October 27, 2020

TECHNICAL MEMORANDUM

INTERSECTION SAFETY STUDY

SR 544 AT DERBY AVENUE

Roadway section ID: 16140000 Milepost: 0.345

Polk County

Submitted to:
Florida Department of Transportation, District One

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1.0 INTRODUCTION

The Florida Department of Transportation, District One Safety Office has retained Johnson, Mirmiran, & Thompson, Inc. (JMT) as part of the District Wide Safety and Minor Design contract to perform a safety analysis and recommend improvements at the intersection of SR 544 and Derby Avenue in Polk County, Florida.

The analysis methods used in conducting this study are consistent with those set forth in the Highway Capacity Manual (HCM), Manual on Uniform Traffic Control Devices (MUTCD) and Toolbox for Countermeasures and Their Potential Effectiveness for Intersection Crashes, and the Florida Department of Transportation's (FDOT's) Manual on Uniform Traffic Studies (MUTS), and Traffic Engineering Manual (TEM). The rate and frequency-based methods that were used concentrate on the exposure and the quantity of crashes and the comparisons to the Florida statewide averages.

Crash analysis tools implemented include the Signal Four Analytics crash software and the Florida Department of Transportation's (FDOT's) Crash Analysis Reporting System (CARS) databases. Crash reports, rates, and statewide comparisons were analyzed using the crash data from January 1, 2015 through December 31, 2019. The FDOT's Florida Traffic Online software was utilized to compute the average daily entering volumes for the intersection, which were needed in order to calculate the average crash rate for the intersection.

2.0 EXISTING CONDITIONS

This section of the report describes the existing physical and operational condition of the intersection at SR 544 and Derby Avenue.

SR 544 is a two-way, six-lane divided urban principal arterial and extends in the northwest-southeast direction located in Auburndale, Florida. **Figure 1** shows the study intersection in relation to the adjacent roadway system. There is 2-foot curb-and-gutter shoulder on both sides of SR 544. SR 544 in the study area has 12-foot lane widths. The posted speed limit along SR 544 is 45 mph. There is lighting along both sides of SR 544. There is no existing sidewalk along either side of SR 544. There are no designated bike lanes along SR 544 at the study intersection.

Derby Avenue is a two-way, two-lane undivided urban collector road and extends in an east-west direction located in Auburndale, Florida. Derby Avenue in the study area has 11-foot lane widths. The posted speed limit along Derby Avenue is 30 mph in both directions east of SR 544. The posted speed limit along Derby Avenue is 40 mph westbound and 35 mph eastbound west of SR 544. There are no paved shoulders or bike lanes on Derby Avenue east of SR 544, and there are 6-foot paved shoulders on both sides of Derby Avenue west of SR 544. There is no lighting along either side of Derby Avenue east of SR 544. There are multiple lighting fixtures on both sides of Derby Avenue west of SR 544. There is no existing sidewalk on either side of Derby Avenue.

The intersection is currently a four-legged signalized intersection. A condition diagram is included in **Appendix A**.

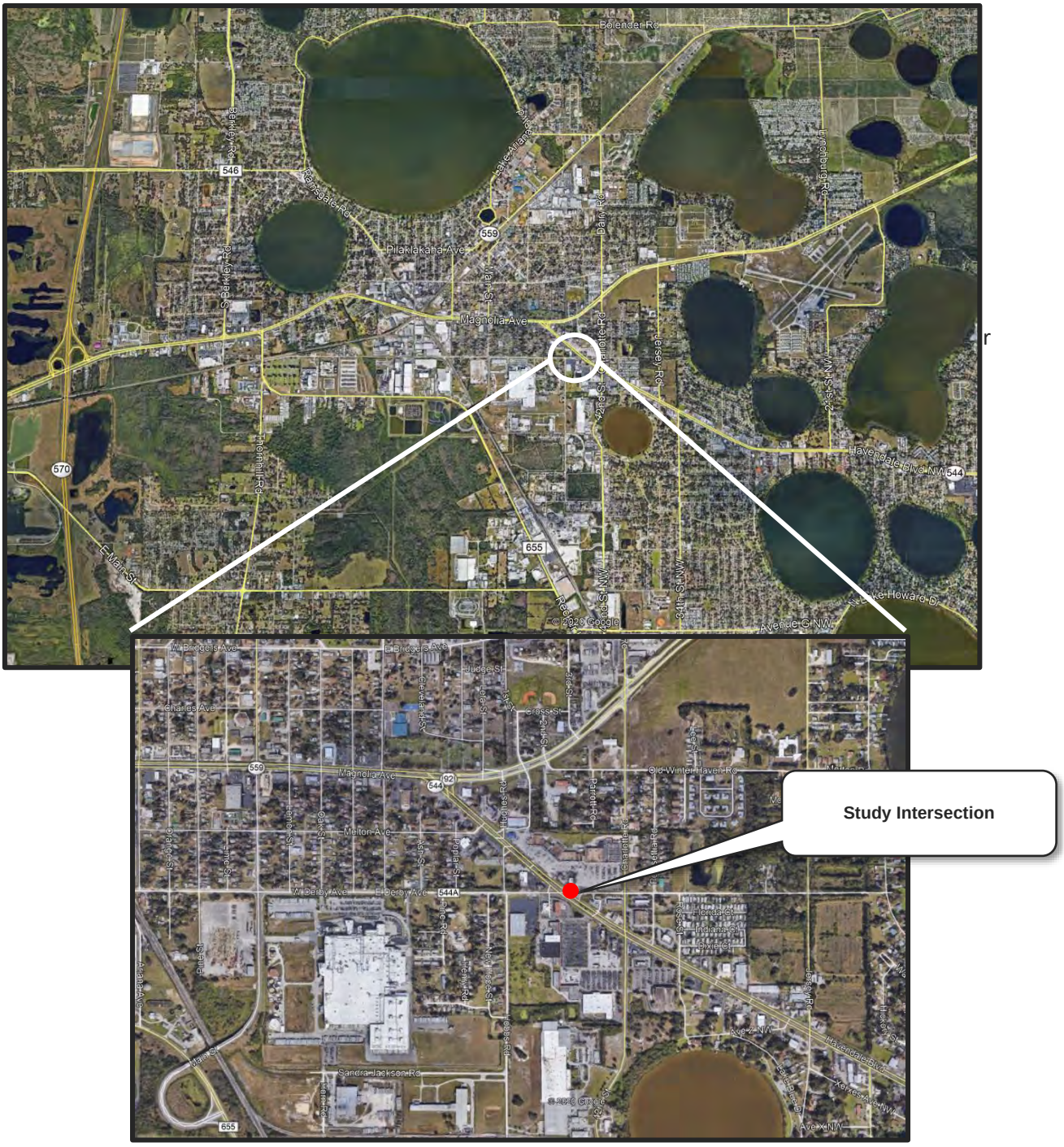


Figure 1: Study Intersection Location

3.0 QUALITATIVE ASSESSMENT

The following is an assessment of existing conditions at the study location.

- The posted speed limit along SR 544 is 45 mph. The posted speed limit along Derby Avenue is 30 mph in both directions east of SR 544. The posted speed limit along Derby Avenue is 40 mph westbound and 35 mph eastbound west of SR 544.
- FDOT's Florida Traffic Online (FTI) 2019 shows the daily truck percentages along SR 544 to be 5.5% about 200 feet northwest of the study intersection. It also shows the daily truck percentages along Derby Avenue to be 13.3% about 1 mile west of the study intersection. These daily truck percentages at FDOT count stations in the vicinity of the study intersections are included in **Appendix B**.
- There is 2-foot curb-and-gutter shoulder on both sides of SR 544. There are no designated bike lanes along SR 544 at the study intersection. There are no paved shoulders or bike lanes on Derby Avenue east of SR 544, and there are 6-foot paved shoulders on both sides of Derby Avenue west of SR 544.
- There are two Lakeland Area Mass Transit (Citrus Connection) bus stops within the vicinity of the intersection. The first bus stop is approximately 500 feet northwest of the study intersection on the east side of SR 544. The second bus stop is approximately 200 feet southeast of the study intersection on the west side of SR 544.
- There is no existing sidewalk at the intersection or along the approaches.
- There is lighting along both sides of SR 544. There is no lighting along either side of Derby Avenue east of SR 544. There are multiple lighting fixtures on both sides of Derby Avenue west of SR 544.
- There is a signalized intersection (SR 544 at Magnolia Avenue) approximately 0.33 miles northwest of the study intersection. There is a signalized intersection (SR 544 at 42nd Street/Charlotte Road) approximately 0.12 miles southeast of the study intersection. There is a signalized intersection (Derby Avenue at Main Street) approximately 0.60 miles west of the study intersection.
- There are 4 driveway entrances within 500 feet east of the intersection along both sides of Derby Avenue. There are 4 driveway entrances within 500 feet west of the intersection along both sides of Derby Avenue. There are 5 driveway entrances within 500 feet southeast of the intersection along both sides of SR 544. There are 5 driveway entrances within 500 feet northwest of the intersection along both sides of SR 544.
- Pavement condition at the intersection is fair to good.
- The intersection is signalized with protected left turns along SR 544 and permissive left turns along Derby Avenue.
- The study intersection contains no pedestrian features or crosswalks.

4.0 CRASH ANALYSIS AND SAFETY EVALUATION

Crash reports were obtained from the University of Florida's Signal Four Analytics database and the FDOT CARS database for the 60-month period extending between January 2015 and December 2019. The crash data for this intersection within the five-year time period is summarized in **Table 1**, and collision diagrams and collision summary sheets are included in **Appendix C** of this report.

