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Publication Date
2022-06-01

Data Availability
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Georgia Express Lane Corridors Vehicle Occupancy and Throughput Study 2018-2020

Volume I: Vehicle and Person Throughput Analysis Before and After the I-75 Northwest Corridor and I-85 Express Lanes Extension

May 2022

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Sponsored by:

SRTA State Road & Tollway Authority

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.
NCST-GT-RR-22-24

2. Government Accession No.
N/A

3. Recipient's Catalog No.
N/A

4. Title and Subtitle
Georgia Express Lane Corridors Vehicle Occupancy and Throughput Study 2018-2020 Volume I: Vehicle and Person Throughput Analysis Before and After the I-75 Northwest Corridor and I-85 Express Lanes Extension

5. Report Date
June 2022

6. Performing Organization Code
N/A

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8. Performing Organization Report No.
N/A

9. Performing Organization Name and Address
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10. Work Unit No.
N/A

11. Contract or Grant No.
USDOT Grant 69A3551747114

12. Sponsoring Agency Name and Address
U.S. Department of Transportation,
Office of the Assistant Secretary for Research and Technology
1200 New Jersey Avenue, SE, Washington, DC 20590

Georgia State Road & Tollway Authority
245 Peachtree Center Ave, NE, Suite 2200, Atlanta GA, 30303-1224

13. Type of Report and Period Covered
Final Report (July 2018 – May 2022)

14. Sponsoring Agency Code
USDOT OST-R

15. Supplementary Notes
N/A

16. Abstract
Ongoing assessment of system performance monitoring is critical to successful and efficient transportation planning, ensuring that infrastructure investments provide a desired return on investment. As with any new transportation facility, itis important to understand how Express Lane facilities affect travel behavior, resulting on-road vehicle activity, and subsequent person-throughput (a function of vehicle occupancy) as part of the facility performance assessment. This report summarizes the vehicle and person throughput analysis for the I-75 Northwest Corridor (NWC) and I-85 Express Lanes in Atlanta, GA, undertaken by the Georgia Institute of Technology research team for the State Road and Tollway Authority (SRTA). The research team tracked changes in observed vehicle throughput on four managed lane corridors and collected vehicle occupancy (persons per vehicle) data to assess changes in both vehicle throughput and person throughput associated with the opening of new Express Lane facilities. The team collected traffic volumes by video observation (GDOT's Georgia NaviGAtor machine vision system and SRTA's vehicle activity monitoring system). The team implemented a large-scale data collection effort for vehicle occupancy across all general purpose freeway lanes and from SRTA's Express Lanes over a two-year period (before-and-after the opening of the Express Lanes). Between the baseline year (2018) and post-opening year (2019), the team observed a decrease in average vehicle occupancy (persons/vehicle), coupled with a significant increase in traffic volumes, especially on the NWC. The combined effect of increased traffic volumes and decreased occupancy stilled to an overall increase in person throughput at all sites. Vehicle throughput on the I-85 corridor increased by about 5-7% and person throughput increased by 1-2% in the morning peak, and increased by around 10% for vehicles and5% for persons in the evening peak. Vehicle throughput increased by more than3 5% on I-575 in the AM and PM peaks, and by the same onI-75 in the AM peaks (only minor increases were noted in the PM peaks), likely due to the diversion of commute traffic from arterials onto the freeway corridor once the Express Lanes opened and congestion declined. Based upon vehicle throughput and occupancy distributions, the largest share of the increase in vehicle throughput in the peak periods came from an influx of single-occupant vehicle activity onto the corridor. Even though the number of carpools traversing the I-575 corridor increased slightly during the morning peak, the overall carpool mode share (percentage of carpools) decreased after the significantly greater numbers of single-occupant vehicles began using the corridor.

17. Key Words
Carpools; Demographics; Evaluation and assessment; Express lanes; Focus groups; High occupancy toll lanes; Reversible traffic lanes; Surveys; Through traffic; Vehicle occupancy

18. Distribution Statement
No restrictions.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	346	N/A

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Abstract

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Acknowledgments

The authors of this report wish to thank the Georgia State Road and Tollway Authority, Georgia Department of Transportation, and the Atlanta Regional Commission for their data contributions, support, and assistance throughout this research effort.

Executive Summary

This report summarizes research conducted by the Georgia Institute of Technology for the Georgia State Road and Tollway Authority (SRTA), to quantify the changes in vehicle and person throughput between 2018 and 2020 on SRTA's four managed lanes systems in the Atlanta, GA, metropolitan area:

- Northwest Corridor Express Lanes (reversible toll lanes on I-75 and I-575)
- I-85 Express Lanes (HOT Lanes, I-285 to Old Peachtree Road)
- I-85 Express Lanes Extension (HOT Lanes, Old Peachtree Road to Hamilton Mill)
- I-75 South Metro Express Lanes

Quantifying the changes in vehicle throughput and person throughput on these Express Lane corridors required the tracking of changes in vehicle volumes over time, as well as changes in vehicle occupancy over time (person throughput = vehicle flow * occupancy). Hence the Georgia Tech research team collected vehicle flows from GDOT and SRTA monitoring systems and conducted field studies on all of the corridors to obtain vehicle occupancy data.

The review of the NaviGAtor data identified no recalibration of machine vision systems during the study period, so no scaling adjustments to traffic operations data were necessary. Filtering of data outliers caused by machine vision system error or fleeting changes in unstable on-road conditions excluded only 0.003% of the data points (removing these records from the analyses did not have a significant impact on the vehicle throughput assessment). The team observed vehicle occupancy profiles on general purpose (GP) freeway lanes and SRTA's Express Lanes, before-and-after the opening of the Express Lanes, and coupled these observations with license plate data captured from adjacent overpasses to classify vehicles by type.

The research team collected passenger occupancy data via traditional roadside observational methods and then performed QA/QC assessment of the occupancy data using regression tree analysis to identify any variables that might have introduced bias in data collection (i.e., some data collectors may not have accurately recorded vehicle occupancy). The QA/QC process removed 6.6%, 7.6%, and 6.1% from the data sets from Fall 2018, Spring 2019, and Fall 2019, respectively. The regression tree analysis did not yield a significant impact on overall vehicle occupancy (average impact of 0.03 persons/vehicle in the AM peaks, and 0.01 persons/vehicle in the PM peaks). Analyses indicate that after controlling for vehicle class, the most significant factor affecting average occupancy was the lane (site location, lane type, and lane position), followed by AM vs. PM peak period. Managed lanes in general tend to have higher occupancy, as was observed on the I-85 Express Lanes; however, the NWC Express Lanes exhibit lower occupancy than the parallel general purpose lanes. For system-wide general purpose lanes, the middle lanes generally tended to have higher average vehicle occupancy than the fast lanes (inside lanes) or the slow lanes (outside lanes). Evening peak periods also tend to have higher occupancy than morning peak periods, due to the integration of a wider variety of trip purposes, such as shopping and recreation. Day of the week, given that data collection was constrained to Monday through Thursday, was the least prominent factor among the variables.

The research team observed a decrease in average vehicle occupancy (persons/vehicle) between the baseline year (2018) and post-opening year (2019), and a substantial increase in vehicle throughput during the same period. Although vehicle occupancy declined significantly, the increase in traffic volumes also led to an overall increase in person throughput (to a lesser extent than vehicle throughput) at all sites. Vehicle throughput on the I-85 corridor increased by about 5-7% and person throughput increased by 1-2% in the morning peak, and by around 10% for vehicles and 5% for persons in the evening peaks. However, vehicle throughput increased by more than 35% on I-575 in the AM and PM peaks, and by about the same on I-75 in the AM peak. This large increase in combined freeway and Express lane traffic volumes after the NWC Express Lanes opened was likely due to the diversion of commute traffic from arterials, and perhaps some traffic from the temporal shoulders of the peak, after the Express Lanes facilitated a decrease in corridor congestion. Based upon changes in vehicle throughput and occupancy distributions, the largest share of the increase in vehicle throughput in the morning and afternoon peak periods came from a large increase in single-occupant vehicle activity. For example, the number of carpools traversing the I-575 corridor increased only slightly during the morning peak, but the overall carpool mode share (percentage of vehicles by mode) and overall vehicle occupancy decreased after significantly greater numbers of single-occupant vehicles began using the corridor.

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List of Acronyms

ABM	Activity-Based Model
ARC	Atlanta Regional Commission
ASCII	American Standard Code for Information Interchange
AVO	Average Vehicle Occupancy
CHS	Chastain Road
DOT	Department of Transportation
ETL	Express Toll Lane
FHWA	Federal Highway Administration, USDOT
Georgia Tech	Georgia Institute of Technology
GDOT	Georgia Department of Transportation
GP Lane	General purpose lane
GP1, GP2, etc.	General purpose lane 1, lane 2, etc.
GRA	Graduate research assistant
GRTA	Georgia Regional Transportation Authority
HAM	Hamilton Mill Road
HD	High definition
HDV	Heavy-duty vehicle
HIC	Hickory Grove Road
HOT Lane	High-occupancy toll lane, allows SOVs to pay a toll to use the facility
HOT2+	High-occupancy toll lane, requiring a driver plus one or more passengers
HOT3+	High-occupancy toll lane, requiring a driver plus two or more passengers
HOV	High-occupancy vehicle, driver plus passenger(s)
HOV2	High-occupancy vehicle, driver plus one passenger
HOV2+	High-occupancy vehicle, driver plus one or more passengers
HOV3	High-occupancy vehicle, driver plus two passengers
HOV3+	High-occupancy vehicle, driver plus two or more passengers
HOV4+	High-occupancy vehicle, driver plus three or more passengers
HOV Lane	High-occupancy vehicle lane (a carpool lane)
HOV-to-HOT	Conversion of a HOV lane to a HOT lane
HPMS	Highway Performance Monitoring System
IND	Indian Trail/Lilburn Road
JOD	Jodeco Road
LDV	Light-duty vehicle
MARTA	Metropolitan Atlanta Rapid Transit Authority
ML	Managed Lane (Toll Lane, HOV lane, HOT lane, etc.)
NaviGAtor	The intelligent transportation system operated by the Georgia DOT
OPT	Old Peachtree Road
PPLPH	Persons per lane per hour
PTZ	Pan, tilt, zoom (cameras)
RFID	Radio frequency identification
SOV	Single occupant vehicle (driver only)
SRTA	State Road and Tollway Authority
SUV	Sports utility vehicle
TMC	Traffic management center
USDOT	United States Department of Transportation
URA	Undergraduate research assistant
USB	Universal Serial Bus
USDOT	United States Department of Transportation
VDS	Vehicle detection systems (video-based in Atlanta)
VPLPH	Vehicles per lane per hour
VPSI	Vanpool Services, Inc.
VPTC	Vehicle and Person Throughput Calculator

1 Introduction

Major metropolitan areas that face severe congestion problems have been implementing a variety of transportation control measures designed to manage transportation demand and reduce congestion during morning and afternoon peak periods (Guensler, 1998; Guensler et al., 2013a). A growing congestion management trend has been the implementation of managed lanes, to enhance freeway operations (USDOT, 2012; FHWA, 2020). Managed lanes include high-occupancy vehicle (HOV) carpool lanes, high-occupancy toll (HOT) lanes, and express toll lanes (ETLs), which typically run within or alongside congested Interstate highways. Managed lanes provide commuters with an option to obtain more reliable travel speeds either by carpooling or paying a toll to access the managed lane. However, an important operational consideration with any managed lane is ensuring that demand for lane use remains below lane capacity, to ensure that congestion does not form on the lane (i.e., speeds remain above 45 mph during the peak period).

The demand for high-occupancy carpool lanes requiring 3+ persons per vehicle (HOV3+ lanes) almost always remains below the lane capacity, because 3-person carpools are very difficult to form and retain. However, in large metropolitan areas, demand for carpool lanes that require only 2+ persons per vehicle (HOV2+) often exceed lane capacity, as they did on the Atlanta I-85 corridor prior to 2009 (Toth et al., 2014; Guensler, et al., 2013a; Guin, et al., 2008). When carpool demand exceeds capacity, congestion forms on the managed lane, which means that carpoolers and transit users do not attain their expected/promised levels of service. When a HOV2+ lane becomes congested, one might think that the logical approach is to convert the lane to an HOV3+ lane; however, 3-person carpools are very difficult to form. Converting an HOV2+ lane to an HOV3+ lane so drastically diminishes demand for use of the lane, that conversion results in an under-utilized managed lane and increases congestion on the regular (general-purpose or GP) lanes. For example, before-and-after data in Texas showed a reduction in demand for the HOV lane by 65% (Pratt, et al., 2000) after HOV2 to HOV3+ conversion, which pushed vehicles into the general purpose (GP) lanes, and made corridor congestion worse than before the conversion (the lane was later converted back to HOV2).

To solve the reduction in demand associated with an HOV2+ to HOV3+ conversion, FHWA and others introduced the concept of high-occupancy toll (HOT) lanes. HOT lanes increase the occupancy requirement, which reduces demand for the lane, and then fills the free capacity on that lane with drivers who are willing to pay a toll. When tolls are low, demand for the lane is high. As demand increases and threatens to swamp the lane with congestion, facility operators increase the HOT lane toll price, which reduces demand. As demand decreases, the operators decrease the toll price to increase demand for the lane. With accurate anticipation of changes in demand for the lane, and proper setting of the toll price, demand never exceeds capacity and the lane achieves optimal flows. Express toll lanes (ETLs) work the same way as HOT lanes, increasing and decreasing toll pricing as needed to manage demand, with the difference that carpools and other vehicles that may be exempt on HOT lanes (e.g., electric vehicles) are also charged tolls in ETLs.

In the Atlanta Metropolitan area, the Georgia Department of Transportation (GDOT), in collaboration with relevant state and regional transportation agencies, designs, contracts, and constructs managed lane facilities that are part of the planned $16.1 billion managed lanes system (HNTB, 2015; HNTB, 2010). The State Road and Tollway Authority (SRTA) procures the financing for these systems and then operates the tolled transportation facilities within the State. The first priced managed lane facility was an HOV-to-HOT conversion on the I-85 corridor that opened on October 1, 2011. The second facility, the I-75 South Metro Express Lanes, opened about five years later (January 2017). In September 2018, SRTA opened new reversible express toll lanes on the I-75/I-575 Northwest Corridor, and then extended the existing I-85 HOT Express Lanes north of Atlanta from Old Peachtree Road to Hamilton Mill Road in November 2018 (SRTA, 2018). All four facilities are within the metro area (Figure 1). The Study Area chapter of this report describes the specific characteristics of each facility.

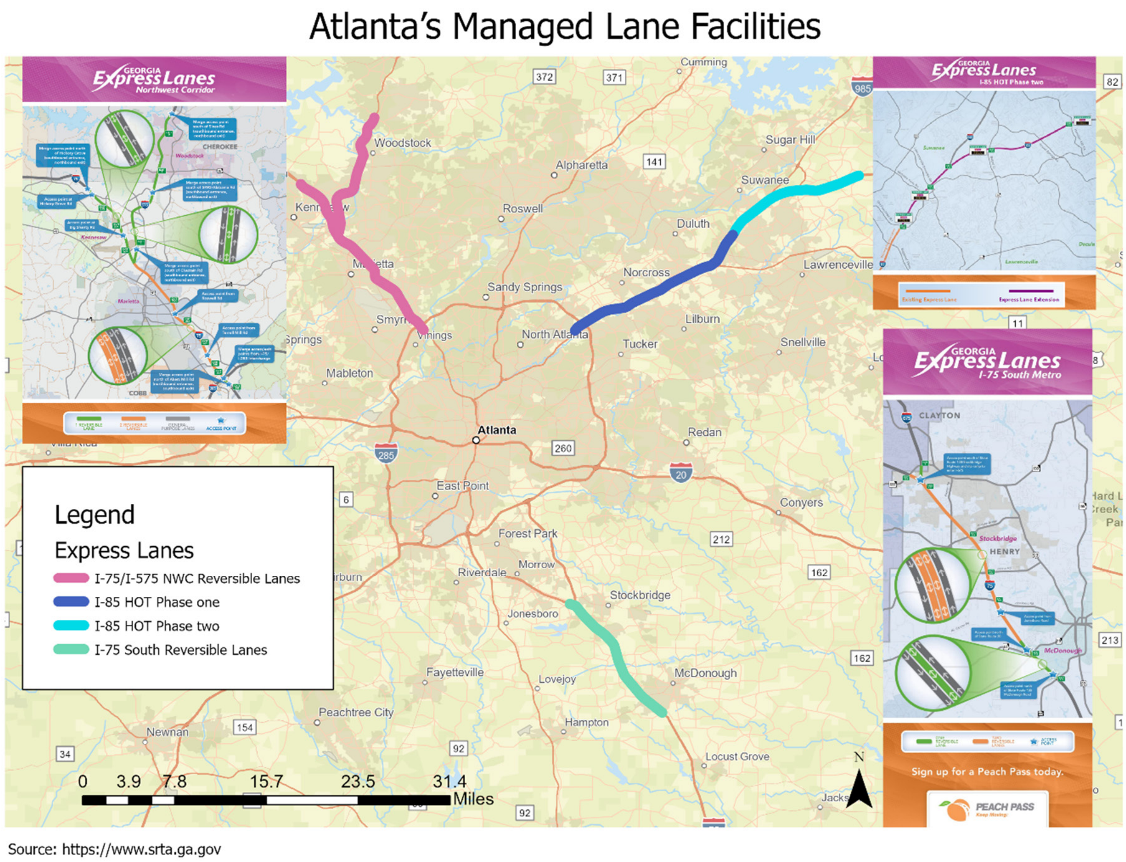


Figure 1 – Map of Atlanta's Managed Lane Facilities

All four managed lane corridors collect tolls that change dynamically (variable pricing based on operating conditions) so that toll price responds to congestion. As demand for use of each of these lanes increases, the toll increases to ensure that managed lane demand remains below capacity and users experience reliable trip times. To use any of the Express Lanes, vehicles must have a Peach Pass account and display a Peach Pass toll tag inside the front windshield. Vehicles with 3+ axles and/or 6+ wheels (i.e., light-heavy-duty vehicles or larger) may not use any of the priced managed lanes. Registered buses, 3+ person carpools, vanpools, motorcycles, emergency vehicles, and dedicated alternative fuel vehicles (AFVs) with the proper AFV license plate (which excludes all hybrid electric vehicles) may use both of the I-85 facilities toll-free. However, on the I-75 Northwest Corridor and I-75 South Metro express lanes, only state-registered Xpress buses, vanpools, and law enforcement vehicles may use the lanes toll-free (carpools, motorcycles, and AFVs pay the full toll). All vehicles using the Express Lanes must display a registered Peach Pass toll tag and have a valid account.

The I-85 facilities employ dedicated managed lanes in each direction. That is, users have access to a northbound and southbound Express Lane all day, every day. However, the NWC and South Metro Express Lanes are reversible, serving traffic inbound to Atlanta during the morning peak period and outbound traffic during the afternoon peak period. At around noon, SRTA closes the inbound access points, waits for all traffic to clear, conducts a drive-through safety check to ensure that the lanes are completely clear, and then opens the outbound access points for afternoon commute traffic. Hence, the latest Express Lane additions have added significant lane capacity to the pre-existing general purpose lanes to handle peak period traffic.

FHWA's transportation performance management goals include congestion reduction, system reliability, freight movement and economic vitality, and environmental sustainability (FHWA, 2021). The metrics used to assess system performance have moved toward developing a better understanding of vehicle mix and associated vehicle occupancies under reliable conditions. According to FHWA, the use of local occupancy data will be highly recommended in meeting these metrics rather than the use of national defaults by vehicle class (the use of national defaults may not be to the agency's advantage). In addition, FHWA has stated that there will likely be an increased focus on transit occupancy and alternative modes in urban areas. With respect to freight operations, vehicle classification data and freight hauling data will need to be coupled with freeway performance data in the future.

Because performance metrics require the assessment of vehicle and passenger throughput on managed lane facilities, and because dynamically-priced facilities have been noted to impact carpooling decisions (Guensler, et al, 2013a), the Georgia Tech team has been tasked with assessing vehicle throughput, vehicle occupancy, and person throughput during the morning and evening peak periods on SRTA's managed lane systems. For this project, the team updated previous data collection methods and deployed students to collect vehicle throughput and vehicle occupancy data for use in the calculation of vehicle and person throughput under congested conditions. This research effort is observational in nature, and methods remained consistent throughout the entirety of the study.

- The team collected occupancy data in Fall 2018 and Fall 2019 for I-75 Northwest corridor and the I-85 Express Lanes Extension, before and after managed lane facilities opened on these corridors. Hence, these data allow the research team to assess changes in vehicle occupancy and vehicle and person throughput before-and-after the facilities opened.

- All of the occupancy data associated with the above data collection efforts have been QA/QC-processed and summarized in this report.

- All of the 2018 and 2019 license plates have been processed (a second graphics computer was dedicated to the analysis), and Volume II of the report assessing the commutershed and demographic characteristics was drafted separately for review.

- In the 2010-2012 HOT lane assessment (Guensler, et al., 2013a), traffic volumes at I-85 at Center Way served as the standard for corridor assessment. However, this current project is assessing performance on four-corridors, which requires the use of data from multiple NaviGAtor locations. All the traffic volume profiles needed from NaviGAtor were QA/QC-processed as input to the throughput assessment.

- The before-and-after comparative occupancy and throughput results based upon field observations are complete, with the substitution of average vehicle occupancy for vanpools and express buses.

This report first presents the throughput methodology and the results associated with each step of the data collection and modeling efforts. Chapter 2 describes the facilities and their specific operating characteristics, the nature of dedicated vs. reversible toll facilities, and the data collection efforts. Chapter 3 provides an overview of the throughput calculation methodology, a detailed discussion of vehicle activity data sources, data processing challenges, and calibration procedures. Vehicle occupancy data collection is described in Chapter 4, including the specific data collection deployment efforts. Quality assurance and quality control of field data collection is described in Chapter 5, and factors affecting occupancy are discussed in Chapter 6. Chapter 7 and Chapter 8 describe express bus and vanpool data sources and occupancy values that will ultimately be used in calculating average vehicle occupancy. Chapter 9 presents the field collected vehicle occupancy for before and after the opening of the new facilities. Final vehicle throughput and person throughput results, based upon noted changes in vehicle throughput and occupancy, are presented in Chapter 10. Finally, conclusions and further research work is presented in Chapter 11.

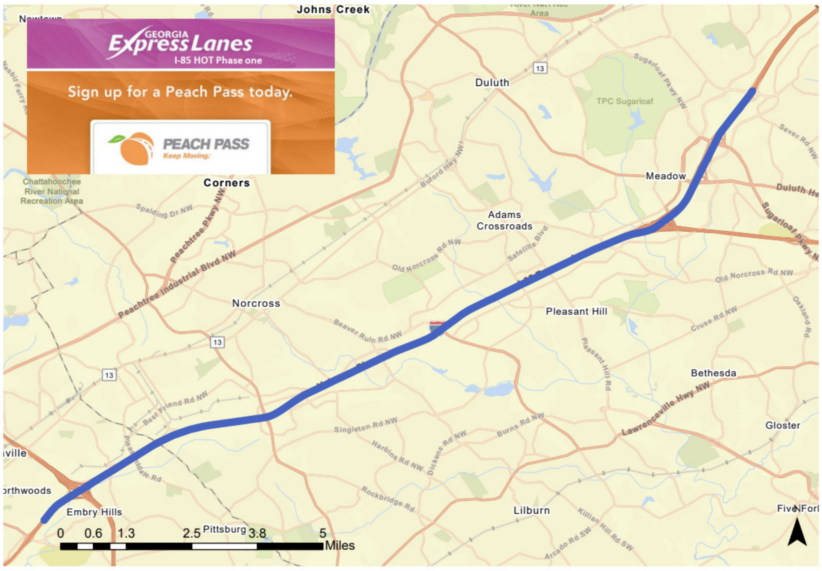
2 Study Area

The overall Georgia Managed Lanes Plan calls for $16.1 billion in capital investments on managed lanes facilities (HNTB, 2010; HNTB, 2015). The managed lane system plan identifies the following operational goals and objectives (Smith, 2011):

- Protect mobility in the managed lanes
- Increase vehicle throughput
- Increase average travel speeds and reduce corridor travel times
- Decrease delay
- Decrease travel time variation
- Improve transit on-time performance
- Increase access to major activity centers
- Increase system efficiency

GDOT and SRTA have endeavored to meet these goals through project implementation (corridor selection, design, and operations). Over the past ten years, the state has begun implementing Express Lanes corridors as part of the overall plan. As part of the planning and implementation process, SRTA has been committed to monitoring the outcomes of these new facilities. In 2010-2012, GDOT and SRTA conducted a before-and-after assessment of the HOV-to-HOT conversion on I-85 to see how the project affected vehicle and person throughput. In preparation for the opening of two new facilities, SRTA funded this 2018-2019 before-and-after study to also assess changes in vehicle and person throughput. The four facilities included in the assessment of vehicle and person throughput include:

- I-85 Express Lanes (I-285 to Old Peachtree Road) - This original I-85 Express Lanes corridor runs from Chamblee Tucker Road, just south of I-285, to just north of Old Peachtree Road. The facility is the result of a conversion of pre-existing northbound and southbound HOV2+ carpool lanes into HOT lanes (Guensler, et al, 2013a; Toth, et al, 2012). The original I-85 Express Lanes corridor is about 16 miles in length and includes 13 different interchanges, providing entry and egress to the managed lanes (11 off-ramps and 10 on-ramps in the northbound direction and 10 off-ramps and 11 on-ramps in the southbound direction). The SR-316 off-ramp in the northbound direction is located on the left side of the facility, providing Express Lane users a direct exit from I-85. In the southbound direction, drivers coming from the SR-316 HOT lanes merge directly into the left-hand Express Lane on I-85. Lane separation markings are accompanied by physical grooves carved into the pavement within the lane separations, designed to discourage vehicles from crossing into or out of the HOT lanes at non-designated locations. Flexible pylon barriers are also in place in the southbound direction at the I-85/SR-316 weave to discourage illegal weaving into the managed lane (which interferes with the SR-316 traffic entering the facility). The original I-85 Express Lanes (HOT lanes) opened on October 1, 2011.



Source: https://www.srta.ga.gov

Figure 2 – I-85 Express Lanes

- I-75 South Metro Express Lanes - The I-75 South Metro Express Lanes consist of about 12 miles of reversible toll lanes constructed within the center median of I-75, south of Atlanta. The lanes serve inbound traffic to Atlanta in the morning peak and outbound traffic in the afternoons, adding new capacity to the pre-existing general purpose lanes. The facility runs from McDonough Road (State Route 155) in Henry County to Stockbridge Highway (State Route 138) in Clayton County (SRTA, 2019). The I-75 South Metro Express Lanes opened in January 2017.

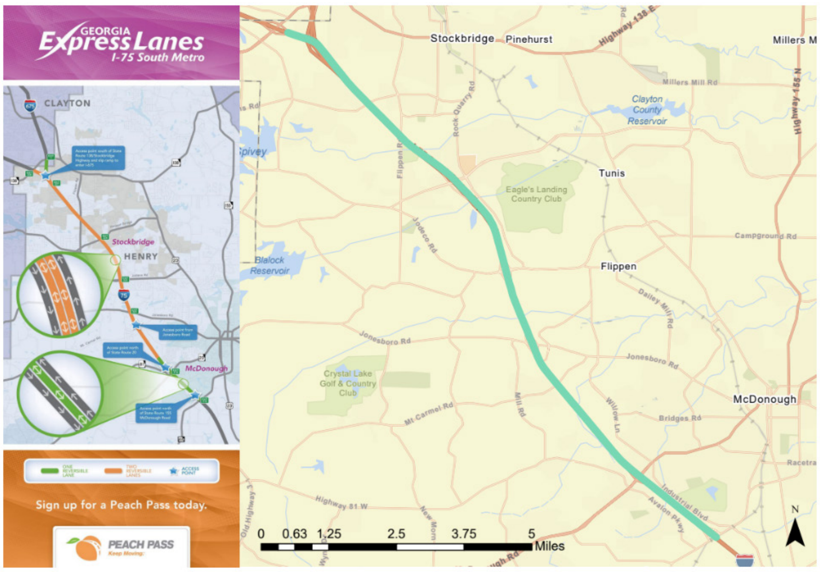


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Figure 3 – South Metro Corridor Express Toll Lanes

- Northwest Corridor Express Lanes (along I-75 and I-575) - The Express Lanes on the I-75/I-575 Northwest Corridor consist of about 30 miles of reversible toll lanes along I-75 from Akers Mill Road to just past Hickory Grove Road, and along I-575 from I-75 to just past Sixes Road. Two Express Lanes run parallel to the I-75 between I-285 and the I-575 split, at which point single lanes continue northward along each Interstate leg. Hence, one Express Lane was added along I-75 north to Hickory Grove Road and one Express Lane was added along I-575 north to Sixes Road. The I-75/I-575 Northwest Corridor Express Lanes opened in September 2018.

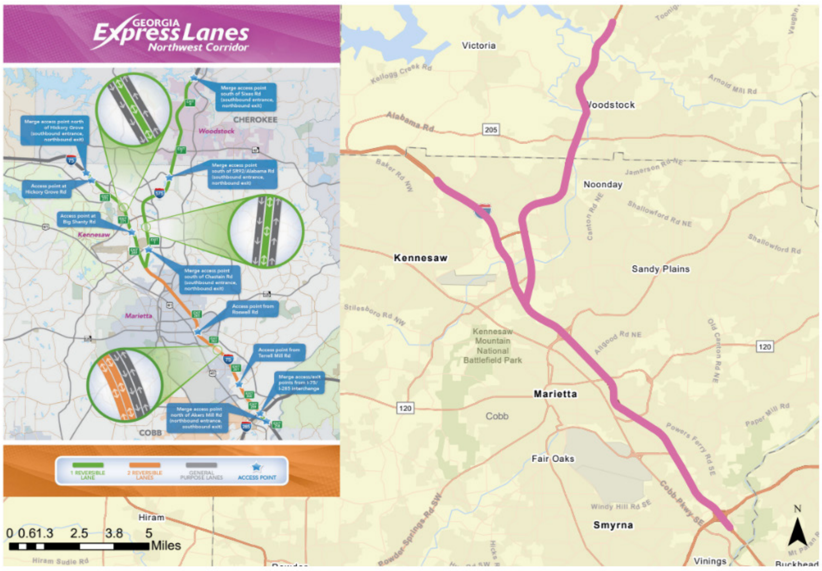

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Figure 4 – Northwest Corridor Express Toll Lanes

- I-85 Express Lanes Extension (HOT lanes running from Old Peachtree Road to Hamilton Mill) - The extension of the I-85 Express Lanes consists of new lane construction located entirely within Gwinnett County. About ten miles of newly constructed lanes begin north of the existing I-85 Express Lanes at Old Peachtree Road and extend just past Hamilton Mill Road. Auxiliary lanes constructed between on-ramps and off -ramps allow drivers to merge into traffic and help prevent bottlenecks caused by drivers attempting to enter or exit the freeway. All of the same rules that apply on the original I-85 Express Lanes apply to the I-85 Express Lanes Extension. SRTA charges separate tolls on the I-85 Express Lanes and I-85 Express Lanes Extension; drivers may enter or leave the facility at the transition between facilities. The I-85 Express Lanes Extension opened in November 2018.

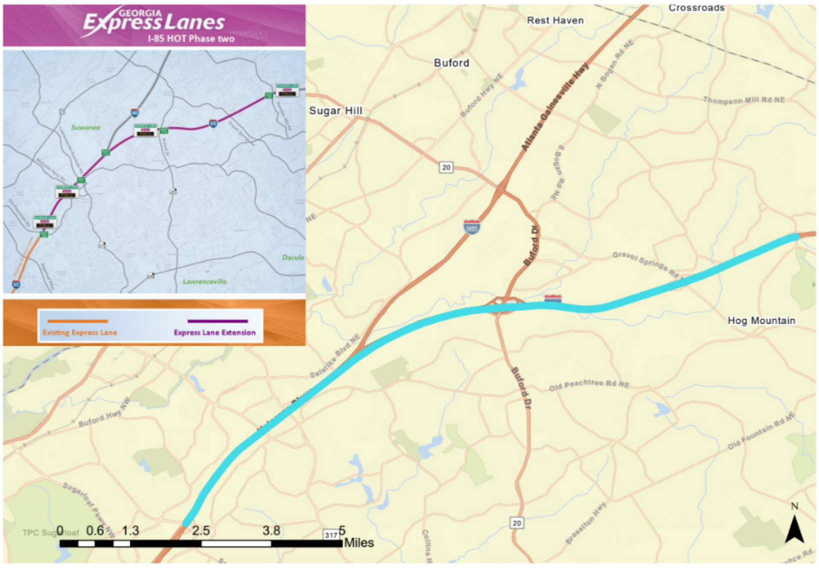

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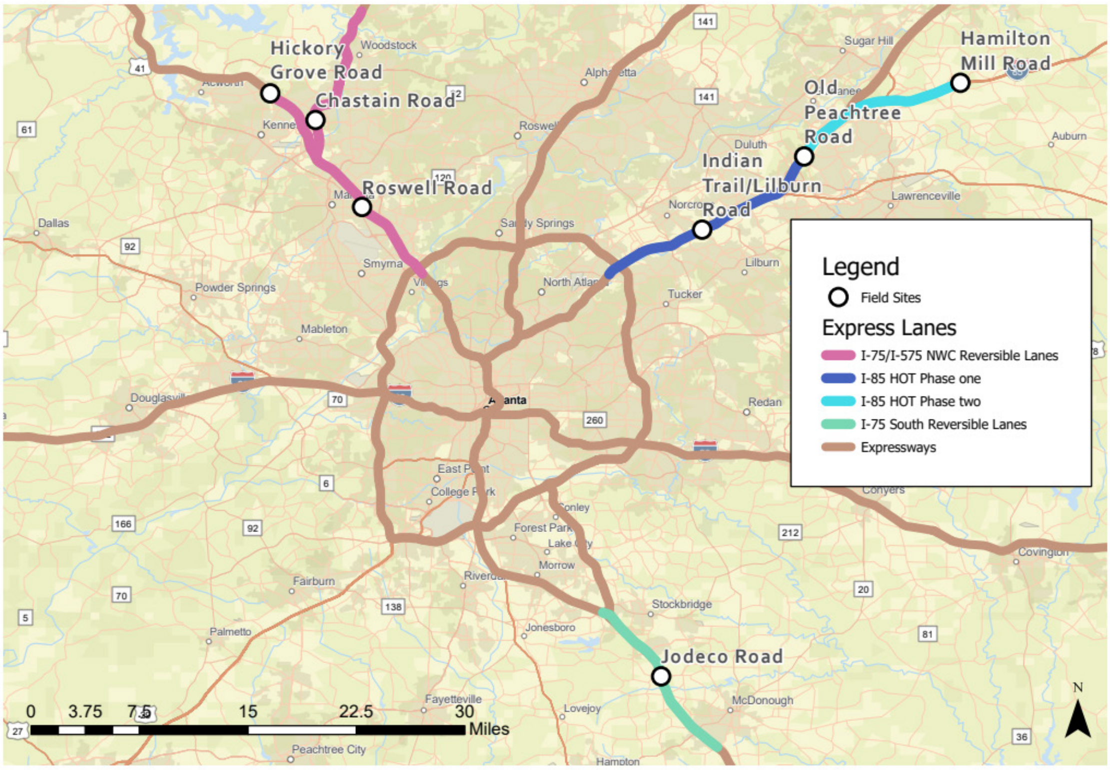
Figure 5 – I-85 Express Lanes Extension

The managed lanes operations rules are not the same on each corridor. For example, the I-85 Express Lanes (including the original HOV-to-HOT conversions stretch and the extension) are free for registered carpools (carrying three or more occupants), motorcycles, transit vehicles, emergency vehicles, and Alternative Fuel Vehicles (AFVs) with the proper license plates. However, the Northwest Corridor and I-75 South Metro facility do not provide toll-free travel to any of these vehicles. Only registered Xpress and CobbLinc buses and state-registered vanpools are provided with toll-free trips on these two corridors. Using any of the four facilities requires a Peach Pass is now required. The Peach Pass radio frequency identification (RFID) tag is used to electronically collect the toll. Even vehicles that are exempt from the toll on any facility require the presence of a Peach Pass in the vehicle. The passage of each exempt vehicles is recorded via readings of the Peach Pass tag number, but the vehicles are not charged if they are confirmed by back-office routines to be exempt.

