

Mr. Peter Hsu, P.E.
District Safety and Special Projects Engineer
Florida Department of Transportation, District 7
11201 North McKinley Drive
Tampa, FL 33612-6403



RE: Financial Project I.D. 254494-1-32-21
Curve Studies – Various Locations
Pasco County, Florida

April 17, 2014

Dear Mr. Hsu:

Enclosed please find the Curve Studies Technical Memorandum for the above referenced project, which has been provided for the Department's review and approval.

As always, please feel free to contact me at (813) 498-5118 or by e-mail at squevedo@HNTB.com if you have any questions regarding this project.

Sincerely,

A handwritten signature in blue ink, appearing to read "S. Quevedo". The signature is stylized and cursive.

Sergio Quevedo, PE, PTOE
Project Manager

Enclosures

Cc: Project File

To: Peter Hsu, P.E., District Safety and Special Projects Engineer

Date: April 17, 2014

Financial Project ID: 254494-1-32-21

Project Name: Curve Studies – Pasco County

State Road Number: various Co./Sec./Sub. various

Begin Project MP: various End Project MP: various

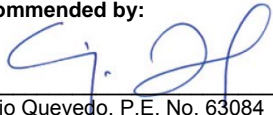
Full Federal Oversight: Yes () No (X)

The project includes performing curve studies on the curves of three roadways within Pasco County. This involves determining if the current advisory speeds within the curves are set appropriately and also evaluating the existing curve signing to determine if it meets current standards and guidelines.

According to criteria set forth by the Institute of Transportation Engineer's (ITE's) **Manual on Transportation Engineering Studies**, the advisory speeds for the curves are set in accordance with current standards for all of the roadways evaluated except for one. The study found that the posted advisory speeds for curves on Sea Forest Drive should be reduced. New advisory speeds are proposed for several of the curves on these roadways as detailed within this Technical Memorandum.

According to the guidelines set forth by the Federal Highway Administration's (FHWA's) **Manual on Uniform Traffic Control Devices** (MUTCD), the curve signing for several of the curves does not comply with current standards. A Signing and Pavement Marking Design is proposed to modify the existing curve signing at these locations as detailed within the summary matrix.

Recommended by:



Date 4/17/2014

Sergio Quevedo, P.E. No. 63084

Approvals:

Date _____

Peter Hsu, P.E.
District Safety and Special Projects Engineer

Date _____

Bill Riha
Project Manager

CURVE STUDIES

Pasco County, Florida
Various Locations

FOR

FLORIDA DEPARTMENT OF TRANSPORTATION
DISTRICT 7



Prepared By:

HNTB

One Tampa City Center
201 N. Franklin Street, Suite 550
Tampa, Florida 33602

April 2014

Engineer of Record:

A handwritten signature in blue ink, appearing to read "S. Quevedo", is written over a horizontal line.

Sergio Quevedo,
P.E. No. 63084

Date 4/17/2014

To: Peter Hsu, P.E.
District Safety and Special Projects Engineer

Date: April 17, 2014

RE: Pasco County Curve Studies

SUMMARY OF ATTACHMENTS

- Summary Matrix
- Curve Location Maps

PROJECT DESCRIPTION

The Florida Department of Transportation – District Seven has retained HNTB as part of a District-Wide Traffic Operational Studies and Design Project to perform curve studies for the following three roadways in Pasco County:

- Perrine Ranch Rd from Meadowood Dr to CR77/Seven Springs Blvd
- Old Lakeland Hwy from Clinton Ave to CR 54
- Sea Forest Dr from Main St to Marine Pkwy

These locations were chosen for further study due to the number of crashes that have occurred along curves on these roadways in recent years. A map of the high risk rural road curves is located in Appendix B. The purpose of the studies is to determine if the advisory speeds are set appropriately on the curves and if the curve signing is in compliance with the latest guidelines.

