SITE ANALYSIS AND JUSTIFICATION

COLUMBIA COUNTY

TASK 3 AND 4 REPORT SUPPLEMENT-1

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1. INTRODUCTION

SCOPE AND PURPOSE

The Florida Department of Transportation (FDOT) is committed to improving safety on all public roads. There is a greater emphasis and need to assist small communities in Florida that experience a disproportionate number of crashes. Available federal funds require data-driven processes and technical justification that are often beyond the capacity and resources of small agencies. The Transportation Safety Center (TSC) at the University of Florida's T2 Center has successfully assisted three counties to date by developing a systematic and systemic procedure to produce the necessary data and justifications. This report documents the safety study for selected road segments and intersections in Columbia County.

STUDY SITES

The TSC team initially examined crash information from two sources: the FDOT Safety Portal and Signal Four Analytics. The team also discussed the safety problems with a number of Columbia County stakeholders. The preliminary study sites were drawn from three sources:

- Sites recommended by Lake City Police Department
- Sites recommended by County's Engineering and Public Works Department
- Sites identified from crash data portals.

Reviewing the sites recommended by the Lake City Police Department (PD) revealed that most sites included intersections on US-90, which is maintained by the FDOT. TSC's focus is limited to local and county roads; however, these locations within the FDOT jurisdiction were recommended to be included in the County's Local Road Safety Plan (LRSP) for stakeholder discussion at Community Traffic Safety Team (CTST) meetings and for FDOT consideration.

Columbia County's Engineering and Public Works Department recommended 14 sites (Table 1) for the TSC program. Ten sites, shown in Figure 1, are county or local roads discussed in detail in this document. The four sites shown in Figure 2 were recommended for LRSP because they are within FDOT's State Highway System and would require further review and action from FDOT.

For categorization purposes, the report segregates the sites based on resources required for improvement. Locations that require fewer resources that may be within the capacity of the county (low cost, maintenance related, etc.) are termed as sites for immediate implementation, and sites that require more resources and which would qualify for HSIP funding are included under Future Implementation.

It must be noted that throughout this report, "correctable" crashes refers to crashes where the recommended countermeasures have crash modification factors available. This does not directly mean that the crashes could be or will be corrected or mitigated. It implies that with the countermeasures installed, the risk of a similar crash occurring would be reduced. In addition, the figures are for reference purpose only and are not to scale. Measurements were extracted using either the Google Earth ruler tool or by ArcGIS generic algorithm approaches, both of

which need to be validated with detailed surveys.

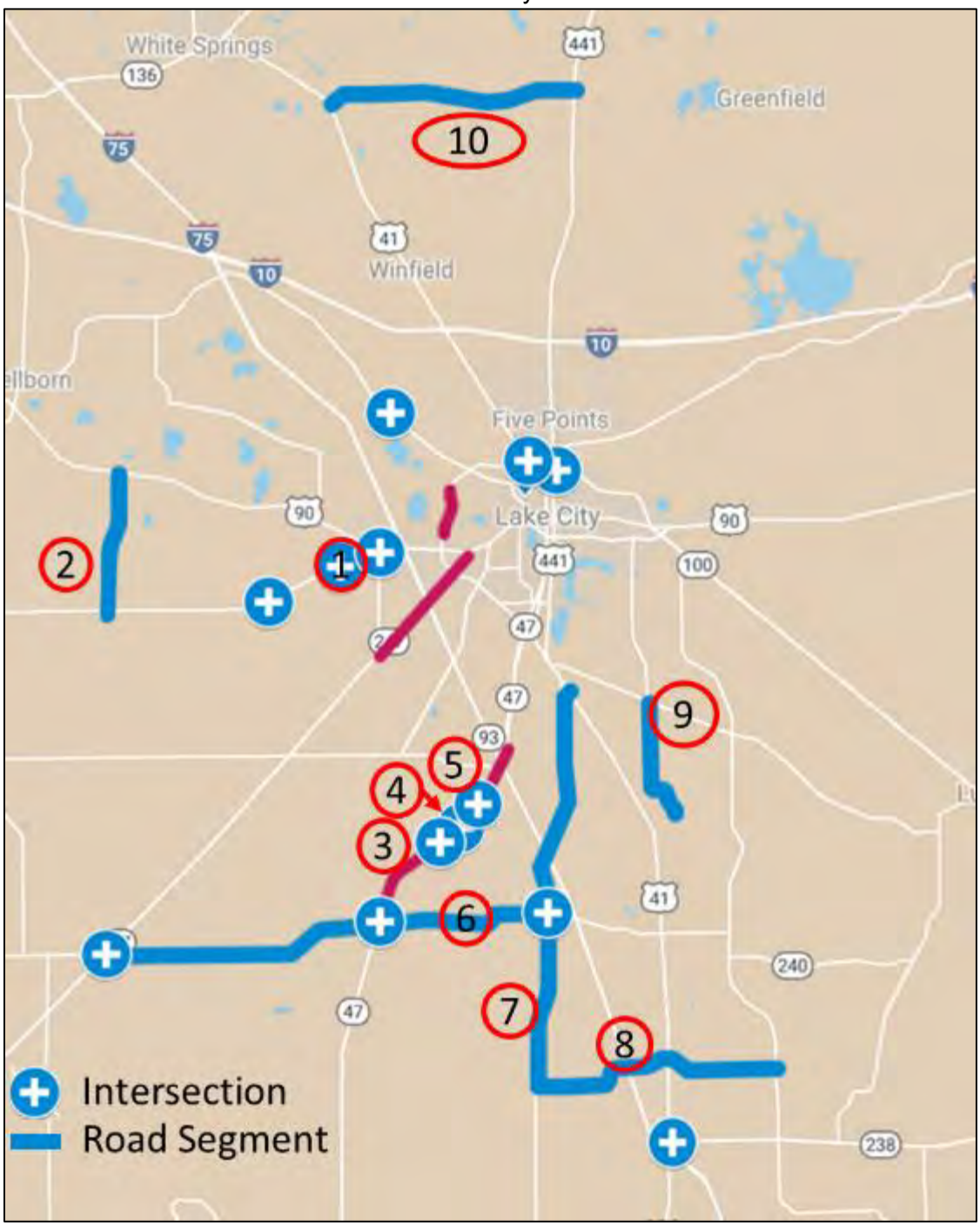


Figure 1. Columbia County Sites for Immediate Implementation

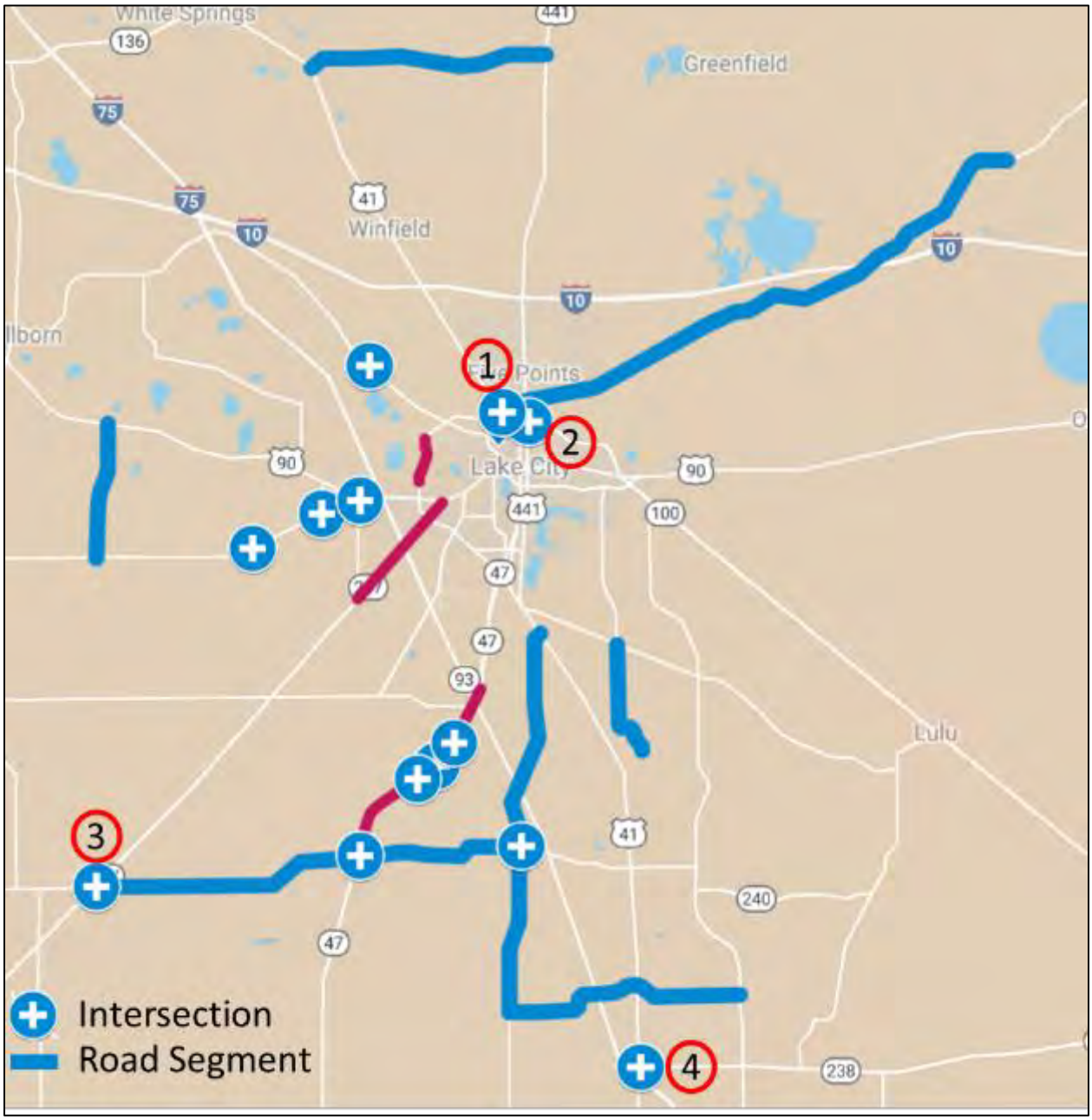


Figure 2. Columbia County Sites for Future Implementation

Table 1. Columbia County, Sites

	Site #	Site
Primary Locations	1	Southwest Deputy J Davis Lane & CR-252B
	2	CR-252A from CR-252 to SR-10
	3	SR-47 & Walter Little Road
	4	SR-47 & Brentwood Way[1]
	5	SR-47 & Wester Road[1]
	6	CR-240 from SR-247 to CR-131
	7	CR-131 from Buckley to US-41
	8	CR-349 from CR-131 to CR-245
	9	SE Country Club Road (CR-133) from Alfred St to CR-252
	10	CR-246 from US-41 to US-441
Secondary Locations	1	US-41 & NW Bascom Norris Drive
	2	US-441 & NE Bascom Norris Drive
	3	SR-247 & CR-240
	4	US-441 & SR-238

Primary locations included sites for initial consideration. Secondary locations included sites that were within FDOT jurisdiction.

[1] Two of the SR-47 sites are within the jurisdiction of FDOT. We included them in the study because they were viable candidates for HSIP and also addressed access to the intersecting county roads. Based on subsequent information we received from FDOT, we learned that these are already being addressed by FDOT.

2. STUDY METHODOLOGY

STUDY TEAM

The analysis was conducted generally following the principles of the FHWA Road Safety Audit Guidelines[2]. The FHWA process calls for a multidisciplinary team to provide input throughout the process. There were several stakeholders that assisted the project in various capacities. The following is a list of all stakeholders that provided assistance and input.

FDOT

- Mr. Joe Santos, P.E., State Transportation Safety Engineer
- Mr. Jeff Scott, P.E., District 2 Traffic Services Program Engineer
- Mr. Mario Dipola, P.E., District 2 Safety Engineer

Columbia County

- Mr. Ben Scott, County Manager
- Mr. Chad Williams, P.E., County Engineer

UF Transportation Safety Center (TSC)

- Dr. Nithin Agarwal, Project PI
- Dr. Siva Srinivasan, UF Faculty and Co-PI
- Dr. Ilir Bejleri, UF Faculty and Co-PI
- Dr. Roozbeh Rahmani, Post-doctoral Scholar
- Dr. John Goodknight, TSC Consultant

Columbia County Community Traffic Safety Team (CTST)

- Ms. Andrea Atran, FDOT
- Ms. Shayne Morgan, Columbia County Emergency Management
- Ms. Jacqueline Martin, Florida Department of Health
- Mr. Troy Roberts, FDOT
- Ms. Katherine Rhoden, Century
- Mr. H. K. Weaver, Suwannee County Sheriff's Office (SCSO)
- Mr. Jeremy Gifford, Hamilton County
- Ms. Holly LeFebvre, Florida Department of Health
- Mr. Morris Sherman, Wells, Florida, Safe Routes to School (SRTS)
- Capt. Mike Burroughs, Florida Highway Patrol (FHP)
- Ms. Jennifer Graham, FDOT

DATA SOURCES AND APPROACH TO DATA COLLECTION

This section provides a list of data that were retrieved and their sources.

[2] https://safety.fhwa.dot.gov/rsa/guidelines/documents/FHWA_SA_06_06.pdf, accessed September 3, 2018

CRASH DATA

In selecting sites for the study, the team reviewed historical crash records and police reports for sites or corridors where crash risks could be reduced. Crash records for the period from Jan. 1, 2013, through Dec. 31, 2017, were used for the analysis in this study. Even though the team had access to the FDOT Crash Data Portal, Signal Four Analytics data were used because the source data (from DHSMV) was the same and Signal Four Analytics has the built-in features to produce graphs and maps showing locations of fatalities, clusters of crashes, and sites where there appeared to be an unusual concentration of a specific crash type.

ROADWAYS AND BRIDGES DATA

To gather roadway characteristics and field conditions data, to the extent practical, the team used data obtained from public sources before conducting field reviews. Field studies were conducted on candidate sites, and video data were gathered by vehicle dash camera. The photographs in this report were mostly obtained from screenshots from these dashcam videos. Where appropriate angles were not found, Google Street view screenshots supplemented our data.

Roadway data were retrieved from FDOT RCI GIS shape files. TSC also used data from a recently completed UF research project for FDOT which located all the curves and intersections in the county and estimated associated characteristics through Python programing in ArcGIS.

In addition, data on road jurisdiction and rural/urban attributes were compiled. For road jurisdiction, there were six fields: Interstate, U.S. Highway, State, County, Local, and Off-system. The base network selected was NAVTEQ street map, and the road data from FDOT GIS data directory were used as a reference. For rural/urban classification, there were two fields: urban and rural. Since there are several ways to classify urban and rural areas, the team determined that the FHWA adjusted urban boundary was better suited because it designates boundaries of a census urban/urbanized area which are adjusted to be more consistent with transportation needs. The team also compiled the National Bridge Inventory (NBI) data from FHWA. The metadata link below provides information on each field of that file. The field for Bridge Condition ranks bridges in Good, Poor, or Fair condition, which was used in our analysis to identify risk factors and also for countermeasure recommendation.

- NBI data https://www.fhwa.dot.gov/bridge/nbi.cfm
- Metadata: https://www.fhwa.dot.gov/bridge/nbi/format.cfm

Estimates and approximate locations of features like signs, guardrails, and paving were considered adequate for estimating costs, but more detailed survey work will be required to obtain the information necessary to develop construction plans and quantities.

DATA FROM COUNTY

The Columbia County engineer provided access to several datasets including recent transportation projects completed between 2008-2016, traffic counter data, bridge data, 911 call center data of traffic accidents, and county roadway. These data were combined with the FDOT GIS shape file along with the curve and intersection database file for further analysis.

DATA FROM STATE

The FDOT Safety Office provided access to AADT estimates (in 2015 ARBM) for this study; however, another dataset was available from the FDOT GIS data website. Because we received some probe data from the Columbia County engineer to serve as ground truth, a correlational analysis was conducted to compare the two datasets. There were 235 traffic counts from the local traffic counters from Columbia, of which 215 AADT values were greater than 0. Ignoring the 0 value counts, it was found that the correlation with the local traffic counter data and the FDOT website data was 0.34, with 46 counting observations matched. In comparison, the correlation with the local and the ARBM data received from the Safety Office was 0.59, with 215 counting observations matched. It can be inferred that the quality of the AADT in ARBM was better so we used this dataset in our analysis.

STUDY PROCESS

This study generally adopted the Highway Safety Manual (HSM) process in identifying safety issues and quantifying through benefit-cost analysis. Four main steps adopted by HSM are:

1. Network Screening
2. Data Analysis
3. Problem Identification and Countermeasure Selection
4. Benefit-cost analysis.

Figure 3 provides an overview of the each step and the different sources that contributed to collecting or processing data:

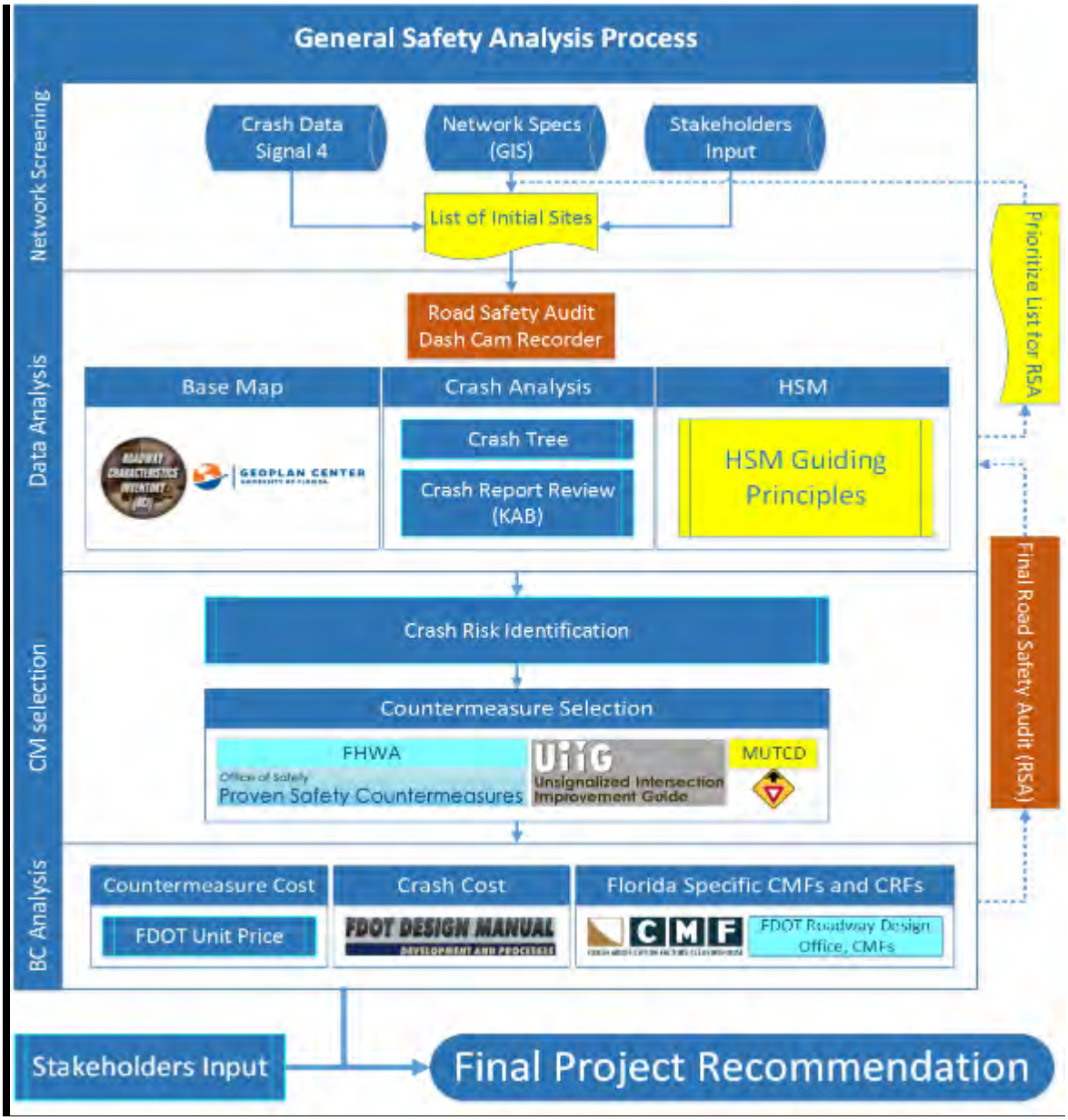
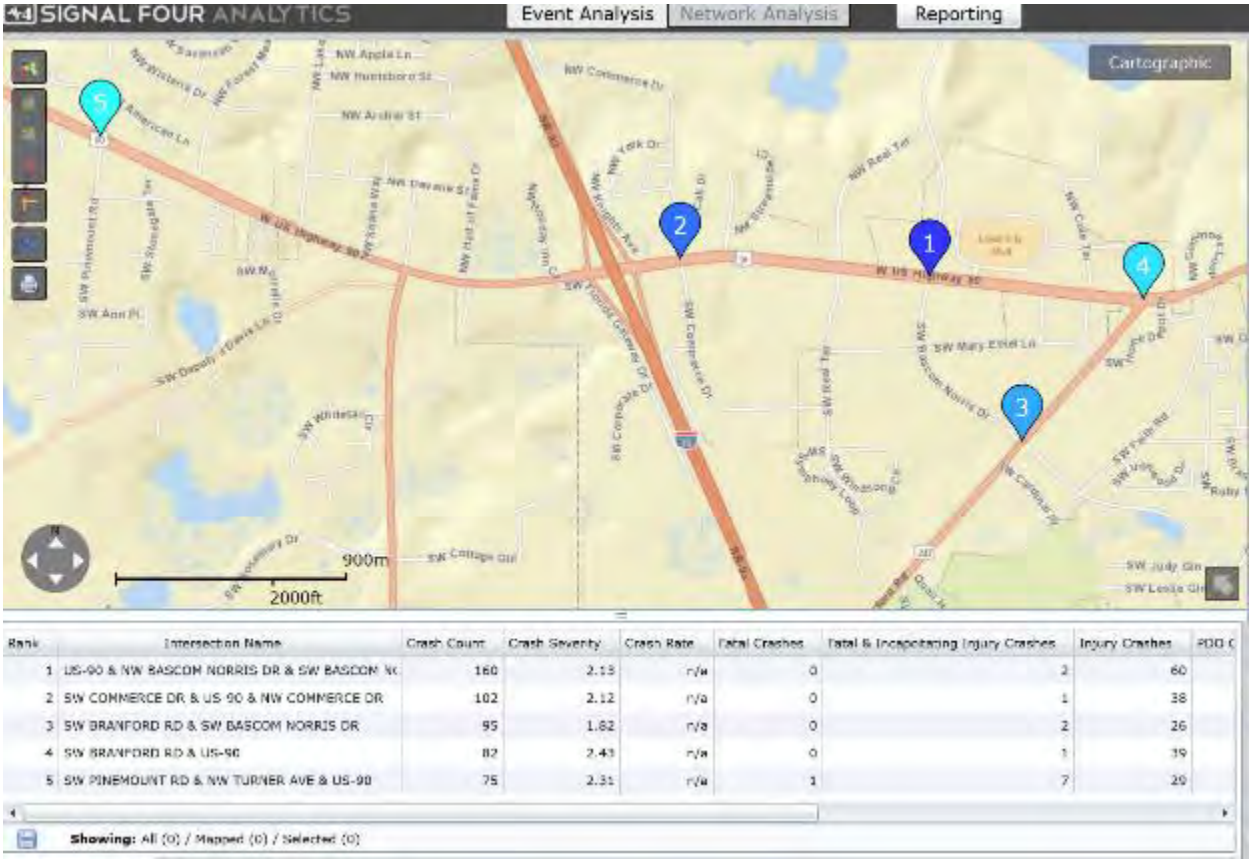


Figure 3. Identification and Quantification of Safety Projects

Network Screening

Network Screening is used to identify sites most likely to benefit from safety improvements. It is a process for reviewing a transportation network to identify and rank sites from most likely to least likely to realize a reduction in crash frequency with implementation of a countermeasure. Those sites identified as most likely to realize a reduction in crash frequency are studied in more detail to identify crash patterns, contributing factors, and appropriate countermeasures. Several datasets, including crash data, GIS data, and stakeholder inputs, were used for network screening purposes. Several of the historically high crash locations coincided with the locations suggested by the county officials and other stakeholders.

