RESEARCH & DEVELOPMENT

Guidelines for Implementation of Right Turn Flashing Yellow Arrows and Leading Pedestrian Intervals

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16. Abstract

North Carolina has been a leader in implementation of flashing yellow arrows (FYA) for left turning permissive movements. The public acceptance of such devices has resulted in the implementation of FYA for right turns at intersections with high pedestrian volumes. In addition to this, there are existing sites where Leading Pedestrian Intervals (LPI) have been deployed. LPIs allow pedestrians to enter the street before concurrent vehicular movements are given a green indication.

This report provides data from 10 RT FYA and 14 LPI stand-alone treatment locations across NC. No data were able to be captured at sites with the combination of both treatments at the time of closing the project. Data were only collected at sites following installation as there were no new installations to capture before and after data. For this reason, the project was closed early as nearby sites posed problems to capture surrogate data to represent the before data condition.

Even so, the data captured from both stand-alone treatments following construction offer some potential insights. On first glance, LPI's seem to provide better yielding to pedestrians compared to RT FYA's, with yield rates of 84% compared to 49%, respectively. However, as this study indicates, there may be inherent flaws when comparing the yield rates based on location and staged versus naturalistic crossings. Second, although sample sizes were relatively small, there appeared to be no difference in yield rates when comparing single and dual lane configurations where multiple-threat situations may present dangerous conflicts. Last, observations from the field indicated that most conflicts and violations were the result of vehicles turning right-turn-on-red. As such, the research team believes the use of "blank out" signs in lieu of static signage could help encourage more yielding to pedestrians when the push button is activated. However, given the limited studies of such signs, they should be studied carefully to determine the effectiveness of the additional treatment.

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Executive Summary

North Carolina has been a leader in implementation of flashing yellow arrows (FYA) for left turning permissive movements. The public acceptance of such devices has resulted in the implementation of FYA for right turns at intersections with high pedestrian volumes. In addition to this, there are existing sites where Leading Pedestrian Intervals (LPI) have been deployed. LPIs allow pedestrians to enter the street before concurrent vehicular movements are given a green indication. This allows drivers better sight distance of pedestrians in the intersection.

Charlotte DOT, along with other municipalities and NCDOT Divisions have implemented RT FYA at numerous sites in conjunction with a leading pedestrian interval (LPI). The LPI allows pedestrians to enter the intersection before the vehicle movement receives a green (or flashing yellow) indication, thereby providing right-turning vehicles with a better view of the pedestrians they must yield to.

The objectives of this research include determining 1) the conditions under which LPIs and RT FYA provide benefit to the pedestrians, 2) how RT FYAs, LPIs, and the combination impact driver yielding rates, and 3) the impact of LPIs on vehicular delay.

In total, 10 RT FYA and 14 LPI stand-alone treatment locations were studied across NC. No data were able to be captured at sites with the combination of both treatments at the time of closing the project. Data were only collected at sites following installation as there were no new installations to capture before and after data. For this reason, the project was closed early as nearby sites posed problems to capture surrogate data to represent the before data condition. The report here-in provides a synopsis of work completed prior to the cancellation of the project due to site identification issues

The data that was captured from both stand-alone treatments following construction of each of the treatments prior to the closeout of the project did offer some insights. The data collected as part of this study seems to indicate that LPI's provide much better yielding to pedestrians than RT FYA's with yield rates of 84% compared to 49%, respectively. However, this comparison comes with at least two inherent flaws that should be studied more carefully in the future. First, RT FYA sites required the use of significantly more staged pedestrian crossings when compared to LPI sites, indicating possible bias as drivers in the area were not exposed to pedestrians at a similar rate. Second, the locations where RT FYA and LPI installations were evaluated varied greatly across the state.

Two other findings were noted in this study. First, although sample sizes were relatively small, there appeared to be no difference in yield rates when comparing single and dual lane configurations where multiple-threat situations may present dangerous conflicts. Second, observations from the field indicated that most conflicts and violations were the result of vehicles turning right-turn-on-red. As such, the research team believes the use of "blank out" signs, in lieu of static signage, with an activated message such as "Yield to Pedestrians" could help improve yielding rates. Relatively speaking, this dynamic feature is cost effective compared to the rest of the signalization features already present and could help encourage yielding to pedestrians when the push button is activated. If this supplemental treatment is considered, a before-and-after study should be considered to determine the effectiveness of this additional treatment.

Disclaimer

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1. Introduction

In recent years, drivers have become accustomed to left turn flashing yellow arrows (FYA) as an indication to yield to opposing traffic movements. Given that success, efforts have now been made to implement a right turn (RT) FYA as an indication to drivers to yield to conflicting pedestrian movements. In some cases, a Leading Pedestrian Interval (LPI) has been used with and without a RT FYA which allow pedestrians the ability to enter the intersection ahead of the right turn vehicle phase, thereby becoming more visible to drivers.

Questions have risen about the effectiveness of these two strategies and the conditions under which they should be implemented. The objectives of this research effort were to develop guidelines for when to use the RT FYA, when and how LPIs should be used with or without the RT FYA, and documenting the expected impact on yielding, pedestrian safety, and vehicular delay. As noted in the proposal, these guidelines should be developed from field generated data using the best possible comparison methods available.

After a significant effort collecting data at previously constructed FYA and LPI sites, several concerns arose about the efficacy of the analysis method that would need to be employed. As such, the project was cancelled. This report provides a summary of the work done to date for reference by NCDOT staff or future research teams should the opportunity present itself to conduct a true before-and-after analysis of FYA and LPI.

2. Literature Review

Prior work in the two subject areas – namely Flashing Yellow Arrows (FYA's, right and left turn) and Leading Pedestrian Intervals (LPI's) – has shown better driver understanding of traffic signal indications and improved safety for pedestrians wanting to cross the conflicting right turn vehicular movement. A broad scan of work in these two areas is provided below for reference and should help guide the research effort as well as assist in future guidance development.

2.1. Flashing Yellow Arrow

2.1.1. Operation and Safety Effects

In recent years, use of the flashing yellow arrow (FYA) signal for permissive left-turn (PLT) or the permissive portion of protected-permissive left-turn (PPLT) phasing has become an increasingly popular treatment for indicating left-turn traffic to yield to opposing traffic movements. In the early 2000s, extensive research through a National Cooperative Highway Research Program (NCHRP) grant evaluated the use of the FYA as a permissive left-turn indication through a series of approaches including expert surveys, field study, crash analysis, etc. This research provided evidence that a FYA left-turn application was a safe and well comprehended indication, and was deemed a practical alternative to the circular green indication (*Brehmer et al., 2003*). Based on this NCHRP study, the 2009 Manual on Uniform Traffic Control Devices (MUTCD) stated that the FYA indication aims to relay the message for drivers to cautiously approach and enter the intersection before making the movement displayed by the arrow;

the yellow arrow signal provides drivers with a warning message to observe surroundings prior to performing the intended maneuver (*FHWA, 2009*).

Shortly after the MUTCD inclusion of the FYA, *Hurwitz and Monsere (2013)* investigated the conflict between pedestrians and the permissive left-turning vehicles based on a driving simulator study. The effects of opposing traffic, the presence and walking direction of pedestrians, and the number of section heads to display the FYA on driver performance were investigated. This research revealed that the increased presence of pedestrians led drivers to focus more attention on these crossing pedestrians, while the increased number of opposing vehicles also distracted left-turning drivers in terms of fixating on pedestrians. In terms of the display of the FYA, no significant difference was found between any variable and the presence of a three- or four-section head. Nevertheless, this driving simulator study did not present a clear conclusion regarding the use of FYA, particularly under high pedestrian volume conditions. Instead, the results suggest that it may be desirable to limit the permissive operation when pedestrians are present.

In view of the potential limitations of the driving simulator-based approach, a number of studies have been conducted to evaluate the safety and operational impacts of FYA based on real-world data.

Appiah and Cottrell (2014) reviewed state-of-the-practice on the use of the optional FYA delay through a literature review, a survey of state departments of transportation, and consultations with practitioners and national experts. It was found that approximately 70% of the responding state departments of transportation that use the FYA also delayed the start of the FYA because of the perceived safety benefit. In addition, based on a simulation study, this research showed significant safety benefits in a delay to the start of the FYA signal indication with no significant negative impacts on average delay, average queue length, or average stopped delay for either left-turning traffic or the intersection.

Simpson and Troy (2015) developed crash modification factors (CMFs) for the implementation of FYA's using naïve before-and-after studies of 222 signalized intersections in North Carolina. Five category types of FYA were identified and evaluated, namely: permissive only to FYA-PPLT, protected only to FYA-PPLT, protected only to FYA-PPLT with time of day operation, five-section PPLT to FYA-PPLT, and permissive only to FYA permissive only. In general, results showed a statistically significant decrease in target left-turn crashes and injury crashes after a signal underwent a change from a solid green ball to an FYA for permissive left turns when phasing remained unchanged.

Rescot et al. (2015) evaluated the use of FYA for permissive left turns in Indiana through the analysis of field collected driver behavior, a survey, and a national review of media reports. In conclusion, this research recommended that a larger scale implementation of FYA signal heads should be considered in view of the huge benefit-cost ratio of FYA.

Scattler et al. (2017) evaluated the safety-effectiveness of FYAs at 86 intersections and 164 approaches in central Illinois based on three years of before-and-after FYA installation crash data using the Empirical Bayes (EB) method. The resulting mean CMFs for the targeted crash types ranged from 0.59 to 0.71,

which supported the continued use of FYAs for PPLT control to improve safety at signalized intersections in central Illinois.

Appiah et al. (2018) conducted a before-and-after safety evaluation of deploying FYA at PPLT signals at 28 intersections in Virginia. The results indicated that using the FYA signal indication instead of the circular green indication had a statistically significant effect in reducing overall frequency and severity of crashes, with total crashes reducing by 12% following conversion from PPLT to PPLT-FYA.

Srinivasan et al. (2018) employed the EB before-and-after analysis approach for evaluation of FYA's using data from signalized intersections in Nevada, North Carolina, Oklahoma, and Oregon. This research divided the FYA treatments into seven categories based on the phasing system, the number of roads, and the number of legs at the intersections. Results showed that the reduction of left-turn related crashes ranged from 15% to 50% depending on the treatment category. Nevertheless, it was found that intersections that had at least one protected left turn phase in the before period and had FYA protected–permissive left turn phase in the after period experienced an increase in left turn crashes and left turn with opposing through crashes, indicating that replacing a fully protected left turn with FYA might cause an increase in left-turn crashes.

2.1.2. Implementation Guidelines

In terms of the implementation guidelines for FYA, the MUTCD provides detailed guidelines on the use of different FYA display patterns *(FHWA, 2009)*. *Hurwitz et al. (2015)* further investigated the conditions for implementation of three- or four-section FYA signal displays. This research pointed out that the MUTCD permits the operation of a three-section vertical head FYA only for permissive turns in locations where heights are restricted, while some jurisdictions have or are considering implementing FYA with a three-section vertical head for cost and other reasons. Through a driving simulator experiment, this research concluded that measurable driver performance was not changed significantly by the vertical positioning of the FYA display in the permissive interval.

Davis et al. (2015) developed guidelines for time-of-day use of permitted left-turn phasing, which can be implemented using FYA. Statistical models, which were embedded in a spreadsheet tool, were developed to estimate the risk of left-turn crashes dependent on left-turn demand, opposing traffic demand, and intersection classification. Intersections are classified by approach speed and whether left turn vehicles have sight distance issues. This research recommended that, for a candidate intersection approach, the implementation of FYA should be determined based on existing turning movement counts, and a classification of the approach with respect to speed limit, turn protection, and sight distance issues, and receive a prediction of how the risk of left-turn crash occurrence varies throughout the day.