2.1 Data Collection Overview

The research team selected seven locations (see Figure 6) to represent the performance of the four Express Lane corridors. Each data collection site was selected to be representative of the applicable facility. Each site had to be accessible to an appropriate roadside location, and a good view into the vehicle needed to be present for occupancy data collection. Identifying a site on I-85 that would be consistent with the 2010-2012 study was also important. However, the primary concern in site selection was the safety of the data collection crews while accessing the site, collecting data, and leaving the site. The team conducted safety inspections for each site prior to finalizing the data collection plan, and safety reports were prepared for each site (safety plans are available under separate cover).



Source: https://www.srta.ga.gov

Figure 6 – Map of Data Collection Locations

At each site, the research team collected vehicle occupancy data on each facility for five morning and afternoon peak periods (i.e., during the baseline year for each facility and again one year later), typically over a two-week time span. As vehicles passed the observation location, student workers manually recorded the vehicle's occupancy on a specialized tablet using an app designed for occupancy data collection (see Chapter 4). The team concurrently collected video from the closest overpass while collecting the occupancy data. Each camera was set up to cover two lanes, with the zoom set such that license plates in both lanes could be read clearly when played back in the laboratory. Video also allows the team to accurately count the number of vehicles traversing the roadways during each data collection session (video time-stamps provide second-by-second vehicle flow by lane). The team also used license plate data to confirm vehicle class distributions.

Data collection efforts were performed on I-85 and on the NWC I-75/I-575 facilities two study periods (one before the 2018 opening of each Express Lane facility and another one year later in 2019). These efforts were designed to assess changes of vehicle occupancy and throughput before-and-after facility opening. The I-75 South Metro Express Lane facility had already opened in January 2017. I-75 South Metro data were collected in Spring 2019 (there was not sufficient time to assess all four corridors in Fall 2018). The South Metro facility was scheduled to be assessed again in Spring 2020 to see whether any notable changes had occurred during the year; however, data could not be collected in 2020 due to the COVID-19 pandemic. The rationale behind the selection of each data collection site is described in the bullets below, and more details are provided on data collection methods and deployment dates provided in Chapter 4.

- I-85 Express Lanes (I-285 to Old Peachtree Road) - Data collected on the I-85 Express Lanes allows the team to compare current throughput and occupancy to the data collected in the 2010-2012 study. The team selected Indian Trail Lilburn Road and Old Peachtree Road as two of the data collection sites. The Old Peachtree Road site was the same site used in 2010-2012. Indian Trail was the closest practical site to the Center Way location used in the previous study. Indian Trail data collection sessions ran from September 11 to September 25 in 2018 (with a follow-up day on October 2 in 2018), and from September 4 to September 17 in 2019 (with two follow-up days on October 8 and October 10 in 2019). Old Peachtree Road data collection sessions ran from October 3 to October 25 in 2018, and from October 1 to October 17 in 2019 (with a follow-up day on October 29 in 2019).

- I-75 South Metro Express Lanes - This facility was already open during the first year of data collection. Data were collected to evaluate changes on the facility over the one-year study period. Jodeco Road provides data for the middle of the corridor and includes all traffic south of the split onto multiple corridors. Data collection sessions ran from April 2 to April 25 in 2019. However, the COVID-19 pandemic prevented the collection of follow-up data in 2020.

- Northwest Corridor Express Lanes (along I-75 and I-575) - The goal of data collection on this facility was to assess the traffic volume and vehicle occupancy impacts of the Northwest Corridor reversible Express Lane. Hickory Grove Road and Chastain Road are selected as data collection sites to represent the I-75 and I-575 corridor, respectively. Chastain Road data collection sessions ran from August 14 to August 23 in 2018 (with a follow-up day on September 6 in 2019), and from August 6 to August 20 in 2019 (with a follow-up day on October 8 in 2019). Hickory Grove Road data collection sessions ran from August 28 to September 7 in 2018, and from August 21 to September 5 in 2019 (with a follow-up day on October 9 in 2019).

- Roswell Road Dedicated Access Points to the Northwest Corridor Express Lanes - The goal of this data collection was to assess the usage of the new direct access point on I-75 North associated with the reversible Northwest Corridor Express Lanes. Roswell Road was selected to represent the changes in travel behavior associated with the opening of new direct-access entry points to the managed lanes (i.e., where no previous freeway entrance was located). Given the uniqueness of this facility and dedicated access points, data were collected three times for this study (Fall 2018, Spring 2019, and Fall 2019). Data collection sessions ran from October 25 to November 1 in 2018, from April 2 to April 4 in 2019, and from October 22 to November 6 in 2019. The fourth set of planned data collection sessions in Spring 2020 were prevented by the COVID-19 pandemic.

- I-85 Express Lanes Extension (HOT lanes running from Old Peachtree Road to Hamilton Mill) - The goal of data collection on this facility was to assess the usage of I-85 phase 2 HOT lanes. Hamilton Mill Road was selected to represent the activity at one end of the corridor, to compare against the activity at the other end of the corridor (Old Peachtree Road). Data collection sessions ran from September 20 to October 25 in 2018, and from September 18 to September 26 in 2019.

This report focuses on the vehicle occupancy, vehicle throughput, and person throughput collected during the baseline period (2018 Fall – 2019 Spring), and one-year after the baseline period (2019 Fall – 2020 Spring), across the facilities. The major infrastructure changes between baseline and second year data collection included the opening of the new I-75 Northwest Corridor reversible Express Lane, and the opening of the I-85 Express Lane Extension. Neither facility was in operation during the baseline year. Chapter 9 provides the before-and-after comparison of vehicle occupancy results, and Chapter 10 provides the before-and-after comparison of vehicle and person throughput results.

3 Vehicle Throughput Methodology and Data Sources

The research team developed the Vehicle and Person Throughput Calculator (VPTC) to estimate hourly vehicle flow rates (vehicles/hour and vehicles/four-hour peak period) and person throughput (persons/hour and persons/four-hour peak period) using data collected for specific monitoring stations. Observation of changes in vehicle occupancy, vehicle flow, and person flow data at each location over time, will help the team assess the potential influence of the new reversible expressway of the Express Lanes on I-75, and I-85 Express Lanes (HOT) Extension on vehicle occupancy and throughput.

The team developed the original calculator as an Excel spreadsheet, and then translated the code to a series of Python scripts for implementation. The scripting process allowed the calculator to interface directly with the analytical database and the tables of pre-processed input data, including: 1) NaviGAtor ITS traffic volume data, after processing through quality assurance routines; 2) field-collected occupancy and vehicle classification data, after quality assurance processing and allocation of uncertain occupancy observations (described later in this report), and 3) express bus and vanpool vehicle occupancy data. Outputs are aggregated to five-minute bins for vehicle and person flows for the selected times and dates (which can be further aggregated to hourly and peak-period flows).

The implementation of this much larger and much more complex assessment for the four corridors required the team to revert to an Excel-based calculator process. All data and calculation methods employed in this project can be found in the companion spreadsheet to this report.

The spreadsheet calculator employs monitored traffic volumes by lane collected by the Georgia Department of Transportation (GDOT) Traffic Management Center (TMC) in Atlanta, GA. Video-based vehicle detection systems (VDS), located at monitoring stations along freeways throughout the region, feed traffic volume data by lane back to the TMC. NaviGAtor data are aggregated from 20-second lane-by-lane observations to five-minute summaries by station. For any given location, date, and time, the team matches the most relevant field-collected occupancy field data by vehicle class (in space, time, and location) to the monitored five-minute traffic volumes to estimate passenger throughput.

Vehicle classification data from field data collection efforts are used to split NaviGAtor traffic volumes into the number of light-duty vehicles (LDVs), sport utility vehicles (SUVs), buses, motorcycles, vans, small heavy-duty trucks (small HDTs), and large heavy-duty trucks (large HDTs). The researchers assign the vehicle occupancy data collected by field teams (by vehicle class) to class-specific vehicle throughput by lane. Hence, initial person throughput estimates are derived by multiplying vehicle class traffic volumes (e.g., vehicles/hour for sport utility vehicles), by vehicle-class-specific occupancy observations (persons/sport utility vehicle). More information on occupancy data collection and person throughput calculations are provided in following chapters. Initial hourly person throughput results are later corrected to account for the impact of vanpools and express buses for which occupancy data are available. Following the same process used in the 2011-2012 analysis, vanpool and express bus impacts are handled by replacing the persons in each applicable bus/vanpool field observation (4+ persons) with the SRTA-monitored occupancy for these regularly scheduled vehicles (i.e., number of persons in each bus and vanpool derived from SRTA tracking data). The specific procedures for addressing express bus and vanpool occupancy are also presented in detail later in this report.

3.1 NaviGAtor Traffic Data

The Georgia NaviGAtor system housed in the GDOT Traffic Management Center (TMC) monitors vehicle speed and throughput data for the I-75 and I-85 corridors. The NaviGAtor system monitors more than 220 miles of freeway in Atlanta's metropolitan area, providing data to improve safety and efficiency. Georgia NaviGAtor system is composed of video monitoring systems, communications systems, and advanced signage (Lee and Bradford, 2004). Video-based vehicle detection systems (VDS) are located at monitoring stations approximately every 1/3-mile along freeways throughout the region. A machine vision process counts vehicles that traverse the video system's field of view and generates the VDS data. The change in pixel colors occurring within a vehicle detection zone in the video field of view indicates the entry and departure of a vehicle. By establishing two detection zones at a known distance separation, the system also provides vehicle speed estimates. Navigator data include: traffic volumes in the managed lane, traffic volumes in each general purpose lane, vehicle speeds in the managed lane, and vehicle speeds in each general purpose lane. Some machine vision systems also perform vehicle classification (light-duty vehicles, heavy-duty vehicles, etc.), but classifications were not available for the specific study areas. Hence, the team conducted manual observations of vehicle classification.

The NaviGAtor data flow to the Georgia Tech NaviGAtor archive through a remote GDOT TMC network monitoring station in the transportation research laboratory at Georgia Tech. The monitoring station is isolated from the Georgia Tech network for security purposes. The VDS data feed includes traffic volumes and spot speed data, by lane, at 20-second resolution. The research team manages an analytical archive of the TMC data, including the raw and processed 20-second data, aggregation of data to 5-minute bins, 15-minute bins, and hourly volumes. The Georgia Tech team used 2019 and 2020 NaviGAtor data for this analysis. The data are archived in near real time, with 20-second bin data arriving within 2 minutes. Figure 7 provides an overview of the NaviGAtor system, which consists of:

- Approximately 1,645 VDS stations along major interstates around Atlanta (1/3-mile)
- About 500 full-color CCTV cameras along major interstates around Atlanta (1-mile)
- A total of 2,958 cameras (2,208 in metro Atlanta and 750 in other areas) available online (some cameras listed online may be temporarily unavailable)
- A total of 208 changeable message signs (172 in metro Atlanta and 36 in other areas)
- More than 160 ramp meters
- The GaTech archives of historical GA Navigator data for 2016 to 2019 include about 1,950 stations (devices)

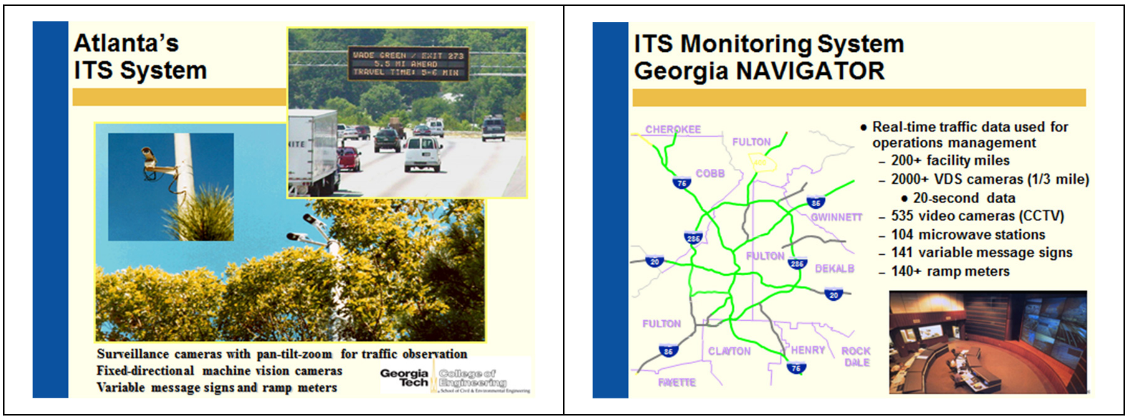


Figure 7 – Overview of the NaviGAtor System

Figure 8 shows the NaviGAtor web interface, which provides the NaviGAtor system camera locations used to collect traffic count data. Cameras are located roughly every 1/3 mile along the corridor and are usually mounted on 60' poles and pointed downward at the traffic. The location of the cameras relative to the lane monitored (vertical and horizontal angle) can significantly impact the accuracy and reliability of the data being collected (Grant, et al., 1999). Figure 8 illustrates the web interface provided by GDOT for the public to access camera views and visualize congestion conditions on the roadway.

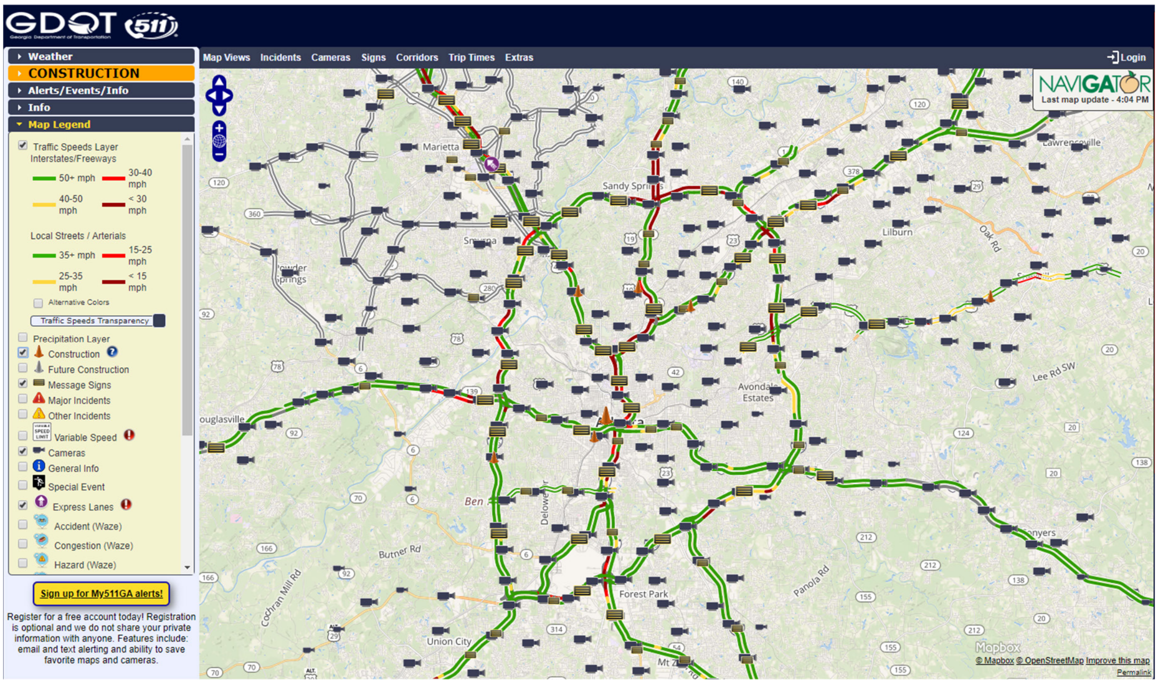


Figure 8 – NaviGAtor Web Interface

As discussed above, the Georgia Tech data archive receives a direct feed from the NaviGAtor system. Because each NaviGAtor device only covers a limited distance of road, it is important to select the appropriate devices to represent the traffic operations at or near the observation sites, so that the traffic operating data can be properly integrated with the field observed occupancy profiles (for example, to exclude the impact of downstream ramps that are not included in the field occupancy collection). The research team selected the NaviGAtor devices for all observation sites based on the NaviGAtor device list provided by GDOT, which includes the information of primary road, cross road, direction, mileage marker, etc. for every device, in additional to a short description of the device location (for example, “CUMBERLAND BLVD W AT I-75”, or “EXT RMP TO JONESBORO RD”). The descriptions include a short explanation of the road type, primary road and cross road, and helps locate the devices with respect to its position compared to the cross road (for example, “S OF CHASTAIN RD” vs. “N OF CHASTAIN RD”).

Though the device list also provides the latitude and longitude information, these data are not always accurate (information of various offsets not available) and the research team selected potential NaviGAtor devices based on the short descriptions and camera views instead. Multiple potential NaviGAtor devices were selected for both bounds at each observation site, and the exact locations of these devices (poles installing the NaviGAtor devices) were verified based on the mileage marker information (coupled with the primary road). The pole of NaviGAtor device for Northbound at Chastain Road of I-575 is shown as an example in Figure 9 (Google Earth, 2020).

Figure 9 – Locating the NaviGAtor Device #3471, Northbound, Chastain Road at I-575, Screenshots from Satellite Map and Street View of Google Earth

Each NaviGAtor device captures the traffic flow of one or multiple lanes, but not necessarily for all lanes at that location. For example, after the opening of the Express Lane of I-75/575 NWC, new NaviGAtor devices were deployed for the managed lanes, separated from the existing GP-lane devices. Therefore, for Chastain Road of I-575 and Hickory Grove Road of I-75, two devices (one existing device for GP lanes, and one lately deployed device for Express Lanes) were selected, while one device was selected for other sites.

The Old Peachtree Road and Hamilton Mill Road at I-85 were beyond the coverage of NaviGAtor devices in 2018 (new devices deployed in 2019 by GDOT as an expansion of NaviGAtor coverage), and no devices can be selected at these two sites to provide baseline volumes. The research team selected Sugarloaf Road at I-85 (closest available device to the observation site at Old Peachtree Road) as a replacement to represent Old Peachtree Road. No available device close enough could be selected as replacement to represent the Hamilton Mill Road at I-85 in 2018 (a before-and-after assessment could not be conducted as only data of 2019 are available).

The research team processes the 20-second VDS data through a series of quality control measures to identify and eliminate highly improbable values. Gaps in real-time data do occur and are attributable to several different factors, such as sensor failures, data communications interruptions, etc. Georgia Tech researchers also process the 20-second data to impute missing data. After filtering and imputation, 20-second data are re-aggregated to five-minute bins, and one-hour bins, and are retained in the separate analytical archive for use in research activities. Raw speed profiles (20-second) are in time-mean speed (simple average of spot speed data), and are converted to space-mean speed during aggregation for proper use in traffic flow studies and energy/emissions modeling.

3.2 Vehicle Speed Variability

As presented in the previous assessment report (Guensler, et al., 2013a), Figure 10 provides an example plot of the average daily free-flow speeds at one of the detection stations between October 2010 and May 2012. The sudden shifts in the data across all lanes (December 2010 and October 2011) indicate potential calibration changes in the data. Recalibration can also affect the accuracy of any imputed data from adjacent stations. To prevent the propagation of errors, cross-station imputation strategies were not employed and imputation in the 2013 analyses was only performed over time. For example, for a 5-minute aggregate, if data was available only in 10 out of the fifteen 20-second time intervals, the count data was simply scaled by 15/10 to adjust for the missing data. The average speed was computed from the 10 data points that were available. If no data were available in an entire 5-minute period, these missing points were accounted for in a scaling factor when aggregated up to a larger period such as 15 minutes or an hour. Any NaviGAtor data used in vehicle throughput analyses and corridor speed assessments need to be assessed for potential changes in equipment calibration over time. In this study, multiple NaviGAtor data collection locations were assessed, and no recalibration (sudden changes in speed patterns) was identified during the studied period (February 2018 to November 2019). Hence, the research team adopted a scaling factor of 1.0 to the NaviGAtor data.

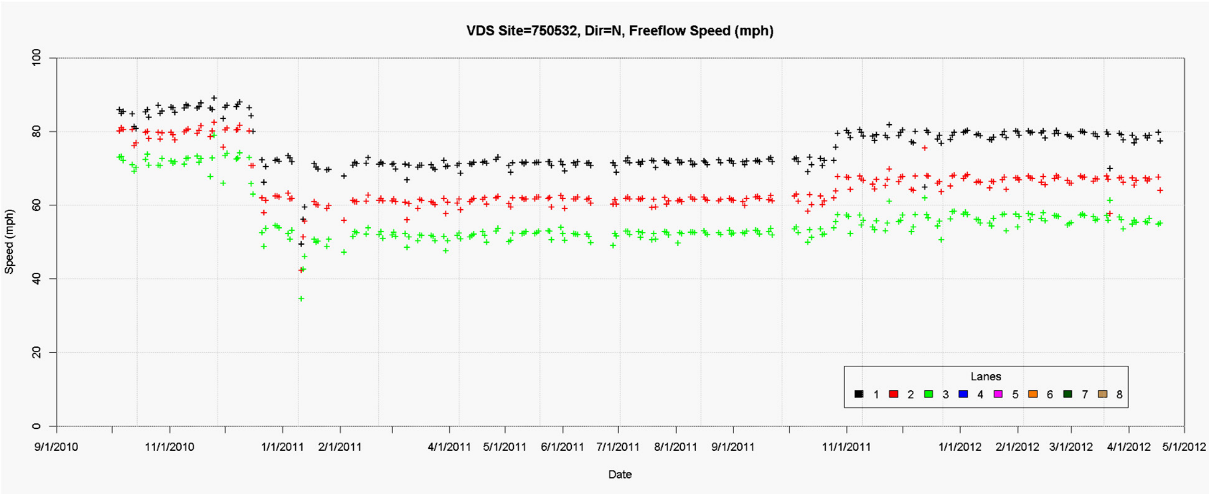


Figure 10 – Time Series Plot of Daily Averages for Free-flow Speeds

3.3 Quality Assurance/Quality Control (QA/QC)

The fundamental relationship between speed and flow is employed to filter VDS data in the QA/QC process. Highly improbable 20-second paired speed and volume data points are removed from the data set and replaced with null values, using a series of data filtering scripts applied to the raw data feed. Null values are imputed in a later step.

Video detection data quality varies as a function of field configuration, including height of device, camera angle, presence of obstructions (e.g., blocking by overpass), sunlight level, sun angle, rain, etc. Hence, improper camera setup, poor camera angles, weaving activity in the detector zone, and even fleet composition (because large vehicles can block the detection of smaller vehicles) can affect data accuracy (Castrillon, et al., 2012; Grant, et al, 1999).

An appropriate calibration of the camera field-of-view is essential to estimate the vehicle length and vehicle speeds (Grant, et al., 2000). The calibration provides a 3-D measurable perspective to a 2-D video image by establishing ground distances relative to the view of the camera. Calibration lines placed parallel and perpendicular to the travel lanes form detection zones for each lane in the image. Single detection zones use distance and estimated vehicle length to estimate speed, while dual detection zones use the distance and time separation between detections to estimate speed. An improper or obsolete calibration may lead to errors in volume count and vehicle speeds. Re-calibration of detectors by GDOT staff can create problems in comparing older data to newer data; however, re-calibration events can usually be identified by examining the continuity of the speed/volume profiles over time.

False detection of vehicles can still happen even after careful calibration of the detection zones. For example, large vehicles can block the field of view, and inclement weather conditions can lead to poor vehicle visibility, causing traffic volumes to be under-counted. On the other hand, weaving may lead to a duplicate identification of the same vehicle and cause over-counting of traffic volumes. Other factors such as movement of the camera (which can happen when cameras installed on overpass bridges shake as vehicles travel across the bridge), or communication error during data transfer, may also lead to error or loss in the raw NaviGAtor data.

Because raw video feeds are typically not archived, QA/QC can often be conducted only by analyzing the resulting speed/volume profiles. Because the detector placement and camera configuration vary for each site, cross-validation strategies are usually impractical given the lack of archived video data. Therefore, the QA/QC is best when based upon the calibration of speed/volume profiles at each specific site. The following steps are used to clean the NaviGAtor data:

Step 1: Collect Free Flow Data:

Because the speed data are obtained from video processing, sudden and systematic shifts in the data may be due to the potential calibration changes. Free-flow conditions are used first to assess speeds estimated by the machine vision systems. Then, laser guns are used to collect accurate free-flow speed data for each lane at each site (one hour for each lane and each site) to verify machine vision results.

Step 2: Aggregate Laser Gun Data:

The team aggregates the laser gun speed data collected in Step 1 into five-minute bins, and identifies the appropriate free-flow speed for each lane at each site. Here the notation v_{sl}^{m} represents the measured free-flow speed of site s and lane l.

Step 3: Aggregate Navigator Data:

For each site and each lane, the NaviGAtor speed and volume data are aggregated from raw 20-second readings to five-minute bins. Here the notation v_{sl}^{n} represents the observed NaviGAtor free-flow speed of site s and lane l.

Step 4: Calculate Scaling Factor:

A scaling factor f_{sl} for site s and lane l is defined as the ratio of v_{sl}^{m} and v_{sl}^{n}, i.e., $f_{sl} = v_{sl}^{m}/v_{sl}^{n}$. The scaling factor essentially calibrates the speeds estimated by the machine vision system to the accurate speeds measured by the laser guns. The team did not note any significant changes in speed patterns (resulting from recalibration) during the data collection period in reviewing operating speed data from NaviGAtor devices. The free flow speed collected by laser guns did not present significant differences vs. the NaviGAtor profiles, and scaling factors of 1.0 were applied in this study (i.e., no revision of NaviGAtor data to compensate for recalibration).

Step 5: Apply Scaling Factor:

Use the scale factor f_{sl} from Step 4, scale the 20-second raw NaviGAtor data by multiplying all NaviGAtor speed with f_{sl} based on the site and lane. After assessing each data source, the team concluded that the scaling factor should be set to 1.0 for all locations in this study (i.e., no recalibration of any machine vision processes was detected).

Step 6: Filter Data:

The filter criteria illustrated in Figure 11 and Table 1 are applied to the scaled data (20-seconds interval) in Step 5 (Guensler, et al., 2013a). Figure 11 shows an expected speed-flow plot. The red hatched regions represent the zones where no data points are expected, based upon fundamental traffic engineering concepts. A conservative approach is adopted, and only the data in the red hatched zones are identified as invalid and removed from consideration. Data points that meet two or more of the following three conditions are removed from further analysis as they are likely missing record due to communication errors: 1) zero volume, 2) zero speed, and 3) zero density. Data points that meet the following conditions are also removed, as these cases are highly unlikely to occur for more than an instant: 1) volumes larger than 8 vehicles/20 seconds, with density higher than 230 vehicles per mile, as this is an unreasonably high density at a high flow rate; 2) volumes larger than 20 vehicles/20 seconds, as this provides an unreasonable headway of 1.0 seconds/vehicle; and 3) speeds larger than 110 mph, as these high speeds are unlikely high speed at the data collection sites during peak periods. The conditional logic and the thresholds used in data filtering are provided in Table 1 (one row for each condition). Less than 0.003% of the records were excluded after QA/QC filtering, and the team did not observe any impact on vehicle throughput analysis.

Step 7: Aggregate Filtered Data:
Aggregate the filtered 20-seconds data from Step 6 to 5-minute interval, plot and verify it is ready to use. Imputation was only performed on the time scale. For example, for a 5-minute aggregate, if data was available only in 10 out of the fifteen 20-second time intervals, the count data was simply scaled by 15/10 to adjust for the missing data. The average speed was computed from the 10 data points that were available. If no data were available in an entire 5-minute period, these missing records were accounted for in a scaling factor when aggregated to a larger period (i.e., 1-hour). The imputation followed the same methodology of the previous project (Guensler, 2013b).

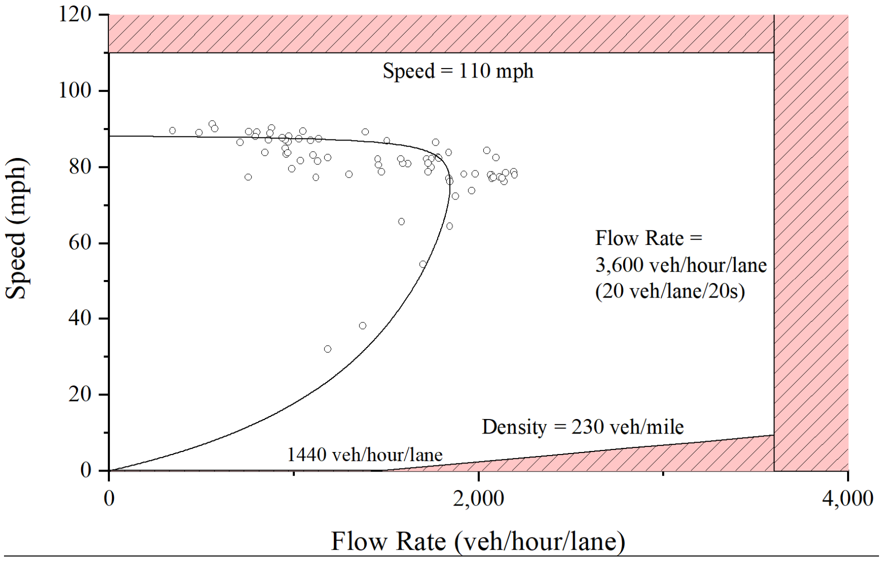


Figure 11 – Data Validity Zones in a Generally Representative Speed-Flow Plot

Table 1 – QA/QC Screening Threshold Values

Threshold Values		
Volume (vehicles/20sec)	**Speed (mph)**	**Density (vehicles/mi)**
(Two conditions must be true to be declared invalid)		
Zero (= 0)	Zero (= 0)	Zero (= 0)
(All conditions must be true to be declared invalid)		
Not Low (>8)	All	Too High (>=230)
Too High (>= 20)	All	All
All	Too High (> 110)	All

The GDOT lane numbering rule marks the inside lane as lane #1, and the lane number increases from inside to outside. The research team verified the speed-flow rate relationships across the lanes to make sure lanes are numbered correctly, as an additional step to the QA/QC process. The inside lane is the fast lane and is expected to have the largest free flow speed and the largest capacity among all lanes. When the managed lane is protected and separated from GP lanes by concrete barriers, such as in Chastain Road at I-575 NWC (2019 only), Hickory Grove Road at I-75 NWC (2019 only), and Jodeco Road at I-75 South, the inside GP lane is considered as the fast lane. Lane-by-lane speed-flow rate diagrams were used to make sure lanes are numbered correctly, with an example of Northbound of Chastain Road at I-575 (2018) presented in Figure 12.

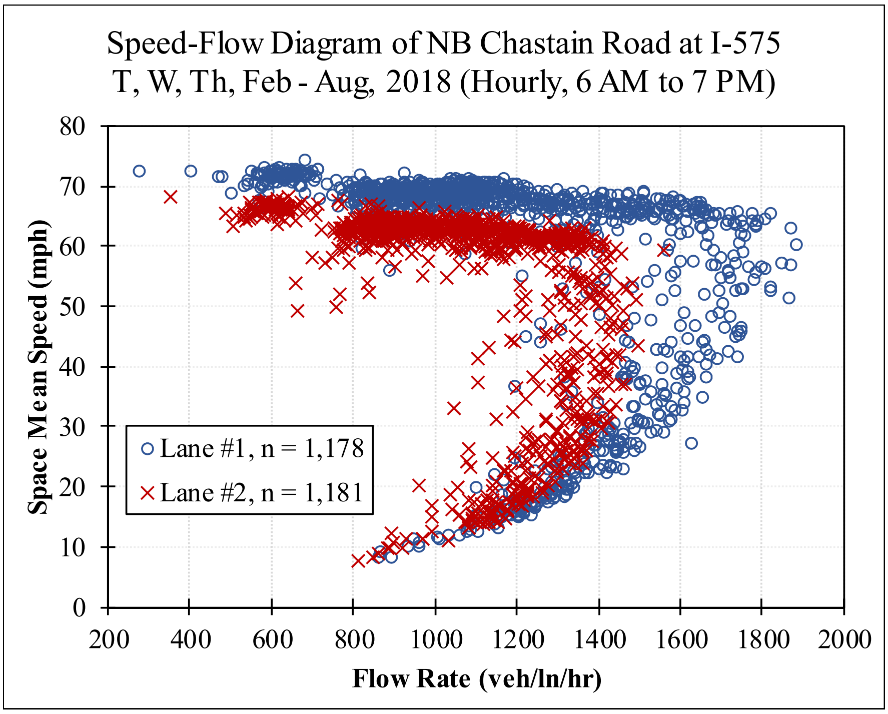


Figure 12 –Speed-Flow Diagram, Aggregated at One Hour, Northbound, Chastain Road at I-575, Pre-Opening (2018), Day Time (6 AM-7 PM)

3.4 Vehicle and Person Throughput Calculator (VPTC) Steps

After the QA/QC process for NaviGAtor data are complete, the VPTC operates in a stepwise process:

Step 1: Select Location, Date, and Time:
The user selects a desired location (VDS Station ID), date, and time.

Step 2: Query Traffic Volume and Speed Data:
The scripts pull the applicable vehicle flow rates (at five-minute resolution) from the VDS database table for the station ID, date, and time. Data are tracked lane-by-lane. Hourly equivalent volumes are calculated by summing five-minute volumes for the hour. Hourly average vehicle speeds are derived from five-minute data using space-mean speed averaging (raw data are converted from 20-second resolution time-mean speed data to space-mean speeds for all analyses).