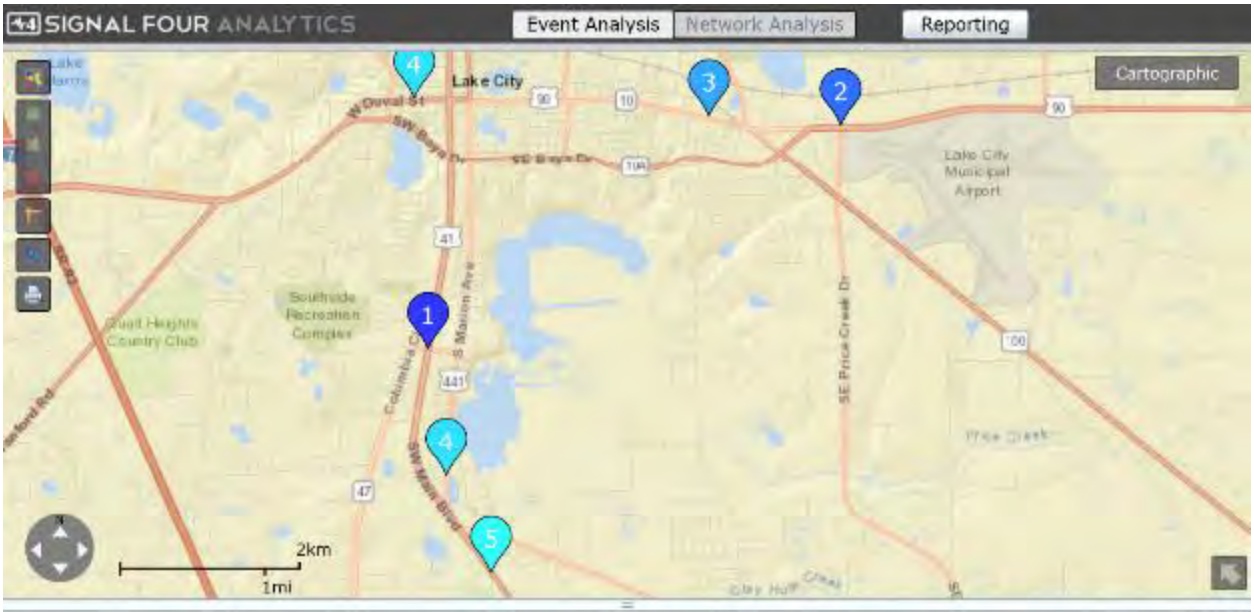
Signal Four Analytics's network screening tool was used to initially screen the county network. Figure 4 shows the top five intersections for crash count between 2013 and 2017. Four of the five locations were at an intersection of state highway system (US-90). SW Bascom Norris Drive was selected for further review.



Rank	Intersection Name	Crash Count	Crash Severity	Crash Rate	Fatal Crashes	Fatal & Incapacitating Injury Crashes	Injury Crashes	PDO C
1	US-90 & NW BASCOM NORRIS DR & SW BASCOM N	160	2.13	n/a	0	2	60	
2	SW COMMERCE DR & US 90 & NW COMMERCE DR	102	2.12	n/a	0	1	38	
3	SW BRANFORD RD & SW BASCOM NORRIS DR	95	1.82	n/a	0	2	26	
4	SW BRANFORD RD & US-90	82	2.43	n/a	0	1	19	
5	SW PINEMOUNT RD & NW TURNER AVE & US-90	75	2.31	n/a	1	7	20	

Figure 4. Top 5 intersections by Crash Count between 2013 and 2017

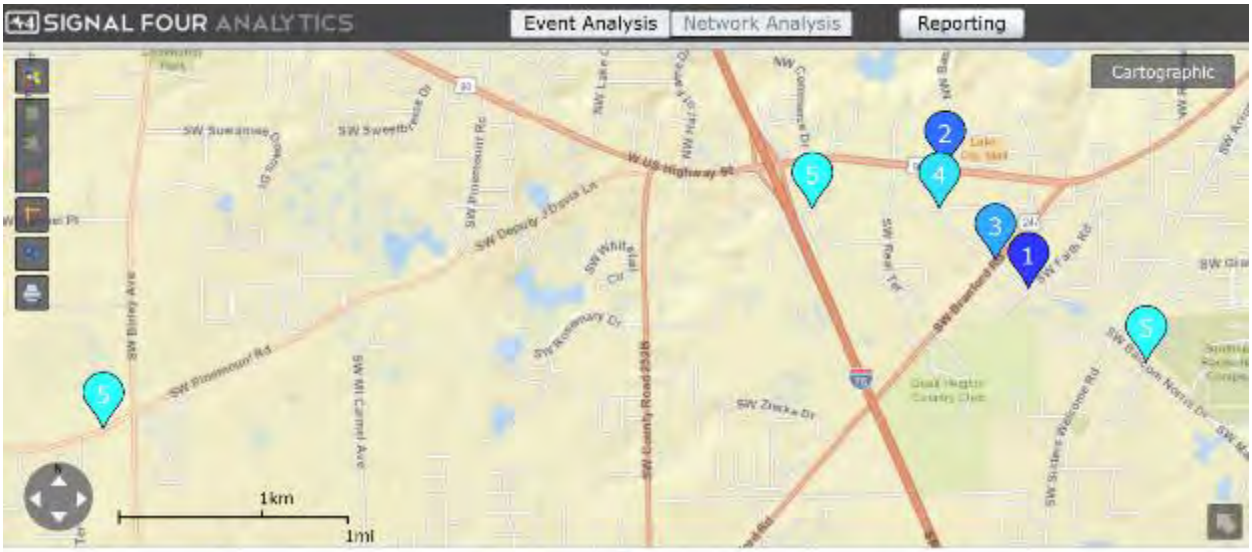
Further, the network was screened for location based on crash severity. Figure 5 shows the top five intersections based on severity between 2013 and 2017. Four of the top five intersections were associated with the state highway system. Of the two locations tied for fourth ranking, the intersection at Marion Ave and Fighting Tiger Dr was selected for further review.



Rank	Intersection Name	Crash Count	Crash Severity	Crash Rate	Fatal Crashes	Fatal & Incapacitating Injury Crashes	Injury Crashes	PDO C
1	SW MAIN BLVD & SW MALONE ST	17	3.41	n/a	1	2	10	
2	E US-90 & SE PRICE CREEK DR & CR-245	10	3.30	n/a	1	1	4	
3	SE COUNTRY CLUB RD & NE COUNTRY CLUB RD & U	17	3.24	n/a	1	2	9	
4	W DUVAL ST & SW HILTON AVE & NW HILTON AVE	10	3.10	n/a	0	0	7	
4	S MARION AVE & SE FIGHTING TIGER DR & SW HIG	10	3.10	n/a	0	1	7	
5	SW FOREST LAWN WAY & S US HIGHWAY 441	11	3.09	n/a	1	1	4	

Figure 5. Top 5 Intersections based on Crash Severity

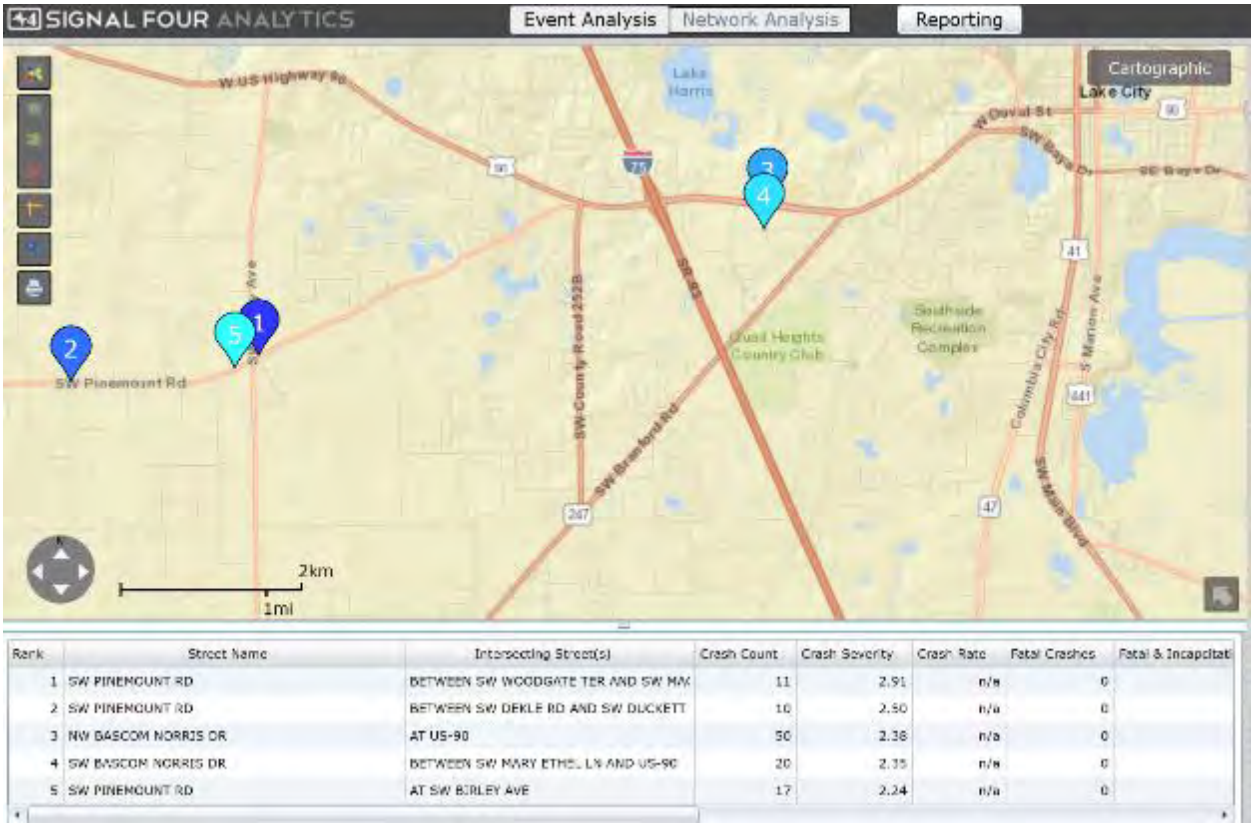
A similar query was run to identify the top five segments with highest crashes; Figure 6 shows the sites. One of the segments was around US-90, and the rest were on county and local roads. We observed that four segments were on Bascom Norris Dr and one on Commerce Dr; these were selected for further analysis.



Rank	Street Name	Intersecting Street(s)	Crash Count	Crash Severity	Crash Rate	Fatal Crashes	Fatal & Incapcitat
1	SW BASCOM NORRIS DR	BETWEEN SW FAITH RD AND SW BRANFORI	61	2.13	N/A	0	
2	NW BASCOM NORRIS DR	AT US-90	50	2.38	N/A	0	
3	SW BASCOM NORRIS DR	BETWEEN SW BRANFORD RD AND SW MARY	21	1.86	N/A	0	
4	SW BASCOM NORRIS DR	BETWEEN SW MARY ETHEL LN AND US-90	20	2.35	N/A	0	
5	SW PINEMOUNT RD	AT SW BIRLEY AVE	17	2.24	N/A	0	
5	SW BASCOM NORRIS DR	AT SW SISTERS WELCOME RD	17	2.06	N/A	0	
5	SW COMMERCE DR	AT US-90	17	1.18	N/A	0	

Figure 6. Top 5 Segments by Crash Count

Similar to intersection, the top five segments based on crash severity were found using Signal Four Analytics. We observed that three segments were on Pinemount Rd and two segments on Bascom Norris Dr.



Rank	Street Name	Intersecting Street(s)	Crash Count	Crash Severity	Crash Rate	Fatal Crashes	Fatal & Incapacitat
1	SW PINEMOUNT RD	BETWEEN SW WOODGATE TER AND SW MA	11	2.91	n/a	0	
2	SW PINEMOUNT RD	BETWEEN SW DEKLE RD AND SW DUCKETT	10	2.50	n/a	0	
3	NW BASCOM NORRIS DR	AT US-90	50	2.38	n/a	0	
4	SW BASCOM NORRIS DR	BETWEEN SW MARY ETHEL LN AND US-90	20	2.35	n/a	0	
5	SW PINEMOUNT RD	AT SW BIRLEY AVE	17	2.24	n/a	0	

Figure 7. Top 5 Segments Based on Crash Severity

In addition to these, 14 locations were selected for further review based on feedback provided by the stakeholders listed earlier in the report as well as the study team findings from the crash database.

Data Analysis

This step included evaluating crash data, historic site data, and field conditions to identify crash patterns. The intended outcome of a data analysis task was to identify the causes of the collisions and potential safety concerns or crash patterns that could be evaluated further before countermeasures could be proposed. The study team independently reviewed each site. The notes from the field survey, the inputs from road audit participants, and selected videos and pictures from the road audit were reviewed in detail to identify the risk factors. The road safety audit team independently reviewed each site as a group, and follow-up visits were made as needed on a site-by-site basis over the period of the study. The notes from the field survey, the inputs from road audit participants, and selected videos and pictures from the road audit were reviewed in detail to identify the risk factors that are detailed for individual sites in the following section of the report.

Countermeasure Selection

Once the factors that may contribute to crashes at a site were identified, the next step was to select possible countermeasures to reduce the average crash frequency. Based on the risk factors and field conditions, appropriate countermeasures were considered from several sources including FHWA Proven Safety Countermeasures, ITE's Unsignalized Intersection Improvement Guide (UIIG), and the Manual on Uniform Traffic Control Devices (MUTCD).

The MUTCD includes a variety of warning signs that can be used to alert the driver of a sudden change in alignment, so they can adjust accordingly. The below section provides a general overview of some of the most common countermeasures, their description and guidance for implementation that is referenced in the later section for individual sites.

Signs and Markings

- **Pavement markings**: Pavement markings in general have an important function in providing guidance and information to road users. General guidelines for pavement markings are discussed in MUTCD, Chapters 3A and 3B. Pavement markings include thermoplastic centerline and edge-line markings, raised pavement markers, etc. In this study, pavement marking refers to placement of standard thermoplastic markings on centerlines and edge lines.
- **Raised Pavement Markers** (RPM): Raised pavement markers (RPMs) are durable reflective or non-reflective markers used to provide lane guidance. RPMs also provide a tactile warning when a driver deviates from the lane. These rely on a source of light such as a vehicle's headlights so that, effectively, these can be seen at the distance of the headlight's projection. Internally illuminated RPMs (IIRPM) function similarly to RPMs except that they do not rely on a vehicle's headlight. They are solar powered and can be seen well before a traditional RPM. Where nighttime crashes were predominant, IIRPMs were proposed instead of RPMs on shoulders or edge lines and at center lines where appropriate. General guidelines for RPMs are discussed in MUTCD sections 3B-11 to 3B-14. On the curves, RPMs are suggested with a spacing of 40 ft or less and extending them after the curve for 350 ft where the posted speed is 45 mph and less or for 450 ft where the posted speed is greater than 45 mph.
- **Roadside Post-Mounted Delineators (PMDs)** are used to highlight the edge of the roadway and provide guidance at critical geometric changes in the roadway in the places

with many lane departure crashes. The delineator guidelines are discussed in Chapter 3F.01 and Section 2A.21 of MUTCD respectively.

- **Bright Sticks** are used to enhance existing countermeasures, such as signs, or highlight features on a roadway. These are low cost and were recommended in most locations.
- **Chevron Signing and Curve Warning Sign**: Chevron alignment signs are common roadway delineators located at horizontal curves or at sudden changes in roadway alignment, which provide additional emphasis and guidance for drivers. Guidance on placement and size of warning signs and chevrons is provided in the MUTCD, Chapter 2C. For certain sites with extreme conditions, a conservative or narrower spacing that deviates from MUTCD (Table 2C-6) was recommended.
- **Advisory Speed Sign**: These are common signs that call a driver's attention to unexpected conditions. These signs alert road users to conditions that might call for a reduction of speed. These signs are generally proposed on minor streets of two-way stop-controlled (TWSC) intersections or T-intersections or on curves because reduced speed can reduce or mitigate crash risk.
- **End of Road Markers**: Object markers are used to mark obstructions within or adjacent to the roadway. The end-of-roadway marker is used to warn and alert road users of the end of a roadway in other than construction or maintenance areas. These markers were typically suggested for T- or Y-intersections to warn drivers of the dead end. This signing includes three OM4-1 and one W1-7 (MUTCD Figures 2C-9, 2C-12, and 2C-13) signs.
- **Intersection Treatment** refers to signs and pavement markings on the intersecting road. The treatments may include double stop signs (stop signs on both sides of the road), "Stop Ahead" signs, RPMs, end-of-road signing, intersection conflict warning system (ICWS), flashing beacon, overhead flashing beacon, sight distance improvement, or "Cross Traffic Does Not Stop" sign. Other improvements for intersections included larger signs, RPMs, IIRPMs, and bright sticks for extra emphasis or warning to drivers at intersection approaches.

Enhanced Conspicuity or Other Special Signing or Marking Treatments

- In some cases, merely upgrading to minimum standards is not enough to solve a problem, and MUTCD (section 2A.15) calls for enhanced conspicuity for standard signs, based on engineering judgment. As a result, additional suggestions were made, such as use of bright sticks, flashers, or other devices to call attention to signs or roadway features. These issues and recommendations are described in the detailed discussion of each site. This part of the study focuses on high-risk locations for sites with a history of severe crashes (only 11 sites). Adding bright sticks to the signs was suggested for all sites.

Geometry

- Due to varying geometry at intersections, there could be increased crash risk due to vehicles waiting to find a gap in the opposing or conflicting traffic stream. Two strategies were considered: reducing the conflict (or conflict area) and eliminating the conflict. Reducing the conflicting area can be accomplished by relocating the stop bar and/ or introducing a splitter island. Eliminating the conflict can be accomplished by introducing a left-turn lane or an acceleration lane. In the case of a signalized intersection, optimized signal timing and new signal heads could reduce crash risks.

High Friction Surface Treatment (HFST)

- High-friction surface treatments increase the coefficient of friction between the roadway and vehicle wheels to keep a vehicle on the roadway. A high-friction surfacing system consists of a combination of resins and polymers (usually urethane, silicon, or epoxy) with a binder that is topped with a natural or synthetic hard aggregate. The rougher texture and greater surface area of the system increase the pavement friction (Julian and Moler, 2008). FDOT's general guidelines on using HFS (Figure 5) were considered on curves. There is no specific curve characteristics guidance for screening, so the team determined, based on empirical analysis, that curves with lower radii correlated to higher crash risk; however, no statistically significant threshold could be established. A rank order analysis for statewide curves indicated that curves with a radius less than a 1000 ft experienced high crash risk, and that threshold was established for our recommendation. Adding high friction surface treatment increases skid resistance and helps drivers negotiate the curve and decelerate effectively.

Where to Use HFST	Where NOT to Use HFST
Roadway applications	
• Locations with a high crash rate related to a friction deficiency. (i.e. Run-off-the-road crashes, and wet-weather crashes) • On rural horizontal curves where drivers tend to take turns too fast and super elevations are inadequate. • On tight-radius freeway loop ramps. • At a downhill signal approaches. • On roadways that may need geometric corrections, but the agency does not have the funding. • On concrete pavements and bridge decks, to help with preservation.	• If less-expensive traffic control devices (chevrons, curve-warning signs) are expected to adequately reduce crashes. • Tangent sections where crashes are related to driver errors. • Inside signalized intersections. • After a tight curve or more than 1,000 ft before a curve. (No benefit here) • Preventative maintenance on asphalt pavement.
Pavement condition	
• Dense graded asphalt or concrete. • Pavement condition rating of "Good" and higher. • Polished surface. • Highly oxidized. • Few low-severity cracks. Very few cracks greater than 0.25 inch Wide. • Minor rutting ≤ 0.25 inch. • No structural damage.	• Open graded asphalt (OGFC) • Asphalt pavements with 6+ percent of cracking in or outside the wheel paths. • Widespread rutting > 0.25 inch deep. • Raveling surface. • Bleeding pavement. • Areas where layer debonding or subsurface stripping is suspected. (Verify with coring and other pavement forensics.) • Concrete single slab with moderate or severe distress, patching, or shattered in more than 3 pieces.

Figure 8. FDOT general guidance on pavement candidates[3]

[3] https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/content/materials/pavement/performance/ndt/documents/hfstguidelines.pdf?sfvrsn=1c797e12_0

BENEFIT-COST ANALYSIS

This section describes the process of benefit-cost (BC) analysis. Once the countermeasures were selected and identified, the next step was to evaluate the benefits and costs of the possible countermeasures and further identify individual projects that are cost effective or economically justified based on FDOT's minimum requirement for BC ratio. The benefit-cost analysis methodology developed by the study team in prior projects was adopted. The BC ratio for each site was computed as detailed in the next section. Site visits were made as needed at various stages of the project to verify field conditions. It should be noted that for FDOT to consider a project to be funded under the Highway Safety Improvement Program (HSIP), a minimum BC ratio of 2 is required. The detailed BC tables are included in Appendix A.

For every site, the number of crashes occurred in the five years duration between 2013 and 2017 were retrieved. For each site, based on crash risk from field studies, appropriate countermeasures were suggested. Each countermeasure has a specific crash reduction factor (CRF)[4] and a crash modification factor (CMF)[5]. In certain cases, if an appropriate CRF or CMF was unavailable, based on engineering judgement, an alternate or closely related factor was selected that was conservative.

Multiplying the CMF by the observed crashes at a site yields the expected number of crashes. The difference between the expected and observed crashes provides the expected reduction in crashes. As the purpose of the countermeasures is to reduce the crashes, the benefit of this reduction is quantified by multiplying the expected reduction of crashes with the average crash cost that would be mitigated. The average crash cost was retrieved from FDOT Design Manual.

Table 2. FDOT Average Crash Cost Based on Facility Type

Type Facility	Divided Roadway			Undivided Roadway		
	Urban	Suburban	Rural	Urban	Suburban	Rural
2-3 Lanes	$106,967	$186,651	$347,278	$121,332	$246,741	$506,164
4-5 Lanes	$116,176	$213,668	$461,464	$110,657	$183,491	n/a
6+ Lanes	$116,034	$154,430	$431,516	$31,282	n/a	n/a
Interstate	$145,263	n/a	$331,210	n/a	n/a	n/a
Turnpike	$141,607	n/a	$277,755	n/a	n/a	n/a

Notes:
(1) Average Cost/Crash: **$151,677**
(2) The above values were derived from 2011 through 2015 traffic crash and injury severity data for crashes on state roads in Florida using the formulation described in *FHWA Technical Advisory "Motor Vehicle Accident Costs", T 7570.2, dated October 31, 1994* and from a memorandum from USDOT, *Revised Departmental Guidance: Treatment of Economic Value of a Statistical Life (VSL) in the U.S. Department of Transportation Analyses*, dated August 8, 2016 updating the value of life saved from $9.4 million to $9.6 million.
(3) Link to ***Revised Departmental Guidance 2013***

The costs of countermeasures proposed were based on the letting data from FDOT 2017 12-month Historical Cost and Other Information[6]. Other public data that were available online were used if letting data could not provide the necessary estimates.

