SPACE COAST TPO

ROAD SAFETY AUDIT

Malabar Road from Jupiter Boulevard to Minton Road and Emerson Drive to San Filippo Drive

Prepared for:
Space Coast Transportation Planning Organization
2725 Judge Fran Jamieson Way
Bldg. B / Room 105 / MS #82
Melbourne, FL 32940

Prepared by:
Kittelson & Associates, Inc.
225 E. Robinson Street, Suite 450
Orlando, FL 32801
407.540.0555
kittelson.com

June 2016

High Crash Corridors Analysis

Road Safety Audit Report for

Malabar Road from Jupiter Boulevard to Minton Road and Emerson Drive to San Filippo Drive

City of Palm Bay

Prepared for:

Space Coast Transportation Planning Organization
2725 Judge Fran Jamieson Way, Building B, Room 105
Melbourne, FL 32940

Prepared by:

Kittelson & Associates, Inc.
225 E Robinson St., Suite 450
Orlando, FL, 32801

June 2016

Project Title: Malabar Road Safety Audit

Field Review Dates: October 27th and 28th, 2015 (AM/PM/afternoon/nighttime reviews and follow-up meeting)

Participants:
Casey Bergh – formerly with Kittelson & Associates, Inc. – Team Leader
Laura Carter – Space Coast Transportation Planning Organization
Georganna Gillette – Space Coast Transportation Planning Organization
Steven Bostel – Space Coast Transportation Planning Organization
Rachel Gerena – Brevard County
Officer Greg Moore – Palm Bay Police Department
Travis Hills – Kittelson & Associates, Inc.

Project Characteristics:
Field Review Type:

- All Users (Vehicular, Pedestrian, Bicycle, Transit)

Adjacent Land Use:

- Urban – Commercial, Residential

Posted Speed Limit:

- 45 miles per hour (MPH) from Jupiter Boulevard to Palm Bay West Plaza Entrance;
- 35 MPH from the Palm Bay West Plaza Entrance to Minton Road;
- 45 MPH from Emerson Drive to Holiday Park Boulevard; and
- 35 MPH from Holiday Park Boulevard to San Filippo Drive.

Opposite Flow Separation:

- Undivided from Jupiter Boulevard to Belvedere Road;
- Divided by Paint from Belvedere Road to the Palm Bay West Plaza Entrance;
- Raised Median from the Palm Bay West Plaza Entrance to Minton Road and from Emerson Drive to Holiday Park Boulevard;
- Center Two-Way Left-Turn Lane (TWLTL) from Holiday Park Boulevard to San Filippo Drive.

Service Function:

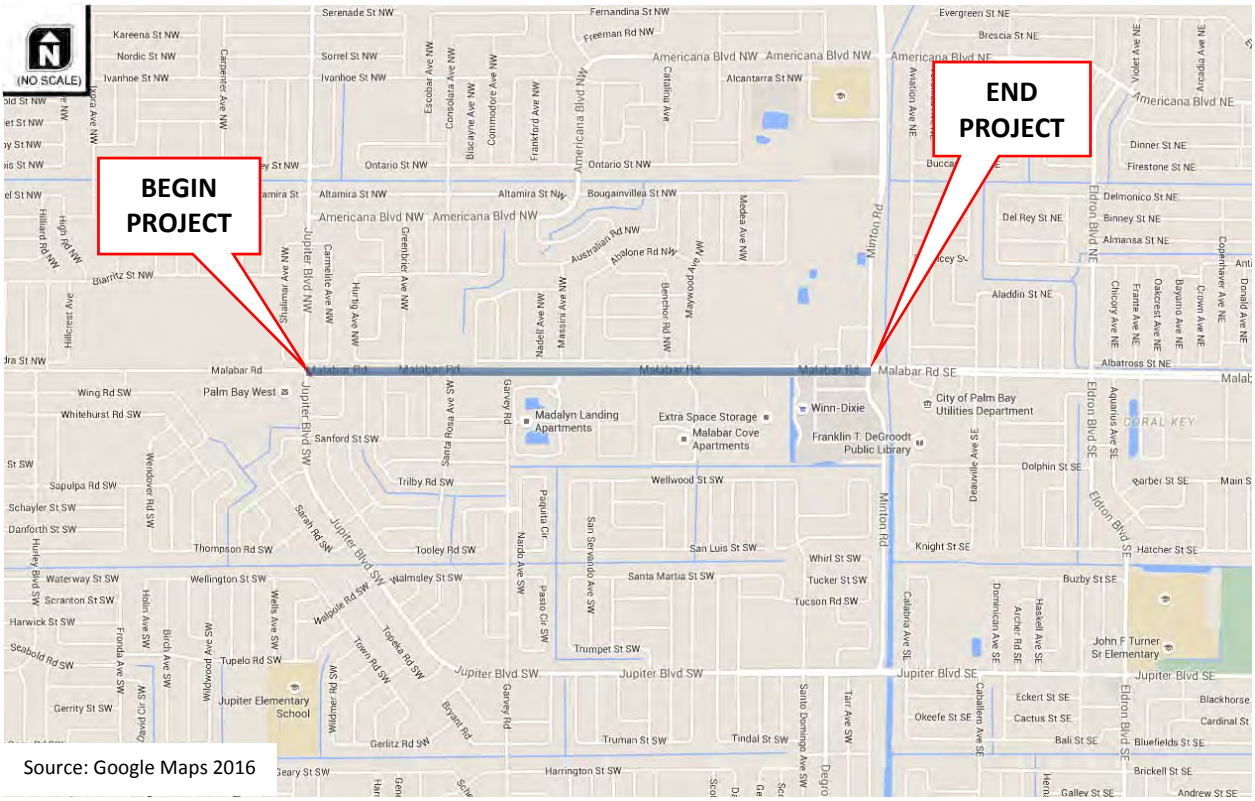
- Urban Minor Arterial from Jupiter Boulevard to Minton Road; and
- Urban Principal Arterial from Emerson Drive to San Filippo Drive.

Terrain:

- Flat

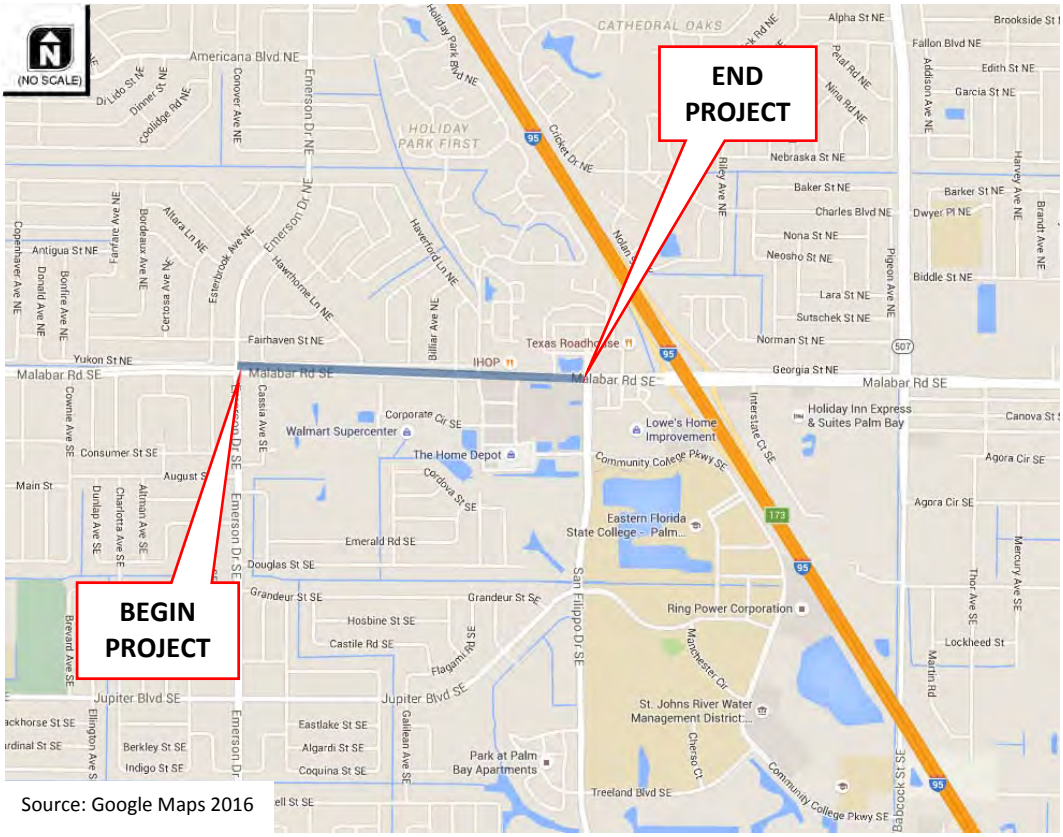
Climatic Conditions:

- Sunny, Hot



Source: Google Maps 2016

Figure 1 – West Segment: Malabar Road from Jupiter Boulevard to Minton Road



Source: Google Maps 2016

Figure 2 – East Segment: Malabar Road from Emerson Drive to San Filippo Drive

Background

In December 2014, the Space Coast Transportation Planning Organization (TPO) released the 2014 Annual Countywide Safety Report. The results identified high crash segments and intersections based on various crash metrics. The goal of the High Crash Corridors project is to generate a list of suggested improvements along five (5) high crash frequency corridors to address the growing need for vehicular safety in Brevard County:

- Wickham Road from Sarno Road to Parkway Drive;
- Malabar Road from Jupiter Boulevard to Minton Road and Emerson Drive to San Filippo Drive;
- SR A1A from US 192 to Eau Gallie Boulevard;
- Emerson Drive/Minton Road/Palm Bay Road from Jupiter Boulevard to Culver Drive; and
- Babcock Street from Malabar Road to Palm Bay Road.

Malabar Road, from Jupiter Boulevard to Minton Road and from Emerson Drive to San Filippo Drive in Brevard County (**Figure 1** and **Figure 2**), was identified as one of the high crash corridors. In order to suggest improvements along this corridor, crash history was evaluated and a Road Safety Audit (RSA) was conducted. This RSA was commissioned by the Space Coast Transportation Planning Organization (SCTPO) to identify potential safety improvements to be considered by SCTPO staff and partner agencies (i.e. Brevard County, local law enforcement). This report summarizes the evaluation of the Malabar Road corridor.

The RSA process involves multi-disciplinary representatives from various stakeholders, including representatives from transportation planning, traffic operations, roadway design, safety, and law enforcement, as needed. RSAs are conducted to identify potential safety issues and provide improvement suggestions in a team collaborative environment. Some improvements presented in this report may be implemented through maintenance-type activities, while other suggested safety improvements may be considered for future study. Each suggestion identified in this study is classified into one of three categories:

- Maintenance – issues identified for maintenance may be addressed by public agency staff on a short timeframe and at a relatively low cost.
- Near-Term Improvement (within 5 years) – activities that may be incorporated into an upcoming construction project in the area, including 3R milling and resurfacing projects.
- Long-Term Improvement (5+ years) – activities that may be incorporated into upcoming construction projects and may need to be programmed for funding as separate projects.

The issues and suggested improvements reflect the consensus of the RSA team and not necessarily that of the SCTPO.

The RSA team met in the morning on Tuesday, October 27, 2015 at the Palm Bay City Hall to discuss the study corridor and crash history. Starting at 1:00 PM, the study team drove the entire corridor, west to east then east to west, to gain an understanding of the facility characteristics from a driver's perspective. The team was then divided into two groups:

1) Observed characteristics from Jupiter Boulevard to Minton Road, and
2) Observed characteristics from Emerson Drive to San Filippo Drive.

Once the afternoon observations were completed, the study team observed PM peak hour observations at the signalized intersections. The team reassembled in the evening, after sunset, to make observations in nighttime conditions. The following day (Wednesday October 28th), the study team observed AM peak hour observations at the signalized intersections. A follow-up debrief meeting was held at the Palm Bay City Hall once the AM observations were completed to discuss the corridor's issues and potential improvements.

Study Corridor Characteristics

As noted above, the Malabar Road RSA took place along two segments of Malabar Road:

- Jupiter Boulevard to Minton Road (West Segment); and
- Emerson Drive to San Filippo Drive (East Segment).

The segment characteristics for each segment are reviewed below:

West Segment – 1.5 miles

- Posted speed limits as follows:
  - Malabar Road (Jupiter Boulevard to Palm Bay West Plaza Entrance) = 45 MPH; and
  - Malabar Road (Palm Bay West Plaza Entrance to Minton Road) = 35 MPH.
- Two lane undivided (one eastbound and one westbound lane).
- There are no marked bicycle lanes.
- There are continuous sidewalks on the north side of the roadway and sidewalks in spot locations on the south side of the roadway.
- This segment has open drainage.
- The land use is primarily residential on both sides of the roadway.
- This segment is served by Space Coast Area Transit (SCAT) Route 23 with ½ hour to 1 hour headways.
- Three (3) signalized intersections within study segment:
  - Malabar Road/Jupiter Boulevard:
    - Old version of special emphasis crosswalk markings on all legs;
    - All crosswalks include pedestrian actuated signals with push buttons;
    - Continuous sidewalks in the following places:
      - North side of the intersection on the east side only;
      - South side of the intersection on both sides;
      - East side of the intersection on the north side only; and
      - West side of the intersection on the south side only.
    - Protected-permissive left-turn phasing with a "doghouse" five-section signal head on all approaches.
  - Malabar Road/Palm Bay West Plaza Entrance
    - Old version of special emphasis crosswalk markings on the north and east legs only;
    - Crosswalks on north and east leg include pedestrian actuated signals with push buttons and countdown timers; and
    - Continuous sidewalks in the following places:
      - East side of the intersection on both sides; and

- West side of the intersection on the north side only.
- Protected-permissive left-turn phasing with a "doghouse" five-section signal head on all approaches.

- Malabar Road/Minton Road:
  - Old version of special emphasis crosswalk markings on all legs;
  - All crosswalks include pedestrian actuated signals with push buttons and countdown timers; and
  - Continuous sidewalks in the following places:
    - North side of the intersection on both sides;
    - South side of the intersection on the east side only;
    - East side of the intersection on both sides; and
    - West side of the intersection on both sides.
  - Protected-permissive left-turn phasing with a "doghouse" five-section signal head for the northbound and southbound movements.

East Segment – 0.85 miles

- Posted speed limits as follows:
  - Malabar Road (Emerson Drive to Holiday Park Boulevard) = 45 MPH; and
  - Malabar Road (Holiday Park Boulevard to San Filippo Drive) = 35 MPH.
- Roadway cross sections as follows:
  - Malabar Road (Emerson Drive to Walmart) – five lane divided (two eastbound and three westbound lanes) with raised median;
  - Malabar Road (Walmart to Holiday Park Boulevard) – six lane divided (three eastbound and three westbound lanes) with raised median; and
  - Malabar Road (Holiday Park Boulevard to San Filippo Drive) – seven lane undivided: three eastbound lanes, three westbound lanes, and a two-way left-turn lane (TWLTL).
- There are no marked bicycle lanes, but there is a four-foot paved shoulder on both sides of the roadway.
- Continuous sidewalks are present along both sides of the roadway.
- Street lighting is present along both sides of the roadway.
- Type F curb and gutter is present along both sides of the roadway.
- The land use transitions to mainly commercial on the south side of the roadway between Emerson Drive and San Filippo Drive with residential on the north side.
- This segment is served by SCAT Routes 22 and 23 with ½ hour to 1 hour headways.
- Four (4) signalized intersections within study segment:
  - Malabar Road/Emerson Road:
    - Old version of special emphasis crosswalk markings on all legs;
    - All crosswalks include pedestrian actuated signals with push buttons and countdown timers; and
    - Continuous sidewalks in the following places:
      - North side of the intersection on both sides;
      - South side of the intersection on the east side only;
      - East side of the intersection on both sides; and
      - West side of the intersection on both sides.
    - Protected-permissive left-turn phasing with a "doghouse" five-section signal head for the northbound and southbound movements.

- Malabar Road/Corporate Circle:
  - Old version of special emphasis crosswalk markings on the south and east only;
  - Crosswalks on south and east leg include pedestrian actuated signals with push buttons; and
  - Continuous sidewalks in the following places:
    - South side of the intersection on the west side only;
    - East side of the intersection on both sides; and
    - West side of the intersection on both sides.
  - Protected-permissive left-turn phasing with a "doghouse" five-section signal head for the eastbound and westbound movements.
- Malabar Road/Holiday Park Boulevard:
  - Old version of special emphasis crosswalk markings on all legs;
  - All crosswalks include pedestrian actuated signals with push buttons and countdown timers; and
  - Continuous sidewalks in the following places:
    - North side of the intersection on the east side only;
    - East side of the intersection on both sides; and
    - West side of the intersection on both sides.
  - Protected-permissive left-turn phasing with a "doghouse" five-section signal head for the eastbound, northbound, and southbound movements.
- Malabar Road/San Filippo Drive:
  - Old version of special emphasis crosswalk markings on all legs;
  - All crosswalks include pedestrian actuated signals with push buttons; and
  - Continuous sidewalks in the following places:
    - South side of the intersection on both sides;
    - East side of the intersection on both sides; and
    - West side of the intersection on both sides.
  - Protected-permissive left-turn phasing with a "doghouse" five-section signal head for the northbound and southbound movements.

Crash History (2009 – 2014)

Six (6) full calendar years (January to December) of available vehicular related crash data, 2009 to 2014, was obtained from the Signal Four Analytics database, maintained by the University of Florida, and utilized for the Malabar Road crash analysis. Because Malabar Road is a county maintained facility, the Signal Four database was the primary source for crash data. FDOT Crash Analysis Reporting System (CARS) data was not utilized for this study because no state maintained facilities intersect with Malabar Road within the study limits.

Because the review took place along two different segments of Malabar Road, the following crash summary is separated into the West Segment (from Jupiter Boulevard to Minton Road) and the East Segment (from Emerson Drive to San Filippo Drive).

West Segment

305 vehicular crashes were reported over the six-year study period. A map displaying the locations of crashes along the Malabar Road West Segment is located in **Appendix A** along with a map showing the

signal spacing and access management along the corridor. Of the 305 crashes reported during the study period, there were:

- No fatal crashes (0 percent);
- 98 injury crashes (32 percent); and
- 207 property damage only (PDO) crashes (68 percent).

Collision diagrams (located in **Appendix A**) for the corridor include the following crashes:

- At signalized intersections;
- Pedestrian crash locations; and
- Bicycle crash locations.

West Segment Overall Crash Trends

The reported corridor crashes are displayed by different key crash trends such as measures of time (year, month, day, and hour), crash types, lighting conditions, and alcohol/drugs. Overall, the number of crashes has increased between 2009 and 2014. In 2011 and 2012, the Signal Four dataset displayed approximately 60 to 95 percent lower crashes than in the other years due to the availability of city or county crash records. Key crash trends include:

Time (**Figure 3** through **Figure 6**)

- May (35 crashes), November (31 crashes), April (31 crashes), and June (29 crashes) were the highest crash months during the year while Friday (56 crashes) and Monday (55 crashes) were the highest crash days.
- Seventy-eight (78) percent of all crashes occurred between 7:00 AM and 7:00 PM and 36 percent of the crashes occurred on Monday and Friday.

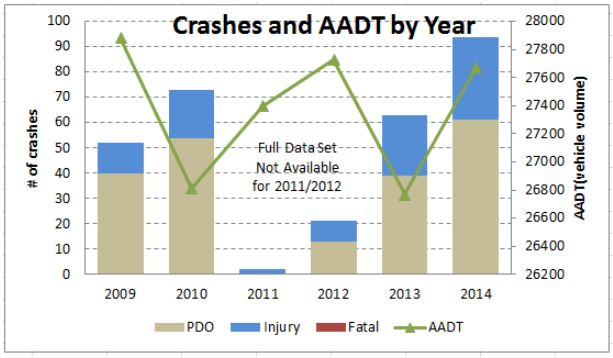


Figure 3

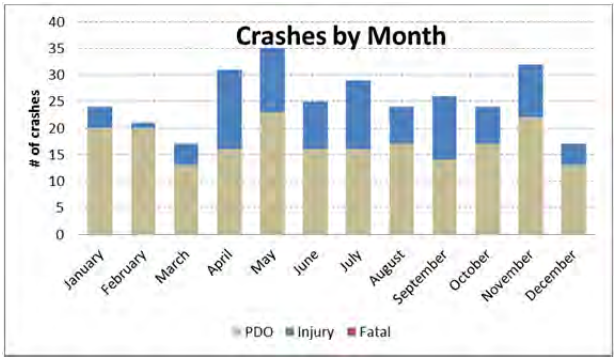


Figure 4

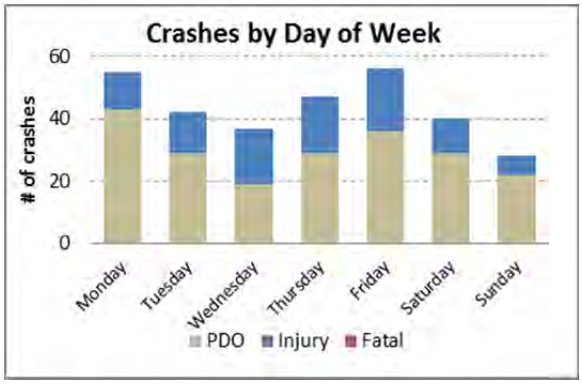


Figure 5

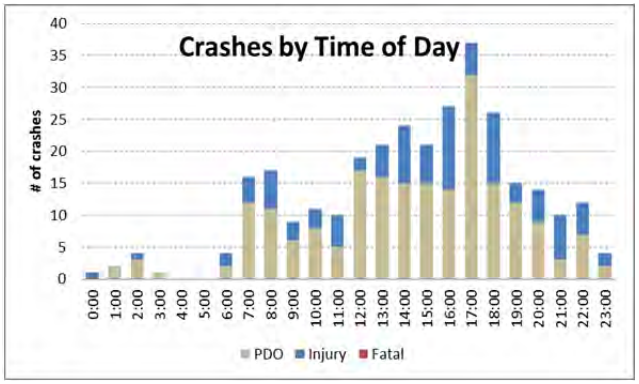


Figure 6

Crash Type and Lighting (**Figure 7** and **Figure 8**)

- Fifty-six (56) percent (171 crashes) were rear-end;
- Fifteen (15) percent (46 crashes) left-turn;
- Eight (8) percent (23 crashes) sideswipe;
- Seven (7) percent (21 crashes) angle; and
- Twenty-seven (27) percent of crashes occurred under non-daylight conditions.

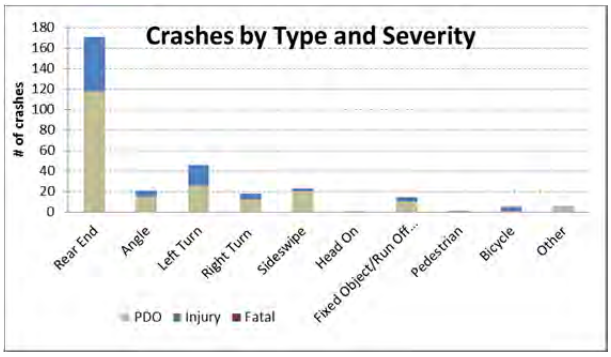


Figure 7

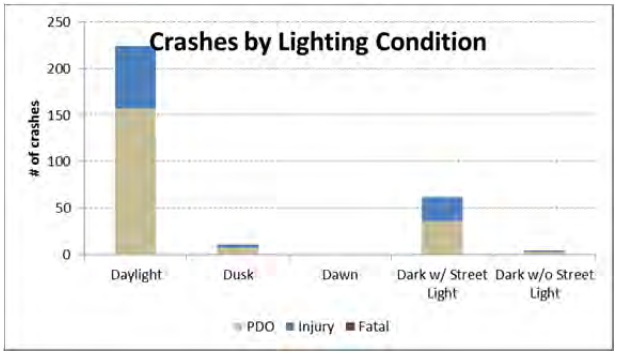


Figure 8

Intersection Crash Statistics

Of the 305 total crashes along the West Segment of Malabar Road, 186 occurred at the three (3) signalized intersections. The individual crash statistics for each of those intersections is detailed as follows:

- Malabar Road at Jupiter Boulevard (62 crashes)
- Malabar Road at Palm Bay West Plaza Entrance (22 total crashes)
- Malabar Road at Minton Road (102 total crashes)

Malabar Road at Jupiter Boulevard (62 total crashes)

- 26 percent (16 crashes) were injury-related and 74 percent (46 crashes) were PDO.
- 52 percent (32 crashes) were rear-end, 21 percent (13 crashes) were left-turn, and 11 percent (7 crashes) were angle (**Figure 9**).

  - 17 of the 32 rear-end crashes occurred in the westbound direction.
  - 8 of the 32 rear-end crashes occurred in the eastbound direction.
  - 5 of the 13 left-turn crashes occurred between southbound left-turning turning vehicles and northbound vehicles.
  - 4 of the 13 left-turn crashes occurred between northbound left-turning turning vehicles and southbound vehicles.
- 34 percent (21 crashes) occurred in non-daylight conditions.
- May (9 crashes) and July (8 crashes) were the highest crash months.
- 23 percent (14 crashes) occurred between 5:00 PM and 7:00 PM (**Figure 10**).
- 1 bicycle crash occurred on the west leg crosswalk.
- 3 crashes were alcohol related.