According to the crash data, there have been a total of 38 crashes reported within 500 feet of the intersection of SR 544 and Derby Avenue over the five-year period. Thirteen (34%) of the crashes were rear end collisions, nine (24%) of the crashes were sideswipe collisions, five (13%) of the crashes were angle collisions, three (8%) of the crashes were left turn collisions, three (8%) of the crashes were off-road collisions, two (5%) of the crashes were bicycle collisions, one (3%) of the crashes was a pedestrian collision, one (3%) of the crashes was a right turn collision, and one (3%) of the crashes was an other collision. Seven (18%) of the crashes resulted in personal injury and there were two (5%) fatalities. The distribution of the crashes at this intersection by crash type is shown in **Figure 2**. Nine (24%) of the crashes occurred at night and five (13%) occurred on wet pavement. FDOT's Florida Traffic Online 2019 software was utilized to compute the average daily entering volumes for the intersection in order to calculate the average crash rate. An AADT of 28,500 was calculated. The relevant historical AADT sheets are shown in **Appendix B**. The average crash rate for this study intersection was calculated based on the number of crashes per million entering vehicles and was found to be 0.731 crashes per million entering vehicles (MEV). This is lower than the statewide average of 0.884 crashes/MEV for similar urban 4-leg 6+lane 2-way divided raised intersections from 2013 to 2017.

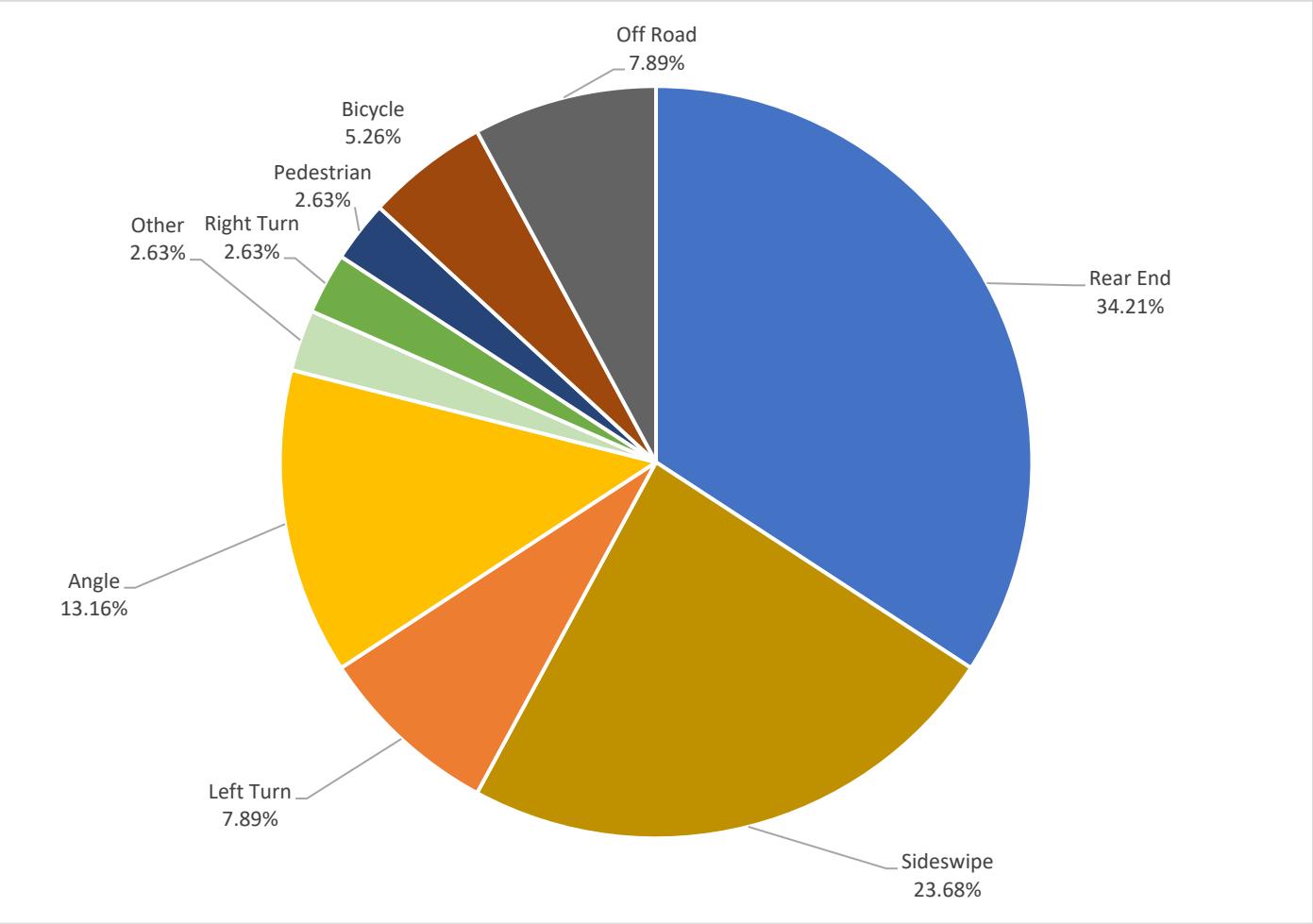


Figure 2: Crash Distribution at SR 544 at Derby Avenue from January 2015 to December 2019

Table 1: Collision Summary
SR 544 at Derby Avenue
January 2015 - December 2019
(60 months of data)

COLLISION TYPE	2015	2016	2017	2018	2019	TOTAL
Rear End	3	3	2	2	3	13
Angle	2	2	1	0	0	5
Left Turn	0	1	0	0	2	3
Right Turn	0	0	1	0	0	1
Sideswipe	3	1	1	2	2	9
Run-Off-Road	1	2	0	0	0	3
Bicycle	2	0	0	0	0	2
Pedestrian	1	0	0	0	0	1
Other	0	0	0	0	1	1
Total	12	9	5	4	8	38
Fatal Crashes	0	0	1	0	1	2
Injury Crashes	3	1	0	2	1	7
Property Damage Only	9	8	4	2	6	29
Day	10	6	4	4	5	29
Night	2	3	1	0	3	9
Wet	1	0	0	1	3	5
Dry	11	9	5	3	5	33
CONTRIBUTING CAUSE	**2015**	**2016**	**2017**	**2018**	**2019**	**TOTAL**
Operated MV in Careless or Negligent Manner	4	2	2	3	2	13
Failed to Yield Right-of-Way	5	1	2	0	3	11
Failed to Keep in Proper Lane	2	1	0	1	1	5
Ran Red Light	0	2	1	0	0	3
Followed too Closely	1	2	0	0	0	3
No Contributing Action	0	1	0	0	0	1
Drove too Fast for Conditions	0	0	0	0	1	1
DUI	0	0	0	0	1	1
Crash Rate (Crashes/MEV)	0.731					

The crash data reveals there was one pedestrian related crash and two bicycle related crash. It should be noted that this study intersection of SR 544 and Derby Avenue does not have any safety features for pedestrians and bicycles. There is no crosswalk across any approaches of the study intersection. There are no bike lanes or sidewalks.

The following is a brief synopsis of the two fatalities that occurred at or within the influence of the intersection of SR 544 and Derby Avenue within the five-year time period.

Crash Report Number 85621543: A sideswipe collision between a motorcycle (Vehicle 1) and a passenger car (Vehicle 2). This fatal crash occurred in 2017. Vehicle 2 turned left from northbound SR 544 to go westbound on Derby Avenue when Vehicle 1 going southbound on SR 544 made a right turn to go westbound on Derby Avenue. Vehicle 1 did not yield at the yield sign before merging onto Derby Avenue and therefore ended up colliding with Vehicle 1. It was determined that Vehicle 1 "failed to yield right-of-way" in this crash. This crash occurred at night under dark-lighted condition. Pavement condition was dry. It was determined that the driver of Vehicle 1 was under DUI (drug under influence).

Crash Report Number 85895260: A left-turn collision between a passenger vehicle (Vehicle 1) and a motorcycle (Vehicle 2). Vehicle 1 traveling southbound along SR 544 made a left-turn to go to the Winn-Dixie shopping plaza north of the study intersection when it hit Vehicle 2 which was traveling northbound along SR 544 at an extremely high speed as indicated by the witnesses. Vehicle 2 was at fault and the cause of this collision was determined to be "Drove too fast for conditions". Vehicle 1 failed to yield right-of-way. This crash occurred at night under dark-lighted condition. Pavement condition was dry.

5.0 NET PRESENT VALUE/BENEFIT-COST ANALYSIS

This section presents the net present value and benefit-cost analysis that was performed for the recommended improvements at the study intersection as shown in the concept layout included in **Appendix D**. The procedures outlined in the Department's ***Highway Safety Improvement Program Guideline*** were used to determine the net present value, and a benefit-cost form has been prepared for the proposed improvements.

The benefit-cost (B/C) analysis was conducted to evaluate the effectiveness of the proposed improvements in reducing crashes at the study intersection. The detailed calculations along with the crash modification factors (CMF) used are included in **Appendix E**.

The FHWA's ***Crash Modification Factors Clearinghouse*** was used as a reference to estimate the percentage of crashes that would be expected to be eliminated with the improvements. Each crash was also reviewed on an individual basis to determine if the proposed improvements would have potentially prevented the crash. Five years of crashes from 2015 to 2019 were used for this analysis. The 2019 five-year average statewide cost per crash based on the roadway typical section and functional classification was used, as reported in Table 122.6.1 of the FDOT Design Manual.

A crash reduction factor of 59% (CMF ID: 9240) was applied to the collisions that would potentially be impacted by the proposed improvement of installing sidewalk at the study intersection. A second crash reduction factor of 40% (CMF ID: 4123) was applied to the collisions that would potentially be impacted by the proposed improvement of installing high-visibility crosswalk at the study intersection. A third crash reduction factor of 58% (CMF ID: 7840) was applied to the collisions that would potentially be impacted by the proposed improvement of installing bike lanes at the study intersection. A fourth crash reduction factor of 9.9% (CMF ID: 4112) was applied to the collisions that would potentially be impacted by the proposed improvement of installing signal backplates. A fifth crash reduction factor of 4% (CMF ID: 5194) was applied to the collisions that would potentially be impacted by the proposed improvement of installing overhead "No Right Turn On Red" signs on the eastbound and westbound approaches to the intersection. A sixth crash reduction factor of 53% (CMF ID: 8320) was applied to the collisions that would potentially be impacted by the proposed improvement of increased intersection illuminance.

The costs for the proposed improvements are $246,966.25 or $18,176.72 annually. This estimate includes roadway, lighting, signing and pavement marking, signalization, maintenance of traffic, mobilization, project unknowns and C.E.I. costs. It does not include right-of-way costs. See **Appendix D** for the cost estimate for the project.