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[4] https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/roadway/qa/tools/crf.pdf?sfvrsn=ffd98504_2
[5] http://www.cmfclearinghouse.org/
[6] https://www.fdot.gov/programmanagement/estimates/historicalcostinformation/historicalcost.shtm

3. BENEFIT-COST (BC) ANALYSIS SUMMARY

The summary of benefit-cost analysis for the 10 suggested projects in Columbia County is in Table 3.

Table 3. Columbia County Summary of Benefit-Cost Analysis

	Site #	Site	Annual benefit in crash reduction cost	Annualized cost	Total cost	BC ratio
Sites for Immediate Implementation	1	SW Deputy J Davis Ln at CR-52B	$142,912	$6,069.70	$31,818	23.5
	2	CR-252A from CR-252 to SR-10	$218,662	$8,047	$42,185	27.2
	3	SR-47 & Walter Little Rd	$198,416	$118,464	$1,850,662	1.7
	4	SR-47 & Brentwood Way	$255,107	$118,465	$1,850,662	2.2
	5	SR-47 & Wester Rd	$30,370	$8,783	$24,705	3.5
	6.1	CR-240 from SR-247 to CR-131, Site #1	$44,413	$4,182	$21,923	10.6
	6.2	CR-240 from SR-247 to CR-131, Site #2	$80,373	$22,510	$165,807	3.6
	6.3	CR-240 from SR-247 to CR-131, Site #3	$9,870	$2,846	$14,920	3.5
	6.4	CR-240 from SR-247 to CR-131, Site #4	$187,538	$29,574	$226,744	6.3
	6.5	CR-240 from SR-247 to CR-131, Site #5	$4,935	$211	$1,106	23.4
	7	CR-131 from Buckley to US-41	$263,205	$3,722	$19,626	70.7
	8	CR-349 from CR-131 to CR-245	$241,283	$25,993	$184,066	9.3
	9	SE Country Club Rd (CR-133) from Alfred St to CR-252	$219,837	$49,876	$380,977	4.4
	10	CR-246 from US-41 to US-441	$464,253	$12,854	$67,386	36.1

4. SAFETY ANALYSIS OF SITES

This section provides the summary of all 10 sites recommended for HSIP funding. For each site, the site description, crash analysis, existing condition of the site, risk conditions, suggested countermeasure, and benefit-cost analysis are detailed. For detailed calculations, please refer to Appendix I.

Figure 9 shows the annotation for the countermeasures used in the figures in this section.

Chevron	C	High Friction Surface Treatment	HFST
Large Chevron	LC	Advisory Speed Sign	AdSS
Edge RPM	E-RPM	Speed Feedback Sign	Sp-Fbc
Center RPM	C-RPM	Center and Edge RPM	CE-RPM
Edge IIRPM	E-IIRPM	Center and Edge IIRPM	CE-IIRPM
Center IIRPM	C-IIRPM	Curve Warning Sign	CWS

Figure 9. Countermeasures annotation

1 – SW DEPUTY J DAVIS LANE AT CR-252B

Site Description

This site is a T-intersection with one-lane per approach as shown in Figure 10. The southbound (SB) approach has a vertical curvature (downgrade) and the westbound (WB) approach has a combined horizontal and vertical alignment. From field observations, it could be inferred that the WB traffic experienced several lane departure crashes with possible property damage evidenced by new or replacement section of walls that can be seen in Figures 9 and 10. In addition, from the partial deterioration of the stop bar pavement marking, it could be deduced that the WB left turn was the dominant movement for the approach which requires navigating multiple conflict points from northbound and southbound traffic with limited sight distance.

Figure 10. SW Deputy J Davis Lane at CR-252B

Figure 11. Damaged walls on west end of the intersection (Google Maps cache)

Figure 12. Replaced section of walls on the west end of the intersection

Analysis of Problem

Crashes

Table 4 lists the 20 historical crashes at this intersection between 2013 and 2017 with four injury and 16 PDO crashes. Seventeen of the 20 crashes occurred during dry conditions, and 12 of the 20 occurred during daylight conditions. Figure 13 shows the crash type by severity. At the intersection, there were one incapacitating injury crash, two non-incapacitating injury crashes, and one possible injury crash, along with 16 PDO crashes. Lane departure crashes included head on, sideswipe, off-road, and rollover crashes. There were three injury crashes and seven PDO lane departure crashes at this intersection, including four off-road, two head-on, and three rollover crashes. Two lane departure injury crashes that occurred in daylight conditions on the curve resulted in head-on collisions. There was one night-time PDO crash in which the vehicle was overturned on WB Deputy J Davis Lane curve. Another PDO rollover crash on WB Deputy J Davis Lane was animal related. One nighttime PDO rollover crash occurred on the NB CR-252B curve. At this intersection, three WB vehicles failed to stop and crashed into the wall on the west side of the intersection (Figure 11).

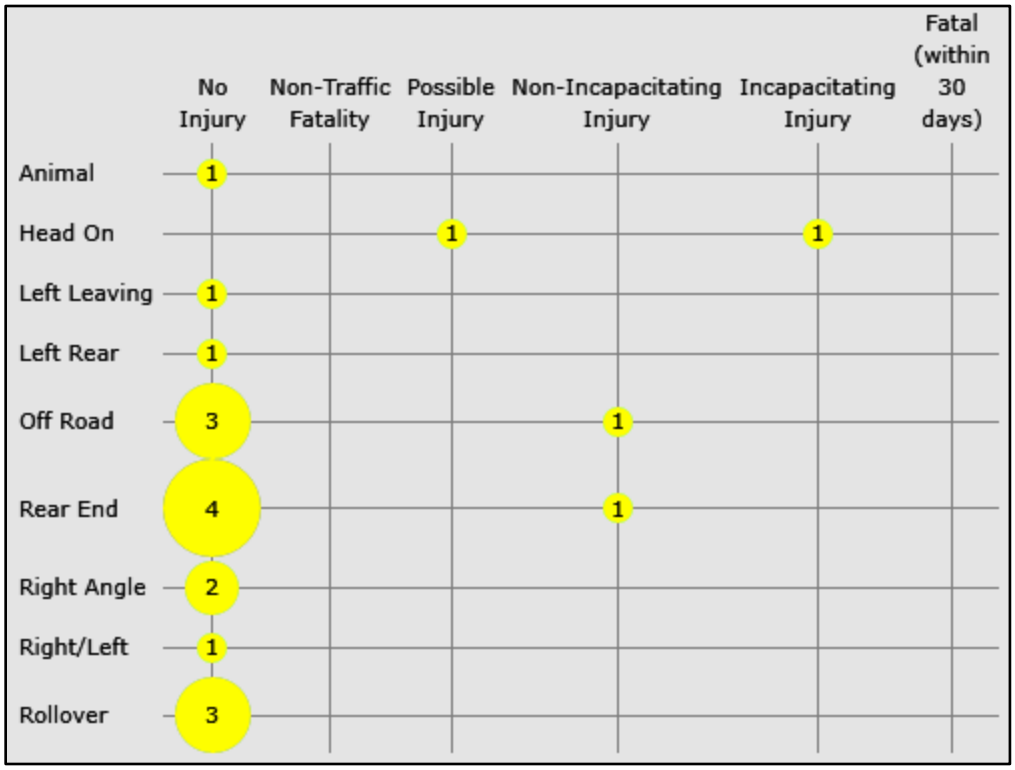

Figure 13. Crashes by severity at SW Deputy J Davis Ln at CR-252B

Table 4. Intersection-Related Crashes at SW Deputy J Davis Ln at CR-252B

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83335491	8/31/2013	Dark - Not Lighted	Rollover	W	PDO	Wet
83309068	12/28/2013	Dark - Not Lighted	Off Road	W	PDO	Dry
83827975	12/2/2014	Dark - Not Lighted	Rear End	W	PDO	Dry
84549267	12/18/2014	Daylight	Rear End	W	Injury	Dry
85421271	11/1/2016	Daylight	Rear End	E	PDO	Dry
85417404	11/5/2016	Dark - Not Lighted	Animal	N	PDO	Dry
85421307	1/5/2017	Daylight	Right Angle	SW	PDO	Dry
85442238	3/17/2017	Daylight	Left Rear	E	PDO	Dry
85515810	4/16/2017	Daylight	Rear End	N	PDO	Dry
84549722	1/23/2015	Daylight	Right Angle	SW	PDO	Wet
83731916	1/18/2014	Dark - Not Lighted	Off Road	W	Injury	Dry
87104951	10/5/2017	Daylight	Left Leaving	N	PDO	Dry
85340701	8/22/2016	Dawn	Right/Left	E	PDO	Dry
85363103	9/16/2016	Daylight	Head-On	NS	Injury	Wet
85277657	3/14/2016	Daylight	Rear End	W	PDO	Dry
84552487	5/31/2015	Daylight	Rollover	E	PDO	Dry
83827567	9/3/2014	Daylight	Head-On	EW	Injury	Dry
83662968	12/28/2013	Dark - Not Lighted	Off Road	W	PDO	Dry
87102851	12/13/2017	Daylight	Off-Road	W	PDO	Dry
83829392	11/5/2014	Dark - Not Lighted	Rollover	E	PDO	Dry

Field Observations

➢ *Existing conditions*

- Pavement:

  Pavement structure is serviceable; skid resistance is unknown.

- Shoulders and pavement edge drop-offs:

  Unpaved shoulders with some pavement edge drop-offs, but this did not appear to be a contributing factor in any of the crashes.

- Signage:

  Standard stop sign on right side of WB Deputy J Davis Ln at intersection.

  “Intersection Ahead” sign on WB Deputy J Davis Ln

  Chevrons along the southern edge of Deputy J Davis Ln in the WB approach to the curve were recently upgraded.

- Pavement markings:

  Standard thermoplastic markings on center and edge line

  Centerline RPMs on approach to curve on Deputy J Davis Ln

  Centerline RPMs on south leg of CR-252B

  No RPMs on north leg of CR-252B

  Transverse rumble strips on the approach to the intersection on Deputy J Davis Ln

- Guardrail:

  No guardrail, but concrete/brick wall along the western edge of CR-252 screens and separates residential area from the road.

➢ *Risk Conditions*

There is both a hill and a curve on the Deputy J Davis Ln WB approach to the intersection that limit the driver’s view of the intersection. Although there are rumble strips and a “Stop Ahead” sign, the number of crashes involving vehicles that fail to stop suggests that additional measures are needed to alert the driver of the expected change in alignment. The problem seems to be exacerbated by the downhill grade of Deputy J Davis Ln on the WB approach to the intersection.

The hill on the approach to the curve on Deputy J Davis Ln limits the view of the curve for vehicles approaching from the east.

The absence of the visual cue to slow down for the curve appears to have contributed to lane departure crashes at this location. Chevrons have been doubled (two regular chevrons on each pole).

Figure 14. Deputy J Davis Ln – WB approach to curve obscured by hill

The friction demand for WB vehicles approaching the intersection is exaggerated by at least three factors: downhill grade on the approach, the curve, and the short distance a driver who fails to acknowledge the advanced warning signs has to apply brakes. On December 13, 2018, a high-friction surface treatment was implemented.

Figure 15. Evidence of lane departures at the curve on Deputy J Davis Ln

Emphasis Areas for Countermeasures

- Increase communication with the driver about the need to reduce speed because of the presence of the curve and the intersection.

Suggested Countermeasures

Signs:

- Speed feedback sign on crest vertical alignment on Deputy J Davis Ln
- Increase mounting height of chevrons on Deputy J Davis Ln, and add chevrons on CR-252B curves
- Curve warning sign on south leg of CR-252B
- Two large stop signs at intersection

RPM:

- Center- and edge-line IIRPM through length of Deputy J Davis Ln curve
    - Traditional RPM relies on reflecting the vehicle's headlight. This is while there is a vertical alignment before the horizontal curve on SW Deputy J Davis WB. In such conditions, it might be too late for the driver to realize the change in alignment, as shown in Figure 16.
- Centerline RPM on north leg

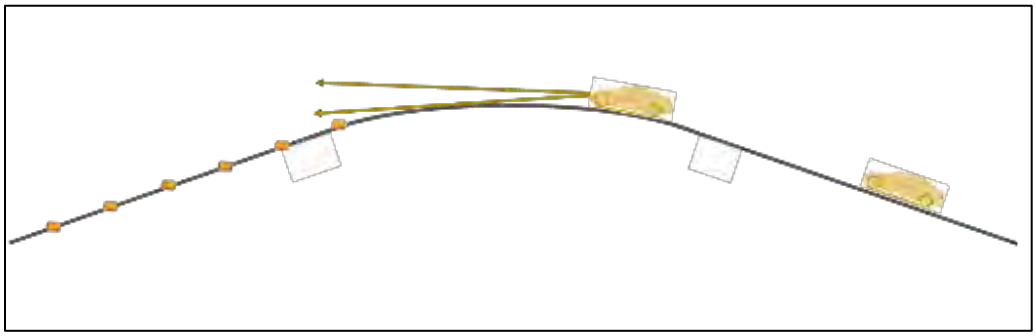

Figure 16. Traditional RPM functionality on a combination of vertical and horizontal curve

HFST:

- HFST on Deputy J Davis Ln curve was recommended and was already implemented in December 2018. Figure 17 shows an aerial view of the application.

Figure 17. Aerial view of the SW Deputy J Davis Ln intersection with HFST treatment

The suggested countermeasures are shown in Figure 18. The summary of benefit-cost analysis is in Table 5. Total estimated cost of the suggested countermeasures is $74,843, and the BC ratio is 14.7. Details of cost calculations are in Table 34 and Table 35 of Appendix A.

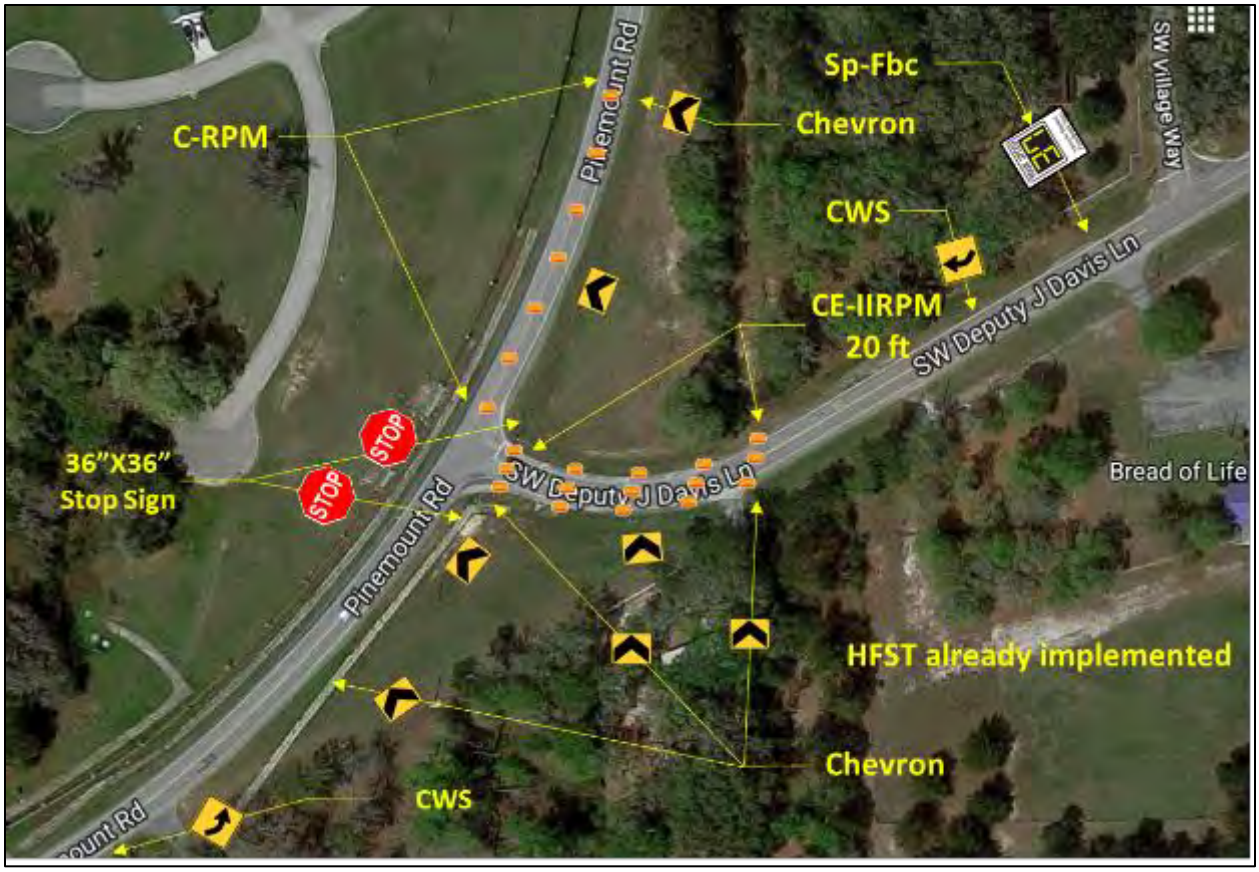

Figure 18. Suggested countermeasures for SW Deputy J Davis Ln & CR-252B

Table 5. Benefit-cost summary for SW Deputy J Davis Ln at CR-252B

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$203,611	$18,514	$74,843	$831,595	14.7

Factors Affecting Implementation

Right of way (ROW)	The countermeasures recommended will be on the roadway and within the County's ROW.
Environmental impacts	It appears to have no or minimal environmental impact.
Utilities	None anticipated.
Community impacts	None anticipated.

2 – CR-252A FROM CR-252 TO SR-10

Site Description

CR-252A is a 2.9-mile, two-lane highway with multiple curves (Figure 19; curve #1, 800 ft). Along CR-252A between CR-252 and SR-10, adjoining properties include a mix of agricultural and few residential land uses. The terrain is relatively flat. There is a benign vertical alignment on one of the horizontal curves that makes a visual trap for SB flow (Figure 19). The southbound (SB) approach to curve #1 has a vertical curvature (downgrade). Pavement width is approximately 22 ft, and shoulders are unpaved with some pavement edge drop-offs. The speed limit on this segment is 55 mph, and there is a 35-mph advisory speed sign on SB approach of curve #1.

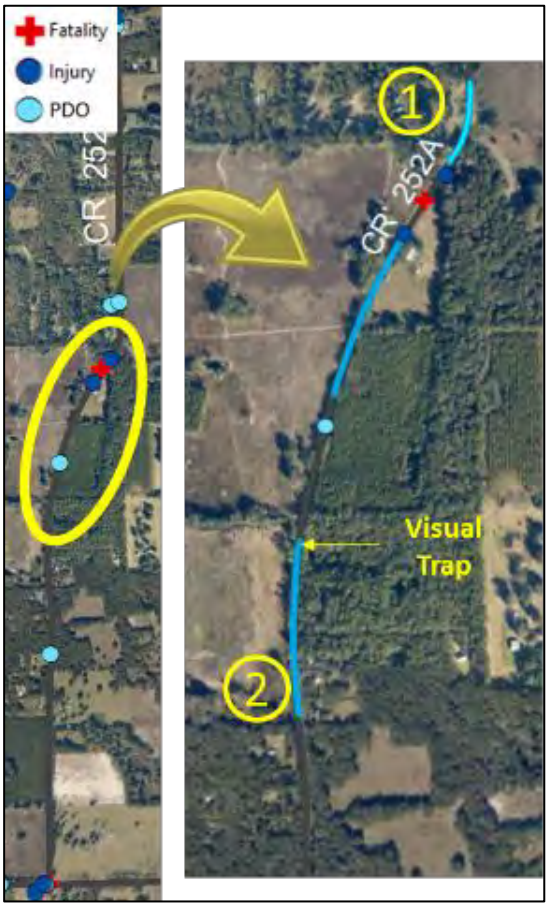

Figure 19. CR-252A from CR-252 to SR-10 aerial

Analysis of Problem

Crashes

Table 6 shows crashes on two horizontal curves on this section, which included two PDO, two injury, and one fatal crashes. All these crashes were lane departure crashes that occurred at nighttime. One PDO was animal related, so it was excluded from the analysis.

Table 6. Crashes on the curve, CR-252A from CR-252 to SR-10

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83829192	11/19/2014	Dark - Not Lighted	Rollover	S	Injury	Dry
84561040	1/12/2015	Dark - Not Lighted	Off Road	S	Fatality	Wet
85146097	11/1/2015	Dark - Not Lighted	Rollover	S	Injury	Dry
84549736	2/8/2015	Dark - Not Lighted	Animal	N	PDO	Dry
85174511	10/25/2015	Dark - Not Lighted	Off Road	N	PDO	Dry

Field Observations

- *Risk Conditions*

There were four nighttime curve-related crashes (one fatal, two injury, and one PDO). Field observation noted that there was no “Curve Ahead,” chevron, or RPM for this curve. In addition. There is no paved shoulder for recovery, and one side of the curve has narrow clearance and sharp roadside slope (Figure 20 and Figure 21). Curve #1 has a small radius, with only 800 ft, and four of the crashes occurred on this curve. This curve is an ideal candidate for implementation of high-friction surface treatment (HFST) and internally illuminated RPM (IIRPM) because these measures can help the drivers decrease their speed effectively and negotiate the curve safely. All the crashes at curve #1 occurred SB with its downgrade curvature.

Field observation also noted that there were two chevrons on the wrong side of the road on curve #1, which we recommend be removed.

There is a T-intersection with CR-252 in the south of this segment. It has flashing beacon, stop-ahead sign, and rumble stipes. This intersection experienced two failed-to-stop crashes (in one case, the driver was impaired). The only countermeasure for this intersection recommended is to add a “Cross Traffic Does Not Stop” sign.

Figure 20. CR-252A curve #1, looking south

Figure 21. CR-252A curve #2, looking north

Emphasis Areas for Countermeasures

- Increase communication with the driver about the presence of the curve.
- Increase skid resistance on curve #1.
- Assist drivers in recognizing that the CR-252 intersection is two-way stop-controlled.

Suggested Countermeasures

HFST:

- High-friction surface on SB lane of curve #1.

Signs:

- Chevrons and curve warning signs on the curves. Chevron spacing of 80 ft on curve #1 is suggested.
- “Cross Traffic Does Not Stop” sign on the CR-252 intersection.

RPM:

- Centerline RPMs on entire road.
- Install IIRPMs on center- and edge-line on curve #1.
- Edge-line RPMs on the rest of curves.

Figure 22 shows the location of countermeasures. The summary of the benefit-cost analysis is in Table 7. The approximate cost of the suggested project is $137,366, and the BC ratio is 9.1. The details of cost calculations are shown in Table 36 of Appendix A.

