

**M E M O R A N D U M**  
**FLORIDA DEPARTMENT OF TRANSPORTATION**  
**Roadway Design - MS 7-810**

DATE: February 7, 2020

TO: Kara Van Etten, Project Manager

FROM: Allan Urbonas P.E., District Design Engineer  
BY: Daniel Lauricello, District Roadway Design Engineer

COPIES: File

SUBJECT: Work Program Item Segment: 437535-1-52-01  
County: HILLSBOROUGH COUNTY  
Project Description: US 41/SR 45/NEBRASKA AVE AT E  
TWIGGS ST  
**DIAGONAL MAST ARM  
ORIENTATION**

**Approved Design Variation**

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Transmitted herewith is an approved design variation for the above subject project. Please file the originals in the project management file system and provide a hard copy to the Engineer of Record. Thank you for your continued support and cooperation.

JAN 21 2020 SP

**MEMORANDUM**  
**FLORIDA DEPARTMENT OF TRANSPORTATION**  
**Roadway Design MS 7-810**

Design Department

DATE: January 15, 2020  
 TO: Allan Urbonas, P.E., District Design Engineer  
 FROM: David B. Hubbard, P.E., Engineer of Record

SUBJECT: **DESIGN VARIATION MEMO FOR DIAGONAL MAST ARM ORIENTATION**  
 Financial Project ID: 437535-1-52-01  
 County / Section No. 10-040-000  
 State Road Number: SR 45 / US 41 (Nebraska Avenue)  
 Federal Aid Number: N/A  
 Project Description: THEA Twiggs Street Improvements from Nebraska Avenue to Meridian Avenue, Hillsborough County, FL  
 New Construction [X] RRR [ ]

**DESCRIPTION:**

This project is being procured by the Tampa-Hillsborough Expressway Authority (THEA) and is located along Twiggs Street in Downtown Tampa, Hillsborough County, FL. The project includes intersection improvements where Twiggs Street intersects US Highway 41/State Road 45/Nebraska Avenue (Nebraska Avenue) at MP 0.110. Within the vicinity of the improvements, Nebraska Avenue has a posted speed limit of 35 miles per hour (MPH), is not a Strategic Intermodal System (SIS) corridor, and is classified as an Urban Minor Arterial. The intersection is directly adjacent to the Selmon Expressway/SR 618 and services an exit from the Reversible Express Lanes (REL).

The intent of the project is to improve the signal operation of the Twiggs Street and Nebraska Avenue intersection, reducing weaving along Twiggs Street by adding a dedicated right-turn lane, as well as provide safety improvements through the addition of new traffic signals, pedestrian ramps, and other features.

A design variation is being requested to provide diagonal mast arms rotated 45 degrees from the US 41/ SR 45/Nebraska Avenue mainline alignment at the Twiggs Street and Nebraska Avenue intersection.

**DESIGN CRITERIA VERSUS PROPOSED DESIGN:**

FDOT Criteria: The 2020 Florida Design Manual (FDM), Section 232.8, states, "Orient mast arm signal structures approximately 90° to approach traffic; i.e., mast arms diagonal to traffic are not allowed."

Proposed Design: The proposed design at the Nebraska Avenue intersection utilizes two diagonal mast arms, rotated approximately 45° from the Nebraska Avenue mainline alignment as shown in the Attachments.

**LIMITS APPLICABLE**

BEGIN STA. (MILEPOST)	END STA. (MILEPOST)	POSTED SPEED	DESIGN CRITERIA FDOT	DESIGN CRITERIA AASHTO	PROPOSED DESIGN	REMARKS
103+85 (MP 0.104)	104+67 (MP 0.118)	35 MPH	90° Orient.	N/A	45° Orient.	Single arm mast arm in NE & SW corners

The intent of this variation is to justify the diagonal span orientation with drilled shafts and single mast arms in the NE and SW corners of the Nebraska Avenue/Twiggs Street intersection. Final location of the mast arms will be determined by the design-build firm, however no further approval would be required if the signal spans are oriented generally in the same location as shown in the appendices.

