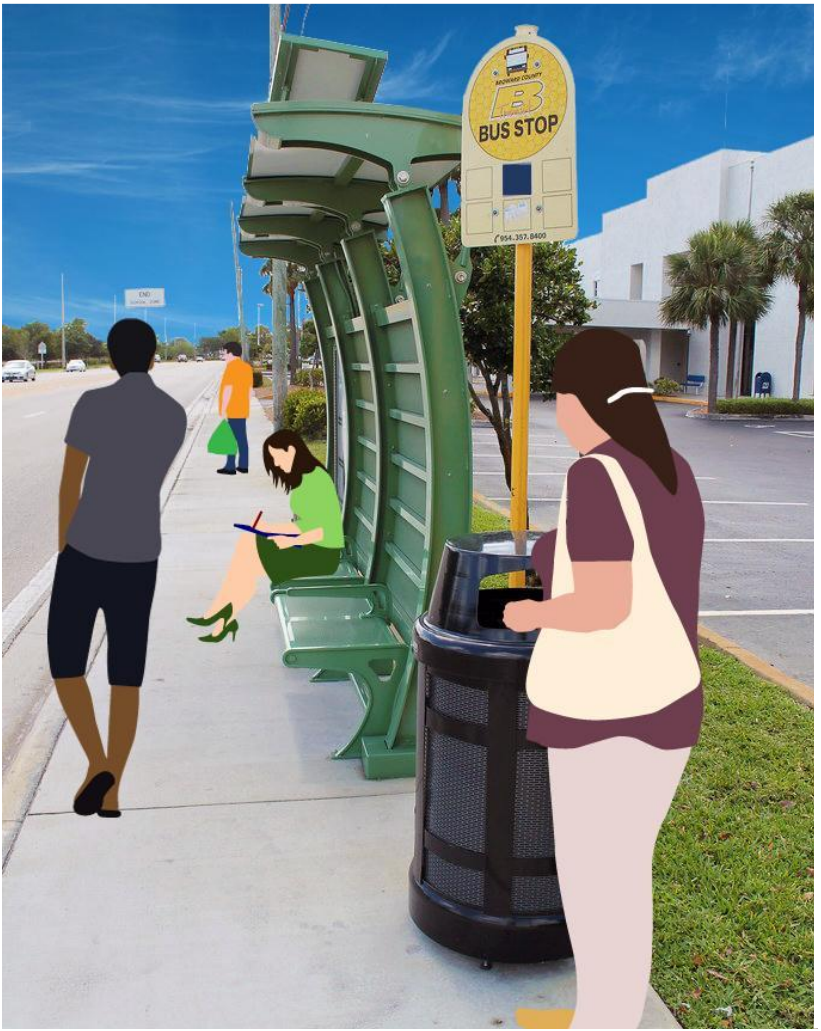
TRANSIT PLANNING & OPERATIONS

NON-MOTORIZED

TRAFFIC MONITORING



Public Transit Office /
Transportation Data and
Analytics Office

Transit Planning & Operations

Non-Motorized Traffic Monitoring

Report

FEBRUARY 2021

PREPARED FOR

PREPARED BY

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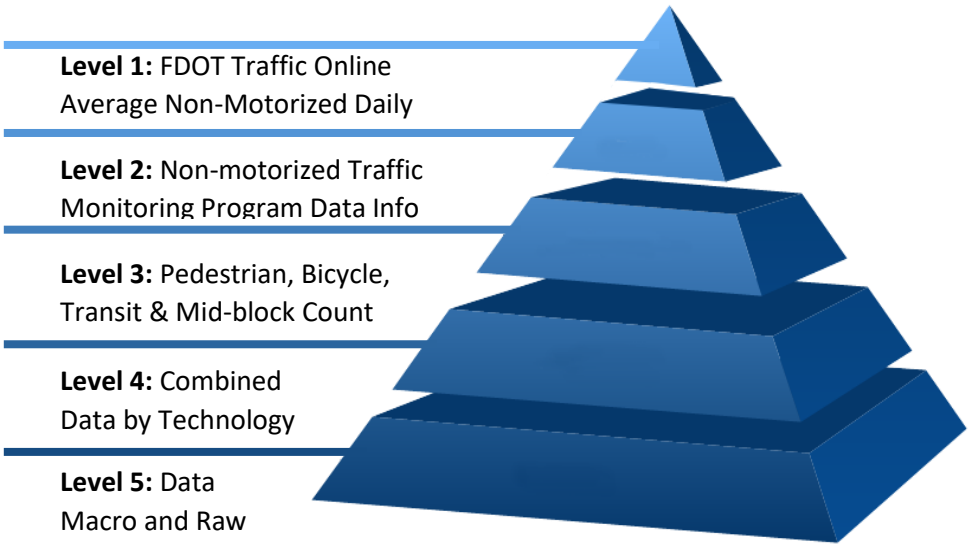
EXECUTIVE SUMMARY

The mission of the Florida Department of Transportation (FDOT) Public Transit Office (PTO) is to "identify, support, advance and manage cost effective, efficient and safe transportation systems and alternatives to maximize the passenger carrying capacity of surface transportation facilities".

In an effort to support the PTO's mission and objectives, FDOT initiated a research-based study to provide guidance for non-motorized data collection and to evaluate innovative tools in coordination with Florida's transit agencies. This Task Work Order includes identifying best practices in the utilization of emerging datasets and technologies to support effective transit planning, with a focus on non-motorized data usage, transit facility ridership and connectivity, while developing a framework for data collection management and operations.

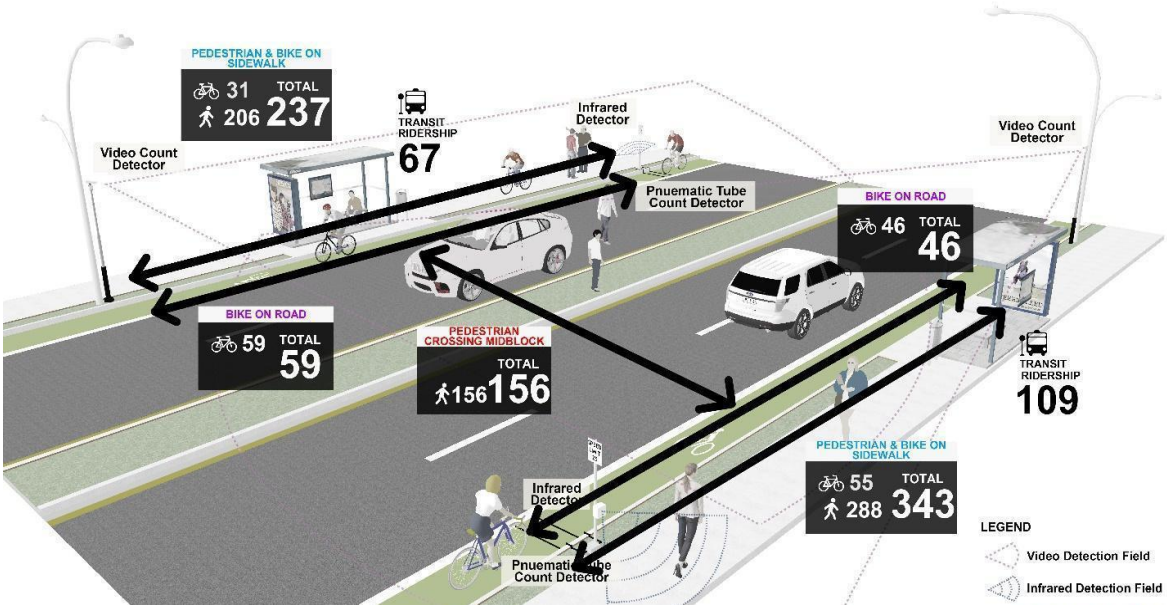
Sample Deployment and Technology

FDOT conducted this study to determine if the Statewide Non-motorized Traffic Monitoring program could incorporate transit planning and operational needs for volume data by collecting traffic volumes for the statewide program. The study results show that it is possible to collect statewide non-motorized traffic volume data simultaneously for statewide data collection purposes and for transit planning and operational needs. A large and key part of this research study was to provide FDOT and partnering agencies with processed datasets that were collected as a part of this project. These datasets can be complicated with a lot of data points and details. Therefore, the project team provided a method for understanding the large datasets provided in the Data Aggregation Pyramid with 5 different levels of data. The data user can then access data and turn it into information and use the data according to their specific need. One example is if a user only needs a total volume number for non-motorized travel in a location without any further details, the user would only need to look at level 1 data.

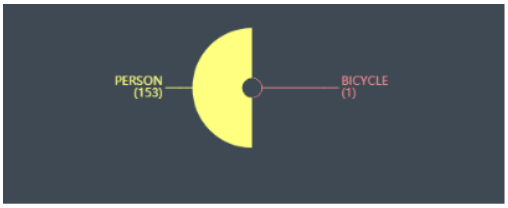


Data Disaggregation Pyramid

While extra coordination and communication is required to successfully collect statewide data for dual purposes, engaging data collection, data users, data collaborators and data contributors from state and local government agencies (specifically transit agencies) show very promising results. Engaging transit agency staff early-on in statewide data collection activities, such as virtual and on-site selection of where to collect data, yields a dataset that can be used for transit needs as well as for the statewide data collection program needs. This is well documented in the findings throughout this report and summarized in the Non-motorized Traffic Data Applications for Transit Purposes table in Section 6.



Level 3 Pedestrian, Bicycle, Transit and Mid-Block County Summary Graphic



Sunrise Blvd. Smart Camera Mid-block Crossing Data Results

In expanding the findings of this report, the opportunity for FDOT to continue developing the transit non-motorized datasets and implementing enhancements/results of this report even further by allocating resources, implementing business process strategies for collaboration and communication with local transit staff, and funding additional research/implementation strategies documented in this report. This report provides the conclusions of the study and an itemized summary of all follow-up actions.

Summarized below is a list of all of this research projects follow-up action items:

- Conduct Additional Statewide Data Collection Activities
- Continue Following Statewide Site Selection Standardized and Documented Methods
- Develop a Training Program and Provide Regular Data Collection Training to Data Partners
- Continue to Collect Short-term Count Data Using Multiple Technologies
- Create a Statewide NMTM Transit Data Collection Application
- Data Quality Assurance and Quality Control (QA/QC) processes should always be implemented in projects requiring the highest quality of data. In this project several equipment and counting technologies were used to ensure counts provided have a high level of accuracy.
- Policies for where to use certain equipment based on travel behaviors should be established for the statewide NMTM program. This includes potentially not using bike tube technology to count NMTM volumes on designated bike lanes.

- Since bike tubes are not an ideal option for counting volumes on sidewalks, other technologies such as video and infrared detection technologies need to be utilized for counting NMTM volumes.
- NMTM statewide data collection policies should include regularly checking the equipment when installed.
- 24-hour data collection is important using video technologies and should be added to NMTM statewide data collection procedures.
- Implementing site selection methods as used in this project are mission critical to any NMTM data collection project and should be used when collecting NMTM volume data at and around transit facilities.
- For all data collection device installations, communication with and education of local agencies is key to avoid any security concerns.
- Non-motorized Factor Application Study
- Equipment Data Accuracy Study
- Safety near transit stops is important and video detection tools need to be incorporated as a routine method of collecting data to capture potential safety and travel behavior issues.
- Many bicyclists were found riding on the sidewalk when the bike lane was adjacent and available. Additional study needs to be conducted to analyze the rider experience on the sidewalk and the reasoning behind the decision to ride on the sidewalk and the extent that vehicle speed is a factor. FDOT should develop a follow-up intercept survey study to gain more knowledge on travel behaviors.

This project leaves FDOT with many promising future endeavors that would, upon implementation, provide for a truly coordinated and integrated non-motorized data collection and data usage effort ultimately making the return on time and cost worthwhile.

1. INTRODUCTION

The mission of the Florida Department of Transportation (FDOT) Public Transit Office (PTO) is to "identify, support, advance and manage cost effective, efficient and safe transportation systems and alternatives to maximize the passenger carrying capacity of surface transportation facilities".

In an effort to support the PTO's mission and objectives, FDOT initiated a research-based study to provide guidance for non-motorized data collection and to evaluate innovative tools in coordination with Florida's transit agencies. This Task Work Order includes identifying best practices in the utilization of emerging datasets and technologies to support effective transit planning, with a focus on non-motorized data usage, transit facility ridership and connectivity, while developing a framework for data collection management and operations.

Utilizing the already existing and evolving Statewide Non-motorized Traffic Monitoring (NMTM) program managed by FDOT's Transportation Data and Analytics (TDA) Office, this project focuses on integrating and researching tangible transit data volumes and trends, in addition to supporting research and identifying non-motorized deployments at transit passenger access and transfer points. At the beginning of this project, statewide non-motorized data questions were unanswered. These research questions included:

- What is the non-motorized volume on any given statewide facility?
- What is the non-motorized volume in proximity to transit facilities?
- How important and how accessible is non-motorized volume data to transit riders, planners, and managers throughout the state?

Focusing on, and working with, FDOT's statewide NMTM program partners, this project attempts to address the above questions and provide communication and coordination of standard methods for collecting, analyzing and utilizing non-motorized traffic datasets specific to transit management and operations.

In April 2018, FDOT began developing a statewide non-motorized traffic volume data collection program through statewide agency partnerships where local agencies across Florida share their non-motorized datasets. This project focused on working with the Statewide Non-Motorized Traffic Data Committee to include transit specific needs by offering additional training and statewide communication and coordination efforts specific to using non-motorized traffic data as it relates to transit facility planning and design for the purpose of improving transit, safety and ridership.

2. LITERATURE REVIEW

The purpose of this literature review was to determine if there are best practices, both nationally and within the State of Florida, for collecting non-motorized traffic volume data which can be used in transit applications. The literature research review methods used included conducting internet searches and contacting nationally recognized data Subject Matter Experts (SMEs). Results of the literature review are documented below.

2.1 Literature Review Topic Organization

A categorized list of topics helps organize the types of literature found during the literature review and discovery process. Below are the 4 topic areas.

1. Topic Area #1 - Statewide non-motorized traffic Volume - this topic area includes statewide traffic monitoring and on-board transit counting publications.
2. Topic Area #2 - Bike Share Program Publications.
3. Topic Area #3 - Transit Modeling.
4. Topic Area #4 - General Transit Program Development and Operations.

In the next section, a table organized by literature review topic area can be found.

2.2 Literature Review Contacts and Internet Research Findings

A total of nine Transit Studies were reviewed. Additionally, eight national SME's were contacted, including members of the Transportation Research Board (TRB) Bike/Pedestrian Data Subcommittee Leadership Team. Below are the documented findings.

Literature Review Research Contact Findings

The SMEs contacted during the early stages of this task were not aware of any existing research or publications where bicycle and/or pedestrian traffic volume data is being utilized in transit applications. However, several contacts provided some documentation and links to studies that are related to transit applications, where there could possibly be a need for non-motorized traffic volume counts.

Literature Review Internet Research Findings

A total of nine Transit Studies were found to have some related transit and potential non-motorized volume data component(s) included in the study. These studies are listed below with the title of the document and what topic area applies to the study. A link to the study has also been provided.

Publications and Links to Transit Studies:

1. NCHRP 08-36 Evaluation of Walk and Bicycle Demand Modeling Practice – Topic #3: Modeling

   https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4277

2. Transportation Research Record – links to several papers on transit – Multiple Topics (Topic Area #1, #2, #3, #4)

   http://www.trb.org/main/blurbs/179007.aspx

3. Synthesis of Transit Practice - Topic #4: General

   https://www.mytrb.org/MyTRB/Store/Product.aspx?ID=9907

4. Portland State University Statewide Non-Motorized Traffic Volume Data Repository Project - Topic #1: Traffic Monitoring

   http://bikeped.trec.pdx.edu/

   https://trec.pdx.edu/events/professional-development/webinar-december-2017

5. Bike Share Docking Stations Website - Topic #2: Bike Share Programs

   https://bikesharp.com/#/7/-104.3391/38.9624/

6. TLC PeerX - Improving Bike and Walk Access to Transit - Topic #4: General

   https://www.mwcog.org/events/2018/05/10/tlc-peerx---improving-bike-and-walk-access-to-transit/

7. FTA Manual on Bicycle and Pedestrian Connections to Transit - Topic #4: General

   https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/64496/ftareportno0111.pdf

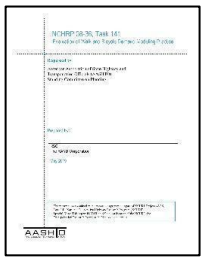
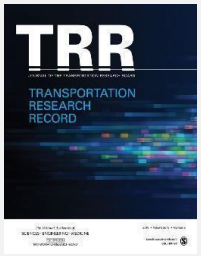
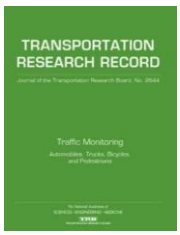
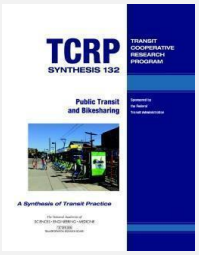
8. Bike to Ride: An Idea Book of Regional Strategies for improving bicycle access to Transit - Topic #4: General

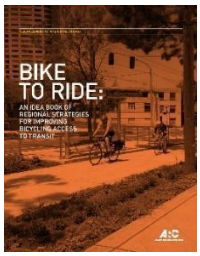
   https://cdn.atlantaregional.org/wp-content/uploads/arc-biketoride-webview.pdf

Summarizing these transit studies, the table below demonstrates how most transit publications would fall into the General topic area number 4, indicating most of the studies are not focused on traffic data collection for transit application. This leads us to the conclusion that this FDOT project is unique and leading the country in developing a methodology for collecting non-motorized traffic volume data for the statistically valid statewide program, in addition to the purposes of using this data for transit application.

