configurations for the end bents and piers for the existing southbound bridge:

Table 3-1: 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

3.3.3 Previous Geotechnical Studies

Soil boring information and pile driving records utilized during the design and construction of the existing southbound Howard Frankland Bridge were reviewed to evaluate conditions that could be anticipated during the design of the rehabilitation/replacement of the northbound Howard Frankland Bridge.

A total of 47 Standard Penetration Test (SPT) borings performed during the design phase for the "new" southbound Howard Frankland Bridge 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.

Tierra also reviewed the pile driving records for the "new" southbound Howard Frankland Bridge. A total of 1460 piles were driven between 1988 and 1989 for "new" southbound Howard Frankland Bridge. Of these, a total of 112 were 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. (Refer to **Figure 3-1** in **Appendix A**)

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. (Refer to **Figure 3-1** in **Appendix A**)

Section 3 consists of the piers along the bridge with 30-inch piles with variations in pile elevations ranging from approximately -35 to -130. (Refer to **Figure 3-1** in **Appendix A**)

A graphic summary of the average, minimum, and maximum pile elevation across the bridge site is included on **Figure 3-1** in **Appendix A**. These three sections with the pile design load are shown in the table below.

Table 3-2: Section Information

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

The following table provides information regarding the tip elevation ranges that occurred within each section.

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.

3.4 GEOTECHNICAL BRIDGE RECOMMENDATIONS

Additional soil borings will be required as part of the design process of the new bridge. The variability observed with the pile lengths across the bridge and within pile groups by the pile driving records, 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 must be considered during the design phase during the Bridge Development phase of the project.

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 new Howard Frankland Bridge and review of existing pile driving records. Based on our experience with similar projects, we initially considered the following foundation alternatives:

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

The following paragraphs discuss each of these alternatives briefly.

3.4.1 Shallow Foundations for the End Bents

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. These soils 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 Howard Frankland Bridge. 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 draft geotechnical PD&E report.

3.4.2 Steel Piles

Steel pile types include pipe and H-piles. Previous experience has shown that steel piles are generally more expensive per lineal foot than 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 the Howard Frankland Bridge site.

The environment of the substructure at the bridge site is extremely aggressive due to saltwater and high chloride contents. Steel piles are therefore not typically considered appropriate for a bridge replacement project in an extremely aggressive saltwater environment.

3.4.3 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 should be considered.

Drilled shafts should 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 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 should 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.

3.4.5 PSC Piles

Prestressed concrete 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 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.

SECTION 4 PRELIMINARY CONSTRUCTION CONSDERATIONS

4.1 GENERAL

The overall site preparation and construction should be in accordance with the FDOT Standard Specifications for Road and Bridge Construction (SSRBC) and Standard Index Requirements.

4.2 TEMPORARY SIDE SLOPES

Side slopes for temporary excavations above the water table may stand near 1.5H:1V for short dry periods of time; however, it is recommended that temporary excavations that are deeper than 4 feet be cut on slopes of 2H:1V or flatter. Where restrictions will not permit slopes to be laid back as recommended above, the excavation should be shored in accordance with OSHA requirements. Furthermore, open-cut excavations exceeding 10 feet in depth should be properly dewatered and sloped 2H:1V or flatter or be benched using a bracing plan approved by a professional engineer licensed in the State of Florida. During foundation construction, excavated materials should not be stockpiled at the top of the slope within a horizontal distance equal to the excavation depth.

4.3 GROUNDWATER CONTROL

Depending upon groundwater levels at the time of construction, some form of dewatering may be required to achieve the required compaction. Due to groundwater levels during the wet season of the year and tidal levels, seepage may enter the bottom and sides of excavated areas. Such seepage will act to loosen soils and create difficult working conditions. Groundwater levels should be determined immediately prior to construction. Shallow groundwater should be kept below the lowest working area to facilitate proper material placement and compaction in accordance with the FDOT SSRBC.

4.4 PROTECTION OF EXISTING STRUCTURES

FDOT, SSRBC Section 455-1 should 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 bridge.

4.5 DYNAMIC LOAD TESTING FOR DRIVEN PILE FOUNDATIONS

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

4.6 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 should 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 should be installed in all drilled shafts in accordance with the FDOT SSRBC Section 455. It is our recommendation that Cross-hole Sonic Logging testing be performed on all test-hole shafts, and selected production shafts on the project. Recommended general notes for drilled shaft construction would occur during project design.

SECTION 5 ENVIROMENTAL CLASSIFICATION

The Howard Frankland Bridge is over Old Tampa Bay, a saltwater body of water. The following table summarizes the environmental classification for the new bridge.