The proposed improvements provide the following net present value results:

- Number of Crashes Potentially Reduced: 18.2 (0.91 annually)
- Annual Monetary Value of Benefits: $112,647.22
- Annual Monetary Value of Cost: $18,176.72
- Benefit-Cost: 6.20
- Net Present Value: $1,425,524.81 (assuming life of the improvements is 20 years)

The proposed improvements result in a high net present value and are expected to have a beneficial impact by reducing a number of the crashes occurring at the study intersection.

The ***Highway Safety Improvement Program Guide*** states that a project can qualify for HSP funds provided that the project is low cost, can be accomplished within three years, and has a net present value greater than 0.

Net Present Value calculations have also been included in **Appendix E** of this report.

6.0 CONCLUSION

Based on the results of the crash analysis and safety evaluation, qualitative assessment, and engineering judgment, the following recommendations were developed for the intersection of SR 544 and Derby Avenue.

1. Consider adding crosswalk along all approaches at the study intersection in order to enhance pedestrian and bicycle safety. This could require adjustment of the stop bars as needed along the approaches.
2. Consider enhancing the signal visibility by adding flexible reflective backplates at the study intersection.
3. Consider extending northbound and southbound left-turn lanes along SR 544.
4. Consider future project programming for adding bike lanes along SR 544 in both directions through the study intersection. This will require a corridor wide assessment to determine if the bike lanes can be installed beyond the intersection limits. There is limited pavement along SR 544 which could hinder the viability of installing bike lanes.
5. Consider adding sidewalk in all four quadrants within the influence of the study intersection to enhance pedestrian safety. The sidewalk and ramps would need to be 6 feet in width. This will require a corridor wide assessment to determine if sidewalks can be installed beyond the intersection limits.
6. Consider installing overhead blank out sign for “No Right-Turn On Red” for westbound and eastbound right turn movements along Derby Avenue to reduce potential right-turn crashes due to the skewed layout of the study intersection.
7. Consider adding yield lines for the northbound and southbound channelized right turn movements.
8. Consider converting the gore on the northwest quadrant of the intersection to a raised island for pedestrian refuge.
9. Consider installing double yield signs to the northbound and southbound right turn movements. Currently there are single yield signs at these locations.
10. Consider reevaluating the clearance interval (yellow and all-red) and the pedestrian timings at the study intersection.
11. Consider shifting the existing signal heads for the through movement along SR 544 to center them over the lane lines.
12. Consider replacing the 11 existing HPS fixtures at the study intersection with LED fixtures.

The conceptual lay out of the study intersection with the proposed improvements along with the cost estimates have been included in **Appendix D**.

APPENDIX A

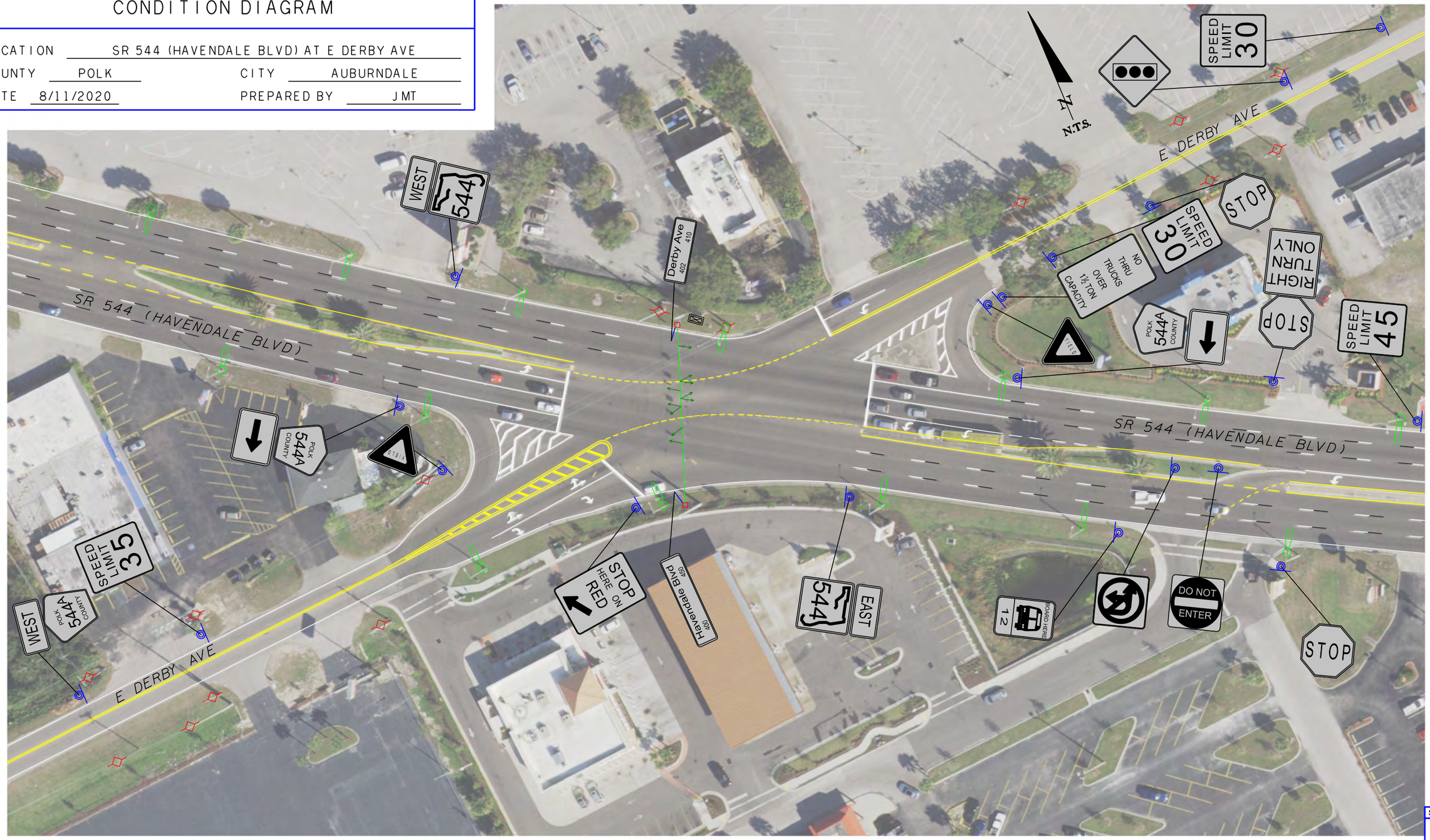
CONDITION DIAGRAM

CONDITION DIAGRAM

LOCATION SR 544 (HAVENDALE BLVD) AT E DERBY AVE

COUNTY POLK CITY AUBURNDALE

DATE 8/11/2020 PREPARED BY JMT



SHEET 1

SYMBOLS

TREES	POWER POLE	COMBINATION POLE	PED. SIGNAL HEAD	OVERHEAD SIGN	FENCE
SHRUBS	SIGN	LIGHT POLE	SIGNAL POLE	HYDRANT	GUARDRAIL
HEDGE	TRAFFIC SIGNAL POLE	SIGNAL HEAD	CONTROLLER CABINET	RR SIGNAL	BUILDING

APPENDIX B

FLORIDA TRAFFIC ONLINE SHEETS

FLORIDA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION STATISTICS OFFICE
2019 HISTORICAL AADT REPORT

COUNTY: 16 - POLK

SITE: 4974 - DERBY AVENUE, E OF MCKEAN ST

YEAR	AADT	DIRECTION 1		DIRECTION 2		*K FACTOR	D FACTOR	T FACTOR
2019	3000 F	E	1500	W	1500	9.00	56.00	13.30
2018	2800 C	E	1400	W	1400	9.00	54.50	12.80
2017	2300 S	E	1100	W	1200	9.00	54.50	12.90
2016	2100 F	E	1000	W	1100	9.00	53.30	12.80
2015	1950 C	E	950	W	1000	9.00	55.70	10.30
2014	2000 S					9.00	55.60	11.00
2013	2000 F		0		0	9.00	55.90	11.30
2012	2000 C	E	0	W	0	9.00	55.80	10.40

AADT FLAGS: C = COMPUTED; E = MANUAL ESTIMATE; F = FIRST YEAR ESTIMATE
S = SECOND YEAR ESTIMATE; T = THIRD YEAR ESTIMATE; R = FOURTH YEAR ESTIMATE
V = FIFTH YEAR ESTIMATE; 6 = SIXTH YEAR ESTIMATE; X = UNKNOWN
*K FACTOR: STARTING WITH YEAR 2011 IS STANDARDK, PRIOR YEARS ARE K30 VALUES

FLORIDA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION STATISTICS OFFICE
2019 HISTORICAL AADT REPORT

COUNTY: 16 - POLK

SITE: 0082 - SR 544, NW OF CR 544A/DERBY AVE AUBURNDALE

YEAR	AADT	DIRECTION 1	DIRECTION 2	*K FACTOR	D FACTOR	T FACTOR
2019	25500 C	E 12500	W 13000	9.00	56.00	5.50
2018	24000 C	E 12000	W 12000	9.00	54.50	5.20
2017	23500 C	E 11500	W 12000	9.00	54.50	6.00
2016	24500 C	E 12500	W 12000	9.00	53.30	4.40
2015	26500 C	E 13000	W 13500	9.00	55.70	4.80
2014	25000 C	E 12500	W 12500	9.00	55.60	4.90
2013	24000 F	E 12000	W 12000	9.00	55.90	4.80
2012	24000 C	E 12000	W 12000	9.00	55.80	4.80
2011	26000 F	E 13000	W 13000	9.00	55.70	4.70
2010	26000 C	E 13000	W 13000	9.55	56.07	4.70
2009	27000 C	E 13500	W 13500	9.36	56.35	5.60
2008	25000 C	E 12500	W 12500	9.78	55.29	5.30
2007	30000 C	E 15000	W 15000	9.66	55.30	5.50
2006	30000 C	E 15000	W 15000	9.62	55.83	6.10
2005	29000 C	E 14500	W 14500	9.30	54.80	8.40
2004	25000 C	E 13000	W 12000	9.50	55.70	8.70