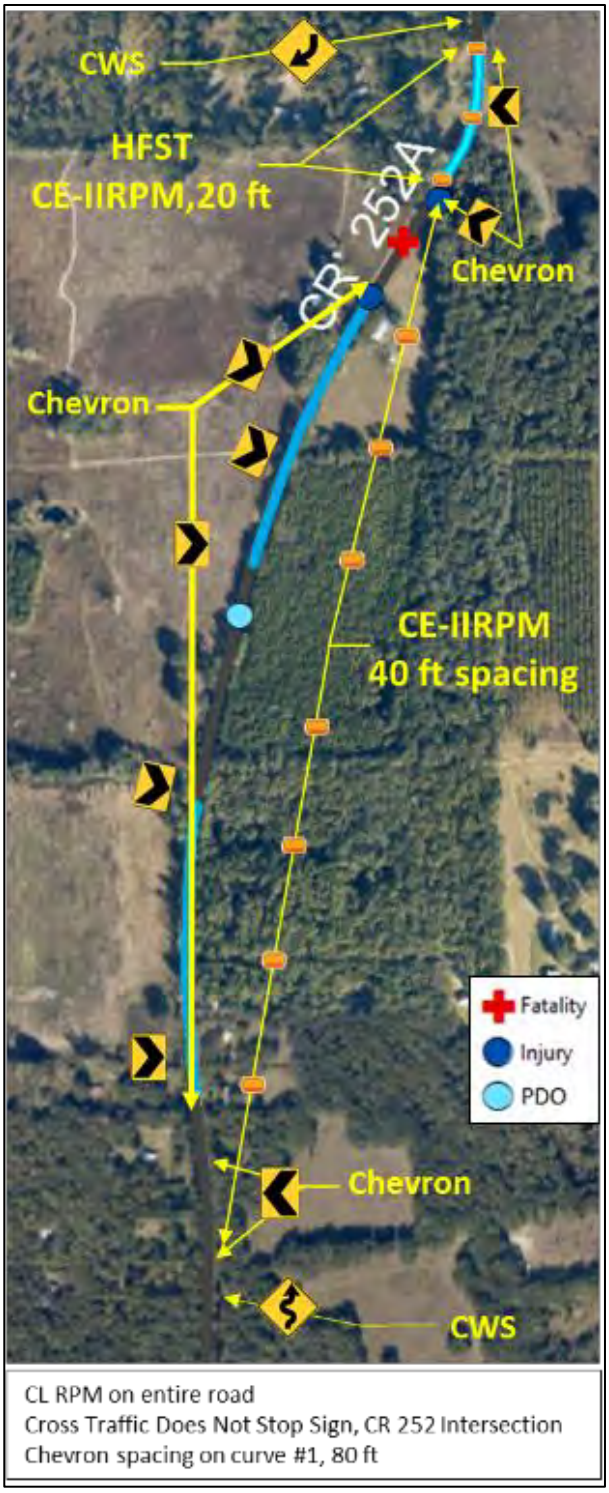

Figure 22. Countermeasures for curves on CR-252A

Table 7. Benefit-cost summary for CR-252A.

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$219,837	$24,067	$137,366	$841,310	9.1

Factors Affecting Implementation

Right of way	HFST, RPMs, and signs can be implemented within the existing right of way.
Environmental impacts	It appears to have no or minimal environmental impact.
Utilities	No significant conflicts are apparent, but will require standard utility coordination.
Community impacts	None anticipated.

3 – SR-47 AT WALTER LITTLE ROAD

Site Description

This is a typical two-lane roadway with a T-intersection; Walter Little Rd is the minor street. Figure 23 shows the aerial view of this intersection, skewed about 20°. Figure 24 shows the residential areas accessed through Walter Little Rd that lead to a high demand on this roadway.

Figure 23. SR-47 at Walter Little Rd

Figure 24. Residential areas accessed by Walter Little Rd

Analysis of Problem

Crashes

Table 8 below shows the crash history at this intersection, which included 13 crashes. One off-road crash resulted in the fatality. One injury and six PDO crashes were rear-end crashes that resulted from left-turning vehicles waiting for a gap on SR-47 SB onto Walter Little Rd. Nine of the 13 crashes occurred in daylight conditions. Figure 25 shows the crash type by severity. At the intersection, there were one fatal crash, one incapacitating crashes, and eleven PDO crashes.

Table 8. Crashes at SR- 47 and Walter Little Rd

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83829049	10/9/2014	Daylight	Rear End	S	Injury	Dry
83235516	12/26/2014	Dark - Not Lighted	Off Road	S	Fatality	Dry
84560227	4/5/2015	Daylight	Rear End	S	PDO	Dry
85140660	10/20/2015	Dawn	Rear End	S	PDO	Dry
85266856	3/17/2016	Daylight	Rear End	S	PDO	Wet
85338210	9/18/2016	Dark - Not Lighted	Rear End	S	PDO	Dry
83652355	1/21/2014	Daylight	Rear End	N	PDO	Dry
87111887	12/15/2017	Dark - Not Lighted	Same Direction Sideswipe	S	PDO	Dry
85176317	11/10/2015	Daylight	Right/Through	W	PDO	Dry
83752344	8/13/2014	Daylight	Off Road	S	PDO	Wet
81967688	10/13/2016	Daylight	Rear End	S	PDO	Dry
84556043	6/18/2015	Daylight	Other	N	PDO	Wet
85464740	5/8/2017	Daylight	Left-Entering	S	PDO	Dry

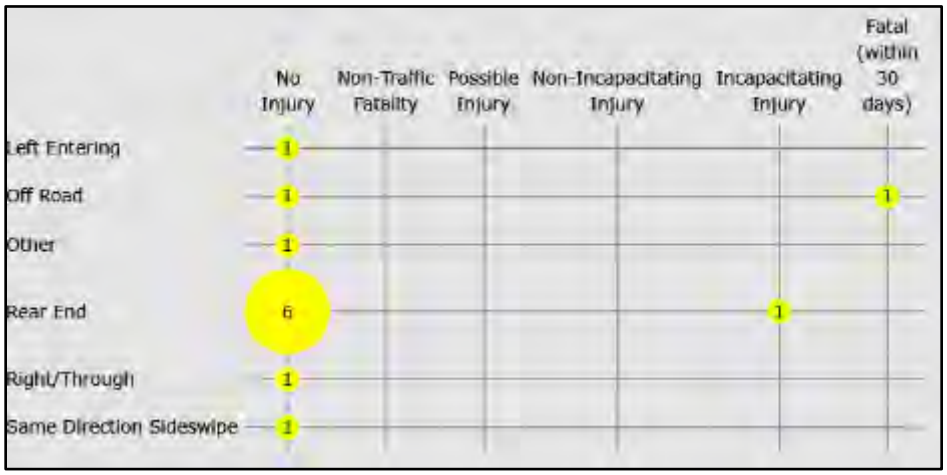

Figure 25. Crashes at SR-47 at Walter Little Rd

Field Observations

Existing conditions

- Shoulders and pavement edge drop-offs:

  SR-47 has a paved shoulder, but Walter Little Rd does not.

- Signage:

  Standard stop sign on right side of Walter Little Rd

  Stop-ahead sign on Walter Little Rd

- Pavement markings:

  Walter Little Rd

  Standard thermoplastic markings on centerline

  No RPM

  SR-47

  Standard thermoplastic markings on center and edge

  Centerline RPM

Risk Conditions

Based on the analysis, adding a left-turn lane was recommended by the team; however, the District Safety Engineer shared information in a meeting on Apr. 16, 2019, that this project was already programmed by FDOT.

4 – SR-47 AT BRENTWOOD WAY

Site Description

SR-47 is a two-lane county road with a T-intersection at Brentwood Way; Brentwood Way is the minor street (Figure 26). North of Brentwood Way, there is another three-leg intersection on SR-47 at SW Dynasty Glen Rd (unpaved). The distance between these intersections is about 150 ft. Figure 24 shows the residential areas accessed through Brentwood Way that lead to a high demand on this roadway.

Figure 26. SR-47 at Brentwood Way

Analysis of Problem

Crashes

This intersection experienced one fatal, six injury, and seven PDO crashes, as shown in Figure 26 and Table 9. Of these, one fatal, four injury, and four PDO crashes were related to SB left-turn movement waiting for a gap in NB traffic (all occurred in daylight conditions). Figure 27 shows the crash types versus their severity. At the intersection, there were one fatal crash, one incapacitating injury crash, three non-incapacitating injury crashes, and two possible injury crashes, along with five PDO crashes. One of the PDO crashes was animal related.

Table 9. Crashes at SR-47 and Brentwood Way intersection

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
85515836	6/29/2017	Daylight	Rear End	N	Injury	Dry
83731962	5/6/2014	Daylight	Rear End	S	PDO	Dry
83755834	7/6/2014	Daylight	Rear End	S	PDO	Dry
85143280	12/13/2015	Dusk	Left Entering	S	Injury	Dry
84549279	1/24/2015	Dark - Not Lighted	Other	S	Injury	Dry
83827146	11/24/2015	Dark - Not Lighted	Animal	S	PDO	Dry
83296120	6/30/2013	Daylight	Rear End	S	Injury	Dry
83295525	7/12/2013	Daylight	Unknown		PDO	Dry
83296144	10/23/2013	Daylight	Rear End	N	PDO	Dry
83652328	10/28/2013	Daylight	Rear End	S	Injury	Dry
85244111	3/6/2016	Dark - Not Lighted	Same Direction Sideswipe	S	PDO	Dry
83335474	7/19/2013	Daylight	Left Entering	S	Injury	Dry
87113835	10/22/2017	Daylight	Rear End	S	Fatal	Dry
83173596	1/24/2013	Daylight	Rear End	S	PDO	Dry

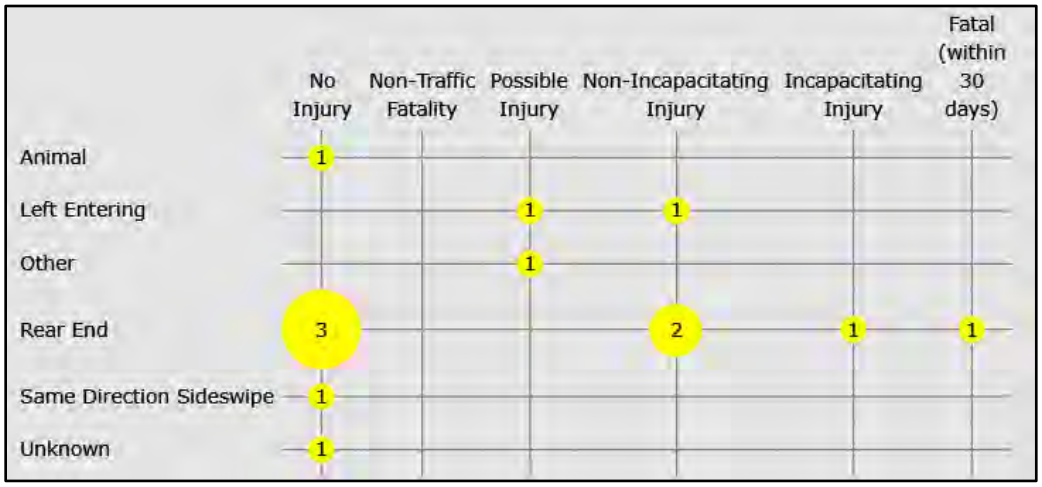

Figure 27. Crashes at SR-47 at Brentwood Way

Field Observations

➢ *Existing Conditions*

- Shoulders and pavement edge drop-offs:

  Paved shoulder on SR-47

  Paved shoulder on Brentwood Way from approximately 150 ft to the intersection; no shoulder beyond that point

- Signage:

Standard stop sign on Brentwood Way

- Pavement markings:

  SR-47

  Centerline RPM, but no edge-line RPM

  Brentwood Way

  No RPMs

  No rumble strips on Brentwood Way approach to the intersection

  Center- and edge-line standard thermoplastic markings on both roads

Based on the analysis, adding a left-turn lane was recommended by the tea; however, the District Safety Engineer shared information in a meeting on Apr. 16, 2019, that this project was already programmed by FDOT. This intersection distance to Walter Little Rd intersection on SR-47 is 0.5 mile. The FDOT-programmed project is to add a lane to the entire segment between these two intersections, functioning as left-turn lane for all the intersections and driveways in between.

5 – SR-47 AT WESTER ROAD

Site Description

This site is a skewed intersection (about 35°) as shown in Figure 28. This is a four-leg, two-way, stop-controlled intersection; Wester Rd and SW King St are minor approaches with stop control. Figure 28 shows that the mainline SR-47 has left-turn lanes both SB and NB. This intersection is located close to a combination of farm and residential land use areas. There is a hill on the Wester Rd approach to the intersection, but the terrain of the other three legs is relatively flat.

Figure 28. SR-47 at Wester Rd

Analysis of Problem

Crashes

This intersection experienced one fatal, two injury, and six PDO crashes, as shown in Figure 27 and Table 10. However, one fatal, one injury, and one PDO angle crash were considered for the analysis (rows with bold font in Table 10), based on available CMFs. Two of the three crashes occurred in non-daylight conditions. Figure 29 shows the crash type versus its severity.

Table 10. Crashes at SR-47 at Wester Rd

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
85110611	10/17/2015	Dark - Not Lighted	Off Road	E	PDO	Dry
83828419	**12/27/2015**	**Daylight**	**Right Angle**	**SW**	**PDO**	**Dry**
85262852	1/16/2016	Dark - Not Lighted	Off Road	N	PDO	Dry
85367398	8/1/2016	Daylight	Same Direction Sideswipe	N	PDO	Dry
85421294	12/16/2016	Dark - Not Lighted	Left Entering	N	Injury	Dry
83828993	10/18/2014	Daylight	Animal	W	PDO	Dry
83331883	**11/18/2013**	**Dark - Not Lighted**	**Right Angle**	**SE**	**Injury**	**Dry**
81967955	**5/25/2013**	**Dusk**	**Right Angle**	**NE**	**Fatality**	**Dry**
85413337	3/27/2017	Daylight	Rear End	N	PDO	Dry

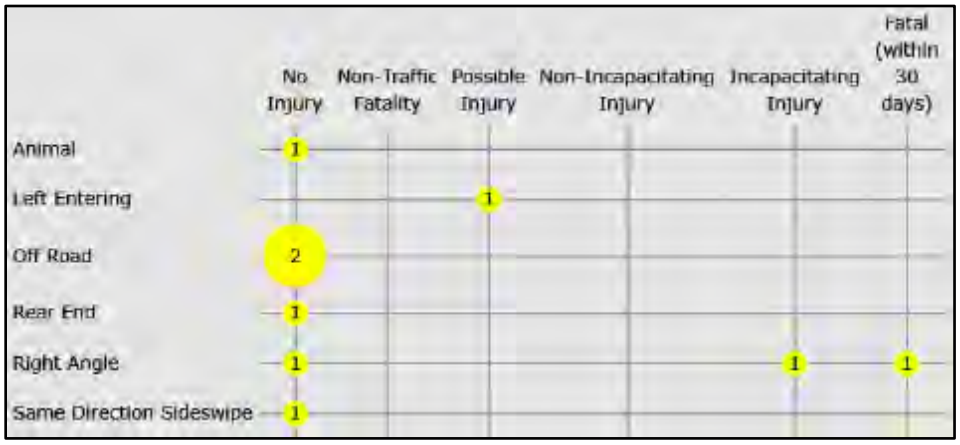

Figure 29. Crash type vs. severity at intersection of SR-47 and Wester Rd

Field Observations

➢ *Existing Conditions*

- Signage:

  Wester Rd and SW King St

  Standard stop sign

  Stop-ahead sign

- Pavement markings:

  SR-47

  Standard thermoplastic markings on center and edge

  Centerline RPMs

  Wester Rd and SW King St

  Standard thermoplastic markings on centerline

No RPMs.

Rumble strips in approach to the intersection, as shown in Figure 30.

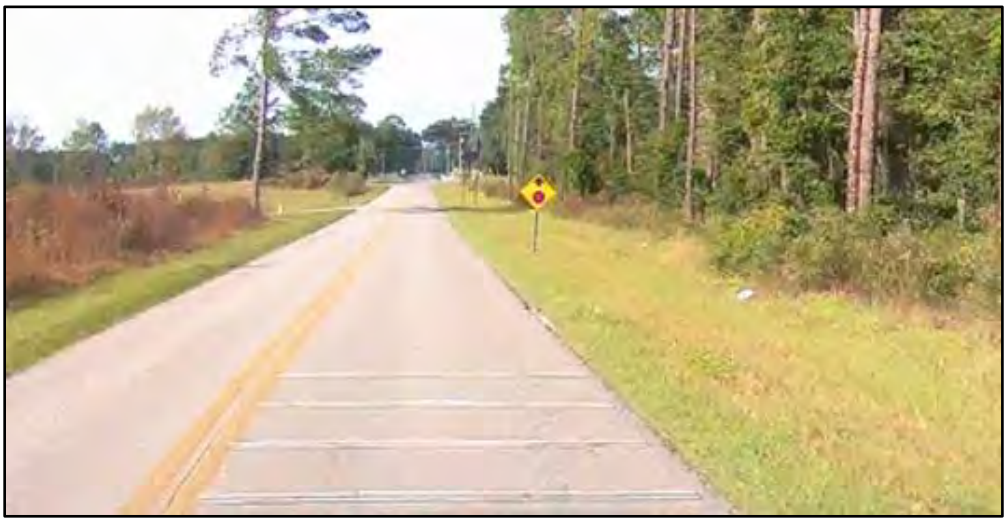

Figure 30. Rumble strips and Stop Ahead sign on Wester Rd (WB) on approach to SR-47 intersection

- *Risk Conditions*

  On the east leg of the intersection, the drivers' sight is limited for the south left turn due to the presence of trees (Figure 31). The WB minor road approach has a hill before the intersection that limits visibility between WB and NB vehicles.

Figure 31. Blocked sight distance Wester Rd WB, looking south

Emphasis Areas for Countermeasures

- Increasing the awareness of drivers on Wester Rd of the presence of intersection
- Remove sight blockage (trees) SE of intersection.

Suggested Countermeasures

- Add overhead flashing beacon.
- Add Intersection Ahead sign on Wester Rd (WB) approach on the hill.
- Remove trees on SE of intersection.
- “Cross Traffic Does Not Stop” sign on minor approaches with flashing beacon

The suggested countermeasures are in Figure 32. The CMF for adding flashing beacon is 0.84 from the CMF clearinghouse. For the rest of the countermeasures, the CMF of 0.9 was assumed, based on engineering judgment. The product of these two CMFs is 0.76. The summary of benefit-cost analysis is in Table 11. The suggested countermeasure costs are approximately $38,222, and the BC ratio is 6.5.

Figure 32. Suggested countermeasures for SR-47 at Wester Rd

Table 11. Benefit-cost summary for SR-47 at Wester Rd

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$74,102	$11,488	$38,222	$291,669	6.5

Factors Affecting Implementation

Right of way	Adding signs is possible with the existing right of way. The property boundaries are shown in Figure 28. From the aerial view, it is not clear whether the trees are in the right of way or not. If so, it would be FDOT responsibility to remove or trim trees.
Environmental impacts	For removing the trees, permits may be required.
Utilities	Regular coordination with utility companies will be required
Community impacts	None anticipated.

6 – CR-240 FROM SR-247 TO CR-131

Site Description

This road segment is a two-lane highway with multiple curves and intersections, as shown in Figure 33. The terrain is relatively flat. The land use close to this segment is mostly farm on the east and west ends of the segment and is a mixture of farms and residential areas in the middle, close to SR-47. The speed limit on CR-240 is 45 mph. The advisory speed on multiple curves and intersections reduces to 35 mph. The focus of this study, based on the crash history, is on curves #1 and #4 and intersections #2, #3, and #5. The speed limit on this road is 45 mph, and there are advisory speed signs of 35 mph on multiple curves.

Figure 33. CR-240 from SR-247 to CR-131

Site #2 is a skewed intersection of CR-240 at SR-47 (skew angle is about 15°). At this two-way stop-controlled intersection, CR-240 is the minor road, as shown in Figure 34. CR-240 is a two-lane highway. Figure 34 shows that the major approach, SR-47, has left-turn lanes on both SB and NB. This intersection has a flashing beacon.

Figure 34. CR-240 site #2

Site #3 is a four-leg, two-way, stop-controlled intersection of CR-240 at Walter Ave with flashing beacon. There is a reverse curve on the WB approach of CR-240 to the intersection.

Site #5 is a four-leg, two-way, stop-controlled intersection of CR-240 at CR-131 with flashing beacon. A more detailed explanation of the sites is given in the next five sections.

Analysis of Problem for CR-240 Site #1

Crashes

The curve shown in Figure 35 experienced two PDO and four injury crashes (Table 12 and Figure 35). One PDO and two injury crashes were curve related (rows with bold font in Table 12). One injury and One PDO were animal related. There was another injury crash due to fatigued driver. For safety analysis, only the three curve-related crashes were considered as correctable. Two of these crashes were nighttime crashes. Figure 36 shows the crash type versus severity.

Figure 35. Crashes on CR-240 site #1

Table 12. Crashes on CR-240 site #1

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83828982	**9/19/2014**	**Daylight**	**Off Road**	**E**	**PDO**	**Dry**
83774009	9/27/2014	Dark - Not Lighted	Off Road	W	Injury	Dry
85559902	8/8/2017	Daylight	Rollover	W	Injury	Dry
85559878	7/18/2017	Daylight	Off Road	E	PDO	Dry
85194246	**1/30/2016**	**Dark - Not Lighted**	**Off Road**	**E**	**Injury**	**Dry**
85130805	**11/10/2015**	**Dark - Not Lighted**	**Off Road**	**W**	**Injury**	**Dry**

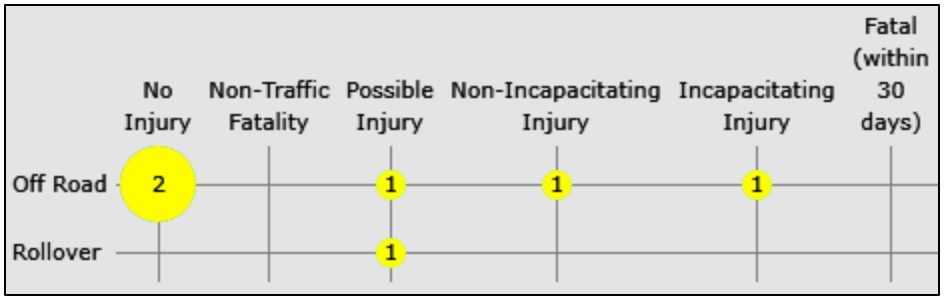

Figure 36. Crash type vs. severity at CR-240 site #1

Field Observations

➢ *Existing Conditions*

- Shoulders and pavement edge drop-offs:

  CR-240 has unpaved shoulders

- Signage:

  Chevron installation as shown in Figure 37

- Pavement markings:

  Standard thermoplastic markings on center and edge

  Centerline RPMs

Figure 37. Existing condition on CR-240 site #1

➢ *Risk Conditions*

These curves are located after a long tangent segment (3.8 mi) on EB. Drivers do not expect the change in alignment (a sudden horizontal curve) after the long tangent segment. Improving the signage will assist drivers' awareness of curve presence. Two of the three curve-related crashes were nighttime crashes. Adding IIRPMs can improve the nighttime visibility.

Emphasis Areas for Countermeasures

- Increase communication with the driver about the change in alignment.
- Improving nighttime visibility of the road alignment.

Suggested Countermeasures

- Chevrons and curve warning signs
- Add center- and edge-line IIRPMs. The beginning of the IIRPMs installation is assumed to be 350 ft before the curve on EB and WB approaches.

The suggested countermeasures are shown in Figure 38. Table 14 shows the summary of benefit-cost analysis. The approximate cost of the suggested project is $193,575 with the BC ratio of 2. Table 38 in Appendix A shows the detail of calculation analysis for this site.