2.1. Right Turn Flashing Yellow Arrow

2.1.1. Operation and Safety Effects

Since the FYA for permissive left turn indication was introduction to the 2009 MUTCD, it had significant success in communicating the permissive left turn message. In light of this, more recently transportation agencies have been utilizing FYAs for the use with right turn applications (hereafter referred to as RT FYA's) as drivers interact with crossing pedestrians. For instance, in 2015, the Utah DOT installed right turn FYAs at several interstate highway off-ramps to state route arterials in Lehi, Utah which provided indication to drivers when they should watch for and yield to pedestrians prior to moving from the off-ramp to the arterial.

The application of FYA indications on right turns may have an impact on drivers' yielding behavior and pedestrian safety at signalized intersections. In this regard, a number of studies have been conducted to investigate the effects of RT FYA on driver behavior and assess the safety benefits for pedestrian due to the changes of driver behavior. Some representative studies are described in this section.

Furth et al. (2014) explored a phasing scheme named "protected-yet concurrent phasing" for cyclists and pedestrians, in which right turns have their own phase and bike and pedestrian crossings run in their own distinct phase concurrent with the parallel vehicular through phase. Based on seven case studies in the United States and the Netherlands, this research concluded that this phasing scheme outperformed the all-pedestrian phasing scheme (sometimes referred to as the "Barne's Dance") in terms of traffic operation efficiency. *Boot et al. (2015)* investigated driver and pedestrian behavior at RT FYA signals with a pedestrian indicator (FPI) through a static survey approach. Results showed that although there was some confusion regarding the meaning of the FPI for drivers proceeding straight through the intersection, drivers could quickly pick up on the meaning of the FPI. In addition, compared to a regular signal, it was found that the FPI significantly encouraged more decisions to yield to pedestrians within a crosswalk; participants were more likely to make a response to yield when the FPI was active even when no visible pedestrian was present.

Similarly, *Knodler et al. (2017)* evaluated driver understanding of the RT FYA and a dynamic no-turn-on-red sign using a computer-generated static survey evaluation to determine whether drivers grasp the message of the devices. Results indicated that drivers have strong comprehension of the RT FYA and dynamic no-turn-on-red messages; there was a significant increase in the response designating the action of yielding as approaching the intersection from the existing condition to the RT FYA.

Hurwitz et al. (2018) investigated the safety and operational implications of using FYA in permitted and protected/permitted right turn (PPRT) operations in Oregon though a web-based survey, a microsimulation model, and a driving simulator study. In summary, the web-based survey revealed that, although there was a general misunderstanding of the required driver response for the steady red arrow signal indication, comprehension of the RT FYA was high. The microsimulation model of several PPRT phasing alternatives indicated that pedestrian volume had the greatest effects on delays, and the driving

simulator experiment proved that driver responses were relatively consistent with those observed in the web-based survey.

Later, *Jashami et al. (2019)* presented a more detailed driving simulator-based study on Oregon driver comprehension and behaviors related to the RT FYA. This study considered signal indication type, active display, length of the right-turn bay, and presence of pedestrians. Results suggested that the RT FYA indication improves driver comprehension and behavioral responses to the permissive right-turn condition since nearly all drivers exhibited caution while turning and yielding to pedestrians when necessary.

Ryan et al. (2019) developed a two-step evaluation methodology – including a large-scale static evaluation and direct driving simulator study – to analyze the effectiveness of FYA for right turn applications in terms of modifying driver behavior (e.g., visual attention, intersection approach speed, and direct perspective). Results revealed that drivers had a strong comprehension of the meaning of the RT FYA and did not behave unsafely when presented with the indication, which indicates that FYA for right turn applications can be an effective countermeasure to mitigate vehicle-pedestrian crashes at signalized intersections.

2.1.2. Implementation Guidelines

The MUTCD documents two categories of RT FYAs. Figure 1 presents the (A) typical position and (B) arrangements of separate signal faces with FYA for permissive only mode right turns *(FHWA, 2009)*. The right-most signal (above the right-turn lane) illustrates a vertical arrangement of right-turn red arrow, right-turn steady yellow arrow, and right-turn flashing yellow arrow signal indications. It includes four arrangements, including two vertical arrangements and two horizontal arrangements of three signal indications – right-turn red arrow/circular red, steady right-turn yellow arrow, and right-turn flashing yellow arrow.

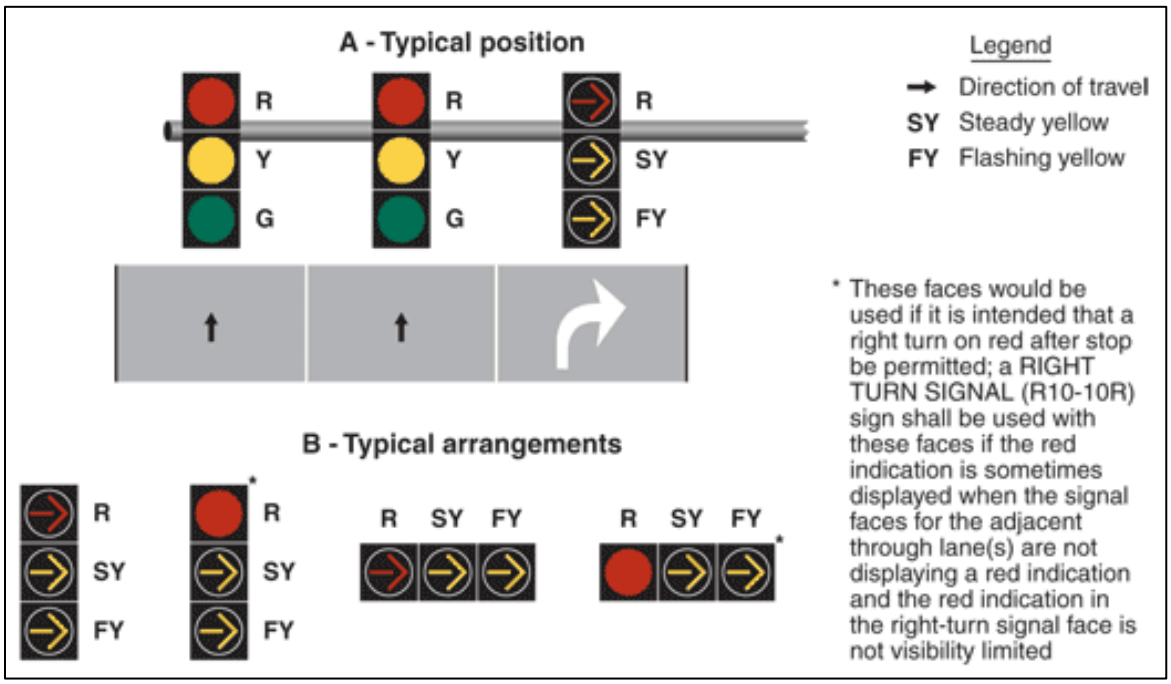

Figure 1. Typical Position and Arrangements of Separate Signal Faces with FYA for Permissive Only Right Turns (copied from Figure 4D-14 of the2009 MUTCD)

Figure 2 presents the (A) typical position and (B) arrangements of separate signal faces with FYA for protected/permissive mode and protected only mode right turns *(FHWA, 2009)*. Similarly, the right-most signal (above the right-turn lane) illustrates a vertical arrangement of right-turn red arrow, steady right-turn yellow arrow, right-turn flashing yellow arrow, and right-turn green arrow signal indications. It also includes four arrangements, including two vertical arrangements and two horizontal arrangements of four signal indications – right-turn red arrow/circular red, steady right-turn yellow arrow, right-turn flashing yellow arrow, and right-turn green arrow.

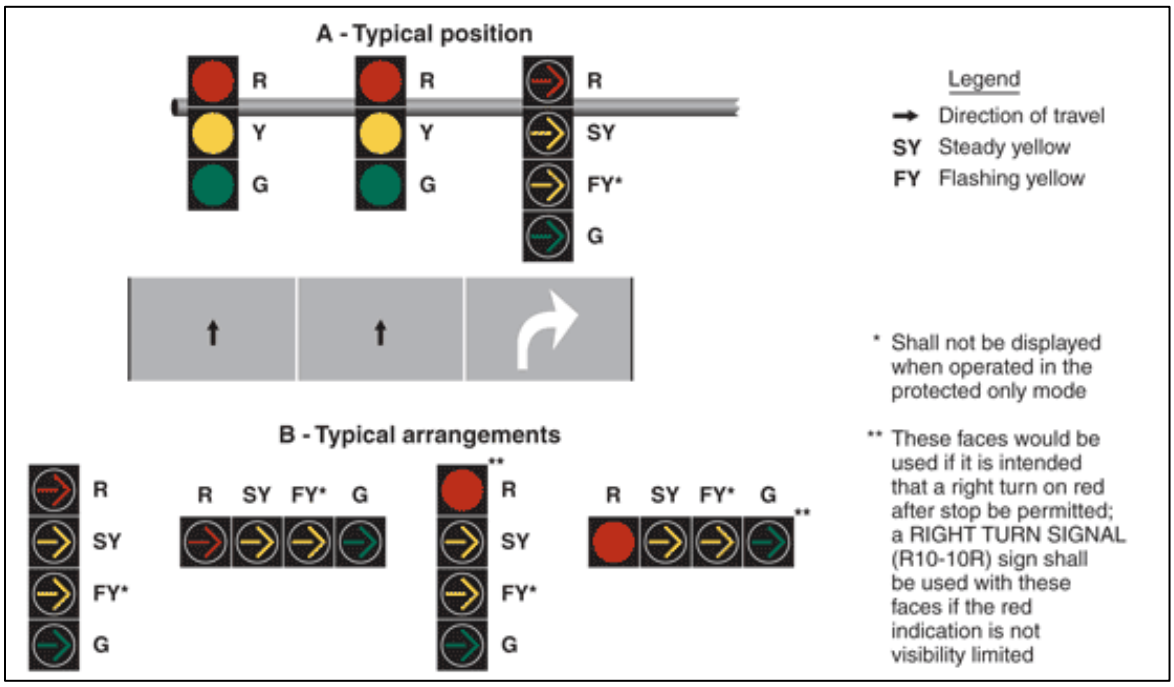

Figure 2. Typical Position and Arrangements of Separate Signal Faces with FYA for Protected/Permissive Mode and Protected Only Mode Right Turns (copied from Figure 4D-19 of the2009 MUTCD)

2.2. Leading Pedestrian Intervals

2.2.1. Operation and Safety Effects

Under most conditions, vehicles are legally required to yield to pedestrians when there is a potential conflict between vehicles and pedestrians. Even so, for many reasons (e.g., driver characteristics, driver distraction, driver impairment, roadway and intersection layouts, surrounding environment), drivers might make risky decisions by accepting short gaps or not yielding to pedestrians which could threaten pedestrian safety – especially when pedestrians enter an intersection with a corresponding green signal in the same direction of travel of vehicles. With this concern, the purpose of the LPI is to provide pedestrians with the opportunity to begin crossing the street before parallel and adjacent right turning vehicles are permitted to proceed. This allows pedestrians to establish a presence in the crosswalk, which increases the visibility of pedestrians to drivers, and thereby reduces conflicts with turning vehicles.

To date, there have been a number of studies that evaluated the safety and operational benefits of LPI's using different datasets and statistical approaches. *King (2000)* analyzed turning vehicle and pedestrian collisions at 26 LPI intersections and their surrounding intersections. This study found a 28% decrease in vehicle turning collisions with pedestrians when compared to control intersections. *Van Houten et al. (2000)* studied three intersections which received LPI interventions and found that a three second LPI reduced conflicts between pedestrians and turning vehicles, as well as reduced the occurrence of pedestrians yielding the right of way to turning vehicles.

Fayish and Gross (2010) conducted a before-after comparison study of 10 signalized LPI's (the treatment group) and 14 stop-controlled intersections (the comparison group) with LPI's in State College, Pennsylvania. The results suggested a 58.7% reduction in pedestrian-vehicle crashes at treated intersections.