Step 3: Query Vehicle Classification Field Data:
For any given station/lane/date/time, VDS traffic counts by lane are apportioned into hourly counts and then into vehicle class fraction (motorcycles, light-duty automobiles, sports utility vehicles, buses, small HDTs, large HDTs) using the class fraction ratios obtained during three-hour quarterly field data collection (see Table 2 for an example of the number of occupancy observations collected at the Indian Trail/Lilburn Road field station on I-85). Lane-by-lane analysis is supported by this method, given that vehicle class fractions vary across lanes, as do average vehicle occupancy values (with higher occupancies on middle GP lanes; discussed later).

Table 2 – Number of Vehicle Occupancy Observations by Vehicle Type, Indian Trail/Lilburn Road at I-85, 09/12/2018, AM Peak (7-10 AM)

Class	ML1	GP2	GP3	GP4	GP5	GP6	Sum
LDV	1,529	1,551	1,510	1,088	1,128	1,332	8,138
SUV	2,320	2,334	1,982	1,428	1,479	1,748	11,291
Small HDV	3	2	122	164	203	188	682
Large HDV	0	0	131	524	447	259	1,361
Bus	50	8	0	0	3	1	62
Van	253	309	246	213	240	257	1,518
MC	27	5	2	0	1	2	37
Total	4,182	4,209	3,993	3,417	3,501	3,787	23,089

Step 4: Apply Monitored Occupancy Data to Traffic Volumes:
The counts by vehicle class are then linked to vehicle occupancy splits (percentage of 1-person, 2-person, 3-person, and 4+ person vehicles, as described in Chapter 7) for each class of LDV, SUV, and HDTs to obtain estimates of vehicle throughput for each vehicle class, lane and time period (see Table 3 for an example of the occupancy observation data collected at the Indian Trail/Lilburn Road field station).

Step 5: Calculate Person Throughput from Vehicle Throughput and Occupancy: The number of persons passing through the corridor per hour is calculated by multiplying each hourly vehicle class count by the applicable vehicle class occupancy value. LDVs and SUVs in the 4+ category are assigned an assumed occupancy value of 4.5 persons per vehicle (the team could not develop a better empirical value based upon field data). Motorcycles are ignored in this process considering the small volume. Person throughput from vans and buses are processed separately in the next step.

Table 3 – Vehicle Occupancy Observations by Vehicle Type and by Lane, Indian Trail/Lilburn Road at I-85, 09/12/2018, AM Peak (7-10 AM)

Vehicle Class	Occupancy	ML1	GP2	GP3	GP4	GP5	GP6	Total
LDV	**1**	1,371	1,475	1,435	1,019	1,053	1,248	7,600
	2	145	76	75	67	72	79	515
	3	13	0	0	0	3	5	21
	4	0	0	0	2	0	0	2
	4+	0	0	0	0	0	0	0
	Subtotal	1,529	1,551	1,510	1,088	1,128	1,332	8,138
SUV	**1**	1,790	2,027	1,636	1,008	1,225	1,511	9,197
	2	497	300	343	397	237	224	1,998
	3	15	7	3	23	14	9	72
	4	18	0	0	0	3	3	23
	4+	0	0	0	0	0	1	1
	Subtotal	2,320	2,334	1,982	1,428	1,479	1,748	11,291
Small HDV	**1**	1	1	90	130	164	159	545
	2	2	1	32	34	36	27	132
	3	0	0	0	0	3	2	5
	4	0	0	0	0	0	0	0
	4+	0	0	0	0	0	0	0
	Subtotal	3	2	122	164	203	188	682
Large HDV	**1**	0	0	125	482	429	249	1,285
	2	0	0	6	42	18	10	76
	3	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0
	4+	0	0	0	0	0	0	0
	Subtotal	0	0	131	524	447	259	1,361
Total		3,852	3,887	3,745	3,204	3,257	3,527	21,472

* Table 2 and Table 3 employ the same field data (some vehicle classes are excluded here).

Step 6: Adjust Vehicle and Person Throughput for Vanpools and Commuter Buses: In the final step, the calculator employs Xpress, and Gwinnett County Transit, and CobbLinc bus route and vehicle occupancy data in the calculations. Buses operate on set schedules and bus throughput data are available for each hour. Each departing bus is allocated to the specific hour it is expected to arrive at a monitoring station based upon departure time, departure location, and average travel time to the station. Monthly vehicle occupancy data collection by route and departure time establishes applicable passenger occupancy of these buses as described in later chapters. HDV4+ person counts are adjusted downward by 4.5 persons per express bus, given the assumed 4.5 persons/vehicle for the 4+ class, and then adjusted upward to reflect the actual number of passengers on each passing bus. For vanpools, SUV4+ person counts are adjusted downward by 4.5 persons per vanpool, and then adjusted upward to reflect the passage of each vanpool. These processes and results are described in Chapters 7 and 8.

4 Vehicle Occupancy Data Collection

In this report, "vehicle occupancy" is defined as the number of persons in a vehicle (persons/vehicle), including the driver. A single-occupant vehicle (SOV) contains only the driver. In Georgia, a high-occupancy vehicle (HOV) is a vehicle that contains a driver plus at least one other person (i.e., one or more passengers). Thus, HOV2 is a carpool that includes the driver plus one passenger, HOV3 includes a driver plus two passengers, HOV3+ includes the driver plus two or more passengers, etc. Vehicle occupancy data are needed to estimate person throughput for each Express Lane corridor, where person throughput (persons/hour) equals vehicle throughput (vehicles/hour) multiplied by vehicle occupancy (persons/vehicle).

Existing methodologies for collecting vehicle occupancy range from manual methods to automated technologies, and numerous hybrid variations. In developing methods for the 2010-2012 data collection effort, the Georgia Tech research team examined the advantages and disadvantages associated with each method via a literature review and then developed a Georgia Tech methodology for data collection on the Atlanta I-85 HOV-to-HOT conversion corridor (Guensler, et al., 2013a). D'Ambrosio (2011) outlined the basis for the new methodology and data collection system. The method and system are based upon a comprehensive literature review of existing methods, assessment of safety considerations (and other constraints and characteristics of the sites along the study corridor), the capabilities of available equipment, potential mental fatigue, and labor costs.

The traditional roadside/windshield method is the most common method for collecting data (Heidtman, et al., 1997) because of its simplicity and equipment requirements. This method positions a data collector such that they can see through a passing vehicle's windshield and the side windows to count the number of occupants as the vehicle passes. The data collector then records the occupancy value using a worksheet or electronic device. The strengths of this method are the minimal equipment required, ease of implementation, and high capture rate. However, there are several limitations to this method, including a relatively short view time into the vehicle (particularly at high speeds), the limitation of collecting data only during daylight hours, and concerns with balancing the safety of the observer with the ideal perspective for viewing inside the vehicle. Another notable limitation is that the method is labor intensive, which can degrade observer performance over time (fatigue). For this project, the team developed a modified windshield survey method for collecting vehicle occupancy data as described in the next report sections.

4.1 Vehicle Occupancy Field Data Collection

In selecting sites for occupancy and license plate data collection, the team visited the overpasses along each corridor and assessed each site for data collection potential (access and views) and for worker safety. After considerable discussion, three sites in I-75/I-575 North Corridor, three sites in I-85 North Corridor, and one site in I-75 South Corridor were selected for data collection as they provided good data collection views, a good spatial distribution of coverage, and provided safe access and observation points (e.g., protected by guardrails, access via crosswalks and signals, etc.).

- The sites on I-75/I-575 Northwest Corridor include I-575 at Chastain Road (Exit 3); I-75 Express Lane Ramps at Hickory Grove Road; and I-75 Express Lane ramps at Roswell Road.

- The sites on the I-85 North Corridor include I-85 at Indian Trail/Lilburn Road (Exit 101); I-85 at Old Peachtree Road (Exit 109), and I-85 at Hamilton Mill Road (Exit 120). The I-75 South Metro site was located at I-75 and Jodeco Road (Exit 222).

Traffic inbound to Atlanta was monitored during the morning peak periods (usually 7:00 AM to 10:00 AM) and in the outbound direction in the afternoon peak periods (usually 3:30 PM to 6:30 PM). Hence, the team monitored morning traffic in the southbound direction on the I-75/I-575 Northwest corridor and I-85, and in the northbound direction on the I-75 South Metro corridor. The team monitored afternoon traffic in the northbound direction on the I-75/I-575 Northwest corridor and I-85, and in the southbound direction on the I-75 South Metro corridor. Figure 13, Figure 14 and Figure 15 show the occupancy data collection sites on these three corridors (aerial photos acquired from https://www.google.com/maps).

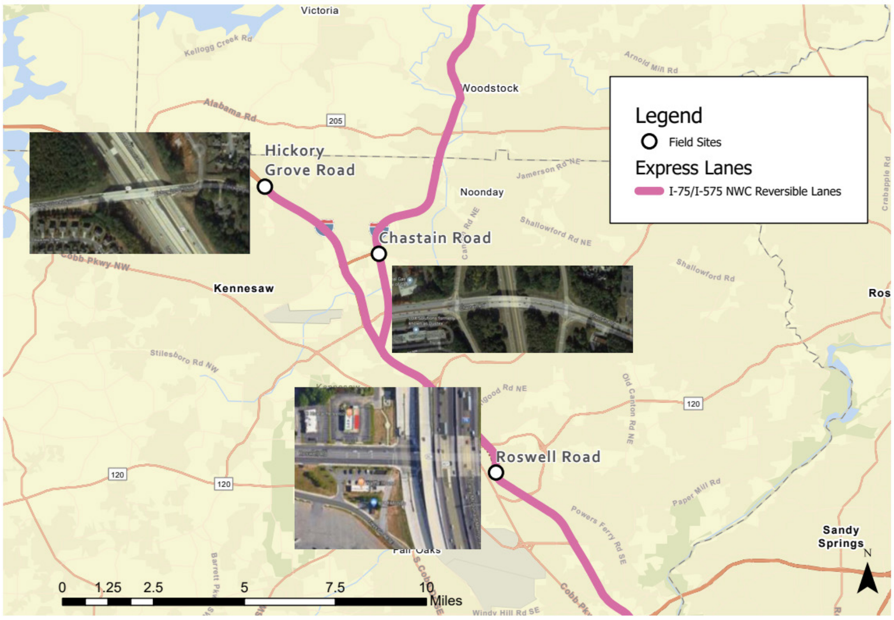


Figure 13 – I-75/I-575 North Corridor Occupancy Data Collection Locations for Before-and-After Assessment of the Northwest Corridor Xpress Lanes Opening

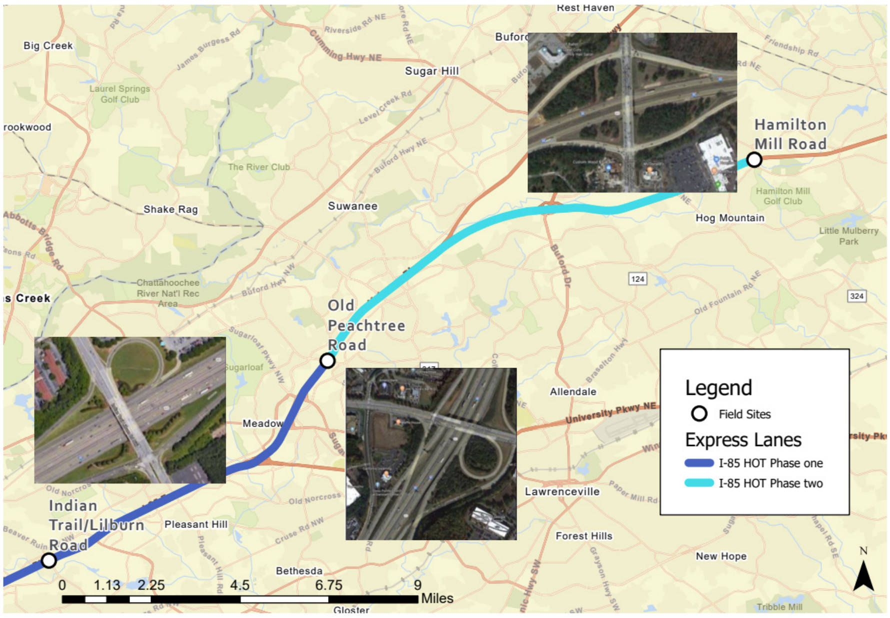


Figure 14 – I-85 North Corridor Occupancy Data Collection Locations for Before-and-After Assessment of the I-85 Express Lanes Extension Opening and Comparison with the Previous Assessment of the 2011 HOT Lanes Opening

Figure 15 – I-75 South Corridor Occupancy Data Collection Location for a Time-series Assessment of Occupancy and Throughput in the 75 South Metro Express Lanes Corridor

For tracking purposes, each lane is identified with two letters and one number in the database. The letters are lane type identifiers, where ML, GP, and RP represents managed lane (Express Lane, HOT lane, or HOV lane), general propose lane, and ramp, respectively. The number following the letter code is the lane number, where lanes are numbered from inside lane to outside lane. For example, in Figure 16, the managed lane is labeled as ML-1, and general purpose lanes are labeled as GP-2 through GP-6

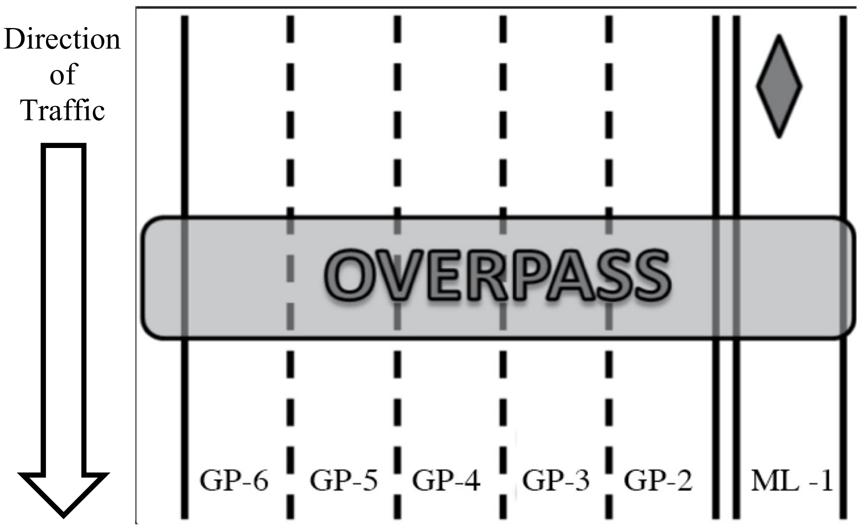


Figure 16 – Lane Numbering Configuration Example

The research team collected vehicle occupancy data during four consecutive fall and spring semesters. Five data collection sessions were pre-opening operations in 2018, and five sessions were post-opening operations in 2019. During each session, about two and a half hours of data were collected, depending upon light levels and visibility. Morning peak period data were collected between 7:00 AM to 10:00 AM and afternoon peak period data were collected between 4:00 PM to 7:00 PM (Tuesdays, Wednesdays, and Thursdays). The research teams deployed well in advance so that data collection could begin on time. Data collection was canceled during rain events, and make-up sessions were conducted as soon as practicable.

Field teams collected data from the elevated portion of the gore area at freeway exit ramps. These locations meet the primary criteria for observation: 10-20 feet above the roadway, distances between 10 and 50 feet from the roadway, located where observers will not distract drivers, convenient parking with safe access to the site, minimal expected weaving movements in observed traffic, and located to minimize glare given the angle of the sun. Figure 17 shows data collection by the undergraduate assistants.

Figure 17 – Vehicle Occupancy Data Collection

Each data collector was assigned to record data from one lane during each deployment. Data collectors positioned themselves between the ramp and the mainline on the elevated slope of the overpass ramp at whatever location provided the best view into vehicles as they passed. Data collectors began watching the vehicle through the windshield as it approached, and visually scanned the vehicle seats through the side windows as the vehicle passed. Given the proximity to the traveled way, no binoculars were needed for data collection (in fact, binoculars and spotting scopes hinder data collection because vehicles are so close that visual tracking of the interior of the moving vehicle is more difficult). The field staff used a new tablet-based data collection system created specifically for this deployment. Table 4, Table 5, Table 6, and Table 7 provide the planned occupancy data collection schedules.

The team scheduled five data collection sessions at each site during both the morning and afternoon peak periods. Regression tree analysis conducted in the QA/QC process (as discussed later in Chapter 5) identified a few data collectors were not accurately recording vehicle occupancy (e.g., one data collector was clearly "mashing" a single button and had to be fired). In essence, a few of the human data collectors were identified as "defective." Because occupancy values collected by these data collectors during their session differed from their cohorts, these data would need to be removed otherwise they would potentially bias occupancy results. In the 2018 data collection efforts, the defective data collectors were randomized across lanes, and exclusion of their data had no significant impact on results (see Chapter 5). However, in 2019, one of these defective data collectors was assigned to the same lane for more than one session. Fortunately, this problem was identified during ongoing QA/QC analysis and the team was able to add several "makeup" data collection sessions, during those same data collection efforts, so that the data collected by this individual could be removed and replaced with supplemental data without reducing the overall sample size for these lanes.

Table 4 – Occupancy Data Collection Sessions
Baseline (Fall 2018)

Site	AM/PM	Session 1	Session 2	Session 3	Session 4	Session 5	Makeup	Makeup
Chastain Road at I-575	**AM**	14-Aug	15-Aug	21-Aug	22-Aug	23-Aug	06-Sep	
	PM	14-Aug	15-Aug	21-Aug	22-Aug	23-Aug	06-Sep	
Hickory Grove Road at I-75	**AM**	28-Aug	29-Aug	30-Aug	04-Sep	05-Sep	07-Sep	
	PM	28-Aug	29-Aug	30-Aug	04-Sep	05-Sep	07-Sep	
Indian Trail at I-85	**AM**	11-Sep	12-Sep	13-Sep	18-Sep	19-Sep		
	PM	18-Sep	19-Sep	20-Sep	25-Sep	02-Oct		
Hamilton Mill Road at I-85	**AM**	20-Sep	25-Sep	26-Sep	27-Sep	02-Oct		
	PM	02-Oct	03-Oct	04-Oct	15-Oct	16-Oct	17-Oct	25-Oct
Old Peachtree Road at I-85	**AM**	03-Oct	04-Oct	16-Oct	17-Oct	18-Oct	23-Oct	
	PM	18-Oct	22-Oct	23-Oct	24-Oct	25-Oct		
Roswell Road at I-75	**AM**	24-Oct	25-Oct	30-Oct	31-Oct	01-Nov		
	PM	29-Oct	30-Oct	31-Oct	27-Nov	28-Nov		

Table 5 – Schedule of Occupancy Data Collection Sessions
Baseline (Spring 2019)

Site	AM/PM	Session 1	Session 2	Session 3	Session 4	Session 5	Makeup	Makeup
Jodeco Road at I-75	**AM**	02-Apr	03-Apr	04-Apr	10-Apr	11-Apr		
	PM	10-Apr	18-Apr	23-Apr	24-Apr	25-Apr		
Roswell Road at I-75	**AM**	16-Apr	17-Apr	18-Apr	23-Apr	24-Apr		
	PM	02-Apr	03-Apr	04-Apr	11-Apr	16-Apr		

Note: The research team had to switch back and forth between Jodeco Road and Roswell due to the difficulty of staffing enough undergrads for each shift toward the end of the semester. Jodeco Road needed at least seven team members, while Roswell Road only requires four. For some shifts, eight staff members were available, and only four people were available for some shifts. The goal was to remain flexible and finish both sites (AM and PM) within the four-week window.

Table 6 – Occupancy Data Collection Sessions
Post-Opening/Extension (Fall 2019)

Site	AM/PM	Session 1	Session 2	Session 3	Session 4	Session 5	Makeup	Makeup
Chastain Road at I-575	AM	08-Aug	13-Aug	14-Aug	15-Aug	20-Aug	08-Oct	
	PM	06-Aug	07-Aug	08-Aug	13-Aug	20-Aug		
Hickory Grove Road at I-75	AM	22-Aug	28-Aug	29-Aug	04-Sep	05-Sep	09-Oct	
	PM	21-Aug	27-Aug	28-Aug	29-Aug	03-Sep		
Indian Trail at I-85	AM	06-Sep	10-Sep	11-Sep	12-Sep	17-Sep	10-Oct	
	PM	04-Sep	05-Sep	11-Sep	12-Sep	17-Sep	08-Oct	
Hamilton Mill Road at I-85	AM	18-Sep	19-Sep	24-Sep	25-Sep	26-Sep		
	PM	18-Sep	19-Sep	24-Sep	25-Sep	26-Sep		
Old Peachtree Road at I-85	AM	01-Oct	02-Oct	03-Oct	17-Oct	29-Oct		
	PM	01-Oct	02-Oct	03-Oct	09-Oct	16-Oct		
Roswell Road at I-75	AM	21-Aug	23-Oct	24-Oct	05-Nov	06-Nov		
	PM	22-Oct	23-Oct	24-Oct	29-Oct	05-Nov		

Table 7 – Planned Occupancy Data Collection Sessions (not Executed due to COVID-19)
One Year After Baseline (Spring 2020)

Site	AM/PM	Session 1	Session 2	Session 3	Session 4	Session 5	Makeup	Makeup
Jodeco Road at I-75	AM	24-Mar	25-Mar	26-Mar	31-Mar	01-Apr		
	PM	24-Mar	25-Mar	26-Mar	31-Mar	01-Apr		
Roswell Road at I-75	AM	02-Apr	07-Apr	08-Apr	09-Apr	14-Apr		
	PM	02-Apr	07-Apr	08-Apr	09-Apr	14-Apr		

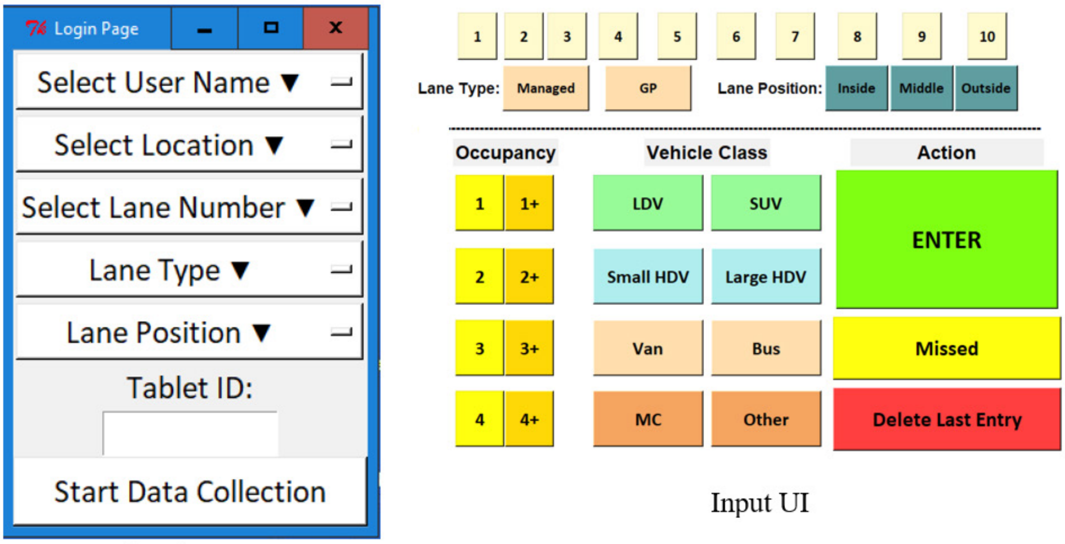
4.2 Occupancy Data Collection System

A new data collection system was developed for the 2018-2020 field observations, considering lessons learned from (and technological advances since) the previous 2010-2012 study conducted for I-85. The roadside/windshield method developed for 2010-2012 SRTA occupancy project employed small netbook computers with wired USB numeric keypads (wireless was problematic) refaced with labels to record vehicle class and vehicle occupancy input (D'Ambrosio, 2011). The data collectors carried the netbook in small backpacks. The numeric keypads were modified to remove keys that were not used. The keys were re-labeled to show vehicle classes, occupancy types, and other elements. Researchers observed the vehicle, pressed the applicable vehicle class key, followed by the applicable vehicle occupancy key. Keys to log a missed vehicle (e.g., not enough time to see into the next vehicle after recording a value) as well as to mark the last record as incorrect were included ("C", for 'clear').

In 2018, the Georgia Tech team developed a new Microsoft tablet-based occupancy data collection app using Python script language. The app has two UI windows, one to input meta-data associated with the data collection effort, and the other to input vehicle class and occupancy information. The layouts are shown in the Figure 18 below. The left image shows the interface to enter the general information about the data collection session, including user's name, field location, assigned lane number, type of lane, position of lane, and tablet id (each tablet is assigned a unique id and the id is labeled on a sticky tape). The selection options for each field are described below:

- "Select Username":
  - Dropdown list of field data collector names
- "Select Location":
  - Dropdown list of field data collection locations
- "Select Lane Number":
  - Dropdown menu from "Lane 1" to "Lane 10"
- "Lane Type":
  - Dropdown menu with three values
    - "Managed Lane"
    - "General Purpose Lane"
    - "Ramp"
- "Lane Position":
  - Dropdown menu with three values
    - "Inside" - For the innermost (fast) lane
    - "Outside" - for the outermost (slow) lane
    - "Middle" - For any other lane in between the inside and outside lane
- "Tablet ID":
  - Text entry field to record the tablet ID used in data collection

Figure 18 shows the data entry input button in the right-hand image. A horizontal line divides the window into two segments. The upper section displays basic information, which corresponds to the general information entered at login. The number of lanes, the type of lane, and position of the lane appear in the upper portion of the display. These session data do not need to be changed during a data collection session (unless the data collector for some reason moves to another lane, in which case they shut down the app and log in again). Moreover, during data collection, if the recorder tries to change a session data selection in the upper window, an alert message pops up requiring the user to log in again and confirm the data change (starting a new session).



Login page

Input UI

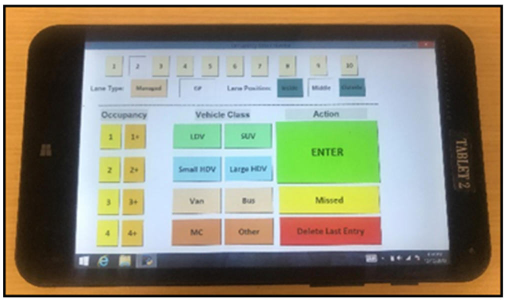
Figure 18 – UI Design for the Occupancy Data Collection System

The lower portion of the screen contains three classes of input buttons (vehicle occupancy buttons, vehicle class buttons, and action buttons. There are eight possible inputs for vehicle occupancy (‘1’, ‘1+’, ‘2’, ‘2+’, ‘3’, ‘3+’, ‘4’, and ‘4+’), corresponding to the occupancy observed by the recorder. An observer can see all seats in a vehicle and sees two (and only two) people inside the vehicle records ‘2’ as the vehicle occupancy. Occupancy numbers with a plus sign indicate that the observer could definitely see that number of people in the vehicle, but that more persons might have been present. So, if a user can see two people in the front seat, but cannot see into the back seat due to window tinting, the observer records ‘2+’ as the vehicle occupancy. For occupied buses and large vanpools, observers click the ‘4+’ button. The second group of buttons allow observers to enter the class of the vehicle observed. The eight vehicle class values include ’LDV’, ‘SUV’, ‘Small HDV’, ‘Large HDV’, ‘Van’, ‘Bus’, ‘MC’, and ‘Other’ as described below:

- Light Duty Vehicle (LDV)
  Sedans, sports cars, etc.
- Sports Utility Vehicle (SUV)
  Pick-up trucks, crossover vehicles, station wagons, etc.

- Small Heavy-Duty Vehicle (Small HDV)
  Panel vans and medium-sized trucks without trailers
- Large Heavy-Duty Vehicle (Large HDV)
  Trucks with trailing part for goods
- Van
  Family vans, large vanpools, food delivery cargo vans, etc.
- Bus
  Small and large school buses, transit buses, inter-city buses, etc.
- Motorcycle (MC)
  Two and three wheel motorcycles
- Other
  Police cars, fire engines, ambulances, etc.

The last column of buttons provides the user interface (UI) action buttons, used to submit the current input, reset the interface, or delete the previous input that was submitted. As the user selects each button in the first two columns, the non-selected buttons on the screen dim and changes color, to indicate which button was selected. The user can also change their selection prior to entering the data and the new button will light up. When satisfied with the on-screen selections, the user selects the "Enter" button to submit the record into the data stream (see Figure 19) and clears the screen for the next data entry event. A Python script records all of the keystrokes into a text file along with the timestamps. If a user cannot complete a record or is unsure about their selections, they hit the "Missed" button, which records that a vehicle was observed but not classified and the screen is reset. The "Delete Last Entry" button allows the user to recognize that the entry they just submitted was inaccurate and should not be used. The previous data record is immediately annotated to indicate that the record is inaccurate and flags the record for exclusion (a time-stamp is added to the deletion time column).



Lane No.	Lane Type	Lane Position	Vehicle Class	Occupancy	Record Time	Deletion Time
1	Managed	Inside	1	LDV	10/17/2019 7:22:39	
1	Managed	Inside	1	LDV	10/17/2019 7:22:46	
1	Managed	Inside	1	LDV	10/17/2019 7:22:47	
1	Managed	Inside	1	LDV	10/17/2019 7:22:49	
1	Managed	Inside	2	SUV	10/17/2019 7:22:59	
1	Managed	Inside	1	LDV	10/17/2019 7:23:01	
1	Managed	Inside	1	LDV	10/17/2019 7:23:14	
1	Managed	Inside	1	SUV	10/17/2019 7:23:16	
1	Managed	Inside	4+	Bus	10/17/2019 7:23:40	
1	Managed	Inside	1	SUV	10/17/2019 7:23:42	
1	Managed	Inside	1	LDV	10/17/2019 7:23:44	
1	Managed	Inside	1	LDV	10/17/2019 7:23:47	
1	Managed	Inside	4+	Bus	10/17/2019 7:23:52	

Figure 19 – Occupancy Data Collection System and Output

In the 2010-2012 assessment effort, the literature review did not identify any previous uses of 'uncertain' values; however, 1+, 2+, and 3+ values were shown to be very important by the research team (Guensler, et al., 2013a). Had researchers not recorded these values, available information about occupancy would have been lost. There are relatively few carpools operating on the corridor. Discarding data for vehicles that were known to contain two or more persons, would have biased low the resulting percentage of carpools and average vehicle occupancy. The allocation of 'uncertain' values to vehicle occupancy is discussed in the next section.

4.3 Establishing Average Vehicle Occupancy for Uncertain Values

In collecting vehicle occupancy data, it is not always possible to see every person inside a vehicle. A driver is always present (at least until automated vehicles begin entering the Atlanta market), and data collectors can usually see any other occupants in the front seats. However, window tinting often obstructs the visibility of passengers in the rear seats. Occupancy data collection currently assumes that no systematic difference exists in occupancy across vehicles with window tinting and without window tinting. That is, a vehicle with extreme rear window tinting is no more likely to carry a passenger in the back seat than one without severe window tinting. Field observers record occupancy data using "certain" occupancy values (1, 2, 3, and 4) when the data collector is certain that they observed all seats and passengers in the vehicle. Field observers use "uncertain" occupancy values (1+, 2+, 3+, and 4+), when the data collector is sure that they saw a specific number of persons in the vehicle, but additional passengers may have been present. Hence, the uncertain value of 2+, where the data collectors were sure that they saw 2 persons, but they could not see all of the seats clearly and one or more additional passengers might have been present in the vehicle. The largest occupancy value employed (4+) is uncommon for non-buses and vanpools. Based upon previous experience, the 4+ values in the analyses does not significantly affect corridor person-throughput estimates, because the throughput analyses handle the contributions of buses and vanpools to average vehicle occupancy as an independent calculation process (Guensler, et al., 2013a; Castrillon, et al., 2014).

To calculate the average vehicle occupancy, "uncertain" values are first distributed to "certain" values using the relative ratio of applicable observed certain values. That is, the researchers distribute all 1+ occupancy values to occupancy categories 1, 2, 3, 4, and 4+ occupancy categories using the relative ratios of those categories. For example, as an illustration of the calculation method, if the distribution of certain occupancy values was 1 = 85%, 2 = 10%, 3 = 4%, 4 = 1%, and 4+ = 0%, the team would assign the values to 1, 2, 3, 4, and 4+ categories as follows:

- 85% of the 1+ values to occupancy category 1
- 10% of the 1+ values to occupancy category 2
- 4% of the 1+ values to occupancy category 3
- 1% of the 1+ values to occupancy category 4
- 0% of the 1+ values to occupancy category 4+

The analysis, however, never assigns uncertain values of 2+ to occupancy category 1, because the data collector observed at least one other passenger. Hence, for 2+ values, the team would assign the values to categories 2, 3, 4, and 4+ categories as follows:

- 66.66% (10%/(10%+4%+1%+0%)) of the 2+ values to occupancy category 2

- 26.66% (4%/(10%+4%+1%+0%)) of the 2+ values to occupancy category 3
- 6.66% (1%/(10%+4%+1%+0%)) of the 2+ values to occupancy category 4
- 0.00% (0%/(10%+4%+1%+0%)) of the 2+ values to occupancy category 4+

In summary, 1+ values are redistributed to 1, 2, 3, 4, and 4+ values, 2+ values are redistributed to 2, 3, 4 and 4+ values, and 3+ values are redistributed to 3, 4 and 4+ values.

The allocation process relies on having an available distribution of certain values. There are some occasions where, for a specific vehicle class during a data collection session, there are insufficient data to allocate an uncertain value to a distribution of known values. For example, a 3+ value may be present for a heavy-duty truck and there are no certain observations of 3, 4, or 4+ for heavy-duty trucks in the data set. For this rare condition, the team could assign the record to occupancy category 3, because there is no distribution of 3/4/4+ to compare with, or generate an artificial value of say 3.5. Because these conditions are rare, and because it is much more likely that the average value for these 3+ occupant trucks in the fleet is closer to 3.0 than 3.5, the team assigns the record to the occupancy category 3. Of the 369,884 raw records of vehicle occupancy, only 12 records were assigned in this manner (so there is no significant impact on occupancy outcomes). As in the previous study, the occupancy category of 4+ is assigned 4.5 persons/vehicle for person throughput calculations, given that the lack of any better assumption that could be made. The majority of vehicles in the 4+ occupancy category are vanpools and transit buses, which are removed from this portion of the calculation process and handled separately in the person-throughput calculations (Castrillon, et al., 2012; Guensler, et al., 2013a).

Previous work by the research team demonstrated that deleting such data, rather than redistributing the data, leads to a significant downward bias in occupancy estimation (Guensler, et al., 2013a). Table 8 illustrates the impact of excluding uncertain occupancy data from an analysis of average vehicle occupancy. The 345 occupancy records for light-duty vehicles in Table 2 are for one data collector, one data collection session (lane 1, one day in the 4th week of September 2018, 3:00 PM to 7:00 PM). The average vehicle occupancy using the re-distribution method is 1.18 persons/vehicle. If uncertain values were excluded from an analysis as “missed vehicles,” as has been common in previous studies in the literature, the calculated average vehicle occupancy would only be 1.13 persons/vehicle. This would correspond to about a 4.4% biased underestimation of occupancy and person throughput.