The analysis methods used in conducting these studies are consistent with those set forth in the Federal Highway Administration's (FHWA's) *Manual on Uniform Traffic Control Devices* (MUTCD), the Florida Department of Transportation's (FDOT's) *Manual on Uniform Traffic Studies* (MUTS), and the Institute of Transportation Engineer's (ITE's) *Manual on Transportation Engineering Studies*.

The following sections of this technical memorandum discuss the **Analyses** for the curve studies, and document the **Conclusions** reached as a result of the studies.

DESCRIPTION OF SPEED ANALYSIS

Curve studies were performed by HNTB for the curves on three roadways within Pasco County. They were performed in accordance with ITE's *Manual on Transportation Engineering Studies*. The average indicator readings for the study speeds were calculated for traffic traveling in both directions and compared to the recommended criteria.

Advisory speeds for the curves on each of the roadways were determined using the ball-bank indicator method. This method involves driving a test vehicle equipped with a ball-bank indicator through the curve to determine at which speed the average reading falls within the acceptable range.

The specific criteria used for the speed limits of the curves within Pasco County are detailed in the table below. The recommended criteria are referenced from ITE's *Manual on Transportation Engineering Studies* Exhibit 18-29.

BALL-BANK RECOMMENDED CRITERIA

STUDY SPEED	MAX BALL-BANK READING	LATERAL ACCELERATION
≤ 20 mph	16°	0.28
25-30 mph	14°	0.24
≥ 35 mph	12°	0.21

According to the collected data, there was one roadway that contained curves in which the posted speed limits did not meet the recommended criteria. The ball-bank indicator tests found that the posted advisory speeds on the following curves should be reduced:

- Sea Forest Drive – curves 1 through 4

A matrix that details the speeds and ball-bank readings for each curve studied is included as an attachment to this technical memorandum.

DESCRIPTION OF SIGNING ANALYSIS

A signing evaluation was performed for the curves on the three roadways in Pasco County. The evaluation involved ensuring that the existing signing for the curves is in accordance with FHWA's *Manual on Uniform Traffic Control Devices* (MUTCD). The signing falls into four main types: curve warning signs, advisory speed signs, chevrons, and large arrow signs. The MUTCD details the signs that are required or recommended for each of the conditions and their required placement. Depending on the posted speed limit on the roadway, the advisory speed on the curve, and the difference between the posted speed limit and advisory speed, different signing is required by the MUTCD.

The signing evaluation found the following requirements and recommendations from the MUTCD.

- All curves with advisory speeds should have curve warning signs (W1-1, W1-2, W1-3, or W1-4) with advisory speed plaques (W13-1P).
- Curves with advisory speeds of 30 mph or less should have W1-1 or W1-3 signing instead of W1-2 or W1-4 signing.
- Where two curves are separated by a tangent distance of 600 feet or less, a W1-3 or W1-4 should be used instead of multiple W1-1 or W1-2 signs.
- Where three or more curves are each separated by a tangent distance of 600 feet or less, a W1-5 sign may be used instead of multiple W1-1 or W1-2 signs.
- Chevrons (W1-8) and/or large arrow (W1-6) signs should be posted on curves where the difference between the advisory speed and the posted speed is 10 mph or greater.



Further signing and pavement marking enhancements recommended for the curves studied due to their crash history are:

- Install reflective post strips on all curve signing.
- Install solar-powered speed feedback signing in conjunction with curve warning signs.
- Install reflective pavement markers at 20' spacing on the striping within the curves.

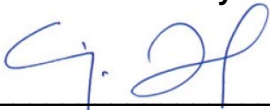
The matrix attached to this technical memorandum details the recommended signing changes for each curve studied.

SUMMARY CONCLUSIONS

Based on the results of the speed analysis, signing analysis, and engineering judgment, the following conclusions were reached:

1. The advisory speed should be posted at 20 mph for curve 1 through 4 on Sea Forest Drive.
2. Solar-powered 'Your Speed' speed feedback signs should be posted in conjunction with the curve warning signs on all curves with advisory speeds.
3. Reflective pavement markers should be installed at 20' spacing on the striping within the curves.
4. Reflective post strips should be installed on all curve signing.