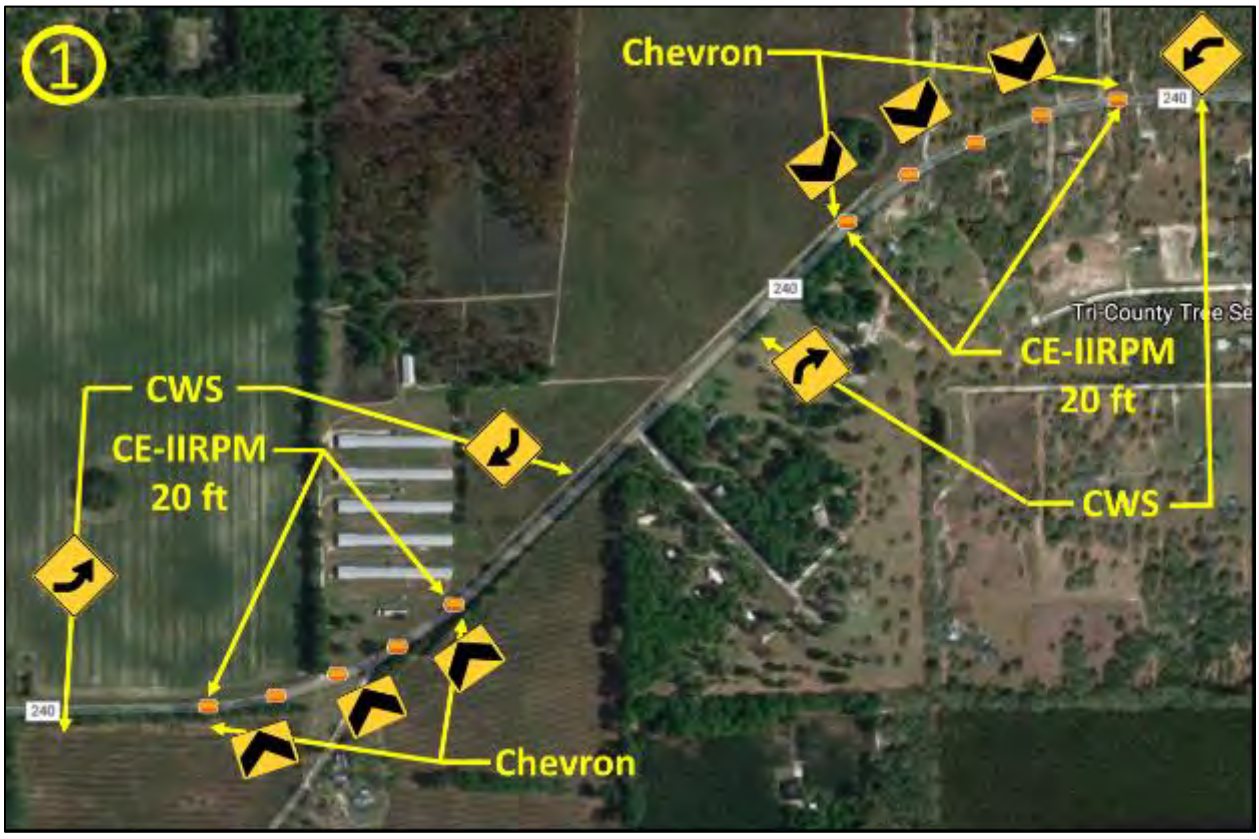

Figure 38. Suggested countermeasures for CR-240 site #1

Table 13. Benefit-cost summary for CR-240 site #1

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$73,430	**$36,927**	**$193,575**	**$133,323**	**2.0**

Factors Affecting Implementation

Right of way	Adding IIRPMs and signs is possible with the existing right of way.
Environmental impacts	None anticipated
Utilities	None anticipated
Community impacts	None anticipated.

Analysis of Problem for CR-240 Site# 2

Crashes

This intersection (CR-240 at SR-47) experienced 11 PDO and three injury crashes, as shown in Table 14. This two-way stop-controlled intersection has a flashing beacon and stop-ahead sign on CR-240. The countermeasure for this location includes a “Cross Traffic Does Not Stop” sign to signal drivers on CR-240 that it is a two-way, stop-controlled intersection and that the mainline traffic does not stop. Of the 14 crashes, two PDO, and two injury crashes were T-angle crashes in which drivers on CR-240 proceeded after a stop. Three of the four crashes occurred in daylight conditions. There were no failed-to-stop crashes at this intersection. As shown in Figure 39, there were one non-incapacitating injury pedestrian crash, three possible injury crashes, and 10 PDO crashes at this intersection.

Table 14. Crashes on CR240 site #2

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83740690	1/1/2014	Dark - Not Lighted	Right Angle	SE	PDO	Wet
83758871	8/19/2014	Daylight	Left Entering	W	PDO	Dry
85277668	3/24/2016	Daylight	Rear End	E	PDO	Dry
85373922	10/31/2016	Daylight	Single Vehicle	E	Injury	Dry
85429875	2/22/2017	Daylight	Left Leaving	W	PDO	Wet
85436380	**2/9/2017**	**Daylight**	**Right Angle**	**SW**	**PDO**	**Dry**
85571192	9/13/2017	Daylight	Other	S	PDO	Dry
84563101	3/18/2015	Daylight	Same Direction Sideswipe	N	PDO	Dry
85140625	**8/2/2015**	**Daylight**	**Right Angle**	**SW**	**PDO**	**Wet**
85563625	7/11/2017	Daylight	Pedestrian	N	Injury	Dry
85571156	**8/4/2017**	**Dusk**	**Right Angle**	**NE**	**Injury**	**Wet**
85353586	8/27/2016	Daylight	Rear End	W	PDO	Dry
83312642	**6/7/2013**	**Daylight**	**Right Angle**	**NE**	**Injury**	**Dry**
85340708	8/27/2016	Dark - Lighted	Parked Vehicle	E	PDO	Dry

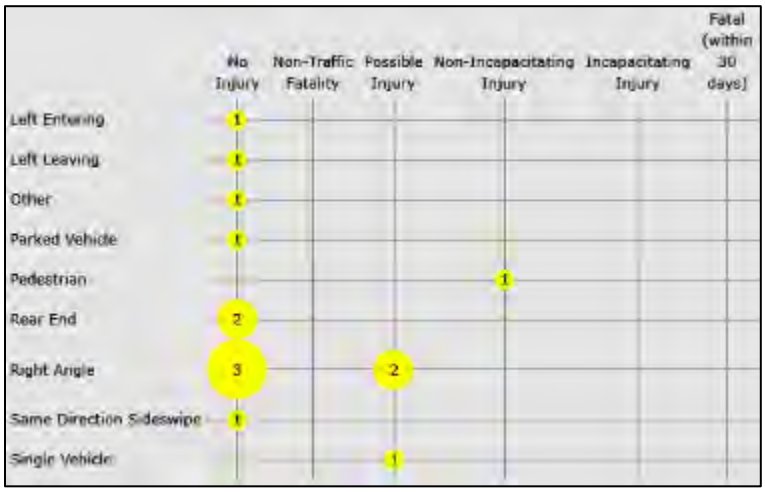

Figure 39 Crash type vs severity at CR-240 site #2

Field Observations

➢ *Existing Conditions*

This intersection is slightly skewed by about 15°.

- Shoulders and pavement edge drop-offs:

  CR-240: unpaved shoulder

  SR-47: paved shoulder

- Signage:

  Regular size stop signs on CR-240

  Stop-ahead signs on CR-240

  Flashing beacon at intersection

- Pavement markings:

  Standard thermoplastic markings on center and edge line on both roads

  Centerline RPMs on both roads

Figure 40. Existing condition of CR-240 site #2

Emphasis Areas for Countermeasures

- Increase the awareness of minor street traffic on EB and WB that the mainline traffic is not stop controlled.

Suggested Countermeasures

- Add “Cross Traffic Does Not Stop” signs for EB and WB approaches, W4-4P MUTCD 36 by 18 inch.

The suggested countermeasures are in Figure 41. No appropriate crash modification factor was found. Based on engineering judgement, the team selected a conservative CMF of 0.95. Table 15 shows the summary of benefit-cost analysis. The approximate cost of the countermeasures is $1,140 with the BC ratio of 45.4. Table 39 demonstrates the cost calculations for this site.

Figure 41. Suggested countermeasures for CR-240 site #2

Table 15. Benefit-cost summary for CR-240 site #2

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$9,870	$218	$1,140	$42,798	45.4

Factors Affecting Implementation

Right of way	Adding sign is possible with the existing right of way.
Environmental impacts	No environmental impact.
Utilities	None anticipated
Community impacts	None anticipated

Analysis of Problem for CR-240 Site #3

Crashes

There were four PDO crashes, two injury crashes, and one fatal crash at this intersection (CR-240 at Walter Ave), as shown in Table 16. All crashes were multi-vehicle between NS and EW movements. The fatal crash involved an impaired driver who failed to stop. The advisory speed on EB and WB approaches is 35 mph. Three out of other six crashes included excessive speed. The focus at this intersection is to reduce the operating speed for WB traffic. For the BC analysis, only three PDO crashes with speed higher than advisory were considered as correctable and were selected for analysis (rows with bold font in Table 16), although it must be noted that since 2017, there was at least one injury crash involving an eastbound vehicle that might be addressed by the proposed improvement. As shown in Figure 42, there were one non-incapacitating injury rollover and one possible injury left-entering crash.

Table 16. Crashes on site #3 of CR240

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
84550724	1/3/2015	Daylight	Rollover	E	Injury	Dry
84513270	10/6/2015	Daylight	Left Entering	S	PDO	Dry
85501905	**5/9/2017**	**Daylight**	**Right Angle**	**SE**	**PDO**	**Dry**
85604869	9/23/2017	Daylight	Left Entering	E	Injury	Dry
85175961	12/8/2015	Daylight	Left Leaving	E	PDO	Dry
83758854	**6/13/2014**	**Daylight**	**Right Angle**	**NW**	**PDO**	**Dry**
83827974	**12/1/2014**	**Dark - Not Lighted**	**Right Angle**	**SE**	**Fatality**	**Dry**

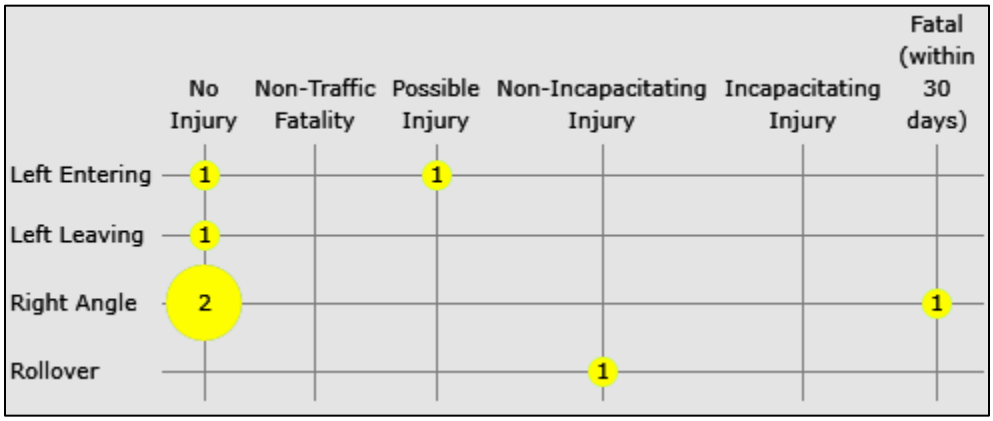

Figure 42. Crash type vs. severity at CR-240 site #3

Field Observations

- *Existing Conditions*

The existing condition of this two-way stop-controlled intersection is shown in Figure 43.

- Shoulders and pavement edge drop-offs:

  Unpaved shoulder on both roads

- Signage:

  Regular-size stop signs on SW Walter Ave and Old Wire Rd

  Stop-ahead signs on Walter Ave

  Flashing beacon at intersection

- Pavement markings:

  Standard thermoplastic markings on center- and edge-line on both roads

  Centerline RPMs on both roads

  Transverse rumble strips on NB and SB approaches

Figure 43. Existing condition of CR-240 site #3

➢ *Risk Conditions*

There is an increased risk due to change in alignment with the “S” curve on the WB approach to the intersection. The risk is a visibility problem between WB vehicles and vehicles on all other approaches. This is caused by a combination of the horizontal and vertical alignment of CR-240 east of the intersection and the vegetation in the SE quadrant of the intersection. The speed limit on CR-240 is 45 mph. The advisory speed on WB and EB approaches is 35 mph. There were three PDO multi-vehicle crashes involving vehicles on EB and WB approaches with higher speed (>35). There is also visibility or sight triangle issue on SE quadrant of the intersection.

Emphasis Areas for Countermeasures

- Decrease vehicle speed approaching the intersection on WB. This countermeasure increases the available reaction time for drivers.

Suggested Countermeasures

- Add radar speed feedback sign on east leg of intersection.

Figure 44. Suggested countermeasure for CR-240 site #3

Figure 44 shows the location for speed feedback sign on WB approach. Because there is no exact crash modification factor for speed feedback sign at intersections, a conservative CMF of 0.95 was adopted, based on engineering judgement. The summary of benefit-cost analysis is in Table 17. The total cost of the project is $15,386 with the BC ratio of 2.5. The cost calculation is shown in Table 40 of Appendix A.

Table 17. Benefit-cost summary for CR-240 site #3

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$7,402	$2,935	$15,386	$17,567	2.5

Factors Affecting Implementation

Right of way	Adding sign is possible on the existing right of way.
Environmental impacts	There seems to be no environmental impact.
Utilities	None anticipated.
Community impacts	None anticipated.

Analysis of Problem for CR-240 Site #4

Crashes

This curve had eight crashes, including one fatal, five injury, and two PDO, as shown in Table 18 and Figure 45. All crashes except one (animal related) were curve related. The fatal crash occurred to a vehicle moving EB in heavy rainy weather condition. The driver lost control of the vehicle and traveled across three raised driveways before overturning. An unrestrained passenger was ejected from the car (fatal). In the same location of the fatal crash, an injury crash occurred, and the unrestrained driver was ejected through the windshield (italic font in Table 18). Six of eight crashes occurred in dry surface conditions. Five crashes were nighttime at this set of curves. Figure 46 shows the crash type versus the severity. Other than the two sideswipe crashes, the rest were single-vehicle off-road crashes.

Figure 45. Location of crashes on CR-240 site #4

Table 18. Crashes on CR-240 site #4

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83331850	7/29/2013	Daylight	Opposing Sideswipe	EW	Injury	Dry
84563098	3/14/2015	Dark – Not Lighted	Off Road	W	Injury	Dry
85316741	8/20/2016	Daylight	Opposing Sideswipe	EW	PDO	Dry
85515821	5/18/2017	Dark - Not Lighted	Off Road	E	Injury	Dry
83296133	*9/13/2013*	*Dark - Not Lighted*	*Off Road*	*E*	*Injury*	*Dry*
85518648	*7/26/2017*	*Daylight*	*Off Road*	*W*	*Fatality*	*Wet*
83316748	6/5/2013	Dark - Not Lighted	Off Road	E	PDO	Dry
82035937	8/15/2013	Dark - Not Lighted	Off Road (Animal related)	W	Injury	Wet

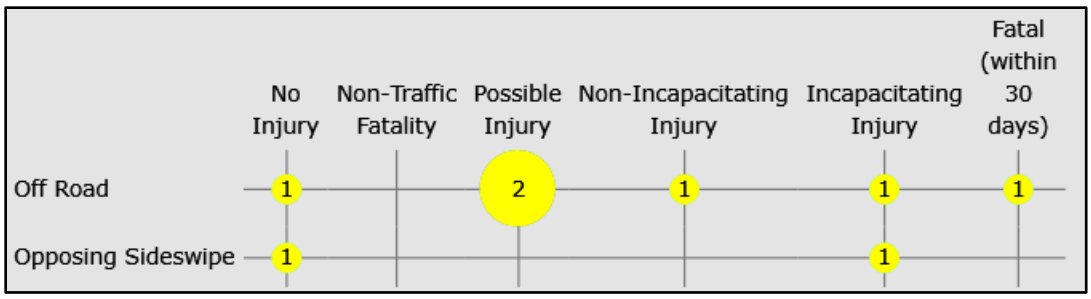

Figure 46. Severity of crashes on CR-240 site #4

Field Observations

➢ *Existing Conditions*

The radii of west and east curves are approximately 450 and 550 ft, respectively.

- Pavement:

  Pavement structure is serviceable

- Shoulders and pavement edge drop-offs:

  Unpaved shoulders with some pavement edge drop-offs

- Signage:

  Limited signs are marking the curves

- Pavement markings:

  Standard thermoplastic markings on center and edge

  Centerline RPMs

➢ *Risk Conditions*

The tight radii of these curves (<600 ft) increases the risk of lane departure for drivers. As seen in a previous section, all the crashes were due to lane departure. Five curve-related crashes were nighttime, so increasing the nighttime delineation can decrease the risk. In addition to signage improvement and nighttime delineation (with enhanced conspicuity), adding HFST will increase the skid resistance (side friction) and helps drivers negotiate the curve effectively.

Emphasis Areas for Countermeasures

- Increase the drivers' awareness of the curves presence (especially nighttime delineation).
- Keep the vehicles in their lane, and help drivers to negotiate the curve effectively.

Suggested Countermeasures

- HFST on both lanes of the curves
  - All six single-vehicle crashes occurred when vehicles were approaching the first curve in either direction. Considering this, one may argue that adding HFST only on EB of curve #1 and WB of curve #2 is enough. However, there were two sideswipe crashes, and one off-road crash occurred when the driver tried to avoid a sideswipe. In the fatal crash, the vehicle was travelling EB when the driver lost control and overturned on the north side of the road. In summary, the increase of side friction on both lanes may reduce crash risk.
- Large chevrons and curve warning signs
  - The advisory speed on the curves is 35 mph, so based on MUTCD recommendations, the chevron spacing of 120 ft is recommended.
- Center- and edge-line IIRPMs on curves

The suggested countermeasures are shown in Figure 47. The summary of benefit-cost analysis is in Table 19. Approximate cost of the project is $290,526 with the BC ratio of 5. Table 41 shows the cost calculations for this project.

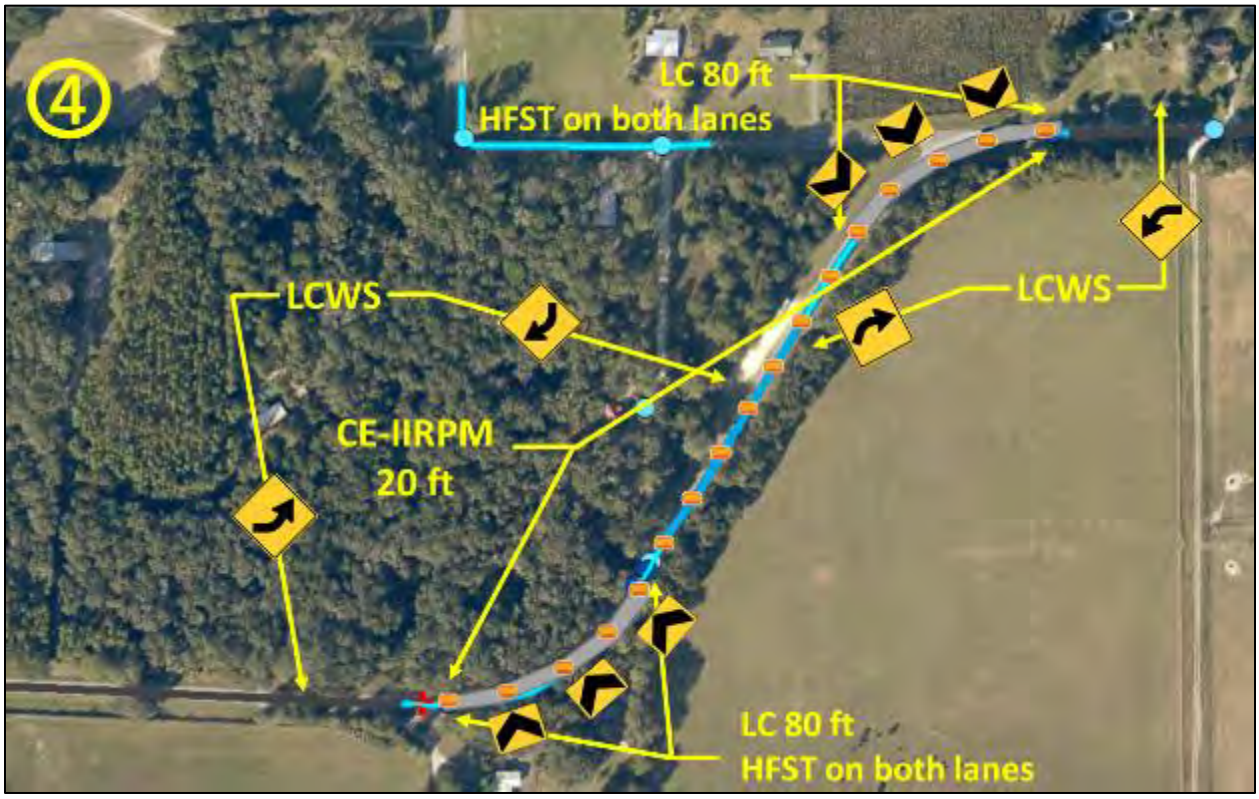

Figure 47. Suggested countermeasures for CR-240 site #4

Table 19. Benefit-cost summary for CR-240 site #4

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$231,750	$46,016	$290,526	$741,183	5.0

Factors Affecting Implementation

Right of way	Adding HFST, signs, and RPMs do not need any additional right of way.
Environmental impacts	None anticipated.
Utilities	None anticipated.
Community impacts	None anticipated.

Analysis of Problem for CR-240 Site #5

Crashes

This intersection (CR-240 at CR-131) experienced one PDO and two injury crashes, as shown in Table 20. One PDO and one Injury crash were angle crashes. All the crashes occurred in daylight in dry surface conditions. In reviewing crashes since 2017, there were at least three WB vehicles that failed to stop at the intersection. The suggested countermeasures were focused on decreasing angle crashes and enhancing the conspicuity of signs used LED stop signs.

Table 20. Crashes at CR-240 site #5

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
87113837	**10/26/2017**	**Daylight**	**Right Angle**	**NW**	**PDO**	**Dry**
81983142	**1/1/2013**	**Daylight**	**Right Angle**	**SW**	**Injury**	**Dry**
83783220	10/16/2014	Daylight	Rear End	N	Injury	Dry

Field Observations

- *Existing Conditions*

The existing condition of this two-way stop-controlled intersection is shown in Figure 48. EB and WB have stop signs.

- Pavement:

  Pavement structure is serviceable

- Shoulders and pavement edge drop-offs:

  Unpaved shoulders on both roads

- Signage:

  Regular size stop signs on CR-240

  Stop ahead signs on CR-240

  Flashing beacon

- Pavement markings:

  Standard thermoplastic markings on center- and edge-line on both roads

  Centerline RPMs on CR-240, but no RPM on CR-131

  Transverse rumble strips on intersection's EB and WB approaches

Figure 48. Existing condition of CR-240 site #5

➢ *Risk Conditions*

There were two T-angle crashes. This intersection is signed appropriately. The additional suggestion is to add two “Cross Traffic Does Not Stop” signs to alert minor street drivers of mainline right of way.

Emphasis Areas for Countermeasures

- Increase the awareness of minor street traffic on EB and WB that the mainline traffic is not stop controlled.

Suggested Countermeasures

- Add “Cross Traffic Does Not Stop” signs for EB and WB approaches, W4-4P MUTCD 36 by 18 inch.
- Add flashing LED stop sign for EB and WB approaches.

No appropriate crash modification factor was found. The CMF for adding flashing LED stop sign from the CMF clearinghouse is 0.59 for angle crashes. Figure 49 and Table 21 show the suggested countermeasure and summary of BC analysis, respectively. The total cost is $7,740,

and the BC ratio of the countermeasures is 27.4. Table 42 shows the detail of cost calculations for this site.

Figure 49. Suggested countermeasure for CR-240 site #5

Table 21. Benefit-cost summary for CR-240 site #5

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$40,466	$1,477	$7,740	$172,405	27.4

Factors Affecting Implementation

Right of way	Adding sign is possible within the existing right of way.
Environmental impacts	None anticipated.
Utilities	Regular coordination with utility companies will be required.
Community impacts	None anticipated.

7- CR-131 FROM CR-349 TO US-41

Site Description

This segment of CR-131 is 8.3 mi of two-lane highway with multiple benign curves, as shown in Figure 50. The terrain is relatively flat with one creek crossing (culvert). Three of the curves experienced curve-related crashes (shown in the following figure). Along CR-131 to the south of CR-242, the land use is agricultural, and there are some residential areas to the north of CR-242. There are two major intersections along this segment at CR-240 and CR-242.

