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**URP6711 Multimodal Transportation Planning**

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Manatee County Corridor Strategy

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About the Office of Community Engagement and Partnerships

OCEP exists to expand and strengthen university–community engagement locally and globally in support of University of South Florida’s strategic priorities to:

- Change lives for the better, improve health, and foster sustainable development and positive societal change through high-impact practice and innovation, including community-engaged scholarship and creative activities that benefit all members of society.
- Produce well-educated and highly skilled global citizens through a continued commitment to student success, including enhancing opportunities for all students by providing transformational learning that develops relevant applied skills and engaged outcomes.
- Create new partnerships to build a strong and sustainable future for Florida in the global economy by establishing mutually beneficial partnerships (internal and external) that enhance student access to academic programs, research, and employment opportunities.

Director  Lillian Wichinsky, Ph.D., LMSW

About the Community Sustainability Partnership Program

The Community Sustainability Partnership Program (CSPP) is an EPIC Network program hosted and supported by the University of South Florida. CSPP is an initiative with the goal to improve the quality of life and social wealth of all involved, whether by expanding social or economic inclusion, increasing environmental sustainability, enhancing livability or spreading democratic self-government. CSPP works with university and community administrative structures to harness USF resources, faculty expertise, and student innovation to create change through community-identified projects. These collaborations are at the forefront of solving important issues that strengthen Florida communities.

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About Manatee County, Florida

Manatee County is located on Florida’s breathtaking Gulf Coast. It is bordered by Tampa Bay and St. Petersburg to the north, Hardee and DeSoto counties to the east and Sarasota to the south. The beautiful beaches of Anna Maria Island fade into the Gulf of Mexico to the west. Many believe the shores of Manatee were the initial landing spot for Spanish explorer Hernando de Soto in 1539. Manatee County – so named for the slow-moving sea cow known as the manatee – was founded in 1855 and included a vast expanse of more than 5,000 square miles. That huge area was eventually divided into seven different counties, leaving Manatee County at 741 square miles. Old Florida still Exists/ before the high rises, and theme parks, there was simply this. Uncover the Beauty.

Manatee County now boasts a population of more than 385,000. With miles of gorgeous beaches bike paths trails, greenways, boating, fabulous shopping and great food, Manatee County has something for everyone.
Acknowledgements

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- Peng Chen, PhD, Assistant Professor, Urban and Regional Planning, School of Public Affairs

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This report represents original student work and recommendations prepared by students in the University of South Florida’s Community Sustainability Partnership Program for Manatee County. Text and images contained in this report may not be used without permission and attribution.
EXECUTIVE SUMMARY

During the University of South Florida (USF) Fall 2019 semester, the Manatee County Transportation Planning office requested that the graduate students of URP 6711 Multimodal Transportation Planning determine multimodal improvements along three high priority county corridors. Two main components of the Manatee County Long Range Transportation Plan are an emphasis on advancing complete streets and expanding multimodal options. In order to advance non-auto modes of transportation, the County plans to provide residents with an organized, safe, and efficiently connected multimodal network of mobility options. The County used socioeconomic information, crash data, potential points of interest, and transit route alignments and ridership to identify Lockwood Ridge Road Corridor, 26th Avenue East, and 53rd Avenue West as some of the high priority corridors in need of analysis and adjustment.

The goal of this report was to assess the conditions of these high priority corridors and to recommend ways that Manatee County can improve the multimodal capabilities of the corridors, while also providing bicyclists and pedestrians a safe, efficient, and more livable environment. Street design concepts were prepared using streetmix software and analysis was conducted using a variety of data sources and guidance documents. Below are just a few of the recommendations in the report. Users are referred to the respective section for further details and design concepts for each of the corridors.

Recommendations for Lockwood Ridge Road include:

- Reduce speed to 30 MPH and reduce lane width to 11’ per lane.
- Combine and extend short medians, provide safe U-turn locations, and remove personal driveways where possible.
- Add midblock crosswalks, signage, embedded lighting, and pedestrian refuges where possible.
- Add a 2’ protected buffer to the bike lane on both sides of the road.
- Repair damaged sidewalks and adopt a policy of cyclical sidewalk inspection and repair.
- Add sidewalk furniture and amenities throughout the corridor.

Recommendations for 26th Avenue East include:

- Add segments of multiuse path on the north and south sides of the corridor.
- Add crosswalk markings at the 5th Street E.
- Upon redevelopment, include back alleys/local streets in the development plan.
- Incorporate a mini roundabout at the 9th Street E intersection due to a high number of crashes at this location.

Recommendations for 53rd Avenue West include:

- Reduce travel speeds from 40 mph to 35 mph through changes in design and posted speed.
- Expand bicycle and pedestrian facilities and lighting.
- Improve the conditions of the MCAT stops by installing new lighting, shelters, and comfortable seating and bicycle/pedestrian facility connections.
- Incorporate detectable warnings, speed management, and access management practices.
- Educate the public about safe walking, bicycling and driving practices.
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A. Study Area Overview

The Lockwood Ridge Road Corridor is in Manatee County, Florida in the City of Bradenton, Florida. The corridor runs in a north/south direction and it approximately 1.2 miles in length (see Figure 1). The majority of the corridor could be classified as C3R - Suburban Residential using the FDOT Context Classification system. The corridor has, “mostly residential uses within large blocks and a disconnected or sparse roadway network” (FDOT Context Classification, 2017). The only exception to this classification within the study area is at the intersection of SR 70, which is C3C – Suburban Commercial and can be described as, “mostly non-residential uses with large building footprints and large parking lots within large blocks and a disconnected or sparse roadway network” (FDOT Context Classification, 2017). Business present in this zone of the corridor include Publix, Walmart, Aldi, Wawa, 7-Eleven, Subway, Beef O Brady’s, The UPS Store, nail spas, small restaurants, and a pet supply store to name a few.

The width of the corridor road and the right of way is approximately 90 feet and includes bike lanes, continuous sidewalks on either side of the road, a four-lane road, and often a median. The land use on either side of the corridor is almost entirely residential with the exception of the most northern intersection near SR 70 which is commercial plaza on both sides of the road (see Figure 2). There are no stop signs, traffic signals or crosswalks along the corridor except for the most southern intersection at Honore Avenue and the most northern intersection at SR 70 which each have a traffic signal and crosswalks. There is an active construction site for a housing project near the Honore Avenue and Lockwood Ridge Road intersection which consists of 12 acres of usable land and 4 acres of wetlands.

According to the FDOT Transportation Data and Analytics office, the Functional Classification of Lockwood Ridge Road is a ‘Major Collector,’ SR 70 is an ‘Other Principal Arterial,’ and Honore Avenue is a...
‘Minor Arterial.’ However, in the Manatee County Comprehensive Plan, within the study area SR 70 is classified as a ‘Principal Arterial’ and both Lockwood Ridge Road and Honore Avenue are classified as ‘Minor Arterial’. The Manatee Comprehensive plan also states that all three road should be classified as Arterials by 2035.

Under Policy 5.2.2.2 of the Comprehensive Plan, Manatee County established that their minimum standards for “…spacing and location of local streets and driveways onto County and State roadways, and minimum standards for the spacing and location of median cuts on County and State roadways... shall be consistent with Florida Department of Transportation Rule Ch. 14-97, F.A.C. State Highway System Access Management Classification System and Standards” (Manatee County Comprehensive Plan, 2019). There does not appear to be an emphasis in the Manatee County Code for Access Management Class, however the FDOT classifies SR 70 within the study area as Access Class 5. Lockwood Ridge Road is not classified by DOT, but given the speed limit (45 MPH), restrictive medians, and driveway locations it could be classified as Access Class 5.

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1 Source: FDOT Transportation Data and Analytics Office Functional Classification and Urban Boundary Maps website https://www.fdot.gov/statistics/hwysys/cubfc.shtm

2 Source: Manatee County Comprehensive Plan https://library.municode.com/fl/manatee_county/codes/comprehensive_plan?nodeId=ELEMENT_STR_TRAFFICSEM_GOAL5.6_OBJECTIVE_5.6.1INCOIS

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Figure 2. Simplified land use map of study area.

Figure 3. Profile view of Lockwood Ridge Road.
Access Management Conditions

There are 18 vehicle access points from Lockwood Ridge Road that either allow access to a subdivision with local roads or a commercial center with shared easements (indicated as green circles in Figure 4). Fourteen of these 18 points are spaced greater than 245 feet from each other. The remaining four, which are near the SR 70 intersection in the suburban commercial portion of the study area, are greater than 200 feet but less than 245 feet from the closest access point. Eight access points on Lockwood Ridge Road are driveways to private residences. They are all located in the residential area in the northwestern portion of the study area (indicated as blue lines and the photo inset in Figure 4). These driveways are as close as 25 feet and as far as 110 feet from each other. There is a median which runs the entire length of Lockwood Ridge Road, both in the residential and commercial areas. The median is raised and restrictive, however, there are many openings that allow left turns (all median opening crossings are indicated by a red circle in Figure 4).

Figure 4. Observed access management configuration of Lockwood Ridge Road.
Pedestrian Access System/Cross Access Easements

There is a well-marked pedestrian access system within the commercial portion of our study area. This system consists of sidewalks and white painted markings that lead pedestrians from the sidewalk, through the parking lots, to the commercial buildings (see Figure 5).

Access management within the commercial plaza area is well thought out and allows both pedestrians and vehicles freedom of movement within the plazas. Along Lockwood Ridge Road there are three access points to the western commercial plaza (see Figure 6). Of these access points, two have a median opening crossing on Lockwood Ridge Road which would allow drivers to turn left or right to both exit and enter the commercial plaza. The most northern access point, however, has a restricted median which allows only right turns. Likewise, for the eastern commercial there are three access points, two of which have median opening crossings and one of which has a restricted median, but the most southern of these points (which has a median opening crossing) leads to an unimproved empty lot that is for sale. Within each of the commercial plazas is a network of cross access easements and connected parking lots which allows mutual access to any business within the plaza once inside. Each access point is greater than the minimum distance required from an arterial intersection, which is 75 feet for other than residential according to the Manatee County Highway & Traffic Manual. Connecting spaces are also at or just under 245 feet from each other (as low as 200 feet), which nearly meets the FDOT Access Classification System minimums for a Class 5 road.

Figure 5. Pedestrian access system at the commercial plaza in study area.

Figure 6. Joint/cross access easement and access from SR 70 and Lockwood Ridge
**Median Length and Placement**

There are eight median openings down the center of Lockwood Ridge Road. All the median openings are full median openings, which according to the Florida Administrative Code means “an opening in a restrictive median designed to allow all safe turning movements.”³ They do not appear to follow the FDOT standards for minimum distances for median openings because if Lockwood Ridge Road was classified as a Class 5, full median openings at ≤45mph should be spaced 1302 feet from each other. Only one of the median openings fall into that category (see Figure 7).

³ Source: Florida Administrative Code Rule 14-96 Definitions accessed from https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/content/planning/systems/programs/sm/accman/pdfs/1497.pdf?sfvrsn=db747af4_0

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**Figure 7.** Lockwood Ridge Road median spacing (color coded on the assumption that the corridor could be an Access Class 5 road).
Vehicle Crash Data

Unsurprisingly, the crash data provided by the Manatee County Transportation Planning Office lines up with the median opening crossings (see Figure 8). Of particular note is the cluster of accidents that occurred in the vicinity of the four shortest median segments (the same cluster highlighted in Figure 7), especially at the opening which has a four-way intersection with no traffic signal. Fewer median opening crossings would likely have prevented some of those accidents. From 2009-2018, there were 172 vehicular crashes. Those crashes resulted in 0 fatalities, 73 injuries, and an estimated $746,200 in property damage. 12 of these crashes involved a single vehicle, 4 involved a pedestrian or cyclists and a vehicle, and the remaining 156 were 2 or more vehicle crashes.