This finding should be considered when selecting sites for data collection. Since there is very little known about collecting data for transit applications, following statewide motorized traffic data collection methodologies will provide a systematic way to complete this project. For example, creating a methodology and following standards for site selection that are documented and easily replicated across the State of Florida will provide a structured, organized, and focused final project deliverable which has already been done for the motorized and non-motorized data collection programs within the State of Florida.

Table 1: Literature Review Summary

LITERATURE REVIEW SUMMARY TABLE				
#	**Document Name**		**Topic Area**	**Study Relevance**
1	**Evaluation of Walk and Bicycle Demand Modeling Practice**		Topic 4: Modeling	The document states, "Pedestrian and bicyclist data collection is flourishing...and models that more accurately predict walking and bicycling activity levels also provide necessary physical activity inputs for health impact assessments and exposure estimates for traffic safety analysis and modeling." If FDOT can collect accurate non-motorized traffic volume data, this study confirms the data can be used in the evaluation of walking and bicycling demand modeling best practices.
2	**TRB Published Papers**		Multiple Topics	The following published papers reference a need for bicycle and pedestrian count volume data: Framing the Bicyclist: A Qualitative Study of Media Discourse about Fatal Bicycle Crashes, Factors Influencing Electronic Bike Share Ridership, Pedestrian Count Expansion Methods: Bridging the Gap Between Land Use Groups and Empirical Clusters, and others.
3	**Traffic Monitoring: Automobiles, Trucks, Bicycles, and Pedestrians**		Topic 5: General	This publication demonstrates the documented need and methods for obtaining bicycle and pedestrian volume counts.
4	**Synthesis of Transit Practice**		Topic 5: General	This study provides a synthesis of the current state of the public transit and bike sharing practice, including the gaps in information, such as bicycle and pedestrian traffic volume data. If FDOT collects accurate non-motorized traffic volume data, the gaps in understanding facility usage will be narrowed and potentially eliminated.
5	**Portland State University Statewide Non-Motorized Traffic Volume Data Repository Project**	TREC TRANSPORTATION RESEARCH and EDUCATION CENTER	Topic 1: Traffic Monitoring	This project has been implemented and demonstrates the need, community interest, and collaborative governmental agency efforts toward collecting, storing, and sharing bicycle and pedestrian volume data.

6	**Bike Share Docking Stations Website**		Topic 2: Bike Share Programs	The website does not provide accurate total volume statistics. It provides a subset of data for a facility. This project demonstrates that the total facility non-motorized volumes should always be larger than the subset of data. This site could potentially provide non-motorized traffic volume quality assurance data to FDOT.
7	**Improving Bike and Walk Access to Transit**		Topic 5: General	This peer exchange illustrates the need for non-motorized traffic volume data. During this peer exchange webinar, several examples of where non-motorized traffic volume data usage is important are covered. For example, using bicycle volumes data to show bike lane facility usage helps to provide volume data that might be used in justifying similar facility improvements by adding a bike lane to an existing facility.
8	**FTA Manual on Bicycle and Pedestrian Connections to Transit**		Topic 5: General	This manual provides a collection of best practices to help transportation professionals improve pedestrian and bicycle safety and access to transit, including information on evaluating, planning, and implementing improvements to pedestrian and bicycle access to transit. This study demonstrates that to improve safety a total facility non-motorized traffic volume dataset is necessary. If FDOT collects accurate non-motorized traffic volume data on and near transit facilities, these improvements can be measured.
9	**Bike to Ride: An Idea Book of Regional Strategies for Improving Bicycle Access to Transit**		Topic 5: General	There are relevant statements throughout this document as there are several references to understanding traffic volumes on different types of facilities. If FDOT collects non-motorized traffic volumes on several different types of facilities, transit operations could potentially use these volumes in their signal timing plans as well as other operational activities.

2.3 Literature Review Findings and Conclusions

After reviewing all literature found and communicating with nationally recognized transportation data SME's across the country, the most significant finding is that **there are currently no agencies in the country using transit bicycle and pedestrian traffic volume data in combination with traffic monitoring operations to serve both statewide agencies need for bicycle and pedestrian volume data**. Since FDOT is already working with multiple agencies to build a NMTM program, there is an opportunity to work towards gathering non-motorized traffic volume data to serve both the statewide data collection program needs and the need that transit has for non-motorized traffic volume data.

Although coordination efforts with multiple offices and external entities can be challenging, there is a strong chance upon completion of this project that the FDOT Transit and Transportation Data and Analytics (TDA) Offices will lead the nation by being the first agency to coordinate data collection activities across multiple DOT divisions for dual purposes. In the future, it is also likely this project will serve a national need to share best practices and lessons learned accompanied with multiple opportunities for publications and presentations needing exemplary national best practices.

Since this project is innovative and new to the practice, there is no literature to directly help guide this project. Several SME's contacted during the literature review have requested a follow-up upon completion. One SME said **"this project is a great example of data fusion and validation, something greatly needed in the travel survey world. For the past 20 years, we focused on needing a demographically representative sample, but from what I'm seeing all that did was make us lose out on 'behaviorally' representative data. It's time for a change and this is a great first step."**

Summarized Findings and Conclusions:

Table 2: Findings and Conclusions

FINDINGS and CONCLUSIONS TABLE	
#	**Findings/Conclusions**
1	There are no agencies in the country using transit bicycle/pedestrian traffic volume data in combination with traffic monitoring operations to serve statewide agencies needs for bicycle/pedestrian data.
2	Working with multiple agencies could both yield and address more bicycle/pedestrian volume data needs (the more we collaborate, the more opportunity to share data and potentially costs).
3	Florida DOT Transit/TDA groups are likely going to be a leader in this area after completing this project (opportunity for publications/presentations, etc.) -- TRB Presentation at Urban Data Committee pending.
4	Great example of data fusion and validation, "something greatly needed in the travel survey world. For the past 20 years, we focused on needing a demographically representative sample, but from what I'm seeing all that did was make us lose out on 'behaviorally' representative data. It's time for a change and this is a great first step."

3. AGENCY COORDINATION & SITE SELECTION

For the project's site selection methodology, the December 2018 *FDOT Statewide Non-Motorized Traffic Monitoring Program: Recommendations Report* and *FDOT Traffic Monitoring Handbook* were the primary sources that guided the process.

There are four steps in FDOT's site selection methodology that are described below to follow a statewide standardized process when determining where to collect non-motorized volumes. All four steps are summarized below with details to describe how each step was implemented for this transit-specific data collection project.

3.1 Site Selection Method Steps Summarized

Nationally accepted and documented methods for selecting sites in which to collect non-motorized traffic data include:

1. Conduct agency outreach – contact agency and any relevant stakeholders to identify high-priority locations for counts
2. Create and document site selection criteria – determine key factors that include roadway characteristics, land use characteristics, anticipated traffic volumes, observed traveler behaviors, etc.
3. Assess site recommendations through virtual and physical site visits – determine if available count equipment is feasible to install at proposed locations
4. Create preliminary installation schedules and start coordinating installation resources.

Specific detailed tasks this project has completed:

- Developed a transit agency screening tool to prioritize transit agencies to contact throughout the state.
- Reached out to potential transit agency partners to propose transit facility traffic data collection and data usage partnership opportunities.
- Developed potential bus stop locations list for potential data collection through previously identified count locations, GIS analysis, and traffic data partner/agency collaboration.
- Conducted virtual site visits covering a large spread of proposed sites.
- Conducted on-site visits with a filtered list of proposed sites, based on virtual site visits.
- Prioritized and organized sites within the Project Tracking Worksheet.
- Finalized site selection for installation of short-term count equipment in collaboration with transit agency partners.
- Developed deployment schedules and allocated equipment resources needed.
- Installed equipment at sites.
- Monitored equipment for 6 two-week installments throughout the state.

Below are the detailed steps defined and methods followed for the transit non-motorized data program.

3.2 Site Selection Step Details

1 STEP 1 - Agency Outreach

Several agency outreach activities were completed throughout the duration of this project. These outreach activities helped the project team to integrate statewide traffic volume data collection efforts with transit specific data collection needs. This innovative approach to coordinating data collection efforts across two different Florida DOT divisions optimizes data collection investments by allowing for data to be collected once and used many times for many purposes. These outreach activities are detailed below.

The first outreach activity conducted by the team included a review of the previous non-motorized program site visit evaluations that noted transit stops nearby, and prioritized the transit agencies that had these locations in their service area.

The second outreach activity the team conducted included filtering, eliminating, and adding additional potential agencies. For example, in addition to transit agencies supporting buses, the team added agencies that also support a train or trolley systems. Adding train/trolley system agencies helped to diversify the data collection efforts and further evaluate the capability of the data collection equipment in different transit environments. The team also filtered through agencies prioritizing any agencies that already offered data collection activities support or assistance. The team also spatially filtered agencies to geographically distribute data collection efforts in effort to balance the data collected within various regions of the State. See the Appendix for the Transit agency comparative table.

The third activity the team focused on was creating an informational transit project data collection brochure. The brochure's objective was to provide interested stakeholders with a quick understanding of the project's objectives and hopefully attract agencies to participate in the study. This brochure was provided to the five transit agencies where data collection efforts would be focused, see the Appendix for the brochure.

The fourth outreach activity the team focused on was producing a slide show presentation to lead kick-off meeting discussions with each transit agency. The slideshows summarized primary objectives of the study, site selection methodology, and available equipment.

The fifth outreach activity the team focused on was conducting the outreach meetings with each individual agency. During these outreach meetings, the project team's approach was to educate transit agency partners about the project's end-goals, and request potential count locations from the agency based on specific agency needs. The project team solicited input from the agencies that provided suggested locations and critical agency input to help determine and guide the data collection efforts.

2 STEP 2 - Create and Document Site Selection Criteria

Step 2 includes the development of site selection criteria which requires updating and evaluating potential non-motorized count sites. This step provides a way to standardize the method of non-motorized traffic volume site selection within the state of Florida. The established FDOT non-motorized site selection criteria are listed below. The selection criteria were developed as a combination of standard motorized traffic data collection methodologies with additional selection criteria included to encompass the transit and non-motorized components of this project.

Site Selection Criteria:

The site selection criteria below provides a list of critical data items used in the method to evaluate and prioritize non-motorized counting sites.

1 

LOCATION
Sites that are on or connect to FDOT managed facilities should be given priority. Transit count locations were determined in coordination with FDOT and local transit agencies.

2 

DURATION
Sites selected and recommended should be evaluated for collecting automated counting technology used to collect data on a continuous (365 days) and short-term (minimum 24 hours of hourly consecutive hourly count data, with a preferred 14-day count) basis.

3 

FACTOR GROUP DESIGNATION
Sites selected and recommended for data collection should include an evenly distributed representation of the State of Florida's factor groups.

The State of Florida Factor Groups (as of January 2021):

1. Urban Commute
2. Urban Recreational
3. Rural Mixed
4. Mixed Commute
5. Mixed Mixed
6. University Recreational
7. Urban Mixed
8. Rural Commute
9. Rural Recreational
10. Mixed Recreational
11. University Commute
12. University Mixed

4 

FACILITY IMPROVEMENTS
Sites selected and recommended for data collection should receive higher priority when sites fall within an area where a known facility improvement (such as adding stripes, bike lanes, shared paths) will occur. For this project, sites were prioritized based on input from Transit agency staff with agency staff providing valuable input and insight to future facility improvements information.

5 

MULTIPLE AGENCY SUPPORT
Sites selected and recommended for data collection received higher priority when sites fall within an area where multiple agency resources were available, ready, and willing to help in installing, maintaining, evaluating, and applying data collected from a site.

To allow for incorporation of the transit component to this project, additional site selection criteria were applied:

Varying by transit agency, the team staff reviewed the data and created a table with additional site selection criteria specific to transit that included:

6 

BUS RIDERSHIP BY BUS STOP
Sites were evaluated using ridership data to help in determining expected traffic volumes that would be collected. The project team attempted to collect low, medium and high-volume locations to diversify the volume group distribution of data collected.

7 

ANNUAL AVERAGE DAILY TRAFFIC (AADT)
If available and applicable, motorized traffic AADT's were used to help in determining expected traffic volumes that would be collected. The project team attempted to collect low, medium and high-volume locations to diversify the volume group distribution of data collected.

8 

LANDUSE
Sites were evaluated virtually and on-site to determine the proximity to parks, high schools, colleges, greenways, trails, and shared-use paths. Often these are traffic volume generators that can produce higher NMTM traffic volumes.

9 

FACILITIES & INFRASTRUCTURE
Sites were evaluated for the type of facility, such as a bike lane, and if the facility had any infrastructure amenities, such as bus stop amenities.

10 

SUPPORTING SITE DATA
Sites were also evaluated using supporting site data such as the available third-party data source providers such as Strava data and StreetLight Data.

11 

PLANNING AND SAFETY NEEDS
Sites were evaluated with transit agency staff for individual transit agency planning needs such as safety, route expansion, route consolidation, incoming bicycle/pedestrian infrastructure, etc.

3 STEP 3 - Assess Site Recommendations

Once the site selection criteria were confirmed, the next step was to assess, evaluate, and prioritize potential sites for collecting data based on equipment feasibility. Recommended sites were organized and prioritized according to the site selection criteria. The process was managed electronically within a spreadsheet with recommendations sorted by the site selection criteria. Further evaluation of each site was conducted using a virtual site audit process and on-site evaluation of the site as described below.

Conducting virtual site audits allows a preliminary site visit to occur prior to visiting the site in person. Using technology tools such as ArcGIS, Google Earth, Google StreetView, and accessing images of the site allows for the efficient and effective evaluation of a proposed location prior to conducting an on-site visit.

The project team virtually visited and prioritized sites by investigating the feasibility and difficulty of deploying three types of non-motorized data counting technologies; pneumatic bike tube counters, infrared devices, and video cameras. Staff took a virtual tour of each site to review roadway characteristics, land use characteristics, observed non-motorized traffic activity, equipment feasibility, and then selected the locations for on-site visits.

The following recommendations were considered when conducting the virtual site visit:

1. Avoid proximity to power lines if possible.
2. Avoid proximity to water bodies if possible.
3. Avoid installation of counters that point towards motorized traffic, windows, or direct sunlight (Infrared devices).
4. Avoid areas where people stop and stand around an area 9very important when selecting a transit stop).
5. Avoid installations on curves.
6. Avoid installations on hills.
7. Select locations with pinch-points that allow a counter to capture all travelers on the facility such as a bridge or a trailhead archway.
8. Avoid counting at intersections, preferred counting locations are mid-block so that an entire roadway segment can be assigned a traffic volume statistic. Turning Movement Counts are not used for volume studies.
9. Look for locations along the facility where a pole, tree, or other structure might be able to serve as part of the counter installation (example, light pole where a bike tube, infrared device, and video camera can be installed).
10. Document the types of pedestrians and bicyclists traveling on the facility (example, do travelers have backpacks, panniers (bags attached to the sides of a bicycle), or business attire which would typically indicate commuter travel versus athletic attire, which would indicate recreational travel).

In preparation for conducting on-site visits, the team utilized the automated on-site Evaluation Form where information could be electronically captured and/or printed and manually completed on-site. Copies of the on-site evaluation forms can be found in the Appendix. Finally, printing out maps, photographs, and Google Earth images assists in conducting a thorough and efficient on-site evaluation. Notes and comments shared by the local partnering agency were also electronically or manually captured and available on-site.

The below process included following the on-site preparation list to conduct the on-site evaluations.

1. Developed schedules with estimated time to drive to sites, and conduct the on-site evaluations.
2. Scheduled site recommendation contacts (transit agency partners) to meet on-site (this includes meeting other potential local representatives that recommended the site(s)).
3. Printed maps/photos/google earth images and any relevant notes provided from the stakeholders.

4. Paper and pencil to take notes about the site conditions while on-site.
5. Evaluation Forms as well as prioritization spreadsheet, google maps, etc.
6. A camera (or picture capable phone) for site evaluation photos.

Many observations were made while on-site, these observations were noted by documenting site conditions during the site visit. Observations documented include:

1. Reviewed facilities to count on-site and make note of available sidewalks, roadways, trails, etc.
2. Observed bicycle, pedestrian, and motorized traffic behaviors (on separated paths, on roadway, direction of travel, travel attire, mid-block crossings, etc.).
3. Observation of transit rider activity and movements at identified locations.
4. Observation of the facility surface type and note whether it is asphalt, concrete, brick, gravel, etc. which could affect equipment usage
5. Observation of pinch-points where all travelers will pass within a 12' to 15' detection zone.
6. Observation of overhead and underground utilities Observation adjacent land uses and of nearby high traffic volume generators such as supermarkets, hospitals, shopping malls, schools, beaches, entertainment venues, etc.
7. Document the ideal type of technology suitable for the site (bike tube, infrared, video, etc.).

4 STEP 4 - Preliminary Site Installation Schedules Were Created and Site Installation Resources Were Coordinated

For each location (25 sites total) a Deployment Table was created with the twenty-five transit count site locations, equipment resources allocated, and date(s) for equipment deployment, including, date for scheduled video recording, dates for field visits/equipment checks, and date(s) for device pickup. A sample deployment table can be found in the Appendix.

3.3 Transit Agency Coordination and Site Selection

Broward County Transit (BCT)

Broward County Transit (BCT) was selected as the first agency to participate in the data collection project.

Prior to meeting with BCT, the Team first reviewed the existing NMTM program data collected, and developed an initial list of potential sites to consider for the agency kick-off meeting. The team then created a table with information on bus ridership by stop, motorized AADTs, proximity to parks, high schools, colleges, greenways, trails, bike lanes, and shared-use paths, bus stop amenities and available Strava data. A total of 28 potential count sites were selected through a sorting, filtering, and prioritization of the criteria.