Recommended by:



Sergio Quevedo, P.E. No. 63084

Date 4/17/2014

HNTB Corporation
One Tampa City Center
201 N. Franklin Street, Suite 550
Tampa, FL 33602
CA # 6500

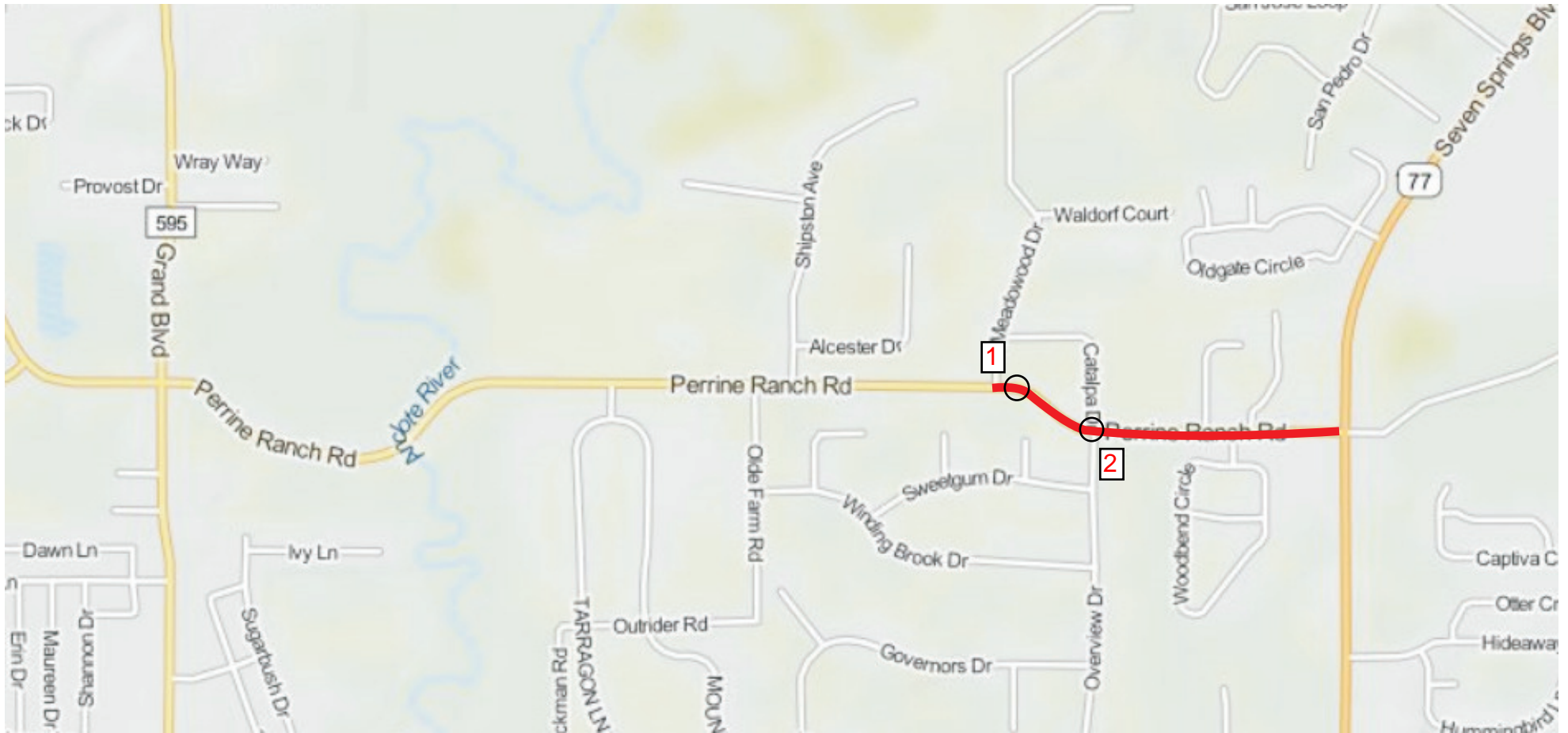
APPENDIX A
SUMMARY MATRIX

Curve Study Summary Matrix

Location	Curve	Direction of Travel	Speed Limit (mph)	Existing Advisory Speed (mph)	Study Speed (mph)	Ball-Bank Readings (degrees)			Average Reading (degrees)	Maximum Allowable Reading (degrees)	Within Range (Y/N)	Curve Advisory Speed Recommendations	Existing Curve Signing	Curve Signing Recommendations	RPM Recommendations
Perrine Ranch Rd from Meadowood Dr to CR77/ Seven Springs Blvd	1	EB	30	25	25	10	9	9	9.3	12	Y	None	W1-3R and 25mph W13-1P	Add Speed Feedback Sign	Install RPM's at 20' spacing on striping
		WB	30	25	25	11	10	11	10.7	12	Y	None	None	None	Install RPM's at 20' spacing on striping
	2	EB	30	25	25	11	11	12	11.3	12	Y	None	None	None	Install RPM's at 20' spacing on striping