ERC

**REASON THE DESIGN CRITERIA ARE NOT APPROPRIATE:**

**Geometric Constraints:**

- Mast arms in all four corners of the intersection are needed for a 90-degree span orientation.
- Providing dual mast arms in the NE and SW corner of the intersection will require the mast arm for the westbound signal heads to span over the eastbound lanes, and the mast arm for the eastbound signal heads will span over the westbound lanes. The line of sight for the westbound signal heads will be obstructed by the eastbound signal heads and vice-versa.
- The SE corner is occupied by an overhead sign support structure and this structure cannot be removed or relocated without causing additional impacts.
- In the SE corner, the back of curb is 6.4 feet from the limited access right-of-way, and is currently occupied by an overhead sign structure support. There is not enough physical space to provide a mast arm drilled shaft, an overhead sign support structure, and pedestrian features. Therefore, requiring a mast arm in this corner would require costly additional improvements to the road below and likely additional costly relocations and impacts to the overpass just east of the intersection.
- In the NW corner, the existing right-turn lane for southbound Nebraska Avenue is significantly offset from the intersection, creating a large raised island. Raised islands are generally not preferred locations for mast arm drilled shafts. The drilled shaft would need to be setback a significant distance from the intersection corner and the subsequent signal orientation would reduce operational efficiency of the intersection due to increased space between stop bars and increased clearance time required.

**Right-of-Way Discussion**

- Requiring a mast arm in the SE corner of the intersection would require limited access right-of-way transfer and is not feasible because of the extraordinary cost associated with impacting the Selmon Expressway including pier impacts.
- Requiring a mast arm in the NW corner would force the relocation of the overhead electric distribution and the communications/fiber optic lines. In addition, there are potential underground utility impacts such as a sanitary sewer crossing through the existing raised island.
- Neither the SE or NW intersection corners provide the necessary flexibility to the design-build firms to reasonably avoid utility conflicts or coordinate within the project schedule.
- The NW intersection corner includes property owned by the City of Tampa, which may require a right-of-way transfer or easement to incorporate a mast arm.

**Impact of Using Proposed Criteria**

- There are no adverse impacts anticipated by using the proposed criteria.
- All signal heads will meet the MUTCD minimum 40 feet between signal heads and stop bar except for the westbound right-turn lane. This right-turn lane will be supplemented with an additional post-mounted signal head on the far side of the intersection as recommended by the MUTCD. This configuration will reduce stop bar distances versus the 90-degree arrangement which improves the signal operation during peak hour and discourages red signal violations through shorter crossing times and multiple signal heads.
- The proposed criteria will remain through the useful service life of the intersection. Future improvements to Nebraska Ave could correct the deficient condition, but there are none anticipated at this time.

**SAFETY IMPACTS/REVIEW OF CRASH HISTORY:**

- Crash data and long form crash reports from November 2013 to November 2018 were reviewed.
- There were 36 crashes identified within the limits of the intersection, and no fatalities.
- One crash involved a bicyclist and no crashes involved a pedestrian. According to crash report #87529298, a bicyclist was traveling southbound along Nebraska Avenue in the outside lane, failed to stop for a red light, and collided with a vehicle traveling eastbound on Twiggs Street. No injury was reported.
- There were no crashes directly attributable to the existing diagonal signal span orientation.

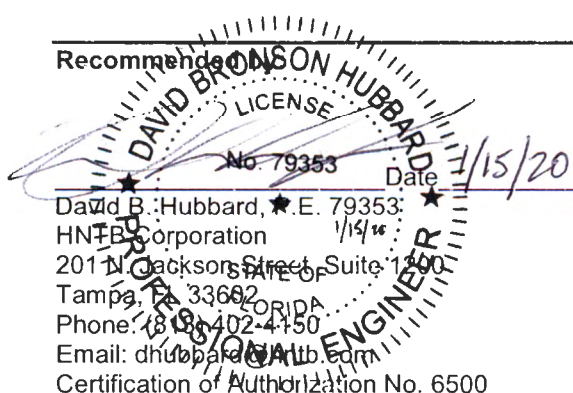
**JUSTIFICATION FOR PROPOSED CRITERIA:**