Figure 50. CR-131 from CR-349 to US-41

Analysis of Problem

Crashes

There were two fatal crashes, 16 injury crashes, and 32 PDO crashes on this road, as shown in Table 22. Among these, there were two fatal crashes, seven injury crashes, and 14 PDO lane departure crashes. There were one fatal crash and two injury curve-related crashes on the three mentioned curves shown in Figure 50 (these crashes are rows with bold font in Table 22). Of the 50 crashes, 23 occurred in non-daylight conditions. Only seven of the crashes happened on a wet surface. Figure 51 shows the crash type versus severity. Among the 23 lane departure crashes (off road, rollover, and sideswipe), there were two fatal crashes, three incapacitating injury crashes, two non-incapacitating injury crashes, and three possible injury crashes, along with 13 PDO crashes.

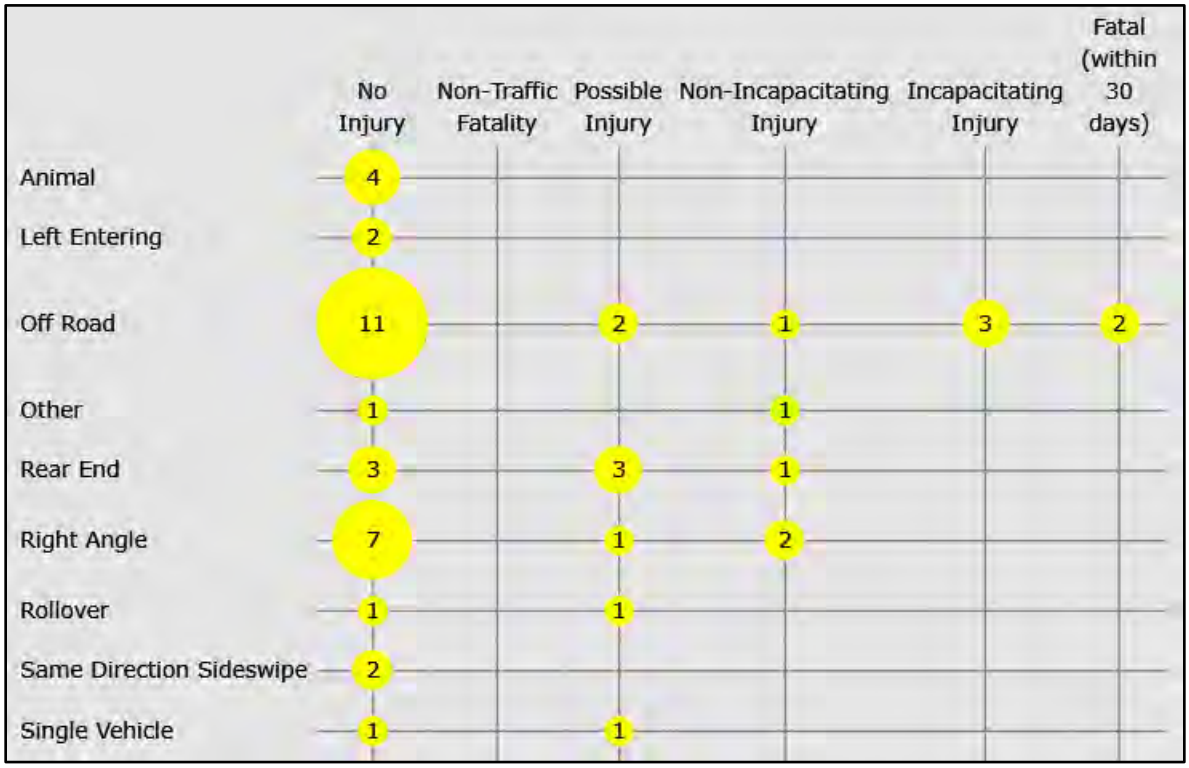

Figure 51. Crashes by severity on CR-131 from CR-349 to US-41

Table 22. Crashes on CR-131 from CR-349 to US-41

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83312637	5/29/2013	Daylight	Rear End	E	Injury	Dry
83295474	**4/12/2013**	**Dark - Not Lighted**	**Off Road**	**S**	**Injury**	**Wet**
83285452	2/22/2013	Dark - Not Lighted	Off Road	S	Injury	Dry
83331829	6/3/2013	Daylight	Right Angle	SW	PDO	Dry
83652296	7/21/2013	Dark - Not Lighted	Off Road	N	PDO	Wet
83331895	12/20/2013	Dark - Not Lighted	Rear End	S	Injury	Dry
81967762	7/7/2014	Daylight	Left Entering	N	PDO	Dry
83761619	9/20/2014	Dark - Not Lighted	Off Road	S	PDO	Dry
83829038	9/7/2014	Dark - Not Lighted	Off Road	W	PDO	Dry
84509295	11/8/2014	Dawn	Off Road	S	Injury	Dry
84549715	1/9/2015	Daylight	Off Road	N	Injury	Dry
84563093	3/1/2015	Dark - Not Lighted	Off Road	S	PDO	Wet
83826899	5/22/2015	Dawn	Animal	N	PDO	Dry
83235522	**5/31/2015**	**Daylight**	**Off Road**	**N**	**Fatality**	**Wet**
85277651	2/29/2016	Daylight	Right Angle	SE	Injury	Dry
85239693	3/14/2016	Dark - Not Lighted	Rear End	S	PDO	Dry
85266019	6/5/2016	Daylight	Other	S	PDO	Dry
85316715	7/8/2016	Daylight	Right Angle	NE	PDO	Dry
85426796	1/5/2017	Daylight	Single Vehicle	N	PDO	Dry
85429851	1/16/2017	Dark - Lighted	Same Direction Sideswipe	N	PDO	Dry
85474927	4/27/2017	Dark - Not Lighted	Right Angle	SE	PDO	Dry
85539895	5/25/2017	Daylight	Off Road	S	PDO	Dry
85499149	6/12/2017	Daylight	Right Angle	SE	PDO	Dry
85574261	8/11/2017	Daylight	Rear End	E	Injury	Dry
85546805	6/9/2017	Dark - Not Lighted	Rear End	S	PDO	Dry
85513470	7/13/2017	Daylight	Off Road	N	PDO	Wet
87114848	11/4/2017	Dark - Not Lighted	Animal	N	PDO	Dry
87114856	11/14/2017	Daylight	Rollover	N	PDO	Dry
85140661	10/20/2015	Daylight	Left Entering	N	PDO	Dry
85413320	2/9/2017	Dark - Not Lighted	Off Road	S	PDO	Dry
83220727	7/31/2014	Dark - Not Lighted	Animal	S	PDO	Dry
85501908	5/12/2017	Daylight	Same Direction Sideswipe	N	PDO	Dry
83312687	10/28/2013	Dark - Not Lighted	Off Road	S	PDO	Dry
83827262	**3/24/2015**	**Dark - Not Lighted**	**Off Road**	**S**	**Injury**	**Dry**
87113837	10/26/2017	Daylight	Right Angle	NW	PDO	Dry
83731904	12/30/2013	Dark - Not Lighted	Other	N	Injury	Dry
81951696	9/23/2014	Daylight	Animal	N	PDO	Dry
85413294	**11/30/2016**	**Daylight**	**Rollover**	**N**	**Injury**	**Dry**
81983142	1/1/2013	Daylight	Right Angle	SW	Injury	Dry
83795567	4/28/2015	Daylight	Rear End	N	PDO	Dry
85140608	6/21/2015	Daylight	Single Vehicle	S	Injury	Dry

84552462	3/26/2015	Dark - Not Lighted	Off Road	N	PDO	Wet
83285489	6/1/2015	Dark - Not Lighted	Off Road	S	Fatality	Dry
83783220	10/16/2014	Daylight	Rear End	N	Injury	Dry
84884868	7/9/2015	Daylight	Off Road	E	PDO	Dry
83827260	3/23/2015	Daylight	Off Road	S	Injury	Wet
83829391	11/2/2014	Dark - Not Lighted	Off Road	N	PDO	Dry
85175972	1/24/2016	Daylight	Right Angle	NW	PDO	Dry
85540637	9/7/2017	Daylight	Right Angle	NW	PDO	Dry
85353570	7/23/2016	Dark - Not Lighted	Right Angle	SW	Injury	Dry

Field Observations

➢ *Existing Conditions*

- Pavement:

  Pavement structure is serviceable

- Shoulders and pavement edge drop-offs:

  Unpaved shoulders

- Signage:

  No chevron signing

  Curve warning signs on curves #1 and #2

- Pavement markings:

  Standard thermoplastic markings on center- and edge-line

  No RPMs

➢ *Risk Conditions*

There were 23 lane departure crashes on CR-131. This road has no RPMs. Adding RPMs can decrease the lane departure crashes. Also, there are three curves with no chevrons.

Emphasis Areas for Countermeasures

- Reduce the lane departure crash risk.

Suggested Countermeasures

- Centerline RPMs on entire road, edge-line RPMs on the curves
- Chevrons on the curves

The summary of countermeasures is shown in Figure 52. Table 23 includes the summary of benefit-cost analysis. The approximate cost of the project is $53,136 with the BC ratio of 26.0.

Table 43 in Appendix A includes the cost calculations for the suggested improvements on this segment.

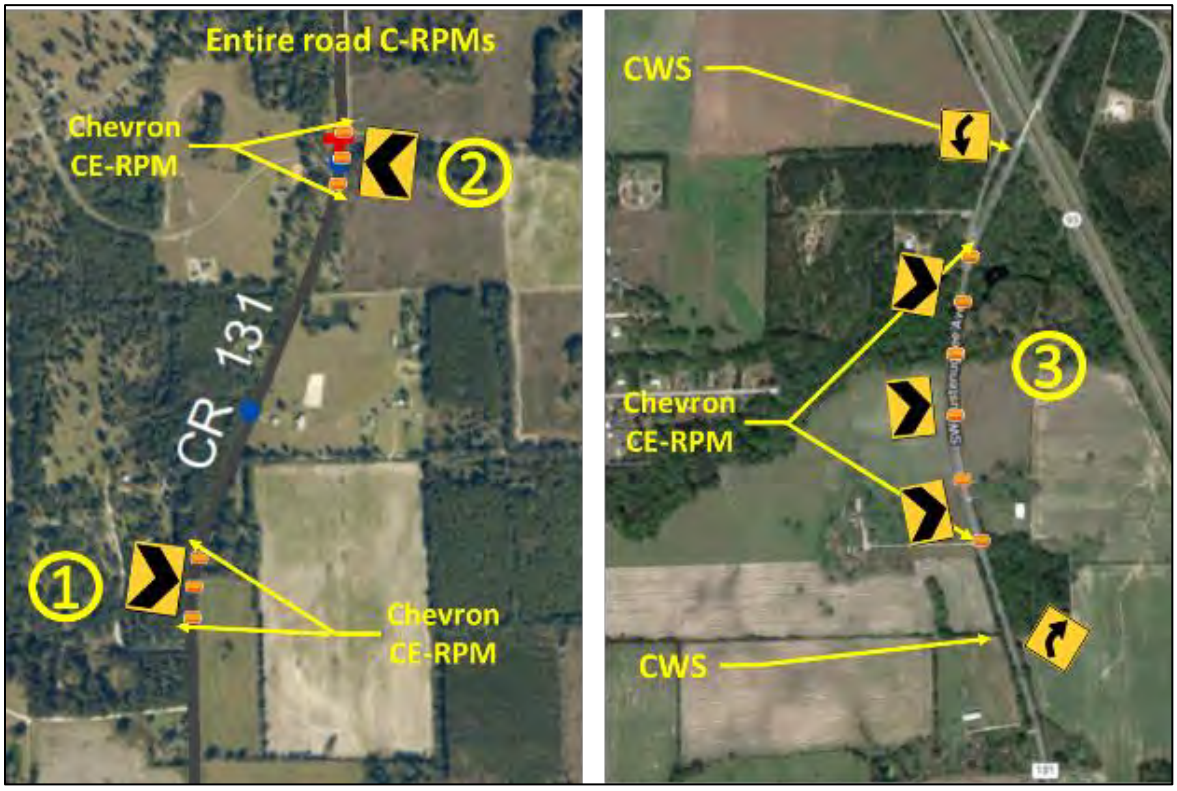

Figure 52. Suggested countermeasures for CR-131 from CR-349 to US-41

Table 23. Benefit-cost summary for CR-131 from CR-349 to US-41

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$263,205	$10,136	$53,136	$1,118,608	26.0

Factors Affecting Implementation

Right of way	The countermeasures are on the roadway (RPM) or adding signs. So, it appears that all improvements can be implemented within the existing right of way.
Environmental impacts	It appears to have no or minimal environmental impact.
Utilities	None anticipated.
Community impacts	None anticipated.

8- CR-349 FROM CR-131 TO CR-245

Site Description

This site is a 5.3-mile section of a two-lane highway, as shown in Figure 48. The terrain is relatively flat with multiple curves, and the speed limit is 45 mph. It has two sets of very short curves with radius less than 1000 ft, #1 and #2. From west to east, the radius of curves #1 and #2 are approximately 600, 700, 900, and 800 ft, respectively. The subject section of CR-349 traverses an area that is primarily agricultural. There is a major two-way stop-controlled intersection at US-441, on which CR-240 is stop controlled.

Figure 53. CR-349 from CR-131 to CR-245

Analysis of Problem

Crashes

This segment experienced one fatal, nine injury, and 20 PDO crashes, as shown in Table 24. Upon reviewing the crash report, it was found that the fatal crash occurred on SW Haltiwanger Rd. Among the rest, there were 26 crashes: eight animal-related, six off-road, seven rear-end, and five rollover. Figure 54 shows the crash type versus crash severity. The incapacitating injury was a crash between a NB left-turning vehicle and a vehicle traveling on SB of US-441 intersection. Considering the rollover and off-road crashes as lane departures, there were two non-incapacitating injury crashes, one possible injury crash, and eight PDO lane departure crashes.

- Set of curves at location #1 had one injury curve-related crash.
- Set of curves at location #2 had one PDO curve-related crash.
- There were three injury crashes and eight PDO lane departure crashes on the entire road.

Of the 29 crashes, 14 occurred in non-daylight conditions, and 24 on dry pavement surface.

Field Observations

➢ *Existing Conditions*

- Pavement:

  Pavement structure is serviceable;

- Shoulders and pavement edge drop-offs:

  Unpaved shoulders with some pavement edge drop-offs

- Signage:

  No chevron signing on curves #1 and #2

  Curve warning signs

- Pavement markings:

  Standard thermoplastic markings on centerline. The edge-line pavement markings have deteriorated and are barely visible

  No RPMs

- Clear zone encroachments:
  The clear zone is limited.

Figure 54. Crashes by severity on CR-349 from CR-131 to CR-245

➢ *Risk Conditions*

Whole road:

The road has no RPM, and the edge pavement markings are worn out.

Curves #1 and #2:

The curves' radii are less than 1000 ft. These curves have no curve warning signs, no chevrons, no RPMs, old edge pavement markings, no shoulder, and steep slope on roadside. Adding RPMs, chevrons, and curve warning signs increases the drivers' awareness of the curves' presence.

Table 24. Crashes on CR349 from CR131 to CR245

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83175870	1/29/2013	Dark – Not Lighted	Animal	W	PDO	Dry
83231044	3/17/2013	Daylight	Rear End	N	PDO	Dry
83317723	8/19/2013	Dark – Not Lighted	Off Road	N	Fatality	Dry
83647150	10/31/2013	Dark – Not Lighted	Rollover	E	PDO	Dry
83758848	5/31/2014	Daylight	Off Road	W	PDO	Dry
84509328	1/17/2015	Dark – Not Lighted	Animal	N	PDO	Dry
83740745	11/26/2014	Dark – Not Lighted	Off Road	E	PDO	Unknown
83164088	3/15/2015	Daylight	Rear End	N	PDO	Dry
84549323	5/21/2015	Daylight	Animal	S	PDO	Dry
85110585	8/22/2015	Dark – Not Lighted	Rollover	S	Injury	Dry
85266823	1/20/2016	Daylight	Rollover	N	PDO	Sand
85237810	¾/2016	Dark – Not Lighted	Off Road	W	PDO	Dry
85266005	5/3/2016	Daylight	Single Vehicle	N	Injury	Mud, Dirt, Gravel
85338215	9/30/2016	Dusk	Rear End	N	Injury	Dry
85442262	4/6/2017	Daylight	Left Entering	S	Injury	Dry
85503616	5/13/2017	Daylight	Backed Into	E	PDO	Dry
85571162	8/15/2017	Daylight	Off Road	E	Injury	Dry
87150395	12/31/2017	Dark – Not Lighted	Rollover	W	Injury	Dry
85266855	3/17/2016	Daylight	Animal	E	PDO	Dry
85244129	4/17/2016	Daylight	Rollover	W	PDO	Dry
83827596	11/3/2014	Dusk	Animal	W	PDO	Dry
85140627	8/5/2015	Daylight	Left Entering	N	Injury	Wet
85320563	7/30/2016	Dark – Not Lighted	Animal	W	PDO	Dry
85562032	8/21/2017	Daylight	Rear End	N	Injury	Dry
85518035	9/7/2017	Dark – Not Lighted	Animal	E	PDO	Dry
83652359	2/4/2014	Dark – Not Lighted	Animal	W	PDO	Dry
85175065	12/2/2015	Daylight	Rear End	N	PDO	Wet
85436351	12/11/2016	Dark – Not Lighted	Off Road	S	PDO	Dry
85599203	10/14/2017	Daylight	Off Road	W	PDO	Dry
83758816	¾/2014	Dark – Not Lighted	Rear End	N	Injury	Dry

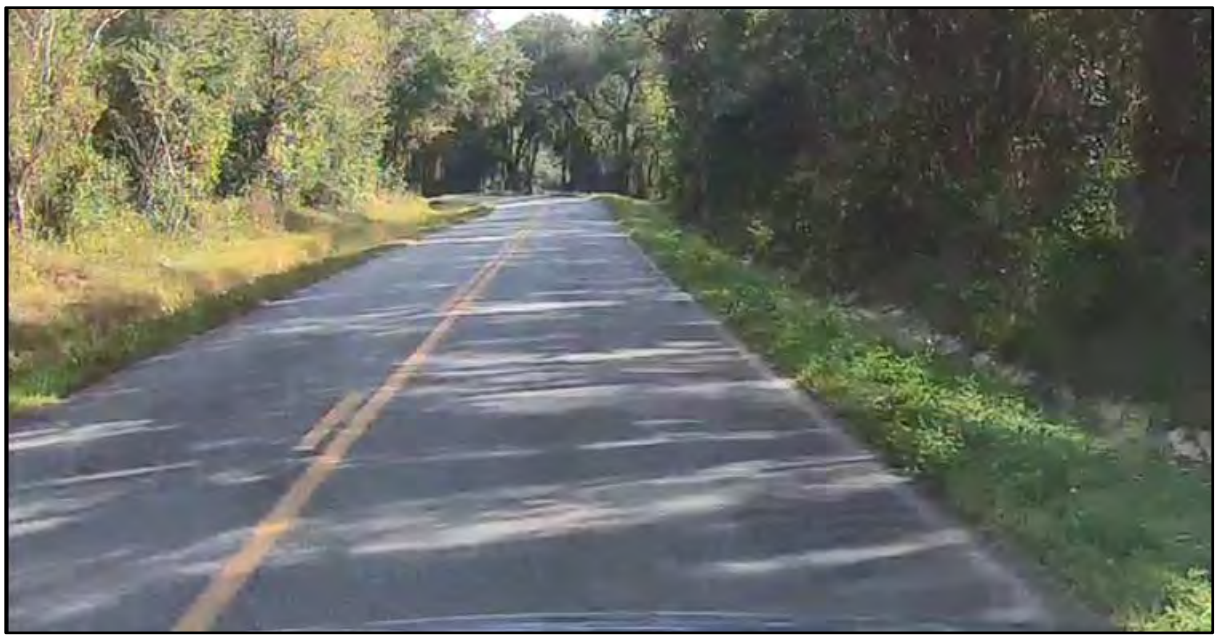

Figure 55. Existing condition of curve #1 on CR-349 from CR-131 to CR-245

Emphasis Areas for Countermeasures

- Mitigate the lane departure crashes on entire road and specifically on the curves at locations #1 and #2.

Suggested Countermeasures

Entire road:

- Centerline RPMs on entire road
- Upgrade edge-line pavement markings

Curves:

- HFST
    - On outer lane of curves #1: As the vehicles negotiate the first curve (in each direction) successfully, most probably they can negotiate the second curve too.
- Signage
    - Large chevrons on the curves #1, and regular-size chevrons on curves #2
    - Curve warning signs on both set of curves
- Pavement markings:
    - Center- and edge-line RPM on curves

The summary of countermeasures is in Figure 56 and Figure 57. The summary of benefit-cost analysis is in Table 25. The approximate cost of the project is $193,697 with the BC ratio of 6.5. Table 44 of Appendix A shows the cost calculations for this site.