		WB	30	25	25	9	8	8	8.3	12	Y	None	W1-3R and 25mph W13-1P	Add Speed Feedback Sign	Install RPM's at 20' spacing on striping
Old Lakeland Hwy from Clinton Ave to CR 54	1	NB	50	None	45	2	3	3	2.7	10	Y	None	None	None	None
		SB	50	None	45	3	2	2	2.3	10	Y	None	None	None	None
	2	NB	55	None	50	6	4	3	4.3	10	Y	None	None	None	None
		SB	55	None	50	5	3	3	3.7	10	Y	None	None	None	None
	3	NB	55	45	50	5	5	6	5.3	10	Y	None	W1-2R and 45mph W13-1P	Add Speed Feedback Sign	Install RPM's at 20' spacing on striping
			40	3	3		3.0	10	Y						
		SB	55	45	50	7	5	5	5.7	10	Y	None	W1-2R and 45mph W13-1P	Add Speed Feedback Sign	Install RPM's at 20' spacing on striping
	4	NB	55	None	50	6	4	3	4.3	10	Y	None	None	None	None
			55	None	50	6	3	4	4.3	10	Y	None	None	None	None
	5	NB	55	None	50	5	4	5	4.7	10	Y	None	W1-2L	None	None
		SB	55	None	50	5	3	4	4.0	10	Y	None	W1-2R	None	None
	6	NB	55	None	50	7	4	4	5.0	10	Y	None	W1-2R	None	None
		SB	55	None	50	5	3	4	4.0	10	Y	None	W1-2L	None	None