Table 8 – Impact of Using and Allocating Uncertain Occupancy Values

Occupancy Category	Vehicles Observed	Percent Observed	Vehicles w/o Allocation	Percent w/o Allocation	Vehicles with Allocation	Percent with Allocation
1	271	78.55%	271	88.85%	293.2	84.99%
1+	25	7.25%				
2	31	8.99%	31	10.16%	45.4	13.16%
2+	13	3.77%				
3	2	0.58%	2	0.66%	4.3	1.25%
3+	2	0.58%				
4	0	0.00%	0	0.00%	0	0
4+	1	0.29%	1	0.33%	2.1	0.61%
Total	345	100.00%	305	100.00%	345	100.00%
Average Occupancy (persons/vehicle)				1.13		1.18

After redistribution of the uncertain values, the occupancy values remain in four occupancy categories (1, 2, 3, and 4+). For each vehicle in each occupancy class, the number of persons in the vehicle is defined by the occupancy class. However, the 4+ occupancy type was assigned an occupancy of 4.5 persons/vehicle for lack of any better assumption that could be made. A significant portion of the vehicles in the 4+ occupancy category are transit buses and professional vanpools, which can carry many more than 4.5 passengers. Hence, the 4+ occupancy values for these vehicles will ultimately be removed from the calculation process outlined above and replaced by their corresponding actual occupancy values (this process is described later in the report).

5 Review and Analysis of Vehicle Occupancy Data

Given the potential impact of technical malfunctions and human error associated with visual observation and manual data entry, a quality assurance/quality control (QA/QC) process is needed before undertaking final analysis of field-collected occupancy data (Elango and Guensler, 2014). In the 2010-2012 study, and again this 2018-2020 study, the team found that some data collectors were "mashing" a single button; hence, their occupancy values differed significantly from their cohorts. In essence, some of the human data collectors were "defective." To assess potential bias introduced by individuals collecting the occupancy data, the team first processed the data to remove known erroneous records and then applied regression tree analysis to the data sets (Wolf, et al., 1998). The analysis ascertains whether any of the specific data collectors were a driving factor in occupancy variability, which would indicate potential bias in observation. If one data collector consistently records different occupancy values for vehicles than their cohorts (after controlling for other factors), regression tree analysis will identify the data collector as being one of the main variables explaining differences in occupancy values.

The first step in the analysis is to remove known data errors from raw data and generate the analytical data set (filter the data). In the raw data stream, blank records indicate that the user interface (UI) did not properly power down after a power loss. These records do not constitute real data; hence, a post-processing script automatically excludes blank records from project analysis. During live data collection, whenever a data collector realizes that they have just made a data input error (i.e., they selected the wrong button for occupancy or vehicle class) they are instructed to press the red "Delete Last Entry" key (Figure 18), which flags the previous data entry for deletion. The program appends a delete record mark to that data record. A post-processing script excludes the data-collector-reported erroneous data from project analysis.

To develop the final data set for regression tree analysis, the filtered data are aggregated to data collector records, based on site location, day of week, session (AM vs. PM), lane monitored, vehicle class, and data collector identifier (Elango and Guensler, 2014). That is, the occupancy data for each vehicle class, in the same lane, during the same session, collected by the same person, are used to generate an average vehicle occupancy data point for regression tree analysis. Large deviations in these average vehicle occupancy records across data collectors, once controlled for vehicle class, facility, lane, AM/PM, etc., will indicate potential bias in the results entered by the data collector. In the 2010-2012 study, the team excluded about 7.0% of the data (91 out of 1,297 samples) from the final analysis, based upon the regression tree results (Guensler, et al., 2013a).

The statistical term "outliers" refers to extreme observations that have an impact on resulting model response. In scientific research, outliers may result from data transcription errors, equipment malfunctions, or even data collector bias. However, many extreme values in a data set may simply represent rare cases, or may represent cases influenced by another independent variable not included in the data set and resulting model. Removal of rare cases that represent real-world effects will, by definition, bias model outputs (Neter, et al. 1990);

hence, researchers must be very careful in removing data from analysis. Data should only be removed from statistical analyses when: 1) there is a clear case of data error (e.g., device error); 2) when there is a clear case of data collection bias that can be explained and supported; or 3) when the data belong in a separate model for some reason (i.e., the data reflect a subset of cause-effect relationships that warrants independent model development). As in the previous project (Guensler, et al., 2013a), the research team removed data from the working data set only when there was clear evidence of error or direct evidence of bias.

The HOV-to-HOT performance evaluation study deployed teams of graduate and undergraduate students to collect vehicle occupancy data (persons/vehicle) by visually identifying the number of persons inside each vehicle as the vehicle passes an observation station. The 2010-2012 assessment of person and vehicle throughput on the I-85 corridor (Guensler, et al., 2013a) identified a number of factors that impact vehicle occupancy, including: data collection site, pre-/post-conversion status of the facility, season/quarter, day of week, session (morning/afternoon peak), lane type (general purpose, HOV lane and ramp), and lane number. The graphic user interface, standardized data collection procedures, and training of data collectors help minimize data entry errors. Nevertheless, the visual identification of the number of persons in a vehicle is still subject to potential data collector bias. Hence, a statistical assessment of collected data to identify possible sources of bias or errors in occupancy data collected by individual data collectors is required, so that researchers can assess whether there is a need to filter such data from occupancy analysis.

Regression tree analysis, adopted in the previous project, proved to be a very effective analytical tool when data have numerous and complicated non-linear interactions (Guensler, et al., 2013a). In this process, the data space is recursively partitioned using the explanatory variables that reduce total deviation error the most, until small chunks of data space can be fitted with simple models (Cosma, 2013). The global model includes two parts, the recursive portioning into cells, or data clusters, and a simple fit for the data in the cells. The tree method highlights the important variables that affect variability in the data. Regression trees can handle stepwise as well as continuous responses. Regression tree analysis helps to quickly assess data and identify potential factors that may be affecting observed vehicle occupancy. Regression tree analysis is not designed to assess causality, but to identify the relative influence of correlations on observed values. Analysts need to exercise caution in interpreting the outputs. It is possible to identify a factor as a cause of data variability, when that factor is simply highly correlated with another factor that is the real culprit.

5.1 Regression Tree Analysis

To assess variables that may affect vehicle occupancy on the corridor, and to identify variables that may have introduced potential bias into the data (e.g., whether specific data collectors are not accurately recording vehicle occupancy), the team applied regression tree modeling techniques (Elango and Guensler, 2014; Cosma, 2013; Wolf, et al., 1998; Washington, et al., 1997). Regression tree analysis (also known as binary recursive partitioning) is a standard technique in multivariate analysis that identifies the variables (and the cut points, or sub-classes, within each variable) that when used to split a sample into two pools of data explain the greatest amount of variability within the original sample. For example, in a pool of human height data, the variable for gender is likely to explain more variability than any other variable associated with all of the data in the pool (race/ethnicity, education, household size, etc.). After splitting the data into two pools, subsequent analyses identify the most influential variables within each particular sub-pool. The resulting tree is made up of binary splits for those variables and cut points with the most influence and these results are very useful for identifying potential cause-effect relationships. It is important to keep in mind that regression tree analysis is entirely dependent upon the sample and that causal variables are not always identified (strong correlations within the data can influence the results), but can be addressed in subsequent analysis (e.g., combining regression tree analysis for variable and interaction identification, followed by more advanced multivariate modeling).

In this report, the regression trees examine the potential effect of explanatory variables on observed vehicle occupancy, including data collection site, day of week, session (morning/afternoon peak), lane type (general purpose, managed lane, and ramp), lane number, vehicle type, and data collector identifier. The research team is using regression tree analysis to search for clusters of data that exhibit significantly different occupancy values, collected on the same corridors, during the same time-periods, for the same vehicle types, etc. Once the regression tree analysis identified these data clusters with significantly different occupancy values, the team further investigates the differences. Those data deemed likely biased, due to specific data collector influence, were filtered from the analysis as outlined below.

Before conducting the regression tree analysis for identifying the data-collector-based bias, the raw data were aggregated into occupancy cases based on site location, day of week, session (AM vs PM), lane monitored, vehicle type, and data collector. The team excluded any data session where data collection time was shorter than one-half hour from the regression tree analysis (these are typically supervisor sessions where the data collector has taken a bathroom break). The team excluded any data session with fewer than 80 vehicle observations, to ensure a sufficient sample size and that the cases are likely to be representative. The analytical data set also excluded training sessions and experimental data collection efforts.

The team identified all data collectors by number, so that the individuals remain anonymous in this report. Table 9 provides the abbreviations of the data collection site names used in the analysis. The identifier for each lane used in regression tree analysis combines the site abbreviation and lane type. For example, CHS_GP1 refers to the leftmost general purpose lane (the fast lane) for Chastain Road at I-575. The vehicle types included in the regression tree analysis were passenger car light duty vehicles, coded as LDVs, sport utility vehicles (SUVs), and large heavy-duty vehicles (HDVs). The other vehicle types (motorcycles, small HDVs, vans, buses, and others) were not included, due to their small sample sizes (i.e., comparisons would not be sufficiently representative). The raw fractions of all vehicle types are shown in Table 10. All categorical variables were set to nominal in the analysis.

Table 9 – Site Abbreviations for Regression Tree Analysis

Site	Abbreviation
Chastain Road at I-575	CHS
Hickory Grove Road at I-75	HIC
Hamilton Road at I-85	HAM
Indian Trail Lilburn Road at I-85	IND
Old Peachtree Road at I-75	OPT
Jodeco Road at I-75	JOD

Table 10 – Number of Data Collection Records by Vehicle Type, Pre-Opening/Extension (Fall 2018), All Locations

Vehicle Type	Number of Records	Fraction
LDV	126,797	40.26%
SUV	132,863	42.18%
Van	14,793	4.70%
Small HDV	7,316	2.32%
Large HDV	31,447	9.98%
Bus	961	0.31%
MC	629	0.20%
Other	170	0.05%
Total	314,976	100.00%

Table 11 - Number of Data Collection Records by Vehicle Type, Baseline (Spring 2019), Jodeco Road at I-75

Vehicle Type	Number of Records	Fraction
LDV	29,522	39.51%
SUV	29,207	39.09%
Van	3,010	4.03%
Small HDV	2,013	2.69%
Large HDV	10,573	14.15%
Bus	265	0.35%
MC	108	0.14%
Other	27	0.04%
Total	74,725	100.00%

Table 12 - Number of Data Collection Records by Vehicle Type, Post-Opening/Extension (Fall 2019), All Locations

Vehicle Type	Number of Records	Fraction
LDV	237,515	42.34%
SUV	234,673	41.84%
Van	29,191	5.20%
Small HDV	15,552	2.77%
Large HDV	41,269	7.36%
Bus	1,418	0.25%
MC	933	0.17%
Other	370	0.07%
Total	560,921	100.00%

The regression tree analyses for Fall 2018, Spring 2019, and Fall 2019 all follow the same methodology. The detailed analytical process for Fall 2018 is presented in this chapter, and the analyses for the other two periods are reported in Appendices C and D.

5.2 Day-of-Week Analysis

Before assessing data collector bias, the research team first employed all variables (other than data collector) in a regression tree analysis to assess the potential impact of day-of-week on vehicle occupancy (the root input is the combinations of all of these variables, except data collector). The reason to exclude the data collector identifier in this step is based on experience from the previous project, which identified that some collectors could only work on certain days of the week. Hence, a regression tree analysis may mistakenly identify a data collector, rather than the correlated day of the week, as the primary source of variability. Figure 20 shows the resulting day of the week regression tree. Unlike the previous project, the data collected on Monday and Fridays were not identified as significantly influencing average vehicle occupancy per session (probably because no data in this study were collected on Monday mornings or Friday afternoons, which tend to influence travel behavior). In fact, day-of-the-week did not actually enter the regression tree model. The split in the previous study may have resulted from the fact that there was so much data collected, and so many Mondays and Fridays collected, that small differences were significant in the tree analysis. For this current study, the team concluded that the data collected on Monday afternoons and Friday mornings would remain in the dataset for further analysis.

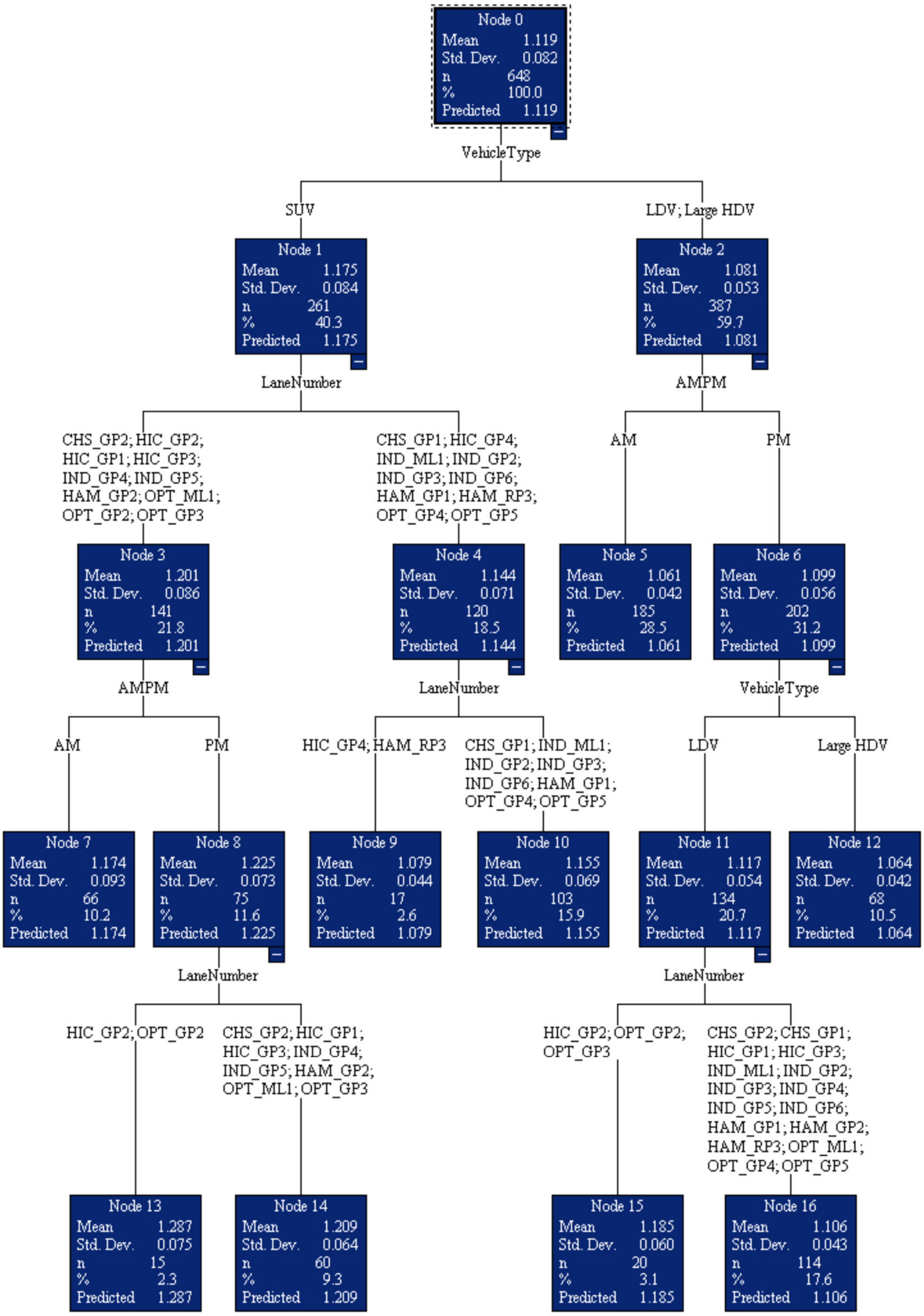


Figure 20 – Regression Tree to Identify Day of Week Impacts, Pre-Opening/Extension (Fall 2018)

5.3 Average Vehicle Occupancy and Potential Data Collector Bias

The results from the first exploratory regression tree include all 39 data collectors (Figure 21). Data collector identifier enters the regression tree analysis as an important potential explanatory variable, but not until after vehicle class, AM/PM, and site-specific elements (location and lane) have already entered the model (these variables are much more influential on vehicle occupancy). To assess potential data collector bias, the research team looks for adjacent leaves on the tree containing a relatively small number of data collection sessions (no larger than 28/648 sessions), split by data collector identifier, with significant differences in average occupancy values across these leaves. The team identified five such nodes (Figure 21, highlighted with red boxes) where the occupancy data in the terminal leaves indicate the potential influence of the individual data collectors on occupancy readings.

The research team manually examined the data in each of the 28 terminal leaves where the data collectors might have influenced occupancy data. Then, the team compared the data from all sessions in which these data collectors were active to the sessions of other data collectors. The research team concluded that the data collected by Collector 13 (Node 22, Figure 21) and Collector 36 (Node 12, Figure 21) differed significantly from the data collected by the other data collectors, and that the potential for bias did exist for these sessions. The same analysis identified three sessions collected by Collector 7 as suspect (Node 23, Figure 21). The research team temporarily removed the data collected by Collector 13 and Collector 36 from the data set, as well as the three sessions collected by Collector 7, to re-assess the impact of the data on overall average vehicle occupancy.

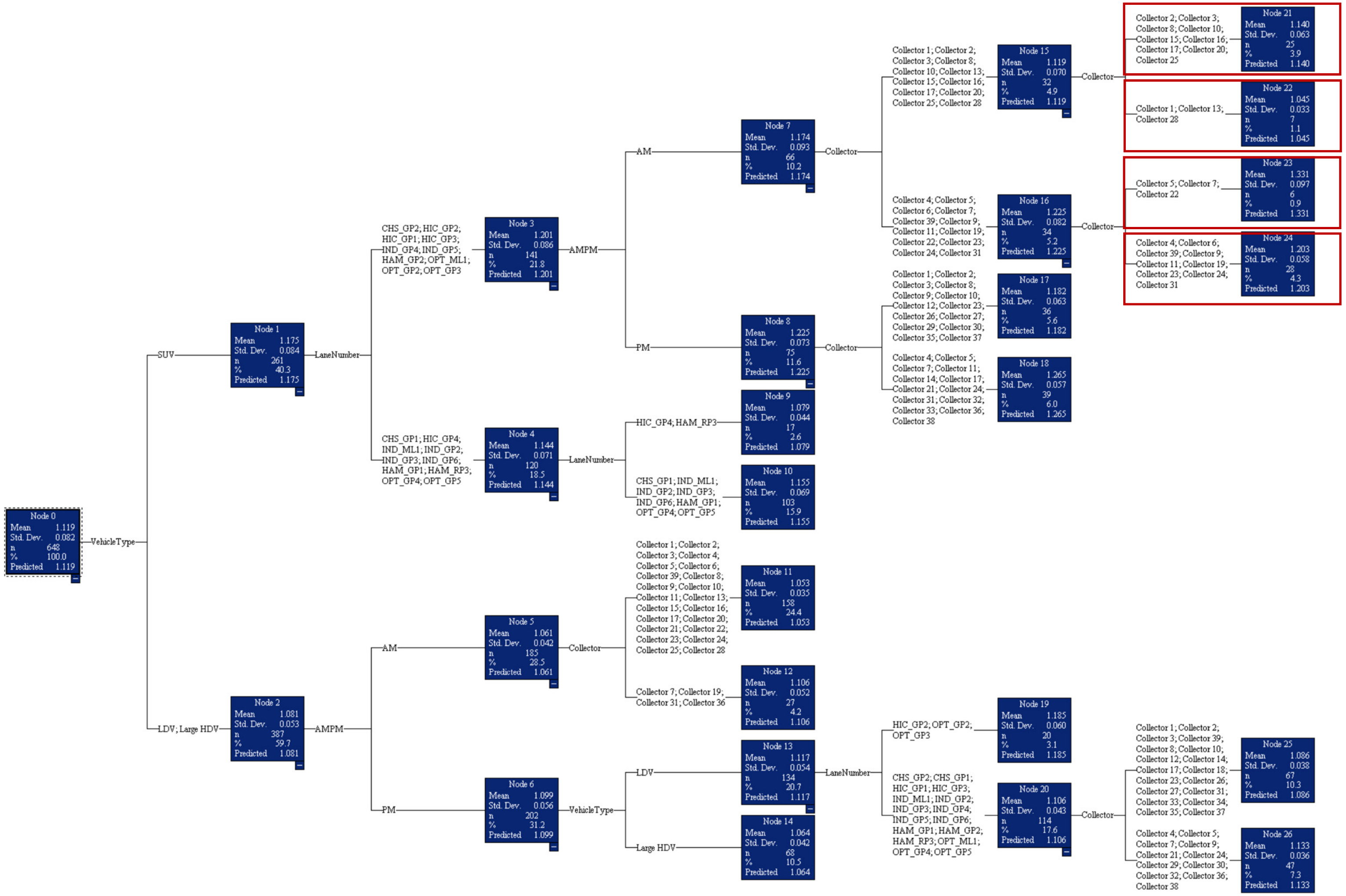


Figure 21 – First Iteration Regression Tree to Identify Potential Data Collector Bias, Pre-Opening/Extension (Fall 2018)

The next regression tree analysis is reported in Figure 22, displaying the regression tree results after removing the relevant data collected by Collectors 7, 13, and 16. The only remaining potentially biased leaf (Node 23, Figure 22) is marked with the red box. After conducting a manual assessment of the data in Node 23 (Figure 22), the team concluded that Collector 27 also likely recorded significantly different occupancy values. The team temporarily excluded the data collected by Collector 27 from the dataset, and generated a new regression tree (shown in Figure 23). The research team applied the same criterion again to search for more potential data collector bias. The team identified no additional suspect leaves; hence, no additional data were reviewed.

Upon manual review of the cases collected by Collectors 7, 13, 27, and 36, the team concluded that significant differences did exist, and that the particular dates or lanes to which these individuals were assigned could not reasonably explain the differences. The research team therefore removed all of the data collected by Collectors 13, 27, and 36, and the three sessions collected by Collector 7 (33 out of 648 cases, or 5.09%) from the analytical dataset.

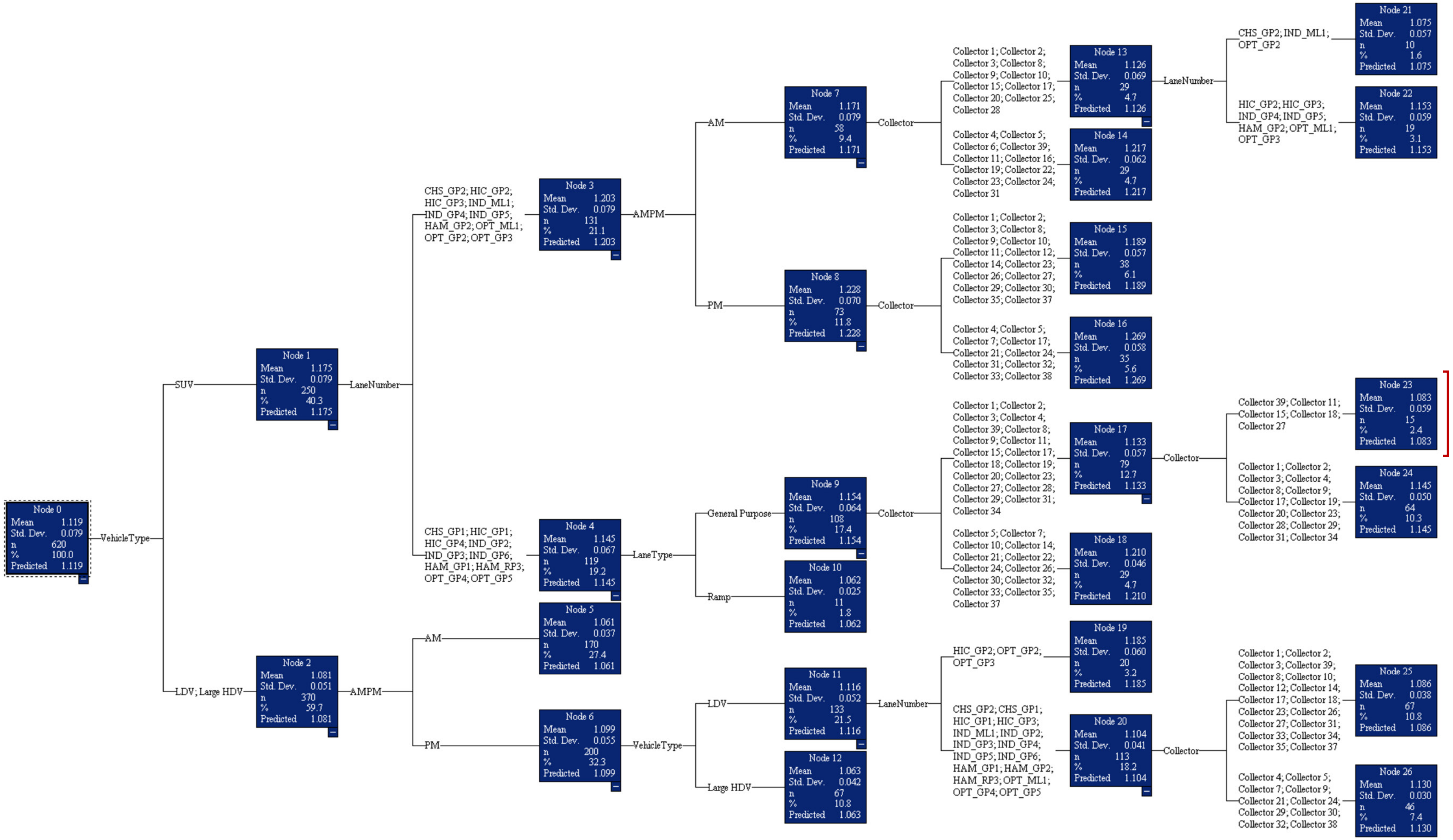


Figure 22 – Second Iteration to Identify Potential Data Collector Bias, Pre-Opening/Extension (Fall 2018)

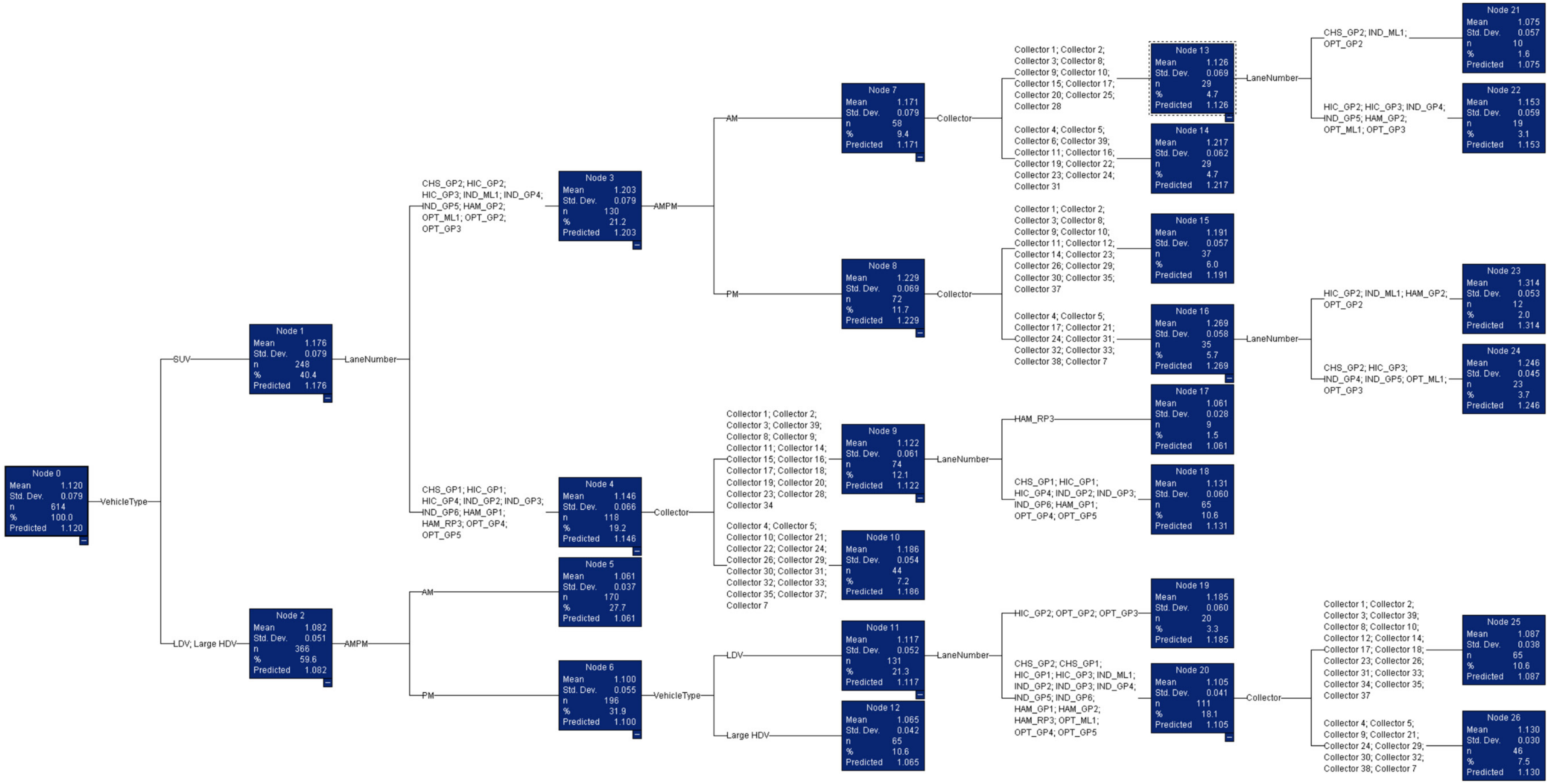


Figure 23 – Third Iteration to Identify Potential Data Collector Bias, Pre-Opening/Extension (Fall 2018)

5.4 SOV and '3+' Vehicle Percentages and Potential Data Collector Bias

In evaluating the average occupancy and potential data collector bias and the impact on person throughput, it is important to analyze the distributions of each data collector across the different occupancy types. Screening based only on average vehicle occupancy does not account for the fact that a bias in single occupancy vehicle vs. high-occupancy vehicle observations may cancel out in average vehicle occupancy. That is, multiple data collectors could obtain the same average vehicle occupancy, but based upon significantly different fractions of SOVs and '3+' HOV vehicles. This part of QA/QC is important because biased results will affect assessment of high-occupancy violation rates and overall passenger throughput. The team assessed potential data collector bias by analyzing the percent of single occupancy vehicles and three-person or more ('3+') occupancy vehicles using regression tree analysis using the same methods described above and for the previous project (Guensler, et al., 2013a).

The SOV/HOV analysis were conducted after uncertain occupancy records were allocated to certain records (see section 4.3). The team conducted separate SOV/HOV '3+' vehicle regression tree analyses for managed lanes and general purpose lanes. The data of passenger car LDVs (coded as LDV) and SUVs were entered separately for their different occupancy patterns. Each analysis followed the same methodology as in section 5.3, where the research team iteratively identified and removed potential biased nodes. In both SOV and HOV '3+'analyses, the extremely high/low portions were manually examined, and those nodes that were found biased were removed from the regression tree. After all analyses, a total of four nodes (9 sessions) with SOV portions larger than 99.15% were excluded; they were significantly higher than other sessions. This may be because certain data collectors may inadvertently (or purposefully) over-input vehicles with only one passenger when they became overwhelmed by the number of vehicles passing their station (also known as "mashing an input button"). Qualified data collectors skip some vehicles in high volume traffic streams to ensure that they get a good field of view and time on target to measure their next vehicle. A detailed description of the four analyses of Fall 2018 can be found in Appendix B, and those of Spring and Fall 2019 can be found in Appendices C and D. Due to the COVD-19 pandemic, no subsequent data were collected in Spring 2020.

5.5 Net Reduction in Sample Size due to Data Screening

In 2018 data collection, the undergraduate and graduate students collected vehicle occupancy data over a period of over two months. More than 40 students participated in this data collection, and each student represented an opportunity for data quality issues to occur. Regression tree analysis was employed to identify significant deviations of data collected by individual data collectors from the data collected by their contemporaries, and to simultaneously control for differences expected across lanes, day of the week, AM/PM, etc. A total of 14 analytical iterations were employed to identify and remove potentially biased data from the vehicle occupancy data. Table 13 provides a summary of the results reported in this chapter and the percentage of data removed from the analysis at each step. In terms of the records of collector and vehicle class, 42 records out of 648 records, or 6.60 percent of the original data, were excluded from the analysis of Fall 2018. In the 2018 effort, 20,610 vehicle observations were excluded from the 314,976 total vehicle observations, or 6.62% of the original data. In the 2010-2012 study, 7.02% of the data were similarly removed (Guensler, 2013a). The summary of the analyses of Fall 2019 and Spring 2019 are provided in Table 14 and Table 15, respectively. The Spring 2019 analysis excluded 5,676 vehicle observations from the 74,725 total vehicle observations, or 7.60% of the original data. The Fall 2019 analysis excluded 34,250 vehicle observations from the 560,921 total vehicle observations, or 6.11% of the original data.