The top five combinations in each of the following selections were prioritized to move forward for review:

- Roadways with bike lanes with high transit ridership
- Greenways and trails within 500' feet with high transit ridership
- High Strava bike ridership data
- Transit stop that met the most criteria
- High AADT with bike lanes with high ridership
- High schools and colleges within ¼ mile with high transit ridership

- High transit ridership and low AADT.

The team conducted two internal virtual site reviews. Through the virtual site review the team was able to remotely visit the 28 potential sites and rank (prioritize) them based on the specifics of each site, including equipment feasibility. Sites were prioritized and presented to BCT at the kick-off meeting held on October 11, 2019. The slideshow presented at the meeting can be found in the Appendix. At the meeting, BCT staff requested the opportunity to provide additional sites. BCT provided the team eight additional count sites for consideration. The sites proposed by BCT included transit stops with new routes, transit stops adjacent to multi-use trails, high ridership locations, stops with high ridership and a narrow sidewalk, and locations with future Complete Streets projects to measure activity before and after the project.

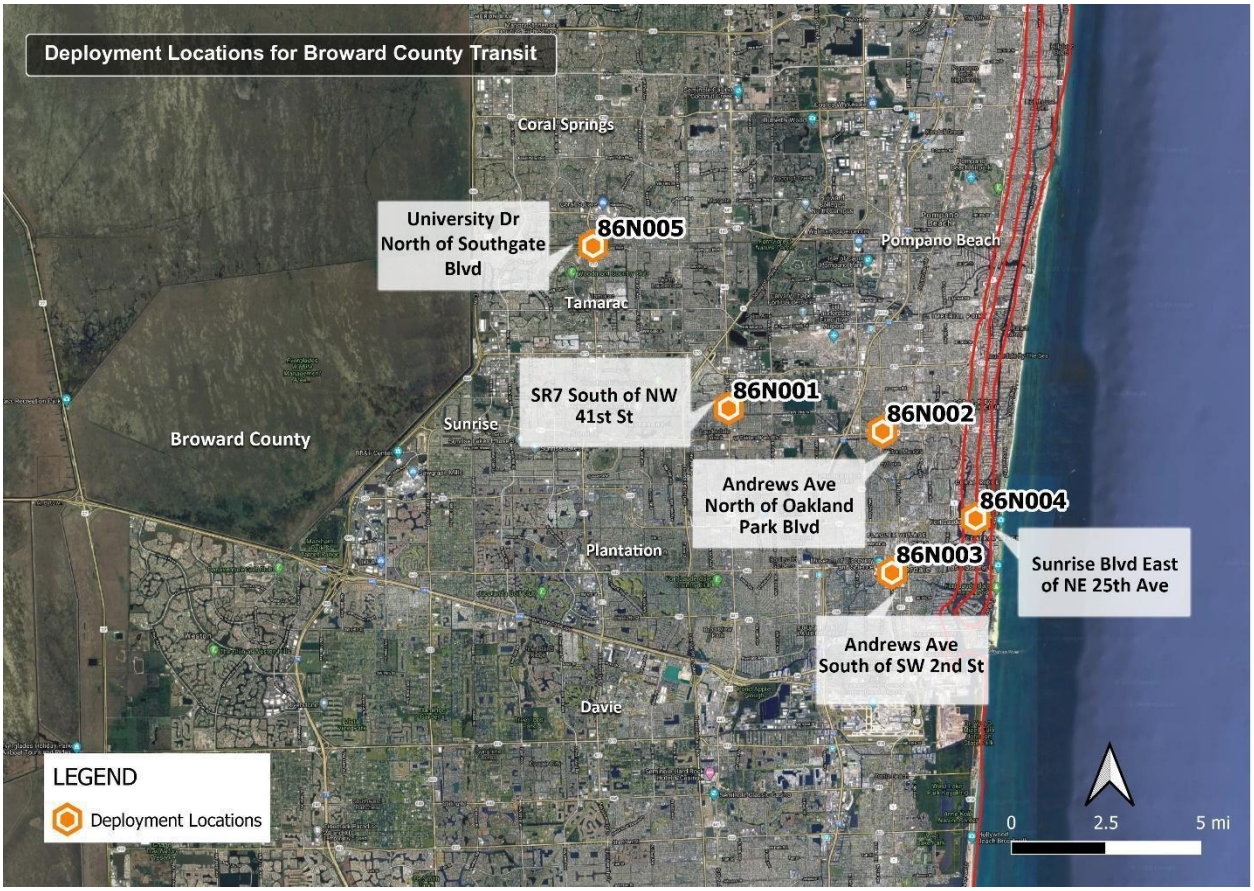
To finalize the site selection process, the team conducted on-site evaluations for the five selected locations --

1. SR7 South of NW 41st Street,
2. Andrews Avenue North of Oakland Park Boulevard,
3. Tyler Street @ 19th Avenue,
4. Andrews Avenue south of SW 2nd Street,
5. Sunrise Boulevard East of NE 25th Avenue

While on site, the team observed that major road work was being conducted in front of the bus stop located at the NW corner of Tyler & 19th Ave., and therefore, it was not ideal for installing equipment and collecting data at the time. The team then selected the next location on the ranking list, University Drive North of Southgate Blvd., as a fifth location. The Figure below shows the final 5 locations selected for BCT data collection.

It is recommended to always have back-up sites ready to visit in case an install crew arrives at a count site to install equipment where the site is undergoing unanticipated construction, has a traffic crash, is not accessible due to a police incident, or other event that hinders the ability to install the count equipment.

Figure 1: Selected Locations for Broward County Transit



Tri Rail/South Florida Regional Transportation Authority (SFRTA)

Tri Rail/South Florida Regional Transportation Authority (SFRTA) was selected as the second agency to participate in the project.

The team prepared for the kick-off meeting with SFRTA by reviewing the monthly ridership at the stations as well as the existing infrastructure of each station for equipment feasibility. The kick-off meeting was held on November 4, 2019. At the meeting, SFRTA staff identified eight locations that were desired in potential non-motorized counts. The discussion cited many aspects in selecting locations for data collection including Transit Oriented Development (TOD) activity potential, collaboration with schools and student passengers, bus/train connections, ridership, pedestrians walking on the tracks, bicyclists accessing the stations, and overall pedestrian activity. The team conducted virtual site visits at the eight proposed locations and narrowed the list down to five stations in three counties (Miami-Dade, Broward, Palm Beach) based on equipment feasibility and number of access points required to count.

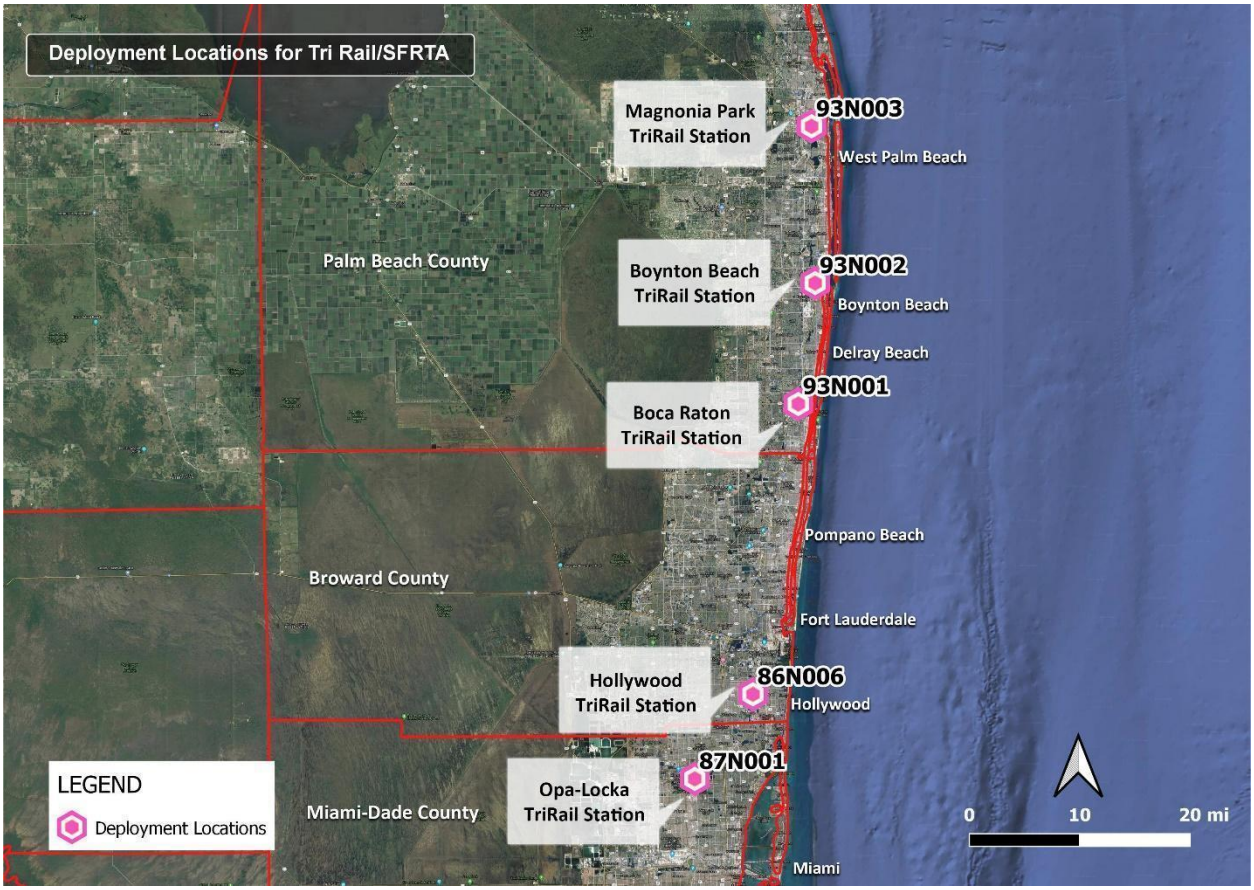
To finalize the site selection, the team conducted on-site evaluations for the five preferred count Trail Rail locations –

1. Mangonia Park Station,
2. Boynton Beach Station
3. Boca Raton Station (in Palm Beach County)

4. Cypress Creek Station and Hollywood Station (in Broward County)
5. The Opa-locka Station (in Miami-Dade County).

The Figure below shows the final 5 locations selected for SFRTA data collection.

Figure 2: Selected Locations for Tri Rail/SFRTA



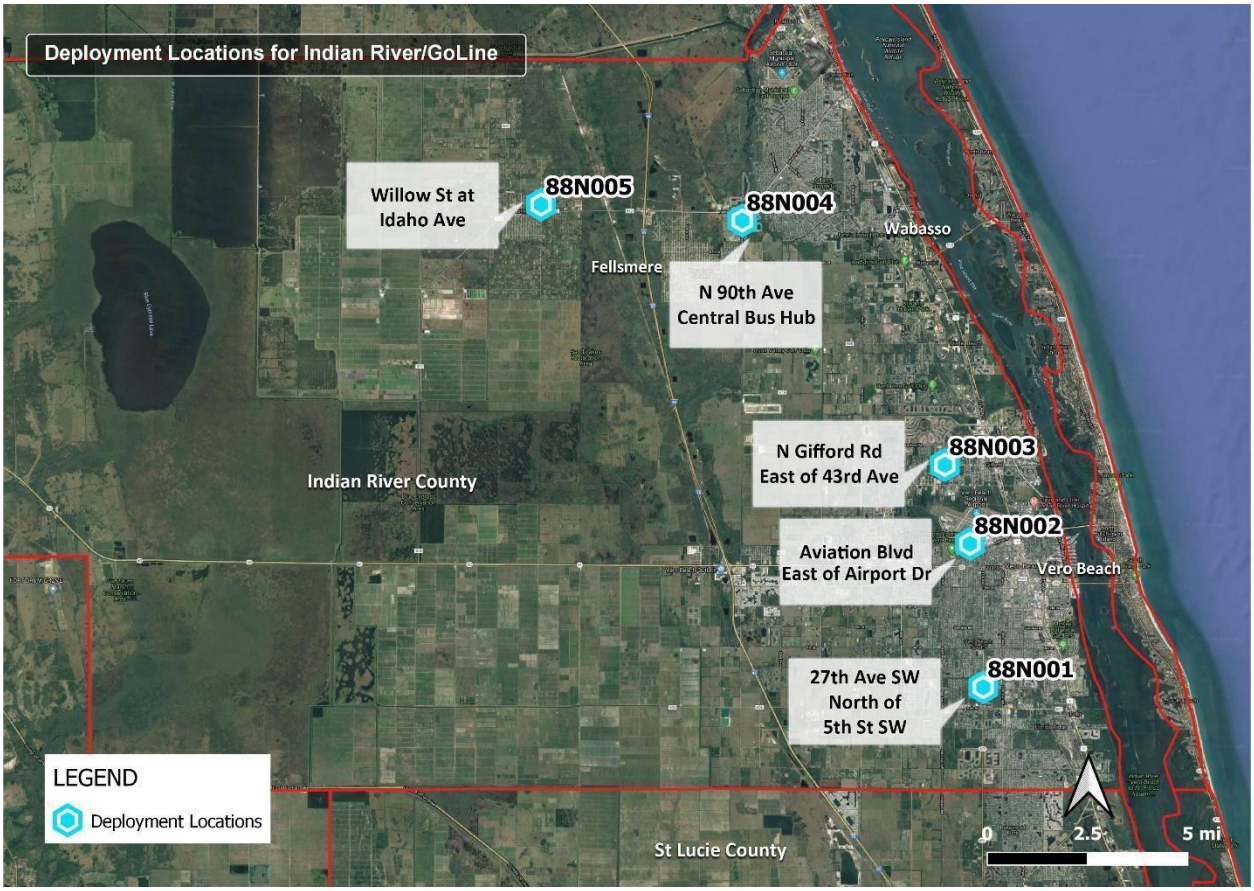
Indian River Goline

Indian River Goline was selected as the third agency to participate in the project.

The team prepared for the kick-off meeting with Goline and MPO staff by reviewing the transit maps of the system and available ridership data. The kick-off meeting was held December 19, 2019. The Indian River Team was highly engaged in providing the study team with an array of existing data to assist in the site selection process. Indian River staff provided the project team with priority transit stops, route information, daily boards and alightings, environmental justice information, bus shelter information, and detailed justification for each potential count site. These data sets, along with direct recommendations from the agency representatives, aided greatly in the site selection process and identified potential count locations that would provide direct benefit to Indian River stakeholders.

The following Figure shows the final 5 locations selected for Indian River Goline data collection.

Figure 3: Selected Locations for Indian River/GoLine



Jacksonville Transportation Authority (JTA)

Jacksonville Transportation Authority (JTA) was selected as the fourth agency to participate in the project.

The team prepared for the kick-off meeting with JTA staff by reviewing the transit maps of the system and available ridership data. The kick-off meeting was held January 16, 2020. JTA and City of Jacksonville staff provided a list of potential count locations that included both bus stop locations and people mover stations. Proposed locations were transit stops located on or near programmed complete street projects, programmed bike lane projects, transit oriented development projects, proximity to university centers, proximity to JTA bus hubs, and Jacksonville Beach. The project team and Jacksonville staff together visited all proposed sites and evaluated the sites based on equipment feasibility. Two proposed locations included Rosa Parks Skyway station, serving as JTA's busiest Skyway station, and its brand-new Jacksonville Regional Transportation Center (JRTC) station. While both locations were justified for non-motorized counts, Rosa Parks station was not selected due to the stations lack of pinch-points, which would make the ability to capture accurate traffic volume counts impossible, and the new JRTC station was still undergoing construction, and would not be open in time for the scheduled 2-week window of data collection. Both locations should still be considered for non-motorized volume counts in the future.

All of the proposed locations did not include facilities with bike lanes, shared paths or trails; therefore, each on-site visit came with an understanding that only infrared devices and cameras would be used for each JTA deployment.

The Figure below shows the final 5 locations selected for JTA data collection.

Figure 4: Selected Locations for Jacksonville Transportation Authority

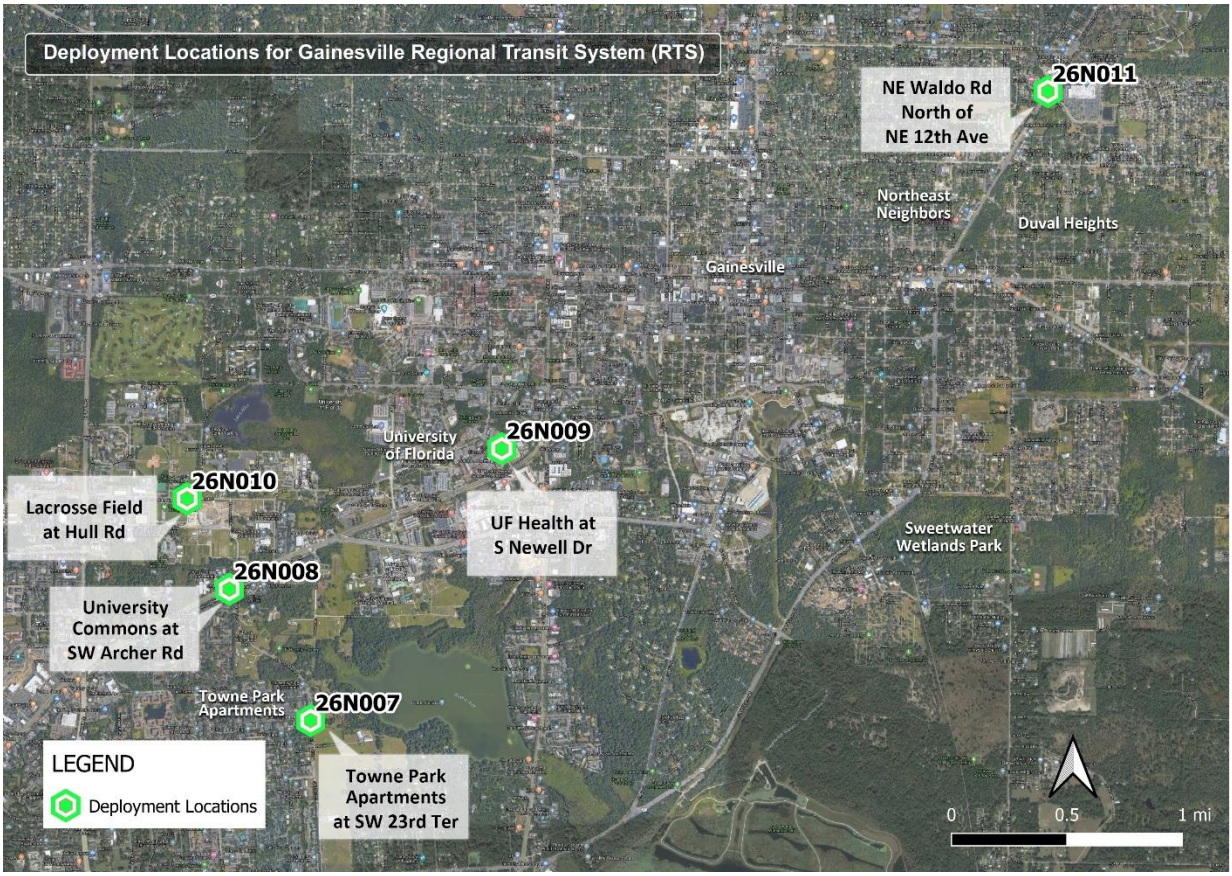
Gainesville Regional Transit System (RTS)

Gainesville Regional Transit System (RTS) was selected as the fifth and final agency to participate in the project.