Figure 8. Crash data from 2009-2018. Source GIS data provided by Manatee County Transportation Office.
**Travel Demand Information**

According to FDOT 2018 data, within the study area the Average Annual Daily Traffic (AADT) for Lockwood Ridge Road is 18,000, State Road 70 is 52,226, and Honore Avenue is 18,700 west of Lockwood Ridge Road and 7,800 to the east. The FDOT generalizes that, for non-state signalized roadways with 40mph speed limit, four lanes, a divided median, and exclusive left lanes the AADT volume should be approximately 32,000 for LOS C (FDOT, 2012). At the present, Lockwood Ridge Road could potentially be reduced to 2 lanes without affecting Level of service. FDOT’s Statewide Lane Elimination Guidelines state, “Lane elimination projects are reported to work best when ADT is less than 20,000 (on a four-lane roadway) and left turning vehicles are removed from the through traffic flow” (FDOT, 2014).

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4 Source: FDOT’s Florida Traffic Online Web Application at https://tdaappsprod.dot.state.fl.us/fto/
Connections between Residential Areas

There are six residential areas that can be differentiated in that they have access to Lockwood Ridge Road through local or private roads, but not to each other (see Figure 9). Although the view in Figure 5 extends beyond the direct focus of the study area, whether these neighborhoods have additional ingress and egress points besides Lockwood Ridge might dictate the types of changes that could be made for access management. The following list describes neighborhood access for these six areas:

- Neighborhood (1): 4 total access points. All on Lockwood Ridge.
- Neighborhood (2): 4 total access points. 1 on Lockwood Ridge, 1 on Honore, and 2 on 39th Street to the west.
- Neighborhood (3): 3 total access points. 2 on Lockwood Ridge and 1 on Honore.
- Neighborhood (4): 1 total access point on Lockwood Ridge.
- Neighborhood (5): 1 total access point on Lockwood Ridge.
- Neighborhood (6): 4 total access points. 3 on Lockwood Ridge and 1 on Honore.

It is immediately clear that the existence of only one ingress/egress point for neighborhoods (4) and (5) could pose an issue and is an access management weakness in this corridor. Likewise, the fact that neighborhood (1) only has the option to ingress/egress by way of Lockwood, albeit from 4 closely placed access points, is not ideal. The other 4 neighborhoods have linkages that allow them access to multiple access points and at least 2 if not 3 different roads.
Transit Locations within Study Area

There are no bus stops on Lockwood Ridge Road. The closest bus stops are part of MCAT’s Route 12 near the intersection of Lockwood Ridge Road and SR 70 (see Figure 11).

**Figure 11. Bus stop locations within study area.**

**Figure 12. Study area bike lanes and connection to the Manatee County network of bike infrastructure.**
Bike Lanes and Connection to Manatee County Bike Trail and Path Network

Figure 12 shows bike lanes in the study area and connection to the overall bicycle network. There are 6’ bike lanes on both the northbound and southbound sides of Lockwood Ridge Road. Likewise, both SR 70 and Honore Avenue have bike lanes on either side of the road. The bike lanes are marked with a white stripe to separate the bike lane from vehicular traffic and has the typical bike image and diamond in white painted within the bike lane.

B. Recommendations for Lockwood Ridge Road Corridor

Existing Condition: 40 MPH speed limit and 12’ lanes.
Recommendation: Reduce speed to 30 MPH and reduce lane width to 11’ per lane.
Discussion: According to the NACTO Street Design Guide, “Research has shown that narrower lane widths can effectively manage speeds without decreasing safety. Narrower streets help promote slower driving speeds which, in turn, reduce the severity of crashes. Narrower streets have other benefits as well, including reduced crossing distances, shorter signal cycles, and less stormwater” (NACTO, Urban Street Design Guide, 2013). Currently Lockwood Ridge Road have 4 lanes which are each 12’ wide. We recommend reducing each lane to 11’ for the reasons mentioned by NACTO and to create additional space for protected bike buffers for the bike lanes which will be discussed later in this paper. Additionally, we recommend that the speed limit, which is currently 40 MPH, be reduced to 30 MPH. Research has shown that the risk of pedestrian fatality which struck by a vehicle rapidly increased at speeds above 30 MPH. “The increase is between 3.5 and 5.5 times from 30 mph to 40 mph” (Richards, 2010).

Existing Condition: Personal driveways and closely spaced full median openings.
Recommendation: Combine and extend short medians, provide safe U-turn locations, and remove personal driveways where possible.
Discussion: There are eight personal driveways that have direct access to Lockwood Ridge Road which are all located in the residential area in the northwestern portion of the study area (see Figure 14). These driveways are as close as 25 feet and as far as 110 feet from each other. Each of these driveways increase the number of conflict points along the corridor which could needlessly cause crashes, injury, and property damage. Of the 30 crashes that occurred in the highlighted region in Figure 14 from 2009-2018, 8 were caused by left turns, 9 were rear ends, 6 were cars driving off the road, 2 were sideswipes,
1 was a right turn, and 4 were listed as ‘other’.\textsuperscript{5} We recommend removing 7 of the 8 driveway access points. Seven of the properties in question already have alternative driveways that lead to local roads within their neighborhoods.

The quick procession of closely spaced medians also creates excessive conflict points in the corridor. The red dots in Figure 14 represent accidents which involved left turns at unsignalized full open intersections. We recommend that the third, fourth, and fifth median openings to the south of SR 70 be combined to form one single median approximately 875 feet in length. Residents in the western neighborhood would have 4 options for right turns and 2 options for left turns. Residents in the eastern neighborhood could turn right and complete a U-turn at the next median opening to turn left. This would cause little to no delay, while greatly increasing safety.

\textsuperscript{5} Source: Crash data provided by the Manatee County Transportation Planning Office.

\textbf{Figure 14. Personal driveways, closely spaced median openings, and accidents in the northern portion of the study area.}
**Existing Condition:** No crossing options for pedestrians.

**Recommendation:** Add midblock crosswalks, signage, embedded lighting, and pedestrian refuges where possible.

**Discussion:** Crosswalks are only present at the southernmost intersection at Honore Avenue and the northernmost intersection at SR 70. According to Designing Walkable Urban Thoroughfares by the Institute of Transportation Engineers, midblock crossing should be considered “...when protected intersection crossings are spaced greater than 400 feet or so that crosswalks are located no greater than 200-300 feet apart in high pedestrian volume locations” (2010, p. 153). During our walk audit, our team did not witness the prescribed pedestrian volume to fit the above criteria (at least 25 pedestrians per hour for at least four hours of a typical day), however, there are currently 6,336 feet between available crosswalks. Although the pedestrian volume was low, the lack of crosswalks for more than a mile caused some pedestrians to run across the street at unsafe locations. We recommend adding white striped crosswalks, signage, and embedded lights for added pedestrian protect. The total distance from curb to curb is 72’ the majority of the corridor, therefore, we also recommend adding pedestrian refuges with the midblock crosswalks where feasible.

![Figure 15. Before and after recommendations for crosswalks, signage, lighting, and pedestrian refuge.](image)

**Existing Condition:** 6’ bike lane with no protected buffer.

**Recommendation:** Add a 2’ protected buffer to the bike lane on both sides of the road.

**Discussion:** While there are 6’ bike lanes lined and marked in white paint on both sides of the road, bike riders we encountered during the walk audit were riding on the sidewalk. This could be due to two factors; a lack of available road crossings encouraged bicycles to ride against traffic but on the sidewalk, or there is a wariness that fast traveling and inattentive drivers will drift into the bike lane. A protected buffer differs from a standard buffer in that there is not only lateral separation between the bike lane and the travel lane, but also there is some type of physical feature that further separates the protected bike lane and the travel lane. Such physical features include curbs, plastic bollards, or planters. In their Urban Bikeway Design Guide, NACTO (2014) states that a protected buffer “dedicates and protects space for bicyclists in order to improve perceived comfort and safety” and “eliminates risk and fear of collision with over-taking vehicles.” We recommend adding a 2’ protected buffer with plastic bollards to both sides of the road.
Existing Condition: Cracks in the sidewalk.
Recommendation: Repair damaged sidewalks and adopt a policy of cyclical sidewalk inspection and repair.
Discussion: Surface issues such as cracks, holes, and encroaching vegetation can cause a tripping hazard and an impediment for bicyclists and wheelchair users. Manatee County currently has a system for reporting infrastructure problems and specifically sidewalk problems. Relying solely on citizen action may leave some sidewalks unrepaired, especially in areas where people area not aware of this system or don’t feel a sense of ownership/stewardship for the right of way. We recommend repairing the current damages and adopting a policy of cyclical sidewalk inspections and repairs throughout the county.

Existing Condition: Incomplete or missing tactile pavers and curb cuts that do not lead to a safe crossing area.
Recommendation: Correctly placed tactile pavers and re-adjusted curb cuts that align with a safe pedestrian path.
Discussion: Manatee County has an aging population. As of the 2010 U.S. Census, 27.4% of the population in the Manatee County was 65 or older (compared to 14.9% of the U.S. population 65 and older). Further, as of 2010 Manatee Country had a median age of 45.7 which rose to 46.7 according to the U.S. Census population update in 2017 (compared to the national median age of 37.2 in 2010 and 38.2 in 2017). Additionally, a recent study found that the number of individuals with visual impairment
and blindness is increasing in the United States as a result of shifting demographics and aging populations. Further, the study claims that the state projected to have the highest per capita prevalence of visual impairments is Florida with 2.56% in 2015 and 3.98% in 2050 (Varma, Vajaranant, & Burkemper, 2016). In the Federal Highway Administration’s Handbook for Designing Roadways for the Aging Population (FHWA, 2014) they state, “There are important consequences of these changing demographics, and life for aging persons depends to an extraordinary degree on remaining independent. Independence requires mobility.” Tactile pavers and sidewalk alignment are important cues for visually impaired people to safely travel on sidewalks and maintain independence while doing so. People with visual impairments use the texture of the tactile pavers as well as the contrasting color of the pavers to receive warning about changes to their route or possible dangers. Faded, incomplete, or missing tactile pavers could put these vulnerable people at risk or discourage them from using the sidewalk system. We recommend repairing and replacing faded and deteriorating pavers, adding pavers where there are none, and realigning sidewalks that angle into the road towards a safe crossing area (see Figure 18).

Existing Condition: An absence of sidewalk amenities such as trash cans, resting spots, and bike racks.
Recommendation: Add sidewalk furniture and amenities throughout the corridor.
Discussion: Much like the discussion above, in order for the aging population of Manatee County to have mobility options and independence (as well as all other demographics that can benefit from improvements) there are sidewalk amenities that can be added to the corridor to better serve pedestrians as well as bicyclists. Rest areas along sidewalks and walkways are important for those who have difficulty walking long distances. Additionally, certain sidewalk amenities could further encourage people to walk and bike rather than take their vehicle. Trash cans, dog poop stations, bike racks, pedestrian level lighting, and shade are all amenities that are missing along the corridor and could be added to improve pedestrian comfort (see figure 19).