Table 5-1: Environmental Classification

Description	Superstructure Environmental Classification	Concrete Substructure Environmental Classification	Steel Substructure Environmental Classification
Howard Frankland Bridge	Extremely Aggressive	Extremely Aggressive	Extremely Aggressive

SECTION 6 REPORT LIMITATIONS

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted Geotechnical engineering principles and practices. This company is not responsible for the conclusions, opinions, or recommendations made by others based on this data.

The scope of the investigation was intended to provide a preliminary evaluation of the subsurface conditions to support the Howard Frankland Bridge PD&E Study. The recommendations submitted in this report are based upon the data obtained from the soil borings performed at the locations indicated. If any subsoil variations become evident during the course of this project, a re-evaluation of the recommendations contained in this report will be necessary after we have had an opportunity to observe the characteristics of the conditions encountered. The applicability of the report should also be reviewed in the event significant changes occur in the design, nature or location of the proposed bridge structure.

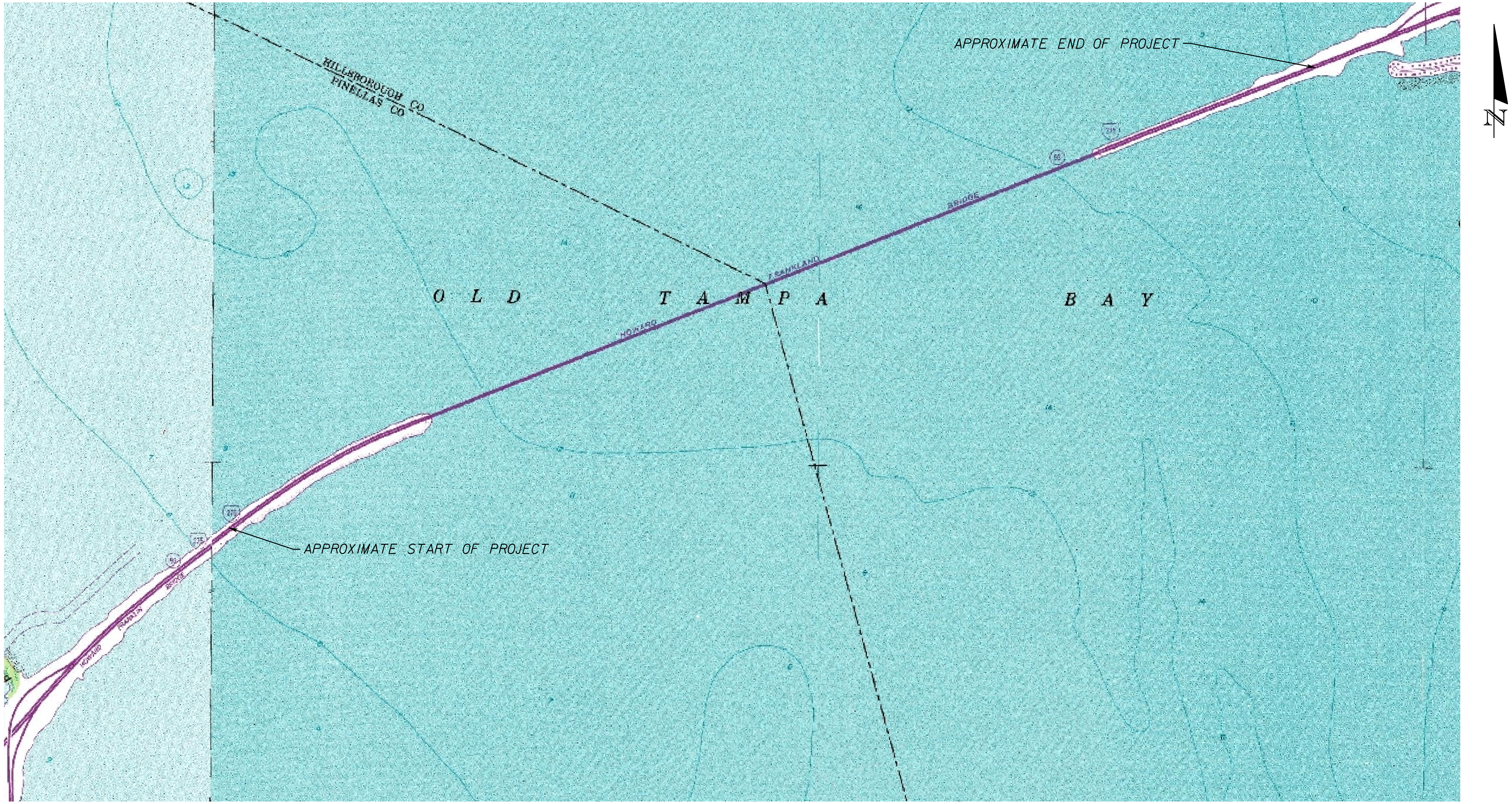
The scope of our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied. Any statements in this report regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of the design team of American Consulting Professionals, LLC and the FDOT.