The team prepared for the kick-off meeting with RTS staff and the City's Bicycle and pedestrian planner by reviewing the transit maps of the system and available ridership data. The kick-off meeting was held December 16, 2019. The Gainesville team proposed numerous transit stops that were within or near the University of Florida campus. Considering Gainesville's high volume of university student activity, there was general interest from FDOT and the City of Gainesville to learn more about non-motorized behavior from students. Other proposed locations were near the city's main hospital, nearby Walmart, and medium density residential developments. Site selection emphasized locations that had several bicycle and pedestrian facilities including sidewalks, trails, and shared paths.

The following Figure shows the final 5 locations selected for RTS data collection.

Figure 5: Selected Locations for Gainesville Regional Transit System



4. EQUIPMENT & DEPLOYMENT

A significant component of this project was to identify and allocate the appropriate equipment needed to capture the data accurately. FDOT TDA provided its in-house inventory of infrared devices and pneumatic bike tubes, while the consultant provided the camera equipment. The team worked diligently to research and discuss the benefits of each type of available data collection device and its accompanying software. The equipment's capabilities were shared with the partnering agencies. The team reviewed the latest in non-motorized data collection technology which resulted in the following combination of data collection technologies and software:

4.1 TRAFx Infrared Counter

The infrared counter produced by TRAFx is a portable device used to count non-motorized activity on trails, sidewalks and paths. It is integrated by an infrared scope and a counting system. The components are enclosed in a 3rd party metal casing for protection from weather and vandalism and ease of installation. The infrared device can be mounted on trees, poles and fences. Some of the key characteristics of the device are:

- Counts pedestrians and bicyclists on diverse types of paths and sidewalks
- Compact, unobtrusive and resistant to rain, dust and extreme temperatures.
- Long battery life, approximately 1.2 years
- Maximum range is approximately 20 feet
- Can sustain temperatures of -40° F to 130° F
- Large data storage capacity

Infrared sensor in opened enclosure box

Infrared sensor in closed enclosure box

4.2 MetroCount Bike Tube Counter

The bike counter manufactured by MetroCount is a portable device integrated by two pneumatic tubes and an electronic counter specially calibrated for bicycles. It is configured to detect and count bicycles, identifying direction, speed, axle spacing, headway and volume. FDOT TDA has an office safety policy to only deploy bike tubes on designated bicycle facilities. Standard 5' sidewalks are not considered a designated bike facility therefore not included in any bike tube deployment.

The particular bike tube model used in this study to count bicycles is the portable RidePod BT. Some of the key characteristics of this device are:

- Counts bicycles in different types of facilities such as bike lanes, trails, and wide sidewalks
- Easy to install with a separation of 18 inches between the pneumatic hoses as specified by the manufacturer
- Resistant metallic casing for protection from weather and vandalism
- Can be attached to a pole, tree or fence
- Large data storage capacity, up to 2 million count.
- Can be installed for extended periods of time with a battery life up to 3-4 years

Bike tube counter installation

Bike tube configuration on shared path

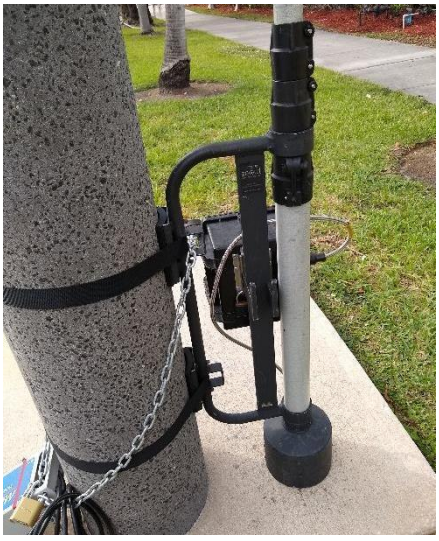
Bike tube configuration on bike lane

4.3 Miovision Traffic Detection System

The pedestrian detection system designed by Miovision is integrated by a high-resolution camera for data collection and an AI-based system for data analysis. The camera records the pedestrian, bicycle, and vehicular activity in the area of study and the videos are uploaded to the web-based system for their respective analysis. Some of the key features of the system are:

- Can be installed on poles, columns, or trees
- Resistant to dust, rain and extreme temperatures
- Can be adjusted in height and angle to improve visibility and object tracking
- Battery is limited to 72 hours of continuous recording
- Telescoping pole can reach up to 20 feet for increased visibility
- Miovision's web-based system allows for clear and consistent reporting
- Customizable tracking and reporting for data analysis

MioVision installation



Telescopic pole for camera

MioVision sensor

4.4 Goodvision Traffic Analysis System

The AI-based system developed by GoodVision is a modern object detection system using highly optimized algorithms and artificial intelligence models to track object activity in the study area. The system is capable of detecting and tracking the movement of vehicles, trucks, bicycles and pedestrians with high accuracy in complex environments. One differentiating attribute of GoodVision is the high capacity to optimize tracking and reporting using dashboards created in its web-based system.

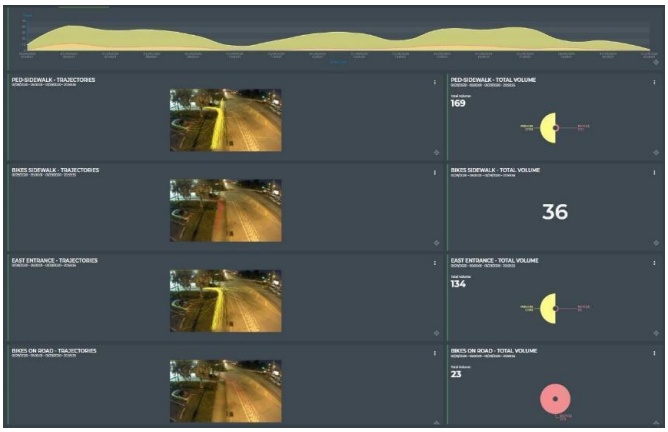
The system requires high-resolution video which is captured by modern camera systems developed by Oversight Data Solutions. These cameras were designed with the latest technology and high-resolution capabilities to collect data under diverse environmental conditions and developed to handle the latest object tracking and AI technologies developed by Goodvision. Some of the characteristics of GoodVision system and the cameras are as follows:

- High-resolution camera fully configurable (up to full HD 1920x1080 pixels)
- Camera pole can install up to 2 cameras simultaneously
- Long battery life up to 144 hours of recording with the option of solar power
- Camera pole can be extended up to 26 feet high for improved visibility.
- GoodVision's web-based system is highly customizable for data analysis
- AI system allows for automatic data retrieval, high volume data analysis and reporting for modelling
- Provides data analysis of pedestrian and bicycle activity including volume, direction, mid-block crossing and activity on different paths

GoodVision deployment

GoodVision deployment

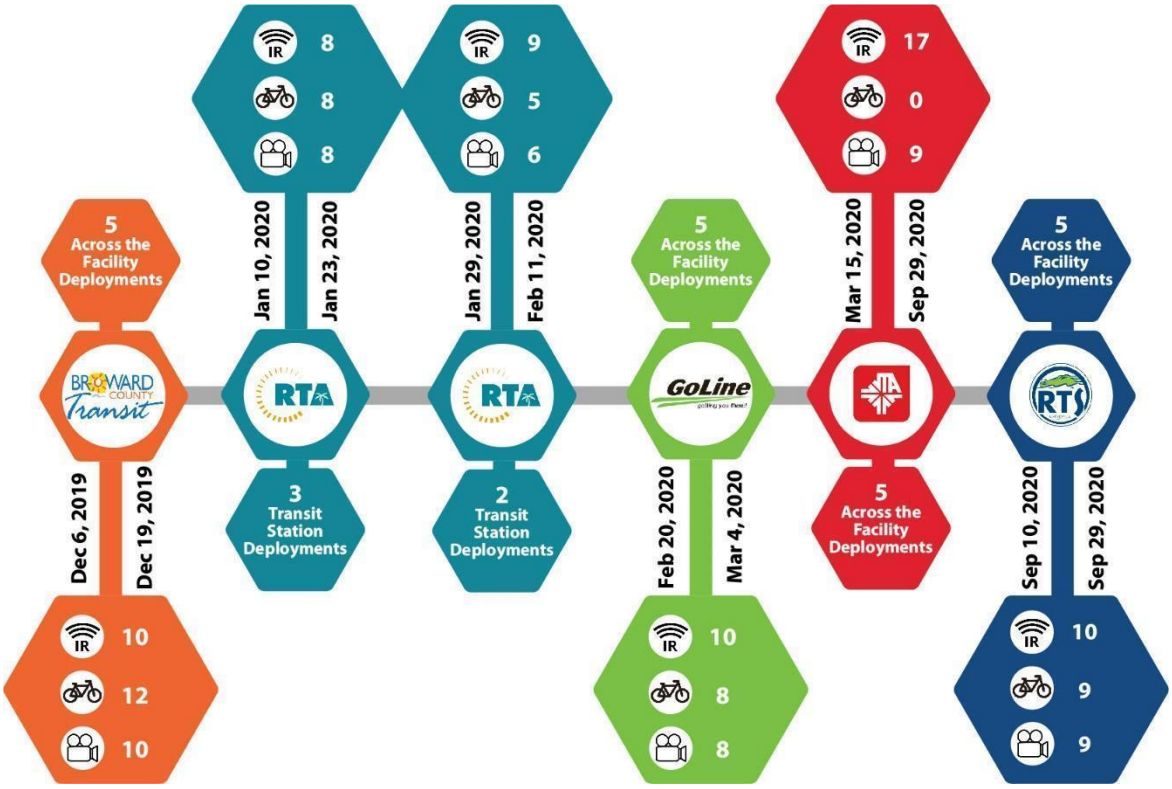
GoodVision output sample



GoodVision dashboard sample

The site selection process was informed by the ability to locate the equipment on site. After the sites had been selected and finalized, the team developed equipment deployment schematics for each location and identified the best placement for the bike tubes, infrared devices, and cameras. In total, 65 infrared sensors, 42 tube counters and 50 video cameras were deployed at 25 across-the-facility and transit station locations across the state.

Figure 6: Equipment Resources and Schedule by Agency Deployment



4.5 Broward Deployment Schematics

Figure 7: Device Installation Locations for SR 7 South of NW 41st St. (86N001)

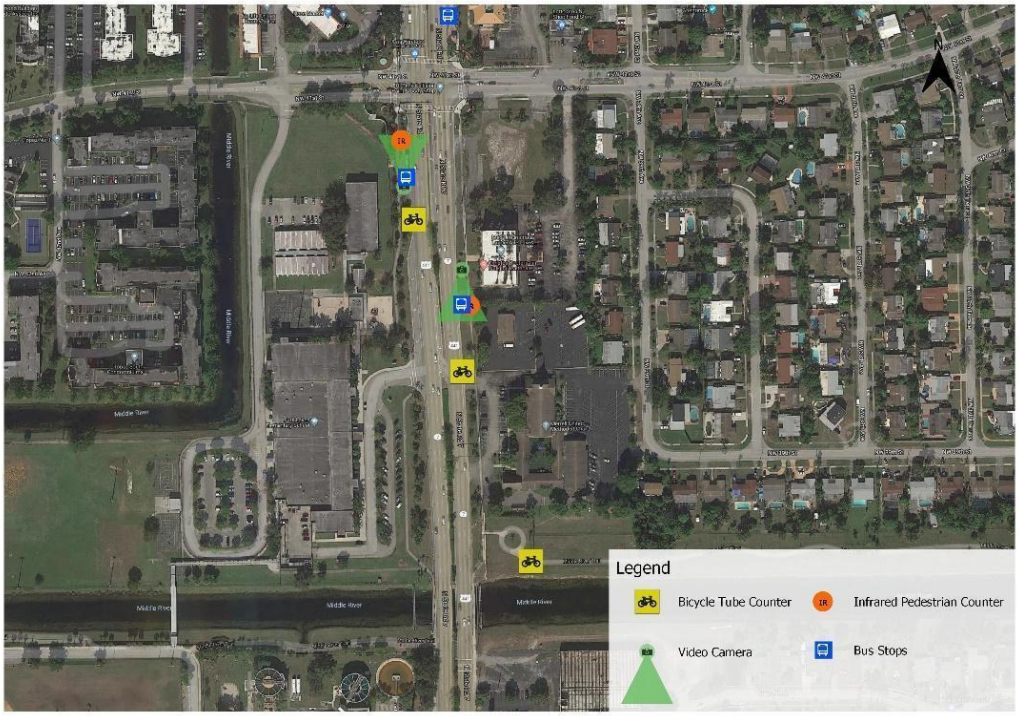


Figure 8: Device Installation Locations for Andrews Ave. North of Oakland Park Blvd. (86N002)

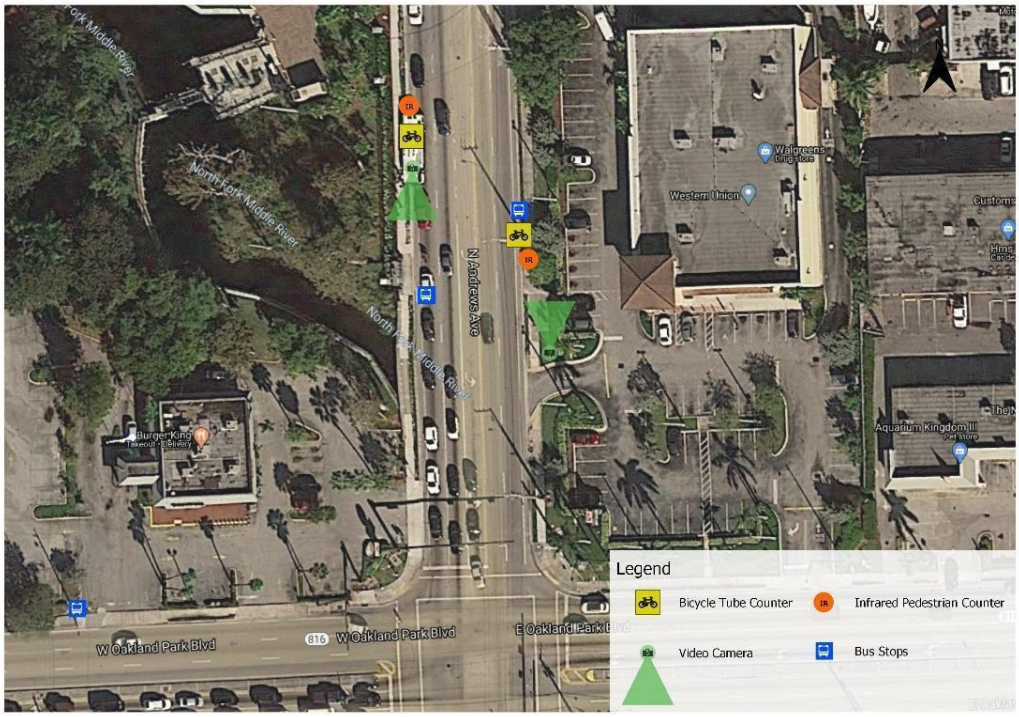


Figure 9: Device Installation Locations for Andrews Ave. South of SW 2nd St. (86N003)