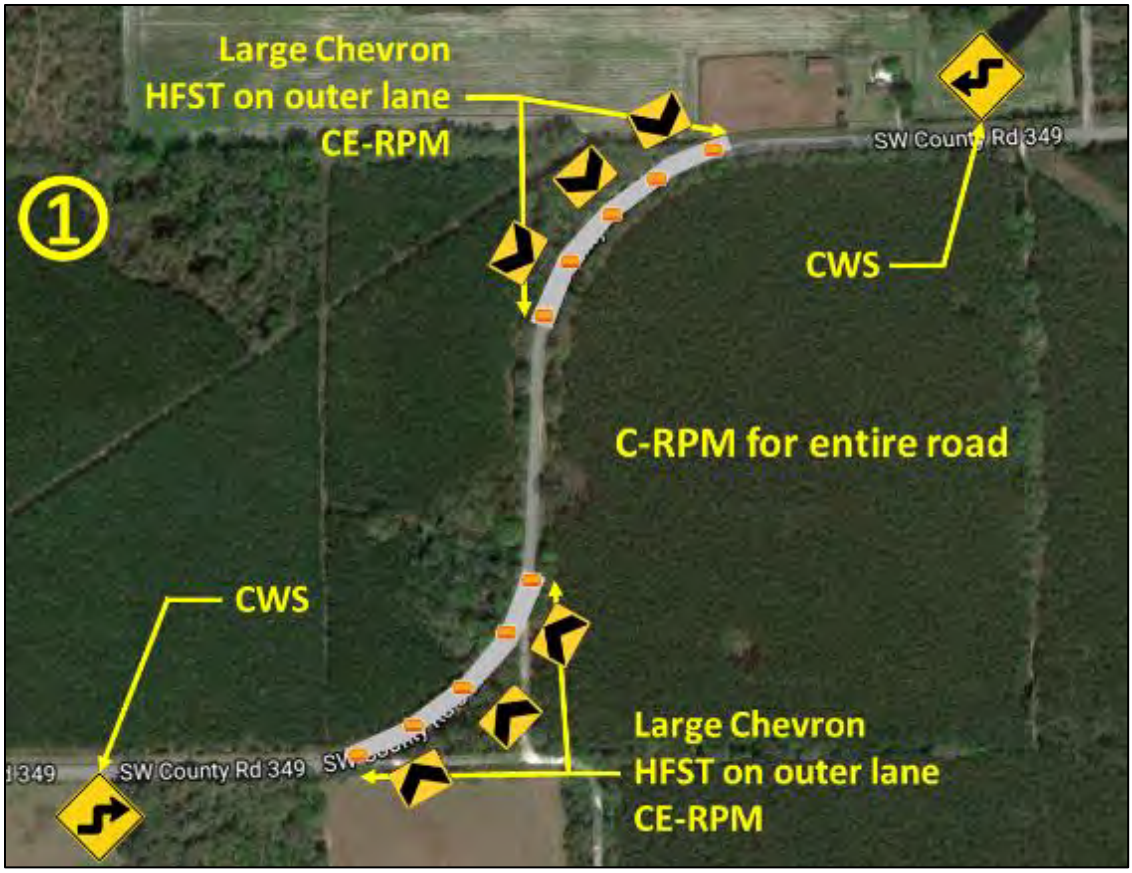

Figure 56. Suggested countermeasures for curve #1 on CR-349 from CR-131 to CR-245

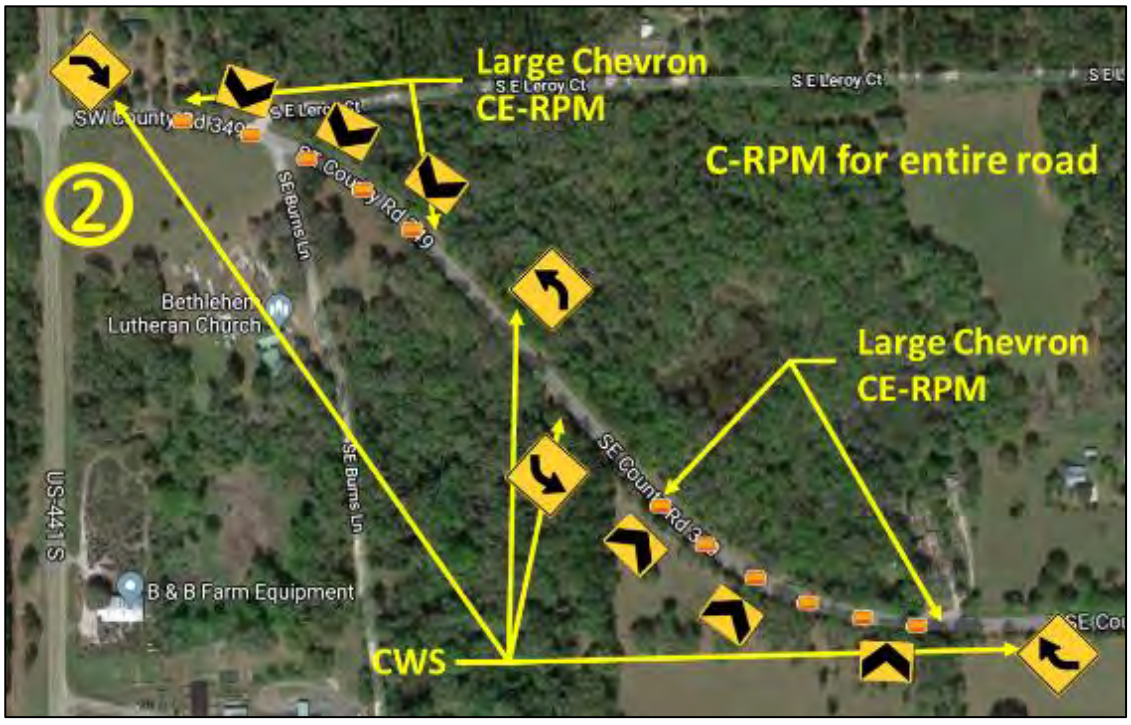

Figure 57. Suggested countermeasures for curve #2 on CR-349 from CR-131 to CR-245

Table 25. Benefit-cost summary for curve #1 on CR-349 from CR-131 to CR-245

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$178,029	**$27,545**	**$193,697**	**$598,856**	**6.5**

Factors Affecting Implementation

Right of way	The countermeasures are RPMs, adding signs, and HFS. So, it appears that all improvements can be implemented within the existing right of way.
Environmental impacts	None anticipated.
Utilities	None anticipated.
Community impacts	None anticipated.

9- SE COUNTRY CLUB ROAD (CR-133C) FROM ALFRED ST TO SE HILLCREST LANE

Site Description

This site is a 0.9-mile section of a two-lane highway on relatively flat terrain. The land use around this segment is mostly agricultural, as shown in Figure 58. The figure shows two simple curves highlighted in blue. The radii of these curve are approximately less than 1000 ft.

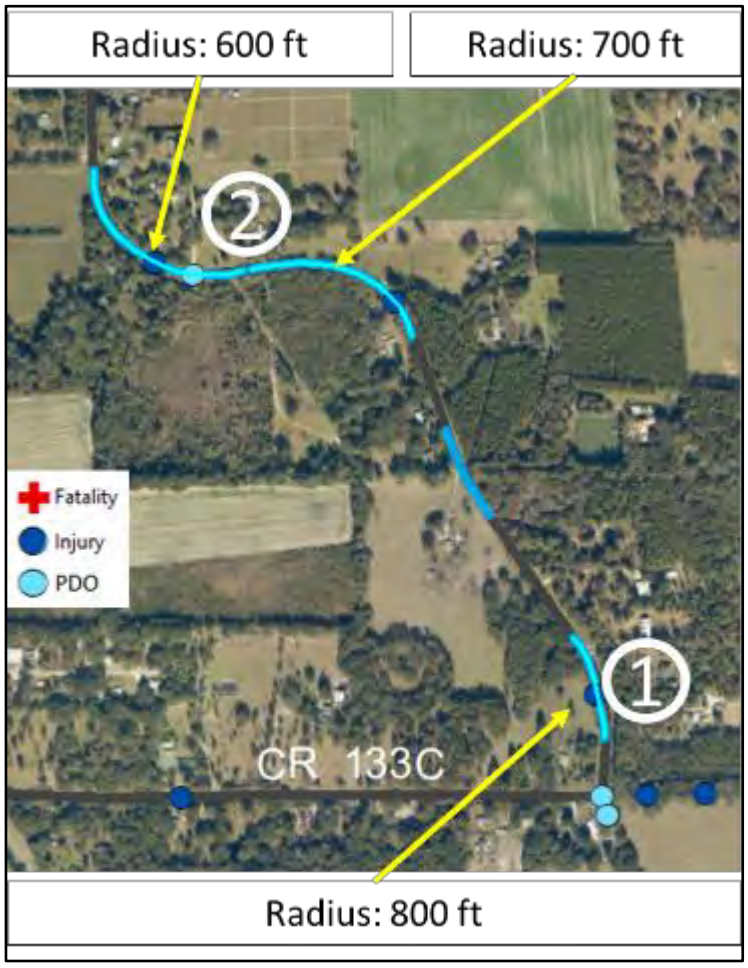

Figure 58. SE Country Club Rd (CR-133C) From Alfred St to SE Hillcrest Ln

Analysis of Problem

Crashes

There were 3 injury and 1 PDO curve related crashes on these curves, 1 injury at curve #1 and the rest on set of curves #2. Three of these crashes were nighttime crashes, so delineation for nighttime is needed. Two of crashes occurred on wet weather condition.

Table 26. Crashes on SE Country Club Rd (CR-133C) From Alfred St to SE Hillcrest Ln

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83826901	7/25/2015	Daylight	Rollover	N	Injury	Wet
85237823	3/19/2016	Dark – Not Lighted	Rollover	S	Injury	Wet
85515824	5/19/2017	Dark – Not Lighted	Off Road	N	Injury	Dry
83783223	10/25/2014	Dark – Not Lighted	Off Road	S	PDO	Dry

Field Observations

➢ *Existing conditions*

- Pavement:

  Pavement structure is serviceable; skid resistance is unknown from crash report reviews. With two wet weather crashes, this needs further analysis.

- Shoulders and Pavement edge drop-offs:

  Unpaved shoulders

- Signage:

  No chevron signing on curves in locations #1 and #2

  Curve warning signs on all curves

- Pavement markings:

  Standard thermoplastic markings on centerline and edge

  No RPMs

➢ *Risk Conditions*

Curves #1 and #2:

Three crashes on the curves were nighttime crashes. It shows drivers have higher risk negotiating the curve in dark condition. Adding chevrons with bright sticks, and IIRPMs can help drivers to better be aware of the curve.

Two out of four crashes occurred on wet road surface condition. This suggests improving side friction on these curves. The curves radii are less than 1000 ft. HFST may help the drivers to negotiate the curves effectively.

Figure 59. Existing condition of curve #1 on SE Country Club Rd (CR-133C) From Alfred St to SE Hillcrest Ln

Emphasis Areas for Countermeasures

- Improve curve delineation, especially nighttime delineation
- Increase pavement skid resistance (side friction)

Suggested Countermeasures

- HFST on set of curves #1 on both lanes
- Chevrons (some curve warning signs are deteriorated. For such signs replacement is suggested)
- Center and edge line IIRPM on curves
- Advisory speed sign on NB after Alfred St

The summary of countermeasures are shown in Figure 60.The summary of benefit-cost analysis is in Table 27. The cost of the project is approximately $545,893 with the BC ratio of 3.0. The cost calculations for this site are shown in Table 45.

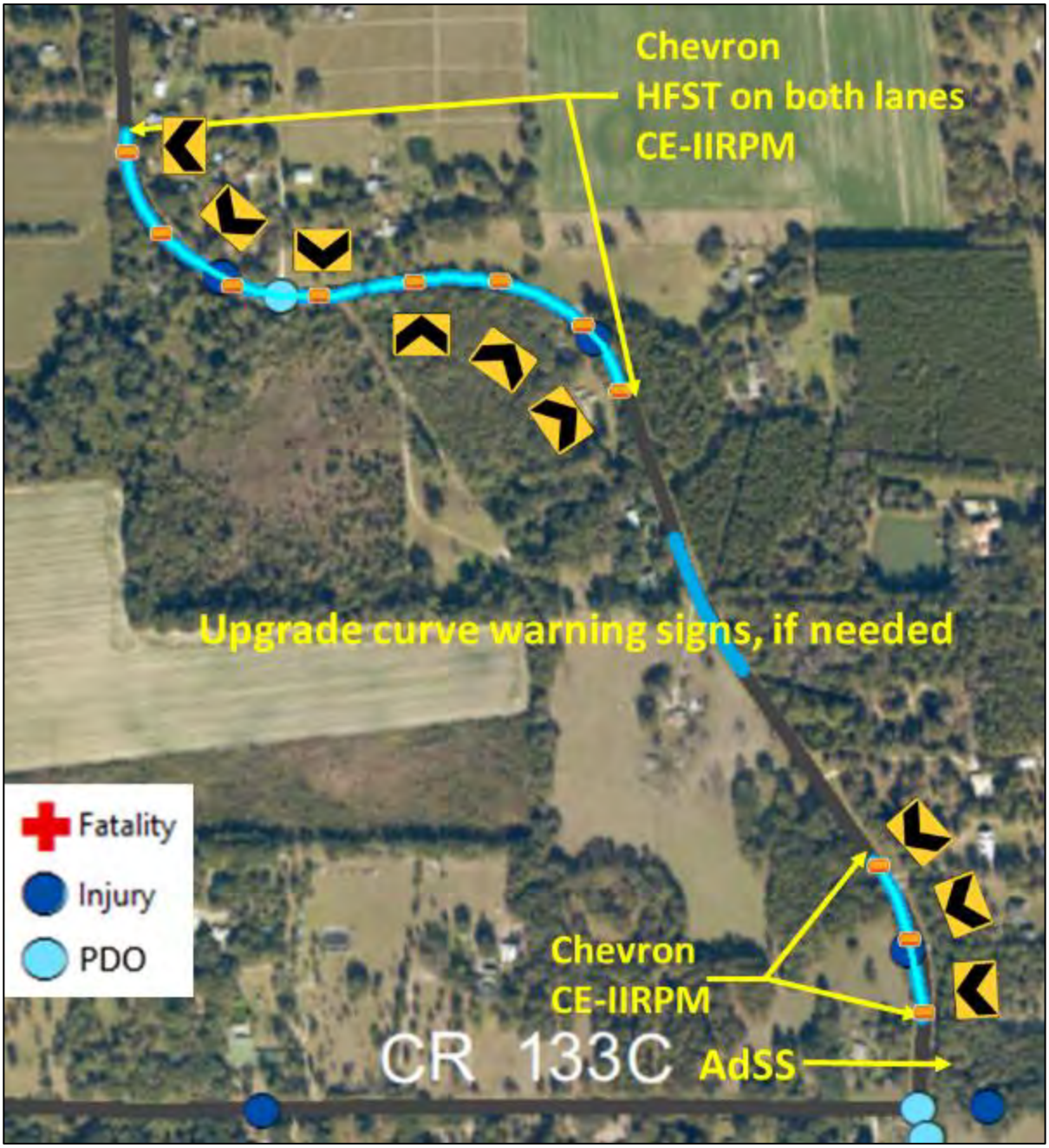

Figure 60. Suggested countermeasures for SE Country Club Rd (CR-133C) From Alfred St to SE Hillcrest Ln

Table 27. Benefit-cost summary for SE Country Club Rd (CR-133C) From Alfred St to SE Hillcrest Ln

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$253,959	$85,326	$545,893	$584,687	3.0

Factors Affecting Implementation

Right of way	All improvements can be implemented within the existing right of way.
Environmental impacts	None anticipated.
Utilities	None anticipated.
Community impacts	None anticipated.

10- CR-246 FROM US-41 TO US-441

Site Description

This site is a 5.1-mile section of a two-lane highway with multiple moderate curves, as shown in Figure 61. The terrain is relatively flat, but several streams or canals cross the highway as shown in Figure 62. As demonstrated in Figure 61, the land use around this segment is agricultural. The speed limit of this road is 45 mph. This segment has a T-intersection on US-41.

Figure 61. CR-246 from US-41 to US-441

Figure 62. CR-246 streams, canals, and two major bridges

Analysis of Problem

Crashes

There were one fatal crash, eight injury crashes, and three PDO crashes on this road, as shown in

Table 28. All the crashes but one injury crash occurred on dry pavement. Eight of 12 crashes were nighttime. This segment experienced one fatal, three injury, and two PDO lane departure crashes. Of these, one fatal and two injury crashes were considered in our analysis, based on countermeasure recommendations. The PDO crashes were animal related (from the crash reports). On the US-41 intersection, there was one injury failed-to-stop crash.

Figure 61, shows the crash types versus severity. The top three crash types were four off-road, two rollover, and two animal related. Of the eight injury crashes, three were incapacitating injury, one was non-incapacitating, and the rest were possible injury crashes.

Table 28. Crashes on CR-246 from US-41 to US-441

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83202666	3/6/2013	Daylight	Right Angle	SE	Injury	Dry
83643835	8/11/2013	Daylight	Off Road	W	Injury	Dry
81967675	10/3/2015	Dark - Not Lighted	Rollover	E	Fatality	Dry
85176048	10/3/2015	Dark - Not Lighted	Pedestrian	E	Injury	Dry
85237819	3/10/2016	Daylight	Animal	E	Injury	Dry
81967686	9/2/2016	Dark - Not Lighted	Single Vehicle	W	Injury	Wet
85421320	2/25/2017	Dark - Not Lighted	Off Road	W	Injury	Dry
85176935	4/1/2017	Dark - Not Lighted	Off Road	W	PDO	Dry
83312685	10/27/2013	Dark - Not Lighted	Rollover	E	PDO	Dry
83662966	12/23/2013	Dark - Not Lighted	Off Road	W	Injury	Dry
85392801	10/31/2016	Daylight	Left Leaving	W	Injury	Dry
85320517	5/16/2016	Dark - Not Lighted	Animal	W	PDO	Dry

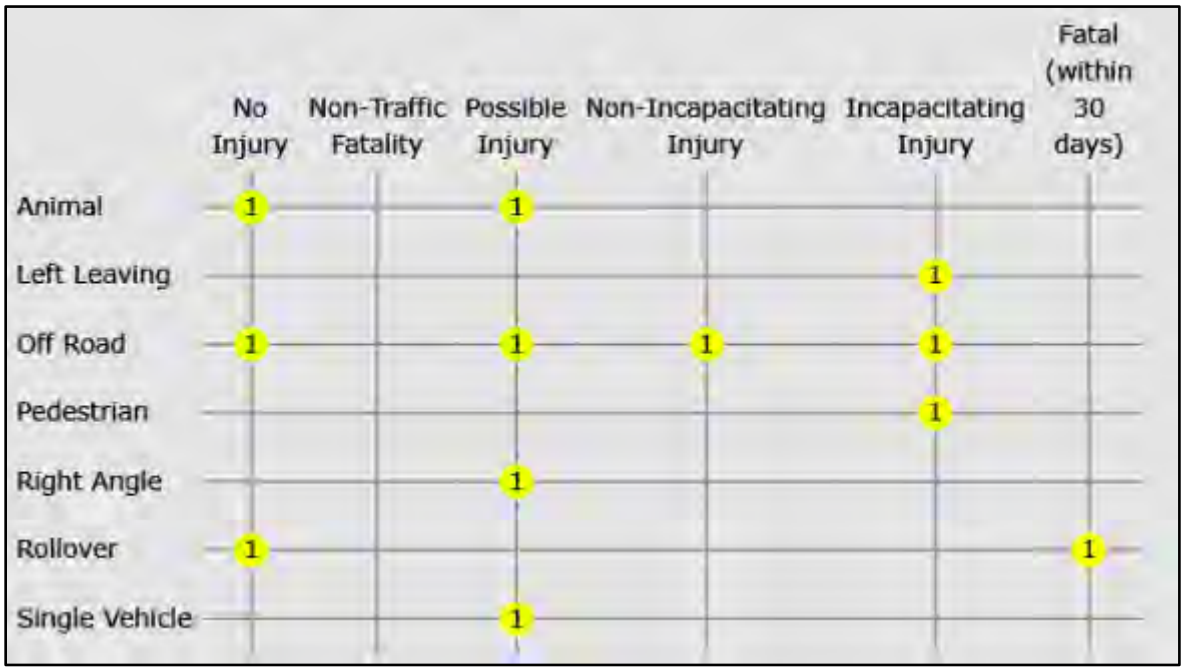

Figure 63. Crash type by severity on CR-246 from US-41 to US-441

Field Observations

➢ *Existing Conditions*

- Shoulders and pavement edge drop-offs:

  Unpaved shoulder

- Signage:

    Curves

        No chevron and curve warning sign

    US-41 intersection

        Intersection-ahead sign

        Regular stop sign

- Pavement markings:

    Standard thermoplastic markings on center- and edge- line. Edge pavement marking are faded in some segments.

    No RPMs

Figure 64. Existing condition of CR-246 from US-41 to US-441

➢ *Risk Conditions*

This road has no RPMs, no curve warning sign, no chevrons on curves. Edge-line pavement markings are functional.

On US-41 intersection, there was a failed-to-stop injury crash. The intersection presence should be delineated more.

Emphasis Areas for Countermeasures

- Mitigate the lane departure crashes on the road
- Mitigate failed to stop crashes on US-41 intersection
- Nighttime delineation at curves

Suggested Countermeasures

RPM

- Centerline RPMs on entire road
- Center and Edge line RPMs on curves

Signs

- Chevrons and curve warnings
- Two large stop sign at US-41 intersection

The suggested countermeasures are shown in Figure 65. The summary of benefit-cost analysis is in Table 29. Approximate cost of the project is $61,657 with the BC ratio of 10.4. Table 46 in Appendix A shows the cost calculations for CR-246.

Figure 65. Suggested countermeasures for CR-246 from US-41 to US-441

Table 29. Benefit-cost summary for CR-246 from US-41 to US-441

Annual benefit in crash reduction cost	Annualized cost	Total cost	NPV	BC ratio
$122,289	$11,762	$61,657	$781,568	10.4

Factors Affecting Implementation

Right of way	All improvements can be implemented within the existing right of way.
Environmental impacts	None anticipated.
Utilities	None anticipated
Community impacts	None anticipated.

5. SITES FOR REFERAL TO FDOT

The focus of this study was to identify and develop effective, low-cost countermeasures for improvements to the local (county or city) road system that will mitigate fatal and serious injury crashes. Several of the sites identified as safety concerns by local officials were either on the state highway system or would require more extensive construction than could be funded with the HSIP program. These sites are identified here with suggestions for further work by FDOT.

VARIOUS INTERSECTIONS IN LAKE CITY

The Lake City Police Department provided a list of intersections as priority concerns. These intersections were mostly on US-90. This segment carries a high volume of traffic and the crashes at the intersections were mostly low severity rear-end crashes. Further review of crashes on US-90, signal timing evaluation, and coordination by FDOT is suggested.

1 – US-41 & NW BASCOM NORRIS DRIVE

Site Description

NW Bascom Norris Dr is the minor approach of this T-intersection, as shown in Figure 66. NW Bascom Norris Dr is a two-lane highway with a left-turn lane in approach to the intersection. US-41 geometry changes along its length. At the intersection, US-41 is a two-lane highway, with exclusive left-turn lane on NB and exclusive right-turn lane on SB. By going 0.2 miles toward SE, US-41 has two through lanes in each direction for almost 4.5 miles. On the north of the intersection, US-41 is a two-lane highway with intermittent turn lanes. All these changes in geometry can complicate the intersection situation for the drivers.

This intersection is surrounded by a mixture of land use: residential area in south and northeast of the intersection, industrial area in north of the intersection, and forest on the west side of the intersection. Approximate distance measure is highlighted in the figure below.

Figure 66. US 41 and NW Bascom Norris Dr

Analysis of Problem

Crashes

This intersection experienced two injury crashes and one PDO crash between 2015 and 2017, as shown in

Table 30. NW Bascom Norris Dr opened in 2015. All the crashes occurred in daylight on dry pavement surface conditions.

Table 30. Crashes on US-41 and NW Bascom Norris Dr, 2015 to 2018.

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83826931	2/12/2016	Daylight	Same Direction Sideswipe	S	PDO	Dry
84316070	11/15/2017	Daylight	Left Entering	W	Injury	Dry

85338216	10/6/2016	Daylight	Rear End	E	Injury	Dry

Risk Conditions

The left- and right-turning traffic on EB of Bascom Norris Dr block each other's sight distance. A right-turn acceleration lane would reduce the conflicting risk. The lines in Figure 66 show the property boundaries, which needs further analysis for available right-of-way estimation.

Figure 67 Blocking view problem on US-41 and NW Bascom Norris Dr

Emphasis Areas for Countermeasures

- Improve sight distance.

Suggested Countermeasures

- Add acceleration lane for the right turn movement, from NW Bascom Norris Dr to US-41.

2 – US-441 AND NE BASCOM NORRIS DRIVE

Site Description

This intersection is in a mixed residential and commercial land use. EB and WB each have one lane per approach. NB has two through lanes and one left-turn lane. SB has one through, one left-turn, and one right-turn lane. It was observed that with single lane EB and WB movement, turning vehicles block the through and right-turn movement.

Figure 68. US-441 and NE Bascom Norris Dr

Analysis of Problem

Crashes

There were seven injury crashes and 12 PDO crashes at this intersection as shown in Table 31. Among these, for two injury and 3 PDO crashes were directly related to the EB left-turn movement.

Table 31. Crashes at US-441 and NE Bascom Norris Dr

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
84316130	12/18/2017	Daylight	Rear End	E	Injury	Dry
84315931	8/23/2017	Dark - Lighted	Rear End	E	Injury	Dry
84315620	6/23/2017	Daylight	Left Entering	W	Injury	Dry
84314607	10/16/2015	Daylight	Off Road		PDO	Dry

84315482	3/27/2017	Daylight	Single Vehicle	E	Injury	Dry
81572759	10/15/2014	Daylight	Single Vehicle	N	Injury	Dry
84314968	10/13/2016	Daylight	Left Entering	E	PDO	Dry
81572376	6/29/2013	Daylight	Off Road	N	PDO	Dry
84313783	12/25/2014	Daylight	Rear End	E	PDO	Dry
84313535	5/31/2014	Daylight	Rear End	E	PDO	Dry
81571936	6/19/2013	Daylight	Unknown		PDO	Dry
84313635	3/9/2014	Dark - Lighted	Head On	N	PDO	Dry
84316169	10/31/2017	Dark - Not Lighted	Left Entering	E	PDO	Dry
84313942	8/21/2014	Daylight	Off Road	N	PDO	Dry
84316128	12/10/2017	Dark - Lighted	Off Road	S	PDO	Dry
84313715	4/23/2014	Daylight	Right Angle	SW	Injury	Dry
81572550	3/23/2014	Daylight	Unknown		Injury	Dry
85499110	4/18/2017	Daylight	Other	W	PDO	Dry
85499122	5/7/2017	Daylight	Same Direction Sideswipe	N	PDO	Dry

Field Observations

➢ *Existing Conditions*

- Pavement markings:

  As shown in Figure 69, pavement in the west leg of the intersection appears to be wide enough to accommodate a left turn, but the space between the EB and WB lanes is marked out with cross hatching.