- Mast arms are required per the FDOT mast arm policy and FDM Section 232.8.1 because this intersection is within the ten-mile coastline boundary as required in the FDM and the FDOT Traffic Engineering Manual.
- Mast arm orientation is not one of the AASHTO controlling design elements and there is no other requirement except the FDM.
- The placement of a 90° mast arm configuration as required by FDM will require additional right-of-way and significant realignment of Twiggs Street resulting in additional project cost and a substantial project delay. In addition, there would be impacts to sidewalks, curb ramps and utilities as a result of the two additional mast arms.
- The proposed design meets MUTCD Part 4 highway traffic signal requirements and provides safer operation for the right-turn lane movement through the use of multiple signal heads and reduced clearance distance from the stop bar for all required vehicular movements at the intersection.
- The project improves the service life of the intersection and is a safer alternative than the existing span wire since this area is in a coastal area and within the urban boundary of Downtown Tampa. The project will maintain vehicular operations along Nebraska Avenue and Twiggs Street by operating within the existing traffic signal coordination patterns.
- The NE and SW corners offer the most flexibility to the design-build firm to avoid unnecessary utility impacts.

**CONCLUSION AND RECOMMENDATION:**

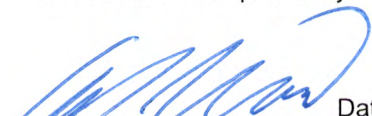
- The proposed improvements will have an immediate benefit to the traveling public and increase the service life of the intersection by improving the signals to the current FDOT Mast Arm Policy. The improvements will provide additional safety benefit from the existing conditions and will be as safe as a 90-degree span orientation through the use of supplementary signal faces. It offers flexibility to the design-build firm so the project can be designed to minimize utility impacts in this heavily access corridor. If this variation is not approved, it will result in additional utility impacts, jeopardize the project's schedule and budget, and will reduce the operational efficiency of the intersection. In addition, the potential impacts to adjacent properties and limited access right-of-way would significantly impact transportation operations critical to downtown Tampa. For these reasons, it is recommended that the Design Variation for Diagonal Mast Arm Orientation as defined in this memorandum be Approved.

Recommended by:

  
David B. Hubbard, P.E. 79353  
HNTB Corporation  
201 N. Jackson Street, Suite 1200  
Tampa, FL 33602  
Phone: (813) 402-4150  
Email: dhubbard@hntb.com  
Certification of Authorization No. 6500

Approved by:

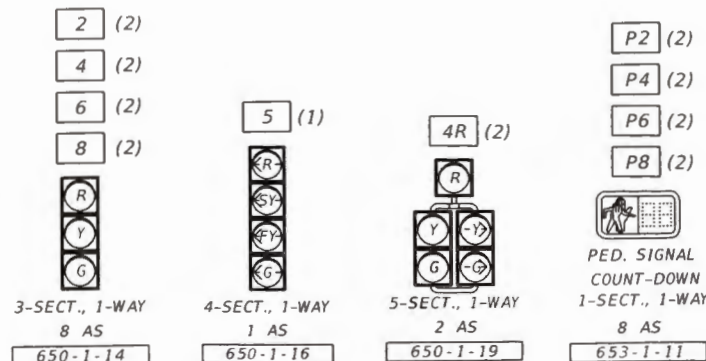
  
Date 1/14/2020  
David May, P.E.  
THEA Director of Expressway Operations

  
Date 2/7/2020  
Allan Urbonas, P.E.  
FDOT District Seven Design Engineer

DML 2/6/2020



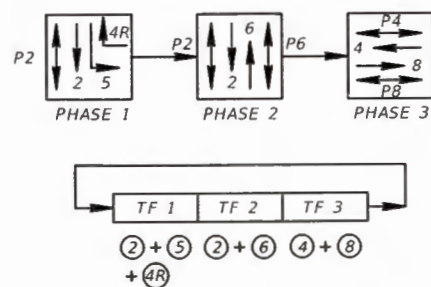
**SIGNAL HEAD DETAILS**



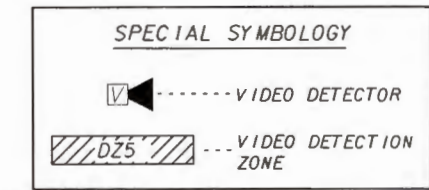
**CONTROLLER OPERATION:**

1. MAJOR STREET IS NEBRASKA AVE (MOVEMENTS 2, 5 AND 6). MINOR STREET IS TWIGGS ST (MOVEMENTS 4 AND 8).
2. FLASHING OPERATION IS YELLOW FOR NEBRASKA AVE AND RED FOR TWIGGS ST. WHEN SIGNAL IS IN FLASHING MODE, MOVEMENTS 2 AND 6 SHALL FLASH YELLOW. ALL OTHER VEHICLE MOVEMENTS SHALL FLASH RED.
3. EACH LEFT TURN MOVEMENT SHALL HAVE CONDUCTORS AVAILABLE FOR PROTECTED AND PERMISSIVE OPERATION.
4. MOVEMENT 5 WILL OPERATE IN PROTECTED/PERMISSIVE MODE.
5. SIGNAL TIMINGS TO BE ADJUSTED BY ENGINEER OF RECORD.
6. CONTROLLER SHALL OPERATE AS AN SOP 11 (MODIFIED).