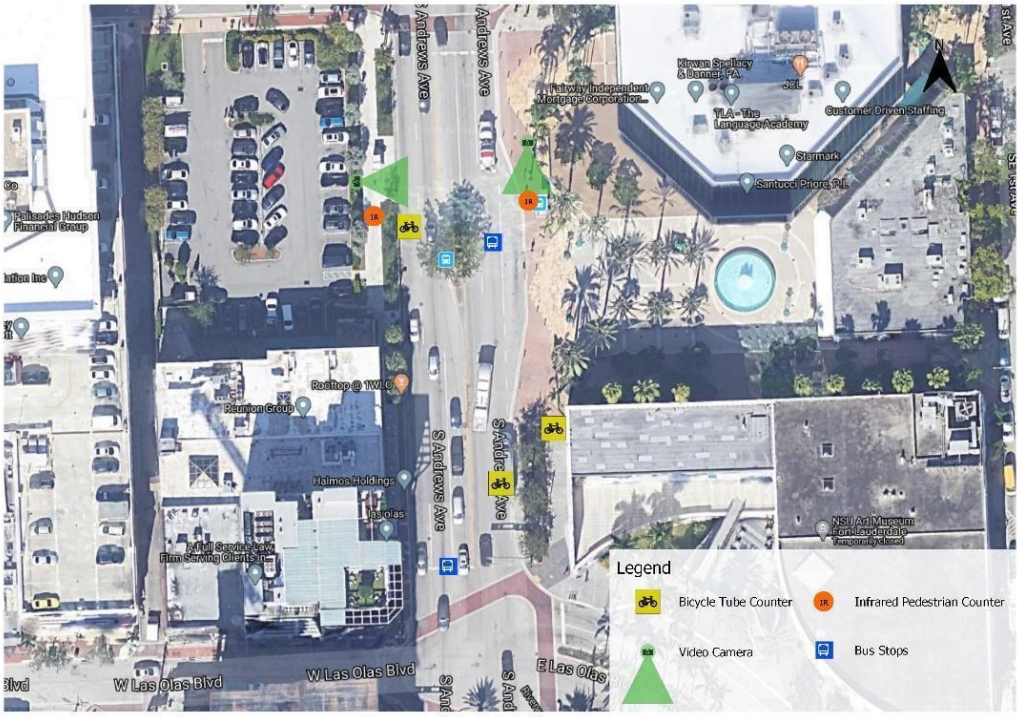


Figure 10: Device Installation Locations for Sunrise Blvd. East of NE 25th Ave. (86N004)

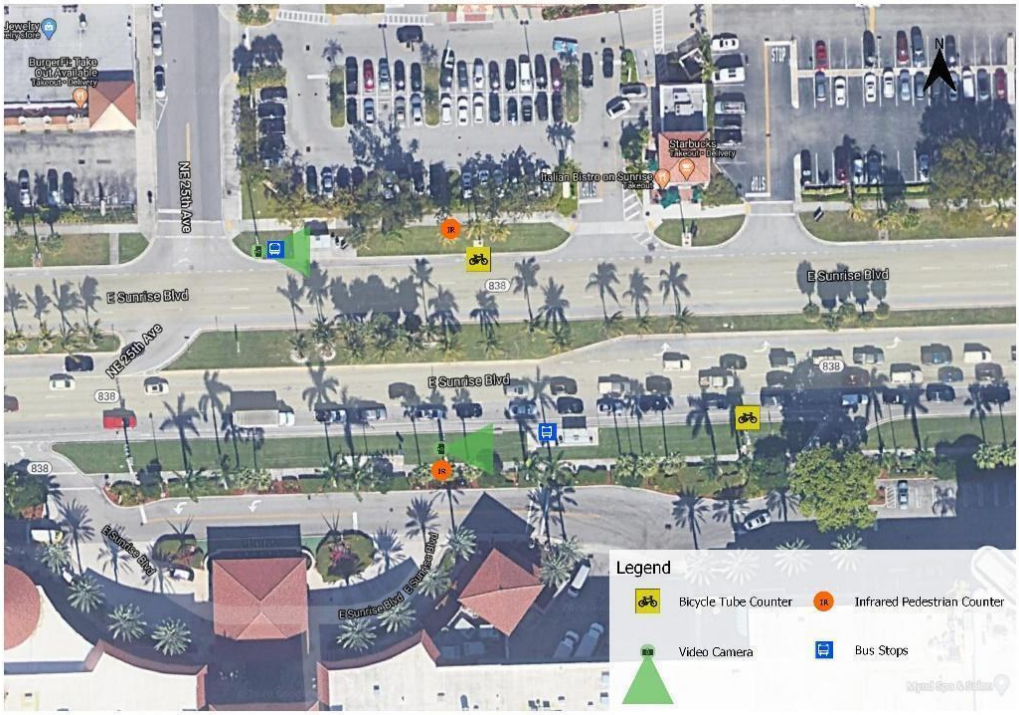


Figure 11: Device Installation Locations for University Dr. North of Southgate Blvd. (86N005)

4.6 SFRTA Deployment Schematics

Figure 12: Devices Installation Locations for Hollywood Tri Rail (86N006)

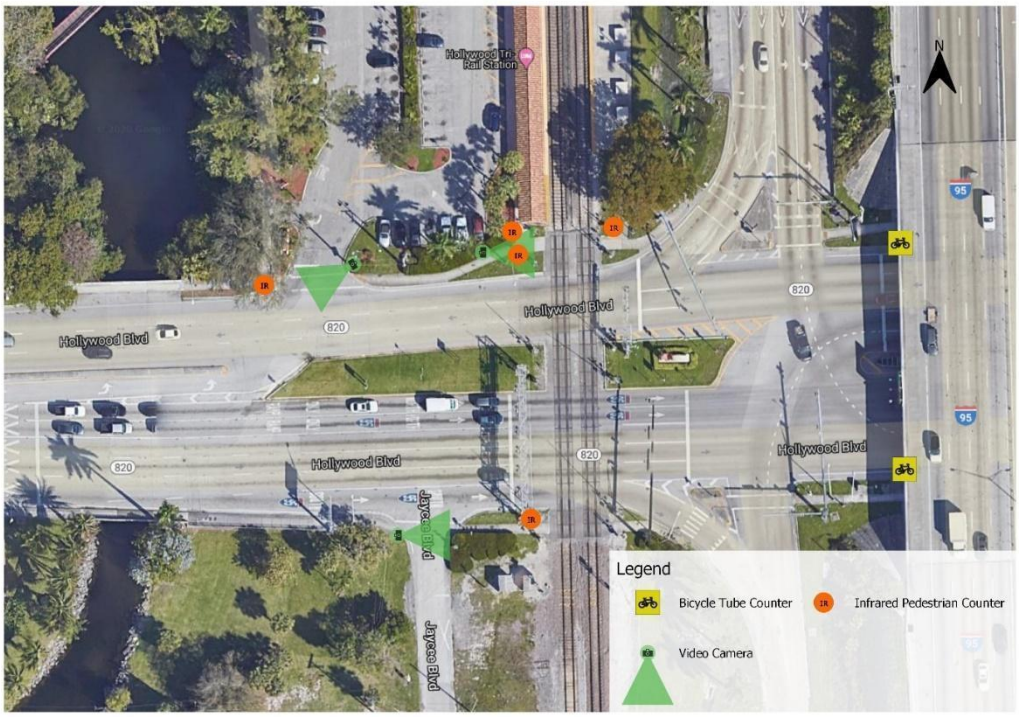


Figure 13: Devices Installation Locations for Opa-Locka Tri Rail (87N001)

Figure 14: Devices Installation Locations for Boca Raton Tri Rail (93N001)

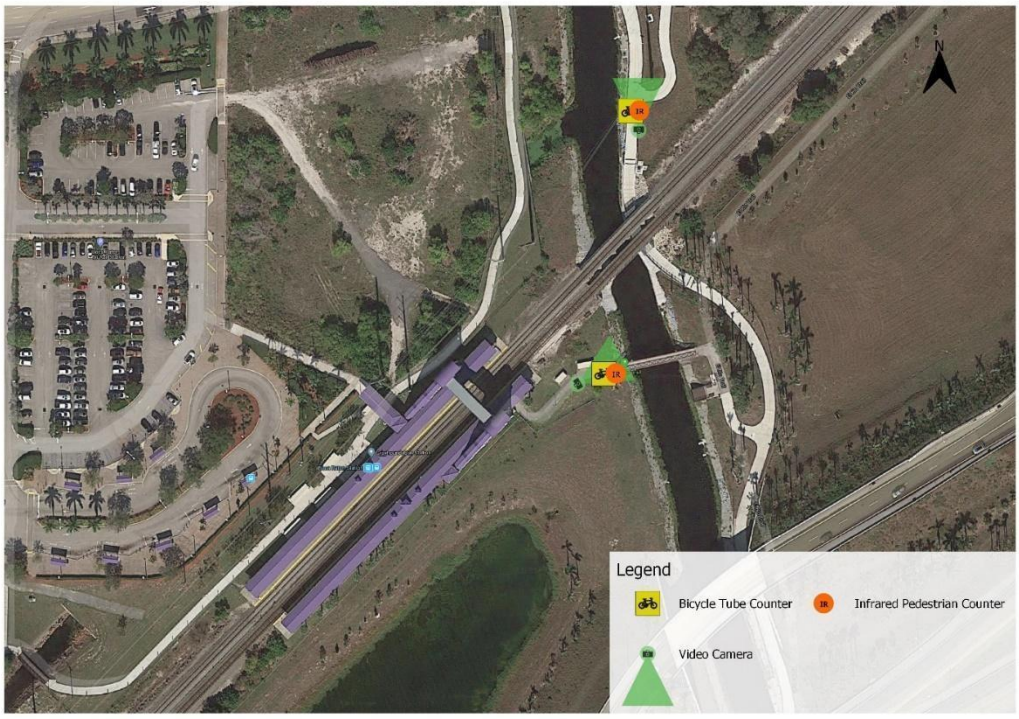


Figure 15: Devices Installation Locations for Boynton Beach Tri Rail (93N002)

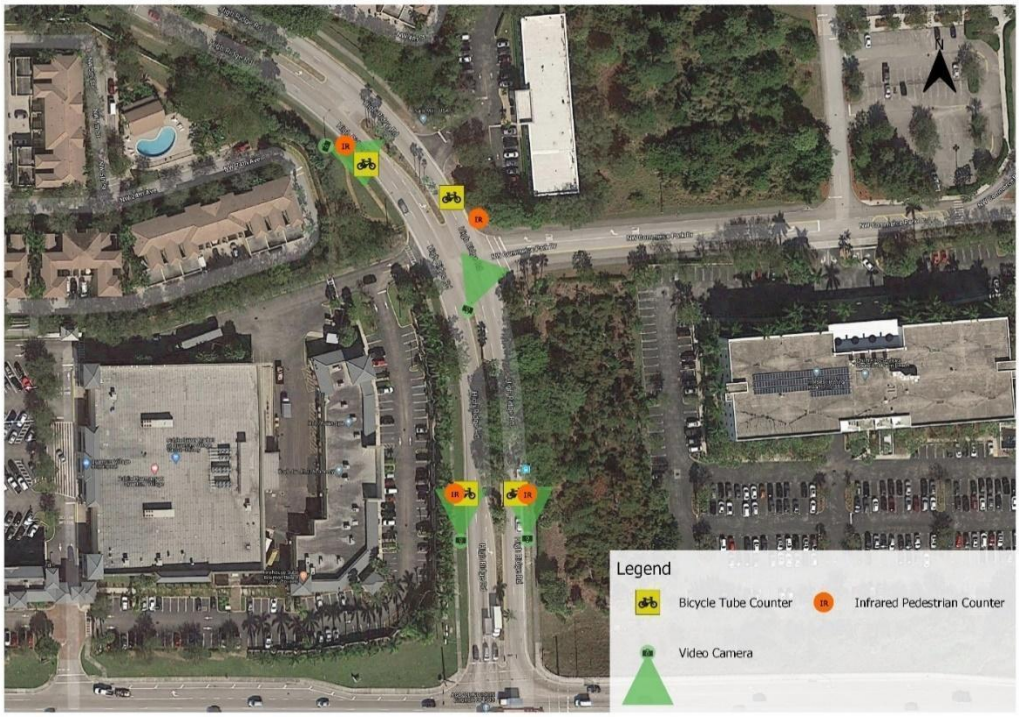


Figure 16: Devices Installation Locations for Mangonia Park Tri Rail (93N003)

4.7 Indian River Goline Deployment Schematics

Figure 17: Device Installation Locations for 27th Ave. SW North of 5th St. SW (88N001)

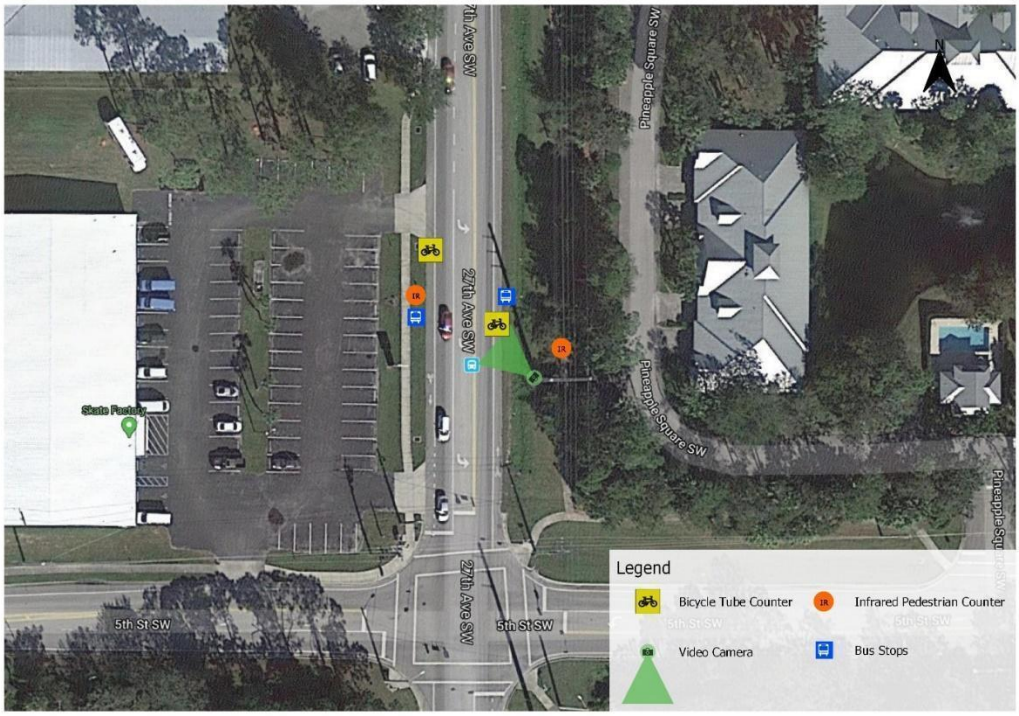


Figure 18: Device Installation Locations for Aviation Blvd. East of Airport Dr. (88N002)

Figure 19: Device Installation Locations for N. Gifford Rd. East of 43rd Ave. (88N003)

Figure 20: Devices Installation Locations for N. 90th Ave. Central Bus Hub (88N004)

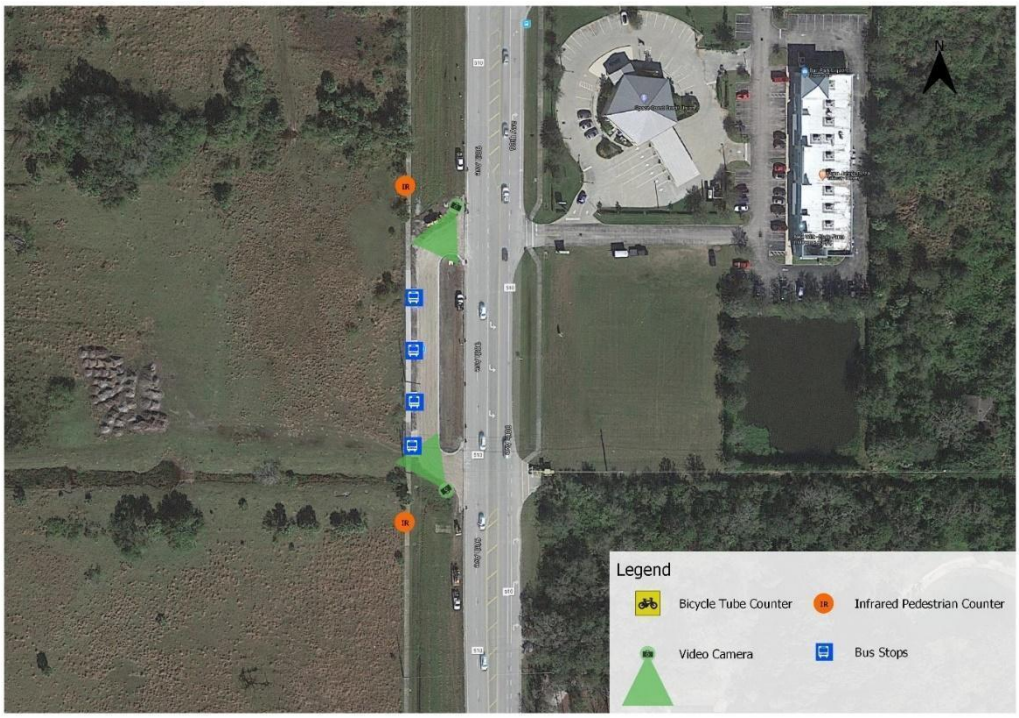


Figure 21: Device Installation Locations for Willow St. at Idaho Ave. (88N005)

4.8 Jacksonville Transportation Authority Deployment Schematics

Figure 22: Device Installation Locations for Park St. at Jackson St. (72N002)

Figure 23: Device Installation Locations for Post St. North of Edgewood Ave. S (72N003)

Figure 24: Device Installation Locations for Beaches Hub at 2nd St. N (72N004)