Figure 18. Before and after recommendations for tactile pavers and sidewalk alignment.
In sum, the Lockwood Ridge Road corridor is a straight road with large residential communities that are often gated, disconnected neighborhoods, wide lanes, and no crossing options for pedestrians. These are characteristics of a highly auto dependent area. The student team found it to be mostly devoid of both pedestrian and bicycle traffic despite the presence of continuous sidewalks and bike lanes. This is likely due to the low level of network connectivity, the structure of the road which allowed vehicular traffic at high travel speeds, and a general lack of destinations or points of interest and shade along much of the corridor. Key issues identified were private driveways with direct access to the corridor, unsignalized four-way intersections, no mid-block crossings, damaged and misaligned sidewalks, missing tactile pavers, and a lack of sidewalk furnishings. While each of the existing conditions could be addressed in multiple ways, the recommendations submitted in this report are meant to be as budget friendly as possible. A cost estimate in Appendix A is provided for each recommendations as well as a total cost for all recommendations combined.

Figure 19. Before and after recommendation for sidewalk amenities.
HIGH PRIORITY CORRIDOR #2: 26TH AVENUE EAST CORRIDOR

A. Study Area Overview

The 26th Avenue East Corridor is a one-mile segment of 26th Avenue East in Manatee County in the City of Bradenton, Florida. The corridor is located between US 41 and 15th St and runs east west (see Figure 20). The posted speed limit along the corridor is 35 MPH with one lane in each direction for automobiles. Sidewalks are present on both sides of the corridor from US 41 to 5th St E. However, from 5th Street E to 15th Street E sidewalks are only present on the north side of the corridor. The grassy buffer between the sidewalk and the road is 12 feet from US 41 to 5th Street E. From 5th Street E to 9th Street there is no buffer and from 9th Street to 15th Street E the buffer is reintroduced but is 9 feet wide. The lack of buffer and complete sidewalks suggests that the infrastructure is designed to supports car usage while neglecting full multimodal options for cyclists, transit users and pedestrians.

Figure 20. Location and orientation of the 26th Ave E study area.

Land use within the study area varies between residential, office, government, commercial and industrial. Between 9th Street E and 15th Street E land use is almost entirely industrial and includes set of railroad tracks which cross the corridor roughly north south. Some of the businesses and organizations in this area include Manatee County Public Works, CSX Transportation, a lumber yard (86 Lumber), a
concrete supplier (Preferred Materials), two packaging companies (Graham Packaging and West Rock), and Tropicana corporate office, company store, and distribution center. West of 9th Street E is primarily residential and includes single family, multifamily, duplexes, and mobile homes. Along US 41 in the commercial zone businesses are comprised of new and used car dealerships, a motorcycle store, a collision center/autobody shop, O’Reilly Auto Parts, and a dentist’s office (see Figure 21). Pedestrians and bicyclists who wish to travel through the corridor do not currently have infrastructure to support their movements.

**Existing Land Use/Zoning (simplified)**

- Industrial
- Commercial
- Residential

*Figure 21. Simplified land use/ Zoning map of study area. Source: original map made by combining similar zones from the public Manatee County interactive GIS land development map.*

**Travel Demand Information**

Existing annual average daily traffic (AADT) on the corridor is 3600, which would serve as LOS C along the minor collector. Given the truck AADT, which is 173 (4% of the total AADT), and existing/future industrial land use between 9th St E and 15th St E, trucks should be considered while designing the corridor elements for future prospects. Additionally, according to the long-range transportation plan (LRTP) from Sarasota-Manatee MPO, the Level of Service (LOS) along 26th Ave E is not expected to increase in near future. Historically, the highest observed AADT was 4000 in 2017 (see Figure 22).

*Figure 22. 26th Ave E AADT data from 2014 to 2018*
**Vehicle Crash Data**

From 2010 to 2017 there have been 45 vehicular crashes reported within the 26th Ave E corridor study area (see Figure 23). While most of these crashes occurred on major intersections (US 41, 9th St E and 15th St E), some crashes also occurred in the vicinity of minor four-way or T intersections where local streets intersect with 26th Ave E. The highest crash vulnerable intersection is 9th St E where there have been 22 crashes reported between 2010 to 2017. This intersection is signalized with marked crosswalks.

![Figure 23. Vehicular crash locations from 2010-2017 within the 26th Ave E study area.](image)

**Pedestrian and Bicyclist Environment within Study Area**

There are no bike lanes within the study area. On the north side of the corridor there is a sidewalk that runs the entire length of the study area, however, the northern sidewalk is damaged or missing in many places, does not exist in the vicinity of the train tracks, and is undermined by 36 residential and business driveways. Several properties have created driveways with access to the corridor by driving over lawns and buffers (Figure 24). People also use the sidewalks for parking further disrupting pedestrian and cyclist traffic. The lack of a curb on both the north and south side of much of the corridor enable this behavior. The south side of the corridor has a sidewalk from US 41 to 5th Street E, however, east of 5th Street E the sidewalk abruptly ends. There is a small sidewalk segment in front of the Manatee County Public Works building, but it does not connect to the sidewalk network. Due to the severely damaged and often missing sidewalks, bicyclists were observed cycling in the road with no bike lanes and no shoulder to rely on. There are three intersections with traffic lights and marked crosswalks: US 41, 9th Street E, and 15th Street E. Each of these intersections are

![Figure 24. Self-made driveways with direct access to the corridor vicinity of 3rd Street E.](image)
over 2000 feet apart from each other and there are no other viable options for crossing the corridor for bicyclists and pedestrians other than random crossing.

**Public Transit Facilities**

There are 6 public bus stops are located along the 26th Street East corridor. The bus stops are ADA accessible, are in good condition with standard designs and landing pads, and are spaced along the corridor for easy access. None of the stops had shelters to protect transit users from the weather, such as heat and rain.

![Map of bus stops](image)

*Figure 25. The locations of the six bus stops within the study area on the map with photos of the bus stops near 3rd Street E and 9th Street E intersections which typify the general condition and set up of all the bus stops.*

**Access Management and Network Connectivity**

26th Ave E intersects with US 41, which is currently classified as an Access Class 3 roadway per the FDOT access classification system. The standards set are based on the usage of the road and its connectivity to other arterial roads and collector roadways. There is no access classification from FDOT for 26th Ave E because FDOT does not classify locally maintained roadways, only state highways.

More than 53 access points were identified along both sides of the corridor, including 7 neighborhood (local) roads that connect into the main road excluding US 41 and 15th street. Under the 301 underpass there are 5 parcels with driveways 70-100 ft from each other. All these
parcels have 2 or more access points that measure anywhere between 24 to 54 ft wide. Within 10ft of one of these driveways is a bus stop making it a risk for transit users walking to or from the stop (see Figure 26). Residential properties along the corridor had a pattern of making their own driveway access to their home with the distance of each driveway being less than 25 ft. There are no paved driveways in front of a few homes. Residents drive over the sidewalks to park in front of their homes creating damage to sidewalks, blockage and unsafe conditions for pedestrians and cyclists.

Figure 26. Multiple driveways with access to the corridor in the vicinity of the 301 underpass.

B. Recommendations for 26th Avenue East Corridor

Existing Condition: Damaged, missing, and non-continuous sidewalks lead bicyclist no other option but to drive in the road, however, there are no bike lanes and no shoulder.

Recommendation: Add a multiuse path on the north and south sides of the corridor.

Discussion: In its present state, the 26th Avenue East corridor is not designed with pedestrian and cyclist comfort and safety in mind. The corridor has an AADT of 3600 and is a minor collector, in light of the low AADT and narrow right of way, the introduction of sharrows onto the road could alert drivers to the possible presence of bicyclists. However, the cargo trucks on the corridor could create a safety concern for bicyclist attempting to share the road. Therefore, we recommend installing multiuse paths on both the north and south side of the corridor in place of the damaged and at times missing sidewalks that is currently in present (see Figure 27). These wide paths can fit within the 58 ft right of way and would accommodate pedestrian and cyclists without reconfiguring existing drive lanes. Due to limited right of way from 5th St E to 15th St E, the multiuse path would only be possible on one side of the corridor (see Figure 28).
Existing Condition: A lack of crossing options for pedestrians and bicyclists.
Recommendation: Add crosswalk markings at the 5th Street E.
**Discussion:** The intersection of 26th Avenue E and 5th Street E is the end point for the southern sidewalk to the east. Pedestrians who are walking east along the sidewalk should have an option to cross the road at this point in order to use the northern sidewalk which continues eastward. Lighting, signage, and reflective elements are also recommended to ensure pedestrian safety.

*Figure 29. Recommended before and after the addition of painted crosswalks at 5th Street E intersection.*

**Existing Condition:** Excessive driveway access to the corridor.

**Recommendation:** Upon redevelopment, include back alleys/local streets in the development plan.

**Discussion:** Nearly every residential and commercial property along the corridor has at least one driveway with access to the corridor. Some even have two or three driveways and each driveway adds conflict points for vehicles, pedestrians, and bicyclists. A separate access road could alleviate these conflict points, and offer an alternative for walking and cycling in the neighborhood. However, with limited right of way space and private properties that back directly into private property, building an access road is prohibitive. It is therefore our recommendation that future redevelopment of this area should include strict access management principles which would eliminate personal driveway access to the corridor.

**Existing Condition:** High crash location at 9th Street E intersection.

**Recommendation:** Incorporate a mini roundabout at the 9th Street E intersection.

**Discussion:** As a short-range proposal, better pavement markings for crosswalks might reduce the chances of a pedestrian crash at this location. To ensure overall safety for all road users, a mini roundabout with a flat island would be the best option.
A. Study Area Overview

The study area for this analysis is a one mile segment of 53rd Ave W. as shown in Figure 30. It is located between 26th St W and 14th St W (US 41) and lies in urbanized west-central Manatee County, Florida. It serves as a highly travelled route to Downtown Bradenton and the beaches, and acts as a boundary between South Bradenton and Bayshore Gardens. The study area includes the roadway, adjacent land uses, and the surrounding roadway network. The corridor is a four-lane arterial with posted speed of 40 mph from 14th St W to 26th St W. Each lane is 12 feet wide with a double yellow line in the center, for a total of 48’ of travel lanes. The right-of-way is between 52’ to 58’ as the properties have varying setbacks throughout.

![Figure 27. Location and orientation of the 53rd Avenue W study area.](image)

The FDOT context classification for this corridor would be C3R - Suburban Residential. As seen in Figure 5, the land use is mostly single-family residential with scattered retail commercial, particularly at the intersection with 14th St W. In addition to nearby public schools, Manatee Technical College West Campus is located just off the corridor. Some of the last developable land in the County urban growth boundary is towards the beaches at the end of 53rd Ave W. Figure 31 shows the existing land use and Figure 32 shows the MU-C/RU zoned land at the west end of 53rd Ave W, which is anticipated to be a multi-use development with residential units.
Figure 28. Existing land use map courtesy of Manatee County.

Figure 29. Future land use showcasing the developable land at the end of 53rd Ave W.
**Study Area Demographics**

The area has a high number of low income persons, with 58% of Bayshore Gardens and 67% of South Bradenton households earning less than the basic cost of living for the County (ALICE: A Study of Financial Hardship in Florida, 2018). The overall poverty rate for the County is 13.4%, according to the 2017 American Community Survey. Figure 2 shows that the corridor serves a wide variety of ages from young children to the elderly. Two nearby schools are denoted with star symbols, indicating that school age children navigate the corridor at dawn and potentially at dusk. This data calls for improvements that can increase the quality of life of all ages from ADA improvements for older persons and better lighting conditions for local students.

*Figure 30. Age distribution by block group within the study area.*
**Pedestrian and Bicyclist Environment within Study Area**

Pedestrian crossings are provided at the major intersections of 14th St W and 26th St at either end of the corridor. Another east/west only crosswalk with faded paint is provided at 20th Ave. No north/south crosswalk exists to connect a transit stop to the single-family residential uses on the other side of the corridor. The segment lacks bicycle infrastructure on the roadway and only has a 4-foot sidewalk on the north side of the street. A few intermittent sidewalks exist on the south side. The current conditions of the roadway are not inviting for other uses as there is no shade, few safety features such as crosswalks and medians, and a sheer lack of consideration for transit users, bicyclists, and pedestrians. Figures 34 and 35 display the current conditions on 53rd Ave W where single family residential land uses are combined with vacant land.