Li et al. (2017) evaluated the safety and operational effectiveness of LPI implementations at signalized intersections. This research demonstrated that proper implementations of LPIs could result in promising safety effects in reducing the number of vehicle-pedestrian conflicts. Even though mixed results of drivers' yielding behaviors were found (i.e., a higher percentage of non-yielding vehicles were observed during the first few seconds equal to LPI length, but a lower percentage of non-yielding vehicles were observed during the entire pedestrian walk phase), in general, the percentage of vehicle-pedestrian conflict reduction ranged from 25% to 100%. In addition, based on the simulation analyses for the two most congested intersections before and after LPI implementation, it was found that the implemented LPI induced a slight increase or decrease in average total delay per vehicle on different approaches, showing a trivial adverse or even favorable influence on intersection operation efficiency.

Goughnour et al (2018) employed the EB method for assessing the safety performance of LPIs in Charlotte, Chicago, NYC, and Toronto. Results showed that collisions between pedestrians and vehicles increased in Chicago and Toronto, but decreased in Charlotte and NYC. Overall, this research found a significant effect of LPIs on total crashes and total injury crashes for all cities combined was a Crash Modification Factor of 0.87 and 0.86, respectively.

A recent FHWA research effort evaluated the nationwide safety performance of LPIs on pedestrian safety *(FHWA, 2018)*. It was concluded that the general CMF for total crashes was 0.87 (with CMFs ranging from 0.84 to 0.90). The effect of the LPI treatment on total injury crashes was also consistent across all cities, with CMFs ranging from 0.83 to 0.86. In addition, the effect on pedestrian crashes was generally beneficial, showing decreases in pedestrian crashes across all cities, and an average CMF of 0.87 was recommended for pedestrian crashes.

Sze (2019) evaluated the impact of LPIs on collision and injury outcomes at nearly 13,000 signalized intersections in New York City. The author employed a "difference in difference" fixed effects panel regression to identify the causal effect of introducing LPIs. Results suggested that LPIs decreased quarterly collision counts by 5.45% and decreased the quarterly number of pedestrians injured by 14.7%, indicating that LPIs were effective in reducing both collisions and injuries.

Hubbard et al. (2008) compared pedestrian crossing behavior (i.e., pedestrian yield to a permitted vehicle movement) before and after the implementation of LPIs during a WALK signal at an intersection in Anaheim, California. Results showed a higher rate of pedestrians compromised on the curb after LPIs were implemented. Although this report is quite dated, the findings are contrary to other research summarized on efficacy of LPI's to improve yielding.

2.2.2. Implementation Guidelines

Despite the considerable safety benefits of LPIs, a traffic agency may not implement LPIs at every intersection since the success of treatment is dependent on the characteristics of the location, traffic conditions, pedestrian activities, number of vehicle and pedestrian conflicts, pedestrians' compliance with traffic signal indications, and signal timing due to the potential adverse effects such as extended travel delay or driver complaints on signal timing. Therefore, there is a need to determine the suitability and effectiveness of LPI implementations at signalized intersections to improve pedestrian safety while providing statewide guidelines for LPI implementation.

The MUTCD (*FHWA, 2009*) suggests LPI's at intersections with high pedestrian volumes and high conflicting turning vehicle volumes to reduce conflicts between pedestrians and turning vehicles. It provides guidance that the delay setting for the right turn should be a minimum of 3 seconds in duration and should be timed to allow pedestrians to cross at least one lane of traffic or, in the case of a large corner radius, to travel far enough for pedestrians to establish their position ahead of the turning traffic before the right turning vehicles are released. The City of Toronto has guidelines for LPI intervals that are greater of 5 seconds or using similar equation of MUTCD as following *(Sanneinejad and Lo, 2015)*:

LPI = (ML + PL)/WS,

where, LPI (seconds), ML = width of moving lane in ft., PL = width of parking lane in ft., and WS = pedestrian walking speed in ft/s.

Pecheux et al. (2009) evaluated LPI's in both San Francisco and Miami. The length of the LPI applied was 3 seconds in San Francisco and 4 seconds in Miami. There were no statistically significant differences found regarding vehicle yielding behavior between the before and after conditions at both locations and no difference in yielding behavior between the locations. However, there was a significant increase in the percent of pedestrians crossing in the beginning of the walk phase because LPI's eliminate turning vehicle conflicts for the first few seconds of the walk phase. Currently, the length of the LPI in the U.S. is applied with 3 seconds to as high as 25 seconds by empirically.

Based on the experience of LPI's at six successful installations at suburban intersections in Virginia, *Dittberner and Vu (2017)* pointed out that an elongated LPI is not right for every signalized intersection, but engineers should consider it at intersections with the following characteristics, often found at pedestrian crossings of wide suburban arterials: pedestrians conflicts with a permissive left-turn movements; vehicular through movements parallel to the crosswalk do not exist or are low volume (such as a T-intersection or where a fourth leg of an intersection is a driveway); the pedestrian phase is actuated; and a pedestrian crossing takes more time than vehicular demand.

Sharma et al. (2017) developed a marginal benefit-cost model with quantitative metrics to assist in decision making for implementation of LPIs at a given intersection and estimated costs associated with a traffic conflict. Marginal safety-delay tradeoffs were used to analyze the appropriateness of implementing an LPI at specific signalized intersections. The method provides guidance to help quantify the probability of a conflict occurring and direction on whether to implement an LPI at a given location

from macro-level inputs, including: number of turning movements, crash data, and geometry. A case study with sample data indicated that an LPI was cost-effective for the scenario presented.

Li et al. (2017) developed a statewide guideline for implementing LPIs based on data review, analysis, and findings of the collected data before and after LPI implementation at in Florida test sites. These guidelines are expected to provide traffic engineers with practice-ready LPI warrants and implementation guidelines for appropriate and effective LPI implementation. In summary, factors considered for LPI implementation at signalized intersections mainly include: crash history between pedestrians and turning vehicles, presence of visibility issues blocking driver view of pedestrians, lane use type that attracts pedestrians near signalized intersections, risk potential of conflicts at a specific approach based on a combination of vehicular and pedestrian volumes, presence of marked school crossing, and citizen complaints about vehicles not yielding to pedestrians. In addition, this research recommended to implement static or blank-out "NO TURN ON RED" signs or "TURNING VEHICLES YIELD TO PEDESTRIANS" signs along with some LPI implementations to improve the safety of several LPIs in Florida.

2.3. Summary

In summary, this literature review found that there has been abundant evidence supporting FYA's (left and right turn) and LPI's in terms of improving pedestrian safety at signalized intersections. There are also considerable guidelines for the implementation of FYAs or LPIs considering various intersection geometric features, traffic demands, and signal control strategies. However, little research has been done in two meaningful areas. First, there has been little-to-no information reported on the efficacy right-turn-on-red operations and its impact on yielding with RT FYA and LPI treatments in place. Second, there is limited guidance on the impact of these two treatments used in conjunction, particularly with regards to the conditions under which implementation is recommended. Since the planning, design, and operation of signalized intersections are complex processes that require the balancing of safety and efficiency for all system users, by studying the two treatments simultaneously, it can be determined if there is an improvement in pedestrian safety over using one treatment in isolation.

3. Site Selection

3.1. Treatment Sites

Shortly after the initial kickoff meeting with the project panel, a request for planned or constructed RT FYA and LPI sites was made in writing to the fourteen NCDOT Divisions, NCDOT Signal Design Section, and various municipal public works/transportation offices. From this request, a total of 77 sites were initially provided in either the planning or operational stages – 28 stand-alone RT FYA, 38 stand-alone LPI, and 11 combined RT FYA + LPI. For reference, a map of each of the site locations across the state are provided in Figure 3, Figure 4, and Figure 5.

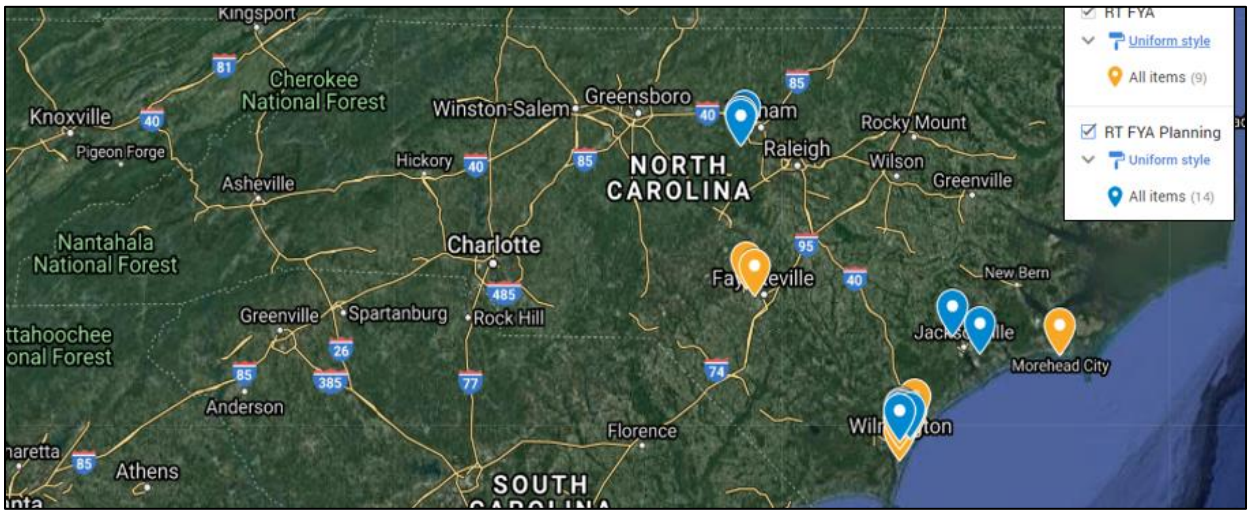

Figure 3. Planned and Operational Right Turn Flashing Yellow Arrow (RT FYA) Sites Across NC

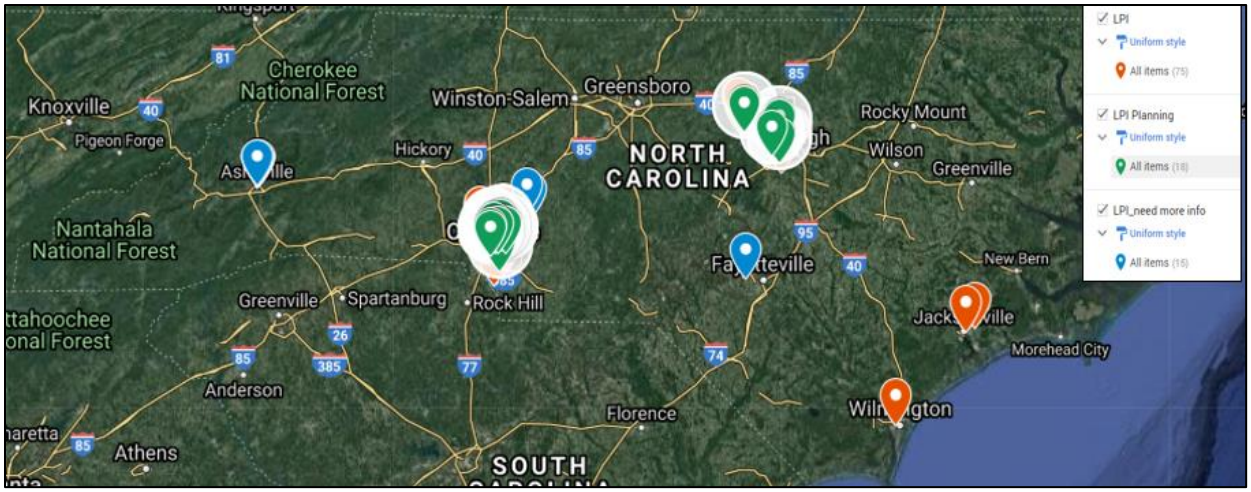

Figure 4. Planned and Operational Leading Pedestrian Interval (LPI) Sites Across NC