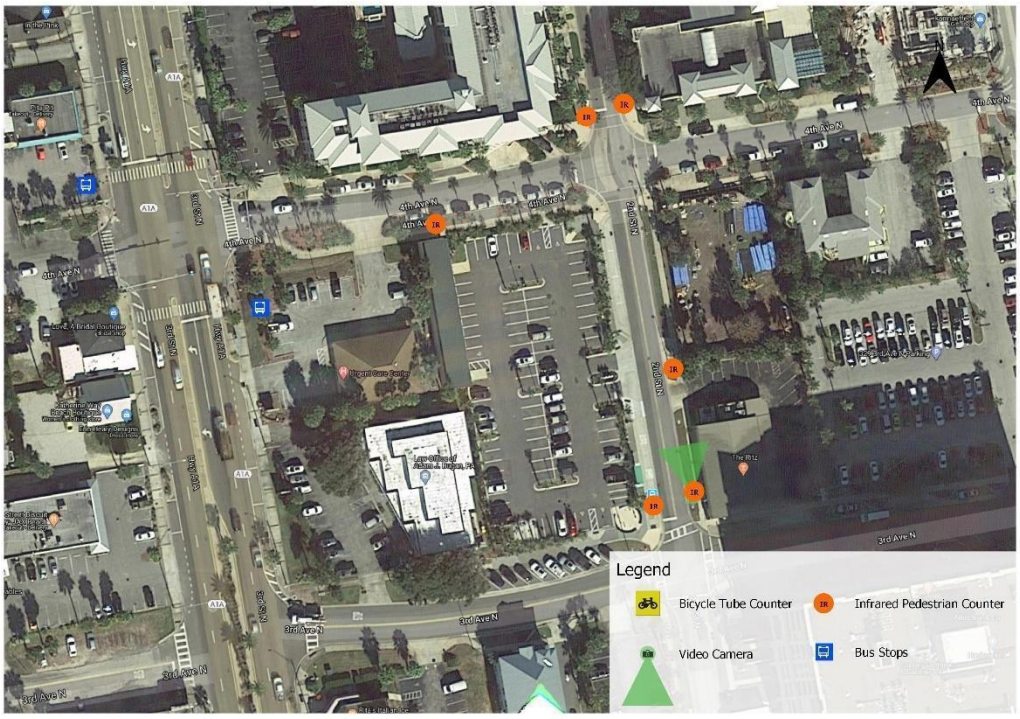
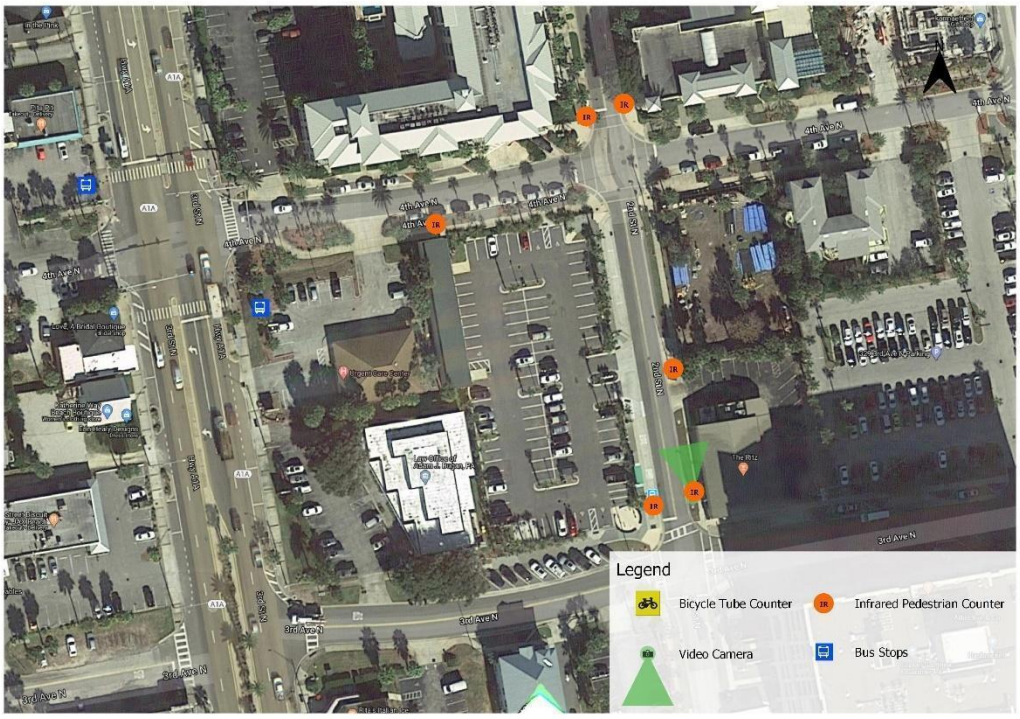


Figure 25: Device Installation Locations for University Blvd. N at Baywood (72N005)

Figure 26: Device Installation Locations for Herschel St. at St Johns Ave. (72N006)



4.9 Gainesville Regional Transit System Deployment Schematics

Figure 27: Device Installation Locations for Towne Park Apartments at SW 23rd Ter. (26N007)

Figure 28: Device Installation Locations for University Commons at SW Archer Rd. (26N008)

Figure 29: Device Installation Locations for UF Health at S. Newell Dr. (26N009)

Figure 30: Device Installation Locations for Pressly Stadium (26N010)

Figure 31: Device Installation Locations for NE Waldo Rd. North of NE 12th Ave. (26N011)

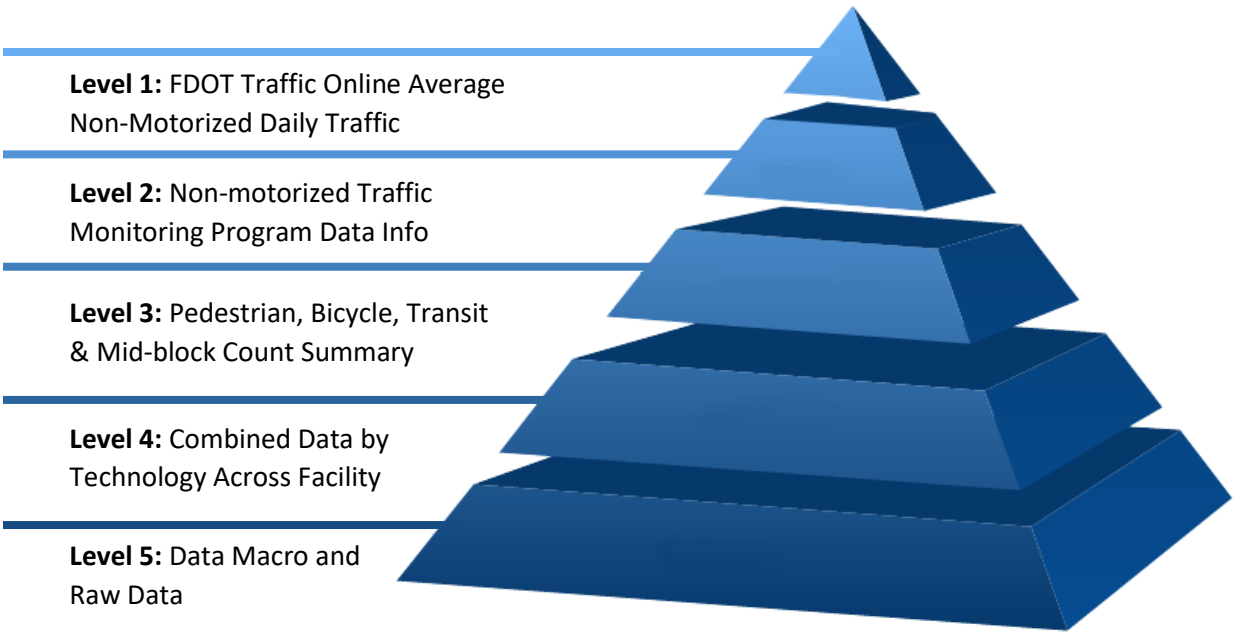
5. STANDARDIZING DATA REPORTING METHODS & INFORMATION DISAGGREGATION PYRAMID REPORTING STANDARD

As the literature review conducted during this project reveals, there are no agencies across the nation currently collecting statewide non-motorized traffic volume data while considering transit agency data needs and simultaneously collecting data on non-motorized access to transit. Additionally there are very few data reporting methods or standards documented that can be applied to transit facility traffic volume reporting. The team used two standards to assist in developing a new ground-breaking standardized method specifically customized for reporting transit facility traffic volume statistics. The first approach was to follow motorized standard reporting methods that have been established since the 1950's such as the Annual Average Daily Traffic (AADT's) statistics. The second standard the team used in developing a new data reporting method was the Federal Highway Administration's (FHWA's) Traffic Monitoring Guidebook (TMG). The TMG contains formatting guidance on how to store non-motorized traffic volume data in a data repository (without considering transit specific needs).

Since the goal of this project was to collect data and develop a standard data reporting method specific to transit needs, the team developed an Information Disaggregation Pyramid as seen in the figure below. This information disaggregation pyramid allows a robust, rich, and large dataset to be easily understood by organizing data into multiple data levels. Each level represents a different amount of data contained in each level. For example, level 1 has the least number of details and data containing only the AADT statistic where level 5 contains a much larger amount of detailed data with all raw data.

Below is the new ground-breaking data reporting method for transit specific traffic volume data depicted in an easy-to-follow graphical representation.

Figure 32: Information Disaggregation Pyramid

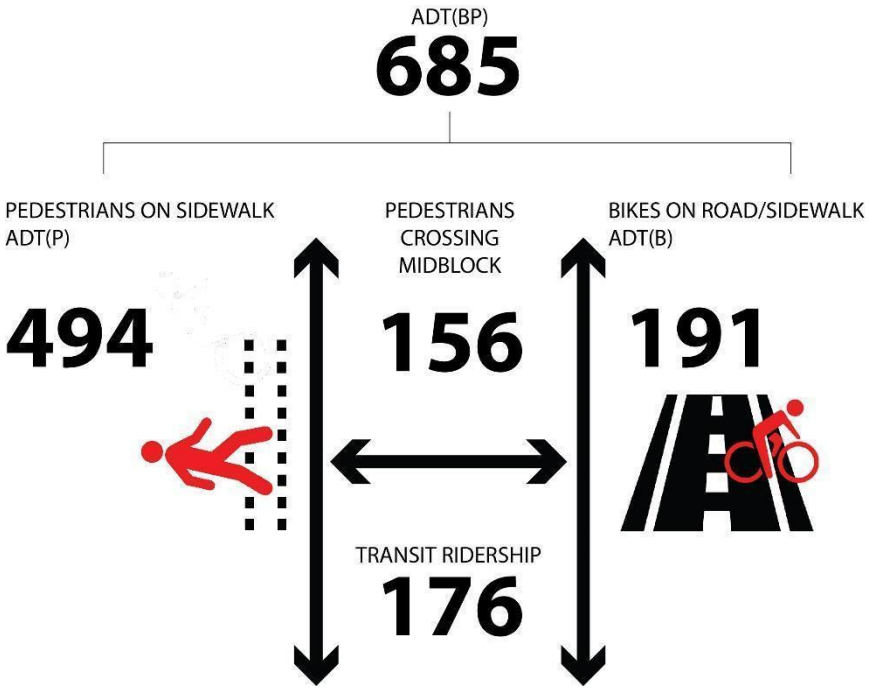


During this project, each agency was provided with a data package containing each level of data within the disaggregation pyramid. The graphic above was used during the agency outreach meetings to educate and inform the transit agencies about the contents of the data package that was provided as a result of the data collection efforts.

The disaggregation pyramid provides an understanding of what is contained within the data package but it does not provide a graphical representation of the roadway. To address this need, the team created another ground-breaking reporting graphic to represent the non-motorized traffic volume data on the roadway. This graphic is referred to as the Roadway Traffic Volume Representation graphic.

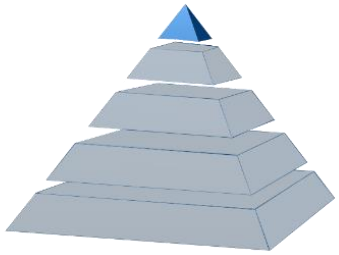
For example, the following Roadway Traffic Volume Representation demonstrates how the ADT(BP) was developed using the location at Sunrise Boulevard east of NE 25th Ave in Fort Lauderdale in Broward County that was located at two Broward County Transit (BCT) stops.

Figure 33: Roadway Traffic Volume Representation Graphic - Average Non-Motorized Daily Traffic (Bicycles and Pedestrians)



The Roadway Traffic Volume Representation Graphic can also be displayed as an infographic as shown below. Generally, these two Figures represent the roadway volumes broken down by type of equipment that collected the data and the direction of travel and organized by bicycle or pedestrian specific volume statistics.

Additional details for each level of the disaggregation pyramid are provided in the text below.

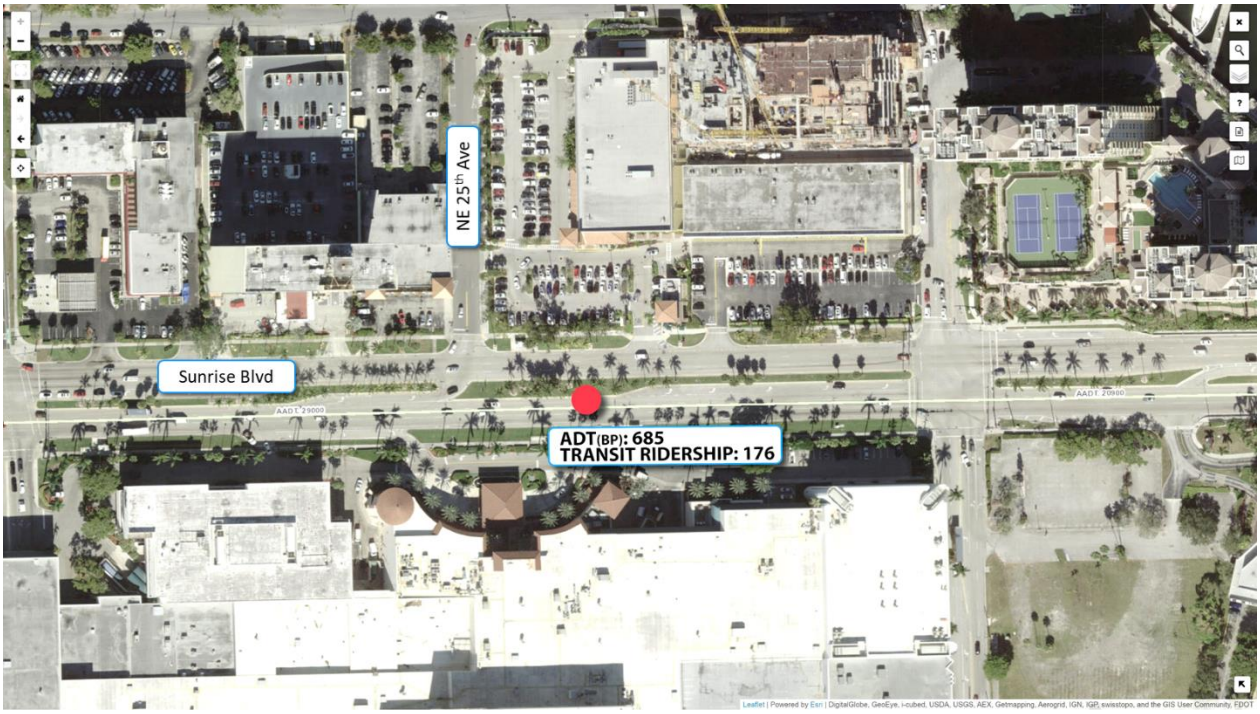


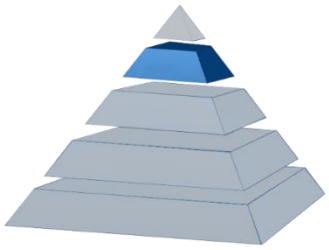
Level One consists of the FDOT Traffic Online Average Non-Motorized Daily Traffic. This level serves as a final product to provide planners, engineers and designers the ADT(BP) as a data point to show the average daily non-motorized count and the transit ridership for the location.

Data Products:

1. ADT(BP)
2. Transit Ridership

Figure 34: Summarized Daily Traffic Illustrating on an FDOT Traffic Online Interface



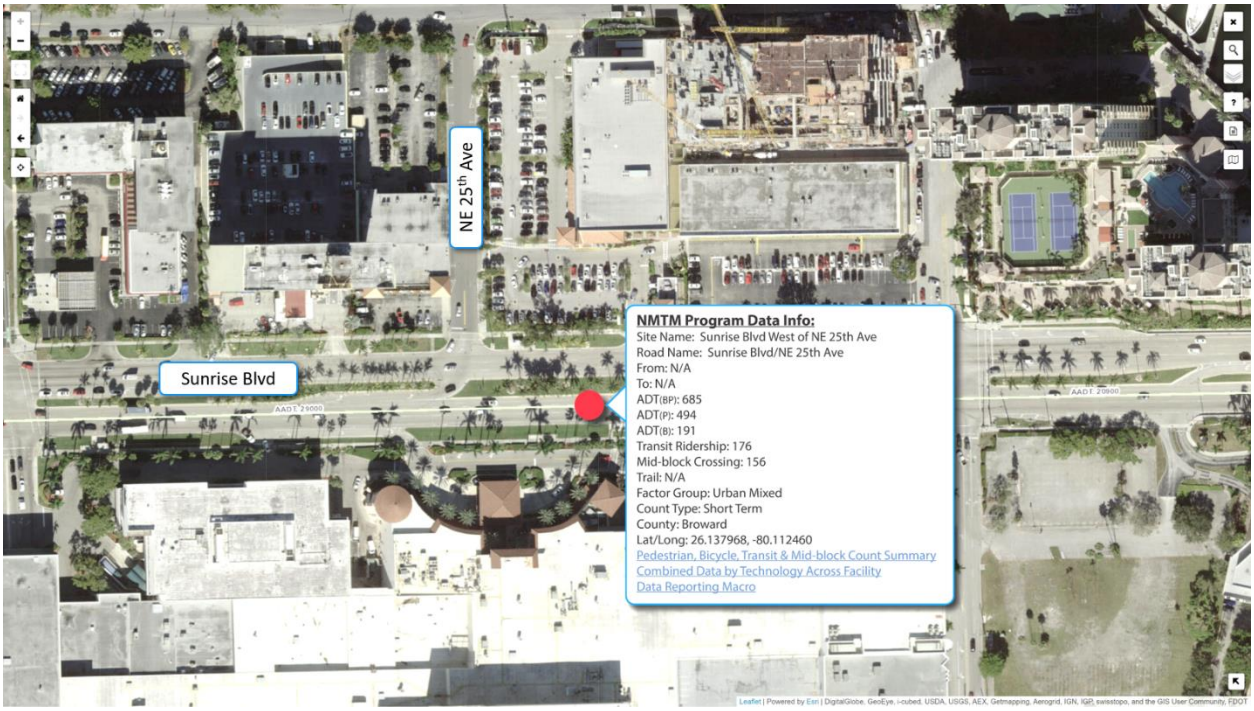


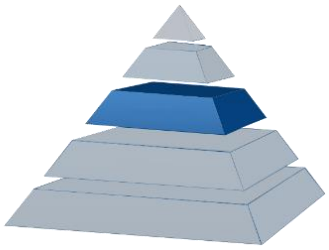
Level Two consists of the Non-Motorized Traffic Monitoring Program Data Information. This level summarizes all the Non-Motorized Program Data Information in and easy to read format consistent with an online interface and lists the ADT(BP), ADT(P), ADT(B), Transit Ridership, Mid-Block Crossings, Trail Traffic, Factor Group, Count Type, County and GIS Coordinates.