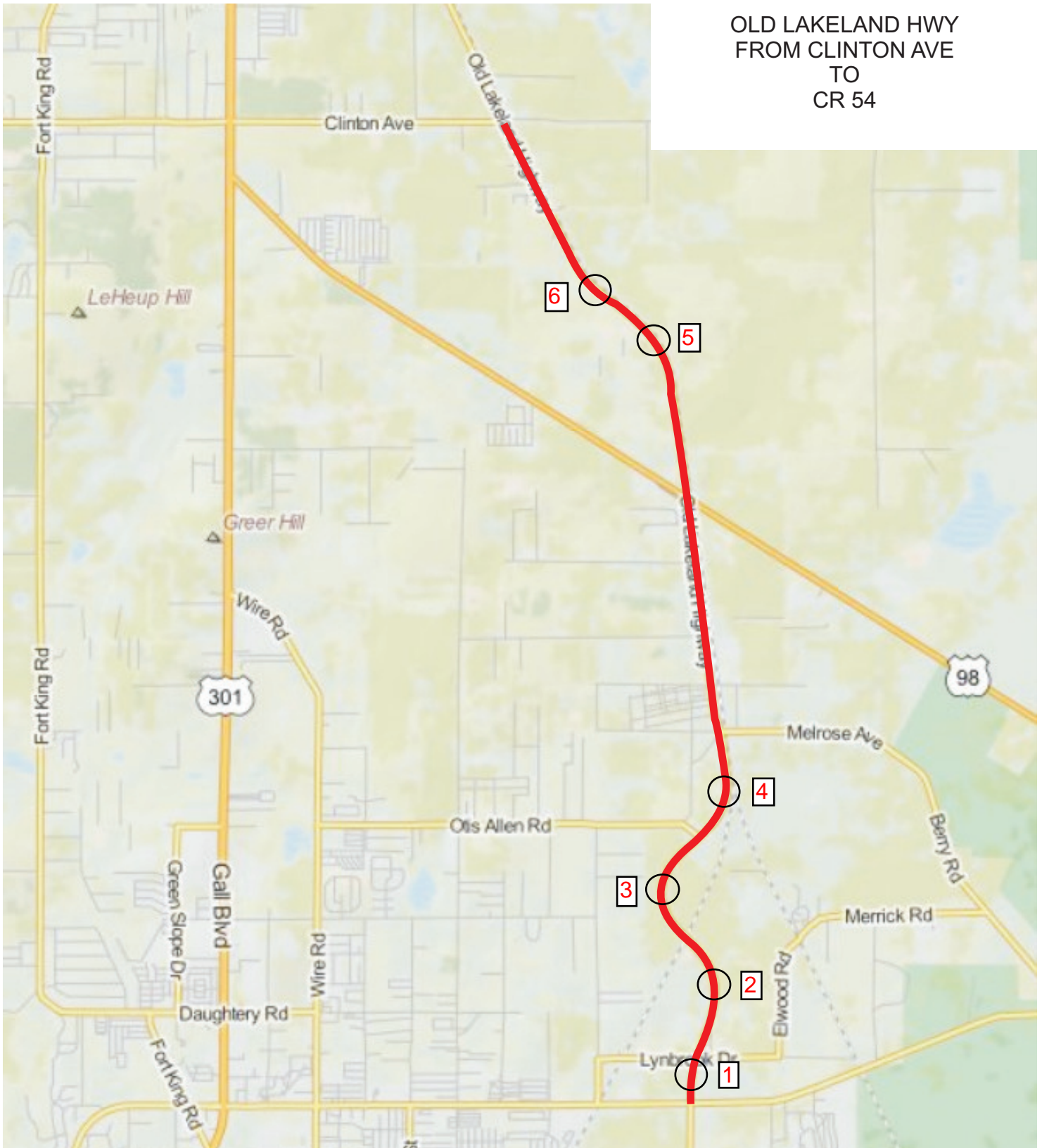
APPENDIX B
CURVE LOCATION MAPS

PERRINE RANCH RD
FROM MEADOWOOD DR
TO
Cr77



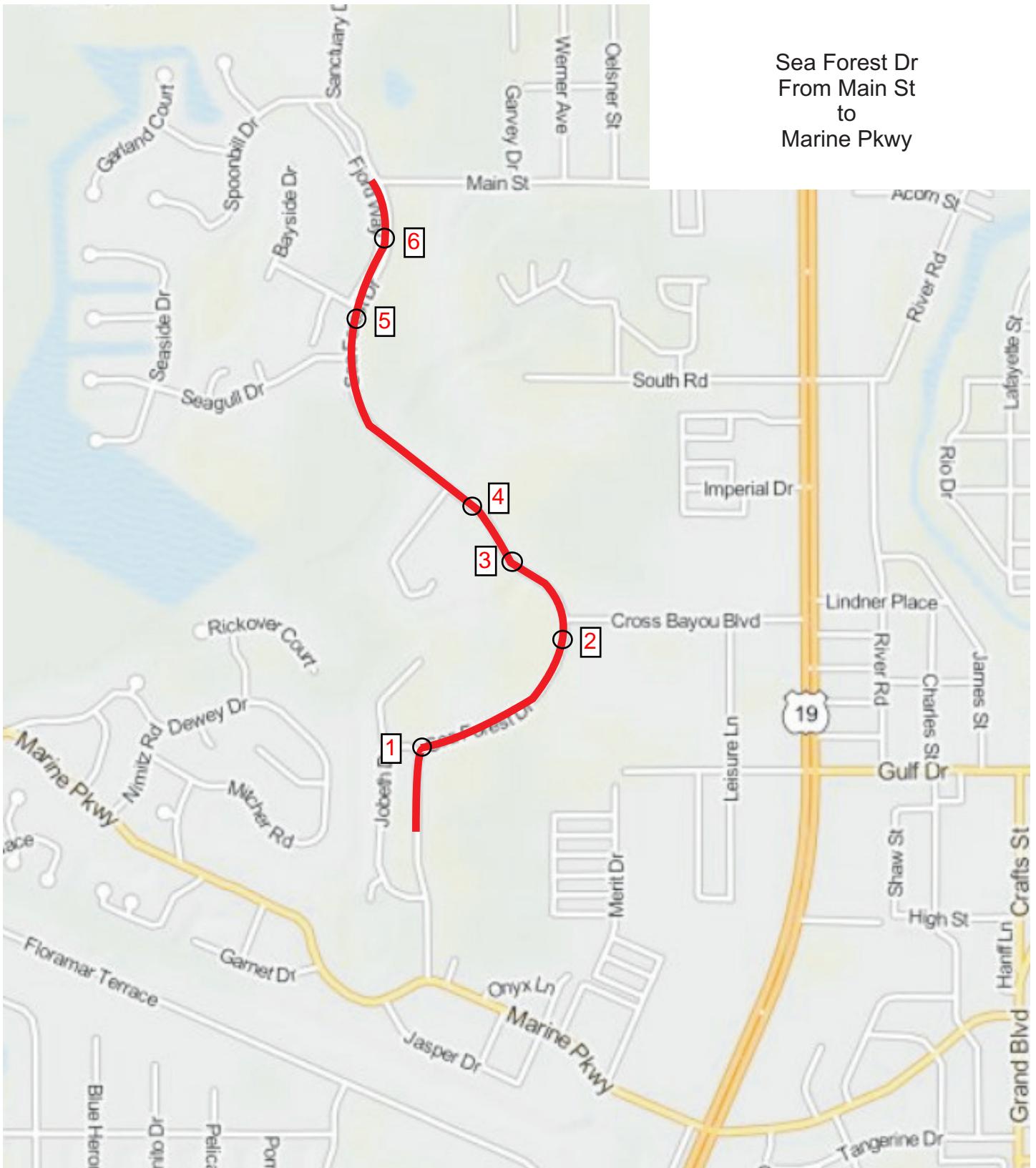
PASCO COUNTY TRAFFIC OPERATIONS			
PROJECT NAME		PERRINE RANCH RD	
WO#	0	DATE	3/19/2014
		SHEET #	1 OF 1
PREPARED BY	M Bunk		
CHECKED BY	R Reck		

OLD LAKELAND HWY
FROM CLINTON AVE
TO
CR 54



PASCO COUNTY TRAFFIC OPERATIONS			
PROJECT NAME		OLD LAKELAND HWY	
WO#	0	DATE	3/18/2014
		SHEET #	1 OF 1
PREPARED BY	M Bunk		
CHECKED BY	R Reck		

Sea Forest Dr
From Main St
to
Marine Pkwy



PASCO COUNTY TRAFFIC OPERATIONS			
PROJECT NAME		SEA FOREST DR	
WO#	0	DATE	3/19/2014
		SHEET #	1 OF 1
PREPARED BY	M Bunk		
CHECKED BY	R Reck		