Table 13 – Impact of Filtering Iterations on Total Sample Size, Pre-Opening/Extension (Fall 2018), All Locations

Analysis Iteration	Regression Tree Type	Input Number of Records	Number of Records Filtered	Percent of Records Filtered	Input Number of Vehicles	Number of Vehicles Filtered	Percent of Vehicles Filtered
1	Average Occupancy: Analysis of Day of Week	648	0	0.00%	314,976	0	0.00%
2	Average Occupancy: Analysis of Collector Bias	648	27	4.17%	314,976	16,441	5.22%
3	Average Occupancy: Analysis of Collector Bias	621	6	0.97%	298,535	1,566	0.52%
4	Average Occupancy: Analysis of Collector Bias	615	0	0.00%	296,969	0	0.00%
5	SOV Portions on GP Lanes: Passenger Car LDVs	615	7	1.14%	296,969	2,310	0.78%
6	SOV Portions on GP Lanes: Passenger Car LDVs	612	0	0.00%	294,659	0	0.00%
7	SOV Portions on GP Lanes: SUVs	612	0	0.00%	294,659	0	0.00%
8	SOV Portions on Express Lanes: Passenger Car LDVs	612	2	0.33%	294,659	293	0.10%
9	SOV Portions on Express Lanes: Passenger Car LDVs	611	0	0.00%	294,366	0	0.00%
10	SOV Portions on Express Lanes: SUVs	611	0	0.00%	294,366	0	0.00%
11	'3+' HOV Portions on GP Lanes: Passenger Car LDVs	611	0	0.00%	294,366	0	0.00%
12	'3+' HOV Portions on GP Lanes: SUVs	611	0	0.00%	294,366	0	0.00%
13	'3+' HOV Portions on Express Lanes: Passenger Car LDVs	611	0	0.00%	294,366	0	0.00%
14	'3+' HOV Portions on Express Lanes: SUVs	611	0	0.00%	294,366	0	0.00%
Total		648	42	6.60%	314,976	20,610	6.62%

Table 14 – Impact of Filtering Iterations on Total Sample Size, Post-Opening/Extension (Fall 2019), All Locations

Analysis Iteration	Regression Tree Type	Input Number of Records	Number of Records Filtered	Percent of Records Filtered	Input Number of Vehicles	Number of Vehicles Filtered	Percent of Vehicles Filtered
1	Average Occupancy: Analysis of Day of Week	625	0	0.00%	560,921	0	0.00%
2	Average Occupancy: Analysis of Collector Bias	625	4	0.64%	560,921	4,968	0.89%
3	Average Occupancy: Analysis of Collector Bias	621	13	2.09%	555,953	8,365	1.50%
4	Average Occupancy: Analysis of Collector Bias	608	0	0.00%	547,588	0	0.00%
5	SOV Portions on GP Lanes: Passenger Car LDVs	608	12	1.97%	547,588	10,096	1.84%
6	SOV Portions on GP Lanes: Passenger Car LDVs	596	0	0.00%	537,492	0	0.00%
7	SOV Portions on GP Lanes: SUVs	596	12	2.01%	537,492	10,821	2.01%
8	SOV Portions on Express Lanes: Passenger Car LDVs	584	0	0.00%	526,671	0	0.00%
9	SOV Portions on Express Lanes: Passenger Car LDVs	584	0	0.00%	526,671	0	0.00%
10	SOV Portions on Express Lanes: SUVs	584	0	0.00%	526,671	0	0.00%
11	'3+' HOV Portions on GP Lanes: Passenger Car LDVs	584	0	0.00%	526,671	0	0.00%
12	'3+' HOV Portions on GP Lanes: SUVs	584	0	0.00%	526,671	0	0.00%
13	'3+' HOV Portions on Express Lanes: Passenger Car LDVs	584	0	0.00%	526,671	0	0.00%
14	'3+' HOV Portions on Express Lanes: SUVs	584	0	0.00%	526,671	0	0.00%
Total		625	41	6.56%	560,921	34,250	6.11%

Table 15 – Impact of Filtering Iterations on Total Sample Size, Baseline (Spring 2019), Jodeco Road

Analysis Iteration	Regression Tree Type	Input Number of Records	Number of Records Filtered	Percent of Records Filtered	Input Number of Vehicles	Number of Vehicles Filtered	Percent of Vehicles Filtered
1	Average Occupancy: Analysis of Day of Week	126	0	0.00%	74,725	0	0.00%
2	Average Occupancy: Analysis of Collector Bias	126	7	5.56%	74,725	5,676	7.60%
3	Average Occupancy: Analysis of Collector Bias	119	0	0.00%	69,049	0	0.00%
4	SOV Portions: Passenger Car LDVs	119	0	0.00%	69,049	0	0.00%
5	SOV Portions: SUVs	119	0	0.00%	69,049	0	0.00%
6	3+' HOV Portions: Passenger Car LDVs	119	0	0.00%	69,049	0	0.00%
7	3+' HOV Portions: SUVs	119	0	0.00%	69,049	0	0.00%
Total		126	7	5.56%	74,725	5,676	7.60%

5.6 Net Impact of Data Screening on Average Vehicle Occupancy

To assess whether the data filtering caused a significant impact on the overall occupancy on a lane-by-lane basis, the team calculated the average occupancy for all lanes before and after QA/QC data filtering of Fall 2018, as shown in Table 16 and Table 17. The results indicate that the data filtering only has a small impact on the overall occupancy, with the largest average impact of 0.03 persons/vehicle in the AM peaks, and 0.01 in the PM peaks (no major bias was identified during the QA/QC process). The research team is confident that the filtered data are more representative of on-road vehicle occupancy than the unfiltered data, especially with respect to the impacts of Collector 13 (which manifested during AM data collection).

Table 16 – Average Occupancy Before-and-After Data Filtering, Pre-Opening/Extension (Fall 2018), AM Peak (7-10 AM), All Locations

Lane Number	Average		LDV		SUV		Large HDV	
	Before-	After-	Before-	After-	Before-	After-	Before-	After-
CHS_GP1	1.12	1.12	1.05	1.05	1.13	1.13	1.15	1.15
CHS_GP2	1.13	1.14	1.06	1.06	1.17	1.17	1.06	1.06
HIC_GP1	1.09	1.09	1.06	1.06	1.11	1.11	1.03	1.03
HIC_GP2	1.11	1.11	1.10	1.10	1.19	1.19	1.04	1.04
HIC_GP3	1.06	1.06	1.03	1.03	1.06	1.06	N/A	N/A
HIC_GP4	1.13	1.15	1.09	1.10	1.15	1.18	N/A	N/A
IND_ML1	1.11	1.11	1.08	1.08	1.17	1.17	1.03	1.03
IND_GP2	1.13	1.13	1.10	1.10	1.20	1.20	1.06	1.06
IND_GP3	1.11	1.11	1.07	1.07	1.14	1.14	1.09	1.09
IND_GP4	1.18	1.18	1.08	1.08	1.16	1.16	N/A	N/A
IND_GP5	1.11	1.11	1.06	1.06	1.15	1.15	N/A	N/A
IND_GP6	1.13	1.13	1.06	1.06	1.18	1.18	1.05	1.05
HAM_GP1	1.13	1.13	1.07	1.07	1.20	1.20	1.07	1.07
HAM_GP2	1.12	1.12	1.08	1.08	1.19	1.19	1.04	1.04
HAM_RP3	1.12	1.12	1.06	1.06	1.15	1.15	1.04	1.04
OPT_ML1	1.22	1.22	1.09	1.09	1.19	1.19	N/A	N/A
OPT_GP2	1.18	1.18	1.13	1.13	1.19	1.19	N/A	N/A
OPT_GP3	1.14	1.14	1.09	1.09	1.17	1.17	1.07	1.07
OPT_GP4	1.07	1.07	1.05	1.05	1.12	1.12	1.02	1.02
OPT_GP5	1.08	1.08	1.06	1.06	1.11	1.11	1.02	1.02

Note: N/A indicates the lanes without sufficient sample size of large HDVs. Shaded cells indicate a change in AVO larger than 0.01 person/vehicle due to quality control filtering.

Table 17 – Average Occupancy Before-and-After Data Filtering, Pre-Opening/Extension (Fall 2018), PM Peak (4-7 PM), All Locations

Lane Number	Average		LDV		SUV		Large HDV	
	Before-	After-	Before-	After-	Before-	After-	Before-	After-
CHS_GP1	1.16	1.16	1.08	1.08	1.17	1.17	1.08	1.08
CHS_GP2	1.21	1.21	1.12	1.12	1.22	1.22	1.12	1.12
HIC_GP1	1.16	1.16	1.11	1.11	1.19	1.19	1.04	1.04
HIC_GP2	1.17	1.17	1.14	1.14	1.25	1.25	1.06	1.06
HIC_GP3	1.07	1.09	1.05	1.07	1.05	1.07	N/A	N/A
IND_ML1	1.15	1.15	1.09	1.09	1.18	1.18	N/A	N/A
IND_GP2	1.22	1.22	1.21	1.21	1.29	1.29	1.06	1.06
IND_GP3	1.14	1.14	1.12	1.12	1.18	1.18	1.07	1.07
IND_GP4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IND_GP5	1.30	1.30	1.10	1.10	1.23	1.23	N/A	N/A
IND_GP6	1.15	1.15	1.10	1.10	1.20	1.20	1.03	1.03
HAM_GP1	1.14	1.14	1.11	1.11	1.18	1.18	1.08	1.08
HAM_GP2	1.17	1.17	1.12	1.12	1.22	1.22	1.08	1.08
HAM_RP3	1.17	1.17	1.12	1.12	1.23	1.23	1.11	1.11
OPT_ML1	1.12	1.12	1.08	1.08	1.14	1.14	1.07	1.07
OPT_GP2	1.26	1.26	1.11	1.11	1.23	1.23	N/A	N/A
OPT_GP3	1.26	1.26	1.19	1.19	1.30	1.30	N/A	N/A
OPT_GP4	1.17	1.17	1.17	1.17	1.20	1.20	1.03	1.03
OPT_GP5	1.13	1.13	1.11	1.11	1.16	1.16	1.06	1.06

Note: N/A indicates the lanes without sufficient sample size of large HDVs. Shaded cells indicate a change in AVO larger than 0.01 person/vehicle due to quality control filtering.

The results of Spring 2019 are provided in Table 18 and Table 19. The largest average impact of 0.01 persons/vehicle in the AM peaks, and 0.02 in the PM peaks. The results of Fall 2019 are provided in Table 20 and Table 21. The largest average impact of 0.02 persons/vehicle in the AM peaks, and 0.03 in the PM peaks. The research team is confident that the filtered data are more representative of on-road vehicle occupancy than the unfiltered data for 2019, similarly with the analysis of 2018.

Table 18 – Average Occupancy Before-and-After Data Filtering, Baseline (Spring 2019), AM Peak (7-10 AM), Jodeco Road

Lane Number	Average		LDV		SUV		Large HDV	
	Before-	After-	Before-	After-	Before-	After-	Before-	After-
JOD_ML1	1.10	1.08	1.05	1.04	1.10	1.08	N/A	N/A
JOD_ML2	1.06	1.06	1.01	1.01	1.06	1.06	N/A	N/A
JOD_GP3	1.11	1.11	1.07	1.07	1.14	1.14	1.03	1.03
JOD_GP4	1.11	1.11	1.11	1.11	1.17	1.17	1.03	1.03
JOD_GP5	1.07	1.06	1.06	1.05	1.10	1.09	1.03	1.01

Note: N/A indicates the lanes without sufficient sample size of large HDVs.

Table 19 – Average Occupancy Before-and-After Data Filtering, Baseline (Spring 2019), PM Peak (4-7 PM), Jodeco Road

Lane Number	Average		LDV		SUV		Large HDV	
	Before-	After-	Before-	After-	Before-	After-	, Before-	After-
JOD_ML1	1.08	1.08	1.06	1.06	1.12	1.12	N/A	N/A
JOD_ML2	1.05	1.03	1.01	1.01	1.04	1.01	N/A	N/A
JOD_GP3	1.20	1.19	1.14	1.13	1.25	1.25	1.00	1.00
JOD_GP4	1.15	1.15	1.14	1.14	1.21	1.21	1.04	1.04
JOD_GP5	1.16	1.16	1.16	1.16	1.21	1.21	1.05	1.05

Note: N/A indicates the lanes without sufficient sample size of large HDVs.

Table 20 – Average Occupancy Before-and-After Data Filtering, Post-Opening/Extension (Fall 2019), AM Peak (7-10 AM), All Locations

Lane Number	Average		LDV		SUV		Large HDV	
	Before-	After-	Before-	After-	Before-	After-	Before-	After-
CHS_ML1	1.04	1.04	1.02	1.02	1.05	1.05	N/A	N/A
CHS_GP2	1.07	1.07	1.04	1.04	1.08	1.08	1.04	1.04
CHS_GP3	1.14	1.14	1.09	1.09	1.16	1.16	1.05	1.05
HAM_GP1	1.06	1.06	1.05	1.05	1.07	1.07	1.03	1.03
HAM_GP2	1.10	1.09	1.10	1.11	1.15	1.13	1.03	1.04
HAM_GP3	1.01	1.01	1.02	1.02	1.00	1.00	1.00	1.00
HAM_RP4	1.05	1.05	1.03	1.03	1.05	1.05	1.04	1.04
HIC_ML1	1.06	1.06	1.03	1.03	1.06	1.06	N/A	N/A
HIC_GP2	1.11	1.11	1.09	1.08	1.13	1.13	1.01	N/A
HIC_GP3	1.13	1.13	1.11	1.11	1.19	1.19	1.02	1.02
HIC_GP4	1.09	1.09	1.08	1.08	1.14	1.12	1.04	1.04
HIC_GP5	1.09	1.09	1.08	1.08	1.11	1.11	1.03	1.03
HIC_RP6	1.06	1.06	1.05	1.05	1.07	1.07	N/A	N/A
IND_ML1	1.12	1.12	1.03	1.03	1.10	1.10	N/A	N/A
IND_GP2	1.10	1.09	1.06	1.05	1.11	1.11	N/A	N/A
IND_GP3	1.09	1.09	1.05	1.05	1.11	1.10	1.02	1.02
IND_GP4	1.08	1.09	1.04	1.05	1.13	1.13	1.03	1.03
IND_GP5	1.04	1.05	1.02	1.03	1.08	1.08	1.02	1.02
IND_GP6	1.07	1.09	1.04	1.05	1.09	1.11	1.04	1.05
OPT_ML1	1.13	1.13	1.05	1.05	1.10	1.10	N/A	N/A
OPT_GP2	1.07	1.07	1.04	1.04	1.09	1.09	N/A	N/A
OPT_GP3	1.08	1.08	1.06	1.06	1.10	1.10	1.02	1.02
OPT_GP4	1.06	1.08	1.04	1.06	1.08	1.11	1.01	1.01
OPT_GP5	1.08	1.08	1.06	1.06	1.09	1.09	1.03	1.03

Note: N/A indicates the lanes without sufficient sample size of large HDVs.

Table 21 – Average Occupancy Before-and-After Data Filtering, Post-Opening/Extension (Fall 2019), PM Peak (4-7 PM), All Locations

Lane Number	Average		LDV		SUV		Large HDV	
	Before-	After-	Before-	After-	Before-	After-	Before-	After-
CHS_ML1	1.06	1.06	1.04	1.04	1.06	1.06	N/A	N/A
CHS_GP2	1.16	1.16	1.12	1.12	1.18	1.18	N/A	N/A
CHS_GP3	1.14	1.14	1.11	1.11	1.15	1.15	1.07	1.07
HAM_GP1	1.11	1.11	1.07	1.07	1.12	1.12	1.03	1.03
HAM_GP2	1.11	1.11	1.10	1.10	1.16	1.16	1.04	1.04
HAM_RP3	1.05	1.05	1.03	1.03	1.04	1.04	N/A	N/A
HIC_ML1	1.10	1.10	1.07	1.07	1.08	1.08	N/A	N/A
HIC_GP2	1.14	1.13	1.10	1.08	1.18	1.17	N/A	N/A
HIC_GP3	1.14	1.14	1.15	1.15	1.19	1.19	1.03	1.03
HIC_GP4	1.09	1.12	1.08	1.11	1.12	1.15	1.03	1.04
HIC_RP5	1.05	1.05	1.03	1.03	1.06	1.06	N/A	N/A
HIC_RP6	1.07	1.07	1.05	1.05	1.08	1.08	N/A	N/A
IND_ML1	1.17	1.17	1.05	1.05	1.13	1.13	N/A	N/A
IND_GP2	1.10	1.10	1.06	1.06	1.12	1.12	N/A	N/A
IND_GP3	1.11	1.11	1.07	1.07	1.14	1.14	1.03	1.03
IND_GP4	1.11	1.13	1.08	1.09	1.16	1.17	1.04	1.05
IND_GP5	1.12	1.12	1.08	1.08	1.15	1.15	1.05	1.05
IND_GP6	1.10	1.12	1.06	1.08	1.12	1.14	1.04	1.04
OPT_ML1	1.17	1.17	1.05	1.05	1.14	1.14	N/A	N/A
OPT_GP2	1.12	1.12	1.08	1.08	1.15	1.15	N/A	N/A
OPT_GP3	1.11	1.11	1.08	1.08	1.13	1.13	1.04	1.04
OPT_GP4	1.08	1.08	1.09	1.09	1.10	1.10	1.02	1.02
OPT_GP5	1.10	1.10	1.08	1.08	1.10	1.10	1.06	1.06

Note: N/A indicates the lanes without sufficient sample size of large HDVs.

6 Factors Related to Observed Vehicle Occupancy

The research team assessed the effects of different factors on vehicle occupancy using regression tree analysis with the QA/QC-filtered data developed in the previous chapter. This chapter first presents the analytical results without considering vehicle type, as was done in the previous study (Guensler, et al., 2013a). Then, the team conducts additional analysis to assess the potential influence of vehicle type on vehicle occupancy (the detailed occupancy results are presented later, in Chapter 9). The combination of lane type and lane number appears to be the most important factor with respect to vehicle occupancy. The Express Lane and middle general purpose lanes tend to have higher occupancy than the rest of the lanes. The NWC Express Lanes exhibit lower occupancy than the GP lanes, while the I-85 Express Lanes have larger occupancy than GP lanes (as presented in Chapter 9). Sessions in the afternoon peak period tend to have higher occupancy than morning sessions, which is not surprising given that many more high-occupancy shopping and recreation trips are intermingled with afternoon commute trips. Vehicle type also appears to be an important factor related to average occupancy. Hence, the assessments in the chapters that follow will account for separate vehicle types.

6.1 Vehicle Occupancy by Site and Lane

The filtered occupancy records were aggregated based on session (AM/PM and date), lane, and site. Collector information was excluded from this part of analysis, given that QA/QC analysis for the data collectors was complete. Variables that enter the regression tree included lane number (combination of site, lane type, and lane ID), AM/PM, lane position (inside, middle and outside), lane type (general purpose lanes, managed lanes and ramps), site, and day of the week. The impact of vehicle type was not considered in this preliminary analysis, as it will be assessed in Section 6.2. Figure 24 shows the resulting regression tree.

The lane number is the most influential factor among all the variables. The first branch splits on two managed lanes (Node 1, Figure 24) and two general purpose lanes (Node 2, Figure 24), which are middle lanes (Lane 2 at Hickory Grove Road and Lane 2 at Old Peachtree Road). The average occupancy of these four lanes is 0.082 larger than the other lanes. The larger occupancy value is consistent with the 2010-2012 study, in which the managed lanes exhibited a larger average vehicle occupancy than the general purpose lanes (Guensler, et al., 2013a). The general purpose lanes classified to this branch (Node 2, Figure 24) indicate that they are more similar to the managed lanes than the other general purpose lanes in terms of average occupancy. The next level of the tree splits by AM vs. PM peaks, which is reasonable because morning peak and afternoon peak travel behavior is typically different (afternoon trip purpose includes more shopping and recreation trips with higher vehicle occupancy). The AM branch of the four lanes (Node 3, Figure 24) further splits by site into two branches. The branch with the larger average occupancy of 1.186 includes the records of Indian Trail Lilburn Road and Old Peachtree (Node 7, Figure 24), and the branch with the smaller average occupancy of 1.100 includes the records of Hickory Grove Road (Node 8, Figure 24). There is no further split of the PM branch of the four lanes (Node 4, Figure 24). The AM (Node 5, Figure 24) and PM (Node 6, Figure 24) branches of the other lanes both split further by lane numbers, while particular lanes are divided differently. The ramp at

Hamilton Mill Road and Lane 6 at Indian Trail Lilburn Road are in the branch with smaller occupancy for both AM and PM peaks. The other lanes divided to the smaller branch include Lane 1 at Chastain Road, Lane 2 at Indian Trail Lilburn Road, Lane 1 at Hamilton Mill Road, and Lane 4 at Old Peachtree Road (AM); and Lane 6 at Indian Trail Lilburn Road (PM).

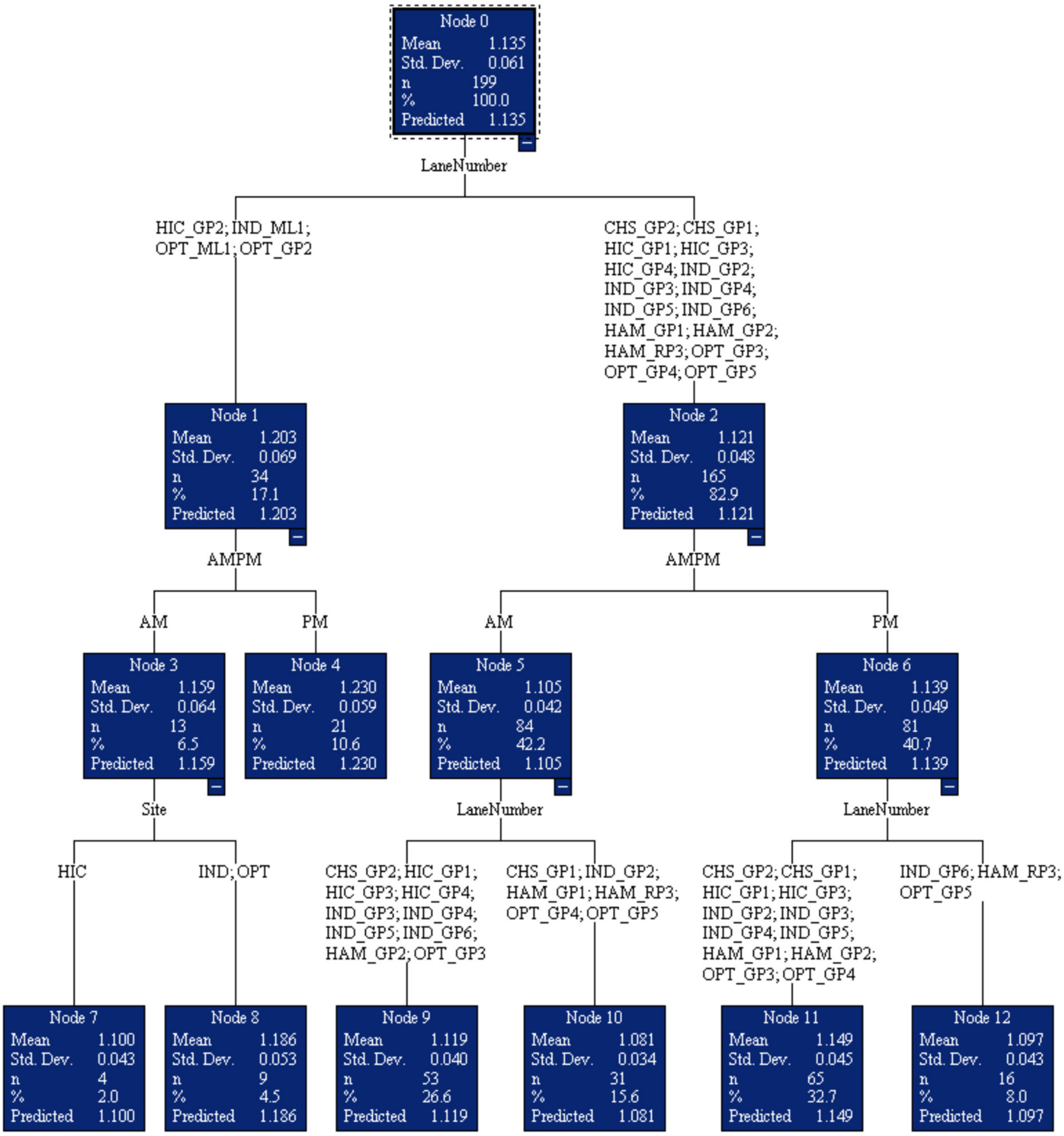


Figure 24 – Regression Tree for Lane Number and Other Factors, Pre-Opening/Extension (Fall 2018)

Overall, the most important affecting factor of the average occupancy is lane number, which is coded as a combination of site, lane type and lane ID. Using such coding makes it easy to represent the lanes. However, it also duplicates the existing variables of site and lane type. The variable of lane number provides more detailed information in combinations and might potentially overwrite the effect of site, lane type, and even lane positions. Therefore, the team next excluded the combined lane number to generate a new regression tree, using the variables of lane information (combination of lane type and lane ID), AM/PM, site, and lane position.

The new regression that redefines the lanes is shown in Figure 25. The tree first splits the lane information into one branch of managed lanes (Node 1, Figure 25) and the other branch of general purpose lanes and a ramp (Node 2, Figure 25). This is expected as managed lanes presented larger occupancy than the other lanes. There is no further split to the managed lane branch. The branch of the other lanes further splits by AM (Node 3, Figure 25) vs. PM peaks (Node 4, Figure 25), which is reasonable. Both the AM and PM branches are further split by lane information. Generally, the sub-branches with smaller occupancy (Node 6 and Node 8, Figure 25) are inside and outside lanes, while the sub-branches with larger occupancy (Node 7 and Node 9, Figure 25) are middle lanes. The research team speculates that lane information here reflects the effect of lane positions, which may relate to origin-destination decision-making and the choice to be in an outside lane. After splitting by lane information, the two AM branches (Node 5 and Node 6, Figure 25) further split by site. The PM branch (Node 7 and Node 8, Figure 25) further splits by lane information again, and then by site.

No further splits for the managed lanes appear in Figure 25. The research team next generated a new regression tree specifically for managed lanes, as shown in Figure 26. The following three variables were entered into the regression tree: AM/PM, site (Indian Trail Lilburn Road and Old Peachtree Road), and day of the week. The tree first splits by AM vs. PM peaks (Node 1 and Node 2, Figure 26), and then by day of the week (Node 3 to Node 6, Figure 26). The variable of site splits the tree after AM/PM and day of the week (Node 7 to Node 10, Figure 26). That is, for the observed data of managed lanes, the site (Indian Trail Lilburn Road vs. Old Peachtree Road) is not a significant factor compared with other variables.

To further verify the speculation that lane position is a factor for the general purpose lanes and ramps, a new regression tree was generated including the following variables: site, AM/PM, combined lane number (site, lane type, and lane ID), lane position, lane type, and day of the week. The new regression tree is shown in Figure 27. The tree first splits by lane information into two branches. The left branch (Node 1, Figure 27) with larger average occupancy includes four lanes that are all middle lanes. The left branch next splits by AM (Node 3, Figure 27) vs. PM (Node 4, Figure 27) peak, and the PM sub-branch (Node 4, Figure 27) splits again by lane information. The right branch (Node 2, Figure 27) includes the other lanes and splits into AM vs. PM peaks. Both the AM (Node 5, Figure 27) and PM (Node 6, Figure 27) branches are next split by lane information, with the smaller sub-branches (Node 8 and Node 10, Figure 27) including inside lanes and outside lanes (including the ramp). Although Lane 2 at Indian Trail Lilburn Road is not the inside lane, it is the most inside general purpose lane at the site (which has five general purpose lanes).

Therefore, the research team concluded that lane position is the most significant affecting factor for general purpose lanes and ramp in terms of the average occupancy.

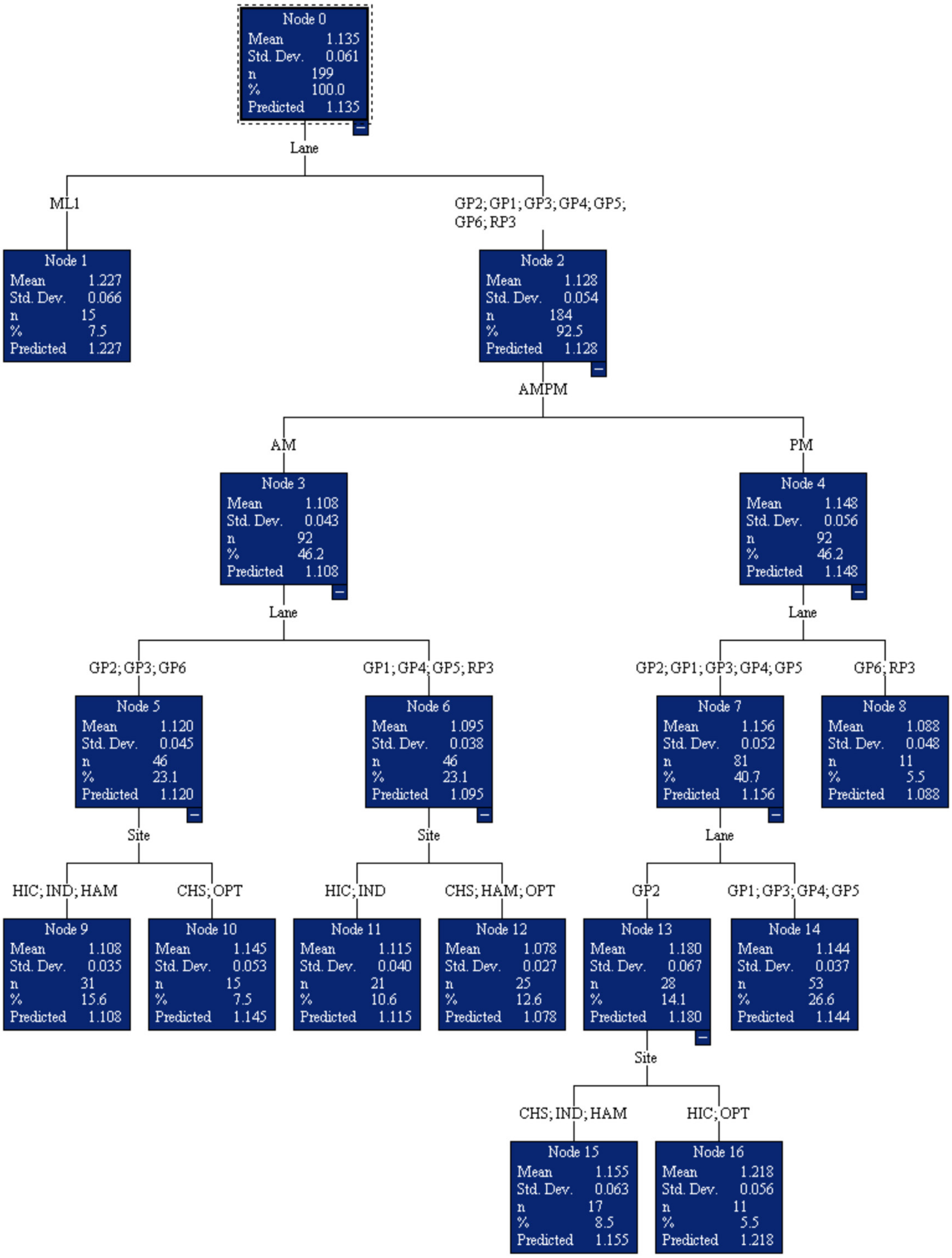


Figure 25 – Regression Tree for All Factors Excluding Lane Number, Pre-Opening/Extension (Fall 2018)

In the previous analyses, the research team concluded that the general purpose lane position reflects a combination of site, lane type, and lane ID, and that relative lane position could be implemented as a variable (inside, middle, and outside). In this analysis, only the inside most and outside most lanes (marked as inside/outside in the field occupancy collection) were coded separately, and all other lanes were marked as middle lanes. This was meant to keep the lane positions consistent across all sites given that the number of lanes at each site varies from two lanes to six lanes. Once the data were re-coded, lane number longer appears to be an influential factor in the regression tree analysis. That is, there was no significant pattern of lanes at certain positions across all sites; a simple classification of the lanes into inside, middle, and outside ones did not yield a significant higher-level split in the tree (i.e., applicable to all sites). Instead, the effects of lane position varied site-by-site. Factors including total number of lanes, whether there is a managed lane, whether there is an entrance/exit ramp, and whether the ramp is upstream or downstream to the data collection site, and the distance to the ramp all appeared to influence the occupancy with respect to lane position. For example, middle lanes generally had larger average occupancy, but Lane 2 at Indian Trail Lilburn Road (the fast general purpose lane) always divided to the branches with smaller average occupancy (Node 10, Figure 27), which might be due to the fact that Indian Trail Lilburn Road has a HOT lane (Lane 1) and a large number of general purpose lanes (five general purpose lanes).