**Transit Locations within Study Area**

This corridor is served by fixed-route bus service. Route 99 is joint operated by MCAT and Sarasota County Area Transit (SCAT). This service operates Monday through Saturday from 5:15am to 9:35pm with roughly 30-minute headways. Route 99 is the highest ridership fixed route, accounting for approximately 15% of the total system ridership for fiscal year 2017 (Manatee County Transit Development Plan, 2018). Trip generators include the State College of Florida, Sarasota-Bradenton Airport, Ringling College of Art and Design, and DeSoto Square Mall. There are a total of six transit stops within the corridor, four of which are on the north side of the corridor where the consistent sidewalk exists. Figure 36 displays the amenities provided at five out of six of the observed transit stops. Analysis of the transit riding population revealed that 77.8% of respondents walked to the bus stop, showcasing a need for consistent sidewalks to access the bus (Manatee County Transit Development Plan, 2018). All of the transit stops provided ADA compliant boarding and alighting areas, however only five of the six stops contained compliant seating. Additionally, none of the stops offered a shaded refuge for transit riders.

Contained within Phase 1 of Manatee County’s Transit Development Plan, it is anticipated that Route 99 will increase frequency, be designated as an urban corridor in 2021, and improve headways to 20 minutes.
**Corridor Safety**

Between 2014 and 2018, there have been 553 traffic crashes along the corridor, including 54 causing severe injury and three causing fatalities. The majority of these incidents occurred at the intersection of 53rd Ave W and 14th St W, as seen in Figure 37. Blue marks injury crashes, cyan marks non-injury crashes, and purple marks multiple crash types. Among the crashes, seven involved bicyclists and five involved pedestrians, the majority of which resulted in driver citations for failing to properly yield the right of way. Previously, data was collected from 2011 - 2015 for bicycle and pedestrian crashes along this corridor. It was found that there were no bicycle fatalities, one non-injury crash and three severe injury crashes. For pedestrian crashes, there were no fatal crashes, one no-injury and two serious injuries.

![Figure 34. Map detailing the locations of bike and pedestrian-related crashes.](image)

**Travel Demand Information**

The Average Annual Daily Traffic (AADT) for the corridor is 23,126. The AADT quickly falls west of this segment as it approaches farmland and Sarasota Bay and rises east of the intersection with 14th St W where it becomes SR-70. It is assumed that the rise in traffic is due to the commercial establishments as well as the high usage of US-41, US-301, and I-75. In contrast, 20th St W shows very low levels of traffic as it is strictly local traffic leading to the single-family residential land use. The approximate locations of the traffic count stations is in Figure 38 and the AADT counts are shown in Figure 39. Based on the traffic station located at 34th St, it was determined that roughly 4.5% of traffic is semi-trucks and tractor trailers. Since the station is approximately one mile away from 53rd Ave W, it is assumed that the corridor is not a trucking route.

![Figure 35. Locations of the traffic count stations.](image)
### Table 1
**Traffic Counts**

<table>
<thead>
<tr>
<th>Year</th>
<th>53rd Ave W. before US-41 20th St. 53rd Ave. before 26th St W. (ID 04-11) (ID 04-16) (ID 04-04)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>25,133 4,074 22,820</td>
</tr>
<tr>
<td>2015</td>
<td>26,490 4,264 27,022</td>
</tr>
<tr>
<td>2016</td>
<td>26,852 4,437 23,700</td>
</tr>
<tr>
<td>2017</td>
<td>28,286 4,802 23,845</td>
</tr>
</tbody>
</table>

*Source: Manatee County GIS Portal.*

**Existing Roadway Capacity Analysis**

A capacity analysis was conducted of the segment to examine congestion issues and determine if ample capacity is available if the number of lanes is reduced. The analysis was conducted following the guidelines of the 2010 Highway Capacity Manual (HCM).

Intersection capacity is a limiting factor so the analysis began by examining capacity at the 20th St W intersection. To identify flow rates through this corridor, one year of hourly continuous counts from a nearby permanent detector was used. After identifying the volumes, the next step was to identify how many vehicles were turning left, from 53rd Ave W eastbound to 20th St W northbound and the volume of vehicles that were turning right from 53rd Ave W westbound to 20th St W northbound. Lastly, the volume of vehicles that would turn from 20th St. to either 53rd Ave W west or east bound. Although hourly continuous counts were found for 53rd Ave W, only AADT was available for 20th St W. For this reason, an assumption was made about the directionality of this road. A 40/60 ratio was used against 20th St W’s AADT to identify the proportion of vehicles going southbound and northbound. This ratio was chosen do to the only available detector being located at the southernmost end of 20th street and it may capture more individuals entering the road to the south going northbound.

With the volume of vehicles going northbound and southbound on 20th street in a day determined, the volume during the peak hour needed to be identified. Furthermore, the volume of vehicles being distributed from 20th St W to 53rd Ave W westbound and eastbound and subsequently, the volume of vehicles from 53rd Ave W westbound and eastbound turning to 20th St northbound. To distribute these volumes, the ratio of the 85th percentile AADT on 53rd East and Westbound was used. Furthermore, to identify the volume for each approach, the ratio of the 85th percentile peak hour for both the eastbound and westbound directions was used against their respective AADT to reach the final percentage of the AADT from 20th St. that would produce flow rates from 20th St W to 53rd Ave W and 53rd Ave W to 20th St W. The results of this method are shown in Table 2.
### Table 2

**Flow Rates**

<table>
<thead>
<tr>
<th>85th Percentile Peak Flow Rate (Veh/hr)</th>
<th>Through</th>
<th>Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>53rd Ave. Eastbound</td>
<td>944</td>
<td>-</td>
<td>112</td>
</tr>
<tr>
<td>53rd Ave. Westbound</td>
<td>1073</td>
<td>124</td>
<td>-</td>
</tr>
<tr>
<td>20th St. Southbound</td>
<td>-</td>
<td>83</td>
<td>75</td>
</tr>
</tbody>
</table>

From the allotted traffic volumes, it was determined that a significant number of vehicles would turn right on 20th St W from 53rd Ave W westbound. A critical capacity restriction was identified, however, for this movement. Using the 2010 Highway Capacity Manual, the westbound through lane and through-right lane movement had a stipulation related to the basic intersection lane group capacity calculation, which is shown in Appendix B. The identification of a required alternate method of capacity calculation for the westbound through and through-right lanes and the process to calculate each lane capacity is documented sequentially in Appendix B and C.

After conducting the analysis, each lane group capacity, as a function of the ratio of green time to signal cycle time \((g/C)\) at this intersection, was identified. The values from this analysis are important to identify the feasibility of a lane reduction on this roadway facility. As can be seen in Table 3 the corresponding capacities for each lane group depends on the allocated green time. To ensure the volume to capacity ratio does not exceed 1.0, there must be sufficient green time allocated to each lane group. However, since it is identified that the right and left hand turn movements to and from 20th St. have minimal volumes, a small green time can be allotted.

### Table 3

**Lane Capacity**

<table>
<thead>
<tr>
<th>Capacity (((g/C) \text{ (veh/hr/ln)}))</th>
<th>Through-Right</th>
<th>Through</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westbound 53rd Ave.</td>
<td>1,536</td>
<td>1,611</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Eastbound 53rd Ave.</td>
<td>-</td>
<td>1,605</td>
<td>1,600</td>
<td>-</td>
</tr>
<tr>
<td>Southbound 20th St.</td>
<td>-</td>
<td>1,600</td>
<td>1,424</td>
<td></td>
</tr>
</tbody>
</table>

An example calculation for one of the lane groups is as follows:

\[
c = Ns(g/C) \quad \text{HCM Equation 18-15}
\]

Where \(N\) is the number of lanes and everything else is as previously mentioned.

If the eastbound through lane group and left turn lane groups anticipated volume needed to be satisfied, the green to cycle length needs to be estimated. Setting the capacity equal to the anticipated volume, the desired green to cycle length would need to be greater than 0.33 or in other words, if the cycle length was 120 seconds, there would need to be at least 40 seconds of green time for this lane group. By successively doing this process it can be found that there is more than enough capacity at this intersection in its current state to accommodate the anticipated flow rates. After reducing the number of lanes to one in this case, the required time for this movement would be 80 seconds, which is still acceptable for a 120 second cycle length.
Additionally, this movement which required roughly two-thirds of the cycle length can also accommodate the opposite, second highest needed capacity during the same time interval. Thus, this intersection, after reducing the number of lanes on 53rd Ave W will still have ample capacity for the required flow rates.

**Walkability Audit**

**Street Lighting:** The walkability assessment of 53rd Ave W revealed many concerns in regards to pedestrian safety along the corridor. Street lighting is poor throughout the segment. The only observed lighting existed at the intersections with US-41 and 20th St W. Only two of the bus stops located along this section of 53rd Ave W had access to lighting. Several segments have deep setbacks to the fronting buildings, or have no buildings at all, so there is no opportunity for residual front lighting. The safety concerns of poor lighting are exacerbated by the lack of adequate crosswalks or buffers between the sidewalk and roadway, as well as the speed at which vehicles are travelling. Speeding occurred frequently during the walk audit and the road design did little to help prevent unsafe behavior. A reduction in lane width would not only reduce opportunities for unsafe driving, but also free up much need right-of-way for other mobility uses.

In Section 6-4 of the 2016 Florida Green Book (FGB), there are minimum requirements for roadway lighting based on several criteria.

- Urban streets of any category experiencing high night time volumes or speeds or that have frequent signalization or turning movements.
- Areas frequently congested with vehicular and/or pedestrian traffic.
- Schools, places of assembly, transit stops, or other pedestrian or bicycle generators.

For this corridor, it was identified that there is ample pedestrian and bicycle traffic going to and from local schools, located just one mile away. Although students travel to and from school predominantly during daylight hours, during the winter months when the sun sets earlier, these streets will become extremely dark. In addition, there are six transit stops within this corridor, none of which are lighted.
Bicycle Facilities: A surprising observation from the walk audit was the number of bicyclists observed and the differing ways in which they navigated 53rd Ave W Ten bicyclists were noted within the hour and a half that we were present on the corridor. A majority of the bicyclists preferred to use the sidewalk instead of biking on the roadway as seen in Figure 39. Since the sidewalk is inconsistent on one side of the corridor, the bicyclists had no choice but to ride on the side with the sidewalk, greatly reducing the walkability for pedestrians. One bicyclist was observed moving against traffic and then cut across the lane to get to the side with the sidewalk. We observed additional unsafe behavior at the intersections in which bicyclists would cross the intersection against the traffic signal, increasing the chance of a serious accident. This unsafe behavior could be attributed to the lack of bicycle infrastructure along the corridor. For instance, no bike lanes are provided and there are few crosswalks. Bicycle lanes currently exist both further to the east and the west of the segment, so facilities are necessary here to improve bicycle network connectivity. Bicyclists do not have the option of a safe route if they traverse 53rd Ave W from US-41 to 26th St W.

Pedestrian Environment: From the intersection of US-41 and 53rd Ave W, the sidewalk was inconsistent, forcing pedestrians to traverse the high-speed roadway by other means. As shown in Figure 40, two individuals were observed during the assessment walking in the grass and on the roadway because there were no other facilities. Along the corridor, it was noted that the sidewalk had varying slopes, cracks throughout, and provided very little protection from the vehicles on the roadway, and sometimes ended abruptly as shown in Figure 41. Walking towards 26th St W from US-41, there was an obvious difference between the maintenance and
attention paid toward the infrastructure. The lack of consistent sidewalks and bicycle facilities deters residents from using these transportation options, making them reliant on personal vehicles. Improvements should be made to this segment to allow walking and cycling to be safer, more efficient, and more convenient.