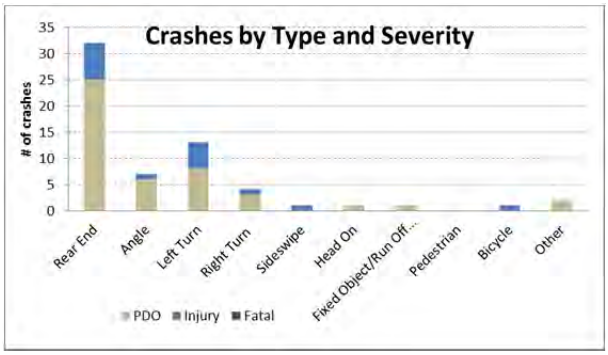


Figure 9

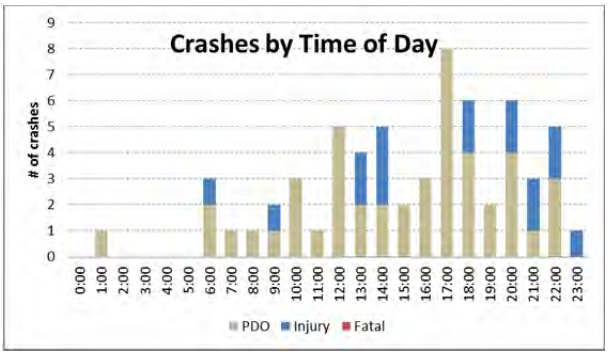


Figure 10

<u>Malabar Road at Palm Bay West Plaza Entrance (22 total crashes)</u>

- 27 percent (6 crashes) were injury-related and 73 percent (16 crashes) were PDO.
- 50 percent (11 crashes) were rear-end, 23 percent (5 crashes) were angle/left-turn/right-turn related, and 14 percent (3 crashes) were fixed-object/run-off road (**Figure 11**).
  - 8 of the 11 rear-end crashes occurred on the eastbound approach.
  - 3 of the 11 rear-end crashes occurred on the westbound approach.
- 23 percent (5 crashes) occurred in non-daylight conditions.
- June (4 crashes) was the highest crash months.
- 50 percent (11 crashes) occurred between 1:00 PM and 5:00 PM (**Figure 12**).
- 36 percent (8 crashes) occurred on Friday.
- 1 bicycle crash occurred approximately 100-feet west of the intersection.
- 1 crash was alcohol related.

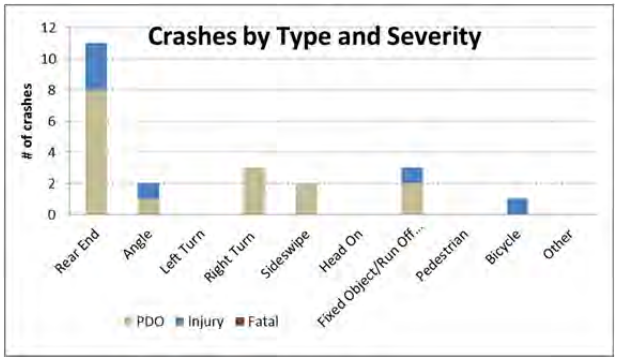


Figure 11

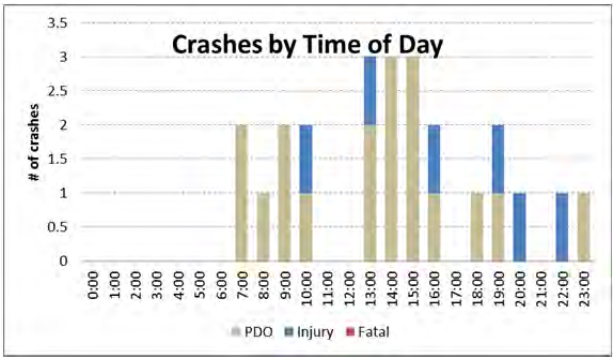


Figure 12

Malabar Road at Minton Road (102 total crashes)

- 33 percent (34 crashes) were injury-related and 67 percent (68 crashes) were PDO.
- 57 percent (58 crashes) were rear-end, 22 percent (22 crashes) were angle/left-turn/right-turn related, and 14 percent (14 crashes) were sideswipe (**Figure 13**).
    - 20 of the 58 rear-end crashes occurred on the westbound approach.
        - 16 of the 20 occurred between vehicles approaching the intersection.
        - 4 of the 20 occurred between vehicles departing the intersection.
    - 19 of the 58 rear-end crashes occurred on the eastbound approach.
        - 11 of the 19 occurred between vehicles approaching the intersection.
        - 8 of the 19 occurred between vehicles departing the intersection.
    - 10 left-turn crashes occurred between southbound left-turning vehicles and northbound vehicles.
    - 6 of the 14 sideswipe crashes occurred on the eastbound approach.
- 1 bicycle crash occurred in the east leg crosswalk.
- 1 bicycle crash occurred in the south leg crosswalk.
- 29 percent (30 crashes) occurred in non-daylight conditions.
- May (13 crashes) and September (12 crashes) were the highest crash months.
- 40 percent (41 crashes) occurred between 3:00 PM and 7:00 PM (**Figure 14**).
- 3 crashes were alcohol related.

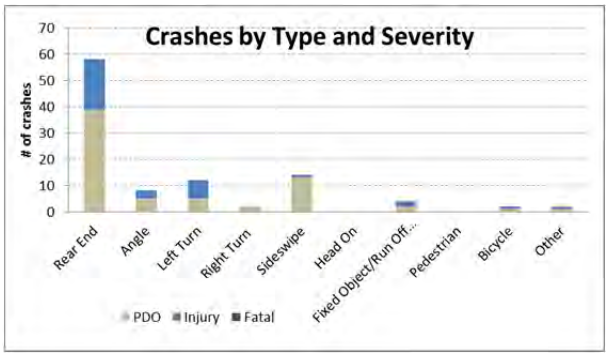


Figure 13

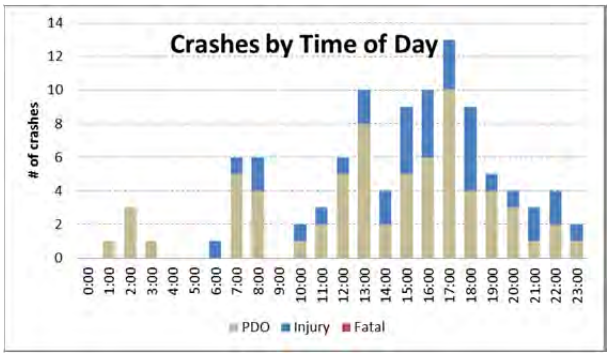


Figure 14

Segment Crash Statistics

There were a total of 119 segment crashes that occurred between Jupiter Boulevard and the Palm Bay West Plaza Entrance during the analysis period. These crashes were reviewed at specific locations to identify any additional trends or high crash locations. The individual crash statistics for each of the locations reviewed is detailed as follows:

Malabar Road near Garvey Road (12 total crashes within 150' of the intersection)

- One crash was injury-related. The remaining 11 crashes were PDO.
- 50 percent (6 crashes) were rear-end and 42 percent (5 crashes) were right-turn or left-turn related.
- All 12 crashes occurred during daylight.
- One crash occurred under wet roadway conditions. The remaining 11 crashes occurred under roadway surface conditions.
- 83 percent (10 crashes) occurred on a weekday.
- 33 percent (4 crashes) occurred between 4:00 PM and 7:00 PM.

Malabar Road near Maywood Avenue/Daffodil Drive (32 total crashes within 200' of the intersection)

- 38 percent (12 crashes) were injury-related and 62 percent (20 crashes) were PDO.
- 53 percent (17 crashes) were right-turn, left-turn, or angle related and 34 percent (11 crashes) were rear-end.
- 31 percent (10 crashes) occurred under non-daylight lighting conditions.
- 81 percent (26 crashes) occurred on a weekday.
- 34 percent (11 crashes) occurred between 4:00 PM and 8:00 PM.

Malabar Road west of the Plaza Entrance (23 total crashes over 0.14 miles)

- There are three driveways within the 0.14 mile segment.
- 22 percent (5 crashes) were injury-related and 78 percent (18 crashes) were PDO.
- 78 percent (18 crashes) were rear-end, 9 percent (2 crashes) were right-turn, and 9 percent (2 crashes) were run-off road crashes.
- One crash occurred under non-daylight lighting conditions.
- 44 percent (10 crashes) occurred on Saturday or Sunday.

Pedestrian and Bicycle Crash Summary

The following bullets summarize the one (1) pedestrian and five (5) bicycle crash distribution along the West Segment:

- Malabar Road at Jupiter Boulevard – 1 bicycle
- Jupiter Boulevard to Palm Bay West Plaza Entrance – 1 pedestrian and 1 bicycle
- Malabar Road at Palm Bay West Plaza Entrance – 1 bicycle
- Malabar Road at Minton Road – 2 bicycle

The pedestrian and bicycle crashes are summarized below (in order from west to east):

Pedestrian Crash

- Crash Number 802360670
  - On November 19, 2010 at 7:06 PM a crash involving a pedestrian and a vehicle occurred near the entrance to the Madalyn Landing Apartments under dry road surface and dark conditions with no street lighting. The pedestrian was attempting to cross Malabar Road just west of the apartment entrance in a motorized wheelchair. The vehicle was traveling eastbound in the inside lane and struck the rear-end of the pedestrian's wheelchair. The vehicle drove off, heading eastbound on Malabar Road. The pedestrian reported pain in her left arm and left leg.

Bicycle Crashes

- Crash Number 118412310
  - On May 24, 2012 at 1:30 PM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and Jupiter Boulevard under daylight conditions. The bicycle attempted to cross Malabar Road in the west leg's crosswalk heading northbound. The vehicle was traveling southbound and made a right-turn onto Malabar Road, striking the bicyclist's front tires. The vehicle never stopped and continued westbound. The bicyclist was treated for a knee injury.
- Crash Number 802359790
  - On October 14, 2010 at 6:42 PM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and Greenbrier Avenue under daylight conditions. The bicyclist was traveling eastbound on the northern sidewalk against the flow of traffic. The vehicle was traveling southbound on Greenbrier Avenue. The bicycle struck the side of the vehicle. The bicyclist reported having several scrapes but refused treatment.
- Crash Number 84203777
  - On April 26, 2014 at 10:43 PM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and the Plaza Entrance under dark lighting conditions with street lighting present. The bicyclist attempted to cross Malabar Road just west of the intersection, heading northbound. The vehicle was traveling westbound. The bicyclist hit the vehicle's passenger side. The driver had the right-of-way in this incident. The bicyclist was transported to the hospital complaining of neck pain.
- Crash Number 80236577
  - On September 23, 2011 at 4:05 PM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and Minton Road under daylight conditions. The bicycle was traveling southbound in the crosswalk on the east leg of the intersection. The vehicle attempted a westbound left-turn onto Minton Road with the green arrow. The bicyclist ran into the rear passenger side door of the vehicle. The driver had the right-of-way in this incident. The bicyclist was transported to the hospital with possible injuries.
- Crash Number 848122960
  - On June 20, 2014 at 4:31 PM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and Minton Road under daylight conditions. The bicycle was traveling westbound on the southern sidewalk against the flow of traffic. The vehicle attempted a northbound right-turn onto Malabar Road and struck the bicyclist.

The driver and bicyclist both claimed to have the right-of-way. No injuries were reported as a result of this incident.

East Segment

395 vehicular crashes were reported over the six-year study period. A map displaying the locations of crashes along the Malabar Road East Segment is located in **Appendix A**. Of the 395 crashes reported during the study period, there were:

- No fatal crashes (0 percent);
- 92 injury crashes (23 percent); and
- 303 PDO crashes (77 percent).

Collision diagrams (located in **Appendix A**) for the corridor include the following crashes:

- At signalized intersections;
- Pedestrian crash locations; and
- Bicycle crash locations.

East Segment Overall Crash Trends

The reported corridor crashes are displayed by different key crash trends such as measures of time (year, month, day, and hour), crash types, lighting conditions, and alcohol/drugs. Overall, the number of crashes has increased between 2009 and 2014. In 2011 and 2012, the Signal Four dataset displayed approximately 60 to 95 percent lower crashes than in the other years due to the availability of city or county crash records. Key crash trends include:

Time (**Figure 15** through **Figure 18**)

- April (42 crashes), June (38 crashes), August (37 crashes), and December (37 crashes) were the highest crash months during the year while Friday (77 crashes) and Thursday (68 crashes) were the highest crash days.
- Eighty-seven (87) percent of all crashes occurred between 7:00 AM and 8:00 PM.

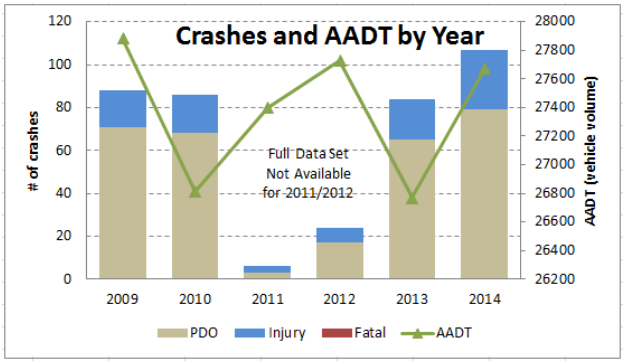


Figure 15

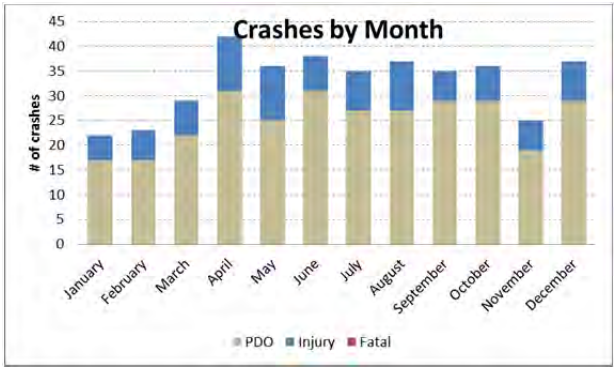


Figure 16

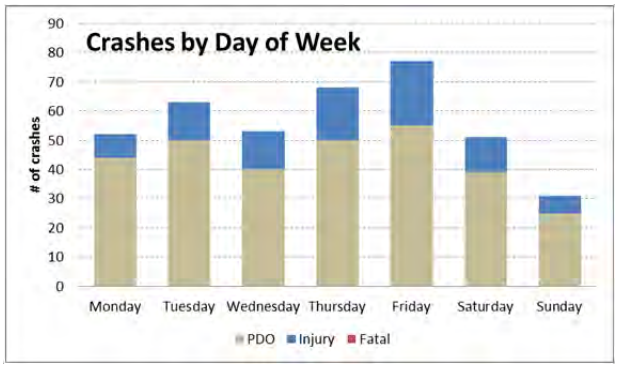


Figure 17

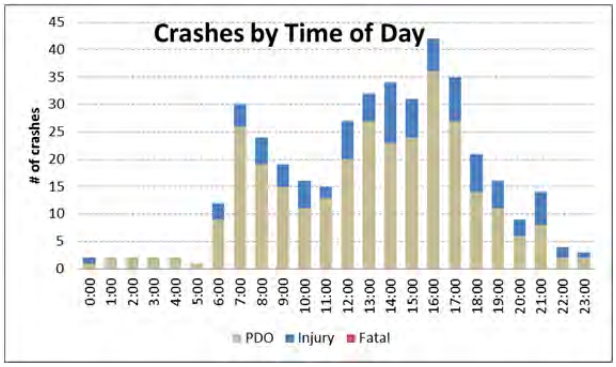


Figure 18

Crash Type and Lighting (**Figure 19** and **Figure 20**)

- Fifty-six (56) percent (221 crashes) were rear-end;
- 12 percent (48 crashes) sideswipe;
- Ten (10) percent (39 crashes) angle; and
- Twenty-one (21) percent of crashes occurred in non-daylight conditions.

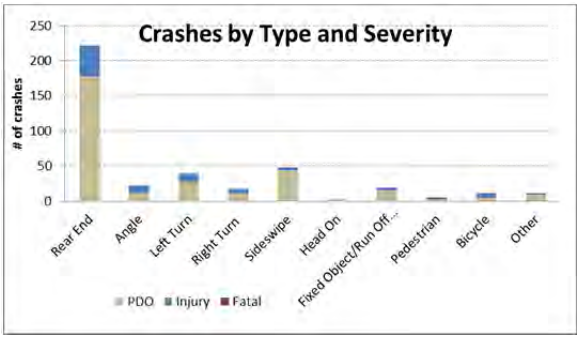


Figure 19

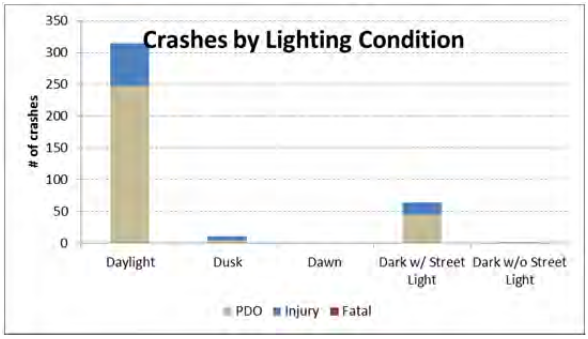


Figure 20

Intersection Crash Statistics

Of the 395 total crashes along the East Segment of Malabar Road, 339 occurred at the four (4) signalized intersections. The individual crash statistics for each of those intersections is detailed as follows:

- Malabar Road at Emerson Drive (112 crashes)
- Malabar Road at Corporate Circle (24 crashes)
- Malabar Road at Holiday Park Boulevard (51 crashes)
- Malabar Road at San Filippo Road (152 total crashes)

Malabar Road at Emerson Drive (112 crashes)

- 32 percent (36 crashes) were injury-related and 68 percent (76 crashes) were PDO.
- 65 percent (73 crashes) were rear-end, 9 percent (10 crashes) were angle, and 8 percent (9 crashes) were left-turn (**Figure 21**).
    - 24 of the 73 rear-end crashes occurred in the westbound direction.
    - 24 of the 73 rear-end crashes occurred in the eastbound direction.

  - 15 of the 73 rear-end crashes occurred in the northbound direction.
  - 5 of the 9 left-turn crashes occurred between vehicles making a southbound left and vehicles traveling northbound.
- 21 percent (23 crashes) occurred in non-daylight conditions.
- December (16 crashes) and May (14 crashes) were the highest crash months.
- 39 percent (44 crashes) occurred between 2:00 PM and 6:00 PM (**Figure 22**).
- 1 bicycle crash occurred on the west leg crosswalk.
- 1 bicycle crash occurred on the east leg crosswalk.
- 1 pedestrian crash occurred just east of the intersection at a nearby driveway.
- Two crashes were alcohol related.

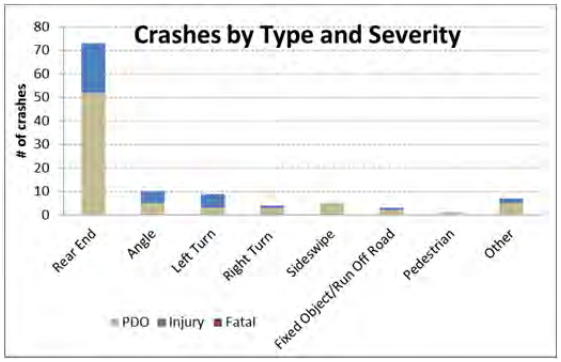


Figure 21

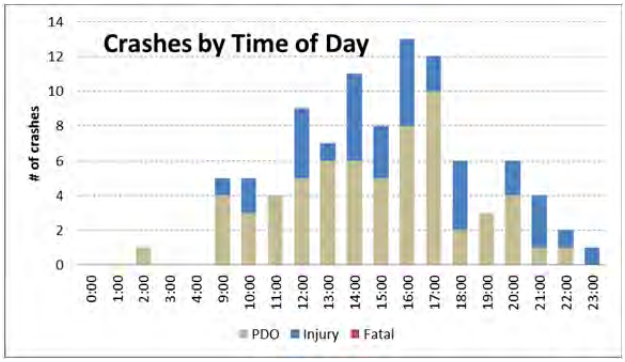


Figure 22

Malabar Road at Corporate Circle (24 crashes)

- 21 percent (5 crashes) were injury-related and 79 percent (19 crashes) were PDO.
- 63 percent (15 crashes) were rear-end, 17 percent (4 crashes) were left-turn, and 13 percent (3 crashes) were sideswipe (**Figure 23**).
  - 8 of the 15 rear-end crashes occurred in the eastbound direction.
  - 7 of the 15 rear-end crashes occurred in the westbound direction.
- 1 crash occurred in non-daylight conditions.
- February and September (4 crashes) were the highest crash months.
- 63 percent (15 crashes) occurred between 1:00 PM and 5:00 PM (**Figure 24**).
- 1 crash was alcohol related.

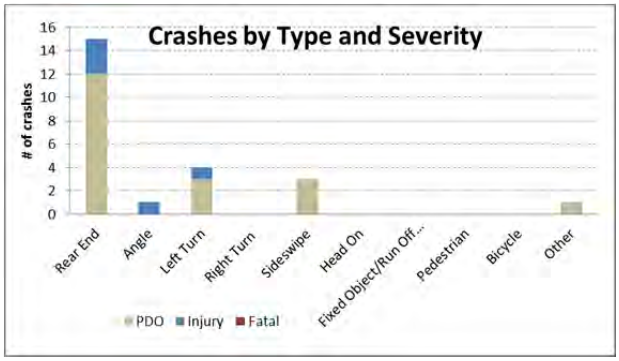


Figure 23

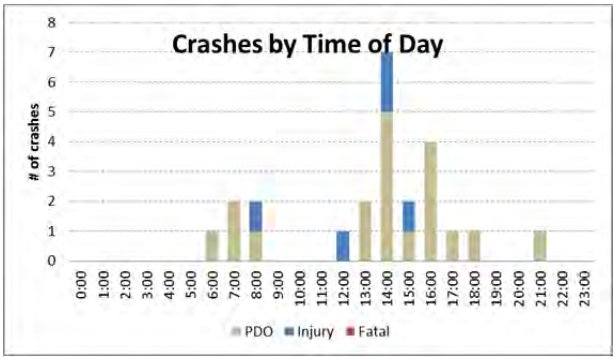


Figure 24

Malabar Road at Holiday Park Boulevard (51 crashes)

- 20 percent (10 crashes) were injury-related and 80 percent (41 crashes) were PDO.
- 61 percent (31 crashes) were rear-end, 18 percent (9 crashes) were angle/left-turn, and 10 percent (5 crashes) sideswipe (**Figure 25**).
    - 16 of the 31 rear-end crashes occurred on the eastbound approach.
    - 15 of the 31 rear-end crashes occurred on the westbound approach.
    - 4 crashes occurred between westbound through vehicles and eastbound left-turn vehicles.
- 1 pedestrian crash occurred just west of the intersection at a nearby driveway.
- 1 bicycle crash occurred in the north leg crosswalk.
- 1 bicycle crash occurred in the east leg crosswalk.
- 4 percent (2 crashes) occurred in non-daylight conditions.
- April (7 crashes) and July (6 crashes) were the highest crash months.
- 16 percent (8 crashes) occurred between 4:00 PM and 5:00 PM (**Figure 26**).
- Four crashes were alcohol related.

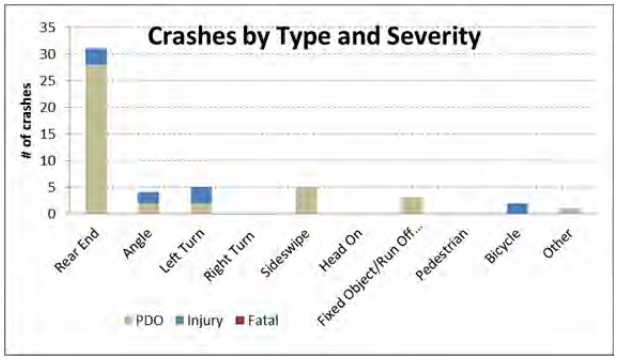


Figure 25

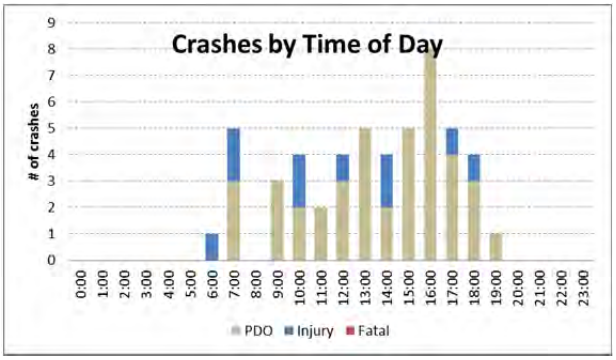


Figure 26

Malabar Road at San Filippo Drive (152 total crashes)

- 12 percent (18 crashes) were injury-related and 88 percent (134 crashes) were PDO.
- 47 percent (72 crashes) were rear-end, 16 percent (25 crashes) were sideswipe, and 13 percent (20 crashes) were angle/left-turn/right-turn related (**Figure 27**).
    - 29 of the 72 rear-end crashes occurred in the eastbound direction.
    - 27 of the 72 rear-end crashes occurred in the westbound direction.
    - 12 of the 72 rear-end crashes occurred in the northbound direction.
    - 7 of the 25 sideswipe crashes occurred while drivers were turning in the dual westbound left-turn lanes.
    - 6 of the 25 sideswipe crashes occurred while drivers were turning in the northbound left-turn lane.
    - 5 crashes occurred between northbound left-turning vehicles and southbound through vehicles.
- 3 bicycle crashes occurred at or near the intersection:
    - Two crossing the southern crosswalk; and
    - One crossing the northern crosswalk.
- 24 percent (37 crashes) occurred in non-daylight conditions.