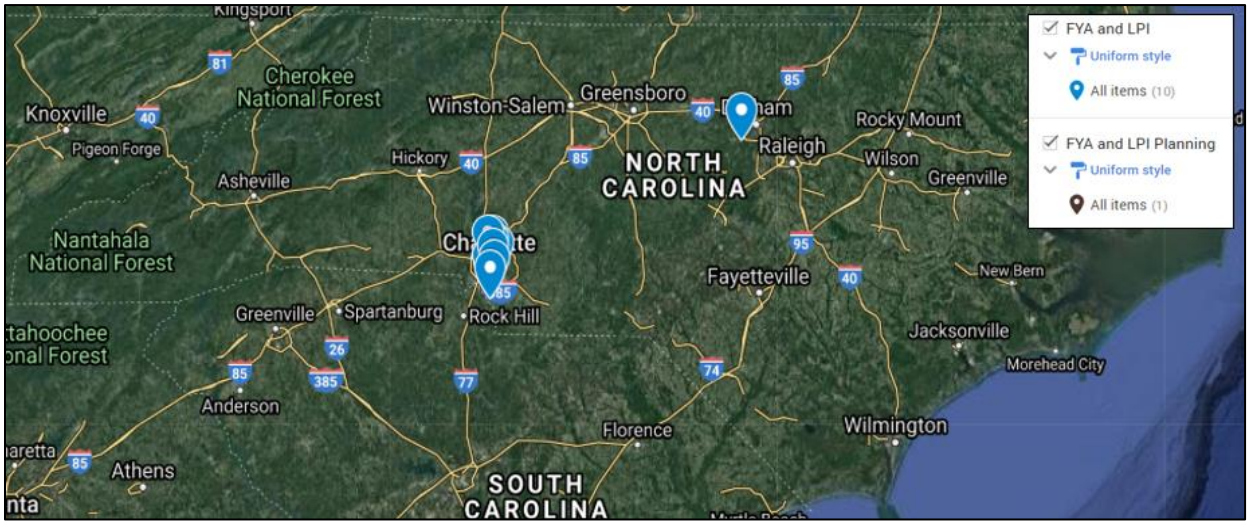

Figure 5. Planned and Operational Combined RT FYA and LPI Sites Across NC

Other descriptive data (such as right turn lane configuration, right turn volume, area type, etc.) were added to the database by students using Google Maps, NCDOT's traffic volume online repository, and even confirmation during the reconnaissance. These data are provided for reference in Table 1. Descriptive Data for 66 sites prior to Site Reconnaissance. *Note: Only data for the 66 RT FYA and LPI sites are provided as the combined 11 RT FYA and LPI sites were not yet captured prior to the conclusion of the project.*.

Table 1. Descriptive Data for 66 sites prior to Site Reconnaissance. *Note: Only data for the 66 RT FYA and LPI sites are provided as the combined 11 RT FYA and LPI sites were not yet captured prior to the conclusion of the project.*

Site Information			Feature (Volume, Geometry)							
Type	City	Status	Vehicle Volume	Pedestrian Volume	Candidate	Area Type	Sign	Right Lane	Address Road 1	Address Road 2
FYA	Wilmington	FYA/LPI not yet, Delayed	Low	Low		Suburban		TR	SR 1175 (Kerr Avenue)	Randall Parkway
FYA	Wilmington	FYA/LPI not yet, Delayed	Low	Low		Suburban		R	SR 1175 (Kerr Avenue)	Cinema Drive
FYA	Wilmington	No FYA, No crosswalk							SR 1175 (Kerr Avenue)	New Centre Drive
FYA	Wilmington	No FYA, No crosswalk							US 17 Business (Market Street)	Cinema Drive
FYA	Wilmington	FYA/LPI ready, working	High	High	Yes	University		R	US 117-NC 132 (S college Rd)	Randall Parkway
FYA	Wilmington	FYA/LPI ready, working	High	Low	Yes	Suburban	Yield Sign	R	US 74-76 (Eastwood Road)	US 76 / SR 1409
FYA	Wilmington	FYA/LPI but No crosswalk							US 74-76 (Eastwood Road)	SR 2782 (Wrightsville Ave)
FYA	Wilmington	FYA/LPI but No crosswalk							US 117 (Shipyard Boulevard)	Holly Tree Road / S. 41st Street
FYA	Wilmington	FYA/LPI but No crosswalk							US 74	SR 1175 (N. Kerr Avenue)
FYA	Wilmington	FYA/LPI but No crosswalk							US 421 (Carolina Beach Road)	SR 1524 (Golden Road)
FYA	Wilmington	FYA/LPI ready, working	Med	Low	Yes	Suburban		R	US 17 Business (Market Street)	Hays Ln-Walmart Entrance
FYA	Wilmington	FYA/LPI ready, working	Med	Low	Yes	Suburban		TR	17th Street	St. Andrews Drive
LPI	Jacksonville	FYA/LPI ready, working	Low	Low		Suburban		R	SR 1406 (Piney Green Road)	SR 1779
FYA	Wilmington	FYA/LPI ready, working	High	Low	Yes	Suburban		R	US 76 (Oleander Dr.)	SR 1209 (Independence BLVD)
LPI	Wilmington	FYA/LPI ready, working	High	Low	Yes	Suburban	Yield Sign	R	SR 1219 (S 17th Street)	Medical Center Drive
LPI	Jacksonville	FYA/LPI ready, working	Low	Low		Suburban		R	NC 24 (Johnson Boulevard)	Chaney Avenue
FYA	Jacksonville	FYA/LPI ready, working	High	Low	Yes	Suburban		R	NC 24 (Freedom Way)	SR 1406 (Piney Green Road)
FYA	Jacksonville	No FYA/LPI, No crosswalk							US 258 / NC 24	NC 111 (Catherine Lake Road)
LPI	Chapel Hill	FYA/LPI ready, working	High	High	Yes	Urban	Yield Sign	TR	Columbia St (NC 86)	Franklin St (SR 1010)
LPI	Chapel Hill	FYA/LPI ready, working	High	Low	Yes	Suburban	Yield Sign	R	Raleigh St (NC 54)	Hamilton Rd
LPI	Chapel Hill	No FYA/LPI, No crosswalk							US 15 / 501 Ramp	Columbia St
LPI	Chapel Hill	FYA/LPI ready, working	Med	Med	Yes	Suburban	Yield Sign	R	Franklin St (SR 1010)	Eastgate Shooping Center
LPI	Chapel Hill	FYA/LPI ready, working	Med	Med	Yes	University		TR	Manning Dr (SR 1902)	Paul Hardin / Craig
LPI	Chapel Hill	FYA/LPI ready, working	Low	Low		Suburban		R	Homestead Rd (SR 1777)	High School Rd (SR 1834)
LPI	Chapel Hill	FYA/LPI ready, working	High	High	Yes	University	Yield Sign	R	Manning Dr (SR 1902)	East Dr
LPI	Chapel Hill	No FYA/LPI, No crosswalk							Homestead Rd (SR 1777)	Weaver Dairy Rd
FYA	Chapel Hill	FYA/LPI ready, working	Low	Low		Suburban		R	Raleigh Rd (NC 54)	West Barbee Chapel Rd
FYA	Chapel Hill	Cancelled							Franklin St (SR 1010)	Eastgate Shopping Center
FYA	Chapel Hill	Cancelled							Columbia St (NC 86)	Cameron St
FYA	Chapel Hill	Cancelled							Columbia St (NC 86)	South Rd (SR 2048)
FYA	Chapel Hill	Cancelled							Columbia St (NC 86)	Manning Dr (SR 1902)
FYA	Chapel Hill	Cancelled							US 15 / 501 at Culbreth	Mt Carmel Rd
FYA	Chapel Hill	Cancelled							Weaver Dairy Rd (SR 1733)	Kingston Dr
LPI	Chapel Hill	Cancelled							Raleigh Rd (NC 54)	Environ Way
LPI	Raleigh	FYA/LPI ready, working	High	High	Yes	University	No turn on Red	TR,R	Avent Ferry	Western Blouevard
FYA	Carteret County	FYA/LPI ready, working	High	Low	Yes	Suburban		R	NC 58 (Fort Macon Rd)	Atlantic Beach Causeway
FYA	Fayetteville	FYA/LPI ready, working	Low	Low		Suburban		R,R	Reilly Rd	Morganton Rd
FYA	Fayetteville	FYA/LPI ready, working	High	Low	Yes	Suburban		R,R	Raeford Rd	Hope Mills Rd
LPI	Cary	FYA/LPI ready, working	High	Low	Yes	Suburban		R	Davis Dr	Waldo rood BLVD
LPI	Cary	FYA/LPI ready, working	Low	Low		Suburban		R	Ederlee Dr	Penny Rd
LPI	Cary	FYA/LPI ready, working	Low	Low		Suburban		R	Morrisville Pkwy	Louis Stephen Rd
LPI	Cary	FYA/LPI ready, working	High	Low	Yes	Urban	Yield Sign	R	Dry Ave	Academy St
LPI	Cary	FYA/LPI ready, working	Low	Low		Suburban		R	Maynard Rd	Village Greenway
LPI	Cary	FYA/LPI ready, working	Low	Low		Suburban		R	West Lake Dr	Optimist Farm Rd
LPI	Cary	No FYA/LPI, No crosswalk							Weston Pkwy	Harrison Oaks Blvd
LPI	Cary	FYA/LPI ready, working	Low	Low		Suburban		TR	Kildaire Farm Rd	Lochemere Rd
LPI	Cary	FYA/LPI ready, working	Low	Low		Suburban		TR	Old Apex Rd	Laura Duncan Rd
LPI	Concord	FYA/LPI ready, working	Low	Low		Urban		R	Church St	Corban Ave
LPI	Concord	FYA/LPI not yet, Delayed	Low	Low				R	Church St	Lake Concord Rd
LPI	Asheville	FYA/LPI but not good (Weird)							Asheland	Aston St / Bus Depot
LPI	Asheville	FYA/LPI but No crosswalk							Patton Ave	Lexington Ave
LPI	Asheville	FYA/LPI ready, working	Med	Low	Yes	Urban	Yield Sign	TR	Patton Ave	Otis Street
LPI	Asheville	No FYA/LPI, No crosswalk							Patton Ave	Haywood Rd
LPI	Asheville	FYA/LPI ready, working	Low	Low		Urban		R	Patton Ave	Asheland Ave
LPI	Asheville	FYA/LPI ready, working	High	Med	Yes	Urban	No turn on Red	R	Patton Ave	Coxe Ave
LPI	Asheville	FYA/LPI ready, working	Med	Med	Yes	Urban	No turn on Red	R	College St	Haywood St
LPI	Asheville	FYA/LPI ready, working	Low	Low		Urban		TR	College St	Lexington Ave
LPI	Asheville	FYA/LPI ready, working	Low	Low		Urban		TR	College St	Market St
LPI	Asheville	FYA/LPI ready, working	Low	Low		Urban		TR	College St	Spruce St
LPI	Asheville	FYA/LPI but not good (Weird)							Coxe Ave	Aston St / Bus Depot
LPI	Asheville	FYA/LPI ready, working	Med	Low	Yes	Urban	Yield Sign	R	Montford Ave	Haywood St
FYA	Fayetteville	FYA/LPI ready, working	High	Low	Yes	Suburban		R	Reilly Rd	Cliffdale
FYA	Clayton	FYA/LPI but No crosswalk							US 70	Cutter Lab Access Rd
FYA	Fayetteville	FYA/LPI ready, working	Med	Low	Yes	Suburban		R	Cliffdale Road	Glensford Dr.
LPI	Asheville	FYA/LPI but not good (Weird)							Patton Ave	Haywood St
LPI	Asheville	FYA/LPI ready, working	High	High	Yes	Urban		TR	College St	Broadway St

For planning purposes, our team grouped the sites by region and conducted a field reconnaissance to determine which sites were viable and what stage of implementation they were at. The first reconnaissance effort included stand-alone RT FYA and LPI sites, with a subsequent reconnaissance

effort to capture the combination of RT FYA and LPI planned at a later date. To be deemed a credible site, the 66 treated locations must be active with marked crosswalks for the treated approaches. In some cases, sites were still in the planning stages and were therefore monitored should they fall within the project window to be included. The site updates were documented from June to August of 2019.