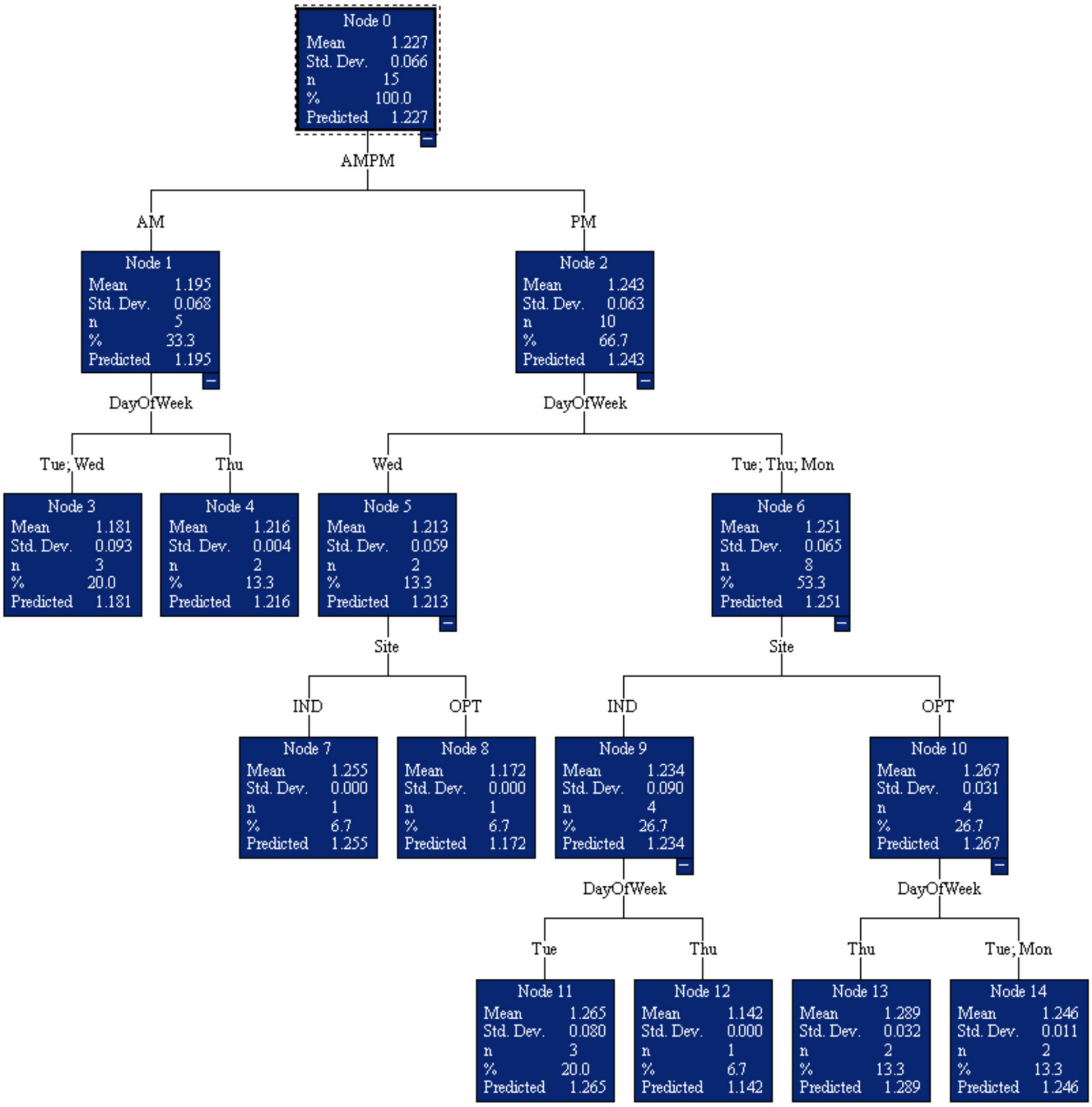


Figure 26 – Regression Tree for Managed Lanes, Pre-Opening/Extension (Fall 2018)

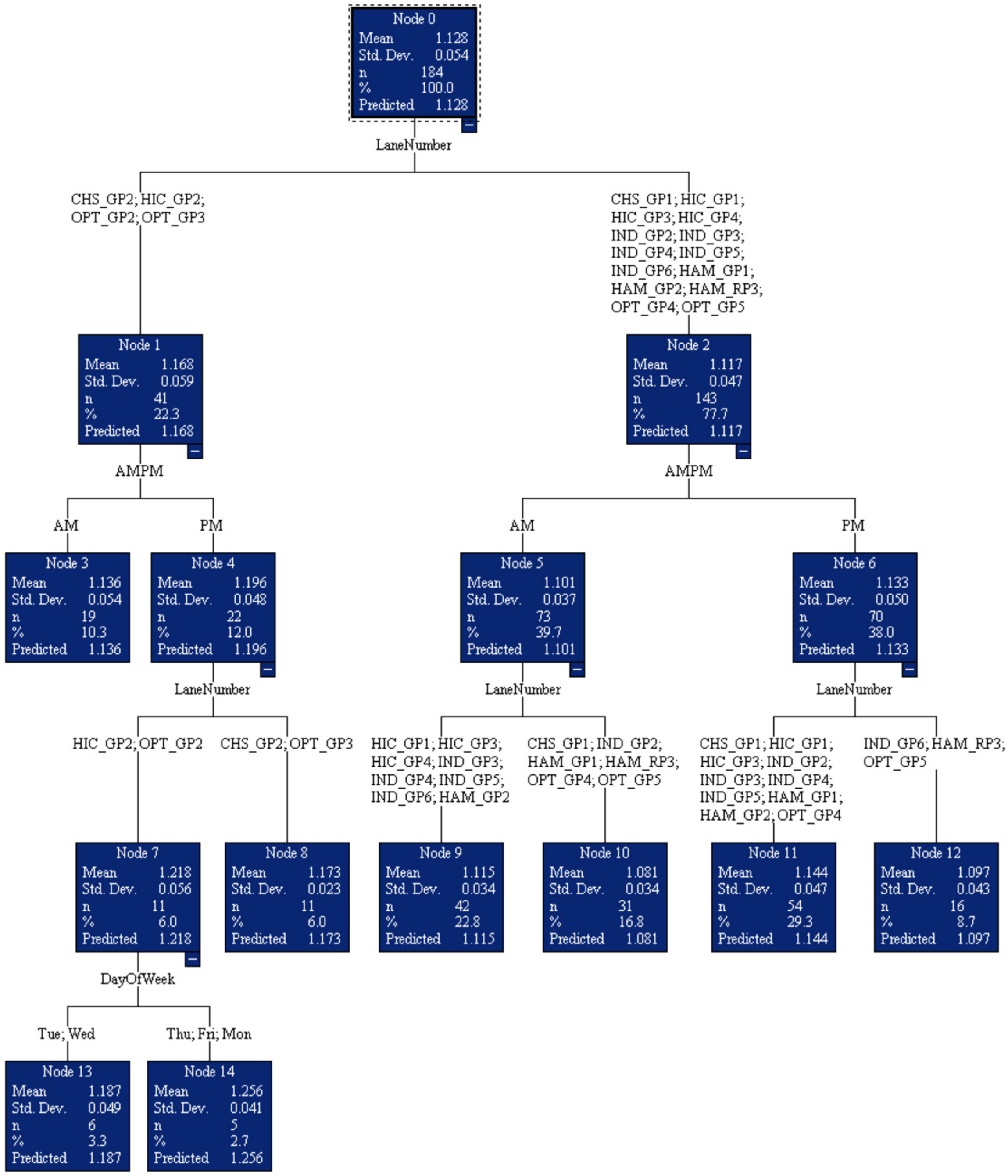


Figure 27 – Regression Tree for General Purpose Lanes and a Ramp, Pre-Opening/Extension (Fall 2018)

6.2 Occupancy and Vehicle Type

The regression tree analyses presented in the previous section did not assess the impact of vehicle type on average occupancy. The research team intuitively expected occupancies to differ across different vehicle types (i.e., more passengers in larger passenger vehicles). In the following analyses, the regression trees use occupancy data of passenger car light-duty vehicles (LDV), coded as LDVs, sport utility vehicles (SUVs), and large heavy-duty vehicles (HDVs). Other vehicle types (e.g., motorcycles) were excluded due to insufficient data. Figure 28 shows the first regression tree for the input variables of site, lane number, lane type, lane position, vehicle type, AM/PM, and day of the week. The tree first splits by vehicle type into two branches: the left branch (Node 1, Figure 28) includes the SUVs with a larger average occupancy, and the right branch (Node 2, Figure 28) includes passenger car LDVs (coded as LDVs) and large HDVs with a smaller average occupancy (which will be of interest in future assessment of carpool formation). The SUV branch next splits by lane number, and the sub-branches (Node 3 and Node 4, Figure 28) further split by AM vs. PM and lane number. The branch of passenger car LDVs and large HDVs next splits by vehicle type again into passenger car LDVs (Node 5, Figure 28), and large HDVs (Node 6, Figure 28). There is no further split for large HDVs. The branch of passenger car LDVs further splits by AM vs. PM.

The team ran the same regression tree analysis for overall average occupancy, but this time excluding lane number to assess the separate impacts of site, lane type, and lane position. Figure 29 shows the resulting tree for the whole dataset. The tree again splits by vehicle type first, indicating that vehicle type is the most important factor. The research team then conducted a separate regression tree analysis for each vehicle type.

The individual vehicle type trees are shown in Figure 30 (passenger car LDVs), Figure 31 (SUVs), and Figure 32 (large HDV). The passenger car LDV tree splits first on AM vs. PM. The PM branch (Node 2, Figure 30) next splits by lane number on middle lanes (Node 3, Figure 30) and other lanes (node 4, Figure 30). The middle-lane branch then splits by site (Node 5 and Node 6, Figure 30). The branch of the other lanes further splits by lane type, when the ramp splits to another branch (Node 8, Figure 30).

For SUVs, the tree first splits by lane type, separating the ramp from other lanes (Node 2, Figure 31). The branch splits next on managed and general purpose lanes (Node 1, Figure 31), then on AM vs. PM, and then two sub-branches (Node 3 and Node 4, Figure 31) further splits by lane information of lane type and ID. Later branches then split by site (Node 6 and Node 7, Figure 31), and one branch (Node 8, Figure 31) splits by lane position.

The tree for large HDVs first splits by site, and then by AM vs. PM. Occupancy of long-haul vs. short-haul heavy-duty trucks may differ significantly, meaning that trucks routing around the metro area on I-285 may have higher vehicle occupancy than vehicles operating inside I-285 (only vehicles picking up or delivering inside the Perimeter may inside the I-285. Lane information variables do not enter the HDV tree. In addition, many lanes do not have sufficiently large HDV counts due to lane use restrictions (see Table 16 and Table 17 in the previous chapter) and lane information might not be complete enough to produce a split.

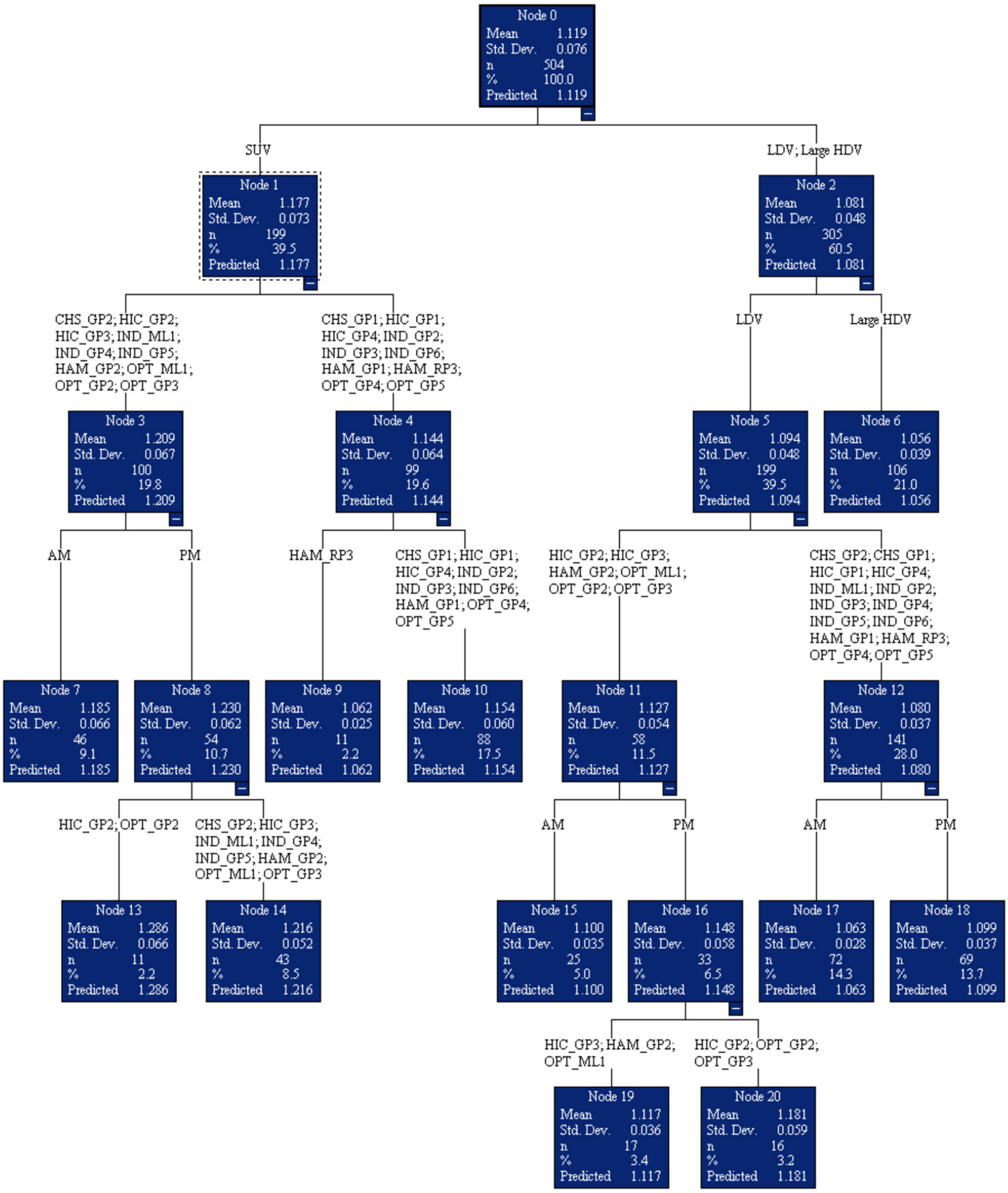


Figure 28 – Regression Tree for Vehicle Types, Including Lane Number, Pre-Opening/Extension (Fall 2018)

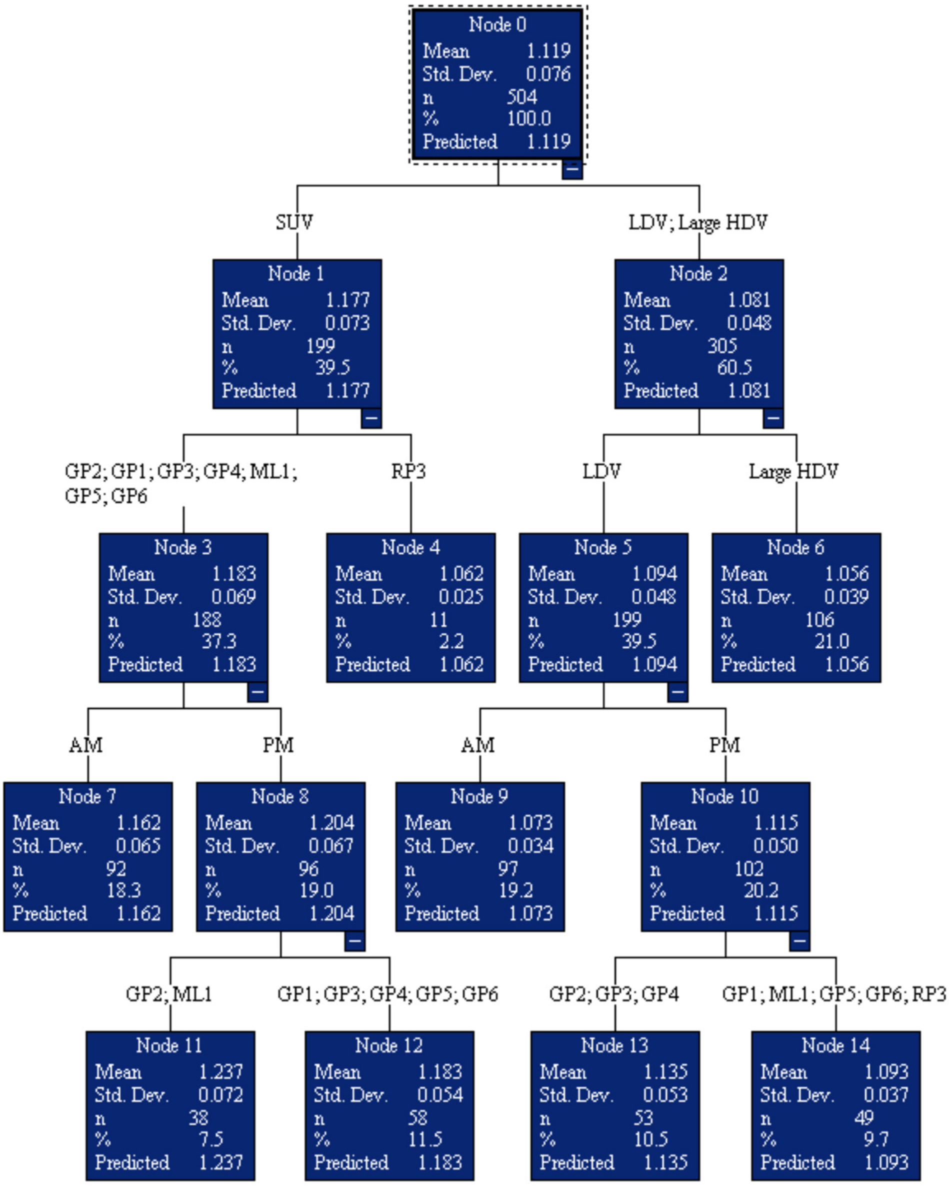


Figure 29 – Regression Tree for Vehicle Types, Excluding Lane Number, Pre-Opening/Extension (Fall 2018)

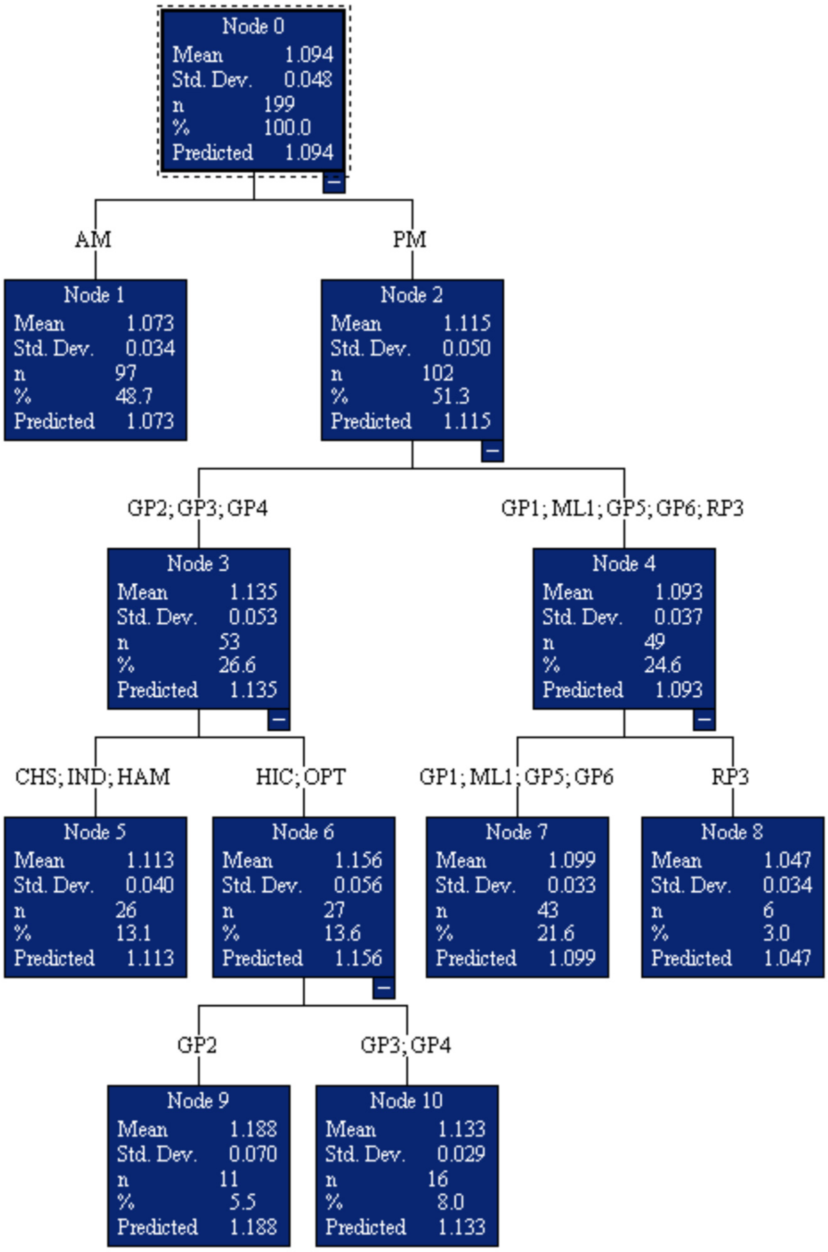


Figure 30 – Regression Tree for Passenger Car LDVs, Excluding Lane Number, Pre-Opening/Extension (Fall 2018)

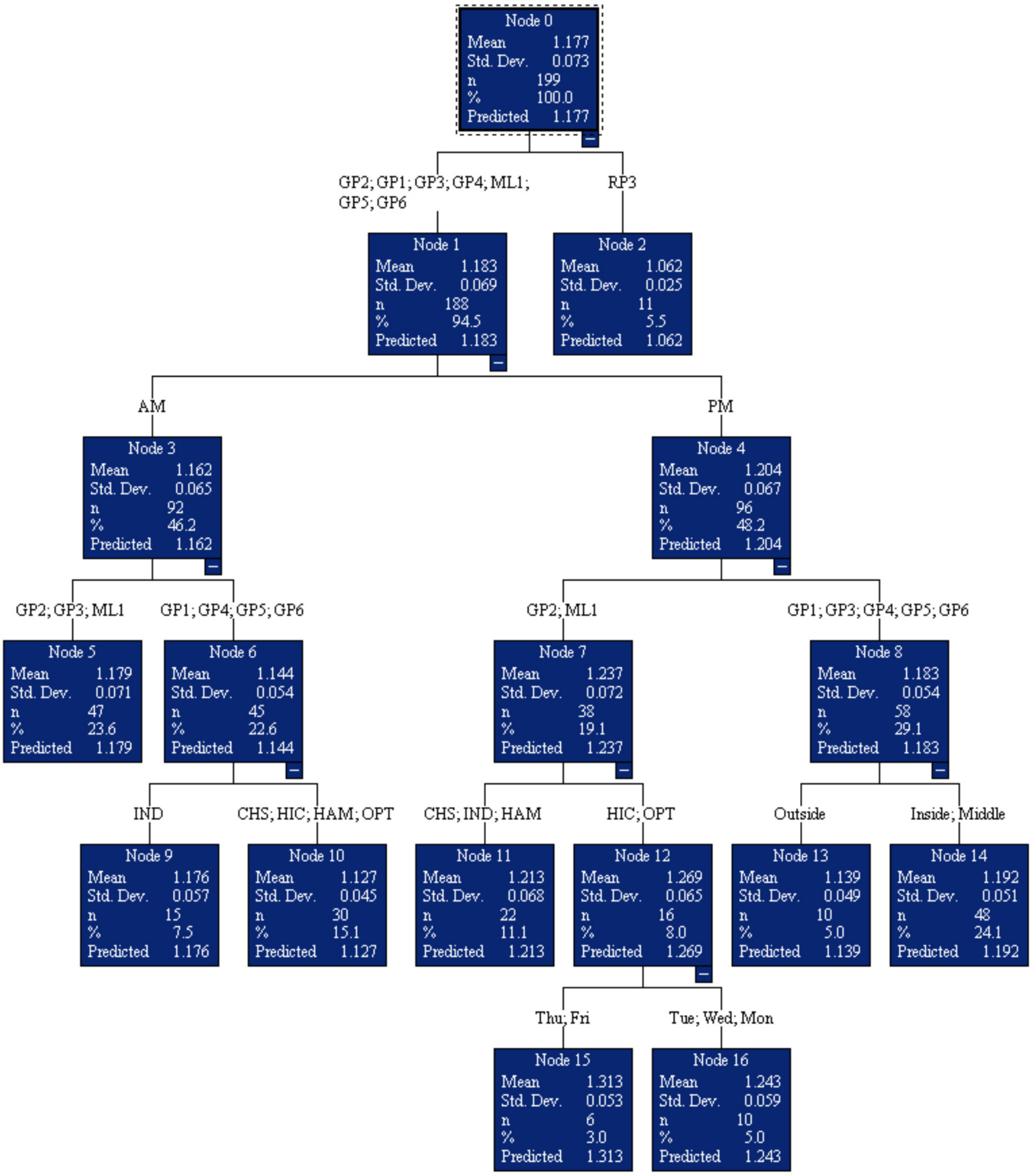


Figure 31 – Regression Tree for SUVs, Excluding Lane Number, Pre-Opening/Extension (Fall 2018)

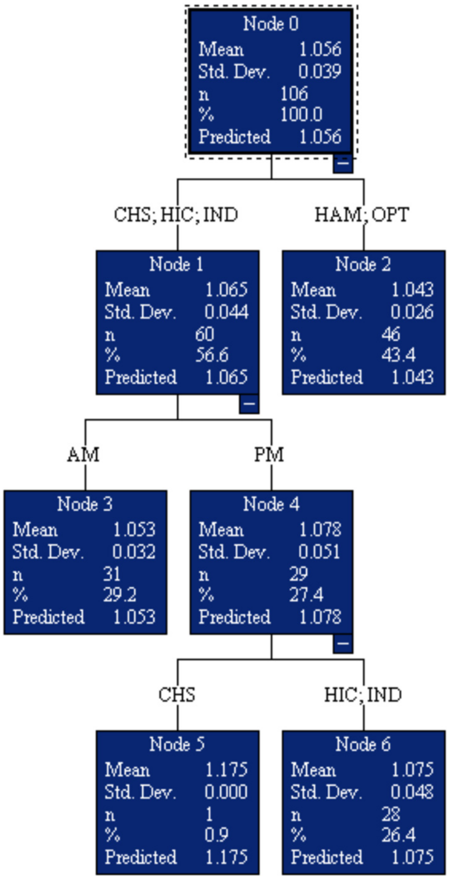


Figure 32 – Regression Tree for Large HDVs, Excluding Lane Number, Pre-Opening/Extension (Fall 2018)

6.3 Summary of the Exploratory Regression Tree Analysis for Occupancy

Overall, the most significant affecting factor in terms of average occupancy, not considering vehicle type, is lane number (a combination of site and relative lane position), followed by AM vs PM. Combining site and relative lane position helps understand the occupancy variability across sites and corridors given the various number of lanes per site (e.g., lane #2 can be the outside lane on a 2-lane facility and a middle lane on a 3+ lane facility). If we consider site, lane type, and lane ID separately, lane type is the most influential factor related to occupancy, and lane position is the second most important. That is, the lane type (GP vs. managed lanes) as well as lane position are both important factors when it comes to vehicle occupancy. The regression tree analyses indicate that the Express Lanes and middle general purpose lanes generally tend to have higher average vehicle occupancy. However, a more detailed analysis of the average occupancy is presented in Chapter 9, which indicates that even though the I-85 Express Lanes have higher occupancy values, the NWC Express Lanes actually have lower occupancy than the parallel GP lanes. This difference may relate in part to facility pricing. Registered high-occupancy carpools (3+ persons) can travel on the I-85 HOT Express Lanes toll-free, while there is no toll exemption on the NWC Express Lanes for high-occupancy carpools. PM peaks generally have higher vehicle occupancy than AM peaks, which is not surprising given that afternoon peak periods also include many more shopping, social, and recreational trips that tend to have much higher occupancy. Day of the week is the least prominent factor among the variables for overall analysis, entering the tree for managed lanes above other variables only when sample sizes were relatively small. However, this is not surprising given that the team purposefully avoided collecting data on Monday mornings and Friday afternoons, which tend to have different travel behavior patterns.

When vehicle type is included as a variable in regression tree analysis, it tends to be the most important factor in explaining vehicle occupancy variability. The vehicle type analysis identifies different factors. For LDVs, the most influential factors are AM vs. PM, followed by lane position, and site/lane type. For SUVs, the most influential factors are lane type, followed by AM vs. PM, lane position, and site. For large HDVs, the most influential factors are site, and then AM vs. PM. However, it is important to note that the findings in this analysis also flow from the correlation between vehicle class and lane use. Hence, while the results indicate that the vehicle type is the most important affecting factor to consider when analyzing occupancy, analysts should keep in mind that there are more SUVs operating on the managed lanes (Guensler, et al., 2013b). Given the results, the research team takes into consideration vehicle type in further analysis of occupancy results, and conducts analysis separately based on vehicle type.

The team did not observe particular lane or site that was distinguishably different from any others, other than the ramp at Hamilton Mill Road has a lower occupancy than other lanes (which seems reasonable, given the distance from the city center and the potential difficulty in forming carpools). This chapter has focused on factors related to vehicle occupancy. More detailed occupancy results will be presented in Chapter 9, after the details related to express bus and vanpool data are covered in Chapters 7 and 8.

7 Express Bus Operations and Impacts on Occupancy

Prior to the implementation of Express Lanes, the corridors and existing carpool lanes experienced significant congestion, preventing larger capacity alternative modes, such as express buses and vanpools from delivering the high level of service that users require to offset inconvenience they experience from using these modes. One of the goals of Express Lane development is to reduce congestion delay and improve travel time reliability for express buses. This chapter reports on the assessment of express bus activity on the corridors and discusses the explicit treatment of express buses in the estimation of vehicle occupancy and calculation of corridor vehicle and person throughput.

7.1 Express Bus Operations

A significant number of persons using the NWC and I-85 corridors during the peak periods are carried by Xpress (operated by the State of Georgia), CobbLinc (a service of Cobb County Transit), and Gwinnett County Transit (GCT). Xpress was originally operated by the Georgia Regional Transportation Authority (GRTA) but, through the course of this study effort, has subsequently been operated by SRTA and now the Atlanta-region Transit Link Authority ATL (the state agency responsible for coordinating regional transit planning and funding among all operators within its jurisdiction). Xpress is now a regional public transportation service provided by ATL, in collaboration with transit partners in Cobb County and Gwinnett County. Xpress also provides convenient connections and free transfers to the Metropolitan Atlanta Rapid Transit Authority (MARTA) bus and rail system. CobbLinc provides local bus service within Cobb County and commuter bus service to and from Downtown and Midtown Atlanta from Monday to Saturday. GCT operates Monday through Friday and includes five routes using the Express Lanes on I-85.

The Xpress bus system includes 27 routes serving 12 metro Atlanta counties, carries more than two million passenger trips annually, and provides morning and afternoon peak-period service from Monday to Friday to commuters working in major employment centers such as Downtown, Midtown, Buckhead, and Perimeter Center (see Figure 33). Xpress buses operate on five main corridors in Atlanta metro area: Northwest corridor (I-75/I-575), West corridor (I-20 West), Northeast corridor (I-85/985 North and GA 400), East corridor (I-20 East/US 78), and South corridor (I-75/I-85 South and US19/41), as also illustrated in Figure 33. As of the dates of data collection for this study, Xpress buses (routes 410, 411, 412, 413, 414, 416, 417, 480, 483 and 490) pass the data collection sites on the NWC and I-85 corridor (all sites except Hamilton Mill Road at I-85). CobbLinc buses (Route 102) pass the Hickory Grove Road at I-75 (Figure 34). GCT Commuter Express (Routes 101, 103, and 110) pass two of the five data collection sites on I-85. The express bus routes passing each site are shown in Table 22 (morning peak) and Table 23 (evening peak).

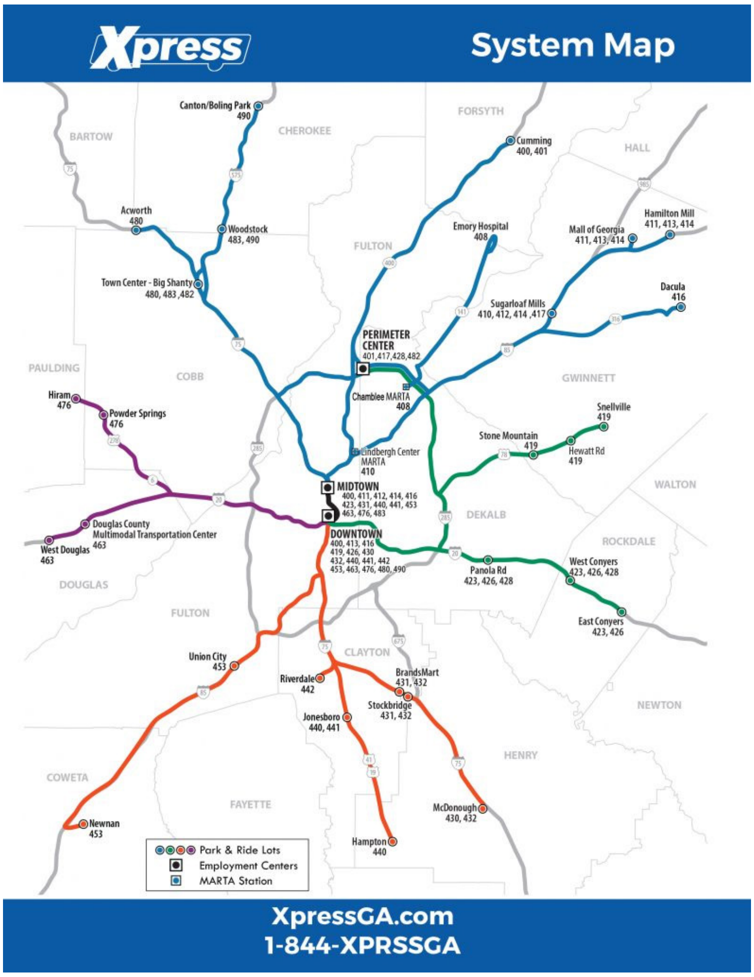


Figure 33 – Xpress System Map (GRTA, Spring 2021)

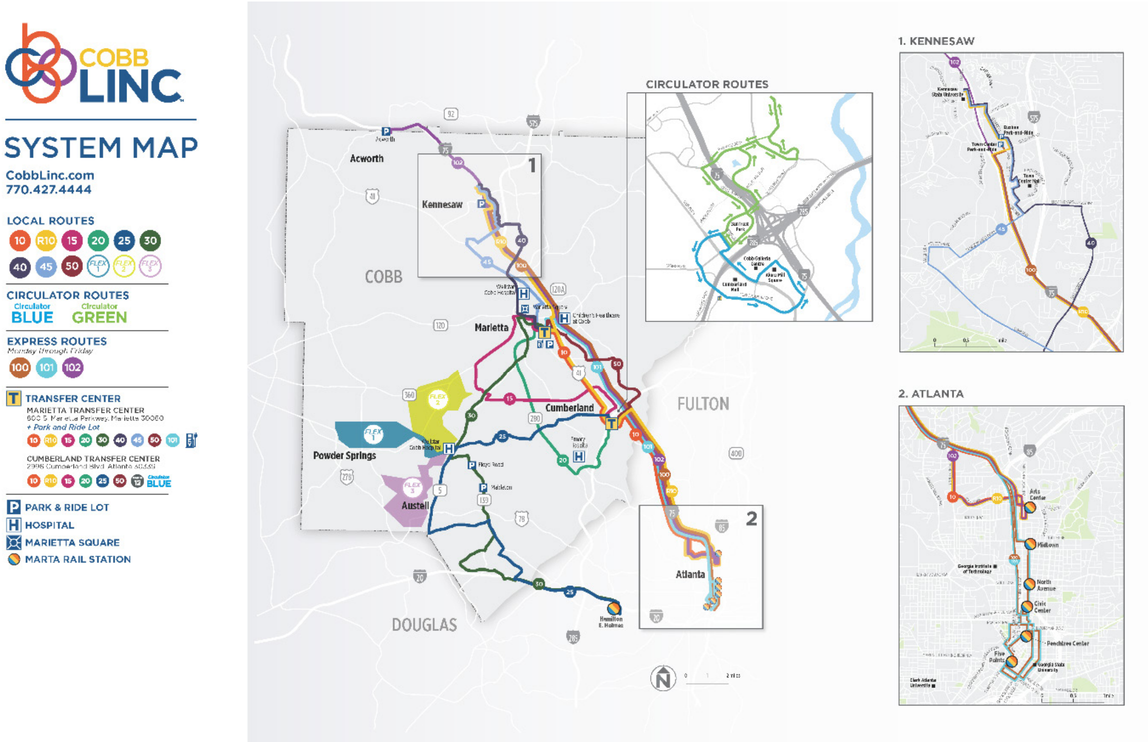


Figure 34 – CobbLinc System Map (CobbLinc, 2021)

Table 22 – Express Bus Routes by Site (Morning Peak), 2018-2020

Site	Xpress	CobbLinc	GCT
Chastain Road at I-575	483, 490	None	None
Hickory Grove Road at I-75	480	102	None
Indian Trail Road at I-85	410, 411, 412, 413, 414, 416	None	101, 103, 110
Old Peachtree Road at I-85	411, 412, 413, 414, 416	None	101
Hamilton Mill Road at I-85	None	None	None

Table 23 – Express Bus Routes by Site (Evening Peak), 2018-2020

Site	Xpress	CobbLinc	GCT
Chastain Road at I-575	483, 490	None	None
Hickory Grove Road at I-75	480	102	None
Indian Trail Road at I-85	410, 411, 412, 413, 414, 416, 417	None	101, 103, 110
Old Peachtree Road at I-85	411, 412, 413, 414, 416	None	101
Hamilton Mill Road at I-85	None	None	None

The calculation of throughput and average vehicle occupancy of express buses (and vanpools) by observation site requires prerequisite knowledge of which routes traverse through each data collection site, as well as how many buses pass the data collectors during the study hours. Because no automatic vehicle location (AVL) data were available at the time of study to provide actual vehicle trace data (i.e., the exact time that each bus passes a data collection site), the team assumed that all buses operate according to their scheduled times (no early departure/arrival) and routes (no detour). All buses were assumed to be running on the Express Lane if there is an Express Lane, and on the outside GP lane if there is no Express Lane (i.e., the NWC sites before the Express Lanes opened) when they passed the data collection sites. The research team assigned the number of buses by route that traversed each observation site by hour, based on schedules for Xpress (Xpress 2021), CobbLinc (CobbLinc, 2021), and GCT Commuter Express (GCT 2021).