Appendix A

USGS Map

USDA Map

Southbound Howard Frankland Bridge – Review of Pile Driving Records



REFERENCE: "GANDY BRIDGE, FLORIDA" USGS QUADRANGLE MAP

TOWNSHIP: 29S
RANGE: 17E
SECTIONS: 24-28 AND 32-34
SCALE: 1 INCH = 2,500 FEET

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

E.O.R.: MARC E. NOVAK, Ph. D., P.E.
P.E. LICENSE NUMBER 67431
TIERRA INC
7351 TEMPLE TERRACE HIGHWAY, TAMPA, FL. 33637
CERTIFICATE OF AUTHORIZATION: 6486

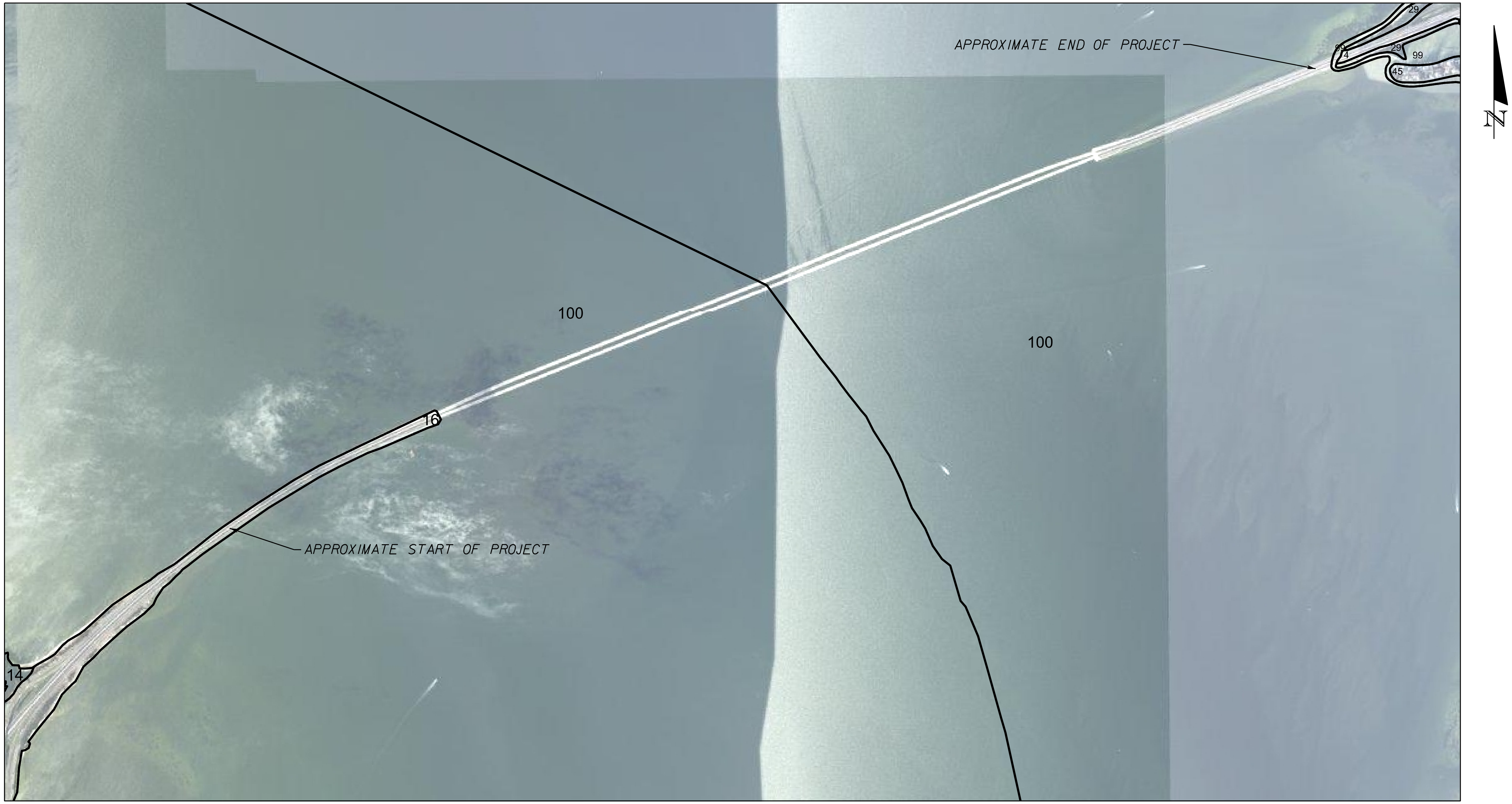
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

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

USGS VICINITY MAP

SHEET NO.

bsawaska 6/14/2012 6:13:53 PM J:\6511\2010 Files\6511-10-261 Howard Frankland PDE\Microstation\Roadway\USGS01.dgn



REFERENCE: "SOIL SURVEY OF PINELLAS COUNTY AND HILLSBOROUGH COUNTY, FLORIDA"

TOWNSHIP: 29S
RANGE: 17E
SECTIONS: 24-28 AND 32-34
SCALE: 1 INCH = 2,500 FEET

REVISIONS			
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93	PINELLAS	422799-1-12-04

USDA VICINITY MAP

SHEET NO.