**S.O.P. 11 MODIFIED**



CONTROLLER TIMINGS								
TIMING FUNCTION	1	2	3	4	5	6	7	8
MOVEMENT NUMBER	1	2	3	4	5	6	7	8
MINIMUM GREEN								
EXTENSION								
MAXIMUM GREEN 1								
MAXIMUM GREEN 2								
YELLOW CLEARANCE								
ALL RED								
PEDESTRIAN WALK								
PED. CLEARANCE								
RECALL								



VIDEO DETECTOR CHART		
VIDEO DETECTOR	DETECTION ZONE	DELAY TIME (SECS)
VD 2	DZ 2	
	DZ 5	
VD 4	DZ 4	
	DZ 4R	5
VD 6	DZ 6	
VD 8	DZ 8	

NOTE:  
\* RELOCATE EXISTING RSU TO THE PROPOSED MAST ARM  
\*\* ALL EXISTING DEVICES ON EXISTING CONCRETE STRAIN POLE AT SOUTHWEST CORNER SHALL BE MOVED TO THE PROPOSED MAST ARM POLE.

**INTERNALLY ILLUMINATED DUAL FACED SIGNS**

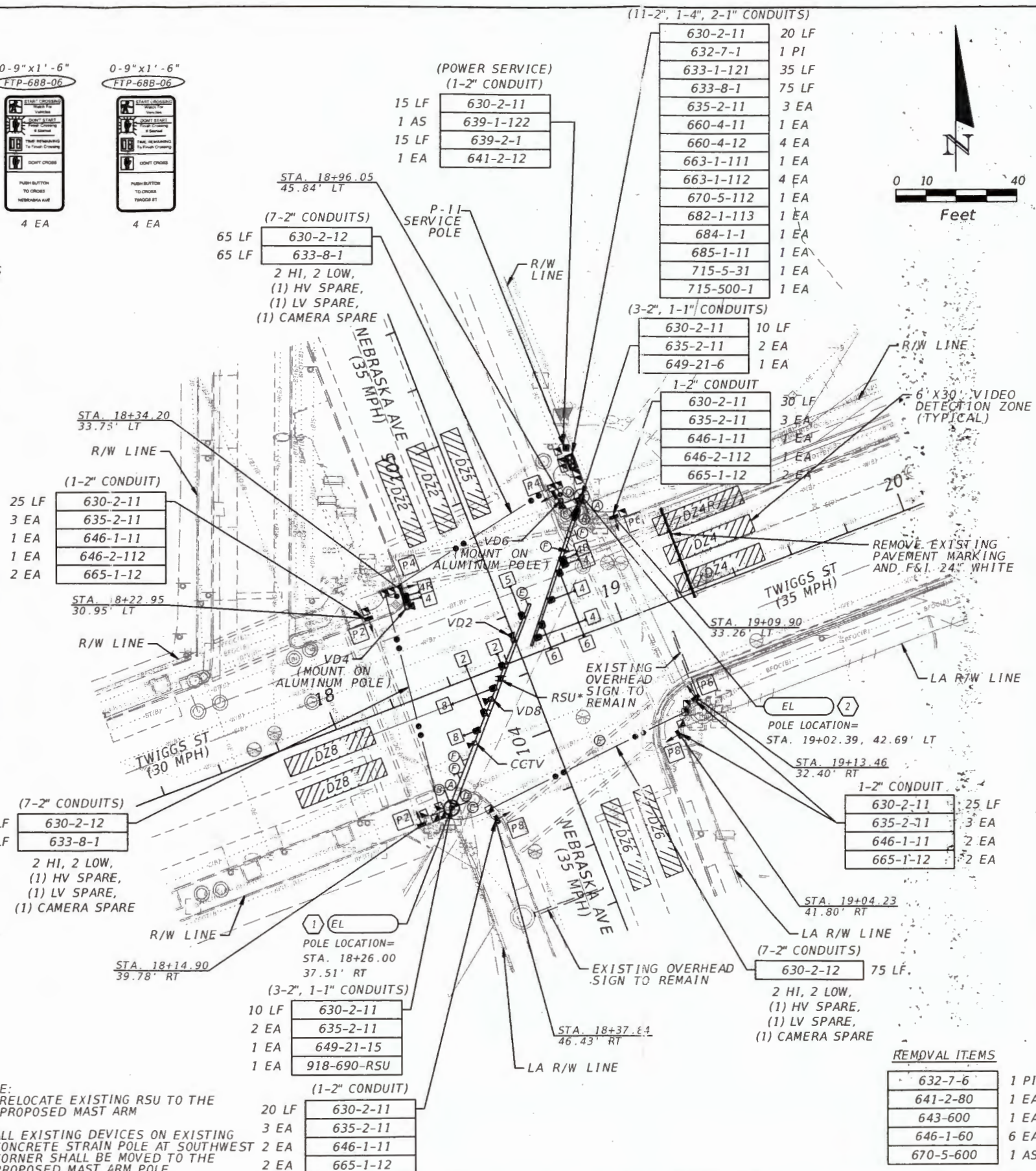


**APPENDIX A  
SIGNAL CONCEPT  
PLANS**

TAMPA HILLSBOROUGH EXPRESSWAY AUTHORITY		
ROAD NO.	COUNTY	FINANCIAL PROJECT ID
	HILLSBOROUGH	

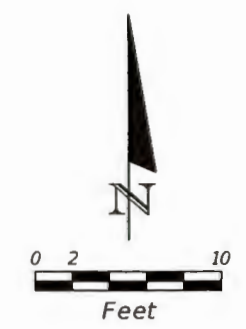
**TWIGGS ST AT NEBRASKA AVE  
SIGNAL CONCEPT**