In addition to physical features, a sufficient queue must be present to make sure there was opportunity to collect metrics on yielding from the pedestrian's standpoint (i.e. yields, pass-by's, conflicts, etc.). For this reason, a queue of five vehicles or more for an estimated 20 cycles during the peak traffic periods was required to consider the site viable. This was estimated using right turn volumes from recent counts and estimating the average arrival rate. During the reconnaissance effort, multiple cameras were installed at sites in the region visited (I.e. Chapel Hill, Asheville, etc.) to capture the queue data to estimate the likelihood of use in this research effort. With an expected 20 cycles with 5 or more vehicles queued, the research team estimated that no site would have less than 10 cycles with queued vehicles, even with right-turn-on-red operations possible and multiple lanes to consider.

As shown in Table 2, the site reconnaissance of RT FYA and LPI sites yielded 40 "constructed", stand-alone, RT FYA and LPI sites available for data collection prior to the research team's initial onsite reconnaissance and data collection. Following the reconnaissance effort looking at crosswalk striping and queuing, it was determined that 10 and 14 stand-alone RT FYA and LPI sites were able to be used for data collection purposes, respectively.

Table 2. RT FYA and LPI Sites Reconnaissance Results

Location	Total		Constructed		Planned		No Longer Planned		Missing Crosswalk or No Treatment	
	RT FYA	LPI	RT FYA	LPI	RT FYA	LPI	RT FYA	LPI	RT FYA	LPI
Wilmington	11	3	3	3	2				6	
Jacksonville	4		3						1	
Chapel Hill	8	8	1	6			7			2
Raleigh		1		1						
Atlantic Beach	1		1							
Fayetteville	4		4							
Cary		9		8						1
Clayton	1								1	
Asheville		14		9						5
Concord		2		1		1				
Total by Group	29	37	12	28	2	1	7	0	8	8
Total Available for Data Collection*			**10**	**14**						

**Accounts for queue length assumption of greater than 5 vehicles in at least 20 cycles during the peak periods.*

3.2. Comparison Sites

Once the team was done collecting the necessary descriptive data from each of the 24 locations by region, the sites were grouped by location type (RTP, University, Military, Beach, and Mountains). The impetus for this grouping was to determine locations where nearby comparison sites could be considered as a surrogate for the "before" data set that would not be possible to capture since sites were already constructed and in operation. For reference, the groupings, along with surrogate data, are provided in Table 3.

Table 3. Grouping of Sites by Location with Additional Descriptive Data

#	Group	List #	Signal	Region	Lane Type	Area Type	Geometry	Hi-Vis	Environment
1	RTP	44	LPI	Cary	R	Urban	T-intx		
2	RTP	41	LPI	Cary	R	Suburban			
3	RTP	20	LPI	Chapel Hill	TR	Urban		Hi-Vis	
4	RTP	21	LPI	Chapel Hill	R	Suburban	Minor		
5	RTP	24	LPI	Chapel Hill	R	Suburban	T-intx	Hi-Vis	Complex
6	University	37	LPI	Raleigh	TR, R	University		Hi-Vis	
7	University	27	LPI	Chapel Hill	R	University		Hi-Vis	Hospital
8	University	25	LPI	Chapel Hill	TR	University		Hi-Vis	
9	University	5	FYA	Wilmington	R	University		Hi-Vis	
10	Military	64	FYA	Fayetteville	R	Suburban			
11	Military	67	FYA	Fayetteville	R,R	Suburban			
12	Military	40	FYA	Fayetteville	R,R	Suburban			
13	Military	18	FYA	Jacksonville	R	Suburban		Hi-Vis	
14	Beach	16	LPI	Wilmington	R	Suburban		Hi-Vis	Hospital
15	Beach	6	FYA	Wilmington	R	Suburban		Hi-Vis	Big intx
16	Beach	12	FYA	Wilmington	R	Suburban		Hi-Vis	
17	Beach	15	FYA	Wilmington	R	Suburban		Hi-Vis	
18	Beach	13	FYA	Wilmington	TR	Suburban			
19	Beach	38	FYA	Morehead City	R	Suburban		Hi-Vis	
20	Mountains	57	LPI	Asheville	R	Urban	T-intx	Hi-Vis	
21	Mountains	58	LPI	Asheville	R	Urban		Hi-Vis	
22	Mountains	63	LPI	Asheville	R	Urban			
23	Mountains	54	LPI	Asheville	TR	Urban		Hi-Vis	
24	Mountains	71	LPI	Asheville	TR	Urban			

While ongoing data collection was taking place at the 24-candidate stand-alone RT FYA and LPI treatment sites, the research team discussed options for nearby comparison sites that would serve as the surrogate "before" data. As was discussed in the initial kickoff meeting with NCDOT, the initial effort focused on nearby intersections with similar traffic volumes and geometry for the right turn (skew angle, turn lane configuration, and number of lanes). The concept was that similar drivers should drive in a similar manner if the existing geometric configuration were in place. However, similar sites in the same municipality proved much more challenging than the research team initially thought. The primary reason was that many of treated sites included dual right turn lanes, or even more challenging, a dual right turn lane with a shared through lane. In total, approximately 50% of the treatment sites had representative comparison sites that could be used for this purpose.

Next, the team considered comparison sites that could be utilized in the same "regions" to help boost the comparison site pool. For instance, treatment sites 10 and 13 were located in the military towns of Fayetteville and Jacksonville (respectively) and had similar geometry for the right turn – a single right turn lane. Using this method, we were still only able to find (moderately) suitable comparison sites with

approximately 60% of treatment sites having a comparison match. For that reason, the team began to consider alternative options.

After much deliberation, the team posed the idea of putting the "before" condition back in place at the (now) treated sites. This alternative was not possible for RT FYA sites because taking the RT FYA signal head down and replacing it with the standard signal head configuration was time consuming and may cause some safety concerns. However, the team believed that this option was worth pursuing for stand-alone LPI sites since it only required turning off the delay setting for the right turn signal for a few hours and collecting data in the original signal configuration. In doing so, this was the most reasonable comparison given the team had no sites that a true before-and-after study could be administered for multiple sites. Therefore, a request to NCDOT was made to remove the LPI delay setting temporarily for approximately 2 hours. However, in discussions with NCDOT upper management and the project panel, the potential (although it would be very low) liability around a crash event taking place during this window negated the upside to capturing this type of data. For that reason, the project was recommended to be closed.

The following sections summarize the "after" data collected to date and provides some summary thoughts for consideration by the panel for these two treatments.

4. Data Collection

Following the treatment site reconnaissance effort, each region was visited a second time for the purposes of data collection. Data consisted of pedestrians – both naturalistic and experimenter driven – crossing the conflicting right turn movement during the peak hour for the right turn movement of interest. For both FYA and LPI sites, a total of 222 crossings were made by staged (182) and naturalistic (40) pedestrians. An example of a naturalistic crossing at a stand-alone LPI treatment in Chapel Hill, NC is shown in Figure 6.

Figure 6. Naturalistic Crossing at an LPI Signal in Chapel Hill, NC.

To take full advantage of the 24 sites, trained staffed members were used to stage crossings at sites where naturalistic pedestrians were low so that the maximum sample size was collected for each site during the peak right turn traffic period. These staged crossings were conducted at every crossing for consistency in data collection. The research team member was trained such that they approached the near-side signal during red, pushed the pedestrian push button, and positioned just behind the edge of curb between ten and twenty seconds before the "WALK" indication was given. For consistency, no eye contact was made with the conflicting motorists that were at the stop bar during this waiting period for the "WALK" indication. Once the "WALK" indication was given, the staged pedestrian looked to their left prior to crossing to determine if the vehicle was yielding or advancing across the crosswalk, and only crossed when they felt it was safe to do so – making the crossing in a similar manner as they would if they were naturalistic.

For analysis purposes, crossing data were summarized using three categories for both the RT FYA and the LPI, including:

1. Yield: *The desired response - as the pedestrian was crossing, the first vehicle in all right turning lanes yielded to the pedestrian.*
2. Conflict: *A potentially dangerous event – as the pedestrian was crossing, the lead vehicle in one or more right turn lanes made a dangerous maneuver that could have led to a crash.*
3. Violation: *A vehicle not yielding to the pedestrian during the crossing, leaving the pedestrian onto the curb.*

For reference, the data are summarized for each of the 24 sites visited in the Appendix.

Examples of "conflicting" crossings include a last-minute sudden stop or a motorist purposely driving around the crossing pedestrian. For dual right turn lanes, "multiple-threat" situations could have also occurred where the vehicle in the farthest lane did not initially see the pedestrian, causing a last-minute yield event that was dangerous. The more obvious "violations" usually left the pedestrian waiting to cross at the curb. For the RT FYA treatment, this "violation" is usually a clearer indication of lack of driver understanding of the signal head. For the LPI, a "violation" might be counterintuitive because a pedestrian should theoretically be well into the travel lanes prior to a right turning vehicle getting the green indication (which is delayed). However, one commonly observed "violation" or "conflict" often found at LPI's right-turn-on red vehicles that did not recognize the "WALK" indication for the pedestrian and coincidentally turned on red during the LPI. Though less commonly observed, this also took place at RT FYA only sites when the red indication was shown prior to the FYA and vehicles were already staging to turn right on red.

5. Analysis

As noted earlier, the full objectives of the project were not realized due to the lack of true "before" data at the sites of interest. For that reason, the project was closed out early. This section summarizes the available "after" data that was captured by the team for stand-alone RT FYA and LPI sites (a total of 24 sites); however, it does not include the combination of RT FYA and LPI sites (11 sites) because that data

was not captured at the time of closing the project. Some preliminary summaries of the "after" data provide some insights that might be useful to NCDOT in consideration of current and future installations of RT FYA and LPI signalization treatments in the future.

Table 4 provides a summary of the yield data collected by site and provides some summary results for the "after" data collection effort for both the RT FYA and LPI installations.

Some explanation of the data is warranted before discussing the summary results. First, "yields" and "violations" are provided by site. As noted earlier in the report, the sample size for each of these data represent crossings when the minimum queue of five vehicles was present during the peak period. In many cases, this was challenging to capture even though right turn volumes were relatively high. The two primary issues were 1) that there was a significant right-turn-on-red volume by right turning drivers which caused queues to disperse quickly and 2) in dual lane configurations, both lanes must meet the minimum queue assumption. Because sample sizes are low in many cases, the reader should be very careful in making generalizations and take sample size into account. Second, results are provided for each treatment for all sites AND by right turn lane configuration. Other summaries could be made (such as "area type"); however, it is assumed that the lane configuration and location of treatment installations are the most important variables. In addition, the research team did not want to parse the data further by area type given the low sample sizes for some conditions.

In summary, the data from the "after" period only for both treatments showed some trends that may be worthwhile considering for future research efforts. First, at first glance, Leading Pedestrian Intervals seem to provide the best opportunity for yielding to pedestrians. Overall, not taking right turn lane geometry, area type, or region into account, the yield rate for LPI's and RT FYA's was 84% compared to 49%, respectively. However, as noted, this does not necessarily mean that the LPI is a better treatment since many factors could impact vehicle yield such as the presence of naturally occurring pedestrians (many FYA sites required stages crossings due to low pedestrian counts) and different cities and towns across NC utilized different signalization treatments (i.e. the treatment locations of LPI's was not consistent with that of FYA's). The different populations of road users and geographic dispersion is not adequately accounted for and should be considered very carefully.