$USER$ $DATE$ $TIME$ $FILE$

Southbound Howard Frankland Bridge - Review of Pile Driving Records

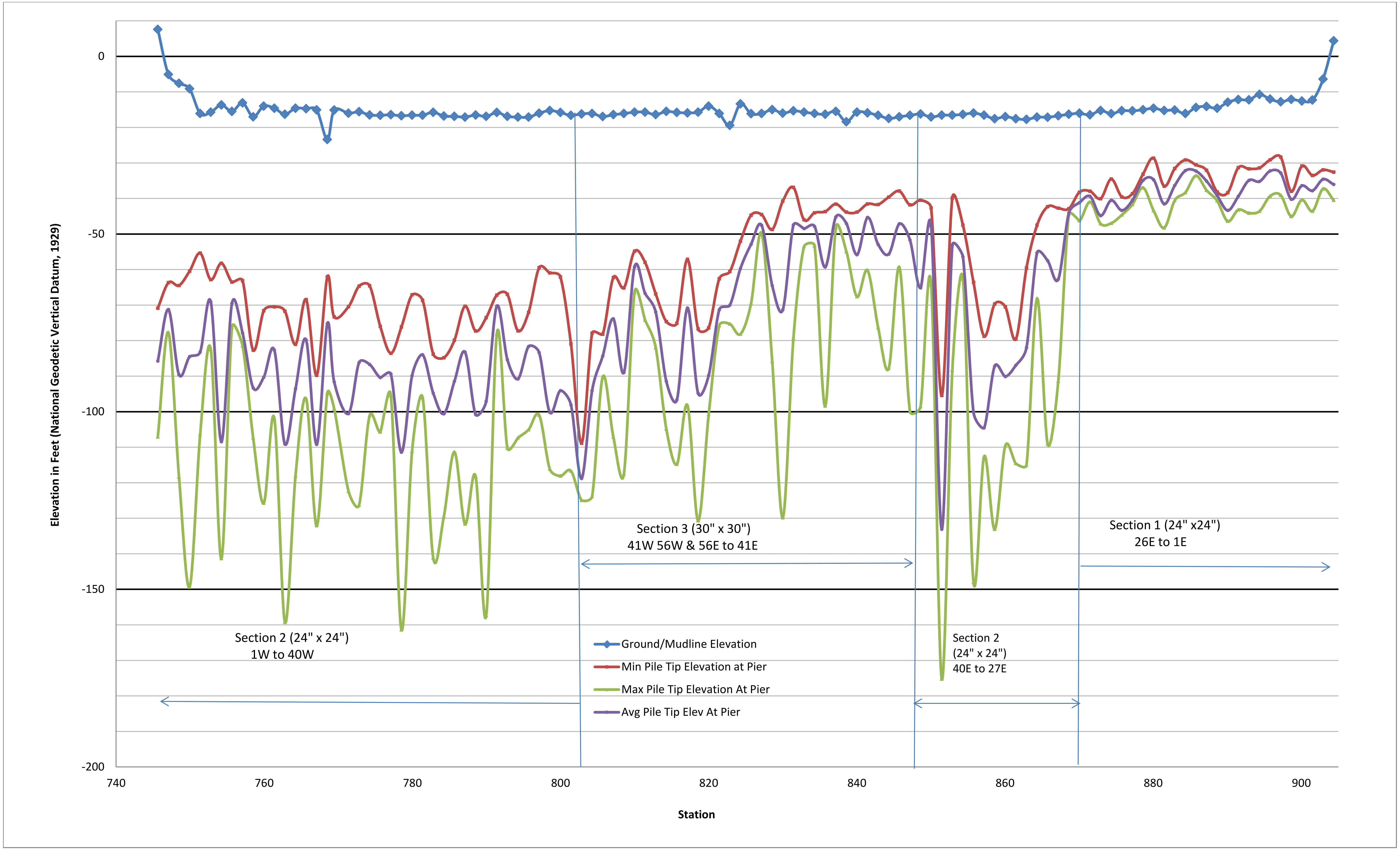

Figure 3-1