AADT FLAGS: C = COMPUTED; E = MANUAL ESTIMATE; F = FIRST YEAR ESTIMATE
S = SECOND YEAR ESTIMATE; T = THIRD YEAR ESTIMATE; R = FOURTH YEAR ESTIMATE
V = FIFTH YEAR ESTIMATE; 6 = SIXTH YEAR ESTIMATE; X = UNKNOWN
*K FACTOR: STARTING WITH YEAR 2011 IS STANDARDK, PRIOR YEARS ARE K30 VALUES

APPENDIX C

COLLISION DATA

FDOT DISTRICT 1 COLLISION SUMMARY

Main Route: SR 544
Intersecting Route: E Derby Avenue
Study Period: 1/1/2015 TO 12/31/2019

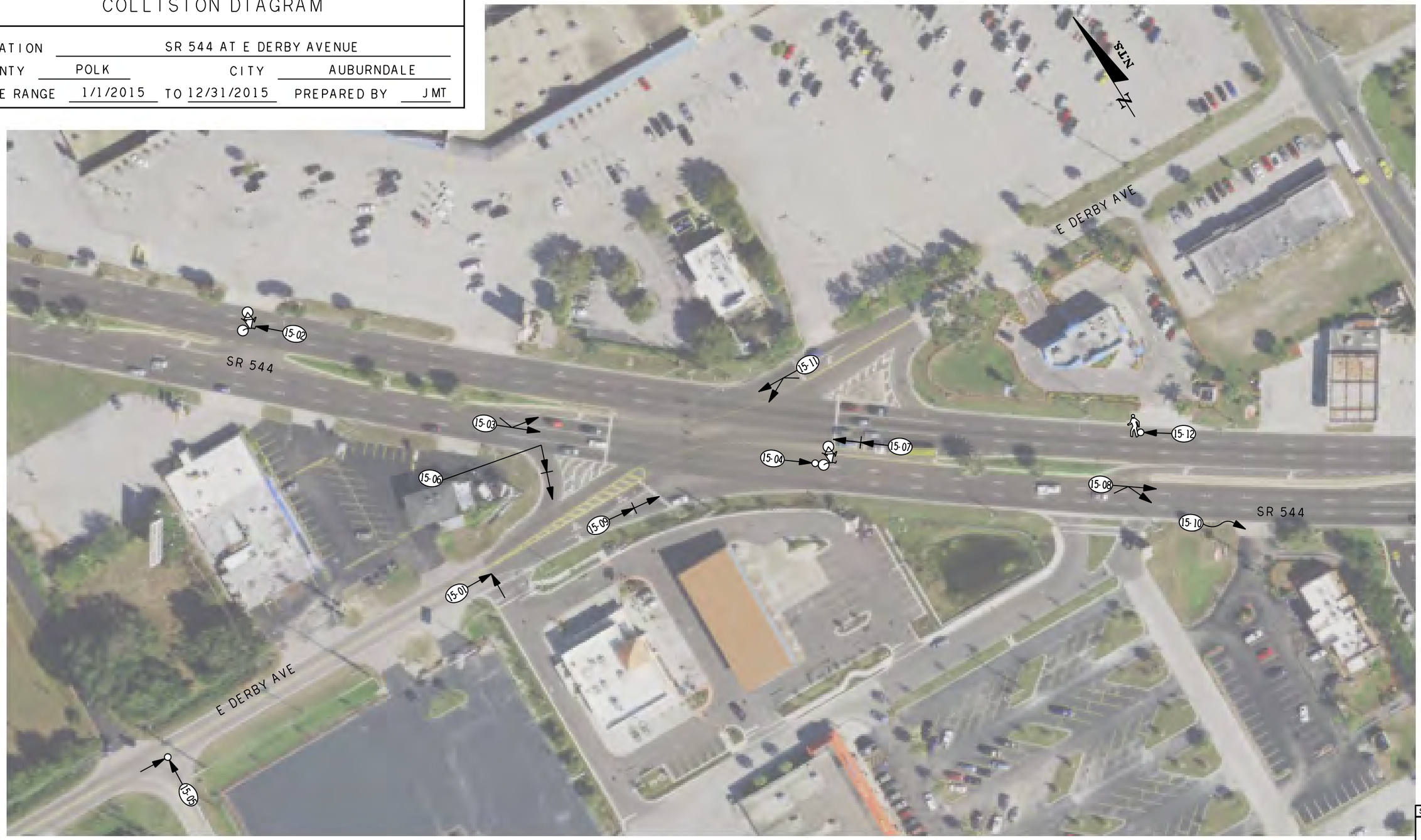
County: Polk
Engineer: JMT

No.	Date	Day	Time	Fatal	Injury	Property Damage	Crash Type	Day/ Night	Wet/ Dry	V1 Cause	V2 Cause
15-01	2/5/2015	Thur.	3:00 PM	0	0	$3,000.00	Angle	Day	Dry	Failed to Yield Right-of-Way	No Contributing Action
15-02	2/10/2015	Tues.	6:04 PM	0	0	$0.00	Bicycle	Day	Dry	Failed to Yield Right-of-Way	No Contributing Action
15-03	2/17/2015	Tues.	4:39 PM	0	0	$0.00	Sideswipe	Day	Wet	Operated MV in Careless or Negligent Manner	No Contributing Action
15-04	3/17/2015	Tues.	3:35 PM	0	1	$500.00	Bicycle	Day	Dry	Failed to Yield Right-of-Way	No Contributing Action
15-05	6/24/2015	Wed.	9:59 AM	0	2	$8,000.00	Angle	Day	Dry	Failed to Yield Right-of-Way	No Contributing Action
15-06	7/2/2015	Thur.	11:45 AM	0	0	$0.00	Rear End	Day	Dry	Operated MV in Careless or Negligent Manner	No Contributing Action
15-07	7/13/2015	Mon.	10:59 AM	0	0	$400.00	Rear End	Day	Dry	Operated MV in Careless or Negligent Manner	No Contributing Action
15-08	7/31/2015	Fri.	4:03 PM	0	0	$0.00	Sideswipe	Day	Dry	Failed to Keep in Proper Lane	No Contributing Action
15-09	9/23/2015	Wed.	8:45 AM	0	0	$0.00	Rear End	Day	Dry	Followed too Closely	No Contributing Action
15-10	10/3/2015	Sat.	12:45 AM	0	0	$0.00	Off Road	Night	Dry	Operated MV in Careless or Negligent Manner	N/A
15-11	12/4/2015	Fri.	11:40 AM	0	0	$0.00	Sideswipe	Day	Dry	Failed to Keep in Proper Lane	No Contributing Action
15-12	12/21/2015	Mon.	6:30 PM	0	1	$5,000.00	Pedestrian	Night	Dry	Failed to Yield Right-of-Way	No Contributing Action
16-01	3/24/2016	Thur.	12:08 PM	0	0	$0.00	Angle	Day	Dry	Ran Red Light	No Contributing Action
16-02	4/18/2016	Mon.	8:15 PM	0	0	$0.00	Rear End	Night	Dry	Followed too Closely	No Contributing Action
16-03	7/23/2016	Sat.	7:31 PM	0	0	$20,000.00	Angle	Day	Dry	Ran Red Light	No Contributing Action
16-04	8/27/2016	Sat.	3:25 AM	0	0	$0.00	Off Road	Night	Dry	No Contributing Action	N/A
16-05	10/4/2016	Tues.	10:25 PM	0	0	$0.00	Left Turn	Night	Dry	Failed to Yield Right-of-Way	No Contributing Action
16-06	10/18/2016	Tues.	7:50 AM	0	0	$0.00	Rear End	Day	Dry	Followed too Closely	No Contributing Action
16-07	11/4/2016	Fri.	3:30 PM	0	0	$0.00	Sideswipe	Day	Dry	Failed to Keep in Proper Lane	No Contributing Action
16-08	11/9/2016	Wed.	4:30 PM	0	1	$5,000.00	Off Road	Day	Dry	Operated MV in Careless or Negligent Manner	N/A
16-09	12/23/2016	Fri.	8:45 AM	0	0	$6,000.00	Rear End	Day	Dry	Operated MV in Careless or Negligent Manner	No Contributing Action
17-01	3/31/2017	Fri.	11:59 PM	1	0	$5,000.00	Sideswipe	Night	Dry	Failed to Yield Right-of-Way	No Contributing Action
17-02	4/26/2017	Wed.	11:00 AM	0	0	$0.00	Rear End	Day	Dry	Operated MV in Careless or Negligent Manner	No Contributing Action
17-03	6/26/2017	Mon.	8:48 AM	0	0	$0.00	Rear End	Day	Dry	Operated MV in Careless or Negligent Manner	No Contributing Action
17-04	9/8/2017	Fri.	1:15 PM	0	0	$2,000.00	Angle	Day	Dry	Ran Red Light	No Contributing Action
17-05	12/6/2017	Wed.	2:25 PM	0	0	$1,000.00	Right Turn	Day	Dry	Failed to Yield Right-of-Way	No Contributing Action
18-01	2/6/2018	Tues.	1:00 PM	0	0	$1,000.00	Sideswipe	Day	Dry	Failed to Keep in Proper Lane	No Contributing Action
18-02	4/12/2018	Thur.	3:35 PM	0	0	$400.00	Rear End	Day	Dry	Operated MV in Careless or Negligent Manner	No Contributing Action
18-03	8/21/2018	Tues.	8:50 AM	0	1	$100.00	Sideswipe	Day	Dry	Operated MV in Careless or Negligent Manner	No Contributing Action
18-04	9/12/2018	Wed.	6:20 PM	0	1	$200.00	Rear End	Day	Wet	Operated MV in Careless or Negligent Manner	No Contributing Action
19-01	1/4/2019	Fri.	7:15 PM	0	0	$3,000.00	Rear End	Night	Wet	Operated MV in Careless or Negligent Manner	No Contributing Action
19-02	2/8/2019	Fri.	8:10 PM	1	1	$13,600.00	Left Turn	Night	Dry	Drove too Fast for Conditions	Failed to Yield Right-of-Way
19-03	4/6/2019	Sat.	8:15 PM	0	0	$750.00	Sideswipe	Night	Dry	Failed to Yield Right-of-Way	No Contributing Action
19-04	5/9/2019	Thur.	3:45 PM	0	0	$300.00	Sideswipe	Day	Dry	Failed to Keep in Proper Lane	No Contributing Action
19-05	6/10/2019	Mon.	2:45 PM	0	0	$1,000.00	Rear End	Day	Wet	Operated MV in Careless or Negligent Manner	No Contributing Action
19-06	10/6/2019	Sun.	2:25 PM	0	0	$500.00	Other	Day	Dry	Failed to Yield Right-of-Way	No Contributing Action
19-07	10/8/2019	Tues.	5:30 PM	0	0	$1,000.00	Rear End	Day	Dry	DUI	No Contributing Action
19-08	10/9/2019	Wed.	5:45 PM	0	2	$10,000.00	Left Turn	Day	Wet	Failed to Yield Right-of-Way	No Contributing Action
TOTAL				**2**	**10**	**$87,750.00**					