Second, even considering differences in site location and pedestrian crossing type, when looking at the summary findings for each treatment by lane grouping, there appears to be no major difference in yield rates based on the lane configuration for RT FYA's and LPI's. This includes right turn only, shared through and right turn, dual right turn, and dual right turn shared with a through lane.

Third, based on the "violation" data collection efforts and our experience conducting hundreds of crossings at crossing with both signal treatments, one conflict/violation occurred quite often which could be mitigated – the right-turn-on-red conflict. Mentioned earlier, this conflict occurred at pedestrian crossings with both treatments, but was most prevalent at RT FYA sites. In short, a pedestrian standing at the curb is given a "WALK" indication; however, right turning vehicles see available gaps in traffic while the traffic signal is red. When the RT FYA or LPI is initiated, there is very little information for the driver to pay attention to a pedestrian waiting at the curb. This often leaves

Table 4. Data Collection and Yield Results by Site, Total Sites, and by Right Turn Geometric Configuration for RT FYA and LPI Sites

Treatment	Site Location			Descriptive Information				Results			
	City	Road 1	Road 2	Right Lane Geometr	Vehicle Volume	Pedestrian Volume	Area Type	Yield Rate by Regio	Yield Rate by Site	Yields*	Violations*
FYA	Morehead City	NC 58 (Fort Macon Rd)	Atlantic Beach Causeway	R	High	Low	Suburban	22%	22%	2 (0)	7 (0)
	Fayetteville	Raeford Rd	Hope Mills Rd	R,R	High	Low	Suburban	54%	60%	6 (0)	4 (0)
		Reilly Rd	Cliffdale	R	High	Low	Suburban		56%	5 (0)	4 (0)
		Cliffdale Road	Glensford Dr.	R	Med	Low	Suburban		40%	2 (0)	3 (0)
	Jacksonville	NC 24 (Freedom Way)	SR 1406 (Piney Green Road)	R	High	Low	Suburban	13%	13%	1 (0)	7 (0)
	Wilmington	US 117-NC 132 (S college Rd)	Randall Parkway	R	High	High	University	63%	67%	0 (8)	3 (1)
		US 74-76 (Eastwood Road)	US 76 / SR 1409	R	High	Low	Suburban		56%	5 (0)	4 (0)
		US 17 Business (Market Street)	Hays Ln-Walmart Entrance	R	Med	Low	Suburban		50%	1 (0)	1 (0)
		17th Street	St. Andrews Drive	TR	Med	Low	Suburban		67%	4 (0)	2 (0)
		US 76 (Oleander Dr.)	SR 1209 (Independence BLVD)	R	High	Low	Suburban		67%	2 (0)	1 (0)
								Yield Rate (All Sites) =	49%	8 (28)	36 (1)
								Yield Rate (R) =	46%	8 (18)	30 (1)
								Yield Rate (R, R) =	60%	0 (6)	4 (0)
								Yield Rate (TR) =	67%	0 (4)	2 (0)
LPI	Asheville	Patton Ave	Otis Street	TR	Med	Low	Urban	100%	100%	3 (0)	0 (0)
		Patton Ave	Coxe Ave	R	High	Med	Urban		100%	11 (1)	0 (0)
		College St	Haywood St	R	Med	Med	Urban		100%	7 (3)	0 (0)
		Montford Ave	Haywood St	TR,R	Med	Low	Urban		100%	19 (1)	0 (0)
		College St	Broadway St	TR	High	High	Urban		100%	2 (2)	0 (0)
	Cary/Raleigh	Davis Dr	Waldo rood BLVD	R	High	Low	Suburban	82%	60%	6 (0)	4 (0)
		Dry Ave	Academy St	R	High	Low	Urban		100%	5 (1)	0 (0)
		Avent Ferry	Western Blouevard	TR,R	High	High	University		100%	1 (5)	0 (0)
	Chapel Hill	Columbia St (NC 86)	Franklin St (SR 1010)	TR	High	High	Urban	75%	100%	0 (5)	0 (0)
		Raleigh St (NC 54)	Hamilton Rd	R	High	Low	Suburban		100%	9 (0)	0 (0)
		Franklin St (SR 1010)	Eastgate Shooping Center	R	Med	Med	Suburban		90%	9 (0)	1 (0)
		Manning Dr (SR 1902)	Paul Hardin / Craig	TR	Med	Med	University		100%	0 (3)	0 (0)
		Manning Dr (SR 1902)	East Dr	R	High	High	University		59%	17 (5)	10 (5)
	Wilmington	SR 1219 (S 17th Street)	Medical Center Drive	R	High	Low	Suburban	71%	71%	10 (0)	4 (0)
								Yield Rate (All Sites) =	84%	99 (26)	19 (5)
								Yield Rate (R) =	78%	74 (10)	19 (5)
								Yield Rate (TR) =	100%	5 (10)	0 (0)
								Yield Rate (TR, R) =	100%	20 (6)	0 (0)

* Crossings were made using staged and naturalistic crossings. The format X (Y) represents X staged crossings and Y naturalistic crossings.

the pedestrian stuck on the curb while the pedestrian crossing time is not being adequately used because the lead vehicle for the right turn movement does not yield. Many times, several vehicles will pass the pedestrian without yielding, causing another potential conflict as pedestrians are inadvertently crossing with little-to-no time to cross the road. Treatments we saw at one site in the field included "No Right-Turn-on-Red" signs; however, this limits the capacity of the right turn movement (often unnecessarily) and is most often not warranted unless there is high pedestrian traffic (such as the one used at Avent Ferry Road and Western Boulevard in Raleigh, NC). Although there is no current research on its effectiveness as a supplemental sign at these treatment locations, a recommended treatment that could be considered for these sites could be a "blank out" sign that says "Yield to Pedestrians" when the push button is activated. If this additional treatment is utilized, it would be advisable to document the effectiveness of the treatment through a before-and-after study.

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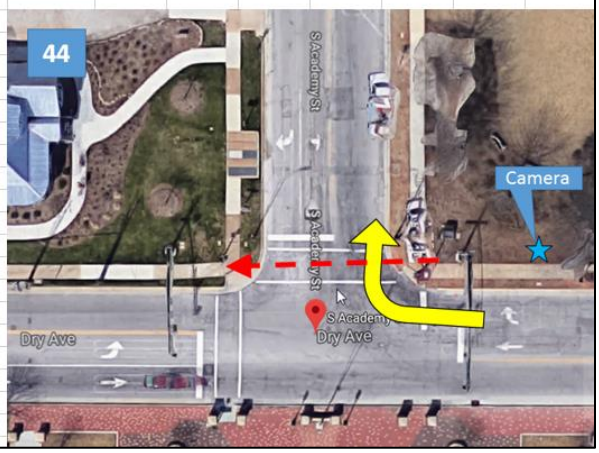
7. Appendix: Yield Data Captured from RT FYA and LPI Sites

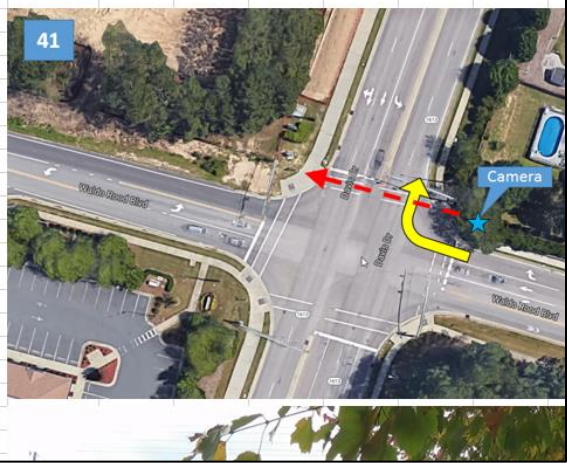
44				
LPI		Vehicle		
5 sec		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	4	6	0	5
Video name				
[44]-1		1.43		
33mins		5.53		
	10.52	8.10		16.01
	13.40	17.10		18.39
		19.52		21.31
	27.30	23.03		28.45
[44]-2	0.54			2.29
3mins				

1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



41	[41] Cary, Davis Dr and Waldo Rood Blvd (181108)			
LPI		Vehicle		
5 sec		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	12	6	4	12
Video name				
[41]-1	13.14	0.37	4.32	6.17
16mins		2.34	8.12	
		10.36		13.15
				15.54
[41]-2	6.12	3.57	2.11	8.10
9mins				
[41]-3	1.25			3.52
22mins	6.49			9.24
	12.10	17.25		14.43
				19.50
[41]-4	5.18	0.00	18.41	7.50
22mins	10.40			16.05
	13.08			21.21
[41]-5	1.21			3.59
14mins	6.40			
	9.16			
	11.55			

1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn

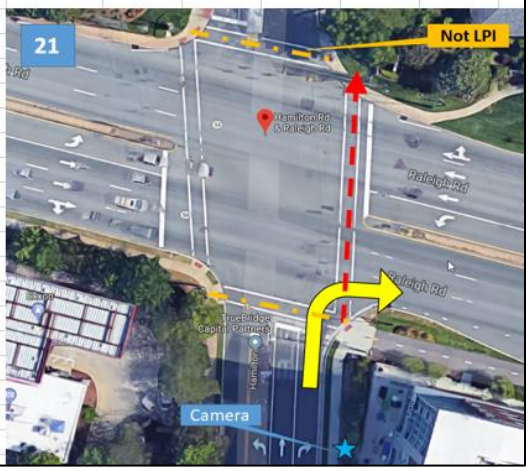


20				
LPI		Vehicle		
5 sec		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	21	5	0	1
Video name				
[20]-1	1.55			
29mins	4.24			
	6.35			
	9.05			
	11.12			
	13.44			
	15.55			
	18.24			
	20.33			
	22.55			
	25.25			
	27.38			
[20]-2	0.29	2.45		7.40
31mins	5.03			
	9.27			
	12.09	14.20		
	16.45	19.17		
	21.32	**23.54**		
	28.28	26.12		
[20]-3	0.42			
3mins	2.53			

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next right turn
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn

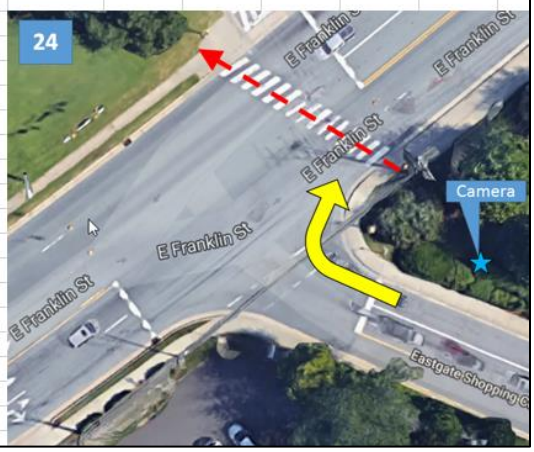
21				
LPI		Vehicle		
5 sec		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	2	9	0	8
Video name				
[21]-1		1.14		3.15
30mins		5.13		7.13
		9.13		11.13
		13.13		15.13
		17.13		19.13
	23.13	21.13		27.13
		25.13		
		29.13		
[21]-2	3.27	15.44		1.27
24mins				18.18

1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



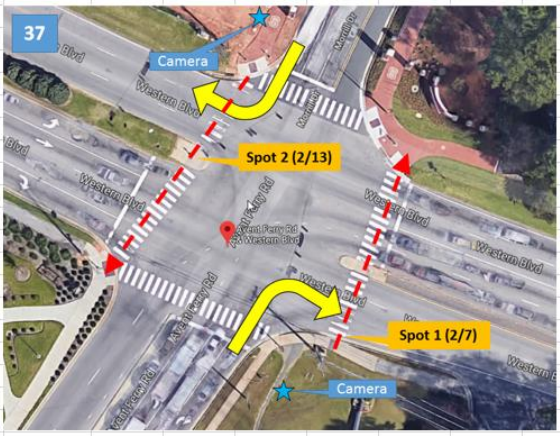
24				
LPI		Vehicle		
5 sec		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	2	9	1	1
Video name				
[24]-1		2.39	0.55	
23mins		6.09		
	15.11	11.24		
	18.45	13.17		
		20.34		
		22.22		
[24]-2		3.19		1.28
9mins		5.09		
		6.55		