Data Products:

1. ADT(BP)
2. ADT(P)
3. ADT(B)
4. Transit Ridership
5. Mid-Block Crossing Volumes
6. Trail Traffic Volumes
7. Factor Group
8. Count Type
9. GIS Coordinates

Figure 35: Level 2 - Non-Motorized Traffic Monitoring Program Data Information



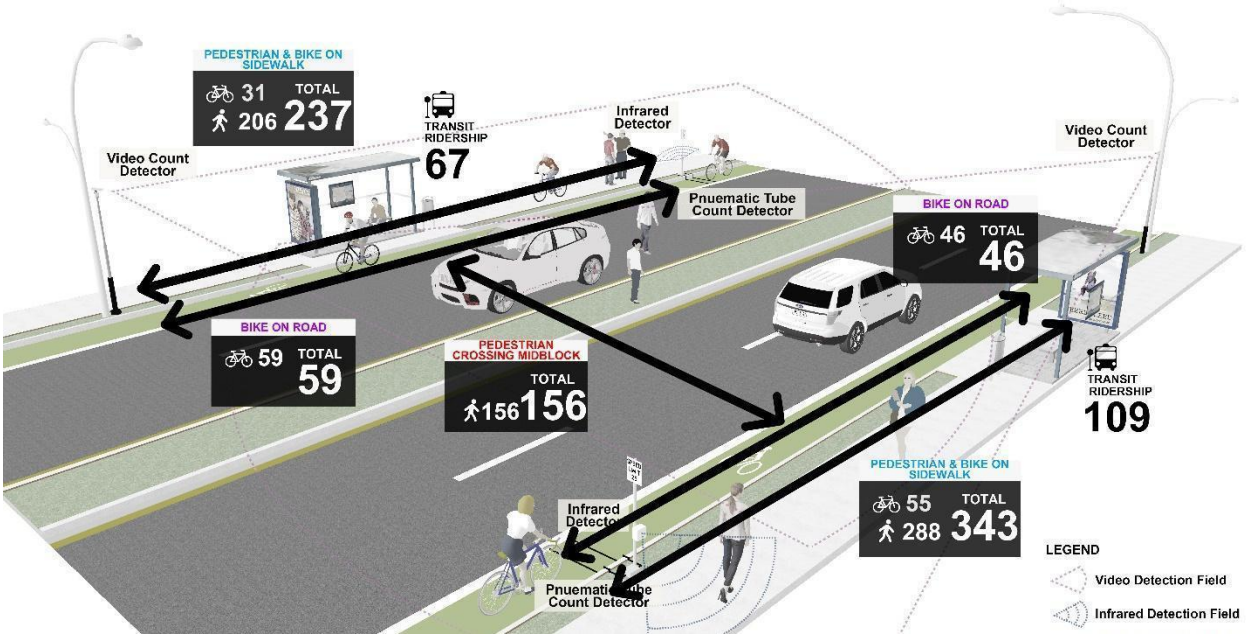


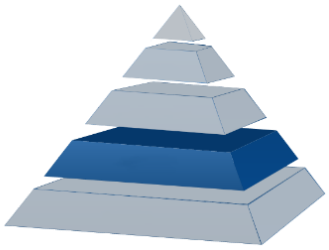
Level Three consists of the Pedestrian, Bicycle, Transit & Mid-block Count Summary information. This graphic conceptually illustrates the information to give transportation planners, designers, and engineers a quick understanding of the data at each location.

Data Products:

1. ADT(BP) - Direction 1
2. ADT (BP) - Direction 2
3. ADT(P) - Direction 1
4. ADT(P) - Direction 2
5. ADT(B) - Direction 1
6. ADT(B) - Direction 2
7. Transit Ridership
8. Mid-Block Crossing Volumes
9. Trail Traffic Volumes
10. Factor Group
11. Count Type
12. GIS Coordinates

Figure 36: Level 3 - Pedestrian, Bicycle, Transit & Mid-block Count Summary



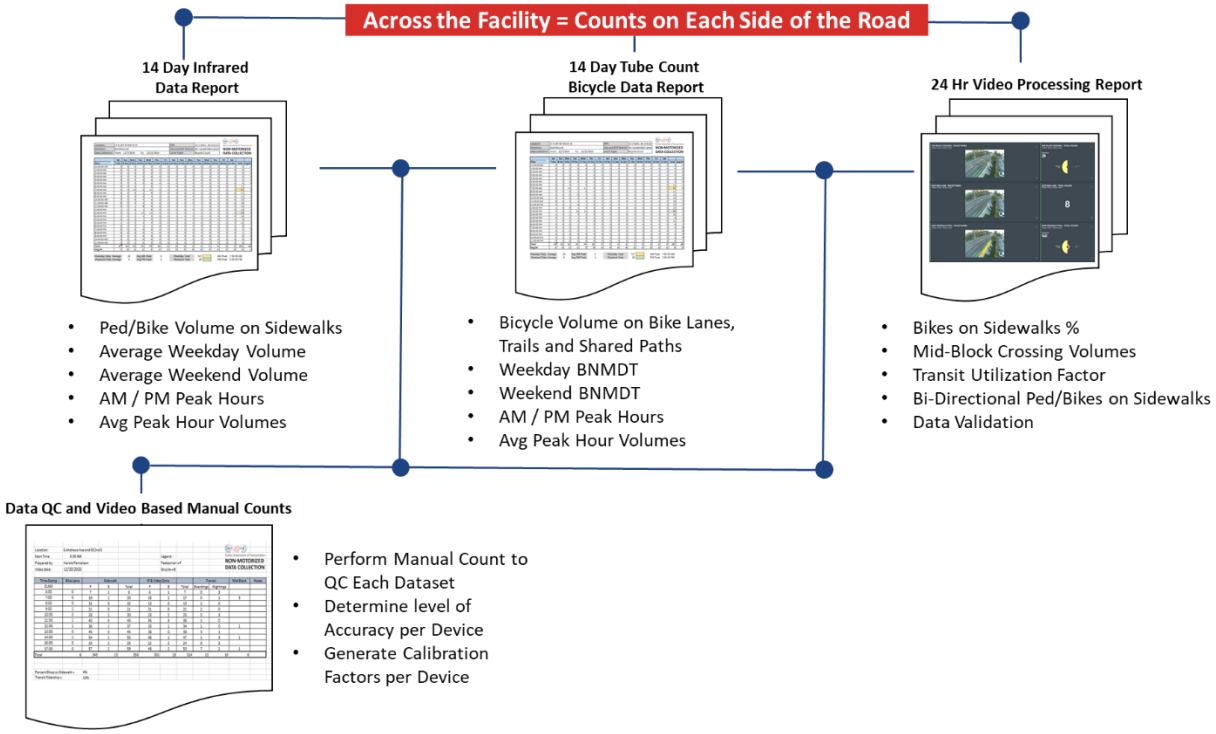


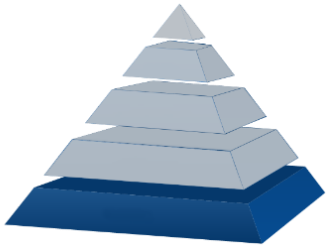
Level Four consists of the Combined Data by Technology across Facility information. This level includes the processed data and provides them in detailed tables. The tables consist of the 14-day Infrared Data, the 14-day Bicycle Tube Data, the 24-hour video processing and the Video-based manual counts.

Data Products:

1. ADT(BP) - Direction 1
2. ADT (BP) - Direction 2
3. ADT (BP) - Daily - Direction 1
4. ADT (BP) - Daily - Direction 2
5. ADT (BP) - Hourly - Direction 1
6. ADT (BP) - Hourly - Direction 1
7. ADT(P) - Direction 1
8. ADT(P) - Direction 2
9. ADT (BP) - Hourly - Direction 1
10. ADT (BP) - Hourly - Direction 2
11. ADT (P) - Daily - Direction 1
12. ADT (P) - Daily - Direction 2
13. ADT (P) - Hourly - Direction 1
14. ADT (P) - Hourly - Direction 2
15. ADT(B) - Direction 1
16. ADT(B) - Direction 2
17. ADT (B) - Daily - Direction 1
18. ADT (B) - Daily - Direction 2
19. ADT (B) - Hourly - Direction 1
20. ADT (B) - Hourly - Direction 2
21. Transit Ridership
22. Mid-Block Crossing Volumes
23. Trail Traffic Volumes
24. Factor Group
25. Count Type
26. GIS Coordinates

Figure 37: Level 4 - Combined Data by Technology Across Facility





Level Five consists of the Data Macros, Raw Data and Videos. This level includes the initial raw data as received from the various data collection equipment before processing and includes the Data Macros, Raw Data and Videos used to develop and provide the pedestrian and bike volumes.

Data Products:

1. ADT(BP) - Direction 1
2. ADT (BP) - Direction 2
3. ADT (BP) - Daily - Direction 1
4. ADT (BP) - Daily - Direction 2
5. ADT (BP) - Hourly - Direction 1
6. ADT (BP) - Hourly - Direction 1
7. ADT(P) - Direction 1
8. ADT(P) - Direction 2
9. ADT (BP) - Hourly - Direction 1
10. ADT (BP) - Hourly - Direction 2
11. ADT (P) - Daily - Direction 1
12. ADT (P) - Daily - Direction 2
13. ADT (P) - Hourly - Direction 1
14. ADT (P) - Hourly - Direction 2
15. ADT(B) - Direction 1
16. ADT(B) - Direction 2
17. ADT (B) - Daily - Direction 1
18. ADT (B) - Daily - Direction 2
19. ADT (B) - Hourly - Direction 1
20. ADT (B) - Hourly - Direction 2
21. Transit Ridership
22. Mid-Block Crossing Volumes
23. Trail Traffic Volumes
24. Factor Group
25. Count Type
26. GIS Coordinates
27. Raw Video Count Videos
28. Per Vehicle Record Raw Volume Count Data

6. TRANSIT AGENCY DATA APPLICATION

For this project, each of the five transit agencies played an integral role in all aspects of the data collection effort from site selection to deployment to reviewing the collected data. Without the level of interest and engagement by the transit agencies, this project would not have been possible. Over the course of the project, two formal meetings were conducted with each transit agency's staff. The first meeting was a kickoff meeting to share the overall goals and objectives of the project. The second meeting was a follow-up meeting and took place after the data had been collected. The second meeting consisted of presenting the data to the agency, explaining the various data collection methods and formats and included a discussion of the potential uses of the data with the agency. In conjunction with the second meeting with the agencies, the data files were provided to the agencies for their review and use. The following is an overview of the discussions with the five transit agencies at the follow-up meetings.

On June 26, 2020, the data results were presented to Broward County Transit (BCT) staff and the BCT Data Package was provided via email. The team discussed the deployment, the technologies used and the resulting data. As typical transit ridership data does not include sidewalk, bike lane and mid-block crossing data, the project team shared the various totals and spreadsheets at the meeting. Project team staff presented the data reflecting activity around the facility and discussed the opportunities to integrate the data into future operations, safety and planning. The team also shared the video of the 156 mid-block crossings over 18 hours on Sunrise Blvd. At the meeting the agency stated they had a better understanding of the scope and what they would get out of the project and that the information and guidance was appreciated.

On August 20, 2020, the data results were presented to SFRTA staff and the SFRTA Data Package was provided via email. The team discussed the deployment, the technologies used and the resulting data. As this was the first opportunity to share the data with the transit agency, SFRTA staff learned from the project team about the various technologies and the data.

SFRTA staff stated that the data collected could **assist them as they develop wayfinding** for their transit stations. The video data provided the paths taken by passengers to access the station and knowing this would **aid in the locating of wayfinding signage.** The video data also would **provide justification for additional safety signage**, for example, safety messaging where mid-block crossings were occurring. The staff stated that a facility closure at Hollywood Blvd. had been discussed and that non-motorized data **could provide justification for keeping the station open** by identifying the positive impacts that transit generates in the form of pedestrian and bicycle activity. Also, the data at Hollywood Blvd. showed a lot of activity unrelated to the transit stop which **could justify some retail activity** such as a coffee shop or news kiosk as a viable opportunity.

The questions generated from the SFRTA staff during the discussion were: Why are the bike tubes located at I-95 and Hollywood Blvd. and not closer to the station? The project team provided information about site selection and the need for funneling points. Staff asked if it would be possible for cyclists to be double counted on the roadway with tubes and IR counter. The project team explained these are independent technologies with independent counts that are compared to one another. The discussion also included

the transit percent of the across the facility numbers. The team noted that non-motorized traffic mixed with behavior analysis is new and will **open up many new studies**.

On September 29, 2020 the data was presented to the Indian River MPO and Goline staff. The Data Package and peak hour videos were provided. The video presented at the meeting displayed a transit location with limited lighting. The video clip showed a bus patron using their cell phone flashlight due to darkness in the early morning to get to the transit stop. With this information it was noted that **lighting upgrades can be easily justified** with video and volumes. Another video demonstrated the **need for shaded shelters** and staff stated the video will be used in an upcoming meeting to provide visual information in a County discussion regarding adding shelters. In addition, Kiss and Ride behaviors were seen on video, and staff stated they would be sure to consider adding upgrades to accommodate this behavior in the future. The team concluded by noting that it's important to collect video in combination with traffic volume data for a true picture of what is happening with the behaviors and numbers.

On December 17, 2020 the data was presented to JTA and the City of Jacksonville. The Data Package was provided. The presentation generated the following questions: Does video software differentiate for scooters and skateboards? The team responded that at this time the Good Vision software can only classify between bicycle and pedestrian. Any other mode such as a skateboard, scooter, or rollerblades would be classified as a pedestrian. However, in the future, it is anticipated that the Good Vision AI software will become more accurate and have the capability to classify other micro-mobility modes. Will there be permanent counters in the future? The team responded that yes, any short-term count associated with the statewide non-motorized traffic monitoring program serves as a candidate for a future continuous count station. The Team concluded that data is important and acknowledged that with this data there is an **opportunity for Complete Streets applications** for pipeline projects. There is also an opportunity with the video cameras to view the **utilization of real time kiosks** and other activity around bus stops, such as **trash composters and ticket vending machines**.

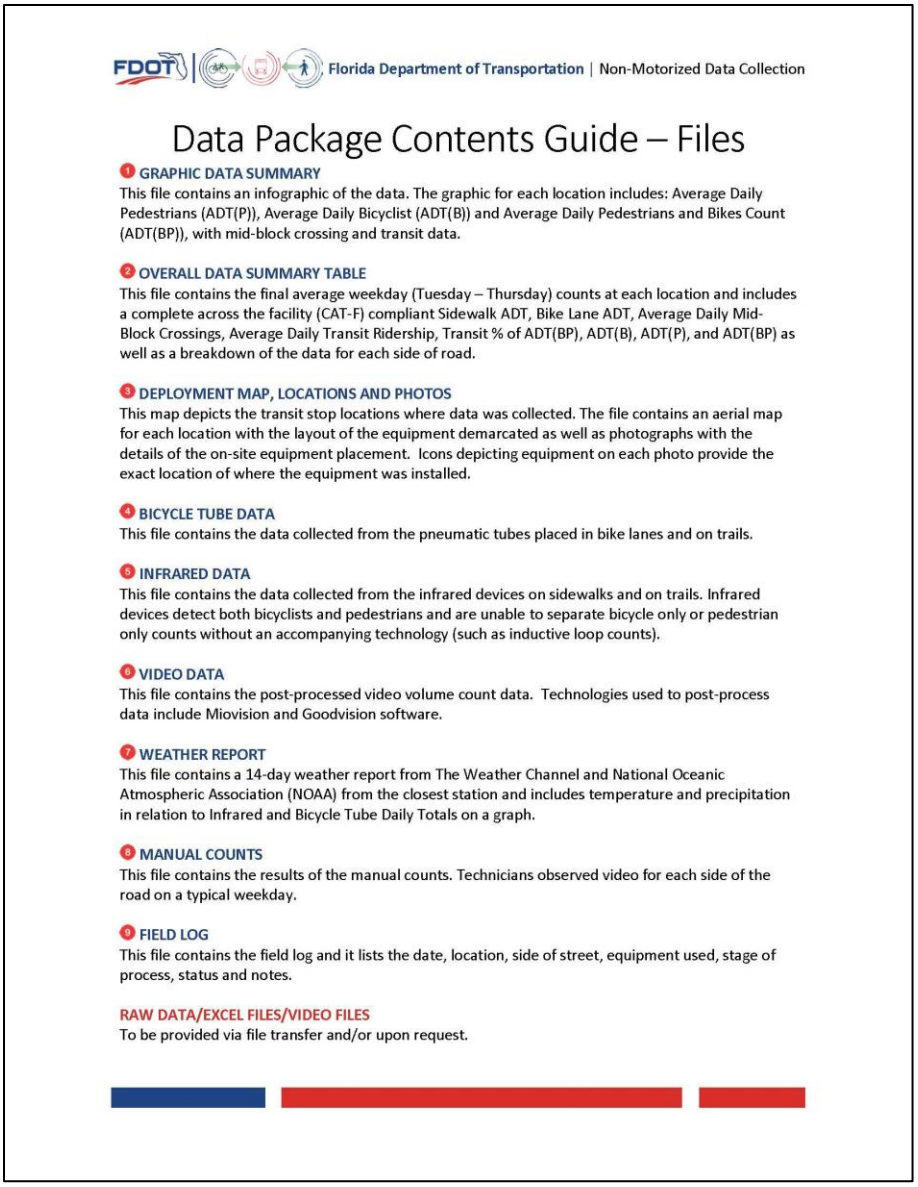
On January 25, 2021 the data was presented to Gainesville city staff and transit staff. The staff complemented the compilation and presentation of the information. Staff confirmed that there was an ongoing UF research effort looking at real time video. The discussion included modal split and if the data can differentiate between motorized and non-motorized modes. Staff confirmed that Goodvision software can break down the traffic by mode. Staff also asked if data is GIS-based. While there are shapefiles of the locations, the data is currently not formatted in GIS. The team highlighted the permanent counter recently placed on University Blvd., and the process of using short-term counts to vet permanent count locations. It was noted that this permanent count location would be highlighted later in the day at a meeting on the University corridor. The transit director stated that it would be valuable to have before/during/after COVID-19 data. The team noted that although the project was limited to the 2-week count, ongoing coordination with the non-motorized FDOT program would continue.