- August (16 crashes), April (15 crashes), and October (15 crashes) were the highest crash months and Tuesday (29 crashes) was the highest crash day.
- 11 percent (17 crashes) occurred between 7:00 AM and 8:00 AM (**Figure 28**).

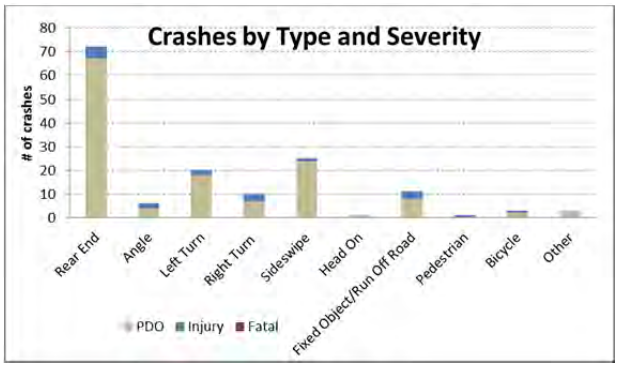


Figure 27

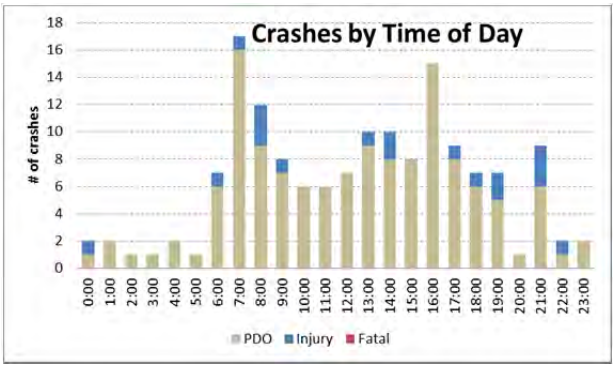


Figure 28

Segment Crash Statistics

There were a total of 56 segment crashes during the analysis period. The following summarizes the total number of crashes for each segment:

- Segment 1 – Emerson Drive to Corporate Circle (13 crashes over 0.20 miles)
- Segment 2 – Corporate Circle to Holiday Park Boulevard (25 crashes over 0.12 miles)
- Segment 3 – Holiday Park Boulevard to San Filippo Drive (18 crashes over 0.15 miles)

The 56 crashes were reviewed at specific locations to identify any additional trends or high crash locations. The individual crash statistics for each of the locations reviewed is detailed as follows:

Malabar Road west of Holiday Park Boulevard (25 total crashes over 0.12 miles)

- There is one directional median opening and one driveway within the 0.12 mile segment
- 32 percent (8 crashes) were injury-related and 68 percent (17 crashes) were PDO.
- 60 percent (15 crashes) were rear-end, 12 percent (3 crashes) were sideswipe, and 12 percent (3 crashes) involved a pedestrian or bicyclist.
- 32 percent (8 crashes) occurred under non-daylight lighting conditions.
- July (5 crashes) was the highest crash month.
- 36 percent (9 crashes) occurred between 5:00 PM and 8:00 PM.

Malabar Road west of San Filippo Drive (11 total crashes over 0.06 miles)

- Two crashes were injury-related and 9 crashes were PDO.
- Four crashes were rear-end and 3 crashes were sideswipe.
- One crash occurred under non-daylight lighting conditions.
- All 11 crashes occurred on a weekday.

Pedestrian and Bicycle Crash Summary

The following bullets summarize the five (5) pedestrian and 11 bicycle crash distribution along the East Segment:

- Malabar Road at Emerson Drive – 1 pedestrian and 3 bicycle
- Segment 1: Emerson Drive to Corporate Circle – 2 pedestrian
- Malabar Road at Corporate Circle – none
- Segment 2: Corporate Circle to Holiday Park Boulevard – 1 pedestrian and 2 bicycle
- Malabar Road at Holiday Park Boulevard – 1 pedestrian and 2 bicycle
- Segment 3: Holiday Park Boulevard to San Filippo Drive – 1 bicycle
- Malabar Road at San Filippo Drive – 3 bicycle

The pedestrian and bicycle crashes are summarized below (in order from west to east):

Pedestrian Crashes

- Crash Number 104153610
  - On January 29, 2009 at 9:29 AM a crash involving a pedestrian and a vehicle occurred near the intersection of Malabar Road and Emerson Drive under daylight and dry roadway surface conditions. The pedestrian was traveling westbound on the southern sidewalk. The driver was attempting to turn right out of a driveway onto Malabar Road. The pedestrian and driver gave conflicting statements. The pedestrian claimed he was struck by the vehicle. The driver alleged the pedestrian tripped and fell on the vehicle. The pedestrian was tested for alcohol; however, the results of the test are not provided in the crash report. No injuries were reported as a result of the incident.
- Crash Number 848126790
  - On August 16, 2014 at 3:19 PM a crash involving a pedestrian and a vehicle occurred near the intersection of Malabar Road and Emerson Drive under daylight and dry roadway surface conditions. The pedestrian was traveling westbound on the southern sidewalk. The driver was attempting to turn right out of a driveway onto Malabar Road and hit the pedestrian. The vehicle continued without stopping. The pedestrian had the right-of-way in this incident.
- Crash Number 842033780
  - On March 3, 2014 at 1:57 PM a crash involving a pedestrian and a vehicle occurred on Malabar Road in front of the Hess gas station under daylight and dry roadway surface conditions. The pedestrian was traveling in a wheelchair westbound on the southern sidewalk. The driver was attempting to turn out of a driveway onto Malabar Road and hit the pedestrian. The pedestrian had the right-of-way in this incident. No injuries were reported as a result of the incident.
- Crash Number 842023480
  - On September 21, 2013 at 2:34 PM a crash involving a pedestrian and a vehicle occurred at the intersection of Malabar Road and the Dunkin Donuts driveway under daylight and dry roadway surface conditions. The pedestrian was traveling westbound on the southern sidewalk in a motorized scooter. The driver was attempting to turn right out of the Dunkin Donuts onto Malabar Road and struck the rear side of the scooter. The pedestrian had the right-of-way in this incident.

- Crash Number 802357250
  - On May 25, 2010 at 9:45 PM a crash involving a pedestrian and a vehicle occurred near the intersection of Malabar Road and San Filippo Drive under dark lighting conditions with street lights. The pedestrian attempted to cross Malabar Road (heading northbound) at a mid-block location to the east of San Filippo Drive. The pedestrian was struck in the inside eastbound through lane. The pedestrian was transported to the hospital.

Bicycle Crashes

- Crash Number 630114100
  - On September 1, 2010 at 1:34 PM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and Emerson Drive under daylight and dry roadway surface conditions. The bicyclist was traveling westbound on the sidewalk and attempted to cross Emerson Drive with a green signal. The vehicle was making a right-turn onto Malabar Road and struck the bicyclist. The bicycle had the right-of-way in this incident. The bicyclist received a few scrapes.
- Crash Number 630155400
  - On December 23, 2010 at 6:28 AM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and Emerson Drive under dark-lighted. The bicyclist was traveling westbound in the crosswalk. The vehicle was making a right-turn onto Malabar Road and struck the bicyclist. The bicycle had the right-of-way in this incident. No injuries were reported as a result of this incident.
- Crash Number 842024000
  - On October 1, 2013 at 10:36 AM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and Emerson Drive under daylight and dry roadway surface conditions. The bicycle attempted to cross Malabar Road in the west leg's crosswalk heading northbound. The vehicle was traveling westbound in the center through lane, ran a red light, and hit the bicyclist. The bicycle had the right-of-way in this incident.
- Crash Number 802355740
  - On March 2, 2010 at 7:20 PM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and the shared Walmart/Hess driveway under dark-lighted conditions. The bicyclist was traveling westbound on the south crosswalk. The vehicle was pulling out of the Walmart driveway and struck the bicyclist. The bicycle had the right-of-way in this incident and sustained minor scratches.
- Crash Number 802358290
  - On July 21, 2010 at 6:03 AM a crash involving two bicycles and a vehicle occurred at the intersection of Malabar Road and Corporate Drive under dawn lighting conditions. The bicyclists attempted to cross Corporate Drive in the south leg's crosswalk. The vehicle was heading northbound on Corporate Drive and hit one of the bicyclists. The bicyclist sustained minor injuries. The bicyclists had the right-of-way in this incident.
- Crash Number 835763850
  - On April 9, 2013 at 7:21 AM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and Holiday Park Boulevard under daylight and dry roadway surface conditions. The bicyclist was traveling westbound in the north

crosswalk. The vehicle was making an eastbound left-turn onto Holiday Park Boulevard and struck the bicyclist. The bicycle had the right-of-way in this incident.

- Crash Number 848135760
  - On December, 24 2014 at 6:12 AM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and Holiday Park Boulevard under dark-lighted conditions. The bicyclist was traveling southbound in the west crosswalk. The bicyclist crossed Malabar Road during a red light and was hit by a vehicle traveling eastbound on Malabar Road. The driver had the right-of-way in this incident. The bicyclist was transported to the hospital.
- Crash Number 835763850
  - On May, 7 2013 at 3:06 PM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and the shared Taco Bell/Chick-fil-A driveway under daylight and dry roadway surface conditions. The bicyclist was traveling westbound in the south crosswalk and crossed into the path of the vehicle.
- Crash Number 802358630
  - On August 12, 2010 at 3:28 PM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and San Filippo Drive under daylight and dry roadway surface conditions. The bicyclist was crossing at an unknown crosswalk when the driver rolled through a red light and hit the bicyclist. The bicycle had the right-of-way in this incident. No injuries were reported as a result of this incident.
- Crash Number 802366410
  - On November 2, 2011 at 3:28 PM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and San Filippo Drive under dark-lighted conditions. The bicyclist was traveling west in the south crosswalk. The driver was traveling northbound on San Filippo Road attempting to make a right-turn onto Malabar Road when they struck the bicyclist. The driver fled the scene. The bicyclist reported non-incapacitating injuries.
- Crash Number 835766000
  - On May 17, 2013 at 1:02 PM a crash involving a bicycle and a vehicle occurred at the intersection of Malabar Road and San Filippo Drive under daylight and dry roadway surface conditions. The bicyclist was traveling west bound in the south crosswalk. The vehicle was traveling northbound on San Filippo Drive. The light turn greened as the bicyclist entered the crosswalk, and the vehicle hit the bicyclist. No injuries were reported as a result of this incident.

ROAD SAFETY AUDIT FINDINGS

Summary of Safety Issues

The RSA team identified and categorized corridor-wide and location-specific safety issues based on a qualitative risk scale. For the purposes of this RSA, risk is defined as a function of exposure, probability, and consequence. *Exposure* reflects the number of roadway users that could be influenced by the design feature. *Probability* reflects the likelihood of a crash influenced by the identified design feature. The *consequence* reflects the severity of a crash, if one occurs.

The RSA team assigned the qualitative risk rating of safety issues identified within the Malabar Road study corridor relative to all other issues observed. ***Category III*** issues have potentially the greatest risk compared to the other observed issues; they are associated with higher exposure, probability, and/or consequence than other issues. ***Category II*** issues indicate higher risk than some issues and lower risk relative to other observed safety issues. ***Category I*** issues indicate the least risk compared to the other observed issues; they are associated with lower exposure, probability, and/or consequence. The qualitative risk ratings for each of the corridor-wide, West Segment, and East Segment safety issues are summarized below.

Corridor-Wide Qualitative Risk Ratings

Category III issues identified by the RSA Team:

- Faded Pavement Markings: Page 24
- Permissive Left-Turn Movements: Page 31

Category II issues identified by the RSA Team:

- Pedestrian Signage at Signalized Intersections: Page 26
- Speed Consistency: Page 28
- Pedestrian Phase Responsiveness: Page 33
- Stop Sign Retro-Reflectivity: Page 34
- Signalized Intersection Lighting: Page 35
- Detectable Warning Surfaces: Page 37

Category I issues identified by the RSA Team:

- Signalized Intersection Street Name Signage: Page 30

West Segment Qualitative Risk Ratings

Category III issues identified by the RSA Team:

- Unsignalized Intersection Control at Maywood Avenue/Daffodil Drive: Page 47
- Minton Road Full Median Opening: Page 58

Category II issues identified by the RSA Team:

- Minor Street Intersections: Page 40
- Westbound Rear-End Crashes at Jupiter Boulevard: Page 43
- Turning Vehicles and Pedestrians in Crosswalk at Jupiter Boulevard: Page 45
- Merge Area West of Palm Bay West Plaza Entrance: Page 51
- Sidewalk Connection: Page 53
- Signalized Intersection Pedestrian Facilities: Pages 54 and 55
- Northbound Lane Designations at Minton Road: Page 57

Category I issues identified by the RSA Team:

- Malabar Road/Minor Street Grade Difference: Page 42
- Left-Turn Lane into Dollar General: Page 49

East Segment Qualitative Risk Ratings

Category II issues identified by the RSA Team:

- Driveway Slopes: Page 60
- Northbound Right-Turn Conflicts: Pages 61 and 64
- Eureka Avenue Curb Ramps: Page 63

ROAD SAFETY AUDIT FINDINGS – MALABAR ROAD CORRIDOR-WIDE

Even though the West Segment and East Segment had different cross sections and adjacent land uses, nine common issues were apparent in both areas:

1. Faded Pavement Markings;
2. Pedestrian Signage at Signalized Intersections;
3. Speed Consistency;
4. Signalized Intersection Street Name Signage;
5. Permissive Left-Turn (5- Section Doghouse Signal Display) Movements;
6. Pedestrian Phase Responsiveness;
7. Stop Sign Retro-Reflectivity;
8. Signalized Intersection Lighting; and
9. Detectable Warning Surfaces.

These nine corridor-wide issues are discussed in the following pages. After discussing corridor-wide issues, issues pertaining specifically the West Segment or East Segment will be discussed.

Location: Corridor-Wide

Issue #1: Faded Pavement Markings

Figure 29

Figure 30

Figure 31

Figure 32

Description of Issue:

Pavement markings along the corridor are wearing and fading. In some cases, the lane markings are faded to a point the driver cannot tell which lane corresponds to which movement (**Figure 29**). Crosswalk markings at the signalized intersections along the corridor are striped with old special emphasis markings and are beginning to wear, as illustrated in **Figure 30**. Ten of the 16 bicycle crashes along the corridor occurred at signalized intersections with the bicycle located in the marked crosswalk. Crosswalk markings across minor streets and driveways (**Figure 31**) are faded as well as lane markings in the roadway (**Figure 32**).

Table 1. Qualitative Risk Rating for Faded Pavement Markings

Function	Classification	Reasoning
Exposure	Category III	Present along entire corridor
Probability	Category III	10 of the 16 bicycle crashes occurred within marked crosswalks, could be a contributing factor to other crash types depending on situation
Consequence	Category II	PDO to injury, depending on crash type
Overall	*Category III*	-

Suggestions for Improvement:
Consider the following suggestions to improve faded pavement markings along the corridor:

- Check with Brevard County on when the next resurfacing project will occur along Malabar Road. During the resurfacing project, the entire corridor will be restriped.
- If no resurfacing project is planned within the next 5 years, perform a corridor-wide restriping project to enhance the crosswalk markings at signalized/unsignalized intersections, the roadway lane markings, and the signalized/unsignalized intersection approach lane markings.
- Upgrade the crosswalk markings at the signalized intersections to be special emphasis as shown on sheet 9 of FDOT Design Standard Index 17346.

Location: Corridor-Wide

Issue #2: Pedestrian Signage at Signalized Intersections

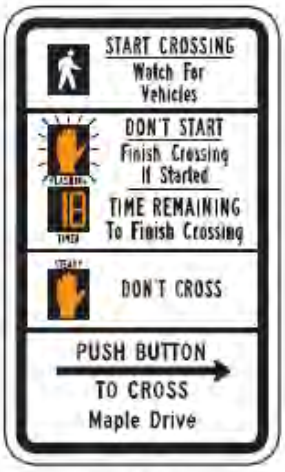
Figure 33

Description of Issue:
The intent of the RSA is to consider safety for all user groups based on both crash data and risk factors. There may not be crash data supporting the noted design deficiencies, but the RSA team conducted a risk-based assessment and identified the locations to address potential safety issues based on risk. At the signalized intersections, the study team observed upgraded pedestrian signal heads with countdown timers, but the pedestrian detector signage was not upgraded to match the improvements, as displayed in **Figure 33**.

Table 2. Qualitative Risk Rating for Pedestrian Signage at Signalized Intersections

Function	Classification	Reasoning
Exposure	Category II	Present at all signalized intersections, utilized when pedestrians are present
Probability	Category I	No pedestrian/bicycle crashes reported due to this issue
Consequence	Category III	Potential for pedestrian/bicycle crash types
Overall	*Category II*	-

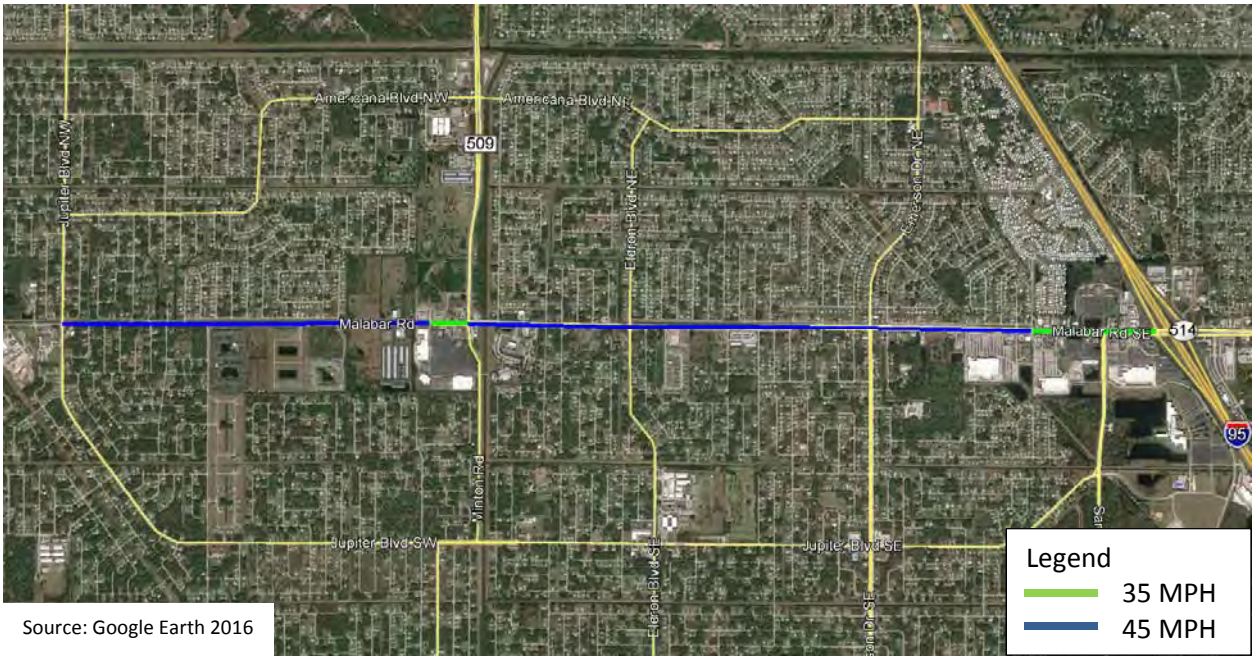
Suggestions for Improvement:
As a maintenance-type activity, consider installing **R10-3i** pedestrian plaques above pedestrian detectors at signalized intersections along the corridor.


START CROSSING
Watch For
Vehicles
DON'T START
Finish Crossing
If Started
18
TIME REMAINING
To Finish Crossing
DON'T CROSS
PUSH BUTTON
TO CROSS
Maple Drive

R10-3i

Location: Corridor-Wide

Issue #3: Speed Consistency



Source: Google Earth 2016

Figure 34

Description of Issue:
Along the Malabar Road corridor from Jupiter Boulevard in the west to I-95 in the east, the speed limit fluctuates between 35 MPH and 45 MPH as displayed in **Figure 34**. Vehicular speeds appeared to be in excess of the posted speeds along the entire length of the study corridor, especially when the speed limit drops to 35 MPH between the Palm Bay West Plaza Entrance and Minton Road, and between Holiday Park Boulevard and the I-95 interchange. It appeared vehicles were traveling 45 to 55 MPH even though the speed limit had reduced to 35 MPH. Fluctuations in speed from 45 MPH to 35 MPH may contribute to rear-end crashes at signalized intersections.

Table 3. Qualitative Risk Rating for Speed Consistency

Function	Classification	Reasoning
Exposure	Category III	Present for vehicles traversing the corridor from Jupiter Boulevard to the I-95 interchange
Probability	Category II	No crashes reported due to this issue, could contribute to rear-ends at signalized intersections between vehicles traveling speed limit of 35 MPH and vehicles traveling 10 to 20 MPH faster than the speed limit
Consequence	Category II	Potential for PDO to injury, depending on crash type
Overall	*Category II*	-

Suggestions for Improvement:
Consider the following suggestions to improve speed consistency along the corridor:

- Perform a speed study along Malabar Road from Jupiter Boulevard to the I-95 interchange to review speed consistency along the corridor. Providing a consistent speed limit along the corridor has the potential to reduce speed differential conflicts between vehicles.
- Increase speed enforcement to encourage vehicles to drive closer to the posted speed limit based on the results of the speed study. Speed feedback signs that display how fast the vehicle is traveling may help deter speeding along the corridor.

Location: Corridor-Wide

Issue #4: Signalized Intersection Street Name Signage

Figure 35

Figure 36

Description of Issue:
Street name signage types and sizes at signalized intersections are inconsistent along the study corridor. At some intersections such as San Filippo Drive/Interchange Drive (**Figure 35**), interior illuminated street signage is present while at other intersections such as the Palm Bay West Plaza Entrance (**Figure 36**), the street name signage is not interior illuminated.

Table 4. Qualitative Risk Rating for Signalized Intersection Street Name Signage

Function	Classification	Reasoning
Exposure	Category I	Not usually an issue for local drivers
Probability	Category I	No crashes reported due to this issue
Consequence	Category I	Potential for rear-ends typically result in PDO or minor injury
Overall	*Category I*	-

Suggestions for Improvement:
In the near term, consider replacing signalized intersection street name signage with interior illuminated, overhead LED street name signs, per section 2A.07 and Table 2A-1 of the 2009 *Manual on Uniform Traffic Control Devices (MUTCD)*. By making the signalized intersection street name signage consistent, the distance from which a driver can see the street signs will increase which may in turn reduce the potential for rear-end crashes associated with sudden deceleration from turning vehicles.

Location: Corridor-Wide

Issue #5: Permissive Left-Turn (5- Section Doghouse Signal Display) Movements

Figure 37

Figure 38

Description of Issue:
Permissive left-turn phases (5-section doghouse signal display) are present at the following locations (the corresponding number of left-turn related crashes is also noted):

- All left-turn movements at Jupiter Boulevard –
  - 4 crashes between northbound left/southbound through movements
  - 3 crashes between southbound left/northbound through movements
  - 1 crash each between eastbound left/westbound through and westbound left/eastbound through movements
- All left-turn movements at Palm Bay West Plaza Entrance (**Figure 37**) – no left-turn crashes
- Northbound and southbound (**Figure 38**) left-turn movements at Minton Road –
  - 10 crashes between southbound left/northbound through movements
- Northbound and southbound left-turn movements at Emerson Drive –
  - 5 crashes between southbound left/northbound through movements
  - 3 crashes between northbound left/southbound through movements
- Eastbound and westbound left-turn movements at Corporate Circle –
  - 1 crash between westbound left/eastbound through movements
- Eastbound, northbound, and southbound left-turn movements at Holiday Park Boulevard –
  - 4 crashes between eastbound left/westbound through movements
  - 1 crash between northbound left/southbound through movements
- Northbound and southbound left-turn movements at San Filippo Drive –
  - 5 crashes between northbound left/southbound through movements
  - 2 crashes between southbound left/northbound through movements

In total, 39 left-turn crashes occurred with through vehicles at signalized intersections. These crashes accounted for 46 percent of the total left-turn crashes (39 out of 85) along the study corridor.

Table 5. Qualitative Risk Rating for Permissive Left-Turn Movements

Function	Classification	Reasoning
Exposure	Category III	Left-turning during permissive phases at each signalized intersection
Probability	Category III	39 left-turn crashes with through vehicles (46% of total left-turn crashes)
Consequence	Category II	PDO to severe injury crashes
Overall	*Category III*	-

Suggestions for Improvement:
In the near term, consider replacing "doghouse" five-section signal displays with 4-section flashing yellow arrow (FYA) protected/permissive left-turn display for the left-turn movements noted above. If the left-turn phasing is converted to a FYA display, consider providing protected only left-turn phasing during peak periods and allow the protected-permissive phasing during the off-peak periods. Even though some of the left-turn phases noted on the previous page do not have associated crashes, the FYA display should be applied corridor wide for corridor consistency and driver expectancy.

Specifically at the Minton Road intersection, review guidance in section 3.2 of the FDOT *Traffic Engineering Manual* (TEM) and section 4D.17 of the MUTCD for changing the northbound and southbound left-turn phases from protected/permissive phasing to protected only phasing.