1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



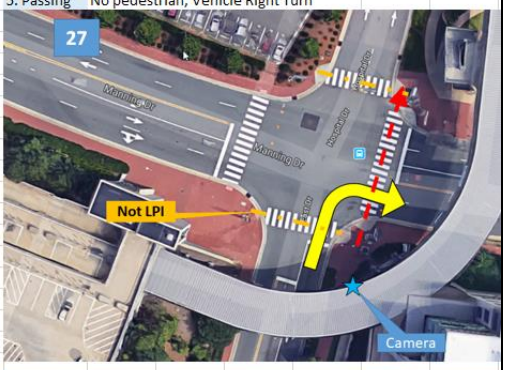
37				
LPI		Vehicle		
		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	8	10	0	3
Video name				
Spot1				
[37]	0.13	2.59		5.32
20mins		10.25		
4 sec		12.40		
		15.25		18.02
Spot2				
[37]-1				
22mins	5.03	0.04		
4 sec	7.30	2.33		
	10.03			
	12.32			15.00
	17.33	20.03		
	22.33			
[37]-2	2.19	4.50		
10mins		7.20		
		9.48		

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next right turn,
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



27	[27] Chapel Hill, Manning Dr and Hospital Dr (181129) (190123)				
LPI		Vehicle			
3 sec	Pedestrian Crossing				
	1. Crossing	2. Yield	3. Warning	4. Violation	5. Passing
Count	8	22	7	8	22
Video name					
[27]-1	20.07	9.09		3.36	12.45
30mins		10.56	5.25		23.48
		14.35		7.16	27.33
		18.15	16.25	21.55	
		25.38			
		29.15			
[27]-2	11.38	0.42		7.55	2.32
30mins	28.13	4.17		15.18	6.07
		13.28		20.46	9.45
		17.05		24.27	19.00
				29.58	22.40
					26.20
[27]-3	5.12	8.52	1.32		3.27
30mins	12.33		16.11		7.04
	18.01	23.34	27.13		10.42
	21.41				14.25
					19.53
					25.23
					29.05
[27]-4	9.32	0.27	2.15		14.09
30mins		4.09	5.55		18.28
		7.50			22.48
		11.59			
		16.20			
		20.38			
		24.59			
		29.18			
[27]-5		3.10			1.00
10mins		7.31			5.19

1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Warning	Crossing pedestrian, Vehicle passing, dangerous for blindness
4. Violation	Crossing pedestrian, Vehicle don't stop and right turn
5. Passing	No pedestrian, Vehicle Right Turn

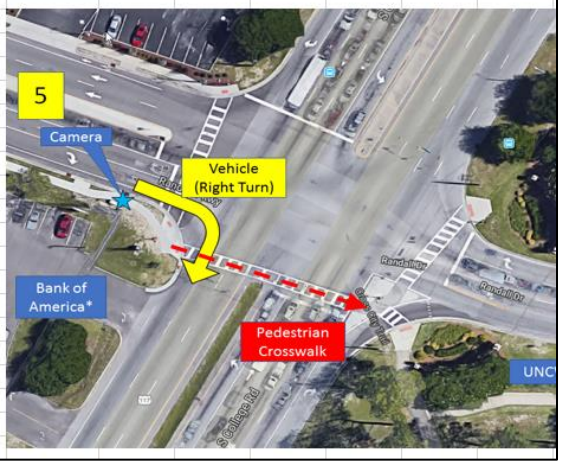


25				
LPI		Vehicle		
5 sec	Pedestrian Crossing			
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	0	3	0	1
Video name				
[25]		0.35		
10mins		4.56		
		7.06		9.15

1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn

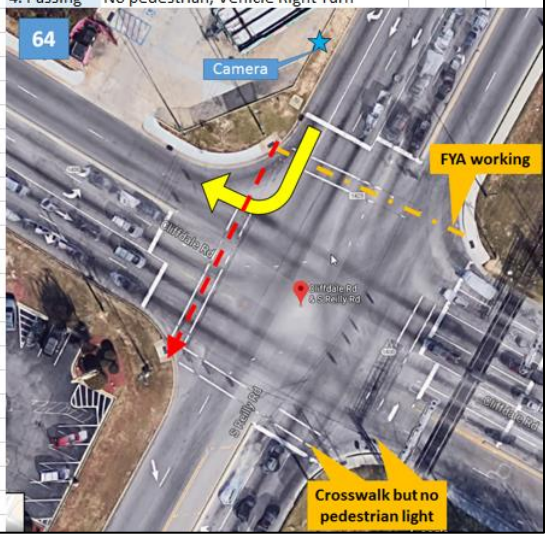
5	[5] Wilmington, S college Rd and Randall Parkway (190131)			
FYA		Vehicle		
		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	5	8	4	7
Video name				
[5]-1	3.18	0.40	5.50	8.20
23mins	13.21	10.54		18.26
	15.51			
	20.55			
[5]-2		3.21	5.51	0.48
23mins		13.28	8.22	10.50
		18.32		16.00
	21.05			
[5]-3		0.50	5.55	3.20
13mins		10.59		8.10
		13.32		

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next r
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



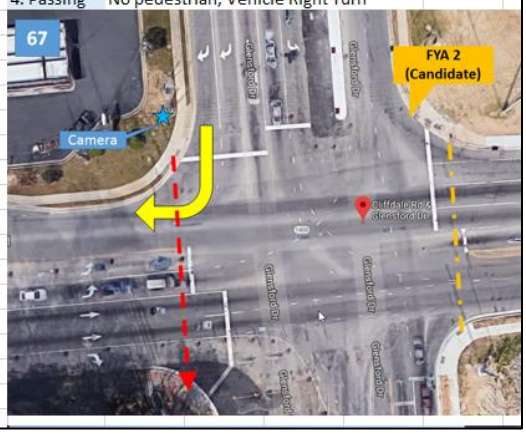
64	[64] Fayetteville, Cliffdale Rd and S Reilly Rd (190206)			
FYA		Vehicle		
		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	1	5	4	10
Video name				
[64]-1		1.09	6.27	3.45
30mins		11.47		9.07
			17.08	14.30
		22.28		19.50
	27.45			25.06
[64]-2			2.45	0.05
22mins		13.29	8.05	5.28
		18.48		10.46
				16.05
				21.27

1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



67				
FYA		Vehicle		
		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	3	2	3	8
Video name				
[67]-1	7.00	2.20		4.43
30mins	21.09	15.25		10.15
	26.26			18.30
				24.16
				29.19
[67]-2			1.38	4.05
23mins			6.35	9.35
			12.29	14.46

1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn

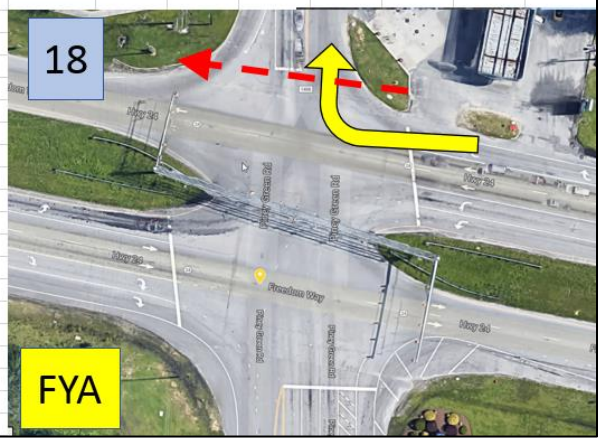


40				
FYA		Vehicle		
		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	3	6	4	11
Video name				
[40]-1	2.04	6.05		4.00
28mins	12.22	10.20	16.19	7.47
		25.02	20.45	14.23
				18.06
				22.43
				27.00
[40]-2	6.00	2.02		4.04
26mins		10.05	16.20	8.00
		24.20	20.20	14.20
				18.24
				22.24

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next r
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn

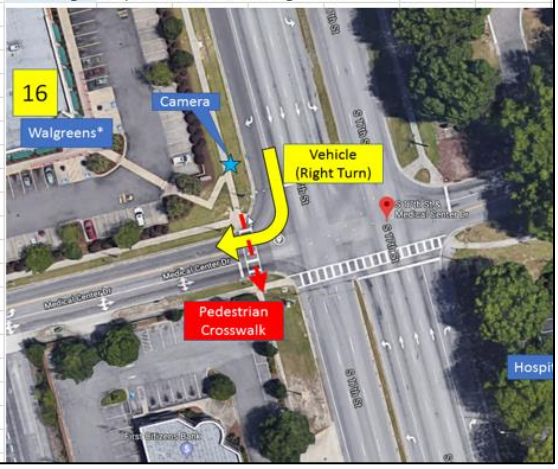
18				
FYA		Vehicle		
		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	4	1	7	4
Video name				
[18]-1	1.46	12.45	8.58	
23mins	5.26			
	16.26		20.05	18.20
				22.00
[18]-2	1.00		4.47	
23mins			10.12	
			15.45	
			21.41	
[18]-3			5.15	1.55
14mins				7.54

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next right turn,
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



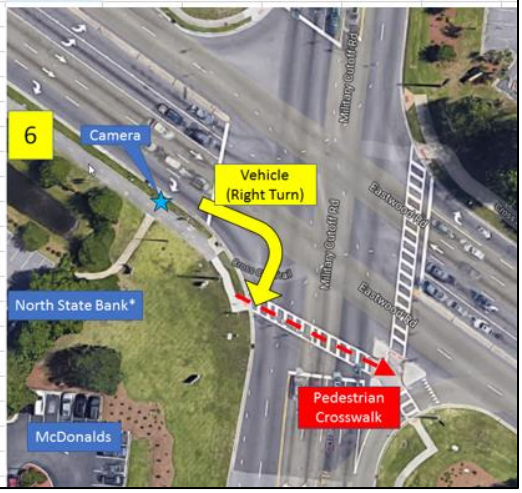
16				
LPI		Vehicle		
3 sec		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	2	10	4	3
Video name				
[16]-1		3.42		5.48
23mins		8.39		13.35
		15.59	18.48	
[16]-2	0.23		3.30	
23mins		6.12		
		8.24		
			13.34	
		18.54	16.03	
[16]-3	0.44	3.44		8.59
13mins		6.14		
		10.51		
		14.27		

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next r
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



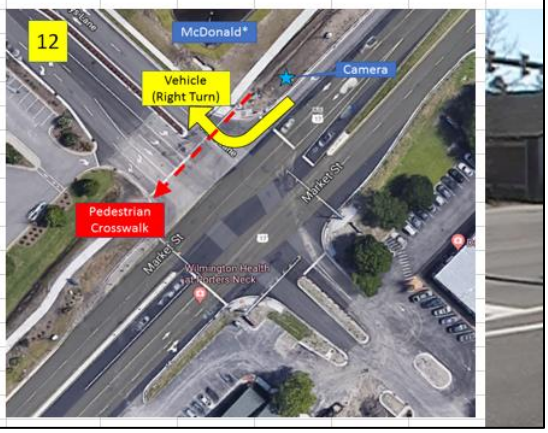
6	[6] Wilmington, Eastwood Rd and Military Cutoff Rd (190131)			
FYA		Vehicle		
	Pedestrian Crossing			
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	3	5	4	10
Video name				
[6]-1	2.10		9.45	7.13
23mins	5.00		12.19	14.48
		22.25	17.23	19.51
[6]-2		4.45		2.13
23mins		9.45		7.15
			14.50	12.12
		19.55		17.25
				22.29
[6]-3	2.15	7.19		4.47
13mins				12.24