	Total No.	Fatal	Injury	Property Damage	Angle	Rear End	Left Turn	Sideswipe	Off Road	Head On
Total	38	2	7	29	5	13	3	9	3	0
%		5%	18%	76%	13%	34%	8%	24%	8%	0%
Pedestrian	Bicycle	Right Turn	Rollover	Other	Day	Night	Dry	Wet	Operated MV in Careless or Negligent Manner	Failed to Yield Right-of-Way
1	2	1	0	1	29	9	33	5	13	11
3%	5%	3%	0%	3%	76%	24%	87%	13%	34%	29%
Ran Red Light	Improper Backing		Failed to Keep in Proper Lane		Followed too Closely	No Contributing Action	Drove too Fast for Conditions	DUI	Failure to Obey Traffic Signs	Exceeded Posted Speed
3	0		5		3	1	1	1	0	0
8%	0%		13%		8%	3%	3%	3%	0%	0%

COLLISION DIAGRAM

LOCATION: SR 544 AT E DERBY AVENUE
COUNTY: POLK CITY: AUBURNDALE
DATE RANGE: 1/1/2015 TO 12/31/2015 PREPARED BY: JMT



SHEET 1

SYMBOLS

- OVERTURNED VEHICLE
- HEAD-ON COLLISION
- COLLISION W/ PED.
- REAR-END COLLISION
- BACKING VEHICLE
- ANGLE COLLISION
- COLLISION W/ BIKE
- SIDE SWIPE
- OUT OF CONTROL
- RIGHT TURN COLLISION
- LEFT TURN COLLISION
- PERSONAL INJURY
- FATALITY

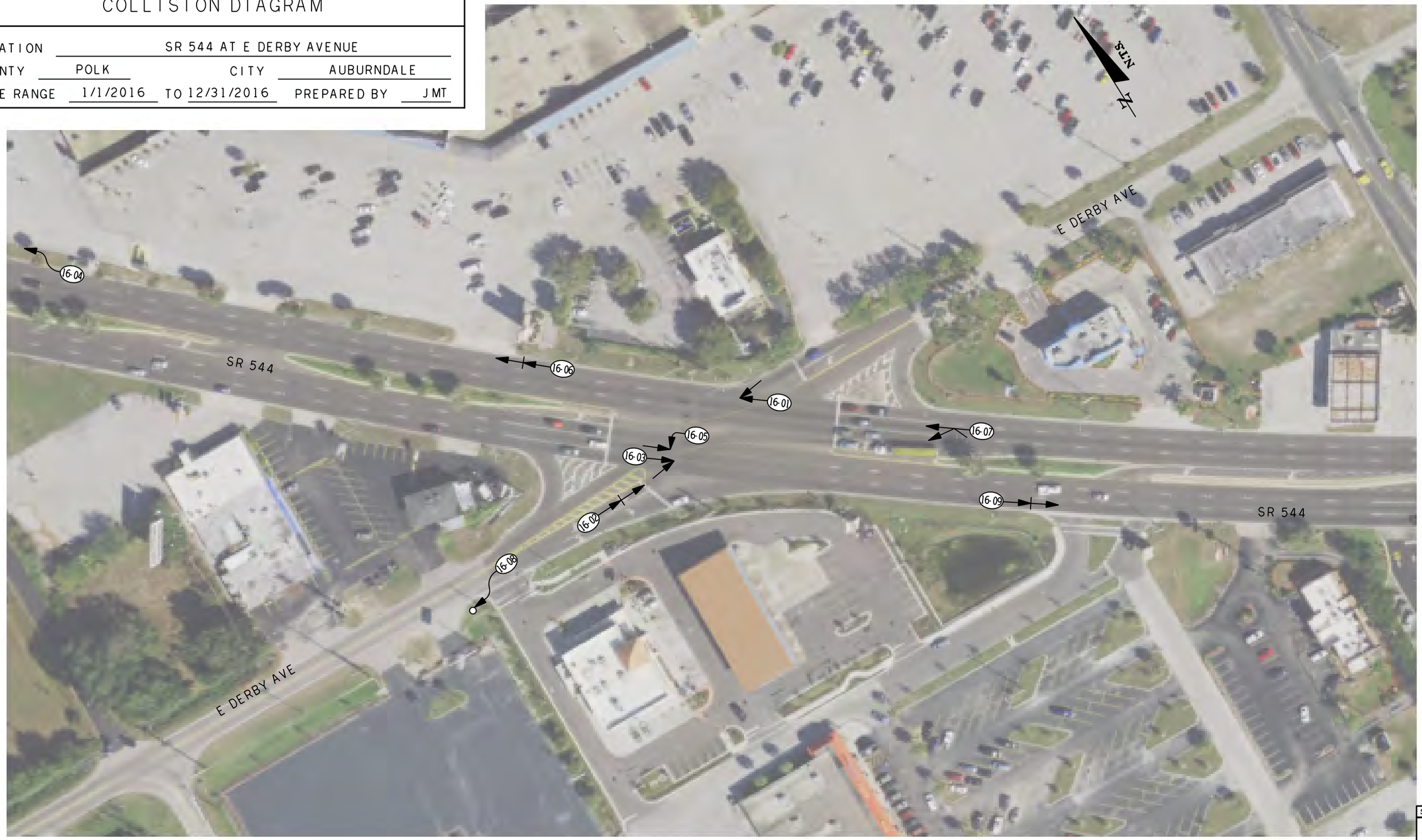
13-01: COLLISION NUMBER; YEAR OF COLLISION (I.E. 13 = 2013)

CRASH SUMMARY

	PROPERTY DAMAGE ONLY	INJURY	FATAL	TOTAL
DAYTIME	8	2	0	10
NIGHTTIME	1	1	0	2
TOTAL	9	3	0	12

COLLISION DIAGRAM

LOCATION: SR 544 AT E DERBY AVENUE
COUNTY: POLK CITY: AUBURNDALE
DATE RANGE: 1/1/2016 TO 12/31/2016 PREPARED BY: JMT



SHEET 2

SYMBOLS

- OVERTURNED VEHICLE
- BACKING VEHICLE
- OUT OF CONTROL
- HEAD-ON COLLISION
- ANGLE COLLISION
- RIGHT TURN COLLISION
- COLLISION W/ PED.
- COLLISION W/ BIKE
- LEFT TURN COLLISION
- REAR-END COLLISION
- SIDE SWIPE
- PERSONAL INJURY
- FATALITY
- 13-01: COLLISION NUMBER; YEAR OF COLLISION (I.E. 13 = 2013)

CRASH SUMMARY

	PROPERTY DAMAGE ONLY	INJURY	FATAL	TOTAL
DAYTIME	5	1	0	6
NIGHTTIME	3	0	0	3
TOTAL	8	1	0	9

COLLISION DIAGRAM

LOCATION: SR 544 AT E DERBY AVENUE
COUNTY: POLK CITY: AUBURNDALE
DATE RANGE: 1/1/2017 TO 12/31/2017 PREPARED BY: JMT

SHEET 3

SYMBOLS

- OVERTURNED VEHICLE
- BACKING VEHICLE
- OUT OF CONTROL
- HEAD-ON COLLISION
- ANGLE COLLISION
- RIGHT TURN COLLISION
- COLLISION W/ PED.
- COLLISION W/ BIKE
- LEFT TURN COLLISION
- REAR-END COLLISION
- SIDE SWIPE
- PERSONAL INJURY
- FATALITY
- 13-01: COLLISION NUMBER; YEAR OF COLLISION (I.E. 13 = 2013)