Location: Corridor-Wide

Issue #6: Pedestrian Phase Responsiveness

Description of Issue:
The intent of the RSA is to consider safety for all user groups based on both crash data and risk factors. There may not be crash data supporting the noted design deficiencies, but the RSA team conducted a risk-based assessment and identified the locations to address potential safety issues based on risk. The walk phase associated with crossing the north leg of Palm Bay West Plaza Entrance, the south leg of Corporate Circle, and the north/south legs of Holiday Park Boulevard coincide with the Malabar Road eastbound/westbound phases but if there is not a pedestrian present at these crosswalks, the pedestrian phase would not activate. If a pedestrian attempts to utilize the pedestrian phase after the eastbound/westbound phase has begun, the walk phase will not activate even if there is sufficient green time remaining on the eastbound/westbound phase to allow for another pedestrian phase. As a result, pedestrians arriving just after the start of green for the eastbound/westbound phases either experience unnecessary delay or will attempt to cross the minor street when they do not have the walk sign. The maximum split time for the eastbound/westbound phases is 60 to 71 seconds with 21 to 28 seconds of pedestrian clearance time needed depending on the intersection.

Table 6. Qualitative Risk Rating for Pedestrian Phase Responsiveness

Function	Classification	Reasoning
Exposure	Category I	Utilized when pedestrians are present at only three intersections
Probability	Category I	No pedestrian/bicycle crashes reported due to this issue
Consequence	Category III	Potential for pedestrian/bicycle crash types
Overall	*Category II*	-

Suggestions for Improvement:
Consider options to improve the response of walk phases during the eastbound and westbound phases as a maintenance-type activity. Options to consider include:

- Reprogram the pedestrian phase crossing the minor streets to activate every time with the full eastbound/westbound phase; or
- Depending on the controller capabilities and/or if the corridor is signal coordinated, allow the Walk phase (i.e., crossing the minor streets) to activate after the start of green if there is still sufficient green time available for the eastbound/westbound phase to accommodate the pedestrian clearance time, if needed. If the signal is running free, the east/west phase may be extended if there is a pedestrian call and no vehicle detection on the minor street.

Location: Corridor-Wide

Issue #7: Stop Sign Retro-Reflectivity

Figure 39

Figure 40

Description of Issue:
The stop signs along the corridor at some driveways (**Figure 39**) and unsignalized intersections (**Figure 40**) are worn/faded. The worn/faded signs have limited retro-reflectivity at night as displayed in **Figure 39**.

Table 7. Qualitative Risk Rating for Stop Sign Retro-Reflectivity

Function	Classification	Reasoning
Exposure	Category II	Driveways and unsignalized intersections along the corridor
Probability	Category I	No crashes reported due to this issue
Consequence	Category II	Potential for PDO to severe injury turning/angle crashes if someone does not stop before entering Malabar Road
Overall	*Category II*	-

Suggestions for Improvement:
As a part of future maintenance work, consider replacing the existing stop signs (R1-1) along the corridor with new stop signs according to guidance in Section 2B.10 of the MUTCD.

Location: Corridor-Wide

Issue #8: Signalized Intersection Lighting

Figure 41

Figure 42

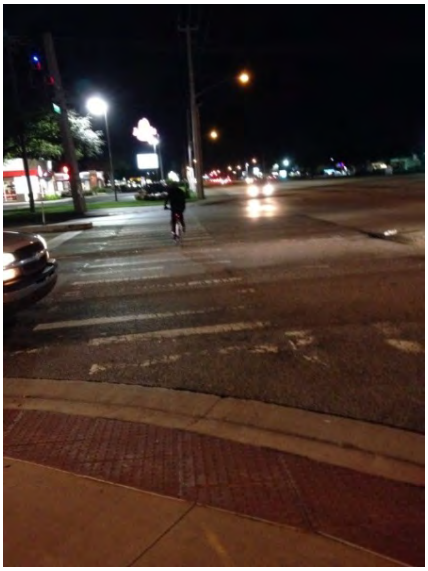


Figure 43

Description of Issue:
Intersection lighting is present at the following locations:

- Jupiter Boulevard: Northwest corner
- Palm Bay West Plaza Entrance: No intersection lighting, but ambient light is present from the southeast and northeast corners from businesses (**Figure 41**)
- Minton Road: All corners with the exception of the southwest corner
- Emerson Drive: All corners with the exception of the northwest corner (**Figure 42**)
- Corporate Circle: No intersection lighting on the north side of the roadway
- Holiday Park Boulevard: No intersection lighting in northeast and southeast corners
- San Filippo Drive: All corners with the exception of the northwest corner (**Figure 43**)

In total, 24 percent of crashes at these seven intersections occurred under non-daylight lighting conditions.

Table 8. Qualitative Risk Rating for Signalized Intersection Lighting

Function	Classification	Reasoning
Exposure	Category II	Intersection under dark lighting conditions for 8-16 hours of the day depending on time of year
Probability	Category II	24 percent of crashes at signalized intersections occurred under non-daylight lighting conditions
Consequence	Category II	PDO to injury, depending on crash type
Overall	*Category II*	-

Suggestions for Improvement:
In the near term, consider upgrading the lighting at the signalized intersections to meet the requirements of section 7.3.2.2 in Volume 1 of the FDOT Plans Preparation Manual (PPM). This may require the existing lighting to be replaced. Lighting the intersection may reduce the number of night time crashes and will make pedestrians utilizing the crosswalk more visible.

Location: Corridor-Wide

Issue #9: Detectable Warning Surfaces

Figure 44

Figure 45

Figure 46

Figure 47

Description of Issue:
The intent of the RSA is to consider safety for all user groups based on both crash data and risk factors. There may not be crash data supporting the noted design deficiencies, but the RSA team conducted a risk-based assessment and identified the locations to address potential safety issues based on risk. Detectable warning surfaces were either not present (**Figure 44**) or were in disrepair (**Figure 45**) at the signalized intersections along the corridor. Detectable warning surfaces present at minor street intersections or driveways were also observed to be in disrepair (**Figure 46** and **Figure 47**).

Table 9. Qualitative Risk Rating for Detectable Warning Surfaces

Function	Classification	Reasoning
Exposure	Category III	At all signalized and unsignalized intersections; driveways where detectable warning surfaces are present
Probability	Category I	No pedestrian/bicycle crashes reported due to this issue
Consequence	Category III	Potential for pedestrian/bicycle crash types
Overall	*Category II*	-

Suggestions for Improvement:
Consider replacing/installing detectable warning surfaces per FDOT Design Standard Index 304 at all signalized intersections and at minor street intersections/driveways where detectable warning surfaces are currently installed.

ROAD SAFETY AUDIT FINDINGS – MALABAR ROAD WEST SEGMENT
JUPITER BOULEVARD TO MINTON ROAD

Transit Related Improvements – West Segment

SCAT completed the Bus Stop Americans with Disabilities Act (ADA) Assessment Report for every transit stop within their network in early 2015. The Malabar Road West Segment study corridor has five transit stops reviewed as part of this assessment. The recommendations from the ADA report are summarized for each stop below:

Jupiter Boulevard Eastbound

- Move the bus stop approximately 240' west and pave a level 5’x8’ slab with a raised 6” curb for the boarding and alighting (B&A) area;
- Pave a 40' path to connect to the existing sidewalk to the west;
- Add detectable warnings to the nearby curb ramps; and
- Verify the pole with the bus schedule is located adjacent to the pavement so it is accessible.

Ware Avenue Eastbound

- Move the stop approximately 80' west. Pave a level 5’x8’ slab with a raised 6” curb for the B&A area and pave a ramp from the B&A area to the shoulder of the road, which will act as the accessible path; and
- Add detectable warnings to the new curb ramp.

Madalyn Landing Eastbound

- Move the bus stop approximately 100' east. Pave a level 5’x8’ slab with a raised 6” curb for the B&A area;
- Verify the B&A area has a cross slope of ≤2%; and
- Add a 50' path to connect the B&A to the existing sidewalk.

Maywood Avenue Eastbound

- Move the bus stop approximately 70' west. Pave a level 5’x8’ slab with a raised 6” curb for the B&A area;
- Add a 50' path to connect the B&A to the existing sidewalk; and
- Resurface the B&A area to have a cross slope of ≤2%.

Palm Bay West Plaza Entrance and Minton Road Eastbound

- Pave a level 5’x3’ slab between the curb and sidewalk to complete a 5’x8’ B&A area.

The detailed ADA bus stop sheets from the assessment report are located in **Appendix B**.

Location: Corridor-Wide West Segment

Issue #10: Minor Street Intersections

Figure 48

Figure 49

Figure 50

Figure 51

Description of Issue:

Along the West Segment between Jupiter Boulevard and Maywood Avenue/Daffodil Drive, the study team observed the following issues at unsignalized minor street approaches:

- Missing crosswalk markings at sidewalk/trail crossings on north side of roadway (**Figure 48**).
- Missing stop bars and double yellow striping along the minor street approaches (**Figure 49**).
- Brush/shrubbery causing intersection sight distance issues (**Figure 50**).
- Stop signs were placed far back from the roadway, leading to sight distance issues and drivers not stopping at the stop sign location (**Figure 51**).

Table 10. Qualitative Risk Rating for Minor Street Intersections

Function	Classification	Reasoning
Exposure	Category II	Utilized when pedestrians are present and/or vehicles are turning from the minor street
Probability	Category I	No crashes reported due to this issue
Consequence	Category III	Potential for pedestrian/bicycle crash types related to crosswalk marking issue. PDO to severe injury turning/angle crashes related to stop sign/stop bar issues.
Overall	*Category II*	-

Suggestions for Improvement:
At the Greenbrier Avenue minor street sidewalk/trail crossing, a pedestrian warning sign along with standard crosswalk markings and detectable warning surfaces was recently installed (**Figure 52**). To provide consistency at the other minor street intersections between Jupiter Boulevard and Maywood Avenue/Daffodil Drive, consider installing the same treatments:

- Crosswalk markings per FDOT Design Standard Index 17346 pages 4 and 9.
- Detectable warning surfaces per FDOT Design Standard Index 304.
- Pedestrian crossing warning signage W11-2.

Figure 52

Consider installing stop bars and double yellow striping per FDOT Design Standard Index 17346 page 4. Consider assessing the stop sign placement at these intersections according to guidance in Section 2B.10 of the MUTCD and move closer to the roadway if applicable.

Consider trimming the shrubbery so minor street turning vehicles can better see vehicles traveling along Malabar Road. If the shrubbery is on private property, consider coordinating with the property owner to trim.

Location: Corridor-Wide West Segment

Issue #11: Malabar Road/Minor Street Grade Difference

Figure 53

Source: Google Earth 2016

Figure 54

Description of Issue:
Over the course of multiple resurfacing projects along the Malabar Road West Segment, an asphalt lip has been created between Malabar Road and the minor streets as displayed in **Figure 53** and **Figure 54**. The study team observed where vehicles had scraped the bottom of their cars on the lip (**Figure 53**). In addition to the lip, a noticeable grade was also present along minor streets leading up to intersections with Malabar Road. This issue creates possible rear-end conflicts with slow turning vehicles from Malabar Road and vehicles approaching from behind.

Table 11. Qualitative Risk Rating for Malabar Road/Minor Street Grade Difference

Function	Classification	Reasoning
Exposure	Category II	Utilized when vehicles are turning to/from the minor street
Probability	Category I	No crashes reported due to this issue
Consequence	Category I	Potential for PDO to minor injury rear-end crashes
Overall	*Category I*	-

Suggestions for Improvement:
As part of the next resurfacing project, consider resurfacing farther down the minor street to limit the asphalt lip that is present. Also consider increasing the amount of base material under the asphalt on the minor street to reduce the grade along the approach.

Location: Jupiter Boulevard Intersection

Issue #12: Westbound Rear-End Crashes

Figure 55

Figure 56

Description of Issue:
Westbound rear-end crashes accounted for 17 of the 32 (53 percent) rear-end crashes and 27 percent of the total crashes at the Jupiter Boulevard intersection. As displayed in **Figure 55**, the outside lane for the westbound approach is a shared through/right-turn lane. No signal head backplates are installed at the intersection (**Figure 56**).

Table 12. Qualitative Risk Rating for Westbound Rear-End Crashes

Function	Classification	Reasoning
Exposure	Category III	Jupiter Boulevard westbound is a major movement
Probability	Category III	53% of rear-end and 27% of total crashes occurred on this approach
Consequence	Category I	PDO to minor injury rear-end crashes
Overall	*Category II*	-

Suggestions for Improvement:
In the near term, consider installing signal head backplates for all four approaches at the intersection. Along with the backplate installation, consider adding the 3" yellow reflective sheeting (**Figure 57**) to help the signal heads stand out during the day and become more retro reflective at night. According to the FHWA CMF Clearinghouse, adding the yellow reflective sheeting can reduce crashes at an intersection by up to 15 percent.

Figure 57

To inform westbound drivers of the upcoming intersection, consider advanced intersection signage (**D3-2**) as discussed in section 2D.44 of the MUTCD.

D3-2

Also, consider a study to review adding a westbound right-turn lane at the intersection per NCHRP Report 457 Evaluating Intersection Improvements: An Engineering Study Guide pages 22 through 23.

Location: Jupiter Boulevard Intersection

Issue #13: Turning Vehicles and Pedestrians in Crosswalk

Figure 58

Description of Issue:
The study team observed multiple conflicts between right turning vehicles from Jupiter Boulevard and pedestrians utilizing the crosswalks on the west and east legs of the intersection. The study team also observed northbound right turning vehicles pulling past the stop bar and stopping just short of the south leg crosswalk or stopping within the crosswalk itself (**Figure 58**). One bicycle crash occurred on the west leg crosswalk with a southbound right turning vehicle.

Table 13. Qualitative Risk Rating for Turning Vehicles and Pedestrians in Crosswalk

Function	Classification	Reasoning
Exposure	Category I	Utilized when pedestrians and right-turning vehicles are present
Probability	Category I	1 bicycle crash in the west leg crosswalk
Consequence	Category III	Pedestrian/bicycle crash types
Overall	*Category II*	-

Suggestions for Improvement:
Consider installing TURNING VEHICLES YIELD TO PEDESTRIANS (**R10-15**) signs for right-turns on the northbound and southbound approaches.

Consider implementing a leading pedestrian interval for the west and east leg crosswalks prior to the onset of the northbound/southbound green phase. If implemented, this should be done in concert with a blank-out NO RIGHT TURN ON RED sign facing the northbound and southbound approaches that is active during the leading pedestrian interval. Blank-out sign options include a NO RIGHT TURN ON RED message that transitions to a YIELD TO PEDESTRIANS message at the onset of the southbound green phase.

R10-15

* A fluorescent yellow-green background color may be used instead of yellow for this sign.

Location: Maywood Avenue/Daffodil Drive Intersection

Issue #14: Unsignalized Intersection Control

Figure 59

Figure 60

Figure 61

Figure 62

Description of Issue:

The West Segment of Malabar Road is primarily a commuter route that serves west Palm Bay neighborhoods; the study team observed heavy eastbound traffic in the AM peak hour (**Figure 59** looking west at eastbound traffic) and heavy westbound traffic in the PM peak hour (**Figure 60** looking east at westbound traffic). With this heavy traffic, limited gaps were observed for vehicles turning from Maywood Avenue/Daffodil Drive. During some AM cycle lengths for the Palm Bay West Plaza Entrance intersection (located 0.33 miles east), the eastbound traffic would queue past the Maywood Avenue/Daffodil Drive intersection (**Figure 61** and **Figure 62**). In this situation, vehicles turning from the minor street become impatient and may make left turning movements with smaller gaps. Twenty-four crashes occurred over the six year crash history with 13 of those involving left-turning or through vehicles coming from Maywood Avenue/Daffodil Drive.

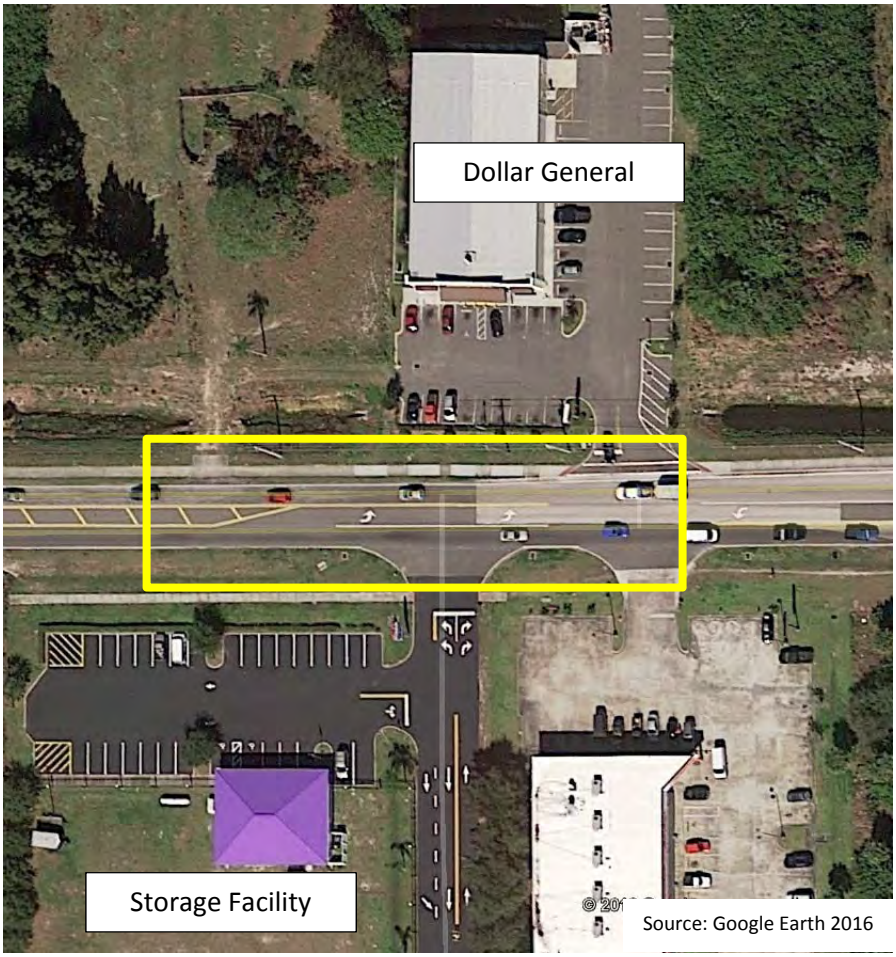
Table 14. Qualitative Risk Rating for Unsignalized Intersection Control

Function	Classification	Reasoning
Exposure	Category III	Heavy mainline traffic volumes with moderate minor street volumes during peak hours
Probability	Category III	24 total crashes occurred at this intersection, 13 being left-turn or through movement related from the minor street
Consequence	Category II	PDO to severe injury crashes
Overall	*Category III*	-

Suggestions for Improvement:
Consider performing a signal warrant analysis consistent with Chapter 4C of the MUTCD. Specifically review the intersection based on Warrant 1: Eight-Hour Vehicular Volume, Warrant 2: Four-Hour Vehicular Volume, Warrant 3: Peak Hour, and Warrant 7: Crash Experience.

Location: Mid-Block between Maywood Avenue/Daffodil Drive and Palm Bay West Plaza Entrance

Issue #15: Left-Turn Lane into Dollar General



Source: Google Earth 2016

Figure 63

Figure 64

Figure 65

Description of Issue:
A Dollar General was recently constructed on the north side of the roadway just west of the Palm Bay Plaza Entrance intersection and an exclusive eastbound left-turn lane is provided onto the property (**Figure 63**). The study team observed multiple vehicles utilizing this eastbound left-turn lane to make westbound left-turns into the storage facility on the south side of the roadway (**Figure 64** and **Figure 65**). Because the center lane is striped as an eastbound left-turn lane, vehicles are not allowed to use this lane as a westbound left-turn lane into the storage facility. Due to the striping, eastbound left-turning vehicles may not realize a westbound left-turning vehicle may be utilizing the lane, thus potentially leading to head-on crashes.

Table 15. Qualitative Risk Rating for Left-Turn Lane into Dollar General

Function	Classification	Reasoning
Exposure	Category I	Low volume of left-turns into those properties
Probability	Category I	No crashes reported due to this issue
Consequence	Category II	Potential for PDO to moderate injury low speed head-on crashes
Overall	*Category I*	-

Suggestions for Improvement:
Consider restriping the eastbound left-turn lane as a two-way left-turn lane (TWLTL). This striping will alert drivers to the possible presence of left-turning vehicles coming from the opposite direction. A CENTER LANE TWO-WAY LEFT-TURN LANE ONLY sign (**R3-9a or b**) accompanied by a BEGIN sign (**R3-9cP**) should be considered in the eastbound direction prior to the start of the TWLTL (section 2B.24 in the MUTCD).

Location: Mid-Block between Maywood Avenue/Daffodil Drive and Palm Bay West Plaza Entrance

Issue #16: Merge Area West of Palm Bay West Plaza Entrance

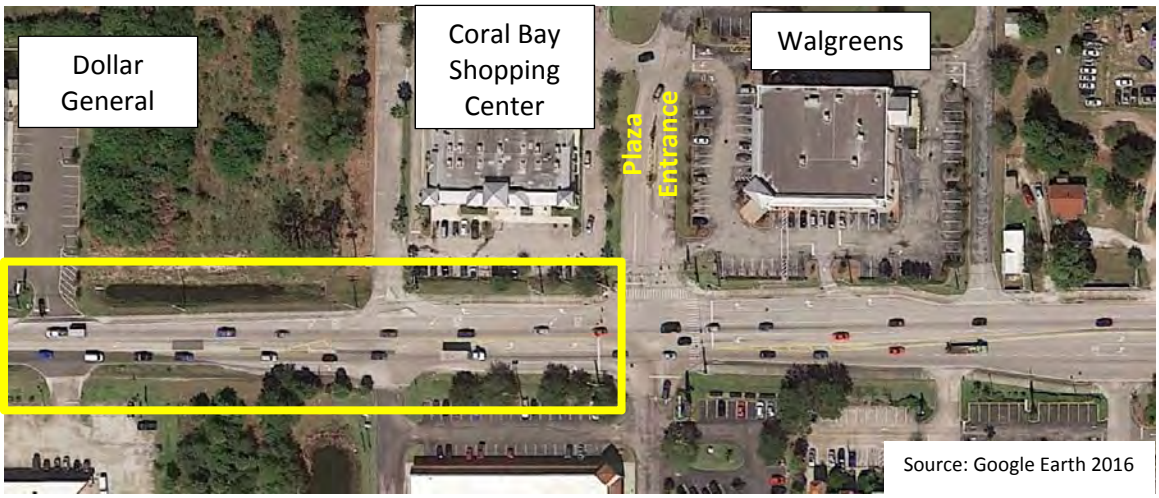


Figure 66

Figure 67

Figure 68

Figure 69

Description of Issue:
Just west of the Palm Bay Plaza Entrance signal, the westbound lanes reduce from two to one within a 500' long merge area, as displayed on **Figure 66** and **Figure 67**. Prior to the Palm Bay West Plaza Entrance, a RIGHT LANE ENDS sign (**W9-1**) is located just west of the Minton Road intersection, a LANE ENDS MERGE LEFT sign (**W9-2**) is located just west of the road that runs on the east side of Walgreens, and a lane merge sign (**W4-2**) is located just east of the Plaza Entrance intersection (**Figure 68**). With these signs in place, the study team observed the driver behavior during the AM and PM peak hour and noted the outside westbound through lane that merges with the inside through lane was being used by one to two vehicles per cycle. The study team observed most of the westbound vehicles utilizing the inside westbound through lane. The few vehicles utilizing the merge lane were observed accelerating at a faster rate of speed to cut in front of vehicles in the non-merging lane. This situation creates a conflict with vehicles attempting to exit the Dollar General driveway because they may not notice the merging vehicle is traveling at a faster speed than the non-merging vehicles. Two sideswipe crashes occurred in the westbound direction, one before and one after the Palm Bay West Plaza Entrance.

Vehicles were also observed making an eastbound left-turn into the Coral Bay Shopping Center where that entrance is limited to a right-in/right-out configuration with the porkchop island on the north leg (**Figure 69** looking south at island).

Table 16. Qualitative Risk Rating for Merge Area West of Palm Bay West Plaza Entrance

Function	Classification	Reasoning
Exposure	Category III	Every westbound vehicle encounters this area if traveling west of the Plaza Entrance
Probability	Category I	2 sideswipe crashes occurred in the westbound direction
Consequence	Category II	PDO to moderate injury sideswipe crashes; moderate to severe injury left turn crashes
Overall	*Category II*	-

Suggestions for Improvement:
Due to the underutilization of the merge lane west of the Palm Bay West Plaza Entrance, consider a traffic operations study to assess the operational feasibility of the merge lane. NCHRP Report 707, Guidelines on the Use of Auxiliary Through Lanes at Signalized Intersections has suggestions to improve lane utilization for merge lanes.

If the result of the study suggests that the merge lane can be removed, the pavement for the outside westbound through lane could be redistributed for a second eastbound through lane from west of the Plaza Entrance to Minton Road.

Consider formalizing the access management just west of the Plaza Entrance by constructing a median to restrict left-turns into or out of the properties on the north and south sides of the roadway. These parcels have access to the Plaza Entrance signal for those left-turn movements.

Location: Mid-Block between Maywood Avenue/Daffodil Drive and Palm Bay West Plaza Entrance

Issue #17: Sidewalk Connection

Figure 70

Figure 71

Description of Issue:
The intent of the RSA is to consider safety for all user groups based on both crash data and risk factors. There may not be crash data supporting the noted design deficiencies, but the RSA team conducted a risk-based assessment and identified the locations to address potential safety issues based on risk. The study team observed a noticeable pedestrian path (**Figure 70**) with pedestrians utilizing that path (**Figure 71**) on the south side of the roadway from the Madalyn Landing apartments (just east of Garvey Road) to the Palm Bay West Plaza Entrance, not including the section of constructed sidewalk in front of the storage facility across from the Dollar General.