1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



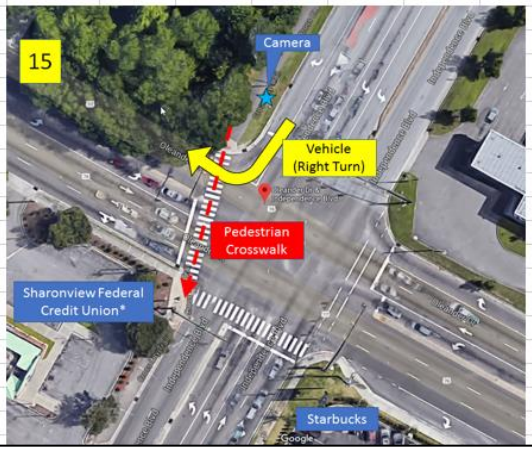
12				
FYA		Vehicle		
	Pedestrian Crossing			
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	7	1	1	6
Video name				
[12]	5.38			7.53
60mins	10.20			15.27
	17.57	23.01		20.30
	27.53			25.30
	35.32		40.47	38.15
	45.52			50.54
	55.58			

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or ne
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



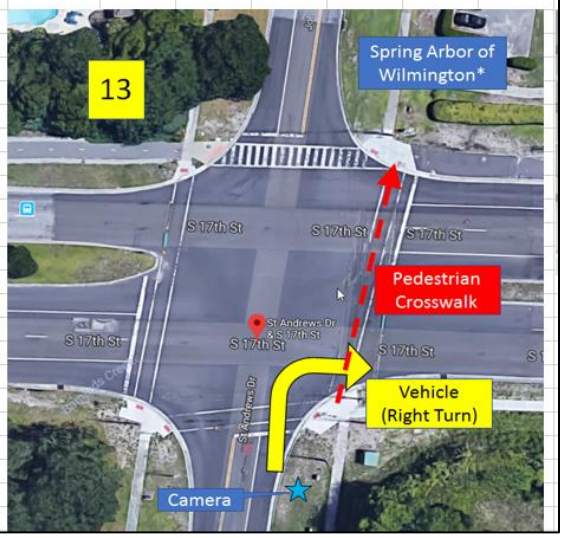
15	Hillary recorded / Right Turn angle is not good /			
FYA		Vehicle		
	Pedestrian Crossing			
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	8	2	1	7
Video name				
[15]	2.50		7.50	5.12
60mins	15.25			10.20
	20.30			17.57
	28.06			23.02
	35.42			38.09
	40.48			43.18
	45.44	50.53		58.18
	53.15	55.58		

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



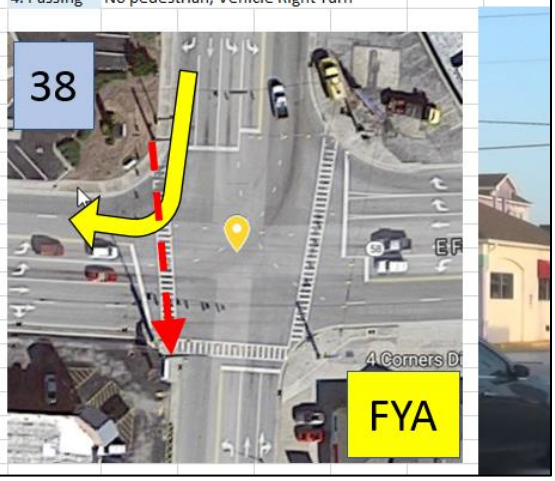
13				
FYA		Vehicle		
	Pedestrian Crossing			
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	6	4	2	9
Video name				
[13]-1	5.21	0.50		3.14
23mins	15.31	10.21		13.05
	20.49			18.14
[13]-2	3.15	13.03	7.54	0.45
23mins		17.58		10.35
	22.35			15.38
				20.39
[13]-3	9.48		4.02	2.01
13mins				12.36

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next r
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



38				
FYA		Vehicle		
		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	6	2	7	16
Video name				
29-Apr				
[38]	7.25		1.20	6.20
16mins	10.00		5.00	8.50
			12.43	11.23
				13.55
30-Apr				
[38]	11.39	0.50		3.17
23mins	13.57			4.24
	16.45		20.00	5.30
				7.09
				8.18
				9.15
				15.32
				18.20
[38]	7.07	10.20	0.10	1.54
17mins			3.00	8.33
			13.09	11.43
				15.32

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield)
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn

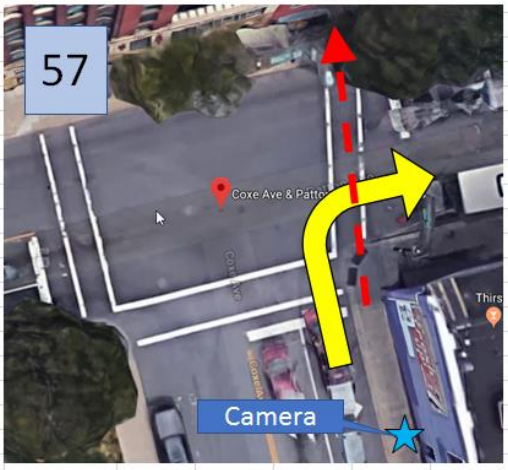


57				
LPI		Vehicle		
3 sec		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	2	12	0	5
Video name				
[57]-1	1.40			3.41
		7.41		5.41
		11.41		9.41
		13.41		
		15.41		
		17.41		
		19.41		
		21.41		
[57]-2	16.11	8.11		6.11
		12.11		10.11
		14.11		
		18.11		
		22.11		

No crosswalk because of no vehicle

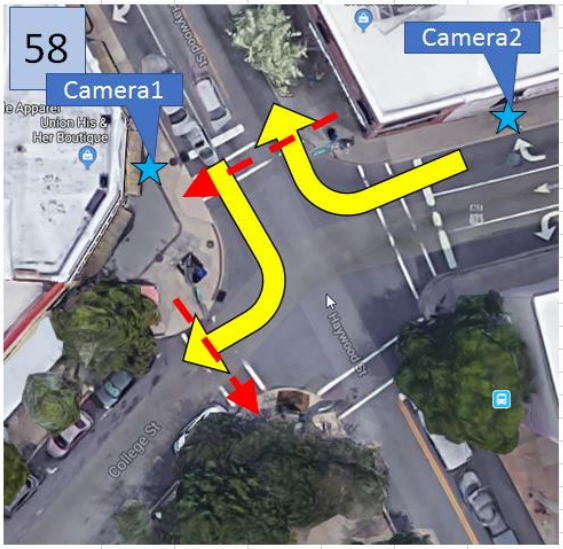
	Crossing pedestrian, Vehicle stop for Go Straight, 2nd
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield) for Right Turn
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn

Both No pedestrian and No Vehicle, Not tracking



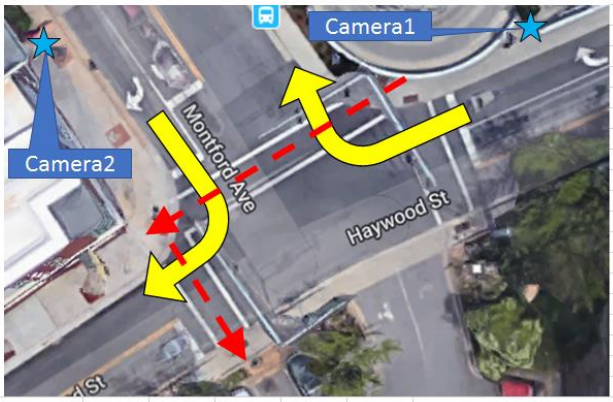
58				
LPI		Vehicle		
		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	12	16	0	10
Video name				
Camera 1				
[58]-1	1.23	7.23		3.23
total 60mins	5.23	9.23		
3 sec		11.30		
		13.34		
	19.34	17.34		
[58]-2		0.51		2.51
	10.51	6.51		12.51
	18.50			
[58]-3		0.05		8.05
		2.05		
		10.05		
Camera 2				
[58]-1	5.53	7.53		3.53
total 60mins	9.53	14.08		
3 sec		16.08		
	22.08	18.08		
[58]-2	5.24			9.24
	11.24			13.24
	15.24			19.24
				21.24
[58]-3	0.40	10.40		8.40
		14.40		

No crosswalk because of no vehicle	
	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next right
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield) for Right Turn
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



63				
LPI		Vehicle		
		Pedestrian Crossing		
	1. Crossing	2. Yield	3. Violation	4. Passing
Count	14	28	4	4
Video name				
Camera 1				
[63]-1	0.35	5.00		1.48
3 sec	7.35	9.00		3.20
4 legs	10.25	13.23		
CHOOSE THIS	16.38	15.13		
	19.24	17.53		
		20.58		
[63]-2		0.00		
		1.44		
		3.37		
		5.24		
		9.32		
		11.19		
		14.18		
		18.37		
		20.12		
		21.59		
[63]-3		2.22		3.47
		5.25		8.41
		7.17		
		10.22		
Camera 2				
[63]-1	0.40	9.15	7.50	
3 sec	12.15	15.30		
	14.05			
	16.42		18.11	
	19.50			
	21.35			

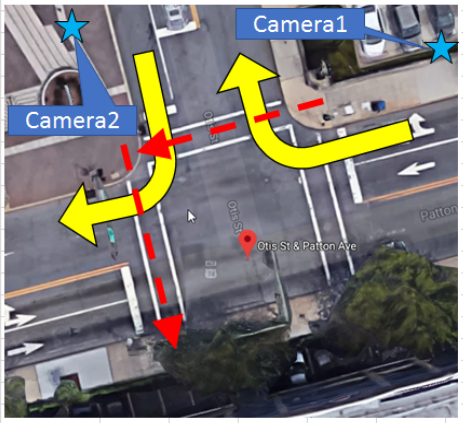
No crosswalk because of no vehicle	
	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next right turn, free flowing
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield) for Right Turn
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



54					
LPI		Vehicle			
		Pedestrian Crossing			
	1. Crossing	2. Yield	3. Violation	4. Passing	
Count	32	5	0	4	
Video name					
Camera 1					
[54]-1	3.09				
3 sec	6.29				
4 legs	9.48				
CHOOSE THIS	11.27				
	13.08				
	14.48				
	16.28				
	19.52				
	21.28				
[54]-2	3.44	0.24			
	5.24				
	7.05				
	8.44				
	10.25				
	12.05				
	15.33				
	17.48				
	19.44				
	21.43				
[54]-3	1.00	3.00			
	5.00	11.00			
	7.00				
	9.00				
Camera 2					
[54]-1	2.54				
3 sec	6.14				
	9.35				
	11.13	16.13			
	19.34				
[54]-2	0.10	6.49		1.51	
	3.28			19.48	
	15.45				
[54]-3	3.05			9.05	
				11.05	

No crosswalk because of no vehicle

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield) for Right Turn
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn



71					
		Vehicle			
		Pedestrian Crossing			
	1. Crossing	2. Yield	3. Violation	4. Passing	
Count	29	4	0	2	
Video name					
Camera 1					
[71]-1	6.00	7.52			
LPI	9.53				
3 sec	11.52				
	13.52				
	15.52				
	17.52				
	19.52				
	21.52				
[71]-2	1.10				
	3.10				
	5.10				
	9.10				
	11.10				
	13.10	15.10			
		17.10			
	21.10	19.10			
[71]-3	2.25				
	4.25				
	6.25				
Camera 2					
[71]-1	3.24				
GENERAL	5.24				
	7.24				
	9.24				
	11.24				
	17.24				
	19.24				
[71]-2	0.40			2.40	
	4.40				
	6.40			12.40	
	18.40				

No crosswalk because of no vehicle

	Crossing pedestrian, Vehicle stop for Go Straight, 2nd or next right turn, free flowing
1. Crossing	Crossing pedestrian, No right turn vehicle
2. Yield	Crossing pedestrian, Vehicle stop (yield) for Right Turn
3. Violation	Crossing pedestrian, Vehicle don't stop and right turn
4. Passing	No pedestrian, Vehicle Right Turn