CRASH SUMMARY

	PROPERTY DAMAGE ONLY	INJURY	FATAL	TOTAL
DAYTIME	4	0	0	4
NIGHTTIME	0	0	1	1
TOTAL	4	0	1	5

COLLISION DIAGRAM

LOCATION: SR 544 AT E DERBY AVENUE
COUNTY: POLK CITY: AUBURNDALE
DATE RANGE: 1/1/2018 TO 12/31/2018 PREPARED BY: JMT

SHEET 4

SYMBOLS

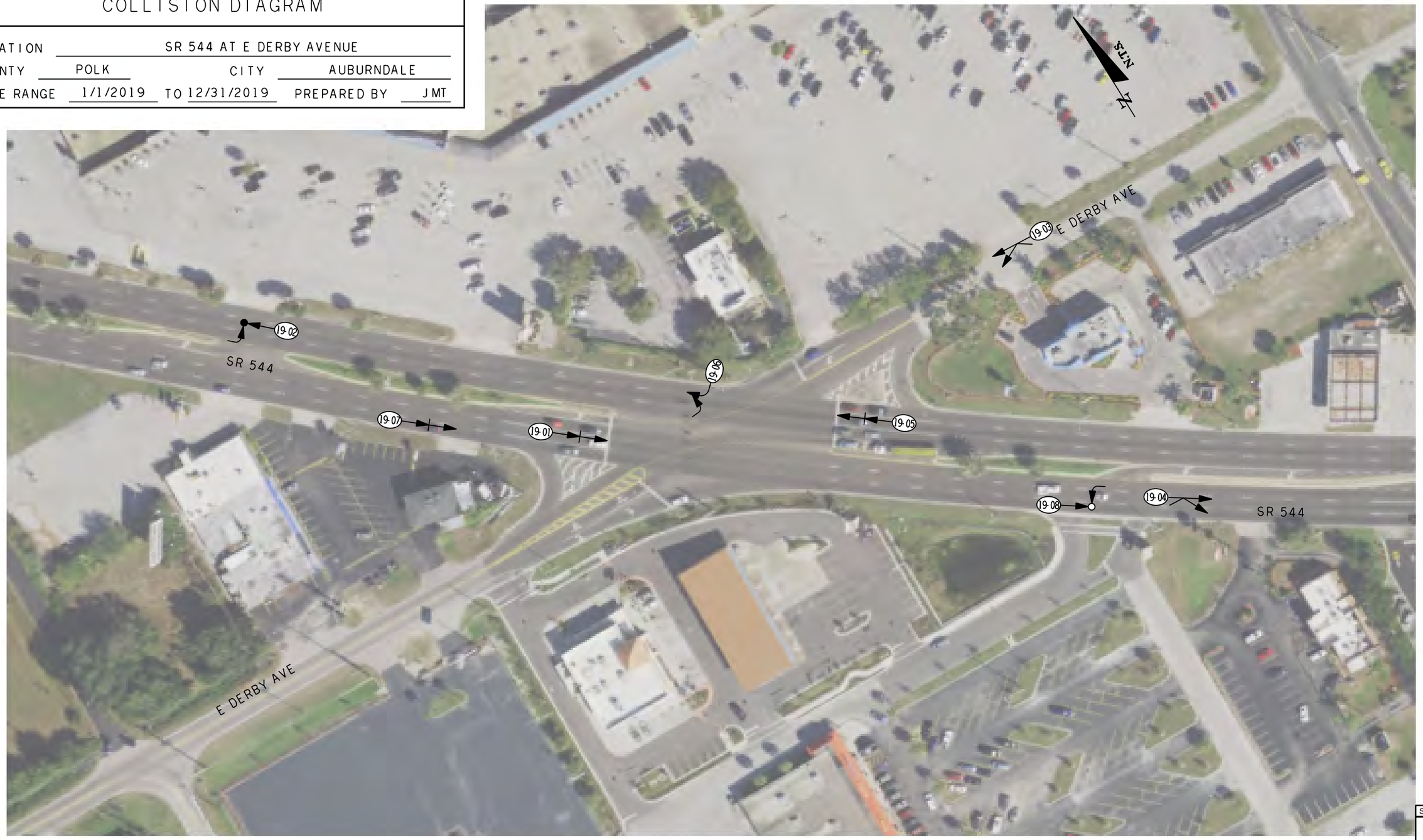
- OVERTURNED VEHICLE
- BACKING VEHICLE
- OUT OF CONTROL
- HEAD-ON COLLISION
- ANGLE COLLISION
- RIGHT TURN COLLISION
- COLLISION W/ PED.
- COLLISION W/ BIKE
- LEFT TURN COLLISION
- REAR-END COLLISION
- SIDE SWIPE
- PERSONAL INJURY
- FATALITY
- 13-01: COLLISION NUMBER; YEAR OF COLLISION (I.E. 13 = 2013)

CRASH SUMMARY

	PROPERTY DAMAGE ONLY	INJURY	FATAL	TOTAL
DAYTIME	2	2	0	4
NIGHTTIME	0	0	0	0
TOTAL	2	2	0	4

COLLISION DIAGRAM

LOCATION: SR 544 AT E DERBY AVENUE
COUNTY: POLK CITY: AUBURNDALE
DATE RANGE: 1/1/2019 TO 12/31/2019 PREPARED BY: JMT



SHEET 5

SYMBOLS

- OVERTURNED VEHICLE
- BACKING VEHICLE
- OUT OF CONTROL
- HEAD-ON COLLISION
- ANGLE COLLISION
- RIGHT TURN COLLISION
- COLLISION W/ PED.
- COLLISION W/ BIKE
- LEFT TURN COLLISION
- REAR-END COLLISION
- SIDE SWIPE
- PERSONAL INJURY
- FATALITY
- 13-01: COLLISION NUMBER; YEAR OF COLLISION (I.E. 13 = 2013)

CRASH SUMMARY

	PROPERTY DAMAGE ONLY	INJURY	FATAL	TOTAL
DAYTIME	4	1	0	5
NIGHTTIME	2	0	1	3
TOTAL	6	1	1	8

CC - CRASH RATE CATEGORY CODE DESCRIPTION	3 LEGS RATE # INTS	3 LEGS # CRASHES/ MILL VEH	4 LEGS RATE # INTS	4 LEGS # CRASHES/ MILL VEH	5 LEGS RATE # INTS	5 LEGS # CRASHES/ MILL VEH	6+ LEGS RATE # INTS	6+ LEGS # CRASHES/ MILL VEH
17 - RURAL 2-3LN 2WY DIVD PAVD	0.265	2542/	0.366	1444/	0.187	6/		
	795	9601.722	179	3941.624	3	32.030		
18 - RURAL 2-3LN 2WY UNDIVD	0.191	9194/	0.229	2556/	0.412	16/	0.130	1/
	6206	48140.556	1191	11156.723	7	38.817	1	7.701
20 - URBAN 4-5LN 2WY DIVD RASD	0.419	117902/	0.623	80671/	0.750	1380/	1.401	554/
	6329	281627.821	2662	129510.639	40	1840.846	5	395.422
21 - URBAN 4-5LN 2WY DIVD PAVD	0.533	93538/	0.769	73425/	1.210	1637/	0.966	508/
	4072	175601.549	2130	95513.995	25	1353.073	11	526.074
22 - URBAN 4-5LN 2WY UNDIVD	0.563	13368/	0.800	13255/	0.730	243/		
	770	23757.046	526	16568.869	9	332.953	1	27.046
23 - SUBURBAN 4-5LN 2WY DIVD RASD	0.270	61348/	0.517	35737/	1.031	937/	1.678	109/
	4865	227608.192	1381	69058.480	16	908.740	1	64.970
24 - SUBURBAN 4-5LN 2WY DIVD PAVD	0.314	7232/	0.542	4221/	0.194	8/		
	445	23023.133	166	7790.391	1	41.281		
25 - SUBURBAN 4-5LN 2WY UNDIVD	0.195	389/	0.188	184/				
	78	1991.221	35	978.181				
26 - RURAL 4-5LN 2WY DIVD RASD	0.202	7350/	0.210	3263/	0.923	105/		
	1696	36343.356	479	15530.769	3	113.788		
27 - RURAL 4-5LN 2WY DIVD PAVD	0.136	51/	0.096	13/				
	23	375.083	3	135.022				
28 - RURAL 4-5LN 2WY UNDIVD	0.076	2/	3.217	33/				
	4	26.243	1	10.256				
30 - URBAN 6+LN 2WY DIVD RASD	0.479	344769/	0.884	227937/	1.139	3928/	1.214	339/
	9151	719927.885	3137	257723.745	34	3448.318	4	279.202
31 - URBAN 6+LN 2WY DIVD PAVD	0.473	17014/	0.686	12312/	0.900	355/		
	504	35943.159	255	17951.660	4	394.492		
32 - URBAN 6+LN 2WY UNDIVD	1.829	153/	2.572	235/				
	7	83.647	4	91.359				
33 - SUBURBAN 6+LN 2WY DIVD RASD	0.343	52472/	0.749	42028/	1.862	1593/	0.433	41/
	1850	152905.887	643	56142.241	10	855.585	1	94.717

APPENDIX D

CONCEPTUAL LAYOUT
COST ESTIMATE

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JOHNSON, MIRMIRAN, & THOMPSON, INC.
2000 E 11TH AVENUE, SUITE 300
TAMPA, FL 33605-3830

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 544	POLK	

SR 544 AT E DERBY AVENUE INTERSECTION IMPROVEMENTS

CONCEPT PLAN

SHEET NO.

ENGINEER'S ESTIMATE

FLORIDA DEPARTMENT OF TRANSPORTATION DISTRICT 1

FINANCIAL PROJECT ID # :	SR 544
PROJECT DESCRIPTION:	SR 544 AT DERBY AVENUE
PAY ITEM SPEC YEAR:	January 2020
SUBMITTAL TYPE:	Concept
COUNTY:	Polk
DATE:	October 16, 2020
ENGINEERING CONSULTANT FIRM:	Johnson, Mirmiran & Thompson, Inc.
CONTACT NAME:	Sergio Quevedo
PHONE NUMBER:	(818) 868-6511
FILE VERSION:	EE_01-14_Rev30
PAGE NUMBER:	1 of 4

COMPONENT GROUPS

100 - STRUCTURES	*NOT USED*		
200 - ROADWAY			$84,815.01
300 - SIGNING & PAVEMENT MARKINGS			$10,720.44
400 - LIGHTING	*NOT USED*		
500 - SIGNALIZATION			$26,443.72
550 - ITS	*NOT USED*		
600 - LANDSCAPE / PERIPHERALS	*NOT USED*		
700 - UTILITIES	*NOT USED*		
800 - ARCHITECTURAL	*NOT USED*		
900 - MASS TRANSIT	*NOT USED*		
1000 - INVALID & OTHER ITEMS	*NOT USED*		
	COMPONENT SUB-TOTAL		$121,979.17
(102-1) MOT (Maintenance of Traffic)		5%	$6,098.96
	SUB-TOTAL		$128,078.13
(101-1) MOB (Mobilization)		10%	$12,807.81
	SUB-TOTAL		$140,885.94
PU (Project Unknowns)		10%	$14,088.59
	SUB-TOTAL		$154,974.53
(999-25) Initial Contingency (Do Not Bid) (5%)			$7,748.73
	PROJECT GRAND TOTAL		**$162,723.26**

NOTES:

ENGINEER'S ESTIMATE

FLORIDA DEPARTMENT OF TRANSPORTATION DISTRICT 1

FINANCIAL PROJECT ID:	SR 544
FILE VERSION:	EE_01-14_Rev30
PAGE NUMBER:	2 of 4

200 - Roadway

PAY ITEM #	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
0101 1	MOBILIZATION	LS	10%	See Summary Sheet	
0102 1	MAINTENANCE OF TRAFFIC	LS	5%	See Summary Sheet	
0999 25	INITIAL CONTINGENCY AMOUNT, DO NOT BID	LS	5%	See Summary Sheet	
0110 1 1	CLEARING & GRUBBING	AC	0.23	$16,667.00	$3,833.41
0110 4 10	REMOVAL OF EXISTING CONCRETE	SY	200	$21.00	$4,200.00
0120 1	REGULAR EXCAVATION	CY	395	$6.80	$2,686.00
0120 6	EMBANKMENT	CY	10	$11.25	$112.50
0160 4	TYPE B STABILIZATION	SY	350	$4.35	$1,522.50
0285707	OPTIONAL BASE, BASE GROUP 07	SY	331	$36.00	$11,916.00
0334 1 13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	27.2	$96.00	$2,611.20
0337 7 83	ASPHALT CONCRETE FRICTION COURSE,TRAFFIC C, FC-12.5, PG 76-22	TN	27.2	$113.25	$3,080.40
0520 1 7	CONCRETE CURB & GUTTER, TYPE E	LF	102	$20.00	$2,040.00
0520 1 10	CONCRETE CURB & GUTTER, TYPE F	LF	235	$25.00	$5,875.00
0520 5 11	TRAFFIC SEPARATOR CONCRETE-TYPE I, 4' WIDE	LF	262	$30.00	$7,860.00
0522 2	CONCRETE SIDEWALK AND DRIVEWAYS, 6" THICK	SY	638	$60.00	$38,280.00
0570 1 1	PERFORMANCE TURF	SY	266	$3.00	$798.00
200 - Roadway		**COMPONENT TOTAL**			**$84,815.01**

ENGINEER'S ESTIMATE

FLORIDA DEPARTMENT OF TRANSPORTATION DISTRICT 1

FINANCIAL PROJECT ID:	SR 544
FILE VERSION:	EE_01-14_Rev30
PAGE NUMBER:	3 of 4

300 - Signing & Pavement Markings

PAY ITEM #	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
0700 1 11	SINGLE POST SIGN, F&I GROUND MOUNT, UP TO 12 SF	AS	2	$333.10	$666.20
0700 1 50	SINGLE POST SIGN, RELOCATE	AS	6	$200.00	$1,200.00
0710 90	PAINTED PAVEMENT MARKINGS, FINAL SURFACE	LS	1	$2,041.00	$2,041.00
0711 11123	THERMOPLASTIC, STD, WHITE, SOLID, 12" FOR CROSSWALK/ROUNDABOUT	LF	772	$2.50	$1,930.00
0711 11125	THERMOPLASTIC, STD, WHITE, SOLID, 24" FOR STOP LINE/CROSSWALK	LF	510	$4.50	$2,295.00
0711 11170	THERMOPLASTIC, STANDARD, WHITE, ARROW	EA	7	$62.50	$437.50
0711 11180	THERMOPLASTIC, STANDARD, WHITE, YIELD LINE	LF	36	$18.00	$648.00
0711 16101	THERMOPLASTIC, STANDARD-OTHER SURFACES, WHITE, SOLID, 6"	GM	0.073	$4,183.00	$305.36
0711 16201	THERMOPLASTIC, STD-OTHER SURFACES, YELLOW, SOLID, 6"	GM	0.140	$4,267.00	$597.38
0711 17 1	THERMOPLASTIC, REMOVE EXIST PAVEMENT MARKINGS- SURFACE TO REMAIN	SF	300	$2.00	$600.00
300 - Signing & Pavement Markings		**COMPONENT TOTAL**			**$10,720.44**

ENGINEER'S ESTIMATE

FLORIDA DEPARTMENT OF TRANSPORTATION DISTRICT 1

FINANCIAL PROJECT ID:	SR 544
FILE VERSION:	EE_01-14_Rev30
PAGE NUMBER:	4 of 4

PAY ITEM #	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
0650 2102	VEH SIGNAL AUX, REPAIR/REPLACE/RETROFIT- F&I, BACKPLATE- BLACK WITH REFLEC	EA	10	$280.00	$2,800.00
0650 1 70	VEHICULAR TRAFFIC SIGNAL, RELOCATE- INCLUDES REMOVAL AND REINSTALLATION	AS	4	$580.93	$2,323.72
0660 2102	LOOP ASSEMBLY, F&I, TYPE B	AS	6	$765.00	$4,590.00
0660 2106	LOOP ASSEMBLY, F&I, TYPE F	AS	6	$1,000.00	$6,000.00
0700 11391	ELECT DISPLAY SIGN, F&I OVERHEAD/AC POWERED, BLANK OUT SIGN, ≤ 12 SF	AS	2	$5,365.00	$10,730.00
			COMPONENT TOTAL		**$26,443.72**

Assumption for Cost associated with Lighting Recommendation

Recommendation: 11 HPS to LED luminaire retrofits.

Cost Assumption: The initial construction cost (IC) for the eleven LED luminaire retrofits was assumed at $22,000 (including luminaires), based on averages of previous construction projects The electrical cost (PVEC) used in the analysis is the average in Florida at $0.10/KWH. The maintenance cost (PVMC) per luminaire was estimated at $100 per year.

Service life: 20 years

SR 544 at Derby Avenue Lighting Cost Calculation Sheet

Pay Item No.	Item Description	Unit	Quantity	Unit Cost	Total Cost
0715 21 2	LIGHTING REPAIRS AND RETROFITS, LED RETROFIT KIT FOR EXISTING LUMINAIRE	EA	11	$2,000.00	$ 22,000.00
					$ 22,000.00

Life of Project (years)			
20	Maintenance Costs	$	22,000.00
	Energy Cost	$	8,030.00
	Total Cost	**$**	**52,030.00**

APPENDIX E

NET PRESENT VALUE/ BENEFIT-COST ANALYSIS

Net Present Value (NPV) Calculation for SR 544 at Derby Avenue

Year	CRF x (PC/YD)	Cost per Crash	(P/F,I,y) Factor	Present Value
1	0.91	$123,598.00	0.97	$109,099.95
2	0.91	$123,598.00	0.94	$105,725.73
3	0.91	$123,598.00	0.92	$103,476.25
4	0.91	$123,598.00	0.89	$100,102.02
5	0.91	$123,598.00	0.86	$96,727.79
6	0.91	$123,598.00	0.84	$94,478.31
7	0.91	$123,598.00	0.81	$91,104.09
8	0.91	$123,598.00	0.79	$88,854.60
9	0.91	$123,598.00	0.77	$86,605.12
10	0.91	$123,598.00	0.74	$83,230.89
11	0.91	$123,598.00	0.72	$80,981.41
12	0.91	$123,598.00	0.70	$78,731.93
13	0.91	$123,598.00	0.68	$76,482.44
14	0.91	$123,598.00	0.66	$74,232.96
15	0.91	$123,598.00	0.64	$71,983.48
16	0.91	$123,598.00	0.62	$69,733.99
17	0.91	$123,598.00	0.61	$68,609.25
18	0.91	$123,598.00	0.59	$66,359.77
19	0.91	$123,598.00	0.57	$64,110.28
20	0.91	$123,598.00	0.55	$61,860.80

Total Present Value	
Benefit	$1,672,491.06
Cost	$246,966.25
Net Present Value	**$1,425,524.81**

Roadway Design
Florida's Transportation Engineers

Rev. 02/2014

Benefit-Cost Analysis

District: **One** County: **16 - Polk** Date Prepared: 10/16/20

Location: **SR 544 at Derby Avenue**

Section : **16140000** Beg. Milepost : **0.345** End Milepost : **0.345**
Rdway Type: **6+ Lanes Urban Divided**

Control Element: **Other (describe in box below)**

Install sidewalk, install bike lanes, install high visibility crosswalk, install signal backplates, install overhead "No Right Turn On Red" signs, and increase intersection illuminance

ANNUAL COST OF IMPROVEMENTS

Type	Cost	Service Life	Capital Recovery Factor	Total
ROW		20	0.0736	$ -
P.E.C.E.I.	$ 32,212.99	20	0.0736	$ 2,370.88
Structure		20	0.0736	$ -
Roadway		20	0.0736	$ -
Drainage		20	0.0736	$ -
Signal		20	0.0736	$ -
Other	$ 214,753.26	20	0.0736	$ 15,805.84
Sub-Total	$ 246,966.25			$ 18,176.72
			Annual Cost =	$ 18,176.72

Total number of crashes =	38
# of correctable crashes, PC =	12
# of years of crash data, YD =	5
PC/YD =	2.40
Crash reduction factor, CRF =	79.15%
CRF x (PC/YD) =	0.91
Cost per crash, CPC =	$123,598.00
Benefit =	$112,647

Primary crash reduction factor (%): 52.33
Install sidewalk, crosswalks, and bike lanes

Additional crash reduction factor: 6.95
Install signal backplates and No Right Turn On Red Signs

Additional crash reduction factor: 53
Increase Intersection Illuminance

BENEFIT/COST RATIO

$$\frac{\text{Benefit}}{\text{Cost}} = \frac{\$112,647.22}{\$18,176.72} = \mathbf{6.20}$$

Prepared by: JMT

CMF / CRF Details

CMF ID: 4112

Improve signal visibility, including signal lens size upgrade, installation of new back-plates, addition of reflective tapes to existing back-plates, and installation of additional signal heads

Description: 4-leg intersections with 3 or 4 lanes on each approach and 50 km/h posted speed

Prior Condition: Smaller signal lens size, old back-plates, no reflective tapes on existing back-plates, and less number of signal heads

Category: Intersection traffic control

Study: *Investigating Effect of Collision Aggregation on Safety Evaluations Using Multivariate Linear Intervention Models: Case Study of Signal Head Upgrade Program*, El-Basyouny et al., 2012

Star Quality Rating:	[View score details]

Crash Modification Factor (CMF)	
Value:	0.901
Adjusted Standard Error:	
Unadjusted Standard Error:	0.029

Crash Reduction Factor (CRF)

Value:	9.9 *(This value indicates a **decrease** in crashes)*
Adjusted Standard Error:	
Unadjusted Standard Error:	2.9