Section 8-13 of the Florida Green Book includes standards for required railing on bicycle and pedestrian paths where drop-offs exceed 10 inches directly adjacent to the path. Figure 42 shows examples of drop off hazards that pedestrians and cyclists must contend with when traversing the corridor. A recommendation set forth in Appendix E is geared towards mediating drop off hazards in a way that allows a continuous circulation path for pedestrians and cyclists.

![Figure 42. Examples of drop off hazards on 53rd Ave W.](image)

Public Transportation Facilities: The assessment of the public transportation facilities along the corridor revealed that a portion of the bus stops are inaccessible and unappealing. A few improvements could be made to make the bus stops more inviting to promote greater ridership. All six of the bus stops were identified with MCAT branded signage adjacent to the roadway as well as benches or simme-seats and trash cans. The stops also included a 5-foot by 8-foot boarding and alighting areas. No shelters were provided. While the stops offered ADA compliant benches, one concern is the simme-seats, which may not offer adequate back support for those who have a disability. The stops were located within travel lanes. None of the stops offered refuge from the elements as no shelters were provided and no shade was available for waiting patrons. Additional amenities could be provided such as lighting, MCAT bus routes and schedules, and bicycle racks due to the amount of bicycle activity along the corridor. An additional concern is the placement of the bus stops along the corridor. One stop was located at an intersection, but was inaccessible from the side with the lack of sidewalk decreasing the effectiveness of public transportation facilities on the corridor as shown in Figure 43.
Access Management and Network Connectivity

Connectivity and Site Access Conditions: Based on the arterial functional classification, County public works design standards require residential driveways be a minimum distance of 60’ from intersections and a minimum of 75’ for all other uses. These standards are not sufficient based on contemporary access management guidance, which calls for corner clearance standards to preserve the safety of intersection functional areas that are consistent with access spacing standards (Transportation Research Board Access Management Manual, 2014). Florida Department of Transportation (FDOT) access spacing standards for arterial roadways by classification range from 125’ to 660’ or higher. The commercial establishment at the corner of 53rd Ave W. and 26th St W. has two driveways that are 50’ and 55’ away from the intersection as shown in Figure 44. This short distance between intersections and driveways increases the potential for crashes at the intersection. Additionally, cul-de-sacs were noted on the walk audit, further reducing access along the corridor as local trips are all funneled onto 53rd Ave W. Single access drives inhibit emergency access and increase traffic congestion at the site during peak

Figure 43. Transit user utilizing an MCAT provided bench.

Figure 36. Distance from 53rd Ave W and 26th St W intersection to commercial driveways.
hours because only one point of ingress and egress is provided (Williams & Barber, 2017). This method of development results in a lack of connectivity between the neighborhoods.

As seen in Figure 45, there are 51 driveways along this particular segment of 53rd Ave W. This includes access to single family homes, cul-de-sacs, businesses, churches, and vacant land. As noted on the context assessment worksheet, there are more than 6 driveways per 500’ resulting in many points of conflict. Both churches, as well as some houses, have multiple access points from the same direction. The intersection of 53rd Ave W and 20th St W is particularly important because it is the only southern access point for the residential neighborhood north of the roadway due to the drainage canal.

An analysis of access and connectivity, reveals a lack of access management standards at the County level resulting in poor access conditions. The County comprehensive plan notes that FDOT access management standards will be adopted and applied to County roadways, but no such standards were identified.

**Median Treatments:** A notable example of access management treatments on the corridor is a permanent median and bollards at the intersection of US-41 and 53rd Ave W., which prevents left turns into and out of the Wawa at this location (see Figure 46 and 47). This is imperative to controlling vehicular movements from US-41 onto the corridor and avoiding conflicts in the functional area of the intersection.

![Figure 45. Driveways along 53rd Ave W.](image)

![Figure 46. Permanent median at 14th St W and 53rd Ave W adjacent to Wawa.](image)

![Figure 47. Bollards placed to prevent left turns into and out of Wawa.](image)
B. Recommendations for 53rd Avenue West

A goal of the project is to increase the number of safe transportation options to promote mobility and reinvent 53rd Ave W into a multimodal transportation corridor allowing for safe, convenient use by pedestrians, cyclists, transit users, and drivers. These modes of transportation should be accommodated in a harmonious manner to allow for maximum mobility. Below are recommendations to advance this goal.

1. **Reduce travel speeds from 40 mph to 35 mph through changes in design and posted speed.** A speed reduction on 53rd Ave W would provide a variety of benefits including allowing pedestrians a greater sense of safety and security and reducing the severity of crashes.

2. **Expand bicycle and pedestrian facilities and lighting.** As noted above, the bicycle and pedestrian facilities are inadequate for the amount of activity noted on the walk audit. Both cyclists and pedestrians are forced to utilize a 4-foot strip of sidewalk along one side of the corridor. This is not adequate when the land uses surrounding the corridor are taken into consideration. The demand for greater bicycle and pedestrian facilities is there. A lack of lighting also creates hazards for non-auto users during non daylight hours.

3. **Improve the conditions of the MCAT stops by installing new lighting, shelters, and comfortable seating and bicycle/pedestrian facility connections.** This existing transit line (MCAT Route 99) is an area of opportunity because it runs through downtown Bradenton and Sarasota, the Sarasota-Bradenton International Airport, and the University of South Florida Sarasota-Manatee. In order to do so, it is crucial to improve the infrastructure at bus stops on 53rd Ave W. by adding shade for the hot Florida climate and continuous access to the bus stops, which either lack a sidewalk or adequate crosswalk connection on the corridor.

**Street Design Concepts**

Two potential new road designs are recommended - one being a “budget” option and the other a more “comprehensive” option. Each plan changes the overall road layout with the stated goal of improving safety for all road users. Both plans include upgrading the bus stops, adding lighting, ADA improvements, and improving the corridor atmosphere. Many factors were taken into consideration throughout the design process, such as feasibility, adverse impacts, and functionality of the new designs. Two examples from Tampa, FL, were used in the design process. A recent complete street project on Nebraska Ave offers bike lanes with bus lane expansions in which buses can pull out of the vehicular way, reducing congestion and driver irritability. Figure 49 shows a close-up view of the medians that were employed on Nebraska Ave to control traffic speed. There are also permanent medians throughout Nebraska Ave that control access by reducing vehicular movements and conflict points. Palm Ave is a prime example of a multimodal corridor in which pedestrians are given greater priority than vehicle traffic. A major takeaway from this corridor is the use of wide medians that provide pedestrian...
islands at mid-block crossings. The mid-block crossing pictured in Figure 49 was strategically placed to give pedestrians direct access to the local YMCA facility.

Figure 48. Aerial view of Nebraska Ave medians.

Figure 49. Midblock crossing on Palm Ave.
Budget/Short Term Concept
The budget concept focuses on low-cost changes that would improve road conditions without fundamentally changing the road. 53rd Ave W would remain a four-lane road, but the lane widths would be reduced; 10’ for the inside lanes, 11’ for the outside lanes that are used by buses. This extra right of way would be used to widen the sidewalk on the northside from 4’ to 10’ to create a multi-use path. No additional right of way would be required for this concept. These recommendations are shown in Figure 50.

![Figure 50. Budget/short term streetmix redesign.](image)

ADA Improvements
Several sidewalk ramps along the corridor were too steep and had missing tactile paving. Based on information from the 2010 FDOT Design Standards, Index #304, Public Sidewalk Curb Ramps, which incorporates ADA regulations, all of the sidewalks in this corridor will be referenced as linear sidewalks/sidewalk ramps (FDOT Design Standards 2010). The following are requirements used to comply with ADA requirements:

- Cross slope should be 2% with a clear 1-ft wide graded area with a maximum slope 1:6 slope needs to be provided adjacent to sidewalks to allow for adequate drainage as seen in Figure 51.
- Curb ramp should be in line with the crossing and must provide a maximum slope of 1:12.
- Transition slope should be 1:10, measured parallel with and adjacent to the curb line.
With this in mind, it was identified that several of the linear sidewalk ramps intersecting the cross streets are missing the tactile paving, exceed the maximum slope allowance (1:12) and do not meet the required width (at least 4’). There were cross slopes exceeding the maximum allowance of 1:48 as per ADA Guidelines and Standards X02.4.7 along the corridor, as shown in Figure 52. Appendix D provides examples to reconstruct these linear sidewalk ramps as recommendations.

**Detectable Warnings**

Detectable warnings are a distinctive surface pattern provided underfoot to alert people with vision impairments of their approach to streets crossings. As per FDOT standards, detectable warnings should be provided to cover the full width of the walking surface and 2’ deep. Figure 53 displays the lack of a detectable at a pedestrian crossing posing a severe hazard to a portion of the population.

Detectable warnings are an integral part of pedestrian mobility and are recommended to be installed in the following locations:

- Curb ramps and transition areas at street crossings
- Cut-through refuge islands
- In all the private and commercial driveways
- Boarding and alighting areas adjacent to the roadway at bus stops
Comprehensive/Long Term Concept
The comprehensive concept plan would restructure the roadway to create a true multimodal corridor. Four travel lanes would be reduced to two 11’ lanes with 7’ buffered bike lanes on either side, and a large median would provide room for intermittent turn lanes, inward bus bays, and pedestrian refuge islands at key points. The mid-block crossings will be equipped with rectangular rapid flashing beacons to alert drivers. The buffered bike lane width matches lanes that already exist east of US-41. Figures 54, 57, and 60 display cross sections of the proposed corridor redesign. The streetmix cross sections are accompanied by AutoCAD redesigns to allow the viewer a better understanding of what is being accomplished with each recommendation.

The most dramatic change to the corridor is road diet in which lanes will be removed to make way for the bus/bike lanes and wider sidewalks. Because of this, the intersection of 53rd Ave W and US-41 will be impacted. Figures 55 and 56 show how the intersection will reduce vehicular movements into and out of the commercial establishments while allowing cyclists to cruise along the side in their designated lane. The additional medians would also assist with reducing the speed of the vehicle entering the corridor off US-41, which has a higher speed limit.
Figure 54. Street mix depicting reduced lane width and sidewalk.

Figure 55. 53rd Ave W and US 41 Intersection before recommendations.

Figure 56. 53rd Ave W and US 41 after recommendations.
An emphasis has been placed on MCAT Route 99 throughout this analysis. Therefore, it is important to show the proposed changes that would assist drivers and public transit users. Figures 58 and 59 show the proposed inward bus bay design. The inward bus bay allows for vehicular traffic to pass while the bus is stopped to reduce congestion. It is possible to also see more efficient bus service as bus drivers spend less time attempting to merge back into flowing traffic. Buses have the right of way as they pull back into traffic. It would be imperative to use signage to inform drivers of the change to reduce conflicts.

One of the most noticeable issues with the corridor was the lack of a crosswalk at 20th St W. This is because a transit stop is located at the intersection denoted in the red circle in Figure 61. A priority of the County should be to provide greater access to the transit stop by constructing a crosswalk like the option 1 depicted in Figure 62. It can be assumed that with the adjacent land

Figure 57. Streetmix depicting new bus bays at bus stops and extended median.

Figure 58. MCAT Transit stop before recommendation.
use of single-family residential households and high ridership that this transit stop is heavily utilized necessitating a safe route for those transit users. Option 2, depicted in Figure 63, suggests a possible right-turn lane at 20th St W. if needed to accommodate turning traffic. In addition, the County should repaint existing crosswalks to ensure that drivers are able to see them.
Figure 61. 53rd Ave W and 20th St W intersection before recommendation.