SHEET NO.  
1

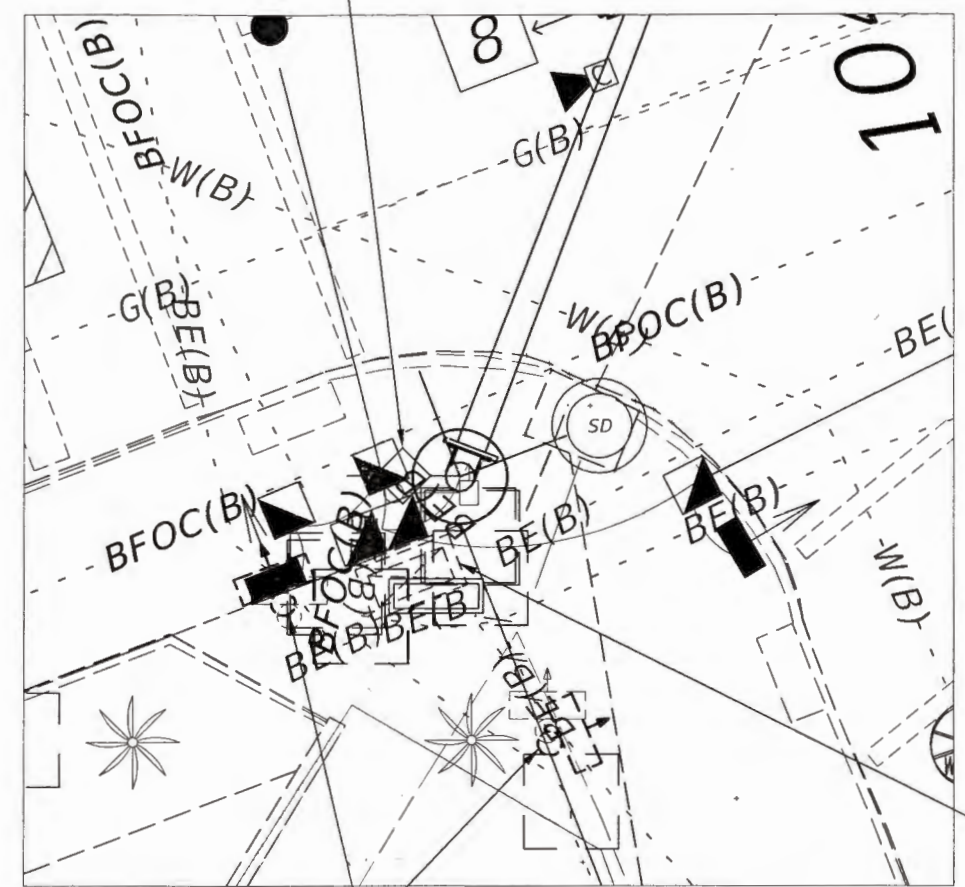


REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION





EXIST. SIGNAL POLE  
TO BE REMOVED

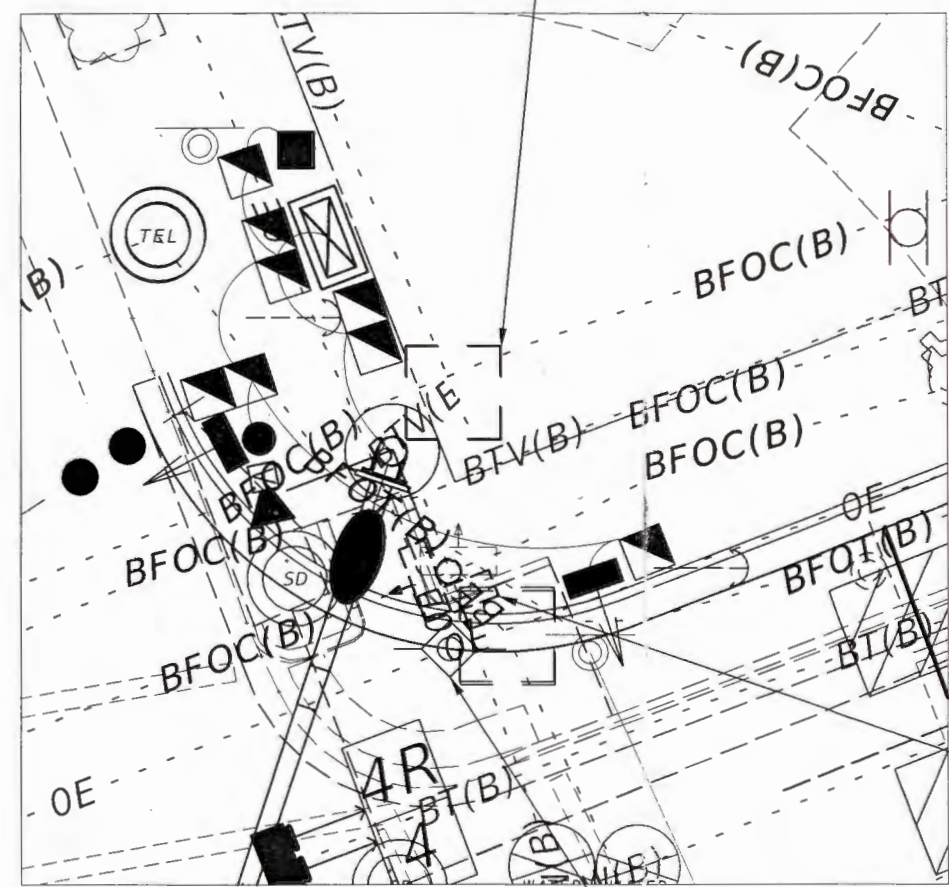


EXIST. PED POLES  
TO BE REMOVED

POLE 1 (SW CORNER)

EXIST. CONTROLLER  
CABINET TO BE  
REMOVED

EXIST. FIBER OPTICS  
PULL BOX TO BE  
RELOCATED



EXIST. PED POLE  
TO BE REMOVED

EXIST. WOODEN SIGNAL  
POLE TO BE REMOVED

POLE 2 (NE CORNER)

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

**APPENDIX A  
SIGNAL CONCEPT  
PLANS**

TAMPA HILLSBOROUGH EXPRESSWAY AUTHORITY		
ROAD NO.	COUNTY	FINANCIAL PROJECT ID
	HILLSBOROUGH	

**TWIGGS ST AT NEBRASKA AVE  
SIGNAL DETAIL**

SHEET NO.
2





Approximate Drill Shaft Location

Approximate Drill Shaft Location

APPENDIX B  
PROJECT  
LOCATION MAP

Google Earth

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200 ft