The bus route assignments were integrated with Xpress, CobbLinc and GCT ridership data (month-by-month profiles) to provide the average ridership profiles by month to estimate express bus passenger throughput by site. The number of operational days for Xpress buses, CobbLinc buses, and GCT buses were extracted for 2018 and 2019 from August to November (which corresponds to the data collection months), and coupled with average vehicle occupancy profiles. For Xpress buses, the average vehicle occupancy by trip is available for each route. For CobbLinc buses, the average vehicle occupancy was available for each trip (by route) in 2018. However, the 2019 data only contained monthly average ridership profiles (no information on the AM vs. PM peak distribution). The team assumed that in 2019 the CobbLinc ridership ratio for AM vs. PM peak proportion remained the same as it was in 2018. For GCT buses, the average ridership is available for each trip in 2018. However, comparable vehicle occupancy data were not available for 2019. The team assumed that average GCT vehicle occupancy data in the month of November in 2018 applied (the closest month to 2019 that was available).

7.2 Average Vehicle Occupancy Analysis for Express Buses

To estimate the person throughput of buses and vanpools in this project, individual express bus and vanpool trips need to be paired with applicable vehicle occupancy observations in time and space (i.e., for each data collection session). Express bus vehicle occupancy for each route was derived from ridership data provided by the contractors for the Xpress, CobbLinc, and GCT Commuter Express services. Because much of the raw ridership data are available only on a monthly average basis (no day-by-day data), ridership was assumed to be uniform across all weekdays in a month for each route and reflected by the average (total passengers/total trips). In the absence of specific occupancy data for the actual buses traversing through the data collection sites, the analyses in this project have to assume that express bus vehicle occupancy during field data collection at each site during the pre-opening and post-opening periods can be represented by these average ridership values. Hence, occupancy data collected for these buses during the project (recorded as 4+) was replaced by these average vehicle occupancy values.

Figure 35 and Figure 36 present the average vehicle occupancy of Xpress Buses for AM vs. PM peak by site (Hamilton Mill Road was not included because no Xpress route passes this site). The data indicate that all sites have an average vehicle occupancy of more than 26 persons/bus, except for Chastain Road at I-575 where the average vehicle occupancy is 22 persons/bus in the morning and evening peaks. Hamilton Mill Road at I-85 had no express buses passing during the data collection periods. The average express bus vehicle occupancy at Chastain Road increased from 19.0 to 22.0 persons/bus (for both AM and PM peaks), and vehicle occupancy passing the Indian Trail Lilburn Road at I-85 site also slightly increased. The average vehicle occupancy of the other sites decreased slightly. But, changes in average express bus vehicle occupancy are less than 1.5 person/bus, except for Chastain Road at I-575 with an increase of 3.0 persons/bus, which could be due to that the opening of the Express Lane provided shorter and more stable travel time of the Express Buses (attracted more passengers).

The average vehicle occupancy of CobbLinc (applicable to Hickory Grove Road at I-75 only) is presented in Figure 37. The occupancy records provided by the contract indicate that CobbLinc carried a much lower vehicle occupancy (i.e., fewer than 22 persons/bus in the morning peak before opening and fewer than 15 persons/bus for evening peak) compared to Xpress buses (average vehicle occupancy of 26+ persons/bus). It also indicates a large increase in the morning peak vehicle occupancy (from 9.5 to 20.8 persons/bus), and along with an increase for evening peak (from 13.1 to 14.5 persons/bus). The large increase in morning vehicle occupancy was likely due in part to the removal of one morning trip on CobbLinc Route 102 in early 2019 (CobbLinc, 2019). It is also possible that some passengers diverted from Xpress to CobbLinc (park and ride at a different location) once the Express Lanes provided more stable and shorter travel time. Note that the PM vehicle occupancy increase was relatively small (from 13.1 to 14.5 persons/bus) and did not significantly affect corridor passenger throughput. However, the increase in average vehicle occupancy during the morning peak (from 9.5 to 20.8 persons/bus) was much larger and did increase total passenger throughput (more discussion is provided in section 7.5) during the monitored peak period.

Figure 38 and Figure 39 show the average vehicle occupancy of GCT Buses in AM and PM peak by site (Indian Trail/Lilburn Road and Old Peachtree Road at I-85). These average vehicle occupancy levels are lower than on the Xpress lines, and they all decreased after the opening of the I-85 Express Lane Extension. This does not necessarily yield a decrease in person throughput. Vehicle occupancy needs to be coupled with vehicle throughput to evaluate net changes in passenger throughput. Because the 2019 data of GCT average vehicle occupancy was based upon November 2018, access to 2019 data would help improve the assessment with respect to GCT throughput.

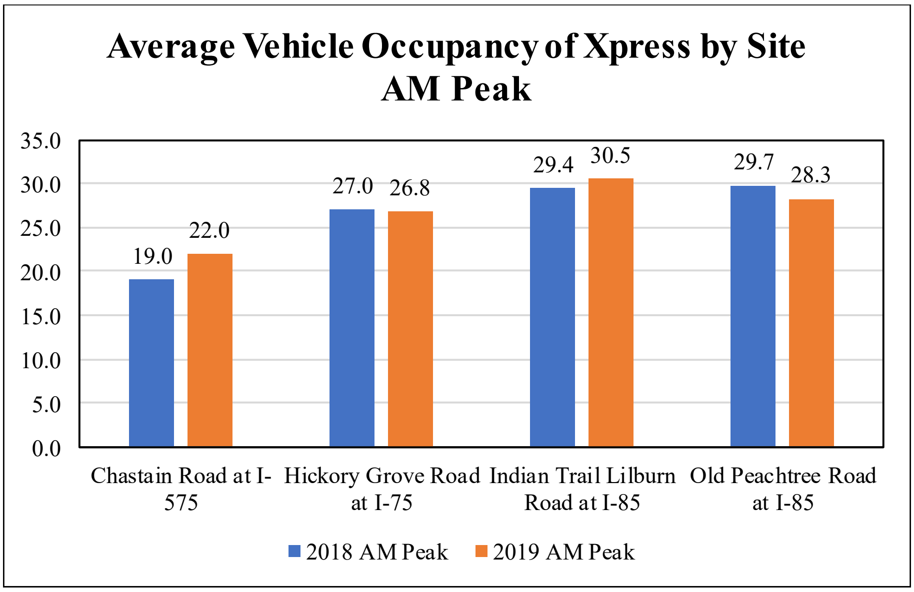


Figure 35 – Average Vehicle Occupancy on Xpress Buses by Site, AM Peak (7-10 AM)

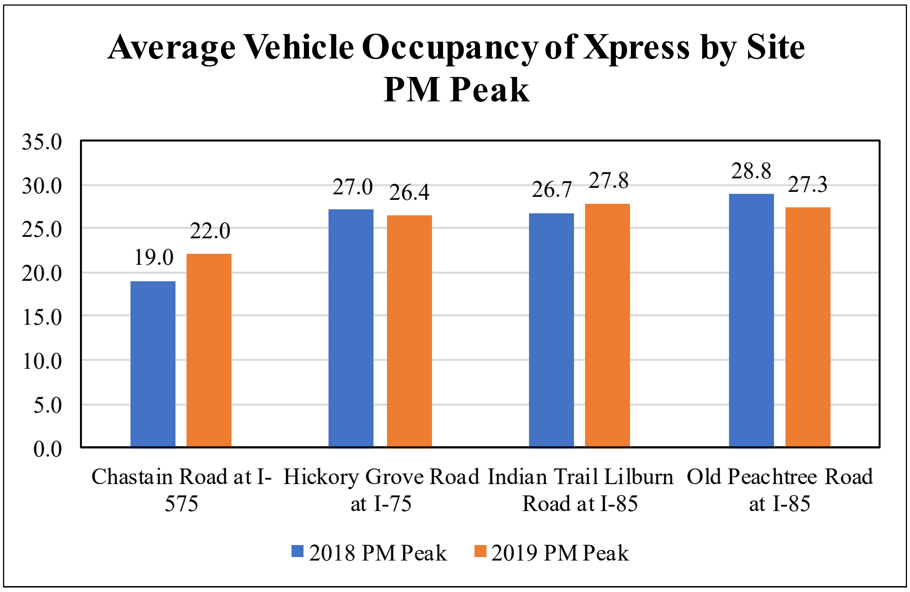


Figure 36 – Average Vehicle Occupancy on Xpress Buses by Site, PM Peak (4-7 PM)

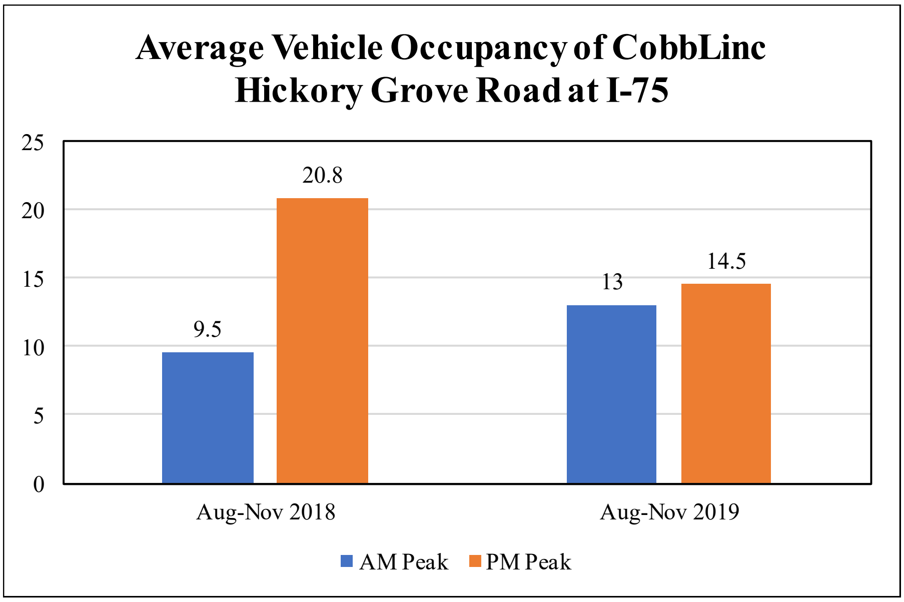


Figure 37 – Average Vehicle Occupancy on CobbLinc Buses, Hickory Grove Road at I-75

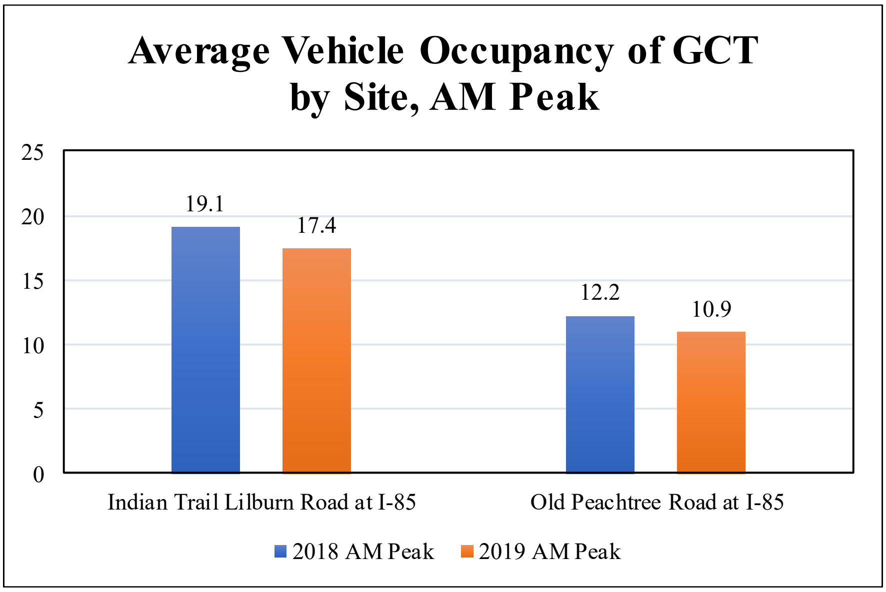


Figure 38 – Average Vehicle Occupancy on GCT Buses by Site, AM Peak (7-10 AM)

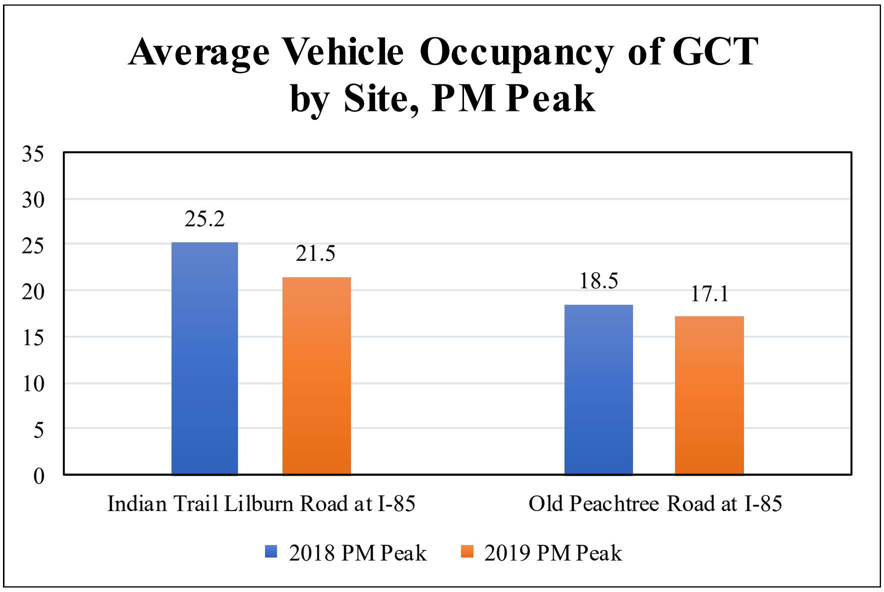


Figure 39 – Average Vehicle Occupancy on GCT Buses by Site, PM Peak (4-7 PM)

7.3 Accounting for Express Bus Passengers in Vehicle Occupancy and Person Throughput Assessment

The vehicle occupancy study conducted in the field and reported in previous chapters involved the collection of joint vehicle classification and vehicle occupancy records. Each record included vehicle class (passenger car LDV, sports utility vehicle, heavy-duty vehicle, bus, vanpool and mini-van, motorcycle, etc.) and occupancy value. Xpress, CobbLinc, and GCT buses, when observed, were always recorded as buses with 4+ occupancy. For every express bus, an occupancy value of 4.5 persons/vehicle was assigned in the steps employed in the regression tree analysis using observed occupancy data. However, express buses typically carry many more than 4.5 persons/vehicle. To properly account for express bus passenger throughput, an additional processing step was added to the person throughput methodology. For each hour, the number of scheduled express buses and corresponding number of persons are estimated via the methods outlined earlier in this chapter. The scheduled express buses (Xpress, CobbLinc, and GCT buses) traversing the corridor are assumed to have been present in the bus throughput on the lane traversed by the express buses. That is, express bus passengers were added to Express Lane whenever an Express Lane was present or to the outside GP lane if no Express Lane was present. For each bus traversing the corridor, 4.5 persons are removed from the person total and the estimated number of persons carried by each bus is added to the person total. The additional processing steps described in this section essentially correct for the inability of field observers to count the actual number of occupants in an express bus. The replacement of field placeholder values with onboard ridership values adjusts the occupancy values for buses, which are also used later in final calculations of average vehicle occupancy.

Occupancy analyses rely on scaling of observed vehicle counts by class and occupancy to total vehicle throughput. However, because the team sampled the vehicles in each lane, not all buses and vans were observed. Hence, it is possible for SRTA to report more buses on the lanes than the field team observed as 4+ buses. Because not all express buses were necessarily observed during the field occupancy data collection (data collectors did not observe and record occupancy data from every vehicle in their assigned lane), a manual adjustment is sometimes required. When the initial person throughput is not large enough to subtract 4.5 times the number of express buses (or vanpools) without leaving 1.0 persons per vehicle in the remaining vehicles, an extra vehicle must be added (with 4.5 persons) to compensate. The number of vehicles that need to be added to prevent negative person throughput for regular buses was generated in Excel (one vehicle added for every -4.5 persons). The team then manually reviewed the cells to ensure that regular buses still contain 1.0 persons. If not, one additional bus or vanpool was added. The only manual adjustments required were adding four 4+ occupancy buses: one 4+ occupancy bus for Hickory Grove Road at I-75 during the morning peak in 2018, one for Hickory Grove Road at I-75 during the evening peak in 2018, and two buses for Old Peachtree Road at I-85 during the morning peak in 2019. Given the traffic volumes observed, the manual adjustments (adding a few vehicles) only had an observable impact (less than a 2% change) on the final estimates of 3+ person occupancy in regular buses and regular vans as these vehicles and their persons were shifted into express bus and vanpool categories.

The number of passengers that need to be added back (i.e., the average vehicle occupancy of the express buses) needs to be consistent with the field occupancy collection, based on the corresponding occupancy data collection dates as described in the previous section. The substitution significantly increases the total number of express bus commuters and average vehicle occupancy, because the average vehicle occupancy of express buses is larger than 20 persons/vehicle. The average occupancy adjusted for the Xpress, CobbLinc, and GCT passengers are shown in Table 24 (AM peak) and Table 25 (PM peak). For I-85 along the existing Express Lane, where many Xpress Bus routes traverse past the collection sites (Indian Trail Lilburn Road and Old Peachtree Road), the impact of express buses on average Express Lane vehicle occupancy can be as large as 0.43 persons/vehicle (increasing average vehicle occupancy from 1.22 to 1.65 persons/vehicle). At other sites, however, the limited number of express buses barely influences the average vehicle occupancy (an increase of less than 0.02 persons/vehicle).

Assigning all express buses to the same lanes (especially for some Express Lanes that have inherently lower volumes than their adjacent GP lanes) results in a significant increase in person throughput for some lanes. Chapter 10 summarizes vehicle and person throughput at the corridor level and will specifically address the number of vehicles and persons served by each mode so that the impact of express buses on overall corridor throughput becomes more evident. The vehicle and passenger throughput for express buses (after substitution) is presented in the following section.

Table 24 – Adjustment of Average Occupancy with Substitution of Express Buses, AM Peak (7-10 AM)

Site	Lane	Year	AVO Before Adjustment	AVO After Adjustment	Impact of Adjustment
Chastain Road at I-575	CHS_GP2	2018	1.14	1.15	0.02
Hamilton Mill Road at I-85	HAM_GP2	2018	1.11	1.11	0.00
Hickory Grove Road at I-75	HIC_GP4	2018	1.11	1.13	0.01
Indian Trail Road at I-85	IND_ML1	2018	1.18	1.48	0.31
Old Peachtree Road at I-85	OPT_ML1	2018	1.22	1.65	0.43
Chastain Road at I-575	CHS_ML1	2019	1.04	1.06	0.01
Hamilton Mill Road at I-85	HAM_GP3	2019	1.01	1.01	0.00
Hickory Grove Road at I-75	HIC_ML1	2019	1.06	1.11	0.05
Indian Trail Road at I-85	IND_ML1	2019	1.12	1.31	0.19
Old Peachtree Road at I-85	OPT_ML1	2019	1.13	1.33	0.21

Table 25 – Adjustment of Average Occupancy with Substitution of Express Buses, PM Peak (4-7 PM)

Site	Lane	Year	AVO Before Adjustment	AVO After Adjustment	Impact of Adjustment
Chastain Road at I-575	CHS_GP2	2018	1.19	1.20	0.02
Hamilton Mill Road at I-85	HAM_GP2	2018	1.17	1.17	0.00
Hickory Grove Road at I-75	HIC_GP3	2018	1.14	1.16	0.02
Indian Trail Road at I-85	IND_ML1	2018	1.30	1.72	0.42
Old Peachtree Road at I-85	OPT_ML1	2018	1.26	1.67	0.41
Chastain Road at I-575	CHS_ML1	2019	1.06	1.08	0.02
Hamilton Mill Road at I-85	HAM_GP2	2019	1.11	1.11	0.00
Hickory Grove Road at I-75	HIC_ML1	2019	1.10	1.19	0.09
Indian Trail Road at I-85	IND_ML1	2019	1.17	1.43	0.26
Old Peachtree Road at I-85	OPT_ML1	2019	1.17	1.46	0.29

7.4 Vehicle Throughput of Express Buses

The total express bus throughput (Xpress, CobbLinc, and GCT) per session (7:00 AM to 10:00 AM for morning peaks, and 4:00 PM to 7:00 PM for evening peaks) is presented in Figure 40 and Figure 41. Express bus throughput per session for each service are illustrated in Figure 42 (Xpress, AM Peak), Figure 43 (Xpress, PM Peak), Figure 44 (CobbLinc, both AM and PM Peak), Figure 45 (GCT, AM Peak), and Figure 46 (GCT, PM Peak). No express buses pass Hamilton Mill Road at I-85 during occupancy data collection hours, according to the Xpress, CobbLinc and GCT schedules, and CobbLinc buses only pass the Hickory Grove Road at I-75 site (no CobbLinc buses pass other sites).

Based upon express bus routes and schedules (i.e., number of trips that pass each site) during both the pre-opening and post-opening observation periods:

- For the I-85 corridor (Indian Trail/Lilburn Road and Old Peachtree Road at I-85), Xpress vehicle throughput is larger than GCT throughput.
- For Hickory Grove Road at I-75, CobbLinc vehicle throughput is larger than Xpress throughput.
- The express bus throughput of I-85 corridor is greater than I-75/I-575 (both the total express buses and the Xpress).
- Hickory Grove Road at I-75 had similar Xpress throughput to Chastain Road at I-575, but larger total express bus throughput given the additional CobbLinc throughput at that site.
- Express bus throughput varies across the study sites and AM vs. PM peaks due to the set routes and schedules.

Due to changes in express bus operations and schedules between the baseline and year 2 observations, there was an increase 26.3 to 34.0 vehicles/session (29.5%) in express bus vehicles passing the Old Peachtree Road at I-85 data collection site during the PM peak. This results from an Xpress vehicle throughput increase from 18.3 to 24.0 vehicles/session (31.4%) and a GCT vehicle throughput increase from 8.0 to 10.0 vehicles/session (25%). The vehicle throughput was derived from the monthly operations by the number of weekdays (averaged across weekdays), and Xpress bus throughput changes were due to the variability between operational days vs. number of weekdays. GCT Commuter express buses also added one more trip to the PM peak. However, given that the update also added trips to Indian Trail Lilburn Road at I-85, and that the throughput of Indian Trail Lilburn Road at I-85 increased only slightly, the impact of the schedule change is relatively small.

The express bus throughput of Hickory Grove Road at I-75 decreased from 11.5 to 10.2 vehicles/session in the evening peaks, with a percent change of approximately 11.3%. The changes for other sites/sessions were all small (especially given that the number of buses is also relatively small), indicating no significant impact of the opening of new facilities on these express buses, which is not surprising given the stable nature of express bus operations.

It is important to note that changes of express bus throughput are not always consistent with changes of person throughput, given the possible changes of average vehicle occupancy that occur concurrently (which can be non-trivial for express buses, as discussed in the previous section). That is, the increase in vehicle throughput of express buses does not necessarily mean an increase in person throughput (presented in the next section), and a decrease in vehicle throughput does not necessarily mean a decrease in person throughput.

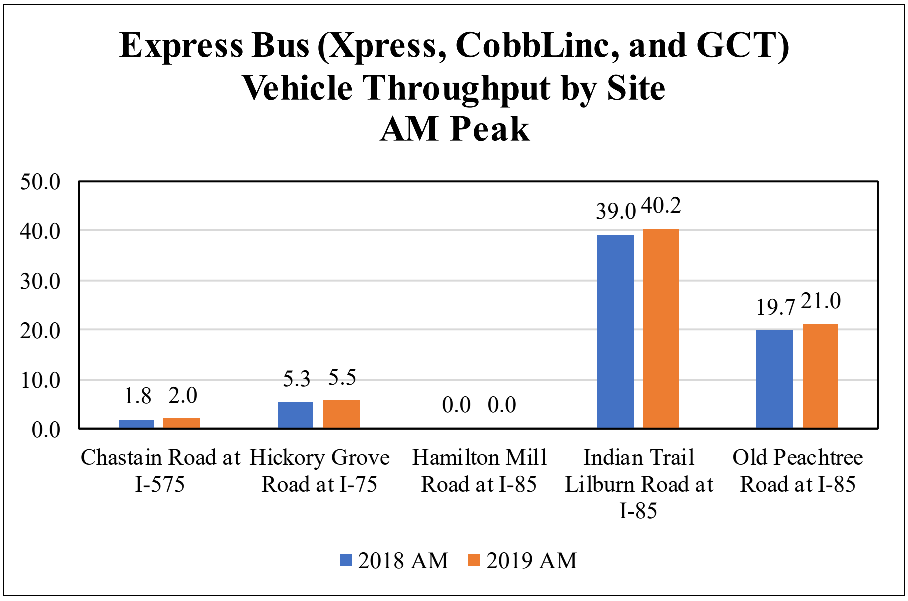


Figure 40 – Express Bus (Xpress plus CobbLinc plus GCT) Vehicle Throughput, AM Peak (7-10 AM), Per Session

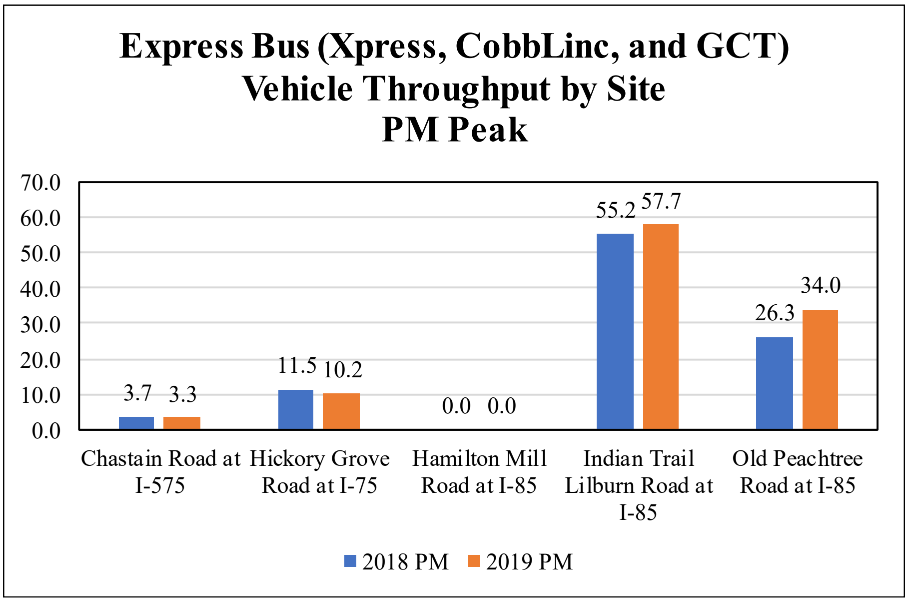


Figure 41 – Express Bus (Xpress plus CobbLinc plus GCT) Vehicle Throughput, PM Peak (4-7 PM), Per Session

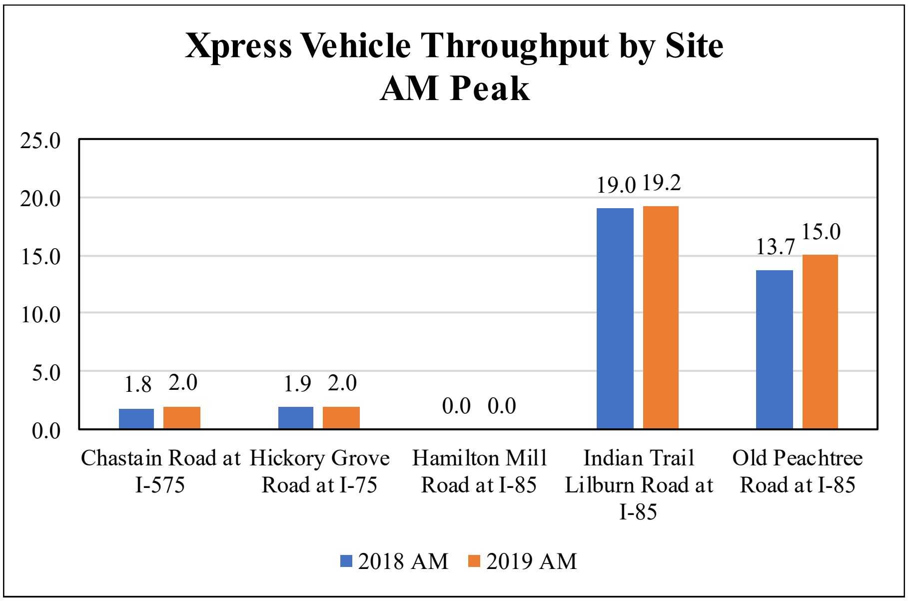


Figure 42 – Xpress Vehicle Throughput by Site, AM Peak (7-10 AM), Per Session

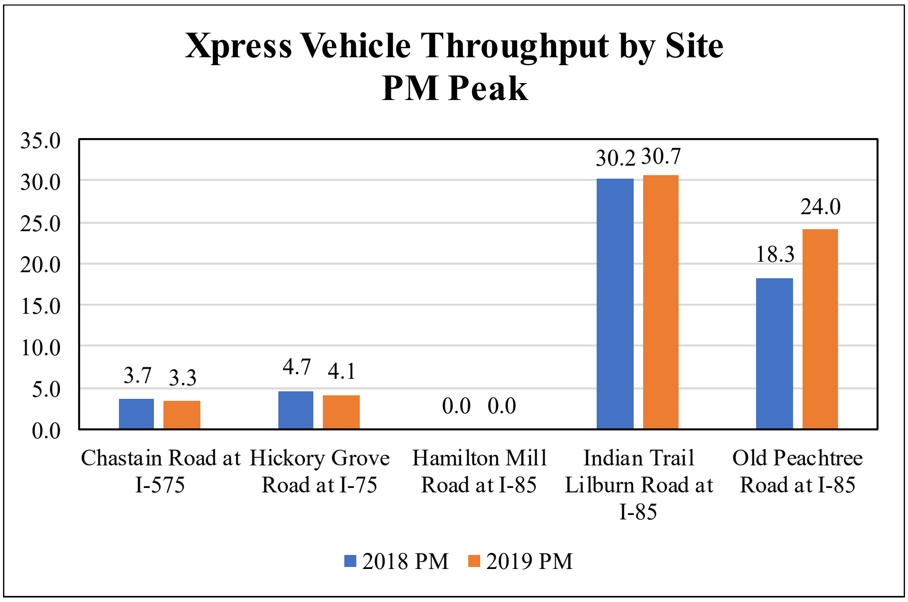


Figure 43 – Xpress Vehicle Throughput by Site, PM Peak (4-7 PM), Per Session

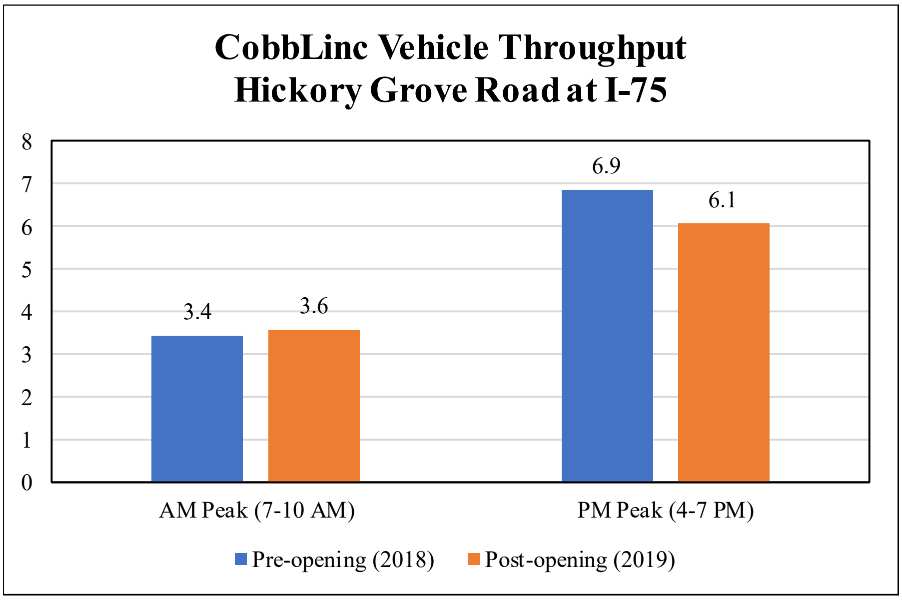


Figure 44 – CobbLinc Vehicle Throughput, Hickory Grove Road at I-75, Per Session

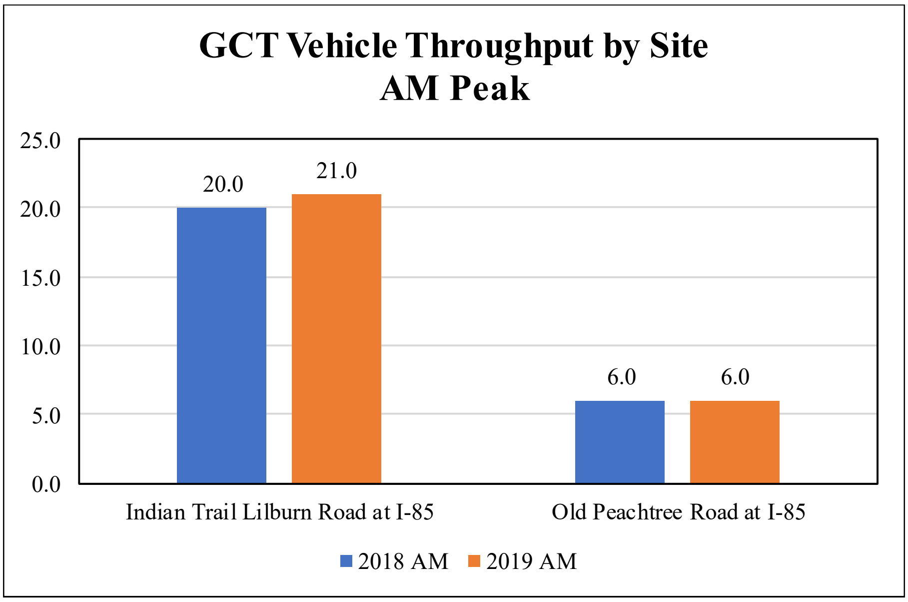


Figure 45 – GCT Bus Vehicle Throughput by Site, AM Peak (7-10 AM)

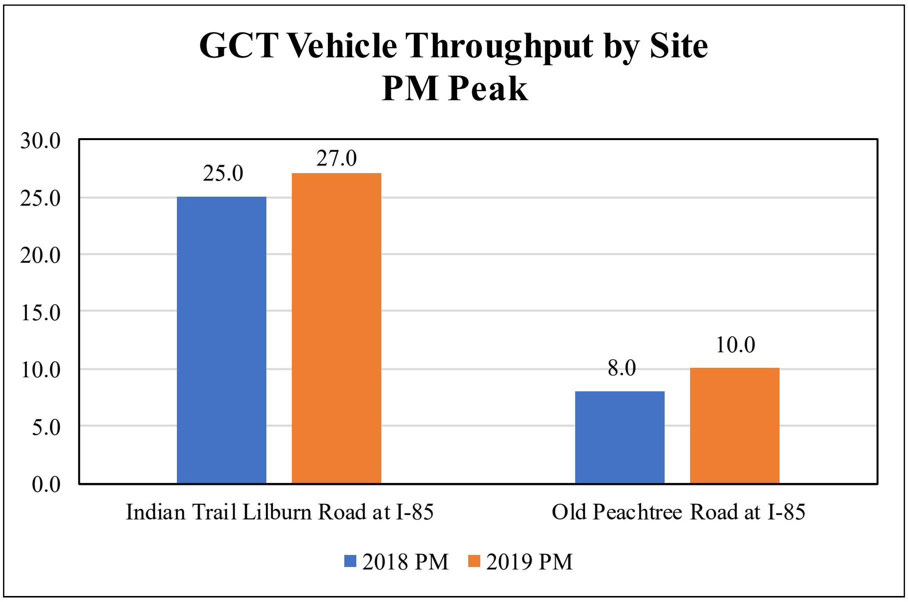


Figure 46 – GCT Bus Vehicle Throughput by Site, PM Peak (4-7 PM)

7.5 Person Throughput of Express Buses

The total express bus person throughput (Xpress, CobbLinc, plus GCT) per session (7:00 AM to 10:00 AM for morning peaks, and 4:00 PM to 7:00 PM for evening peaks) is presented in Figure 47 and Figure 48, and the express bus person throughput per session for each service (Xpress, CobbLinc, and GCT) are illustrated in Figure 49 (Xpress, AM Peak), Figure 50 (Xpress, PM Peak), Figure 51 (CobbLinc, AM and PM Peak), Figure 52 (GCT, AM Peak), and Figure 53 (GCT, PM Peak). No express buses pass Hamilton Mill Road at I-85 during the occupancy data collection hours according to the Xpress, CobbLinc and GCT schedules (zero person throughput). CobbLinc only passes Hickory Grove Road at I-75 (no contribution to person throughput at the other sites). In this section, express bus person throughput rounded to the nearest whole person.