Figure 62. 53rd Ave W and 20th St W proposed redesign (Option 1).

Figure 63. 53rd Ave W and 20th St W proposed redesign (Option 2).
**Speed Management**
To achieve a desirable pedestrian environment, it is imperative to lower the speed limit on the corridor. A reduction of 10 mph would be useful in addition to performing a road diet on the corridor. A reduction in lane width would reduce unsafe driving behavior, but also free up much need right-of-way for other mobility uses. The existing lane width on the roadway is 12’ and will be reduced to 10’ and 11’ for the short-term and long-term concepts presented herein. Additionally, a lane would be removed and converted into a turn lane when needed.

**Bicycle and Pedestrian Infrastructure**
The first improvement to the bicycle and pedestrian infrastructure would be adding a crosswalk at 20th St W. to allow users to cross the corridor to utilize the bus stop. This would be considered both a short-term and a long-term fix as a signal is already in use at the intersection. Currently, access to this bus stop is not only difficult but also dangerous to the transit user. To further connect the bus stop to existing facilities, constructing a sidewalk to this bus stop connected to the proposed crosswalk is ideal. To fulfill the efforts set forth in the street designs, landscaping will be implemented to improve pedestrian experience as well as street lighting and mid-block crossings. An example of a proposed midblock crossing is shown in Figures 64 and 65.

*Figure 64. In-depth view of the proposed mid-block crossing/pedestrian refuge.*
As we have proposed adding bike/bus lanes to the one-mile segment of 53rd Ave W, it would be beneficial for the County to consider this new segment in regards to the overall community connectivity. Adding a one-mile stretch for cyclists to utilize would reduce conflicts on the sidewalk in addition to allowing cyclists the opportunity to use other nearby bike lanes. By constructing bike lanes on the corridor, the County could eventually provide the community with a vast bicycle network as shown in Figure 66. The blue lines show where bike lanes currently exist and the red line shows the 53rd Ave W corridor between 26th St W and US-41. In the future, depending on the priorities of the County, this route could be used as a bicycle route to the beaches reducing traffic on the corridor.

In addition to improving ADA accessibility and pedestrian safety, expanding sidewalk facilities along the corridor will greatly improve the pedestrian experience. However, right of way will
have to be acquired in order to install or expand sidewalks. Figure 67 shows where property acquisition would have to take place and for which purpose. Blue shows right of way necessary to expand existing sidewalks to 6’; red shows right of way required to build new sidewalks.

Figure 67. Manatee County ROW acquisition needs. (Source: Manatee County)

**Reduce Conflict Points**

As stated in the comprehensive/long-term concept, a median is proposed with intermittent turn lanes throughout the one-mile stretch study area. This will ensure that homeowners are able to get to their homes while greatly reducing crash potential. Nearly all of the driveways are privately-owned reducing the options that the County could pursue when addressing access points along the corridor. A secondary benefit of adding a median is reducing the speed of travel of the vehicles by narrowing the travelled way, while also providing a refuge for pedestrians, which is one of the most important needs of the corridor to improve walkability. Implementing this recommendation is crucial to reducing the conflict points that all of the driveways have created on the corridor. The conflict points that currently exist are an ill-effect of the lack of access management policies. Therefore, it is imperative to improve County access management policies to avoid this problem in the future and address current issues during redevelopment.

**Improve Transit Stop Conditions**

An integral part of a multimodal corridor is public transportation via fixed route, bus rapid transit, or other mass transit options. 53rd Ave W. already has fixed route service supporting the single-family residences immediately surrounding the corridor. Route 99 can be improved by increasing access to the transit stops by building proper sidewalks and crosswalks to get to the stops. Specifically, improving the conditions of the transit stop will influence people’s decision to ride MCAT instead of using their own personal vehicle. It is suggested that shade be provided at the six transit stops and the simme-seat be replaced.

Figure 68. MCAT transit stop with ADA compliant shelter. (Photo courtesy of Manatee County)
by an ADA compliant bench. Figure 68 shows an MCAT stop with an ADA compliant structure where patrons can sit comfortably while waiting for the bus.

Additionally, the corridor would be well-served with the addition of a new bus route. Figure 69 shows a proposed east/west route that would take riders from Bradenton Beach to the Walmart Supercenter off US-301. It would also run adjacent to a middle school, high school, and youth center. The proposed route would provide greater access to jobs, retail, schools, and recreational activities to local residents. In time, this bus line would also serve new growth within a quickly developing agricultural corner of Manatee County.

Figure 69. Proposed new bus route between Bradenton Beach and Walmart Supercenter.

Educating the Public
The final recommendation is implementing an education program geared to the conditions of the corridor. Just as important as the infrastructure improvements, is educating the public on pedestrian and bicycle safety to increase awareness and decrease the potential for fatalities. Because of the land uses surrounding the corridor and the nearby schools, Manatee County could work with the schools to implement a program targeting the school-aged children that traverse the corridor to get to school. Students were observed walking alongside the roadway with no sidewalk increasing the chances of being struck especially in early morning and evening times. Figure 70 is an example of a brochure produced by Forward Pinellas in an effort to educate the community on pedestrian safety. Another aspect of the education piece is utilizing signage to ensure that bus drivers, cyclists, drivers, and pedestrians understand the rules of the roadway and the proposed bus bays. An outreach program could also be initiated to generally help increase public support for street design changes to increase safety and expand multimodal options for all residents and visitors.
Figure 70. Sample educational pamphlet created by Forward Pinellas.
CONCLUSION

The goal of this report was to assess the conditions of three high priority corridors and to recommend ways that Manatee County can improve the multimodal capabilities of the corridors, while also providing bicyclists and pedestrians, including transit users, a safe, efficient, and more livable environment. A related goal is to expand the choice of travel options for both residents and visitors. Providing such options also supports those who, due to age, income, or disability, are unable to drive.

Students were engaged in field assessment to understand the characteristics of each corridor and the potential challenges relative to design. During the course of these field assessments and subsequent research, the student teams determined that the infrastructure along these corridors was often deficient for pedestrians, bicyclists, and transit users, despite the presence of such users. It was found, for example, that bicycle and pedestrian demand exceeds infrastructure supply on two of the three corridors evaluated. Small curbs, damaged sidewalks, gaps in the sidewalk network, lack of bus shelters, lack of bike lanes, high speed traffic, a proliferation of driveways, inadequate accommodations for persons with disabilities, and poor or no lighting were among the many issues identified.

Anticipated benefits of the proposed changes include safer walking and biking routes for children, older adults and persons with disabilities, and reduced vehicle crash-related injury and mortality rates. Enhanced routes will inevitably strengthen the economic vitality of the area without significant delay to drivers, by benefitting property values and business sales potential of these areas. The corridors will also allow for safer active mobility, improving health and environmental sustainability.

Many factors were taken into consideration when creating the student concepts, with each student team asked to consider cost effectiveness while seeking the best possible options for consideration by the County. The recommendations provided are designed to improve safety for all modes of transportation and promote an environment where people can safely walk, cycle and use public transportation to meet their daily needs. They also benefit vehicular traffic through access management and other safety improvements. It is the student’s sincere hope that their analysis and concepts will benefit the County as it moves toward a system of complete streets and a more livable and walkable environment.
REFERENCES


## Appendix A – Cost Estimates for Lockwood Ridge Road Corridor Improvements

### Approximate Cost Estimate for Recommended Improvements

<table>
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<th>Items</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Cost</th>
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Source: Barnhill Contracting Company, Public Works Commission, resurface streets, LED Lighting Solutions, online buying website.
1. The calculation starts with equation 31-52 where Vapp is the upstream average flow rate. For convenience, this value was the annual average peak hour volume.

2. The probability of a lane change amongst the approach lanes Plc, Equation 31-51, was needed, which is a function of the maximum flow rate for which a lane change can occur, and uses the critical merge headway.

\[
P_{lc} = 1 - \left( \frac{2 \cdot \frac{V_{app}}{S_{lc}}}{1} - 1 \right)^2 \geq 0.0
\]

Equation 31-51

\[
V_{app} = \frac{V_{lt} + V_{gh} + V_{rt}}{N_{sl} + N_{t} + N_{sr}}
\]

Equation 31-52

3. The modified through car equivalent ER,M value is needed and is shown in equation 31-54. This calculation requires the through car equivalent (Er) and the pedestrian-bicycle adjustment factor for right run groups (fRpb). The pedestrian bicycle adjustment factor takes on the value of one and the through car equivalent value is the ratio of the average right turn volume and the corresponding through volume in that shared lane. With these values identified, the modified through car equivalent for this lane was found.
Equation 31-61 was then estimated. This required the proportion of right turning vehicles compared to through vehicles Pr and the saturation for the through lane portion of the shared lane. In other words, the saturated flow rate if the lane was not shared. In order to calculate this value however, an additional series of equations was required from the HCM Chapter 18 Appendix B.

The modified through-car equivalent for permitted right-turning vehicles is computed with Equation 31-54.

\[ E_{R,m} = \left( \frac{E_R}{f_{P,th}} - 1 \right) P_R + 1 \]

where \( E_{R,m} \) is the modified through-car equivalent for a protected right-turning vehicle, \( f_{P,th} \) is the pedestrian-bicycle adjustment factor for right-turn groups, and other variables are as previously defined.

A procedure for calculating \( f_{P,th} \) is provided later in this section.

where

\[ E_{L,m} = \text{modified through-car equivalent for a protected left-turning vehicle}, \]
\[ E_{L,lm} = \text{modified through-car equivalent for a permitted left-turning vehicle}, \]
\[ E_{L1} = \text{equivalent number of through cars for a permitted left-turning vehicle}, \]
\[ E_{L2,m} = \text{modified through-car equivalent for a permitted left-turning vehicle when opposed by a queue on a single-lane approach}, \]
\[ E_{L2} = \text{equivalent number of through cars for a permitted left-turning vehicle when opposed by a queue on a single-lane approach}, \]
\[ f_{L,th} = \text{pedestrian adjustment factor for left-turn groups}, \]
\[ P_R = \text{probability of a lane change among the approach through lanes}, \]
\[ v_{tpp} = \text{average demand flow rate per through lane (upstream of any turn bays on the approach) (veh/h/ln)}, \]
\[ s_{ch} = \text{maximum flow rate at which a lane change can occur} = 3,600/t_c \text{ (veh/h/ln)}, \text{ and} \]
\[ t_c = \text{critical merge headway} = 3.7 \text{ (s)}. \]

4. Equation 31-61 is used to compute the saturation flow rate in a shared right-turn and through lane group \( s_{ch} \).

\[ s_{ch} = \frac{s_{pr}}{1 + P_R (E_{R,m} - 1)} \]

where \( P_R \) is the proportion of right-turning vehicles in the shared lane (decimal).
Appendix C – Intersection Capacity Calculation Process Continued: HCM2010-CH18

5. Equation 18-5 calls for adjustments to a base saturation flow rate, which is based on an assumed value, for this analysis, Exhibit 18-28 in Appendix B identifies a saturation flow rate of 1750 vehicles per hour per lane.

\[ s = s_0 \sum f_w f_{1iV} f_s f_b f_s f_{LU} f_{LT} f_{RT} f_{Lb} f_{Rb} \]

where

- \( s \) = adjusted saturation flow rate (veh/h/ln),
- \( s_0 \) = base saturation flow rate (pc/h/ln),
- \( f_w \) = adjustment factor for lane width,
- \( f_{1iV} \) = adjustment factor for heavy vehicles in traffic stream,
- \( f_s \) = adjustment factor for approach grade,
- \( f_b \) = adjustment factor for existence of a parking lane and parking activity adjacent to lane group,
- \( f_{Lb} \) = adjustment factor for blocking effect of local buses that stop within intersection area,
- \( f_{Ll} \) = adjustment factor for area type,
- \( f_{LU} \) = adjustment factor for lane utilization,
- \( f_{LT} \) = adjustment factor for left-turn vehicle presence in a lane group,
- \( f_{RT} \) = adjustment factor for right-turn vehicle presence in a lane group,
- \( f_{Lb} \) = pedestrian adjustment factor for left-turn groups, and
- \( f_{Rb} \) = pedestrian–bicycle adjustment factor for right-turn groups.