Table 17. Qualitative Risk Rating for Sidewalk Connection

Function	Classification	Reasoning
Exposure	Category I	Utilized when pedestrian/bicycle are present
Probability	Category I	No pedestrian/bicycle crashes reported due to this issue
Consequence	Category III	Potential for pedestrian/bicycle crash types
Overall	*Category II*	-

Suggestions for Improvement:
In the near term, consider a feasibility study for installation of sidewalks on the south side of Malabar Road. Construction of the sidewalk may be a longer term project due to potential drainage and side slope issues because of the open drainage system currently in place. Priority should be given to installing a sidewalk between the existing sidewalk at the storage facility and the Palm Bay West Plaza Entrance signalized intersection. The pedestrian facilities needed to accommodate this new sidewalk at the Palm Bay West Plaza Entrance intersection is discussed in **Issue #18: Southwest Corner** Pedestrian Facilities.

Location: Palm Bay West Plaza Entrance Intersection

Issue #18: Southwest Corner Pedestrian Facilities

Figure 72

Figure 73

Description of Issue:
The intent of the RSA is to consider safety for all user groups based on both crash data and risk factors. There may not be crash data supporting the noted design deficiencies, but the RSA team conducted a risk-based assessment and identified the locations to address potential safety issues based on risk. If a sidewalk is constructed on the south side of Malabar Road (**Figure 72**) as noted in **Issue #17: Sidewalk Connection**, the southwest corner of the Palm Bay West Plaza Entrance intersection would need to be reconstructed to add pedestrian facilities (**Figure 73**).

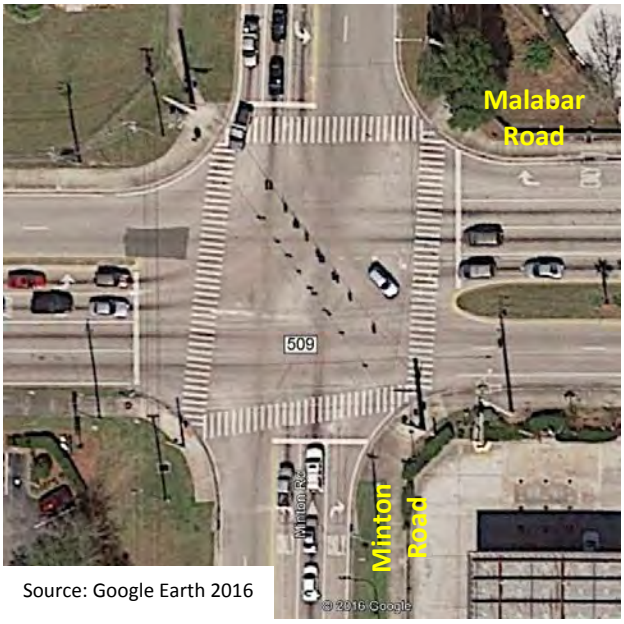
Table 18. Qualitative Risk Rating for Southwest Corner Pedestrian Facilities

Function	Classification	Reasoning
Exposure	Category I	Utilized by pedestrians/bicyclists when sidewalk is constructed
Probability	Category I	No crashes reported due to this issue
Consequence	Category III	Potential for pedestrian/bicycle crash types
Overall	*Category II*	-

Suggestions for Improvement:
Once the sidewalk is constructed on the south side of Malabar Road, consider constructing pedestrian facilities on the southwest corner of the intersection. These pedestrian facilities would include separate curb ramps for the west and south leg crosswalks, special emphasis crosswalk markings per sheet 9 of Design Standard Index 17346, detectable warning surfaces per FDOT Design Standard Index 304, pedestrian poles and push button detectors, pedestrian signal heads with countdown timers, and **R10-3i** pedestrian plaques.

Location: Minton Road Intersection

Issue #19: South and West Leg Crosswalks



Source: Google Earth 2016

Figure 74

Figure 75

Description of Issue:
The intent of the RSA is to consider safety for all user groups based on both crash data and risk factors. There may not be crash data supporting the noted design deficiencies, but the RSA team conducted a risk-based assessment and identified the locations to address potential safety issues based on risk. At the Minton Road intersection (**Figure 74**), the south leg crosswalk is skewed and does not align with the curb ramp on the southeast corner of the intersection (**Figure 75**). The west leg crosswalk is also skewed slightly to align with the curb ramp in the northwest corner of the intersection. The pedestrian is walking longer distances across the west and south legs due to the skew of these crosswalks. One bicycle crash occurred within the south leg crosswalk.

Table 19. Qualitative Risk Rating for South and West Leg Crosswalks

Function	Classification	Reasoning
Exposure	Category I	Utilized when pedestrians are present
Probability	Category I	1 bicycle crash within south leg crosswalk
Consequence	Category III	Pedestrian/bicycle crash types
Overall	*Category II*	-

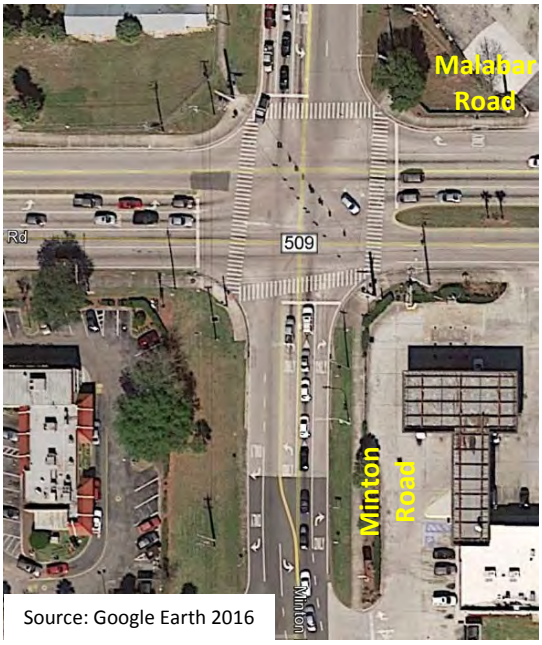
Suggestions for Improvement:
Consider realigning the south and west leg crosswalks to be more perpendicular with Minton Road and Malabar Road. This would require constructing new curb ramps on the northwest, southwest, and southeast corners for those two crosswalks. As part of this project, consider installing new push button poles on the northwest, southwest, and southeast corners having pedestrian detectors that are parallel

to the crosswalk to be used, consistent with the guidance in section 4E.08 of the MUTCD. Consider installing **R10-3i** pedestrian plaques on all push button poles indicating the respective pedestrian detectors corresponding street.

R10-3i

Location: Minton Road Intersection

Issue #20: Northbound Lane Designations



Source: Google Earth 2016

Figure 76

Figure 77

Description of Issue:
The northbound approach at the Minton Road intersection consists of an exclusive left-turn lane, a single through lane, and an exclusive right-turn lane (**Figure 76**). During the peak hours, the study team observed queueing extending approximately 500' to 750' south of the intersection. Three rear-end crashes and one sideswipe crash occurred on the northbound approach.

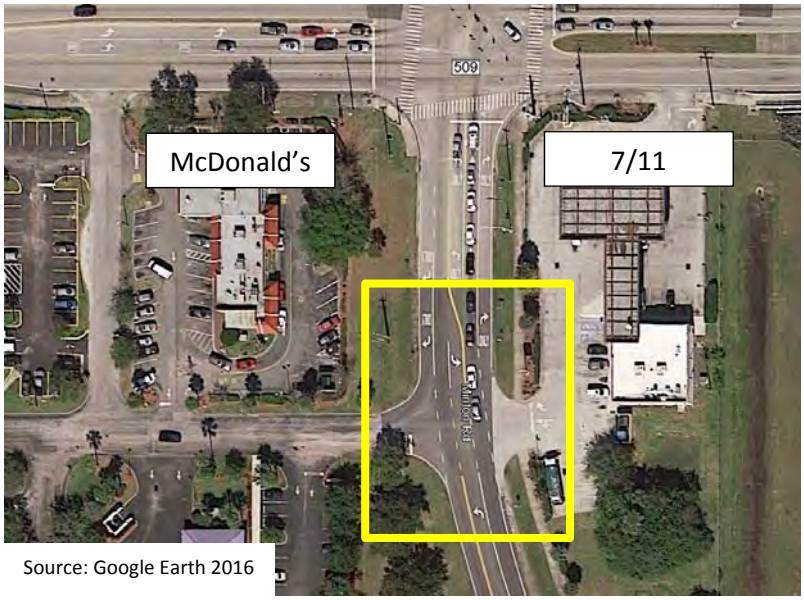
Table 20. Qualitative Risk Rating for Northbound Lane Designations

Function	Classification	Reasoning
Exposure	Category III	Every northbound vehicle encounters this if traveling north on Minton Road
Probability	Category I	3 rear-end and 1 sideswipe crash occurred on this approach
Consequence	Category I	PDO to moderate injury crash types
Overall	*Category II*	-

Suggestions for Improvement:
Consider a traffic operations study to assess the feasibility of converting the exclusive northbound right-turn lane into a shared northbound through/right-turn lane, especially since the north leg already has two receiving lanes. Doing so will help reduce the northbound queueing during the peak hours at the intersection.

Location: Minton Road Intersection

Issue #21: Minton Road Full Median Opening



Source: Google Earth 2016

Figure 78

Description of Issue:
A full median opening is present south of Malabar Road along Minton Road that has access to McDonald's and 7/11 (**Figure 78**). This portion of Minton Road south of Malabar Road was not included in the crash analysis, but was observed by the study team as having conflicts between the left-turns from the driveways and north/south through movements along Minton Road. During the peak hours specifically, it is difficult to make left-turns from the driveway due to the queuing in the northbound direction.

Table 21. Qualitative Risk Rating for McDonald's Driveway

Function	Classification	Reasoning
Exposure	Category III	Minton Road is a major north/south connector
Probability	N/A	Area not analyzed as part of crash data analysis
Consequence	Category II	Potential for PDO to severe injury left-turn crashes
Overall	*Category III*	-

Suggestions for Improvement:
Consider performing an access management study at this location to review if the full median can be converted into a directional median opening, with left-turns allowed from Minton Road into the two properties. For McDonald's traffic that would like to go northbound on Minton Road or westbound on Malabar Road, a driveway connection to Malabar Road is provided just west of the building where they can access the eastbound left-turn lanes. For 7/11 traffic that would like to go southbound on Minton Road, drivers can get into the northbound left-turn lane and perform a U-turn maneuver.

ROAD SAFETY AUDIT FINDINGS – MALABAR ROAD EAST SEGMENT EMERSON DRIVE TO SAN FILIPPO DRIVE

Transit Related Improvements – East Segment

As mentioned earlier, SCAT completed the Bus Stop Americans with Disabilities Act (ADA) Assessment Report for every transit stop within their network in early 2015. The Malabar Road East Segment study corridor has three transit stops reviewed as part of this assessment. The recommendations from the ADA report are summarized for each stop below:

Emerson Drive Westbound

- Move the stop approximately 270' west and pave a level 5’x2’ slab behind the sidewalk to complete a 5’x8’ B&A area.

Holiday Park Boulevard Westbound

- Add detectable warnings to the nearby curb ramps.

Interchange Square Westbound

- Move the stop approximately 280' east and add detectable warnings to the nearby curb ramps.

The detailed ADA bus stop sheets from the assessment report are located in **Appendix B**.

Location: Corridor-Wide East Segment

Issue #22: Driveway Slopes

Figure 79

Figure 80

Description of Issue:
At some driveways along the East Segment, the sidewalk merges into the existing driveway as displayed in **Figure 79**. With the sidewalk not being well-demarcated (stand-alone), it is subject to the cross slope of the driveway, which in most cases was appeared to be greater than the maximum two (2) percent cross slope per section R302.6 in the ADA Public Rights of Way Accessibility Guidelines (PROWAG) guidance (based on field review observations by the study team). The driveways were also observed to be relatively steep and vehicles had to slow down to less than normal turning speeds. This created speed differential and potential rear-end conflicts with slow turning vehicles from Malabar Road and vehicles approaching from behind.

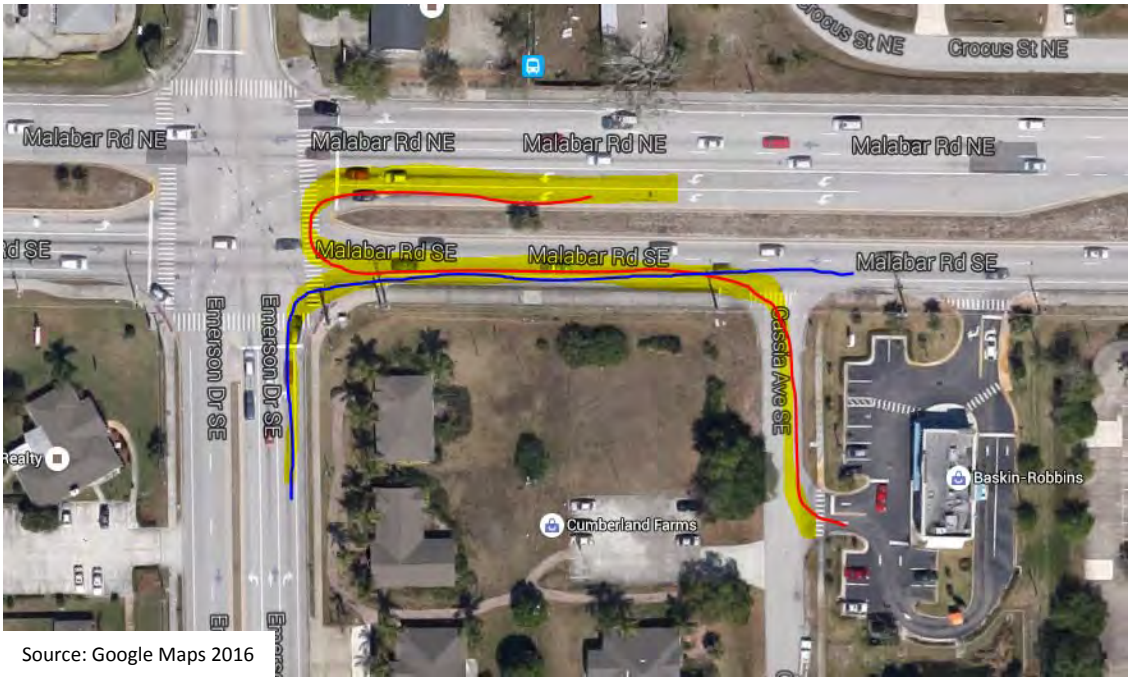
Table 22. Qualitative Risk Rating for Driveway Slopes

Function	Classification	Reasoning
Exposure	Category III	18 driveways along the 0.85 mile length (density of 21 per mile)
Probability	Category I	No crashes reported due to this issue
Consequence	Category I	Potential for PDO to moderate injury crash types
Overall	*Category II*	-

Suggestions for Improvement:
Consider driveway reconstruction during the roadway's next resurfacing project to provide a level path for the sidewalk and meet ADA guidance. As part of this construction, reduce the grades of the driveways so the speed differential between turning vehicles and vehicles approaching from behind is reduced. As properties redevelop along the corridor, consider rebuilding the driveways. It appears these improvements can be done without negatively impacting parking or site circulation on the subject parcels.

Location: Emerson Drive Intersection

Issue #23: Northbound Right-Turn Conflicts



Source: Google Maps 2016

Figure 81

Description of Issue:
As shown in **Figure 81**, westbound traffic (shown by a red line) destined for the retailers in the southeast quadrant of the intersection make a westbound U-turn at the signal. The U-turn movement requires the vehicle to cross both eastbound lanes. Northbound right-turn vehicles (path shown by blue line in **Figure 81**) making a right-turn on red conflict with the westbound U-turn movement.

Two bicycle crashes occurred in the south leg crosswalk with northbound right turning vehicles.

Table 23. Qualitative Risk Rating for Northbound Right-Turn Conflicts

Function	Classification	Reasoning
Exposure	Category II	Present when a vehicle is performing a westbound U-turn and another vehicle is making a northbound right-turn on red
Probability	Category II	2 bicycle crashes in south leg crosswalk with northbound right-turning vehicles
Consequence	Category III	PDO to moderate injury angle crashes; pedestrian/bicycle crash types
Overall	*Category II*	-

Suggestions for Improvement:

Consider performing a traffic operations study to assess installing a blank-out NO RIGHT TURN ON RED sign for the northbound right turn lane that is active during the westbound left turn phase and/or the east/west pedestrian phase. This option would be preferred as it would reduce conflicts with the westbound U-turners as well as pedestrians crossing the south leg of the intersection.

Location: Mid-Block between Corporate Circle and Holiday Park Boulevard

Issue #24: Eureka Avenue Curb Ramps

Figure 82

Description of Issue:
The intent of the RSA is to consider safety for all user groups based on both crash data and risk factors. There may not be crash data supporting the noted design deficiencies, but the RSA team conducted a risk-based assessment and identified the locations to address potential safety issues based on risk. Curb ramps at the Eureka Avenue intersections (**Figure 82**) were greater than the 8.3 percent maximum running slope discussed in section R304.3.2 of the ADA PROWAG.

Table 24. Qualitative Risk Rating for Eureka Avenue Curb Ramps

Function	Classification	Reasoning
Exposure	Category I	Utilized when pedestrians/bicyclists are present
Probability	Category I	No crashes reported due to this issue
Consequence	Category III	Potential for pedestrian/bicycle crash types
Overall	*Category II*	-

Suggestions for Improvement:
During the next roadway resurfacing project, consider rebuilding the curb ramps at Eureka Avenue to meet ADA guidance.

Location: San Filippo Drive Intersection

Issue #25: Northbound Right-Turn Conflicts

Figure 83

Description of Issue:
The northbound approach at the intersection has dual right-turn lanes. Vehicles turning from the inside northbound right-turn lane (yellow line in **Figure 83**) conflict with the permissive southbound left-turning vehicles (orange line in **Figure 83**). The inside northbound right-turn lane is heavily utilized because most of those vehicles are turning left at the interchange to go north onto I-95. Northbound right-turn drivers turning during the northbound permissive phase were also observed not giving the right-of-way to pedestrians in the east crosswalk.

Table 25. Qualitative Risk Rating for Northbound Right-Turn Conflicts

Function	Classification	Reasoning
Exposure	Category III	Northbound right-turning vehicles during most cycles
Probability	Category I	No crashes reported due to this issue
Consequence	Category III	Potential for PDO to moderate injury right-turn crashes; pedestrian/bicycle crash types
Overall	*Category II*	-

Suggestions for Improvement:
Consider a traffic operations study to assess the following treatments to reduce the conflicts between northbound right-turning vehicles and other vehicular/non-vehicular movements at the intersection:

- Change to north/south split phasing or implement protected only signal phasing for the southbound left-turn movement to eliminate conflict between northbound right-turn and southbound left-turn;
- Install a blank-out NO RIGHT TURN ON RED sign for the northbound right turn lane that is active during the east/west pedestrian phase and the southbound left-turn phase; and
- Implement a leading pedestrian interval for the east leg crosswalk.

Summary of Recommendations

This RSA considers operational and safety related issues for vehicles, pedestrians, and bicyclists on Malabar Road from Jupiter Boulevard to Minton Road (West Segment) and Emerson Drive to San Filippo Drive (East Segment). This study was commissioned by the SCTPO to develop recommendations to improve the safety of motorists and non-motorists within the study limits. Each recommendation identified in this study is classified into one of three categories:

- Maintenance – issues identified for maintenance may be addressed by public agency staff on a short timeframe and at a relatively low cost.
- Near-Term Improvement (within 5 years) – activities that may be incorporated into an upcoming construction project in the area, including 3R milling and resurfacing projects.
- Long-Term Improvement (5+ years) – activities that may be incorporated into upcoming construction projects and may need to be programmed for funding as separate projects.

Tables listing the priority of the corridor-wide improvements are provided on the next page. The pages following summarize the recommendations by priority (transit, maintenance, near-term, or long-term) of this study for the west and east segments.

Location	Issue Number	Issue	Suggestion
MAINTENANCE - CORRIDOR-WIDE			
Corridor-Wide	2	Pedestrian Signage at Signalized Intersections	Consider installing R10-3i pedestrian plaques above pedestrian detectors at signalized intersections along the corridor.
Corridor-Wide	6	Pedestrian Phase Responsiveness	Consider options to improve the response of walk phases during the eastbound and westbound phases as a maintenance-type activity. Options to consider include: • Reprogram the pedestrian phase crossing the minor streets to activate every time with the full eastbound/westbound phase; or • Depending on the controller capabilities and/or if the corridor is signal coordinated, allow the Walk phase (i.e., crossing the minor streets) to activate after the start of green if there is still sufficient green time available for the eastbound/westbound phase to accommodate the pedestrian clearance time, if needed. If the signal is running free, the east/west phase may be extended if there is a pedestrian call and no vehicle detection on the minor street.
Corridor-Wide	7	Stop Sign Retro-Reflectivity	Consider replacing the existing stop signs (R1-1) along the corridor with new stop signs according to guidance in Section 2B.10 of the MUTCD.
Corridor-Wide	9	Detectable Warning Surfaces	Consider replacing/installing detectable warning surfaces per FDOT Design Standard Index 304 at all signalized intersections and at minor street intersections/driveways where detectable warning surfaces are currently installed.

Location	Issue Number	Issue	Suggestion
NEAR-TERM PRIORITY - CORRIDOR-WIDE			
Corridor-Wide	1	Faded Pavement Markings	Consider the following suggestions to improve faded pavement markings along the corridor: • Check with Brevard County on when the next resurfacing project will occur along Malabar Road. During the resurfacing project, the entire corridor will be restriped. • If no resurfacing project is planned within the next 5 years, perform a corridor-wide restriping project to enhance the crosswalk markings at signalized/unsignalized intersections, the roadway lane markings, and the signalized/unsignalized intersection approach lane markings. • Upgrade the crosswalk markings at the signalized intersections to be special emphasis as shown on sheet 9 of FDOT Design Standard Index 17346.
Corridor-Wide	3	Speed Consistency	Consider the following suggestions to improve speed consistency along the corridor: • Perform a speed study along Malabar Road from Jupiter Boulevard to the I-95 interchange to review speed consistency along the corridor. Providing a consistent speed limit along the corridor has the potential to reduce speed differential conflicts between vehicles. • Increase speed enforcement to encourage vehicles to drive closer to the posted speed limit based on the results of the speed study. Speed feedback signs that display how fast the vehicle is traveling may help deter speeding along the corridor.
Corridor-Wide	4	Signalized Intersection Street Name Signage	Consider replacing signalized intersection street name signage with internally illuminated, overhead LED street name signs, per section 2A.07 and Table 2A-1 of the 2009 Manual on Uniform Traffic Control Devices (MUTCD).
Corridor-Wide	5	Permissive Left-Turn Movements	Consider replacing “doghouse” five-section signal displays with 4-section flashing yellow arrow (FYA) protected/permissive left-turn display for the left-turn movements noted above. If the left-turn phasing is converted to a FYA display, consider providing protected only left-turn phasing during peak periods and allow the protected-permissive phasing during the off-peak periods. Even though some of the left-turn phases noted do not have associated crashes, the FYA display should be applied corridor wide for corridor consistency and driver expectancy.
Corridor-Wide	8	Signalized Intersection Lighting	Consider upgrading the lighting at the signalized intersections to meet the requirements of section 7.3.2.2 in Volume 1 of the FDOT PPM. This may require the existing lighting to be replaced.

Location	Issue Number	Issue	Suggestion
TRANSIT RELATED - WEST SEGMENT			
Jupiter Boulevard Eastbound	N/A	Bus Stop	Move the bus stop approximately 240' west and pave a level 5'x8' slab with a raised 6" curb for the boarding and alighting (B&A) area; Pave a 40' path to connect to the existing sidewalk to the west; Add detectable warnings to the nearby curb ramps; and Verify the pole with the bus schedule is located adjacent to the pavement so it is accessible.
Ware Avenue Eastbound	N/A	Bus Stop	Move the stop approximately 80' west. Pave a level 5'x8' slab with a raised 6" curb for the B&A area and pave a ramp from the B&A area to the shoulder of the road, which will act as the accessible path; and Add detectable warnings to the new curb ramp.
Madalyn Landing Eastbound	N/A	Bus Stop	Move the bus stop approximately 100' east. Pave a level 5'x8' slab with a raised 6" curb for the B&A area; Verify the B&A area has a cross slope of <=2%; and Add a 50' path to connect the B&A to the existing sidewalk.
Maywood Avenue Eastbound	N/A	Bus Stop	Move the bus stop approximately 70' west. Pave a level 5'x8' slab with a raised 6" curb for the B&A area; Add a 50' path to connect the B&A to the existing sidewalk; and Resurface the B&A area to have a cross slope of <=2%.
Palm Bay West Plaza Entrance and Minton Road Eastbound	N/A	Bus Stop	Pave a level 5'x3' slab between the curb and sidewalk to complete a 5'x8' B&A area.

Location	Issue Number	Issue	Suggestion
MAINTENANCE - WEST SEGMENT			
Corridor-Wide West Segment	10	Minor Street Intersections	To provide consistency at the other minor street intersections between Jupiter Boulevard and Maywood Avenue/Daffodil Drive, consider installing the same treatment as what was installed at Greenbrier Avenue: • Crosswalk markings per FDOT Design Standard Index 17346 pages 4 and 9. • Detectable warning surfaces per FDOT Design Standard Index 304. • Pedestrian crossing warning signage W11-2. Consider installing stop bars and double yellow striping per FDOT Design Standard Index 17346 page 4. Consider assessing the stop sign placement at these intersections according to guidance in Section 2B.10 of the MUTCD and move closer to the roadway if applicable. Consider trimming the shrubbery so minor street turning vehicles can better see vehicles traveling along Malabar Road. If the shrubbery is on private property, consider coordinating with the property owner to trim.
Mid-Block between Maywood Avenue/Daffodil Drive and Palm Bay West Plaza Entrance	15	Left-Turn Lane into Dollar General	Consider restriping the eastbound left-turn lane as a two-way left-turn lane (TWLTL). This striping will alert drivers to the possible presence of left-turning vehicles coming from the opposite direction. A CENTER LANE TWO-WAY LEFT-TURN LANE ONLY sign (R3-9a or b) accompanied by a BEGIN sign (R3-9cP) should be considered in the eastbound direction prior to the start of the TWLTL (section 2B.24 in the MUTCD).