➢ *Risk Conditions*

At this intersection, 35% of crashes were directly related to EB left-turn movement; however, it does not meet the requirements for recommending a protected left-turn phase. The crash risk could be reduced by adding a left-turn lane. Further review and analysis by FDOT will be required.

Figure 69. NW Bascom Norris Dr intersection EB approach

Emphasis Areas for Countermeasures

- Mitigate crash risk for EB left-turn movement.

Suggested Countermeasures

- Add left-turn lane on NW Bascom Norris Dr intersection west leg.

3 – SR-247 AT CR-240

Site Description

This two-way stop-controlled intersection has a large skew angle of 45°, as shown in Figure 70. All the approaches have one lane, but the SB approach has an extra right-turn lane. CR-240 is the minor approach EB and WB with right-turn ramps. There are a gas station and a Dollar General shop on NW and SW corners of the intersection. The driveways of these two are close to the intersection. As a result, the intersection location is in the sag portion between two crest curves, as shown in Figure 71.

Figure 70. SR-247 at CR-240 intersection

Figure 71. Visibility problem at CR-240 intersection

Analysis of Problem

Crashes

There were one fatal crash, nine injury crashes, and 13 PDO crashes at this intersection. All the crashes were multi-vehicle.

Table 32. Intersection-related crashes at intersection of SR-247 and CR-240

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
83731952	4/11/2014	Daylight	Left Entering	N	Injury	Dry
85295556	7/15/2016	Dusk	Rear End	N	PDO	Dry
85140638	8/19/2015	Daylight	Rear End	N	Injury	Dry
85285258	8/25/2016	Dark - Not Lighted	Left Entering	N	PDO	Dry
85379490	8/26/2016	Daylight	Right Angle	NW	Fatality	Dry
85449065	5/12/2017	Dark - Not Lighted	Right Angle	SW	Injury	Dry
85239696	3/18/2016	Dark - Not Lighted	Other	N	PDO	Wet
85381686	8/23/2016	Daylight	Rear End	S	PDO	Wet
84859092	6/29/2015	Daylight	Rear End	S	PDO	Wet
83752327	7/7/2014	Daylight	Left Entering	E	PDO	Dry
84560228	4/8/2015	Daylight	Right Angle	SW	PDO	Dry
83752296	4/4/2014	Daylight	Single Vehicle	N	PDO	Dry
83647133	8/23/2013	Daylight	Rear End	N	PDO	Wet
84542694	1/24/2015	Daylight	Right Angle	NE	PDO	Dry
85559906	8/11/2017	Daylight	Left Leaving	E	Injury	Dry
85442251	3/23/2017	Daylight	Right Angle	NE	PDO	Dry
83779886	4/3/2014	Daylight	Right Angle	SW	PDO	Dry
83295522	7/6/2013	Daylight	Right Angle	NE	Injury	Dry
87106672	10/19/2017	Daylight	Right Angle	NE	PDO	Dry
84859084	6/6/2015	Dark - Not Lighted	Right Angle	SW	Injury	Dry

Field Observations

➢ *Existing Conditions*

- Shoulders and pavement edge drop-offs:

  SR-247 has paved shoulders. CR-240 only has paved shoulder on approaches close to the intersection.

- Signage:

  Standard stop signs on right side of CR-240 at the intersection

  Double flashing beacon, overhead

- Pavement markings:

  Standard thermoplastic markings on center- and edge-line

  RPMs on both roads

➢ *Risk Conditions*

There are two vertical curves on SR-247 on both SB and NB approaches, as shown in Figure 71. The vehicles travelling on SR-247 in both directions have limited sight distance until they pass the crest of the vertical curves. The drivers on CR-240 also have limited cross-traffic view. The speed limit on SR-247 is 55 mph, which is decreased to 45 mph on approaching the intersection. All the above decreases the available reaction time to drivers on both roads.

Emphasis Areas for Countermeasures

- Due to the presence of various multiple vehicle crash types on different directions, decreasing the T-angle crashes is the goal.

Further study by FDOT will be required to find appropriate countermeasure for this intersection.

4 – US-41 AT SR-238

Site Description

This T-intersection of two two-lane highways is located almost 0.3 mile north of I-75, as shown in Figure 72. SR-238 is the minor approach with stop control. There is a hill 0.2 mile before the intersection on WB. The speed limit is 45 mph on both roads.

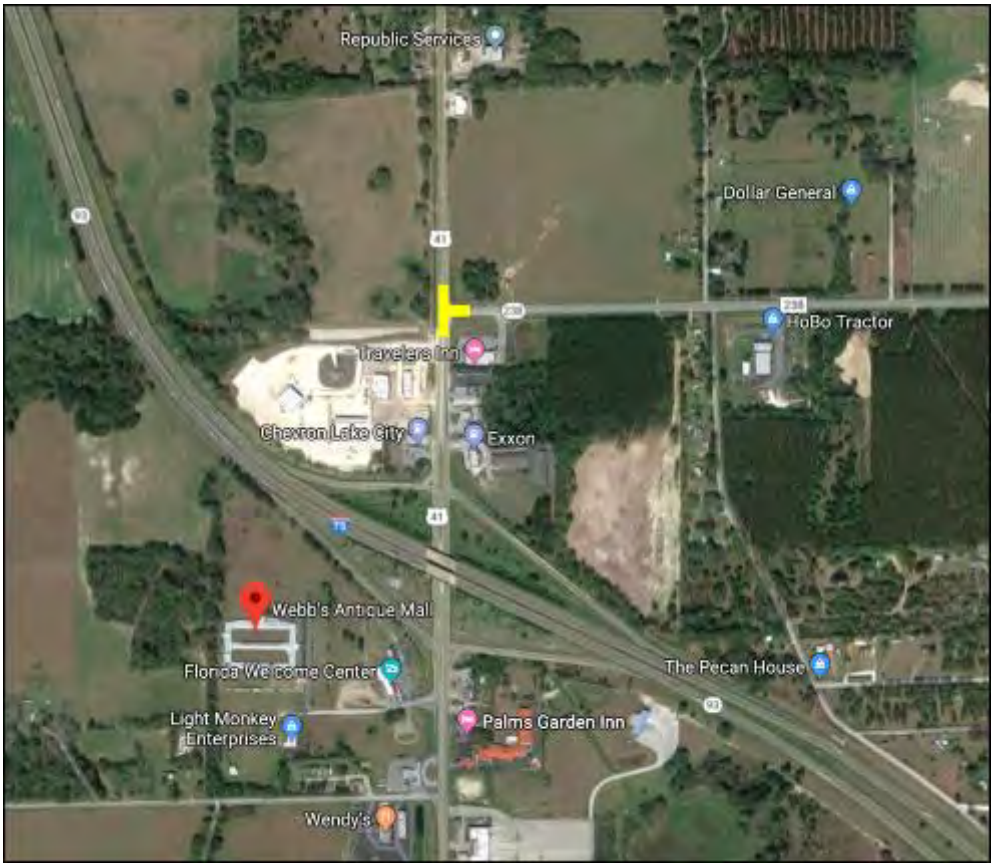

Figure 72. Intersection of US-41 and SR-238

Analysis of Problem

Crashes

There was one fatal crash, six injury crashes, and four PDO crashes at this intersection, as shown in

Table 33. Of the 11 crashes, two crashes occurred on wet pavement surface. Six crashes happened in non-daylight conditions. Figure 73 shows the crash type versus severity. The fatal crash was a failed-to-stop crash due to a fatigued driver. There were three off-road crashes, three rear-end crashes, and three left-leaving crashes. There was one incapacitating injury crash, two non-incapacitating injury crashes, and three possible injury crashes.

Table 33. Crashes at US-41 and SR-238 intersection

HSMV_Num	Date	Light	Crash_Type	Direction	Severity	Surf_Cond
82035909	2/20/2013	Daylight	Rear End	W	Injury	Dry
83651964	12/13/2013	Dark - Not Lighted	Other	S	Injury	Dry
83296151	12/6/2013	Dark - Not Lighted	Rear End	W	Injury	Dry
85520675	**6/6/2017**	**Daylight**	**Left Leaving**	**W**	**PDO**	**Wet**
85563121	**10/27/2017**	**Daylight**	**Unknown**		**Injury**	**Dry**
85520722	**9/3/2017**	**Dark - Not Lighted**	**Off Road**	**W**	**Fatality**	**Dry**
85416923	**2/18/2017**	**Daylight**	**Rear End**	**W**	**PDO**	**Wet**
85413302	**12/19/2016**	**Dark - Not Lighted**	**Off Road**	**W**	**Injury**	**Dry**
85599220	**10/27/2017**	**Dawn**	**Left Leaving**	**W**	**PDO**	**Dry**
85559936	**10/6/2017**	**Daylight**	**Left Entering**	**S**	**Injury**	**Dry**
85239690	3/8/2016	Dark - Not Lighted	Off Road	W	PDO	Dry

Figure 73. Crashes at US-41 and SR-238

Field Observations

➢ *Existing Conditions*

The existing condition of the intersection is shown in Figure 74 and Figure 75.

- Pavement:

  Pavement structure is serviceable

- Shoulders and pavement edge drop-offs:

  Paved shoulder on both roads (Figure 74)

- Signage:

  Standard stop sign with flashing beacon on SR-238 (Figure 74)

  Stop ahead sign and intersection-ahead sign on SR-238 (Figure 75)

- Pavement markings:

  Standard thermoplastic markings on center- and edge-line

  Rumble strips on SR-238 (Figure 75)

Figure 74. Existing condition of US-41 and SR-238, looking west

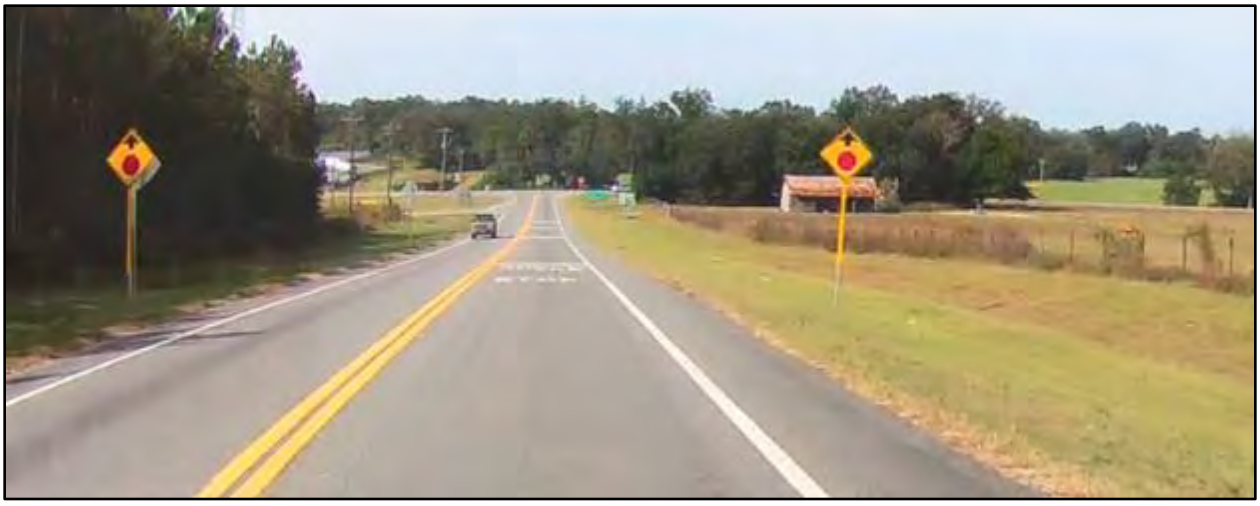

Figure 75. Stop-ahead sign and rumble strips on US-41 and SR-238

➢ *Risk Conditions*

The intersection existing condition includes an intersection-ahead sign, stop-ahead sign, transverse rumble strips, and stop sign with flashing beacon. The intersection stop sign was installed on 8/2016. Seven crashes occurred at this intersection after this date.

6. APPENDIX A COST CALCULATIONS

This section shows the detail of cost analysis and quantity of countermeasures including signs, RPMs, pavement markings, HFST, etc. The annualized costs were calculated by the following formula:

$$Annuity\ Factor\ =\ [1 - (1\ +\ r) - n]\ /\ r$$

$$Annualized\ costs\ =\ Total\ Cost\ \times\ Annuity\ Factor$$

where r is the annual interest rate (0.04) and n is the countermeasure life span reported by the FDOT Roadway Design office.

The yearly benefit of each project is calculated as follows:

$$Anualized\ benefit = Expected\ yearly\ reduction\ in\ crash\ \times Crash\ cost$$

Table 34. Cost analysis for intersection countermeasures at SW Deputy J Davis Ln at CR-252B

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
1	Signs - Single Post Sign <12 SF	Chevrons Signing	30	0700 1 11	AS	$346	$10,366	$1,977
2	RPM - Retro-Reflective Pavement - markers		31	0706 3	EA	$3	$91	$17
3	IIRPM		122	----	0	$170	$20,740	$6,875
4	Speed Feedback	Modify speed limit (increase or decrease)	1	0700 11131	AS	$9,325	$9,325	$1,779
5	Retroreflective Sign Strip		34	0700 13 15	EA	$95	$3,242	$618
6	Signs - Single Post Sign <12 SF	Stop sign	2	0700 1 11	AS	$346	$691	$132
					Subtotal		$44,454	
					Mobilization	10%	$4,445	
					MOT	10%	$4,445	
					CEI	30%	$13,336	
					Eng. & Contingencies	15%	$6,668	
					Total		$73,350	

Table 35. Cost analysis for curve countermeasures at SW Deputy J Davis Ln at CR-252B

#	Countermeasures for cost calculations	description	Quantity	FDOT item	Unit	Unit Cost	Total Cost	Annualized cost
1	Signs - Single Post Sign <12 SF	Combined Unsignalized Intersection Treatment 3Leg 3*22	2	0700 1 11	AS	$345.52	$691	$132
2	Retroreflective Sign Strip		2	0700 13 15	EA	$95.35	$191	$36
3	Sign Removal		1	0700 1 60	AS	$23.49	$23	$4
					Subtotal		$905	
					Mobilization	10%	$91	
					MOT	10%	$91	
					CEI	30%	$272	
					Eng. & Contingencies	15%	$136	
					Total		**$1,494**	

Table 36. Cost analysis for CR-252A from CR-252 TO SR-10

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
1	Signs - Single Post Sign <12 SF	Chevrons Signing	64	0700 1 11	AS	$345.52	$22,113	$4,218
2	Signs - Single Post Sign <12 SF	Curve warning Signing	2	0700 1 11	AS	$345.52	$691	$132
3	IIRPM		192	----	0	$170.00	$32,640	$6,226
4	RPM - Retro-Reflective Pavement - markers		672	0706 3	EA	$2.93	$1,969	$376
5	Signs - Single Post Sign <12 SF	Cross Traffic Does not Stop	1	0700 1 11	AS	$345.52	$346	$66
6	Retroreflective Sign Strip		66	0700 13 15	EA	$95.35	$6,293	$1,200
7	High Friction Surface	High Friction Surface	640	$0.00	Sq ft	$30.00	$19,200	$2,367
					Subtotal		$83,252	
					Mobilization	10%	$8,325	
					MOT	10%	$8,325	
					CEI	30%	$24,976	
					Eng. & Contingencies	15%	$12,488	
					Total		**$137,366**	

Table 37. Cost analysis for SR-47 at Wester Rd

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
1	Large Tree Removal		4	0580 2 10	EA	$3,750.00	$15,000	$5,405
2	Signs - Single Post Sign <12 SF	Stop ahead sign	1	0700 1 11	AS	$345.52	$346	$66
3	Retroreflective Sign Strip		1	0700 13 15	EA	$95.35	$286	$55
4	Signs - Single Post Sign <12 SF	Cross Traffic Does not Stop	2	0700 1 11	AS	$345.52	$691	$132
5	Sign Beacon Double, Sol	Add flashing beacon	1	0700 12 22	AS	$7,032.67	$7,033	$1,342
						Subtotal	$23,355	
						Mobilization	10%	$2,336
						MOT	10%	$2,336
						CEI	30%	$7,007
						Eng. & Contingencies	15%	$3,503
						Total		**$38,536**

Table 38 Cost analysis for CR-240 site #1

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
1	Signs - Single Post Sign <12 SF	Chevrons Signing	40	0700 1 11	AS	$345.52	$13,821	$2,636
2	IIRPM		576	----	0	$170.00	$97,920	$18,679
3	Signs - Single Post Sign <12 SF	Curve warning sign	4	0700 1 11	AS	$345.52	$1,382	$264
4	Retroreflective Sign Strip		44	0700 13 15	EA	$95.35	$4,195	$800
					Subtotal		$117,318	
					Mobilization	10%	$11,732	
					MOT	10%	$11,732	
					CEI	30%	$35,195	
					Eng. & Contingencies	15%	$17,598	
					Total		**$193,575**	

Table 39. Cost analysis for CR-240 site #2

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
1	Signs - Single Post Sign <12 SF	Cross Traffic Does not Stop	2	0700 1 11	AS	$345.52	$691	$132
						Subtotal	$691	
						Mobilization	10%	$69
						MOT	10%	$69
						CEI	30%	$207
						Eng. & Contingencies	15%	$104
						Total		**$1,140**

Table 40. Cost analysis for CR-240 site #3

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
1	Speed Feedback		1	0700 11131	AS	$9,325.07	$9,325	$1,779
					Subtotal		$9,325	
					Mobilization	10%	$933	
					MOT	10%	$933	
					CEI	30%	$2,798	
					Eng. & Contingencies	15%	$1,399	
					Total		**$15,386**	

Table 41. Cost analysis for CR-240 site #4

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
1	Signs - Single Post Sign <12 SF	Chevrons Signing	30	0700 1 11	AS	$345.52	$10,366	$1,977
2	IIRPM	IIRPM	461	----	0	$170.00	$78,370	$14,950
3	High Friction Surface	High Friction Surface	2816	$0.00	Sq ft	$30.00	$84,480	$10,416
4	Retroreflective Sign Strip		30	0700 13 15	EA	$95.35	$2,861	$546
					Subtotal		$176,076	
					Mobilization	10%	$17,608	
					MOT	10%	$17,608	
					CEI	30%	$52,823	
					Eng. & Contingencies	15%	$26,411	
					Total		**$290,526**	

Table 42. Cost analysis for of CR-240 site #5

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
1	Signs - Single Post Sign <12 SF	Cross Traffic Does not Stop	2	0700 1 11	AS	$345.52	$691	$132
2	LED flashing stop sign (solar)		2	----	EA	$2,000.00	$4,000	$763
					Subtotal		$4,691	
					Mobilization	10%	$469	
					MOT	10%	$469	
					CEI	30%	$1,407	
					Eng. & Contingencies	15%	$704	
					Total		**$7,740**	

Table 43. Cost analysis for CR-131 from CR-349 to US-41

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
1	Signs - Single Post Sign <12 SF	Chevrons Signing	58	0700 1 11	AS	$345.52	$20,040	$3,823
2	Retroreflective Sign Strip		64	0700 13 15	EA	$95.35	$6,102	$1,164
3	RPM - Retro-Reflective Pavement - markers	Edge line RPM on Curves	264	0706 3	EA	$2.93	$774	$148
4	RPM - Retro-Reflective Pavement - markers	Centerline RPM entire road	1097	0706 3	EA	$2.93	$3,214	$613
5	Signs - Single Post Sign <12 SF	Curve warning Signing	6	0700 1 11	AS	$345.52	$2,073	$395
					Subtotal		$32,203	
					Mobilization	10%	$3,220	
					MOT	10%	$3,220	
					CEI	30%	$9,661	
					Eng. & Contingencies	15%	$4,831	
					Total		**$53,136**	

Table 44. Cost analysis for CR349 from CR131 to CR245

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
Curve1								
1	Signs - Single Post Sign <12 SF	Chevrons Signing	40	0700 1 11	AS	$345.52	$13,821	$2,636
2	RPM - Retro-Reflective Pavement - markers	Edge line RPM	255	0706 3	EA	$2.93	$747	$143
3	Signs - Single Post Sign <12 SF	Advanced warning signs	4	0700 1 11	AS	$345.52	$1,382	$264
4	High Friction Surface	High Friction Surface	2816		Sq ft	$30.00	$84,480	$10,416
5	Retroreflective Sign Strip		44	0700 13 15	EA	$95.35	$4,195	$800
Curve 2								
1	Signs - Single Post Sign <12 SF	Chevrons Signing	20	0700 1 11	AS	$345.52	$6,910	$1,318
2	RPM - Retro-Reflective Pavement - markers	Edge line RPM	193	0706 3	EA	$2.93	$565	$108
3	Signs - Single Post Sign <12 SF	Advanced warning signs	4	0700 1 11	AS	$345.52	$1,382	$264
4	Retroreflective Sign Strip		26	0700 13 15	EA	$95.35	$2,479	$473
Entire Road								
1	RPM - Retro-Reflective Pavement - markers	Centerline RPM	488	0706 3	EA	$2.93	$1,430	$273
					Subtotal		$117,392	
					Mobilization	10%	$11,739	
					MOT	10%	$11,739	
					CEI	30%	$35,218	
					Eng. & Contingencies	15%	$17,609	
					Total		**$193,697**	

Table 45. Cost analysis for SE Country Club Rd

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
1	Signs - Single Post Sign <12 SF	Chevrons Signing	51	0700 1 11	AS	$345.52	$17,622	$3,362
2	IIRPM	IIRPM	820	----	EA	$170.00	$139,400	$26,592
3	Retroreflective Sign Strip		51	0700 13 15	EA	$95.35	$4,863	$928
4	High Friction Surface		5632		Sq ft	$30.00	$168,960	$20,831
					Subtotal		$330,844	
					Mobilization	10%	$33,084	
					MOT	10%	$33,084	
					CEI	30%	$99,253	
					Eng. & Contingencies	15%	$49,627	
					Total		**$545,893**	

Table 46. Cost analysis for CR-246 from US-41 to US-441

#	Countermeasures for cost calculations	Description	Quantity	FDOT item	Unit	Unit cost	Total cost	Annualized cost
Curves								
1	RPM - Retro-Reflective Pavement - markers	Entire road centerline RPM	674	0706 3	EA	$2.93	$1,975	$377
2	RPM - Retro-Reflective Pavement - markers	Edge line RPM	335	0706 3	EA	$2.93	$982	$187
3	Signs - Single Post Sign <12 SF	Chevrons Signing	68	0700 1 11	AS	$345.52	$23,495	$4,482
4	Signs - Single Post Sign <12 SF	Curve warning Signing	8	0700 1 11	AS	$345.52	$2,764	$527
5	Retroreflective Sign Strip		76	0700 13 15	EA	$95.35	$7,247	$1,382
US 41 Intersection								
1	Signs - Single Post Sign <12 SF	Double large stop sign	2	0700 1 11	AS	$345.52	$691	$132
2	Retroreflective Sign Strip		2	0700 13 15	EA	$95.35	$191	$36
3	Sign Removal		1	0700 1 60	AS	$23.49	$23	$4
					Subtotal		$37,368	
					Mobilization	10%	$3,737	
					MOT	10%	$3,737	
					CEI	30%	$11,210	
					Eng. & Contingencies	15%	$5,605	
					Total		**$61,657**	