### Exhibit 18-28

Default Values: Automobile Mode with Fully or Semiactuated Signal Control

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<td></td>
<td></td>
<td>When buses not expected to stop: 0</td>
</tr>
</tbody>
</table>

6. The adjustment factor for the linewidth was taken as 0.96 and is found in Exhibit 18-13, this is more conservative than the linewidth at 12', and for the future cross section the lanes will indeed be less than 12'.
7. The heavy vehicle adjustment factor, equation 18-6 was calculated by identifying the average heavy vehicle traffic on this roadway from a nearby permanent detector and was found to be 4.28%.

8. The approach grade was taken as zero due to the surrounding areas being flat hence this value was set to one.

9. There are no parking lanes therefore this variable is equal to one. The blocking effect for local buses, equation 18-9 is the anticipated flow rate reduction due to a bus making a stop during a green indication and is a function of the number of lanes in the lane group and the number of buses per hour, or headway. Through MCAT it was identified that route 99 has stops within this corridor at a headway of 30 minutes, therefore Nb took on the value of two.

**Adjustment for Lane Width**

The lane width adjustment factor, $f_w$, accounts for the negative impact of narrow lanes on saturation flow rate and allows for an increased flow rate on wide lanes. Values of this factor are listed in Exhibit 18-13.

<table>
<thead>
<tr>
<th>Average Lane Width (ft)</th>
<th>Adjustment Factor ($f_w$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10.0</td>
<td>0.96</td>
</tr>
<tr>
<td>≥10.0-12.9</td>
<td>1.00</td>
</tr>
<tr>
<td>&gt;12.9</td>
<td>1.04</td>
</tr>
</tbody>
</table>

Note: Factors apply to average lane widths of 8.0 ft or more.

**Equation 18-6**

$$f_{HV} = \frac{100}{100 + P_{HV}(E_r - 1)}$$

where

- $P_{HV}$ = percent heavy vehicles in the corresponding movement group (%), and
- $E_r$ = equivalent number of through cars for each heavy vehicle = 2.0.

**Adjustment for Heavy Vehicles**

The heavy-vehicle adjustment factor, $f_{ev}$, accounts for the additional space occupied by heavy vehicles and for the difference in their operating capabilities, compared with passenger cars. This factor does not address local buses that stop in the intersection area. Values of this factor are computed with Equation 18-6.

$$f_{ev} = \frac{100}{100 + P_{HV}(E_r - 1)}$$

where

- $P_{HV}$ = percent heavy vehicles in the corresponding movement group (%), and
- $E_r$ = equivalent number of through cars for each heavy vehicle = 2.0.

**Equation 18-9**

$$f_{bo} = \frac{N - 14.4N_b}{3,600N} \geq 0.050$$

where

- $N$ is the number of lanes in lane group (ln) and
- $N_b$ is the bus stopping rate on the subject approach (buses/h).

This factor should be used only when stopping buses block traffic flow in the subject lane group. A practical upper limit of 250 buses/h should be maintained with Equation 18-9. A minimum value of $f_{bo}$ from this equation is 0.050. The factor used here assumes an average blockage time of 14.4 s during a green indication.
11. The adjustment factor for area type was identified to be one since this area is not near or within a central business district.

12. The lane utilization factor in the case of the westbound lane groups at this intersection is set to one since there are two lane groups, a through and right-through.

13. The adjustment factor for right-turn vehicle presence in the lane group is set to one since it was identified earlier that this lane group has a shared though-right lane and requires the calculations from chapter 31 of the HCM. It should be noted that the currently calculation can be thought of as only calculated the through capacity of a single lane which will then be proportioned through equation 31-61.

14. The remaining variables are set to one since they are either not applicable or were previously applied during the chapter 31 calculations.
Appendix D: FDOT 2010 Design Standards Index #304 Public Sidewalk Curb Ramps

FDOT 2010 Design Standards Index #304 Public Sidewalk Curb Ramps (i).
Appendix E: Florida Green Book 2016 Section 8-13 (4)

Figure 8 – 5 Drop-Off Hazards for Pedestrians and Bicyclists

CASE 1

=A railing, fence, or other barrier to be placed within these limits in compliance with Section 8.8.

Drop-off greater than 10 inches

2 feet

Sidewalk or path

Slope

A drop-off greater than 10 inches (or a slope resulting in a drop-off greater than 10 inches) that is closer than 2 feet from the edge of path or sidewalk should be considered a hazard and shielded.
Appendix F: Complete Table of Infrastructure Costs