Location	Issue Number	Issue	Suggestion
NEAR-TERM PRIORITY - WEST SEGMENT			
Minton Road Intersection	5	Permissive Left-Turn Movements	Review guidance in section 3.2 of the FDOT Traffic Engineering Manual (TEM) and section 4D.17 of the MUTCD for changing the northbound and southbound left-turn phases from protected/permissive phasing to protected only phasing.
Corridor-Wide West Segment	11	Malabar Road/Minor Street Grade Difference	As part of the next resurfacing project, consider resurfacing farther down the minor street to limit the asphalt lip that is present. Also consider increasing the amount of base material under the asphalt on the minor street to reduce the grade along the approach.
Jupiter Boulevard Intersection	12	Westbound Rear-End Crashes	Consider installing signal head backplates for the westbound approach. Along with the backplate installation, consider adding the 3" yellow reflective sheeting to help the signal heads stand out during the day and become more retro reflective at night. To inform westbound drivers of the upcoming intersection, consider advanced intersection signage (D3-2) as discussed in section 2D.44 of the MUTCD. Consider a study to review adding a westbound right-turn lane at the intersection per NCHRP Report 457 Evaluating Intersection Improvements: An Engineering Study Guide pages 22 through 23.
Jupiter Boulevard Intersection	13	Turning Vehicles and Pedestrians in Crosswalk	Consider installing TURNING VEHICLES YIELD TO PEDESTRIANS (R10-15) signs for right-turns on the northbound and southbound approaches. Consider implementing a leading pedestrian interval for the west and east leg crosswalks prior to the onset of the northbound/southbound green phase. If implemented, this should be done in concert with a blank-out NO RIGHT TURN ON RED sign facing the northbound and southbound approaches that is active during the leading pedestrian interval. Blank-out sign options include a NO RIGHT TURN ON RED message that transitions to a YIELD TO PEDESTRIANS message at the onset of the southbound green phase.
Maywood Avenue/Daffodil Drive Intersection	14	Unsignalized Intersection Control	Consider performing a signal warrant analysis consistent with Chapter 4C of the MUTCD. Specifically review the intersection based on Warrant 1: Eight-Hour Vehicular Volume, Warrant 2: Four-Hour Vehicular Volume, Warrant 3: Peak Hour, and Warrant 7: Crash Experience.
Mid-Block between Maywood Avenue/Daffodil Drive and Palm Bay West Plaza Entrance	16	Merge Area West of Palm Bay West Plaza Entrance	Due to the underutilization of the merge lane west of the Palm Bay West Plaza Entrance, consider a traffic operations study to assess the operational feasibility of the merge lane. NCHRP Report 707, Guidelines on the Use of Auxiliary Through Lanes at Signalized Intersections has suggestions to improve lane utilization for merge lanes. If the result of the study suggests that the merge lane can be removed, the pavement for the outside westbound through lane could be redistributed for a second eastbound through lane from west of the Plaza Entrance to Minton Road. Consider formalizing the access management just west of the Plaza Entrance by constructing a median to restrict left-turns into or out of the properties on the north and south sides of the roadway. These parcels have access to the Plaza Entrance signal for those left-turn movements.
Mid-Block between Maywood Avenue/Daffodil Drive and Palm Bay West Plaza Entrance	17	Sidewalk Connection	Consider a feasibility study for installation of sidewalks on the south side of Malabar Road. Construction of the sidewalk may be a longer term project due to potential drainage and side slope issues because of the open drainage system currently in place. Priority should be given to installing a sidewalk between the existing sidewalk at the storage facility and the Palm Bay West Plaza Entrance signalized intersection.
Minton Road Intersection	19	South and West Leg Crosswalks	Consider realigning the south and west leg crosswalks to be more perpendicular with Minton Road and Malabar Road. This would require constructing new curb ramps on the northwest, southwest, and southeast corners for those two crosswalks. As part of this project, consider installing new push button poles on the northwest, southwest, and southeast corners having pedestrian detectors that are parallel to the crosswalk to be used, consistent with the guidance in section 4E.08 of the MUTCD. Consider installing R10-3i pedestrian plaques on all push button poles indicating the respective pedestrian detectors corresponding street.
Minton Road Intersection	20	Northbound Lane Designations	Consider a traffic operations study to assess the feasibility of converting the exclusive northbound right-turn lane into a shared northbound through/right-turn lane.
Minton Road Intersection	21	Minton Road Full Median Opening	Consider performing an access management study at this location to review if the full median can be converted into a directional median opening, with left-turns allowed from Minton Road into the two properties.

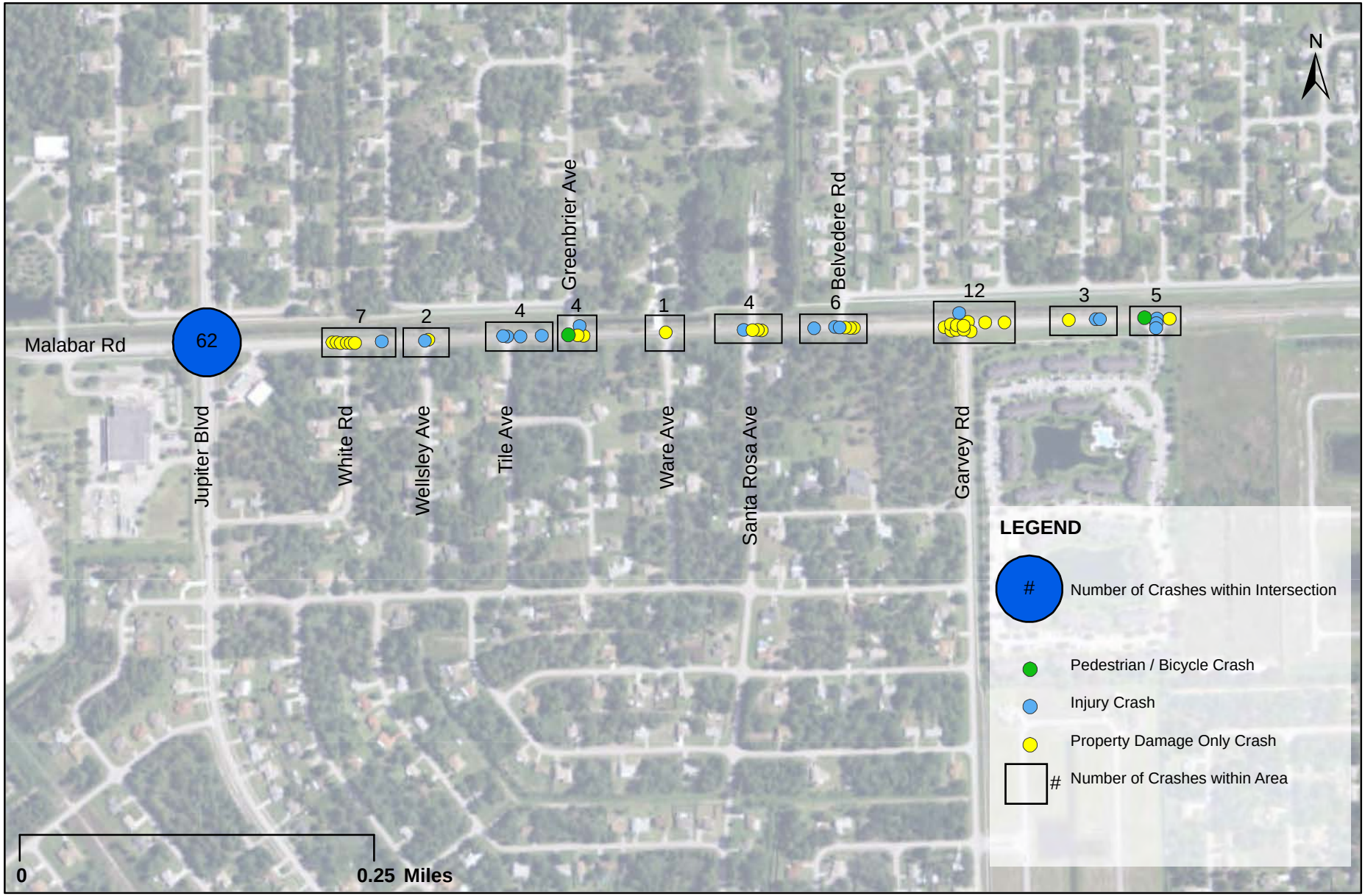
Location	Issue Number	Issue	Suggestion
LONG-TERM PRIORITY - WEST SEGMENT			
Palm Bay West Plaza Entrance Intersection	18	Southwest Corner Pedestrian Facilities	Once the sidewalk is constructed on the south side of Malabar Road, consider constructing pedestrian facilities on the southwest corner of the intersection. These pedestrian facilities would include separate curb ramps for the west and south leg crosswalks, special emphasis crosswalk markings per sheet 9 of Design Standard Index 17346, detectable warning surfaces per FDOT Design Standard Index 304, pedestrian poles and push button detectors, pedestrian signal heads with countdown timers, and R10-3i pedestrian plaques.

Location	Issue Number	Issue	Suggestion
TRANSIT RELATED - EAST SEGMENT			
Emerson Drive Westbound	N/A	Bus Stop	Move the stop approximately 270' west and pave a level 5'x2' slab behind the sidewalk to complete a 5'x8' B&A area.
Holiday Park Boulevard Westbound	N/A	Bus Stop	Add detectable warnings to the nearby curb ramps.
Interchange Square Westbound	N/A	Bus Stop	Move the stop approximately 280' east and add detectable warnings to the nearby curb ramps.

Location	Issue Number	Issue	Suggestion
NEAR-TERM PRIORITY - EAST SEGMENT			
Corridor-Wide East Segment	22	Driveway Slopes	Consider driveway reconstruction during the roadway's next resurfacing project to provide a level path for the sidewalk and meet ADA guidance. As part of this construction, reduce the grades of the driveways so the speed differential between turning vehicles and vehicles approaching from behind is reduced. As properties redevelop along the corridor, consider rebuilding the driveways.
Emerson Drive Intersection	23	Northbound Right-Turn Conflicts	Consider performing a traffic operations study to assess installing a blank-out NO RIGHT TURN ON RED sign for the northbound right turn lane that is active during the westbound left turn phase and/or the east/west pedestrian phase. This option would be preferred as it would reduce conflicts with the westbound U-turners as well as pedestrians crossing the south leg of the intersection.
Mid-Block between Corporate Circle and Holiday Park Boulevard	24	Eureka Avenue Curb Ramps	During the next roadway resurfacing project, consider rebuilding the curb ramps at Eureka Avenue to meet ADA guidance.
San Filippo Drive Intersection	25	Northbound Right-Turn Conflicts	Consider a traffic operations study to assess the following treatments to reduce the conflicts between northbound right-turning vehicles and other vehicular/non-vehicular movements at the intersection: • Change to north/south split phasing or implement protected only signal phasing for the southbound left-turn movement to eliminate conflict between northbound right-turn and southbound left-turn; • Install a blank-out NO RIGHT TURN ON RED sign for the northbound right turn lane that is active during the east/west pedestrian phase and the southbound left-turn phase; and • Implement a leading pedestrian interval for the east leg crosswalk.

Appendix A – Crash Analysis Reference Materials

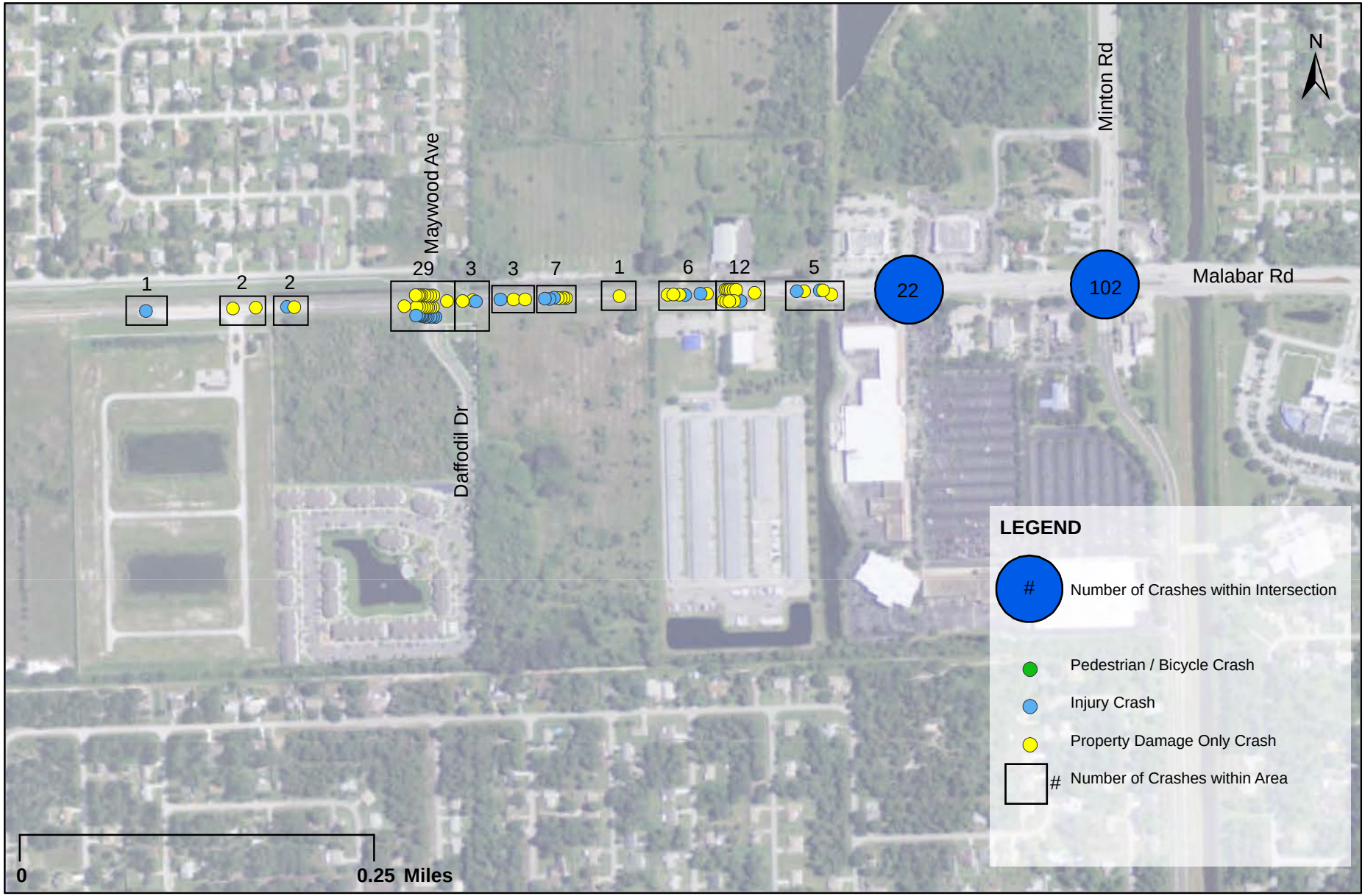
Malabar Road West Segment – Jupiter Boulevard to Minton Road



MALABAR ROAD FROM JUPITER BLVD TO MINTON RD
2009 - 2014 CRASH MAP
BREVARD COUNTY, FLORIDA

Figure
1

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

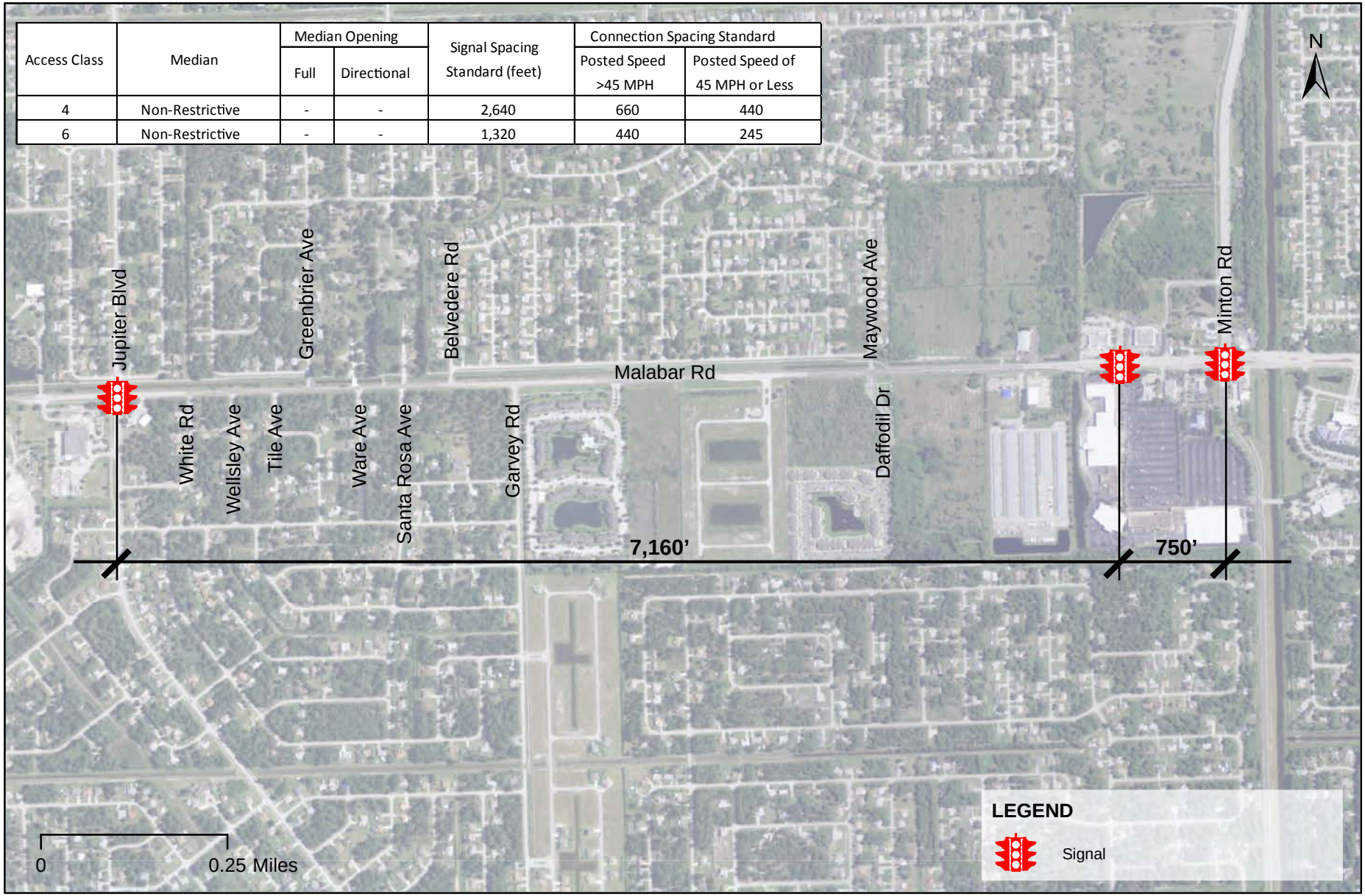


MALABAR ROAD FROM JUPITER BLVD TO MINTON RD
2009 - 2014 CRASH MAP
BREVARD COUNTY, FLORIDA

Figure **2**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

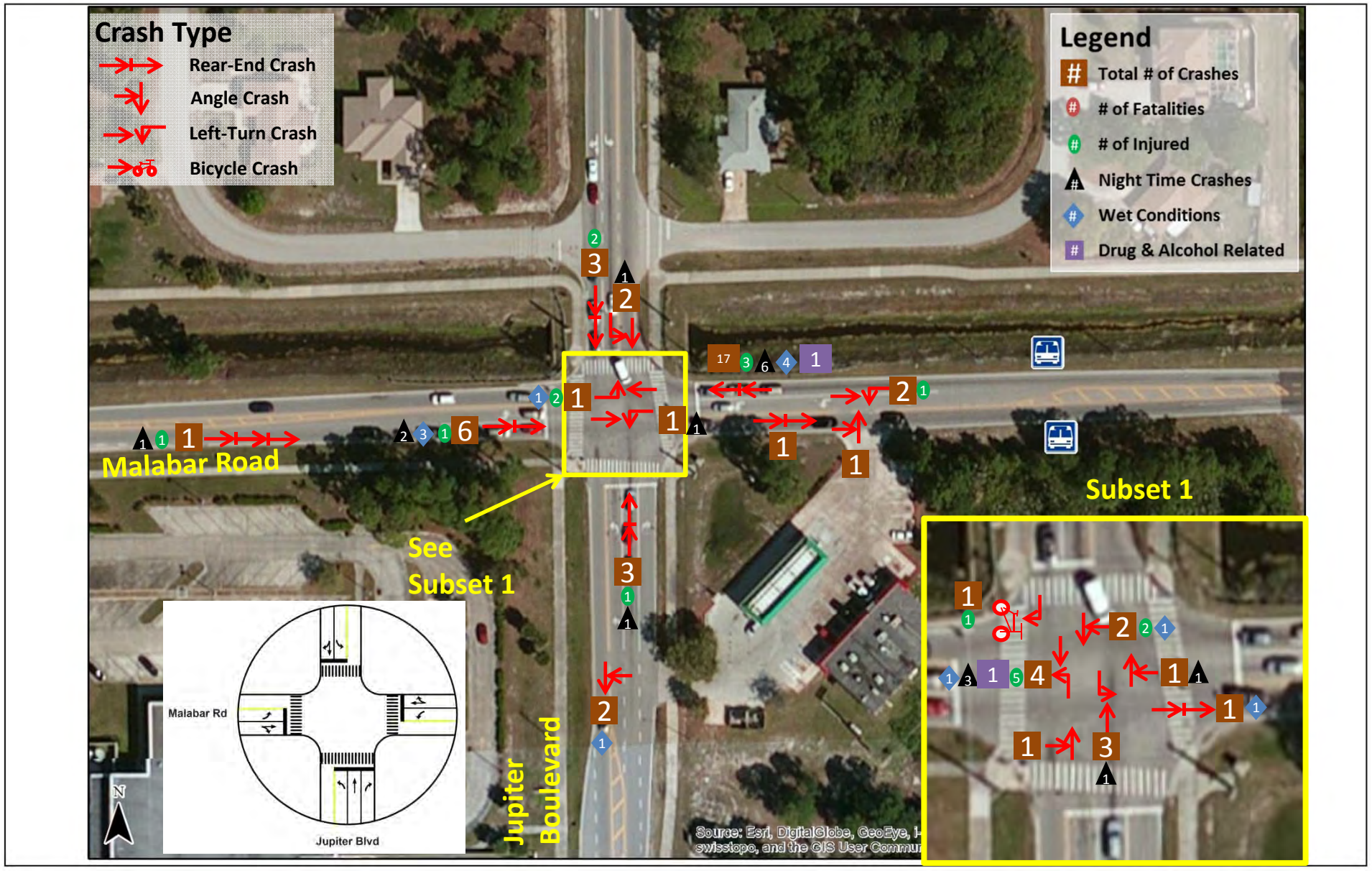
Access Class	Median	Median Opening		Signal Spacing Standard (feet)	Connection Spacing Standard	
		Full	Directional		Posted Speed >45 MPH	Posted Speed of 45 MPH or Less
4	Non-Restrictive	-	-	2,640	660	440
6	Non-Restrictive	-	-	1,320	440	245



Malabar Rd (Jupiter Blvd to Minton Rd)
Access Management Map
Brevard County, Florida

Figure **3**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING



Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Jupiter Blvd. Intersection

Figure **4**

Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 1 Jupiter Blvd. to Plaza Entrance

Figure **5**

Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 1 Jupiter Blvd. to Plaza Entrance

Figure **6**

Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 1 Jupiter Blvd. to Plaza Entrance

Figure **7**

Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 1 Jupiter Blvd. to Plaza Entrance