Each agency was provided a Data Package Contents Guide to assist them in reviewing the data. A sample guide is shown here. The Data Package Contents Guide is a resource to present the robust data sets in a more streamlined way by breaking down the data types and materials produced with an explanation. The

Data Package and the Contents Guide evolved over the life of the project and with each transit agency as the project team made decisions and built on the lessons learned. Below is a sample from the Indian River Data Package.

The materials included in the Data Package were listed with an explanation of each resource. The agency was provided:

1. Graphic Data Summary, an infographic of the data,
2. Overall Data Summary Table, a final table with the totals for each location by collection device,
3. Deployment Maps and Photos, equipment layouts for each location with photos of the equipment on-site,
4. Bicycle Tube Data, totals by hour by day of the bicycle tube data,
5. Infrared Data, totals by hour by day from the infrared devices,
6. Video Data, post-processed video data,
7. Weather Report, weather information by day for each location,
8. Manual Counts, results of staff watching the video, and
9. Field Log, details on the equipment deployment, checks and pick up.



Florida Department of Transportation | Non-Motorized Data Collection

Data Package Contents Guide – Files

1 GRAPHIC DATA SUMMARY
This file contains an infographic of the data. The graphic for each location includes: Average Daily Pedestrians (ADT(P)), Average Daily Bicyclist (ADT(B)) and Average Daily Pedestrians and Bikes Count (ADT(BP)), with mid-block crossing and transit data.

2 OVERALL DATA SUMMARY TABLE
This file contains the final average weekday (Tuesday – Thursday) counts at each location and includes a complete across the facility (CAT-F) compliant Sidewalk ADT, Bike Lane ADT, Average Daily Mid-Block Crossings, Average Daily Transit Ridership, Transit % of ADT(BP), ADT(B), ADT(P), and ADT(BP) as well as a breakdown of the data for each side of road.

3 DEPLOYMENT MAP, LOCATIONS AND PHOTOS
This map depicts the transit stop locations where data was collected. The file contains an aerial map for each location with the layout of the equipment demarcated as well as photographs with the details of the on-site equipment placement. Icons depicting equipment on each photo provide the exact location of where the equipment was installed.

4 BICYCLE TUBE DATA
This file contains the data collected from the pneumatic tubes placed in bike lanes and on trails.

5 INFRARED DATA
This file contains the data collected from the infrared devices on sidewalks and on trails. Infrared devices detect both bicyclists and pedestrians and are unable to separate bicycle only or pedestrian only counts without an accompanying technology (such as inductive loop counts).

6 VIDEO DATA
This file contains the post-processed video volume count data. Technologies used to post-process data include Miovision and Goodvision software.

7 WEATHER REPORT
This file contains a 14-day weather report from The Weather Channel and National Oceanic Atmospheric Association (NOAA) from the closest station and includes temperature and precipitation in relation to Infrared and Bicycle Tube Daily Totals on a graph.

8 MANUAL COUNTS
This file contains the results of the manual counts. Technicians observed video for each side of the road on a typical weekday.

9 FIELD LOG
This file contains the field log and it lists the date, location, side of street, equipment used, stage of process, status and notes.

RAW DATA/EXCEL FILES/VIDEO FILES
To be provided via file transfer and/or upon request.

Based on the follow-up meetings with the transit agencies throughout the life of this project, numerous uses for the non-motorized data collected near transit have been identified. Each type of data collected whether video, tube or infrared provides a resource. The uses include transit stop design, new routes, high ridership locations, transfers, safety, pedestrians, bicyclists, security, accessibility, corridor studies, transit adjacent to trails, before/after data, transit-oriented development (TOD), and school interaction. Staff also stated interest in a public facing database of non-motorized data to inform decision-making.

Beyond stakeholder engagement regarding data application, the following table summarizes effective methods to apply non-motorized traffic data for transit purposes.

Table 3: Non-Motorized Traffic Data Applications for Transit Purposes - Data Usage Table Categorized by Transit Activity

Transit Activity Type (Data Usage Category)	Non-Motorized Traffic Counting Data Usage
Design	Transit station/stop design scale Roadway geometry ADA accessibility Bicycle/pedestrian furniture/shade/amenities 1st mile – last mile infrastructure Context classification research Signalization Crosswalk design
Economics	Benefit of non-motorized improvements Non-Motorized/Micro-mobility demand Transit-Oriented Development (TOD)
Finance	Inform funding prioritization
Legislation	Selection of transit routes Transit policy
Maintenance	Maintenance scheduling and prioritization
Operations	Signal timing for pedestrians, bicyclists, and transit Passenger information
Planning	Transit network evaluation Prioritize transit projects New routes justification High ridership location identification Transit transfers Transit accessibility Corridor studies Transit adjacent to trails Before/after data Facility upgrades Transit-Oriented Development (TOD) School interaction Micro-mobility trends Intelligent Transportation Systems Wayfinding and signage
Environmental	Carbon footprint analysis Emission reduction Equity and Environmental Justice considerations

Safety and Security	Safety Study Crash rates and analysis Mid-block crossing justification Security features Lighting ADA features Emergency operations
Statistics	Annual Average Daily Bike and Pedestrian Traffic Count Across the Facility data
Private Sector	Development planning Transportation Demand Management (TDM) Traffic Impact Studies Access Management Development Review opportunities Transit-Oriented Development (TOD) Public Private Partnerships
Administration, Other	Performance measurement Resource allocation Emergency operations Asset management

7. BEST PRACTICES/LESSONS LEARNED AND NEXT STEPS

With any project that is covering new ground, the opportunity exists to identify the lessons learned and to find the resulting opportunities and follow-up actions. The team was able to respond to many of the below issues through the evolution of the project. In other cases, the team noted the issue and suggests future actions for further consideration. Overall, the project issues and opportunities can be summarized into the following categories; Equipment, Site Selection, Travel Behavior, Safety, and Outreach. These issues and opportunities are summarized in the table below.

Table 4: Issues & Opportunities

CATEGORY	ISSUE	DETAILS	OPPORTUNITY	ACTION
EQUIPMENT	**OCCLUSION**	One of the challenges with infrared data collection devices is occlusion. Occlusion occurs when pedestrians are walking adjacent to each other and multiple pedestrians are only counted as one due to the direction and limitations of the infrared device.	Project team members were able to verify data accuracy of infrared counts through video detection software and manual count comparisons.	Data Quality Assurance and Quality Control (QA/QC) processes should always be implemented in projects requiring the highest quality of data. In this project several equipment and counting technologies were used to ensure counts provided have a high level of accuracy.
SAFETY	**BIKE TUBE DEPLOYMENT LOCATIONS**	Since bike tubes cause intrusive obstructions on sidewalks, FDOT instructed the team not to locate bicycle tubes on the sidewalks as a safety precaution.	Project team members were able to use other technologies that were non-intrusive to count NMTM volumes such as video and infrared detection equipment.	Since bike tubes are not an option for counting volumes on sidewalks, other technologies such as video and infrared detection technologies

				need to be utilized for counting NMTM volumes.
TRAVEL BEHAVIOR	**BIKE TUBES IN BIKE LANE**	The project team installed bicycle tubes on trails and on roadway designated bike lanes. The team found this technology to be inaccurately reporting counts on bike lane locations both under and over-counting.	The project team found data collected from road tubes on bike lanes to be inaccurate deeming this technology to be inappropriate for bike lanes. This is due to the travel behavior of the cyclists going around and not over the bike tubes to be counted causing under-counting and under-reporting of volumes to occur. Cars and Trucks would also drive over the tubes in the bike lane causing over-counting and over-reporting of volumes to occur.	Policies for where to use certain equipment based on travel behaviors should be established for the statewide NMTM program. This includes not using bike tube technology to count NMTM volumes on designated bike lanes.
EQUIPMENT	**VANDALISM**	In downtown Fort Lauderdale the infrared equipment was vandalized. The infrared machine was hanging open but still continued to collect data.	Regularly scheduled checks on the equipment on site by a capable crew for repairs can assist in noting any vandalism and repairing the damage in a timely manner.	NMTM statewide data collection policies should include regularly checking the equipment when installed.

EQUIPMENT / SAFETY	**LIGHTING**	Lighting conditions can prevent the video equipment from being able to capture volume data in low light locations.	On site reviews at night are important as is coordination with local agency staff to determine potential hours of activity for the data collection. A minimum of 24 hours should be collected at all sites. The project team found that even if volume data cannot be captured, several safety concerns (travel behaviors) were captured at night including pedestrian crossing at mid-block and dropped off pedestrians / pedestrians leaving busses crossing mid-block without adequate lighting.	24-hour data collection is important using video technologies and should be added to NMTM statewide data collection procedures.
SITE SELECTION	**LOCATION**	The team found that certain equipment (infrared devices, bicycle tubes, video cameras) are more successful in capturing data in certain locations. Urban, suburban and rural roadways have varying limitations.	Analyzing the equipment used and comparing with FDOT context class could potentially assist in developing a list of recommended equipment for different roadways by context class.	Implementing site selection methods as used in this project are mission critical to any NMTM data collection project and should be used when collecting NMTM volume data at and around transit facilities.

TRAVEL BEHAVIOR	**CYCLIST COMFORT**	Many bicyclists were found riding on the sidewalk when the bike lane was adjacent and available.	Additional study needs to be conducted to analyze the rider experience on the sidewalk and the reasoning behind the decision to ride on the sidewalk and the extent that vehicle speed is a factor.	FDOT should develop a follow-up intercept survey study to gain more knowledge on travel behaviors.
SAFETY / TRAVEL BEHAVIOR	**MID BLOCK CROSSINGS**	The video detection software identified numerous locations with dangerous mid-block crossings.	Video detection equipment allowed the team to identify potential safety improvement opportunities at certain sites that could be prioritized, funded and built as a facility safety improvement.	Safety near transit stops is important and video detection tools need to be incorporated as a routine method of collecting data to capture potential safety and travel behavior issues.
OUTREACH	**COMMUNICATION**	Early in the project the equipment was not clearly labeled and was removed by outside agency staff (non-FDOT project staff) due to miscommunication and a perceived security threat.	Later in the project, all of the equipment was labeled with agency and phone number for any questions. Also, photos of the equipment and deployment location maps were provided in advance of the equipment deployment.	For all data collection device installations, communication with and education of local agencies is key to avoid any security concerns.

8. CONCLUSIONS

Capturing non-motorized and micro-powered traffic monitoring (NMTM) mobility, while similar to monitoring motorized traffic, is uniquely challenging, but similarly requires careful and strategic planning prior to implementing data collection activities. In general, NMTM transit data collection is challenging due to multiple facilities (roadway, sidewalk, trail, bikelane, etc.) that make up a count at one location. There are also challenges due to the undetermined and unrestricted travel patterns where pedestrians are not restricted to funneling points and several NMTM travelers choose travel patterns that are unsafe. Finally, counting near transit requires multiple combinations of technologies (Infrared, Tube, Camera, etc.) to get a complete across the facility (CAT-F compliant or mid-block) count. Findings from this project have been incorporated into the recommendations for future transit NMTM data collection activities and are found below.

The following are recommendations and enhancements for continued transit resources coordination with statewide NMTM data collection activities:

1. **Conduct Additional Statewide Data Collection Activities.**

   This project was able to include data collection activities that included 5 different transit agencies, but the project budget only allowed for a total of 26 across the facility counts to be collected. Conducting additional data collection activities is needed to address all of the transit data user needs within the State of Florida, in addition to continued fine-tuning the processes and protocols to ensure accurate data is collected.

2. **Continue Following Statewide Site Selection Standardized and Documented Methods.**

   Statewide coordination of transit data collection with statewide NMTM data collection activities has proven to be worthwhile by collecting data for two purposes and will continue to ensure data is used by transit facility staff. Statewide coordination of transit data collection with statewide NMTM data collection activities allow strategic data collection efforts to be focused on the users as well as the statewide data collection program needs.

3. **Develop a Training Program and Provide Regular Data Collection Training to Data Partners.**

   Statewide coordination of transit data collection with statewide NMTM data collection activities has proven that more statewide data support is needed. This includes assisting agencies (MPO/City/County) to (1) select sites, (2) determine location specific counting specifications for accurate and complete across the facility counts, and (3) choose counting technologies that yield desired results including advice on the combination of technologies required to collect data at a facility. Statewide coordination of transit data collection with statewide NMTM program data collection activities require skilled resources knowledgeable in the data collection, data analyses, and data utilization of NMTM data. Findings during this project included the need for resources, including training and knowledge transfer from the State to the transit agency. It is recommended that FDOT develop a transit data collection training program that provides regularly scheduled updates of data collection activities including the coordination and presentation of data planned to be collected, already collected, and data analyses/findings to date as well as agency experiences with the process and their findings.

4. **Continue to Collect Short-term Count Data Using Multiple Technologies.**

   Project findings further confirmed nationally accepted and published methods of combining technologies to collect short-term counts for a 2-week period are beneficial to establish accurate travel patterns and groups. During this project, several events happened such as weather (rain storms) and counter vandalism that affected the overall counts for several hours and in some cases at some sites for several days. Because a 2-week data collection period was part of the project's goalss, data was available that represented at least one day or the week for all 7 days of the week. Video cameras are essential to support traditional sensor technology validation and document behavior.

5. **Create a Statewide NMTM Transit Data Collection Application**

   During this project, data was collected at over 25 sites across the transit facility locations from five different agencies. However, there are many more transit agencies and transit locations from which to collect NMTM data. To meet data user needs, an entire statewide data application that contains volume data in both directions of travel is required. Therefore, it is recommended that FDOT combine statewide non-motorized data with transit agency data layer by continuing the work that was completed during this project that includes: working with transit agencies, conducting site selection activities, collecting short-term data, evaluating data including transit ridership data, and providing reports that include the data collected.

In addition, there are two immediate projects recommended as follow-on projects to this Phase 1 - Transit project:

1. **Phase 2 - Non-motorized Factor Application Study**– The project team has already collected much of the data needed for completing a non-motorized factor application study. This data was collected during the Phase 1 – Transit Data Collection Project Study between September 2019 and September 2020. Project findings from the Phase 1 transit data collection project uncovered a need to study the factoring methods for applying factors to non-motorized traffic volume data in effort to increase the accuracy of data collected. Applying adjustment factors to data that is collected using non-motorized equipment requires a complete and thorough understanding of the accuracy of data collected, expertise in the factoring process currently utilized with motorized traffic data, and knowledge of the sites where data was collected which the project team gained during Phase 1.

   During Phase 2 of the project, the consultant would use the data already collected and compare several different methods of applying factors. The Federal Highway Administration's (FHWA's) national *Traffic Monitoring Guide* (TMG) provides limited information on factoring non-motorized data that would be adhered to and expanded upon during Phase 2. The consultant proposes to evaluate as many factoring methods as possible by grouping factors into three types of factors needed, engineering statistical factors, equipment adjustment factors and data collection processing factors. For example, engineering statistical factors could include peak hour, directional distribution, and classification (bike/ped/other) factors, where equipment adjustment factors could include adjusting for occlusion/weather/etc., and data collection processing factors could include Time-of-Day (TOD), Day-of-Week (DOW), Month-of-Year (MOY), and Year-to-Year

(YtY) factors that are all temporal factors. While continuous counting station data is needed to perform some of the factoring, a number of short-term counts already collected could provide much needed data for analyses to develop TOD and DOW factors.

In a Phase 2, a non-motorized factoring methodology could be developed which would be tested, evaluated for accuracy, and documented so the Florida traffic data coalition, transit agency partners, and other non-motorized data collection programs across the nation can follow the factoring protocols.

2. **Phase 3 – Equipment Data Accuracy Study** – The project team has already collected much of the data needed for completing a non-motorized equipment evaluation and accuracy study. This data was collected during the Phase 1 – Transit Data Collection Project Study between September 2019 and December 2020. Project findings from the Phase 1 transit data collection project uncovered a need to study the accuracy of the data being collected using several different types of technology. This need was discovered during the normal process of quality assurance and quality controlling (QA/QC) data collected during Phase 1. For example, data collected using camera technology was found to be 90+ percent accurate when collecting data during daylight hours in high volume sites, where infrared technologies were found to be less accurate at higher volume sites with only 60+ percent accuracy. The consultant proposes to study the data and equipment used during the transit study to develop results and recommendations that will guide the site selection process in the future. For example, data collected during this transit study showed sites that require a bicycle tube installation might only be accurate when installed on trail-only locations.