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Description</th>
<th>Median</th>
<th>Average</th>
<th>Minimum Low</th>
<th>Maximum High</th>
<th>Cost Unit</th>
<th>Number of Sources (Observations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle Parking</td>
<td>Bicycle Locker</td>
<td>$2,140</td>
<td>$2,090</td>
<td>$1,280</td>
<td>$2,680</td>
<td>Each</td>
<td>4 (5)</td>
</tr>
<tr>
<td>Bicycle Parking</td>
<td>Bicycle Rack</td>
<td>$540</td>
<td>$660</td>
<td>$64</td>
<td>$3,610</td>
<td>Each</td>
<td>19 (21)</td>
</tr>
<tr>
<td>Bikeway</td>
<td>Bicycle Lane</td>
<td>$89,470</td>
<td>$133,170</td>
<td>$5,360</td>
<td>$536,680</td>
<td>Mile</td>
<td>6 (6)</td>
</tr>
<tr>
<td>Bikeway</td>
<td>Concrete Bicycle Path</td>
<td>$182,870</td>
<td>$179,340</td>
<td>$91,420</td>
<td>$343,700</td>
<td>Mile</td>
<td>2 (6)</td>
</tr>
<tr>
<td>Bikeway</td>
<td>Signed Bicycle Route</td>
<td>$27,240</td>
<td>$25,070</td>
<td>$5,360</td>
<td>$64,330</td>
<td>Mile</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Bikeway</td>
<td>Signed Bicycle Route with Improvements</td>
<td>$241,230</td>
<td>$239,440</td>
<td>$42,890</td>
<td>$536,070</td>
<td>Mile</td>
<td>1 (6)</td>
</tr>
<tr>
<td>Bollard</td>
<td>Bollard</td>
<td>$650</td>
<td>$730</td>
<td>$62</td>
<td>$4,130</td>
<td>Each</td>
<td>28 (42)</td>
</tr>
<tr>
<td>Chicanes</td>
<td>Chicane</td>
<td>$8,050</td>
<td>$9,960</td>
<td>$2,140</td>
<td>$25,730</td>
<td>Each</td>
<td>8 (9)</td>
</tr>
<tr>
<td>Crosswalk</td>
<td>High Visibility Crosswalk</td>
<td>$3,070</td>
<td>$2,540</td>
<td>$600</td>
<td>$5,710</td>
<td>Each</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Crosswalk</td>
<td>Striped Crosswalk</td>
<td>$340</td>
<td>$770</td>
<td>$110</td>
<td>$2,090</td>
<td>Each</td>
<td>8 (8)</td>
</tr>
<tr>
<td>Crosswalk</td>
<td>Striped Crosswalk</td>
<td>$5.87</td>
<td>$8.51</td>
<td>$1.03</td>
<td>$26</td>
<td>Linear Foot</td>
<td>12 (48)</td>
</tr>
<tr>
<td>Crosswalk</td>
<td>Striped Crosswalk</td>
<td>$6.32</td>
<td>$7.38</td>
<td>$1.06</td>
<td>$31</td>
<td>Square Foot</td>
<td>5 (15)</td>
</tr>
<tr>
<td>Curb/Gutter</td>
<td>Curb</td>
<td>$18</td>
<td>$21</td>
<td>$1.05</td>
<td>$110</td>
<td>Linear Foot</td>
<td>16 (68)</td>
</tr>
<tr>
<td>Curb/Gutter</td>
<td>Curb and Gutter</td>
<td>$20</td>
<td>$21</td>
<td>$1.05</td>
<td>$120</td>
<td>Linear Foot</td>
<td>16 (108)</td>
</tr>
<tr>
<td>Curb/Gutter</td>
<td>Gutter</td>
<td>$23</td>
<td>$23</td>
<td>$10</td>
<td>$78</td>
<td>Linear Foot</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Curb Extension</td>
<td>Curb Extension/ Choker/ Bulb-Out</td>
<td>$10,150</td>
<td>$13,000</td>
<td>$1,070</td>
<td>$41,170</td>
<td>Each</td>
<td>19 (28)</td>
</tr>
<tr>
<td>Curb Ramp</td>
<td>Truncated Dome/Detectable Warning</td>
<td>$37</td>
<td>$42</td>
<td>$6.18</td>
<td>$260</td>
<td>Square Foot</td>
<td>9 (15)</td>
</tr>
<tr>
<td>Curb Ramp</td>
<td>Wheelchair Ramp</td>
<td>$740</td>
<td>$810</td>
<td>$89</td>
<td>$3,600</td>
<td>Each</td>
<td>16 (31)</td>
</tr>
<tr>
<td>Curb Ramp</td>
<td>Wheelchair Ramp</td>
<td>$12</td>
<td>$12</td>
<td>$3.37</td>
<td>$76</td>
<td>Square Foot</td>
<td>10 (43)</td>
</tr>
<tr>
<td>Diverter</td>
<td>Diverter</td>
<td>$22,790</td>
<td>$26,040</td>
<td>$10,000</td>
<td>$51,460</td>
<td>Each</td>
<td>5 (6)</td>
</tr>
<tr>
<td>Diverter</td>
<td>Partial/Semi Diverter</td>
<td>$15,000</td>
<td>$15,060</td>
<td>$5,000</td>
<td>$35,000</td>
<td>Each</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Fence/Gate</td>
<td>Fence</td>
<td>$120</td>
<td>$130</td>
<td>$17</td>
<td>$370</td>
<td>Linear Foot</td>
<td>7 (7)</td>
</tr>
<tr>
<td>Fence/Gate</td>
<td>Gate</td>
<td>$510</td>
<td>$910</td>
<td>$330</td>
<td>$1,710</td>
<td>Each</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Flashing Beacon</td>
<td>Flashing Beacon</td>
<td>$5,170</td>
<td>$10,010</td>
<td>$360</td>
<td>$59,100</td>
<td>Each</td>
<td>16 (25)</td>
</tr>
<tr>
<td>Flashing Beacon</td>
<td>RFFB</td>
<td>$14,160</td>
<td>$22,250</td>
<td>$4,520</td>
<td>$52,310</td>
<td>Each</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Gateway</td>
<td>Gateway Sign</td>
<td>$350</td>
<td>$340</td>
<td>$130</td>
<td>$520</td>
<td>Each</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Gateway</td>
<td>Structure</td>
<td>$15,350</td>
<td>$22,750</td>
<td>$5,000</td>
<td>$64,330</td>
<td>Each</td>
<td>5 (6)</td>
</tr>
<tr>
<td>Pedestrian Hybrid Beacon</td>
<td>Pedestrian Hybrid Beacon</td>
<td>$51,460</td>
<td>$57,680</td>
<td>$21,440</td>
<td>$128,660</td>
<td>Each</td>
<td>9 (9)</td>
</tr>
<tr>
<td>Island</td>
<td>Median Island</td>
<td>$10,460</td>
<td>$13,520</td>
<td>$2,140</td>
<td>$41,170</td>
<td>Each</td>
<td>17 (19)</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Description</td>
<td>Median</td>
<td>Average</td>
<td>Minimum Low</td>
<td>Maximum High</td>
<td>Cost Unit</td>
<td>Number of Sources (Observations)</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------</td>
<td>--------</td>
<td>---------</td>
<td>-------------</td>
<td>---------------</td>
<td>-------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Island</td>
<td>Median Island</td>
<td>$9.80</td>
<td>$10</td>
<td>$2.28</td>
<td>$26</td>
<td>Square Foot</td>
<td>6 (15)</td>
</tr>
<tr>
<td>Lighting</td>
<td>In-pavement Lighting</td>
<td>$18,250</td>
<td>$17,620</td>
<td>$6,480</td>
<td>$40,000</td>
<td>Total</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Lighting</td>
<td>Streetlight</td>
<td>$3,600</td>
<td>$4,880</td>
<td>$310</td>
<td>$13,900</td>
<td>Each</td>
<td>12 (17)</td>
</tr>
<tr>
<td>Median</td>
<td>Median</td>
<td>$6.00</td>
<td>$7.26</td>
<td>$1.86</td>
<td>$44</td>
<td>Square Foot</td>
<td>9 (30)</td>
</tr>
<tr>
<td>Overpass/Underpass</td>
<td>Wooden Bridge</td>
<td>$122,610</td>
<td>$124,670</td>
<td>$91,010</td>
<td>$165,710</td>
<td>Each</td>
<td>1 (8)</td>
</tr>
<tr>
<td>Overpass/Underpass</td>
<td>Pre-Fab Steel Bridge</td>
<td>$191,400</td>
<td>$206,290</td>
<td>$41,850</td>
<td>$653,840</td>
<td>Each</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Path</td>
<td>Boardwalk</td>
<td>$1,957,040</td>
<td>$2,219,470</td>
<td>$789,390</td>
<td>$4,288,520</td>
<td>Mile</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Path</td>
<td>Multi-Use Trail-Paved</td>
<td>$261,000</td>
<td>$481,140</td>
<td>$64,710</td>
<td>$4,288,520</td>
<td>Mile</td>
<td>11 (42)</td>
</tr>
<tr>
<td>Path</td>
<td>Multi-Use Trail-Unpaved</td>
<td>$83,870</td>
<td>$121,390</td>
<td>$29,520</td>
<td>$412,720</td>
<td>Mile</td>
<td>3 (7)</td>
</tr>
<tr>
<td>Pavement Marking</td>
<td>Advance Stop/Yield Line</td>
<td>$380</td>
<td>$320</td>
<td>$77</td>
<td>$570</td>
<td>Each</td>
<td>3 (5)</td>
</tr>
<tr>
<td>Pavement Marking</td>
<td>Advance Stop/Yield Line</td>
<td>$10</td>
<td>$10</td>
<td>$4.46</td>
<td>$100</td>
<td>Square Foot</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Pavement Marking</td>
<td>Island Marking</td>
<td>$1.49</td>
<td>$1.94</td>
<td>$0.41</td>
<td>$11</td>
<td>Square Foot</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Pavement Marking</td>
<td>Painted Curb/Sidewalk</td>
<td>$1.21</td>
<td>$3.40</td>
<td>$0.44</td>
<td>$12</td>
<td>Square Foot</td>
<td>4 (5)</td>
</tr>
<tr>
<td>Pavement Marking</td>
<td>Painted Curb/Sidewalk</td>
<td>$2.57</td>
<td>$3.06</td>
<td>$1.05</td>
<td>$10</td>
<td>Linear Foot</td>
<td>2 (5)</td>
</tr>
<tr>
<td>Pavement Marking Symbol</td>
<td>Pedestrian Crossing</td>
<td>$310</td>
<td>$360</td>
<td>$240</td>
<td>$1,240</td>
<td>Each</td>
<td>4 (6)</td>
</tr>
<tr>
<td>Pavement Marking Symbol</td>
<td>Shared Lane/Bicycle Marking</td>
<td>$160</td>
<td>$180</td>
<td>$22</td>
<td>$600</td>
<td>Each</td>
<td>15 (39)</td>
</tr>
<tr>
<td>Pavement Marking Symbol</td>
<td>School Crossing</td>
<td>$520</td>
<td>$470</td>
<td>$100</td>
<td>$1,150</td>
<td>Each</td>
<td>4 (18)</td>
</tr>
<tr>
<td>Signal</td>
<td>Audible Pedestrian Signal</td>
<td>$810</td>
<td>$800</td>
<td>$550</td>
<td>$990</td>
<td>Each</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Signal</td>
<td>Countdown Timer Module</td>
<td>$600</td>
<td>$740</td>
<td>$190</td>
<td>$1,930</td>
<td>Each</td>
<td>14 (18)</td>
</tr>
<tr>
<td>Signal</td>
<td>Pedestrian Signal</td>
<td>$980</td>
<td>$1,480</td>
<td>$130</td>
<td>$10,000</td>
<td>Each</td>
<td>22 (33)</td>
</tr>
<tr>
<td>Signal</td>
<td>Signal Face</td>
<td>$490</td>
<td>$430</td>
<td>$130</td>
<td>$800</td>
<td>Each</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Signal</td>
<td>Signal Head</td>
<td>$570</td>
<td>$550</td>
<td>$100</td>
<td>$1,450</td>
<td>Each</td>
<td>12 (26)</td>
</tr>
<tr>
<td>Signal</td>
<td>Signal Pedestal</td>
<td>$640</td>
<td>$800</td>
<td>$490</td>
<td>$1,160</td>
<td>Each</td>
<td>3 (5)</td>
</tr>
<tr>
<td>Pedestrian/Bike Detection</td>
<td>Furnish and Install Pedestrian Detector</td>
<td>$180</td>
<td>$390</td>
<td>$68</td>
<td>$1,330</td>
<td>Each</td>
<td>7 (14)</td>
</tr>
<tr>
<td>Pedestrian/Bike Detection</td>
<td>Push Button</td>
<td>$230</td>
<td>$350</td>
<td>$61</td>
<td>$2,510</td>
<td>Each</td>
<td>22 (34)</td>
</tr>
<tr>
<td>Railing</td>
<td>Pedestrian Rail</td>
<td>$95</td>
<td>$100</td>
<td>$7.20</td>
<td>$690</td>
<td>Linear Foot</td>
<td>29 (83)</td>
</tr>
<tr>
<td>Raised Crossing</td>
<td>Raised Crosswalk</td>
<td>$7,110</td>
<td>$8,170</td>
<td>$1,290</td>
<td>$30,880</td>
<td>Each</td>
<td>14 (14)</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Description</td>
<td>Median</td>
<td>Average</td>
<td>Minimum Low</td>
<td>Maximum High</td>
<td>Cost Unit</td>
<td>Number of Sources (Observations)</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------</td>
<td>---------</td>
<td>---------</td>
<td>-------------</td>
<td>--------------</td>
<td>-----------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Raised Crossing</td>
<td>Raised Intersection</td>
<td>$59,160</td>
<td>$50,540</td>
<td>$12,500</td>
<td>$114,150</td>
<td>Each</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Roundabout/Traffic Circle</td>
<td>Roundabout/Traffic Circle</td>
<td>$27,190</td>
<td>$85,370</td>
<td>$5,000</td>
<td>$523,080</td>
<td>Each</td>
<td>11 (14)</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>Asphalt Paved Shoulder</td>
<td>$5.81</td>
<td>$5.56</td>
<td>$2.96</td>
<td>$7.65</td>
<td>Square Foot</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>Asphalt Sidewalk</td>
<td>$16</td>
<td>$35</td>
<td>$6.02</td>
<td>$150</td>
<td>Linear Foot</td>
<td>7 (11)</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>Brick Sidewalk</td>
<td>$60</td>
<td>$60</td>
<td>$12</td>
<td>$160</td>
<td>Linear Foot</td>
<td>9 (9)</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>Concrete Paved Shoulder</td>
<td>$6.10</td>
<td>$6.64</td>
<td>$2.79</td>
<td>$58</td>
<td>Square Foot</td>
<td>1 (11)</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>Concrete Sidewalk</td>
<td>$27</td>
<td>$32</td>
<td>$2.09</td>
<td>$410</td>
<td>Linear Foot</td>
<td>46 (164)</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>Concrete Sidewalk - Patterned</td>
<td>$38</td>
<td>$36</td>
<td>$11</td>
<td>$170</td>
<td>Linear Foot</td>
<td>4 (5)</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>Concrete Sidewalk - Stamped</td>
<td>$45</td>
<td>$45</td>
<td>$4.66</td>
<td>$160</td>
<td>Linear Foot</td>
<td>12 (17)</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>Concrete Sidewalk + Curb</td>
<td>$170</td>
<td>$150</td>
<td>$23</td>
<td>$230</td>
<td>Linear Foot</td>
<td>4 (7)</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>Sidewalk</td>
<td>$34</td>
<td>$45</td>
<td>$14</td>
<td>$150</td>
<td>Linear Foot</td>
<td>17 (24)</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>Sidewalk Pavers</td>
<td>$70</td>
<td>$80</td>
<td>$54</td>
<td>$200</td>
<td>Linear Foot</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Sign</td>
<td>Stop/Yield Signs</td>
<td>$220</td>
<td>$300</td>
<td>$210</td>
<td>$560</td>
<td>Each</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Speed Trailer</td>
<td>Speed Trailer</td>
<td>$9,480</td>
<td>$9,510</td>
<td>$7,000</td>
<td>$12,410</td>
<td>Each</td>
<td>6 (6)</td>
</tr>
<tr>
<td>Speed Bump/Hump/Cushion/Table</td>
<td>Speed Hump</td>
<td>$2,130</td>
<td>$2,640</td>
<td>$690</td>
<td>$6,860</td>
<td>Each</td>
<td>14 (14)</td>
</tr>
<tr>
<td>Speed Bump/Hump/Cushion/Table</td>
<td>Speed Bump</td>
<td>$1,670</td>
<td>$1,550</td>
<td>$540</td>
<td>$2,300</td>
<td>Each</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Speed Bump/Hump/Cushion/Table</td>
<td>Speed Table</td>
<td>$2,090</td>
<td>$2,400</td>
<td>$2,000</td>
<td>$4,180</td>
<td>Each</td>
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</tr>
<tr>
<td>Street Furniture</td>
<td>Street Trees</td>
<td>$460</td>
<td>$430</td>
<td>$54</td>
<td>$940</td>
<td>Each</td>
<td>7 (7)</td>
</tr>
<tr>
<td>Street Furniture</td>
<td>Bench</td>
<td>$1,660</td>
<td>$1,550</td>
<td>$220</td>
<td>$5,750</td>
<td>Each</td>
<td>15 (17)</td>
</tr>
<tr>
<td>Street Furniture</td>
<td>Bus Shelter</td>
<td>$11,490</td>
<td>$11,560</td>
<td>$5,230</td>
<td>$41,850</td>
<td>Each</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Street Furniture</td>
<td>Trash/Recycling Receptacle</td>
<td>$1,330</td>
<td>$1,420</td>
<td>$310</td>
<td>$3,220</td>
<td>Each</td>
<td>12 (13)</td>
</tr>
</tbody>
</table>
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