Applicability

Crash Type:	Day time
Crash Severity:	O (property damage only)
Roadway Types:	Not Specified
Number of Lanes:	3 to 4
Road Division Type:	
Speed Limit:	50 km/h
Area Type:	Urban
Traffic Volume:	
Time of Day:	Day

If countermeasure is intersection-based

Intersection Type:	Roadway/roadway (not interchange related)
Intersection Geometry:	4-leg
Traffic Control:	Signalized
Major Road Traffic Volume:	4637 to 51743 Average Daily Traffic (ADT)
Minor Road Traffic Volume:	134 to 48906 Average Daily Traffic (ADT)

Development Details

Date Range of Data Used:	1999 to 2004

Municipality:	British Columbia
State:	
Country:	Canada
Type of Methodology Used:	Before/after using empirical Bayes or full Bayes
Sample Size Used:	Crashes
Before Sample Size Used:	4690 Crashes
After Sample Size Used:	2460 Crashes

Other Details

Included in Highway Safety Manual?	No
Date Added to Clearinghouse:	Nov-01-2012
Comments:	3 CMF sets are presented: crash severity only, time of day only, severity and time of day. Only disaggregate set (severity and time of day) is reported

This site is funded by the U.S. Department of Transportation Federal Highway Administration and maintained by the University of North Carolina Highway Safety Research Center

CMF / CRF Details

CMF ID: 4123

Install high-visibility crosswalk

Description: High-visibility crosswalks aim to increase awareness of pedestrians at intersections by using highly visible marking patterns. The markings used in this study included a series of longitudinal white stripes constructed from thermoplastic material.

Prior Condition: High visibility crosswalks aim to increase awareness of pedestrians at intersections by using highly visible marking patterns. High visibility crosswalks installed in NYC have a series of longitudinal white stripes that are constructed from thermoplastic materials.

Category: Pedestrians

Study: *The Relative Effectiveness of Pedestrian Safety Countermeasures at Urban Intersections - Lessons from a New York City Experience*, Li Chen, Cynthia Chen, and Reid Ewing, 2012

Star Quality Rating:	[View score details]

Crash Modification Factor (CMF)	
Value:	0.6
Adjusted Standard Error:	
Unadjusted Standard Error:	

Crash Reduction Factor (CRF)

Value:	40 *(This value indicates a **decrease** in crashes)*
Adjusted Standard Error:	
Unadjusted Standard Error:	

Applicability

Crash Type:	Vehicle/pedestrian
Crash Severity:	All
Roadway Types:	Not Specified
Number of Lanes:	
Road Division Type:	
Speed Limit:	
Area Type:	Urban
Traffic Volume:	
Time of Day:	All

If countermeasure is intersection-based

Intersection Type:	Roadway/roadway (not interchange related)
Intersection Geometry:	3-leg,4-leg
Traffic Control:	Not specified
Major Road Traffic Volume:	
Minor Road Traffic Volume:	

Development Details

Date Range of Data Used:	1998 to 2008
Municipality:	New York City
State:	NY
Country:	USA
Type of Methodology Used:	Simple before/after
Sample Size Used:	Crashes
Before Sample Size Used:	63 Crashes
After Sample Size Used:	15 Crashes

Other Details

Included in Highway Safety Manual?	No
Date Added to Clearinghouse:	Nov-01-2012
Comments:	The treatment group included both signalized and unsignalized intersections. The corresponding change in crashes in the comparison group was an 18 percent reduction in pedestrian-vehicle crashes. This could be used to adjust the treatment effect to account for other factors not related to the treatment.

This site is funded by the U.S. Department of Transportation Federal Highway Administration and maintained by the University of North Carolina Highway Safety Research Center

CMF / CRF Details

CMF ID: 7840

Install bicycle lanes

Description:

Prior Condition: Roadway without bike lanes

Category: Bicyclists

Study: *Validation and Application of Highway Safety Manual (Part D) in Florida*, Abdel-Aty et al., 2014

Star Quality Rating:	★★☆☆☆ [View score details]

Crash Modification Factor (CMF)	
Value:	0.42
Adjusted Standard Error:	
Unadjusted Standard Error:	0.1

Crash Reduction Factor (CRF)	
Value:	58 *(This value indicates a **decrease** in crashes)*
Adjusted Standard Error:	

Unadjusted Standard Error:	10

Applicability

Crash Type:	Vehicle/bicycle
Crash Severity:	All
Roadway Types:	Not specified
Number of Lanes:	>2
Road Division Type:	All
Speed Limit:	
Area Type:	Urban
Traffic Volume:	2900 to 59500 *Annual Average Daily Traffic (AADT)*
Time of Day:	All

If countermeasure is intersection-based

Intersection Type:	
Intersection Geometry:	
Traffic Control:	
Major Road Traffic Volume:	
Minor Road Traffic Volume:	

Development Details

Date Range of Data Used:	2008 to 2012
Municipality:	
State:	FL

Country:	USA
Type of Methodology Used:	Regression cross-section
Sample Size Used:	

Other Details

Included in Highway Safety Manual?	No
Date Added to Clearinghouse:	Mar-08-2016
Comments:	

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CMF / CRF Details

CMF ID: 9240

Install sidewalk

Description:

Prior Condition: No sidewalk present

Category: Pedestrians

Study: *Statewide Analysis of Bicycle Crashes*, Alluri et al., 2017

Star Quality Rating:	★★☆☆☆ [View score details]

Crash Modification Factor (CMF)	
Value:	0.41
Adjusted Standard Error:	
Unadjusted Standard Error:	

Crash Reduction Factor (CRF)	
Value:	59 *(This value indicates a **decrease** in crashes)*
Adjusted Standard Error:	
Unadjusted Standard Error:	

Applicability

Crash Type:	Vehicle/bicycle
Crash Severity:	K (fatal),A (serious injury)
Roadway Types:	Principal Arterial Other
Number of Lanes:	2
Road Division Type:	Divided by Median
Speed Limit:	
Area Type:	Urban
Traffic Volume:	600 to 50500 *Annual Average Daily Traffic (AADT)*
Time of Day:	Not specified

If countermeasure is intersection-based

Intersection Type:	
Intersection Geometry:	
Traffic Control:	
Major Road Traffic Volume:	
Minor Road Traffic Volume:	

Development Details

Date Range of Data Used:	2011 to 2014
Municipality:	
State:	FL
Country:	

Type of Methodology Used:	Regression cross-section
Sample Size Used:	

Other Details

Included in Highway Safety Manual?	No
Date Added to Clearinghouse:	Jun-17-2018
Comments:	Minor Arterial, Major Collector, and Minor Collector facility types included.

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CRASH MODIFICATION FACTORS CLEARINGHOUSE

CMF / CRF Details

CMF ID: 5194

Prohibit right-turn-on-red

Description:

Prior Condition: ***No Prior Condition(s)***

Category: Intersection traffic control

Study: ***Highway Safety Manual, 1st Edition*, Various, 2010**

Star Quality Rating:	

Crash Modification Factor (CMF)	
Value:	$CMF = 0.98^{nprohib}$
Adjusted Standard Error:	
Unadjusted Standard Error:	

Crash Reduction Factor (CRF)	
Value:	*(This value indicates an **increase** in crashes)*
Adjusted Standard Error:	

Unadjusted Standard Error:	

Applicability

Crash Type:	Angle,Cross median,Day time,Dry weather,Fixed object,Head on,Left turn,Multiple vehicle,Nighttime,Non-intersection,Parking related,Rear end,Rear to rear,Right turn,Run off road,Sideswipe,Single vehicle,Speed related,Truck related,Vehicle/animal,Wet road
Crash Severity:	All
Roadway Types:	Not specified
Number of Lanes:	
Road Division Type:	
Speed Limit:	
Area Type:	
Traffic Volume:	
Time of Day:	

If countermeasure is intersection-based

Intersection Type:	Roadway/roadway (not interchange related)
Intersection Geometry:	Not specified
Traffic Control:	Signalized
Major Road Traffic Volume:	
Minor Road Traffic Volume:	

Development Details

Date Range of Data Used:	
Municipality:	

State:	
Country:	
Type of Methodology Used:	Not specified
Sample Size Used:	

Other Details

Included in Highway Safety Manual?	
Date Added to Clearinghouse:	
Comments:	This CMF addresses all crash types except vehicle-pedestrian and vehicle-bicycle.HSM 1st Ed, page 14-40

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CRASH MODIFICATION FACTORS CLEARINGHOUSE

CMF / CRF Details

CMF ID: 8320

increase intersection illuminance from low (< 0.2 fc) to medium (≥ 0.2 fc and

Description: Increase intersection illuminance 13 from low (< 0.2 fc) to medium (≥ 0.2 fc and

Prior Condition: Signalized intersections with lower illuminance (

Category: Highway lighting

Study: *Safety Effects of Street Illuminance at Urban Signalized Intersections in Florida*, Wei et al., 2016

Star Quality Rating:	★★★☆☆ [View score details]

Crash Modification Factor (CMF)	
Value:	0.47
Adjusted Standard Error:	
Unadjusted Standard Error:	

Crash Reduction Factor (CRF)	
Value:	53 *(This value indicates a **decrease** in crashes)*
Adjusted Standard Error:	

Unadjusted Standard Error:	

Applicability

Crash Type:	Nighttime
Crash Severity:	All
Roadway Types:	Not specified
Number of Lanes:	
Road Division Type:	
Speed Limit:	
Area Type:	Urban
Traffic Volume:	
Time of Day:	Night

If countermeasure is intersection-based

Intersection Type:	
Intersection Geometry:	3-leg
Traffic Control:	Signalized
Major Road Traffic Volume:	5167 to 67508 Annual Average Daily Traffic (AADT)
Minor Road Traffic Volume:	1300 to 56387 Annual Average Daily Traffic (AADT)

Development Details

Date Range of Data Used:	2010 to 2013
Municipality:	Tampa
State:	FL

Country:	
Type of Methodology Used:	Regression cross-section
Sample Size Used:	

Other Details

Included in Highway Safety Manual?	No
Date Added to Clearinghouse:	Jan-17-2017
Comments:	

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