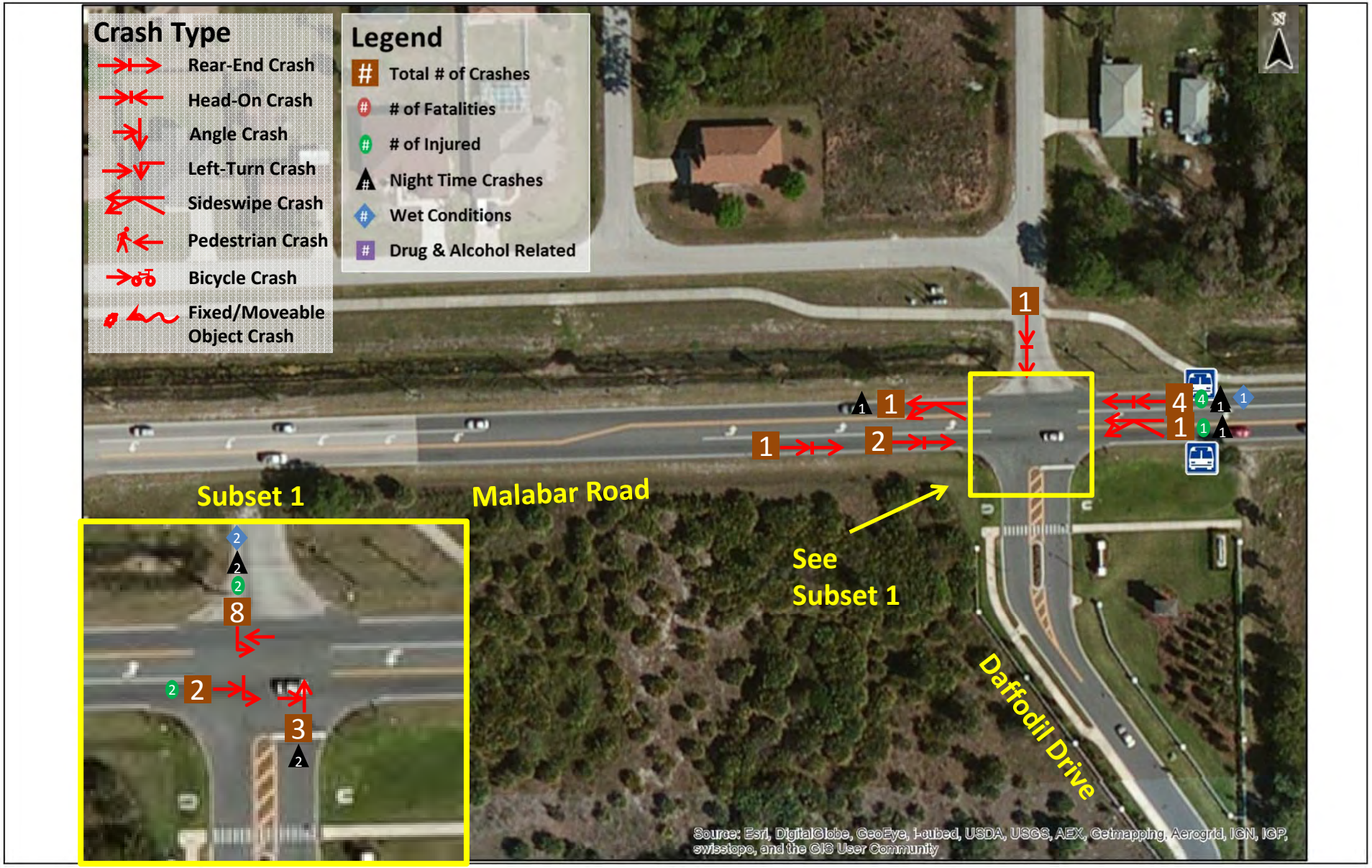
Figure **8**

Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 1 Jupiter Blvd. to Plaza Entrance

Figure **9**

Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 1 Jupiter Blvd. to Plaza Entrance

Figure **10**



Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 1 Jupiter Blvd. to Plaza Entrance

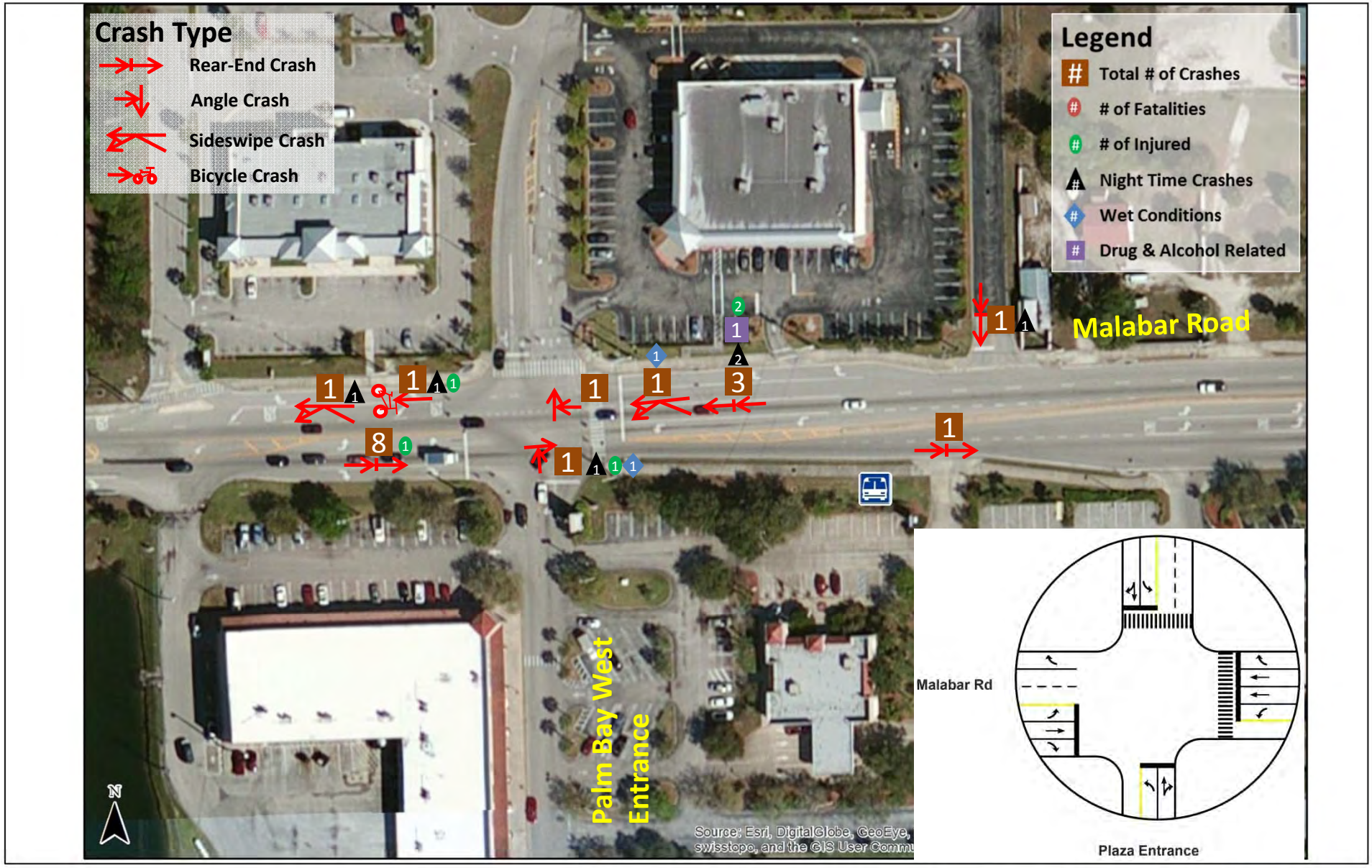
Figure **11**

Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 1 Jupiter Blvd. to Plaza Entrance

Figure **12**

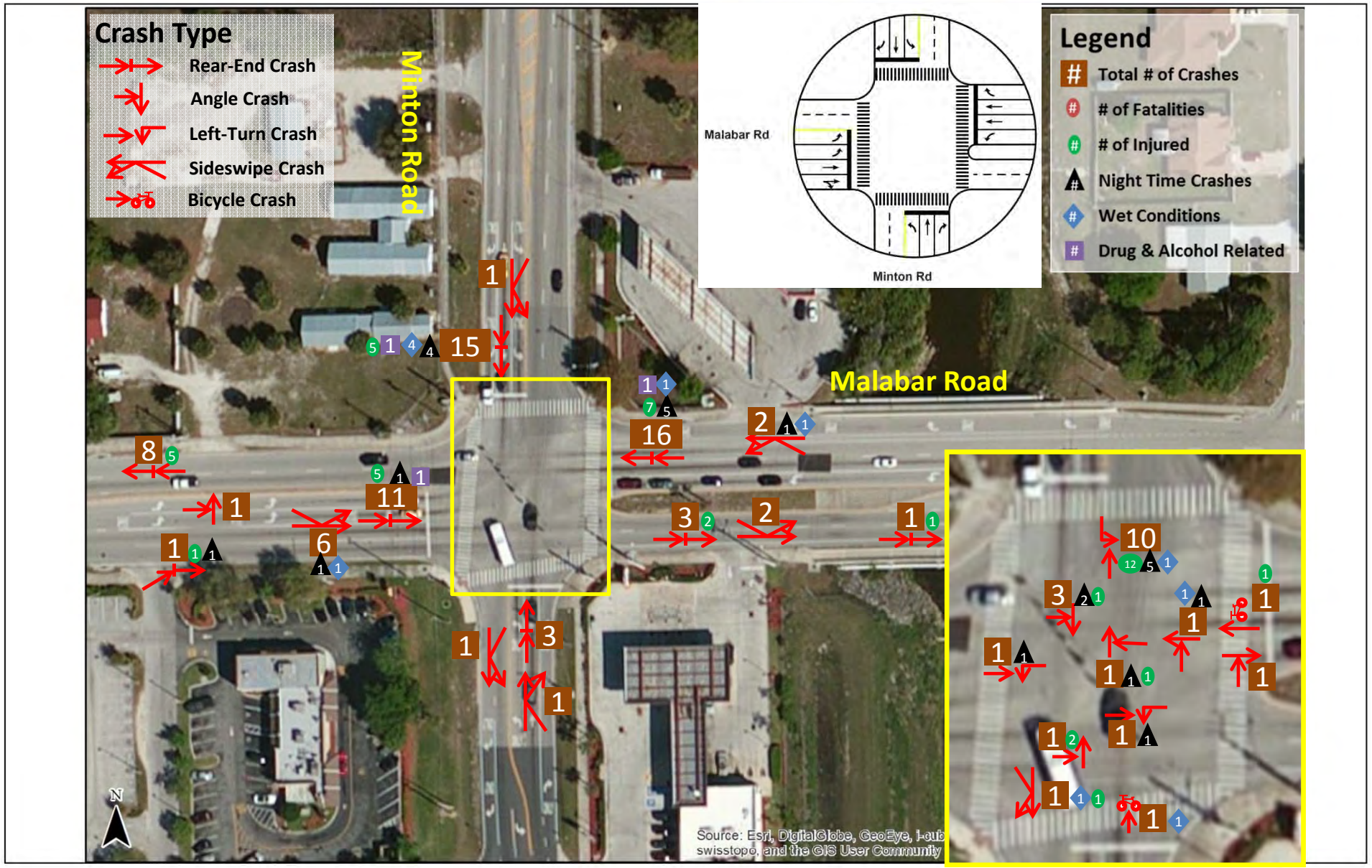
Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 1 Jupiter Blvd. to Plaza Entrance

Figure **13**



Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Plaza Entrance Intersection

Figure **14**



Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Minton Rd. Intersection

Figure **15**

Malabar Road East Segment – Emerson Drive to San Filippo Drive

MALABAR ROAD FROM EMERSON DR TO SAN FILIPPO DR
2009 - 2014 CRASH MAP
BREVARD COUNTY, FLORIDA

Figure **1**

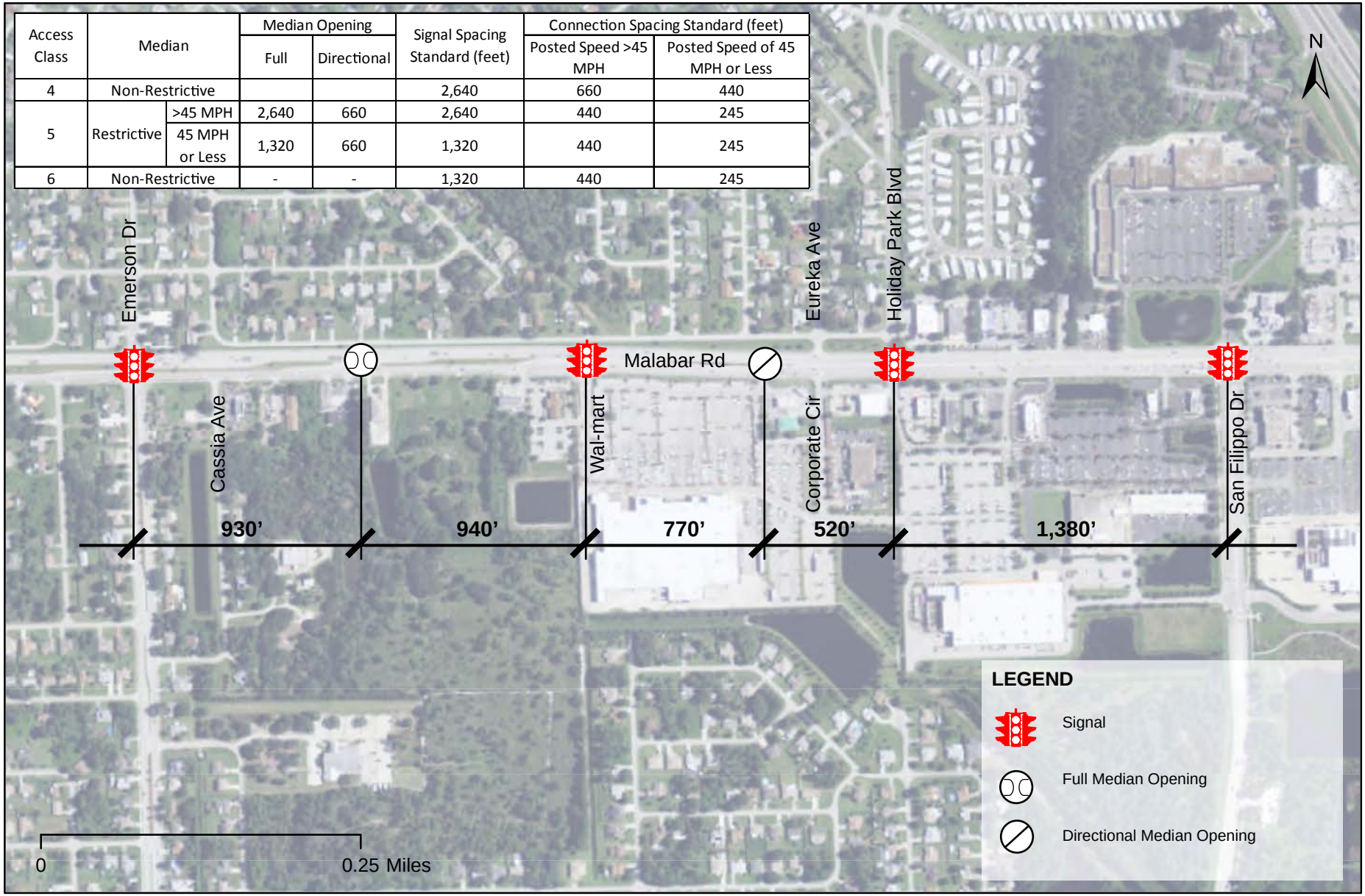
KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

MALABAR ROAD FROM EMERSON DR TO SAN FILIPPO DR
2009 - 2014 CRASH MAP
BREVARD COUNTY, FLORIDA

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Figure
2

Access Class	Median		Median Opening		Signal Spacing Standard (feet)	Connection Spacing Standard (feet)	
			Full	Directional		Posted Speed >45 MPH	Posted Speed of 45 MPH or Less
4	Non-Restrictive				2,640	660	440
5	Restrictive	>45 MPH	2,640	660	2,640	440	245
		45 MPH or Less	1,320	660	1,320	440	245
6	Non-Restrictive		-	-	1,320	440	245



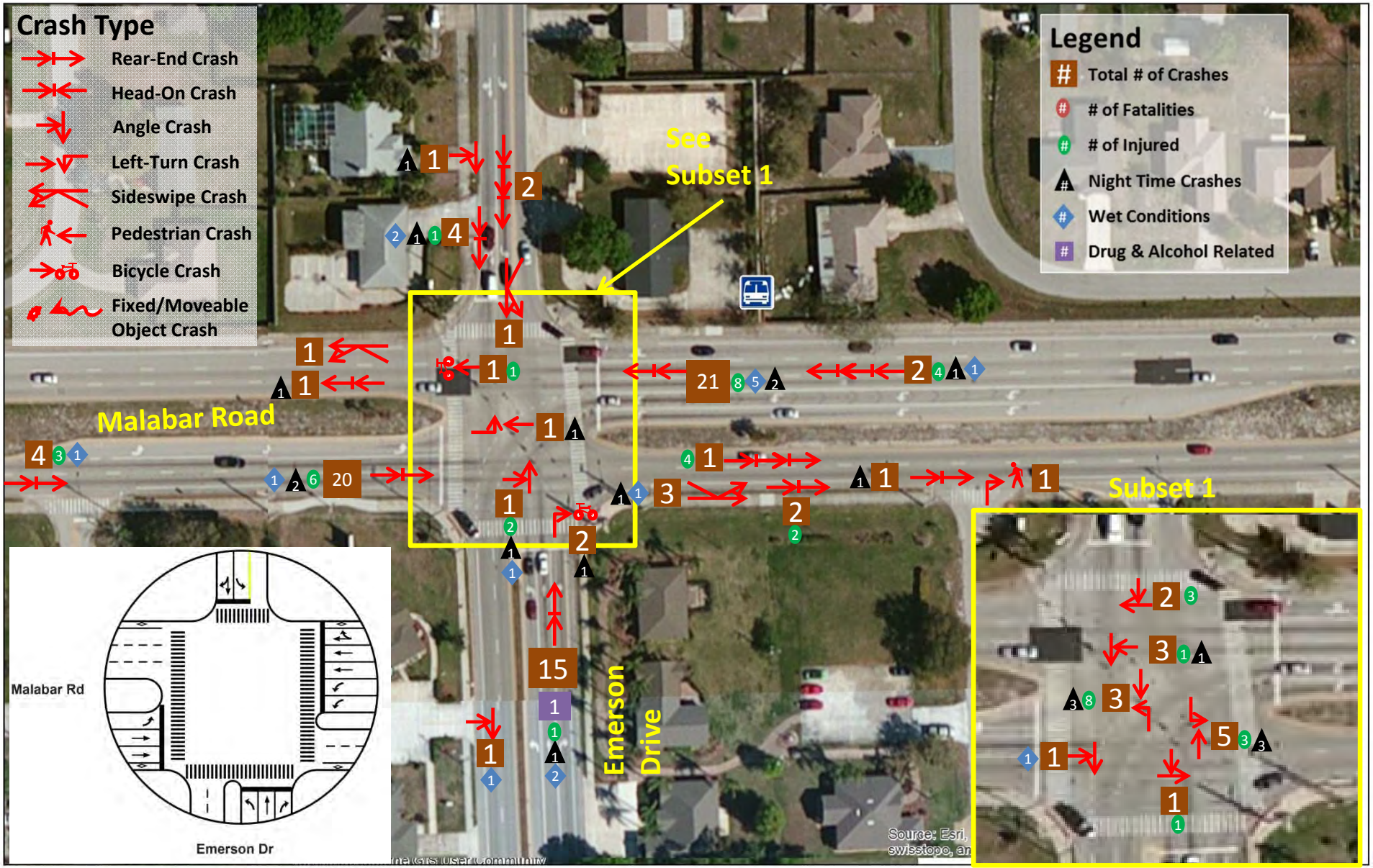
Malabar Rd (Emerson Dr to San Filippo Dr)

Access Management Map

Brevard County, Florida

Figure **3**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

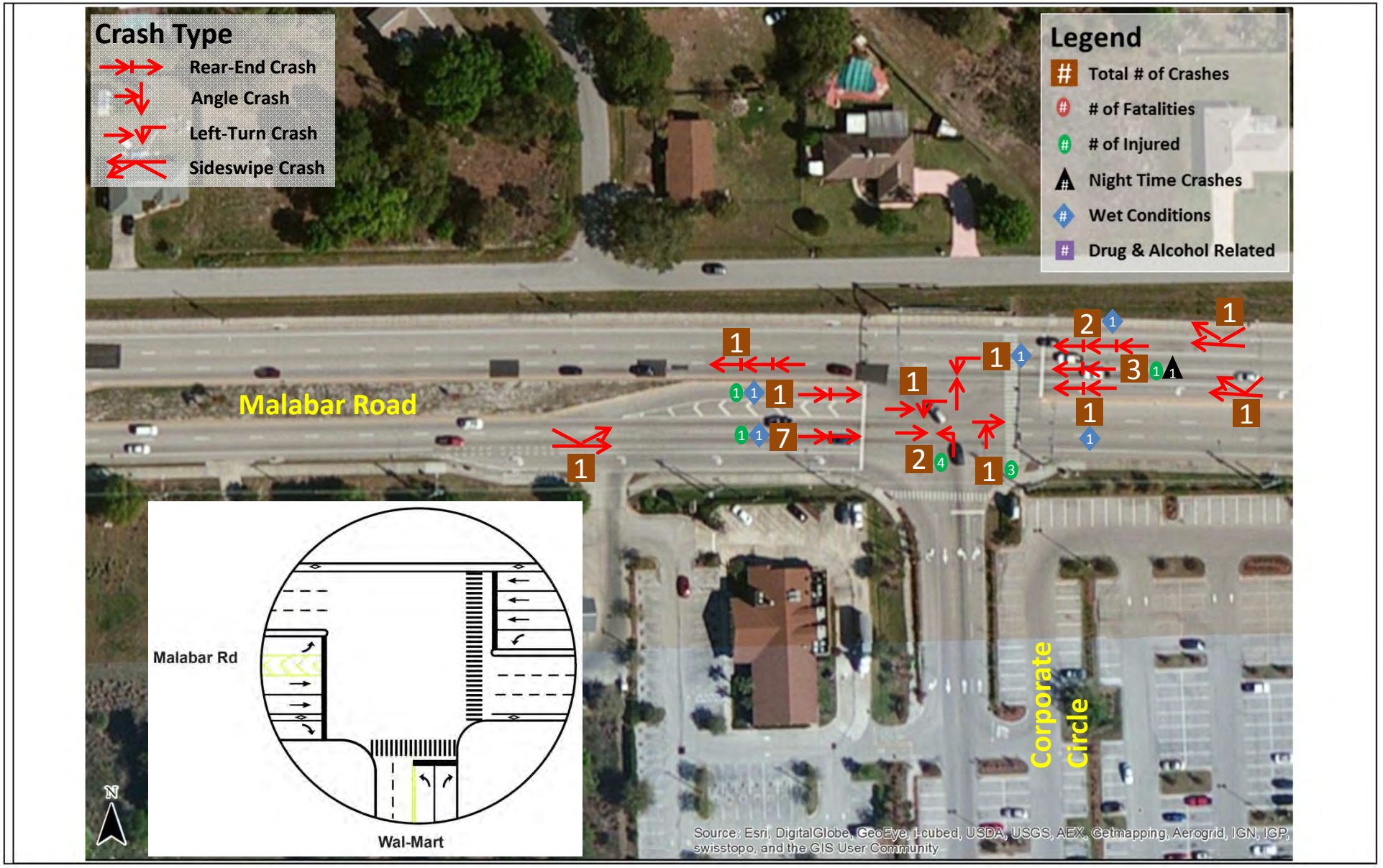


Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Emerson Dr. Intersection

Figure **4**

Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 2 Emerson Dr. to Corporate Cir.

Figure **5**

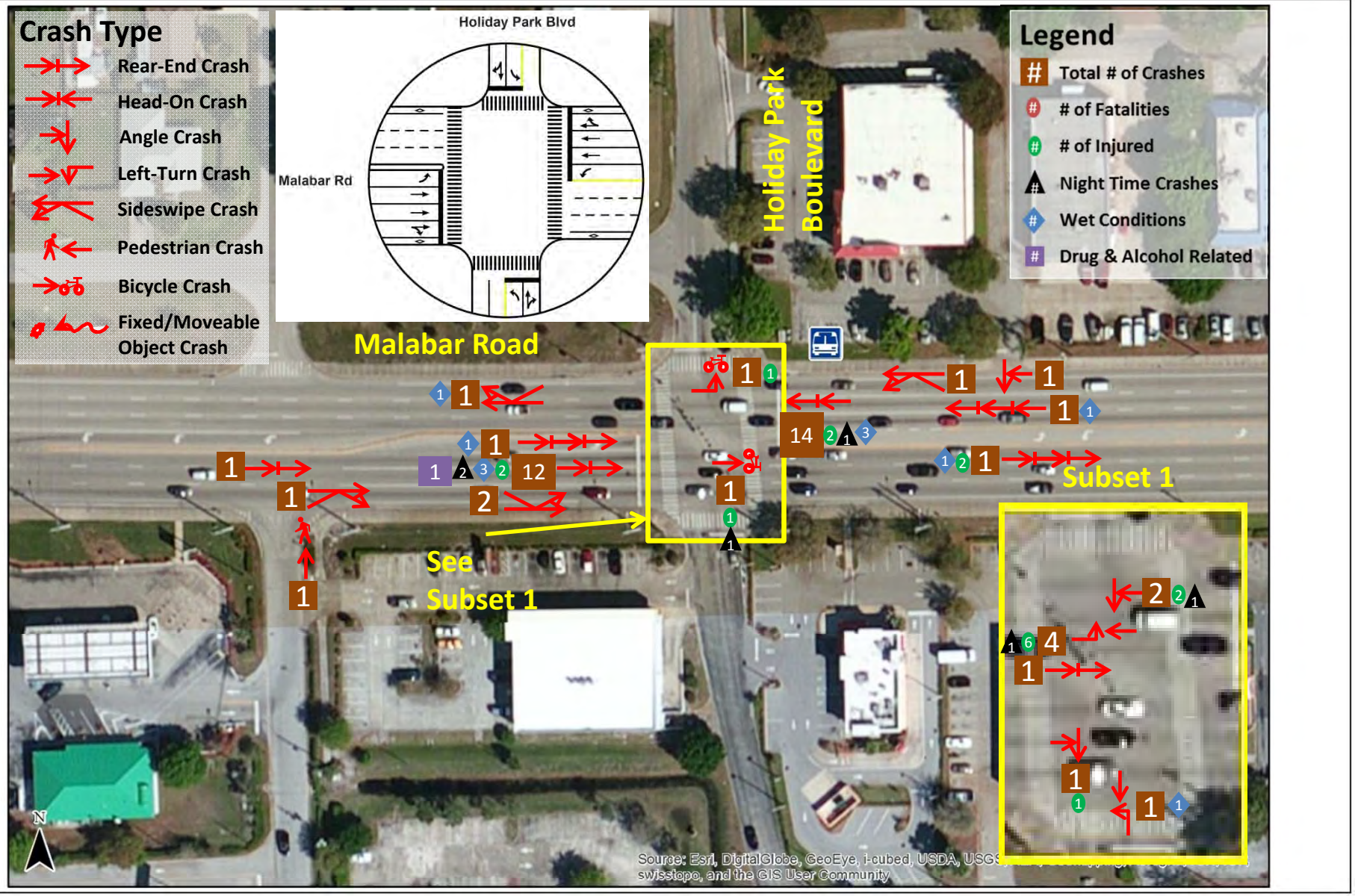


Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Corporate Cir. Intersection

Figure **6**

Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 3 Corporate Cir. to Holiday Park Blvd.

Figure **7**

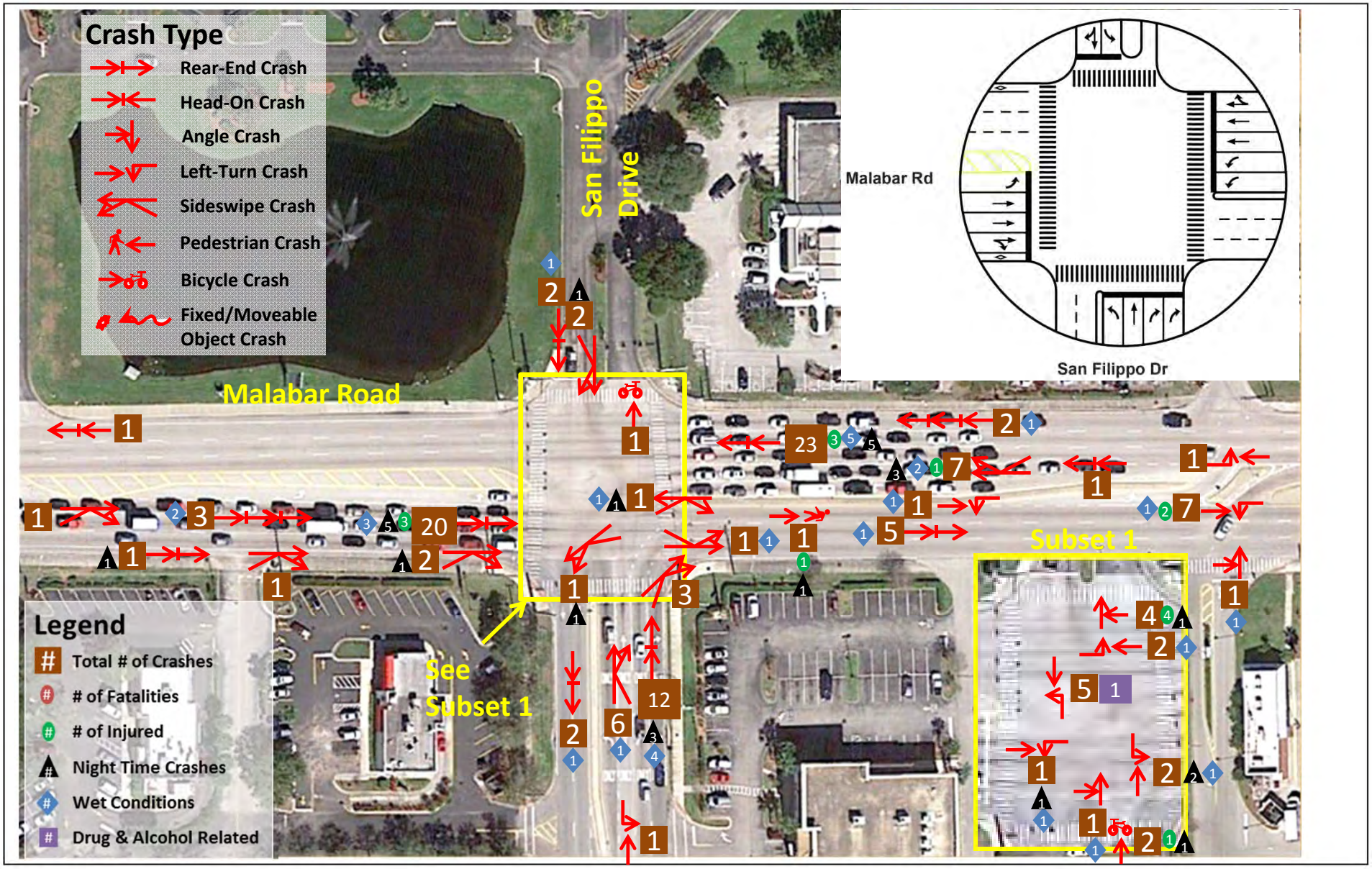


Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Holiday Park Blvd. Intersection

Figure **8**

Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA
Collision Diagram (2009 – 2014)
Segment 4 Holiday Park Blvd. to San Filippo Dr.

Figure **9**



Malabar Rd. (Jupiter Blvd. to Minton Rd./Emerson Dr. to San Filippo Dr.) RSA Collision Diagram (2009 – 2014) San Filippo Dr. Intersection

Figure **10**

Appendix B – SCAT ADA Assessment Bus Stop Sheets

Malabar Road West Segment – Jupiter Boulevard to Minton Road

Location: NW MALABAR RD & JUPITER BLVD **ID:** 341

Quick Fix: No **ADA Compliant:** No **Direction:** Eastbound

Quick Fix Items:

Non-Compliant Features: Boarding and alighting area not compliant, Schedule not accessible, Detectable Warnings, No Raised Curb

Average Ridership per Run: 2

Scoring: Accessibility: -3 **Safety** 0 **Operational:** 4 **Cost:** -5 **Rideship:** 4 **Total:** 0

Rank: 680 Total Cost: $4,300

Northbound

Southbound

Supplemental Photo

Eastbound

Westbound

Stop Location: On an unpaved shoulder of roadway
Bus Location: In a travel-thru lane
Releation to Intersection: At street, on far side of intersection
Hazards None

Curb Type/Height: None
Signage: Standard bus stop sign post
Sign Mounted Correctly: Yes
Amenities: Bus Schedule
Bench Accessible: N/A
Bench Obstruction: N/A
Trashcan Accessible:
Trashcan Obstruction:
Schedule Accessible: No

Is there a B&A area: Yes
Max Clear Space:
What prevents a B&A area:
Is the B&A 5'x8':
B&A Materials: Dirt/Grass
Is the B&A Safe: Yes
B&A Condition: Surface not firm, stable, or slip r
Running Slope (%): 0.2
Cross Slope (%): 0.9
B&A Obstructions: No obstruction
B&A Barriers: No barriers
Sidewalk Connection: No
1/4" Change in Elevation: No
Sidewalk Width (feet):

Marked Crosswalk: No
Protected Crosswalk:
Detectable Warning:
Detectable Warning Condition:
Detectable Full Width:
24" Detectable Warning:
Curb Ramp: No
Smooth Transition at Curb Ramp:
Curb Ramp Slope:
Curb Ramp Surface:

Shelter: No **Shelter Condition:** **Wheelchair Into:**
Distance from Curb (inches): **Accessible Connection:**

Trip Generators: Residential, Retail

Recommendations: Move the bus stop ~240' west. Pave a level 5'x8' slab with a raised 6" curb for the B&A area. See note 1. Pave a 40' path to connect to the existing sidewalk to the west. Add detectable warnings to the nearby curb ramps. Make sure the pole with the bus schedule is located adjacent to the pavement so it is accessible.

Location: NW MALABAR RD & WARE AVE **ID:** 343

Quick Fix: No **ADA Compliant:** No **Direction:** Eastbound

Quick Fix Items:

Non-Compliant Features: Boarding and alighting area not compliant, Detectable Warnings, No Raised Curb

Average Ridership per Run: 3

Scoring: Accessibility: -3 **Safety** 0 **Operational:** 4 **Cost:** -10 **Rideship:** 4 **Total:** -5

Rank: 773 **Total Cost: $5,400**

Northbound

Southbound

Supplemental Photo

Eastbound

Westbound

Stop Location: On an unpaved shoulder of roadway
Bus Location: In a travel-thru lane
Releation to Intersection: At street, on far side of intersection
Hazards None

Curb Type/Height: None
Signage: Standard bus stop sign post
Sign Mounted Correctly: Yes
Amenities: None
Bench Accessible: N/A
Bench Obstruction: N/A
Trashcan Accessible:
Trashcan Obstruction:
Schedule Accessible:

Is there a B&A area: Yes
Max Clear Space:
What prevents a B&A area:
Is the B&A 5'x8':
B&A Materials: Dirt/Grass
Is the B&A Safe: Yes
B&A Condition: Surface not firm, stable, or slip r
Running Slope (%): 0.3
Cross Slope (%): 5.8
B&A Obstructions: No obstruction
B&A Barriers: No barriers
Sidewalk Connection: No
1/4" Change in Elevation: No
Sidewalk Width (feet):

Marked Crosswalk: No
Protected Crosswalk:
Detectable Warning:
Detectable Warning Condition:
Detectable Full Width:
24" Detectable Warning:
Curb Ramp: No
Smooth Transition at Curb Ramp:
Curb Ramp Slope:
Curb Ramp Surface:

Shelter: No **Shelter Condition:** **Wheelchair Into:**
Distance from Curb (inches): **Accessible Connection:**

Trip Generators: Residential

Recommendations: Move the stop 80' west. Pave a level 5'x8' slab with a raised 6" curb for the B&A area and pave a ramp from the B&A area to the shoulder of the road, which will act as the accessible path. See note 1 and note 3. Add detectable warnings to the new curb ramp.

Location: NW MALABAR RD & MADALYN LANDING **ID:** 327

Quick Fix: No **ADA Compliant:** No **Direction:** Eastbound

Quick Fix Items:

Non-Compliant Features: Boarding and alighting area not compliant, No Raised Curb

Average Ridership per Run: 2

Scoring: Accessibility: 0 **Safety** 0 **Operational:** 2 **Cost:** -5 **Rideship:** 4 **Total:** 1

Rank: 665 **Total Cost: $4,800**

Northbound

Southbound

Supplemental Photo

Eastbound

Westbound

Stop Location: On an unpaved shoulder of roadway
Bus Location: In a travel-thru lane
Releation to Intersection: At street, on nearside of intersection
Hazards None

Curb Type/Height: None
Signage: Standard bus stop sign post
Sign Mounted Correctly: Yes
Amenities: None
Bench Accessible: N/A
Bench Obstruction: N/A
Trashcan Accessible:
Trashcan Obstruction:
Schedule Accessible:

Is there a B&A area: Yes
Max Clear Space:
What prevents a B&A area:
Is the B&A 5'x8':
B&A Materials: Dirt/Grass
Is the B&A Safe: Yes
B&A Condition: Surface not firm, stable, or slip r
Running Slope (%): 0.3
Cross Slope (%): 3.4
B&A Obstructions: No obstruction
B&A Barriers: No barriers
Sidewalk Connection: No
1/4" Change in Elevation: No
Sidewalk Width (feet): 6

Marked Crosswalk: No
Protected Crosswalk:
Detectable Warning:
Detectable Warning Condition:
Detectable Full Width:
24" Detectable Warning:
Curb Ramp: No
Smooth Transition at Curb Ramp:
Curb Ramp Slope:
Curb Ramp Surface:

Shelter: No **Shelter Condition:** **Wheelchair Into:**
Distance from Curb (inches): **Accessible Connection:**

Trip Generators: Residential

Recommendations: Move the bus stop 100' east. Pave a level 5'x8' slab with a raised 6" curb for the B&A area. See note 1. Make sure the B&A area has a cross slope of <=2%. Add a 50' path to connect the B&A to the existing sidewalk.

Location: NW MALABAR RD & MAYWOOD AVE **ID:** 331

Quick Fix: No **ADA Compliant:** No **Direction:** Eastbound

Quick Fix Items:

Non-Compliant Features: Boarding and alighting area not compliant, Schedule not accessible, No Raised Curb

Average Ridership per Run: 24

Scoring: Accessibility: -1 **Safety** 3 **Operational:** 5 **Cost:** -10 **Rideship:** 40 **Total:** 37

Rank: 47 **Total Cost: $5,100**

Northbound

Southbound

Supplemental Photo

Eastbound

Westbound

Stop Location: On an unpaved shoulder of roadway
Bus Location: In a travel-thru lane
Releation to Intersection: At street, on far side of intersection
Hazards None

Curb Type/Height: None
Signage: Standard bus stop sign post
Sign Mounted Correctly: Yes
Amenities: Bus Schedule
Bench Accessible: N/A
Bench Obstruction: N/A
Trashcan Accessible:
Trashcan Obstruction:
Schedule Accessible: No

Is there a B&A area: Yes
Max Clear Space:
What prevents a B&A area:
Is the B&A 5'x8':
B&A Materials: Dirt/Grass
Is the B&A Safe: Yes
B&A Condition: Surface not firm, stable, or slip r
Running Slope (%): 0.3
Cross Slope (%): 4.6
B&A Obstructions: No obstruction
B&A Barriers: No barriers
Sidewalk Connection: No
1/4" Change in Elevation: No
Sidewalk Width (feet):

Marked Crosswalk: Yes
Protected Crosswalk: No
Detectable Warning: Yes
Detectable Warning Condition: Excellent
Detectable Full Width: Yes
24" Detectable Warning: Yes
Curb Ramp: Yes
Smooth Transition at Curb Ramp: Yes
Curb Ramp Slope: Yes
Curb Ramp Surface: Yes

Shelter: No **Shelter Condition:** **Wheelchair Into:**
Distance from Curb (inches): **Accessible Connection:**

Trip Generators: Residential

Recommendations: Move the bus stop 70' west. Pave a level 5'x8' slab with a raised 6" curb for the B&A area. See note 1. Add a 50' path to connect the B&A to the existing sidewalk. Resurface the B&A area to have a cross slope of <=2%.

Location: PALM BAY WEST SHOPPING CENTER & MINTON **ID:** 322

Quick Fix: No **ADA Compliant:** No **Direction:** Eastbound
Quick Fix Items:
Non-Compliant Features: Boarding and alighting area not compliant

Average Ridership per Run: 2
Scoring: Accessibility: 7 **Safety** 9 **Operational:** 3 **Cost:** 5 **Rideship:** 4 **Total:** 28
Rank: 105 Total Cost: $2,500


Northbound


Southbound


Supplemental Photo


Eastbound


Westbound

Stop Location: On the sidewalk (adjacent to the street with a raised curb)
Bus Location: In a travel-thru lane
Releation to Intersection: At street, on nearside of intersection
Hazards None

Curb Type/Height: Type F-6 **Signage:** Standard bus stop sign post
Sign Mounted Correctly: Yes
Amenities: None
Bench Accessible: N/A **Bench Obstruction:** N/A
Trashcan Accessible: **Trashcan Obstruction:**
Schedule Accessible:

Is there a B&A area: Yes **Max Clear Space:**
What prevents a B&A area:
Is the B&A 5'x8': **B&A Materials:** Partially Paved
Is the B&A Safe: Yes **B&A Condition:** Surface not firm, stable, or slip r
Running Slope (%): 0.2 **Cross Slope (%):** 1.8
B&A Obstructions: No obstruction
B&A Barriers: No barriers
Sidewalk Connection: Yes **1/4" Change in Elevation:** No
Sidewalk Width (feet): 8

Marked Crosswalk: Yes **Protected Crosswalk:** Yes
Detectable Warning: Yes **Detectable Warning Condition:** Excellent
Detectable Full Width: Yes **24" Detectable Warning:** Yes
Curb Ramp: Yes **Smooth Transition at Curb Ramp:** Yes
Curb Ramp Slope: Yes **Curb Ramp Surface:** Yes

Shelter: No **Shelter Condition:** **Wheelchair Into:**
Distance from Curb (inches): **Accessible Connection:**

Trip Generators: Medical/Rehab, Office/Commercial, Retail

Recommendations: Pave a level 5'x3' slab between the curb and sidewalk to complete a 5'x8' B&A area.

Malabar Road East Segment – Emerson Drive to San Filippo Drive

Location: MALABAR RD & EMERSON DR **ID:** 1005

Quick Fix: No **ADA Compliant:** No **Direction:** Westbound

Quick Fix Items:

Non-Compliant Features: Boarding and alighting area not compliant

Average Ridership per Run: 0

Scoring: Accessibility: 7 **Safety** 9 **Operational:** 3 **Cost:** 0 **Rideship:** 0 **Total:** 19

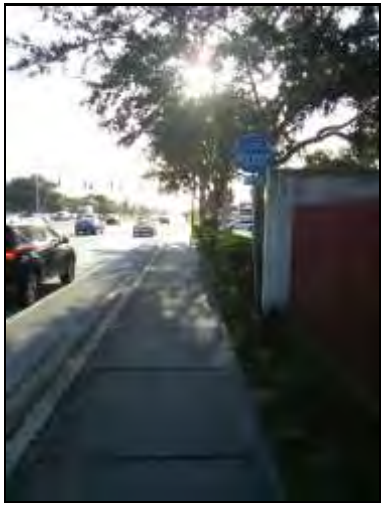
Rank: 261 Total Cost: $3,200

Northbound

Southbound

Supplemental Photo

Eastbound



Westbound

Stop Location: On the sidewalk (adjacent to the street with a raised curb)
Bus Location: In a travel-thru lane
Releation to Intersection: At street, on nearside of intersection
Hazards None

Curb Type/Height: Type F-6 **Signage:** Standard bus stop sign post
Sign Mounted Correctly: Yes
Amenities: None
Bench Accessible: N/A **Bench Obstruction:** N/A
Trashcan Accessible: **Trashcan Obstruction:**
Schedule Accessible:

Is there a B&A area: Yes **Max Clear Space:**
What prevents a B&A area:
Is the B&A 5'x8': **B&A Materials:** Partially Paved
Is the B&A Safe: Yes **B&A Condition:** Surface not firm, stable, or slip r
Running Slope (%): 0.2 **Cross Slope (%):** 0.6
B&A Obstructions: No obstruction
B&A Barriers: No barriers
Sidewalk Connection: Yes **1/4" Change in Elevation:** No
Sidewalk Width (feet): 6

Marked Crosswalk: Yes **Protected Crosswalk:** Yes
Detectable Warning: Yes **Detectable Warning Condition:** Good
Detectable Full Width: Yes **24" Detectable Warning:** Yes
Curb Ramp: Yes **Smooth Transition at Curb Ramp:** Yes
Curb Ramp Slope: Yes **Curb Ramp Surface:** Yes

Shelter: No **Shelter Condition:** **Wheelchair Into:**
Distance from Curb (inches): **Accessible Connection:**

Trip Generators: Retail

Recommendations: Move the stop 270' west. Pave a level 5'x2' slab behind the sidewalk to complete a 5'x8' B&A area.

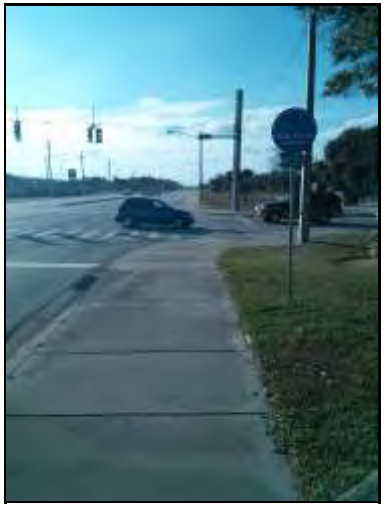
Location: MALABAR RD & HOLIDAY PARK BLVD **ID:** 962

Quick Fix: Yes **ADA Compliant:** No **Direction:** Westbound
Quick Fix Items: Low Cost
Non-Compliant Features: Detectable Warnings

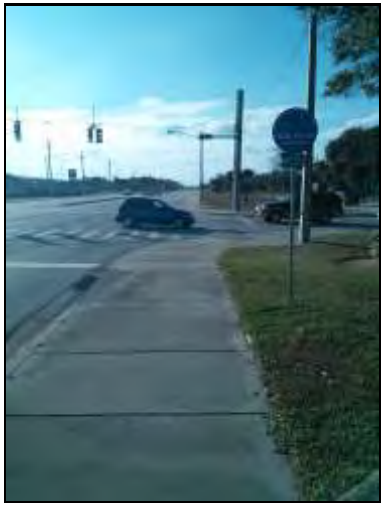
Average Ridership per Run: 1
Scoring: Accessibility: 11 **Safety** 8 **Operational:** 3 **Cost:** 15 **Rideship:** 0 **Total:** 37
Rank: 40 **Total Cost: $800**


Northbound


Southbound


Supplemental Photo


Eastbound


Westbound

Stop Location: On the sidewalk (adjacent to the street with a raised curb)
Bus Location: In a travel-thru lane
Releation to Intersection: At street, on nearside of intersection
Hazards None

Curb Type/Height: Type F-6 **Signage:** Standard bus stop sign post
Sign Mounted Correctly: Yes
Amenities: None
Bench Accessible: N/A **Bench Obstruction:** N/A
Trashcan Accessible: **Trashcan Obstruction:**
Schedule Accessible:

Is there a B&A area: Yes **Max Clear Space:**
What prevents a B&A area:
Is the B&A 5'x8': **B&A Materials:** Concrete
Is the B&A Safe: Yes **B&A Condition:** No defects
Running Slope (%): 0.2 **Cross Slope (%):** 0.4
B&A Obstructions: No obstruction
B&A Barriers: No barriers
Sidewalk Connection: Yes **1/4" Change in Elevation:** No
Sidewalk Width (feet): 8

Marked Crosswalk: Yes **Protected Crosswalk:** Yes
Detectable Warning: No **Detectable Warning Condition:**
Detectable Full Width: **24" Detectable Warning:**
Curb Ramp: Yes **Smooth Transition at Curb Ramp:** Yes
Curb Ramp Slope: Yes **Curb Ramp Surface:** Yes

Shelter: No **Shelter Condition:** **Wheelchair Into:**
Distance from Curb (inches): **Accessible Connection:**

Trip Generators: Retail

Recommendations: Add detectable warnings to the nearby curb ramps.

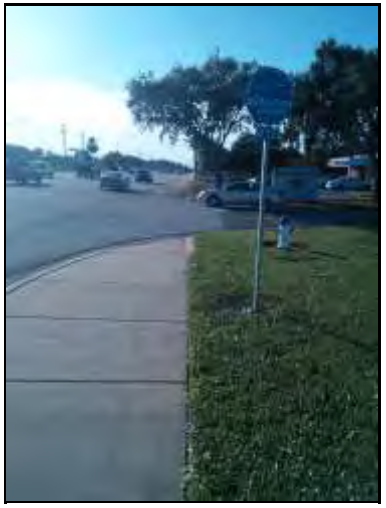
Location: MALABAR RD & INTERCHANGE SQUARE **ID:** 961

Quick Fix: No **ADA Compliant:** No **Direction:** Westbound
Quick Fix Items:
Non-Compliant Features: Boarding and alighting area not compliant, Detectable Warnings

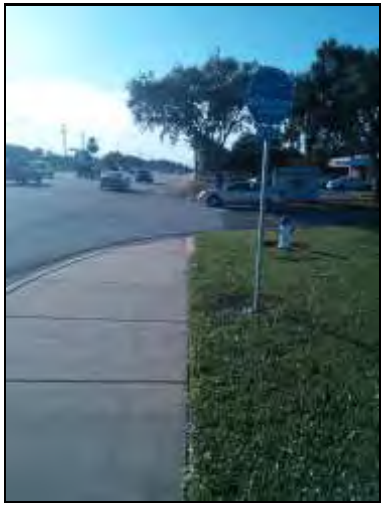
Average Ridership per Run: 1
Scoring: Accessibility: 5 **Safety** 5 **Operational:** 3 **Cost:** 5 **Rideship:** 0 **Total:** 18
Rank: 280 **Total Cost: $2,800**

Northbound


Southbound


Supplemental Photo


Eastbound


Westbound

Stop Location: On the sidewalk (adjacent to the street with a raised curb)
Bus Location: In a travel-thru lane
Releation to Intersection: At street, on nearside of intersection
Hazards None

Curb Type/Height: Type F-6 **Signage:** Standard bus stop sign post
Sign Mounted Correctly: Yes
Amenities: None
Bench Accessible: N/A **Bench Obstruction:** N/A
Trashcan Accessible: **Trashcan Obstruction:**
Schedule Accessible:

Is there a B&A area: Yes **Max Clear Space:**
What prevents a B&A area:
Is the B&A 5'x8': **B&A Materials:** Concrete
Is the B&A Safe: Yes **B&A Condition:** Surface not firm, stable, or slip r
Running Slope (%): 0.2 **Cross Slope (%):** 0.3
B&A Obstructions: No obstruction
B&A Barriers: No barriers
Sidewalk Connection: Yes **1/4" Change in Elevation:** No
Sidewalk Width (feet): 8

Marked Crosswalk: Yes **Protected Crosswalk:** No
Detectable Warning: No **Detectable Warning Condition:**
Detectable Full Width: **24" Detectable Warning:**
Curb Ramp: Yes **Smooth Transition at Curb Ramp:** Yes
Curb Ramp Slope: Yes **Curb Ramp Surface:** Yes

Shelter: No **Shelter Condition:** **Wheelchair Into:**
Distance from Curb (inches): **Accessible Connection:**

Trip Generators: Retail

Recommendations: Move the stop 280' east. Add detectable warnings to the nearby curb ramps.