Among the studied sites, express buses carry the largest person throughput at Indian Trail Lilburn Road at I-85, followed by Old Peachtree Road at I-85, and then by Hickory Grove Road at I-75. This is not surprising given the express bus vehicle throughput discussed in the previous section.

A 26.0% increase in express bus person throughput was observed at Chastain Road at I-575 in the AM peak, which is due to both the increased average vehicle occupancy from 19.0 persons/vehicle to 22.0 persons/vehicle (see Figure 35), and the increase in vehicle throughput from approximately 1.8 vehicles/session to 2.0 vehicles/session (8.8% increase). The person throughput at Chastain Road at I-575 for PM peak did not significantly change (from 70 persons/session to 73 persons/session), despite similar changes in average vehicle occupancy in the AM peak (also from 19.0 persons/vehicle to 22.0 persons/vehicle), due to the decrease in vehicle throughput.

The large increase in express bus person throughput at Hickory Grove Road at I-75 for AM peak from approximately 84 persons/session to approximately 130 persons/session (55.7% increase) was predominantly due to the large increase in CobbLinc average vehicle occupancy (from 9.8 to 20.8 persons/vehicle, as shown in Figure 37), given that the vehicle throughput increase is only 4.6%. Given the increase in total person throughput for express buses, the decrease in average vehicle occupancy of Xpress Buses at Chastain Road at I-575 (see Figure 35) may represent passengers that diverted to use CobbLinc after the opening of the Express Lanes. The decrease in the vehicle throughput for the PM peak discussed in the previous section only led to a decrease in express bus person throughput of 4.8%, which indicates the increase in average vehicle occupancy compensated for the vehicle throughput decrease.

No significant changes of person throughput were found for Indian Trail Lilburn Road at I-85, which is not surprising because the site is essentially farther away from where the Express Lane Extension actually occurred. Similarly, there was no significant change at Old Peachtree Road at I-85 for AM peak, which results from a decrease in average vehicle occupancy coupled with the increased vehicle throughput. This could mean an increase in the comfort of Xpress and GCT trips that traverse Old Peachtree Road with lower average vehicle occupancy (more space per passenger). The person throughput increase of 22.5% in the PM peak is similar. Furthermore, less congested and more stable travel times are being experienced during the evening peaks (indicated by an increase in vehicle speeds and an increase in vehicle throughput of 29.5%).

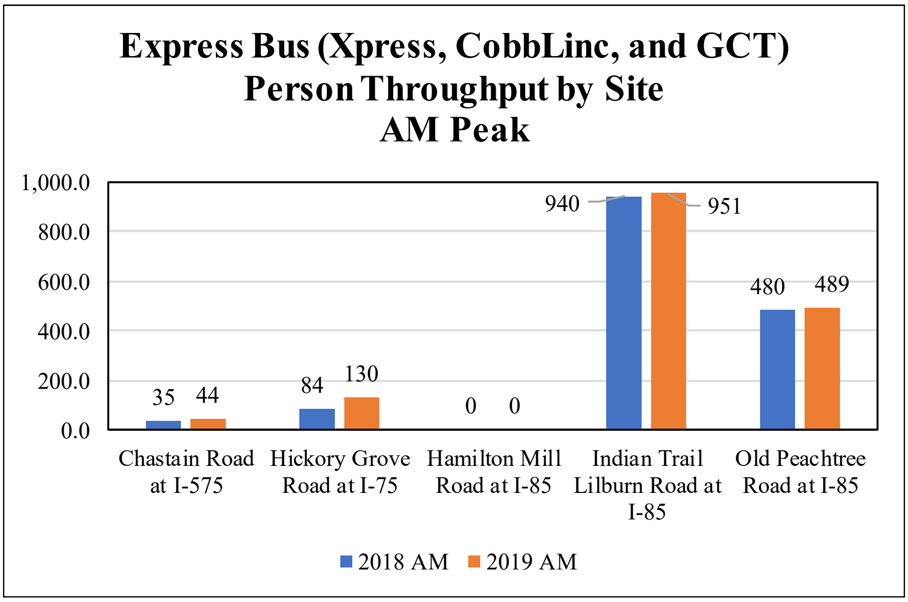


Figure 47 – Express Bus (Xpress plus CobbLinc plus GCT) Passenger Throughput, AM Peak (7-10 AM), Per Session

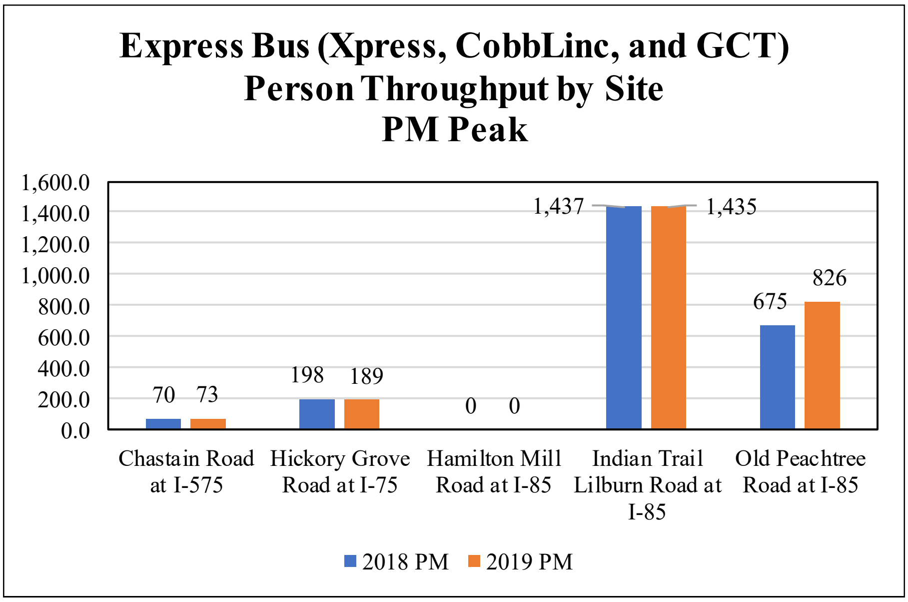


Figure 48 – Express Bus (Xpress plus CobbLinc plus GCT) Passenger Throughput, PM Peak (4-7 PM), Per Session

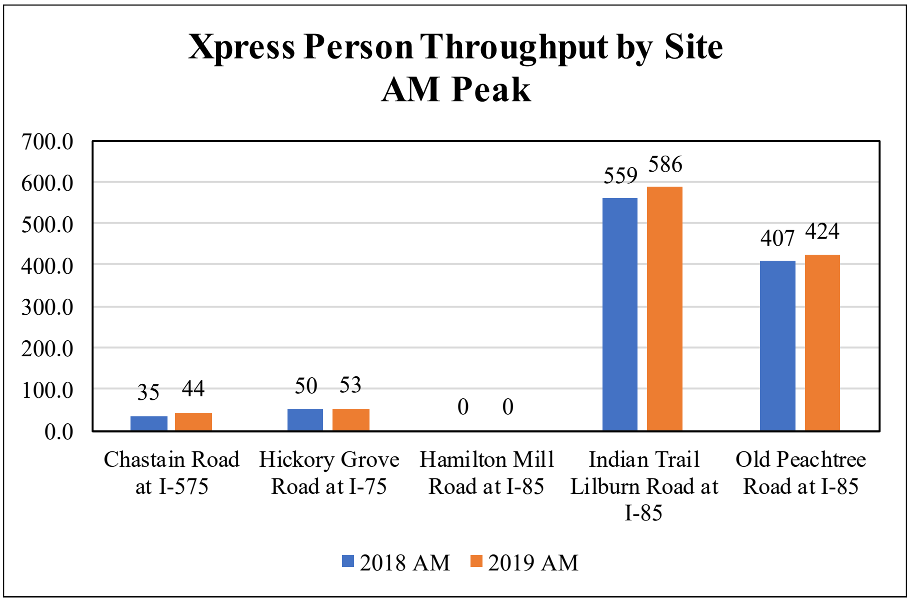


Figure 49 – Xpress Passenger Throughput by Site, AM Peak (7-10 AM), Per Session

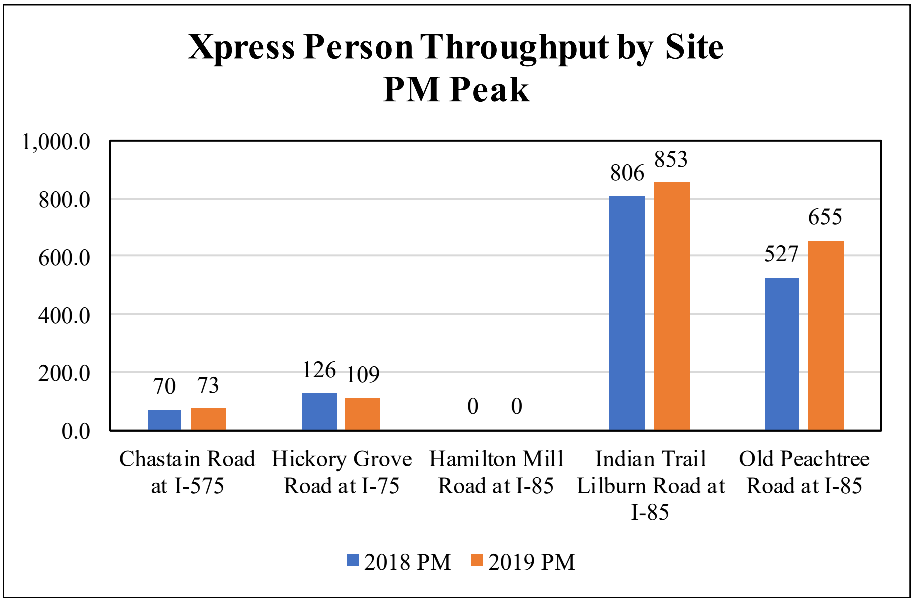


Figure 50 – Xpress Passenger Throughput by Site, PM Peak (4-7 PM), Per Session

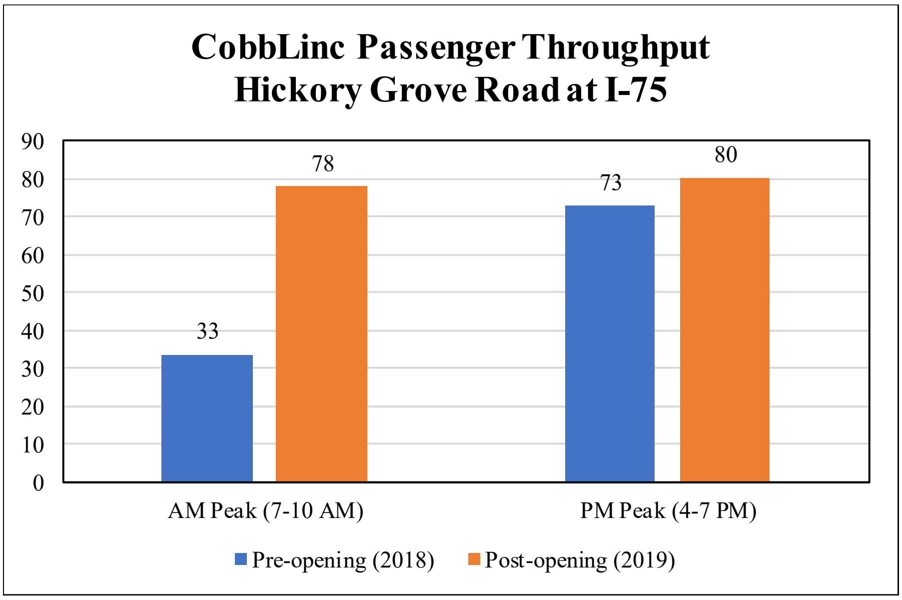


Figure 51 – CobbLinc Passenger Throughput, Hickory Grove Road at I-75, Per Session

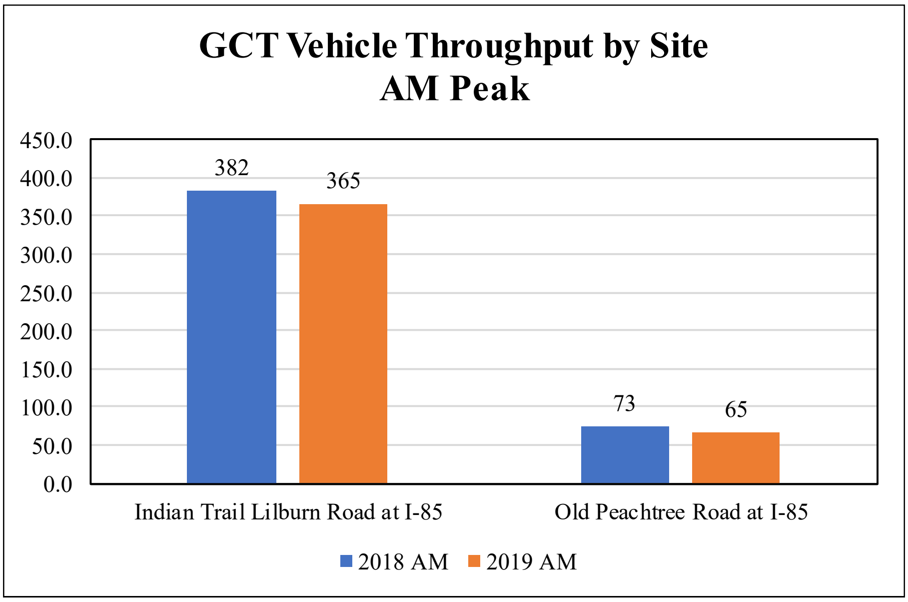


Figure 52 – GCT Bus Passenger Throughput by Site, AM Peak (7-10 AM)

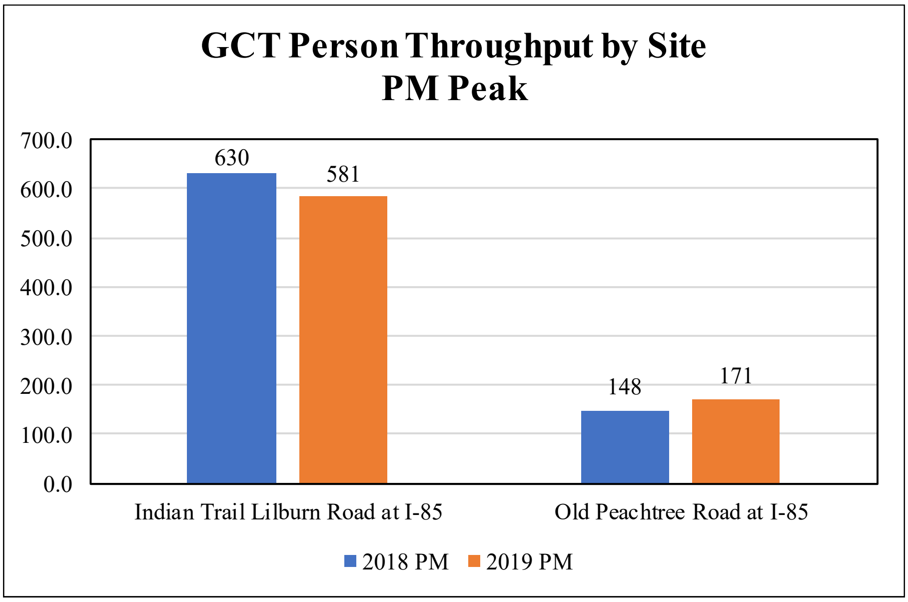


Figure 53 – GCT Bus Passenger Throughput by Site, PM Peak (4-7 PM)

7.6 Express Bus Occupancy and Throughput Discussion

For all practical purposes, express bus vehicle occupancy during the study period remained relatively consistent (slight increase/decrease smaller than or approximates to one person/vehicle) except for Hickory Grove Road at I-75, where the CobbLinc average passengers per vehicle trip increased significantly in the morning peak, which may be due to the removal of the 7:30 AM trip, or due to passengers diverting to CobbLinc. This significant increase could be related to the opening of the Express Lane of NWC.

The data from this study cannot be used to draw specific conclusions regarding the Express Lane's direct or indirect impact on the occupancy of buses and vanpools. Behavioral data collection and analysis would be required to assess how Express Lane performance/price affected traveler decision making. Collection and analysis of more detailed survey data and conduct of panel surveys of bus riders and non-riders is warranted to assess why the changes in travel behavior occurred and to identify factors that need to be addressed if ridership numbers are to increase.

The vehicle and person throughput changes of express buses are shown in Table 26 and Table 27. The number of express buses traversing each observation site was estimated based on the assumption that the travel time was consistent from 2018 to 2019 (due to a lack of better knowledge of the speed changes), and changes in vehicle throughput was due to the variability of operational days across months. However, the team anticipates an increase in vehicle speeds along the corridor after the opening of the Express Lane facilities, and some express buses that used to be running on the outside GP lanes now (which could be the reason for the increase in average vehicle occupancy of NWC express buses) travel faster after the opening. These express buses can now traverse past the observation sites before the peak hour ends. The vehicle throughput increase for PM peaks is not surprising given that the schedules for quite a few evening trips occur near the 7:00 PM end of the evening data collection sessions, while very few morning express bus trips occur near the 10 AM end of the morning data collection sessions. The increase in express bus vehicle throughput at Old Peachtree Road at I-85 relates to the opening of the I-85 Express Lanes Extension, and matches the larger noted impacts on Old Peachtree Road at I-85 than Indian Trail Lilburn Road (further away from the extension). Similar findings were also demonstrated by the demographic analyses in Volume II of this report (Guensler et al. 2021).

Table 26 – Changes of Express Bus (Xpress, CobbLinc and GCT) Vehicle Throughput by Site (AM vs. PM)

Site	AM/PM Peak	Baseline Throughout	Post-Open Throughput	Change in Throughput	Percent Change
Chastain Road at I-575	**AM**	1.8	2.0	0.2	8.8%
Chastain Road at I-575	**PM**	3.7	3.3	-0.3	-9.3%
Hickory Grove Road at I-75	**AM**	5.3	5.5	0.2	4.6%
Hickory Grove Road at I-75	**PM**	11.5	10.2	-1.3	-11.6%
Indian Trail Lilburn Road at I-85	**AM**	39.0	40.2	1.2	3.1%
Indian Trail Lilburn Road at I-85	**PM**	55.2	57.7	2.6	4.7%
Old Peachtree Road at I-85	**AM**	19.7	21.0	1.3	6.6%
Old Peachtree Road at I-85	**PM**	26.3	34.0	7.7	29.5%

An increase in express bus throughput did occur as expected (except for Hickory Grove Road at I-75 for PM peak), but changes in express bus passenger throughput vary across the data collection sites. An increase of approximately 26.0% in express bus passenger throughput was observed at Chastain Road at I-575 for AM peak, 55.7% at Hickory Grove Road at I-75 for AM peak, and 22.5% at Old Peachtree Road at I-85 in the PM peak. Other than these changes, the other increase/decreases are smaller than 2%, as shown in Table 27.

Table 27 – Changes of Express Bus (Xpress, CobbLinc and GCT) Passenger Throughput by Site (AM vs. PM)

Site	AM/PM Peak	Base Throughput	Post-Open Throughput	Change in Throughput	Percent Change
Chastain Road at I-575	**AM**	34.9	44.0	9.1	26.0%
Chastain Road at I-575	**PM**	69.9	73.3	3.5	5.0%
Hickory Grove Road at I-75	**AM**	83.8	130.5	46.7	55.7%
Hickory Grove Road at I-75	**PM**	198.5	189.0	-9.5	-4.8%
Indian Trail Lilburn Road at I-85	**AM**	940.4	951.1	10.7	1.1%
Indian Trail Lilburn Road at I-85	**PM**	1,436.6	1,434.7	-2.0	-0.1%
Old Peachtree Road at I-85	**AM**	480.4	489.4	9.0	1.9%
Old Peachtree Road at I-85	**PM**	674.5	826.0	151.5	22.5%

Over time, express buses are likely to have a larger impact on lane occupancy (anticipating that ridership will continue to grow). As will be seen in the forthcoming passenger throughput assessment chapter (Chapter 10) of this report, express buses represent only about 0.1% of corridor vehicle throughput during the morning peak period, but carry approximately 2.0% of person throughput during peak hours on I-85 (varies across sites). Hence, the express bus mode has the potential to carry an even larger percentage of person throughput on Express Lane corridors. Express buses provide excellent service and capacity, but there may be a need to further improve operational efficiency or implement targeted ridership incentives to increase person throughput.

8 Vanpool Operations and Impacts on Occupancy

A subset of commuters using the NWC and I-85 corridors travel by vanpool. As discussed earlier, one of the goals of the Express Lanes was to provide a high level of service for, and to improve the travel time reliability of, alternative modes. By providing an Express Lane that provides faster and more reliable travel times, individuals may be encouraged to form carpools, take vanpools, and use express bus transit. However, very little research has been undertaken on the effect of Express Lane implementation on vanpool operations. This is likely due to a lack of general data availability on vanpool operations, few surveys of participants, and low vanpool ridership in recent years. This chapter reports on the assessment of vanpool activity pre- and post- the opening of the NWC Express Lanes and I-85 Express Lane Extension.

Private vanpool corporations constitute the majority of vanpools in operation across the country (Deitrick, et al., 2010). Typically, a vanpool ownership company will lease the van to a member of a group that has decided to form a vanpool, and the leaseholder is the individual that serves as the primary driver of the vanpool (on some occasions, companies lease the vehicles on behalf of their employees). The primary driver typically garages the van at their residence. The vanpool group establishes standard morning and afternoon meeting locations (or pickup routes and stops) and sets departure times. Vanpools operate round trip service, from the origin location to a destination location and return. The driver usually communicates with the members of their vanpool only when a problem arises.

8.1 Vanpool Activity

The primary vanpool company in the Atlanta region is Enterprise Vanpools, which acquired the vast majority of vans previously leased by VPSI in the commutershed and used on the I-85 Express Lane corridor. Enterprise owns more than 100 vans that operate in both NWC and I-85 corridors. Vanpool companies have little specific information about each vanpool's travel patterns because vanpools can change any aspect of their travel without informing the leasing company. Enterprise did begin to collect monthly vanpool operation data in recent years. Enterprise monthly operation data for vanpools operated by GRTA, SRTA, and now the ATL alongside Xpress, were provided by SRTA to the study team. Data fields are shown in Table 28.

Table 28 – Information Available in Enterprise Company Vanpool Operation Data

Information Included in Enterprise Company Vanpool Data
Date
Provider
Van Number
Van Capacity
Average Ridership
Operational Days
Number of Paying Riders
Work Bound Total Passenger Trips
Home Bound Total Passenger Trips
Total Passenger Trips
Total Vehicle Revenue Hours
Total Vehicle Revenue Miles
Total Vehicle Miles not Between Residence and Place of Employment
Passenger Miles
Transportation Management Area (TMA)
Federal Riders (Yes/No/Partial)
Origin ZIP Code
Destination ZIP Code
Origin Departure Time
Destination Arrival Time
Destination Departure Time
Origin Arrival Time

Because no detailed information with respect to vanpool travel routes (whether or when a route passes each observation site) is available, the team assigned vanpool routes to each site by employing a shortest path algorithm, based on the origin and destination ZIP Codes, and departure and arrival schedule (at 5-minute resolution) of each route. The link-level travel paths for every vanpool route were used to identify the routes that pass each data collection site, and the time the vanpool was expected to pass the data collectors. The study includes only the routes that pass the data collection sites within the study period (i.e., the morning and evening peak hours when data were collected). These data are employed to assess vanpool throughput, passenger throughput, and average vehicle occupancy by hour.

Because the vanpool profiles are classified by month (and no day-level temporal information is provided, except for the number of operational days), the research team assumed that each vanpool travels every weekday in that month, along the same shortest path routes for every trip. In this chapter, the vanpool vehicle throughput and passenger throughput are based on the vanpool routes for August to November, coupled with the field occupancy collection dates (consistent with the express bus substitution), with each route weighted by its number of operational days (regardless of weekday or not) to calculate the monthly average ridership across routes.

First, the coordinates (longitude and latitude) for route origins and destinations were obtained using the geographic centroid of the origin and destination ZIP Codes. Then, RoadwaySim, a shortest-path simulation platform developed by the research team, was used to generate the travel paths at link-level. The simulator travel speed was set to default roadway speed (70 mph on Interstate highways and 45 mph on major suburb arterials). At each observation site, the highway link IDs where data were collected were manually identified (example of NWC shown in Figure 54), and all paths that traverse these links were considered to pass the observation site. One of the generated paths is shown as an example in Figure 55.

The RoadwaySim output for every vanpool route includes the simulated time that the vanpool is expected to traverse each link, and only the routes that pass the study sites within the study peak hours are selected for future analysis. In this Chapter, route-by-route profiles were classified by occupancy observation site, and then aggregated by session (morning peak 7:00 - 10:00 AM and evening peak 4:00 - 7:00 PM) to assess average vehicle occupancy, vanpool vehicle throughput, and passenger throughput by site.

Figure 54 – Extracted Highway Links of the I-75/575 Northwest Corridor

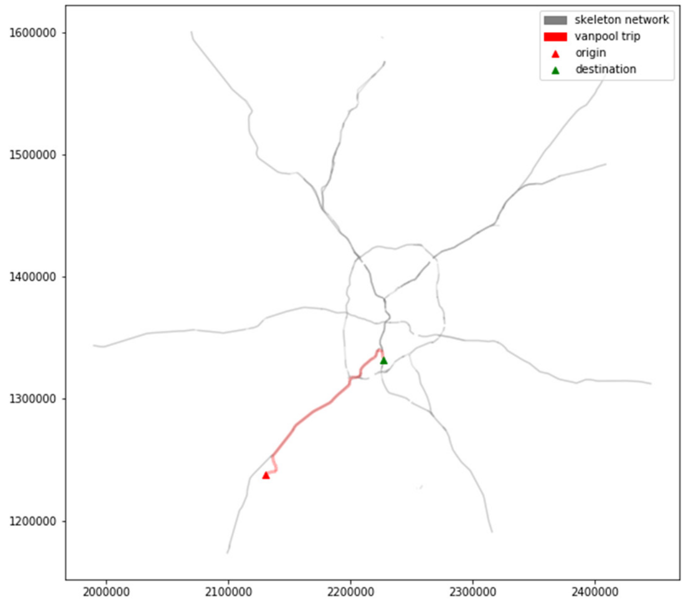


Figure 55 – Travel Path of the Example Vanpool Route Generated by RoadwaySim

8.2 Average Vehicle Occupancy Analysis of Vanpools

The predicted time that each vanpool passed each data collection site, along with other information in the original vanpool operation data (average vehicle throughput by route and number of operational days) served as vanpool ridership data used in calculating average vehicle occupancy. In the field data, each vanpool was identified by vehicle class and an occupancy value of 4+ (or 4.5 persons per van). The number of vanpool passengers to be substituted for the 4.5 value of each vanpool was calculated based on the average vehicle occupancy by month, field data collection date, and site (Figure 56 and Figure 57). A detailed description of the substitution process is provided in Appendix E.

The average vehicle occupancy obtained from field ridership profiles varies across sites, for AM vs. PM peak, and for 2018 vs. 2019. The variability is large, but overall the average ridership of PM peak is larger than AM peak (more passengers join the vanpools on the evening commute back home). It should also be noted that the sites without vanpools could have vanpool routes, but not in the months that the field occupancy collection was conducted. Again, the routes (and vehicle occupancy) vary a lot for each vanpool lease.

Compared with express buses (typically with average vehicle occupancy of 26+ persons/bus), the average vehicle occupancy of vanpools is much smaller, and much closer to 4.5 persons/vehicle (i.e., the number of passengers taken in the substitution). Intuitively, the substitution of actual vanpool vehicle occupancy for the 4.5 persons per vanpool will yield a much smaller change in passenger occupancy and person throughput. In fact, some of the average vehicle occupancy values are actually less than the 4.5 persons/van, meaning the substitution can lead to a slight decrease in average occupancy and vanpool person throughput.

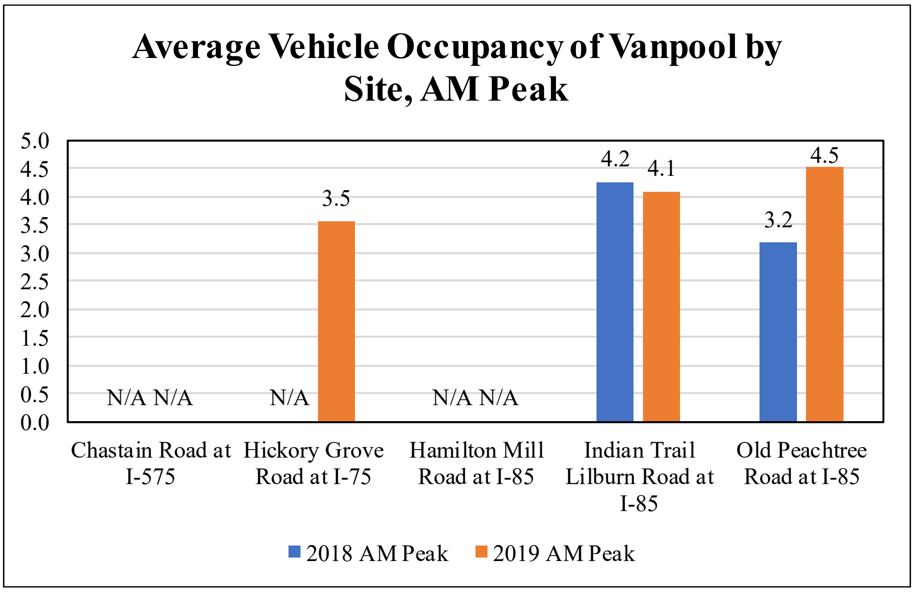


Figure 56 – Average Vanpool Vehicle Occupancy by Site, AM Peak (7-10 AM)

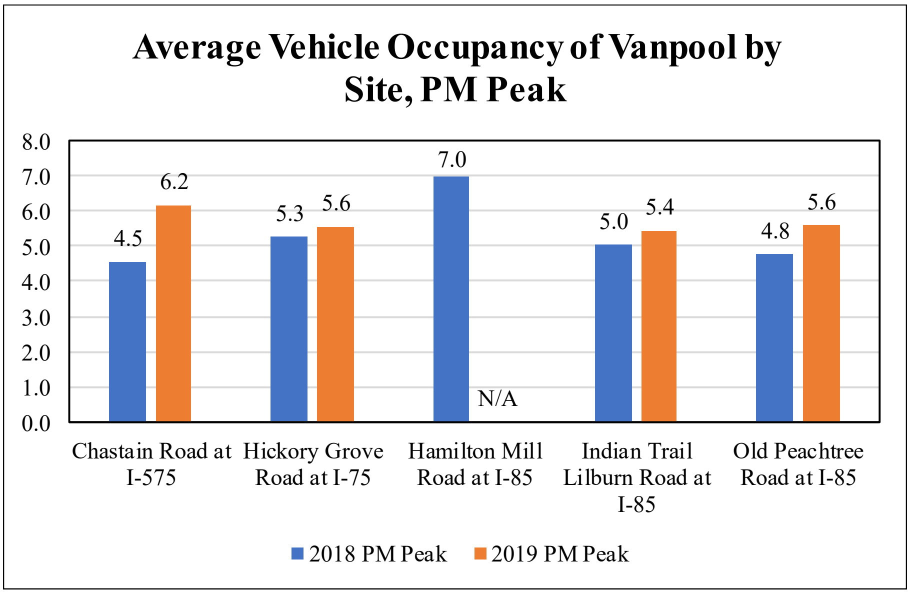


Figure 57 – Average Vanpools Vehicle Occupancy by Site, PM Peak (4-7 PM)

8.3 Accounting for Vanpool Passengers in Vehicle Occupancy and Person Throughput Assessment

The vehicle occupancy data conducted in the field and reported in previous chapters involved the collection of joint vehicle classification and vehicle occupancy records. Each record included vehicle class (passenger car LDV, sports utility vehicle, heavy-duty vehicle, bus, vanpool and mini-van, motorcycle, etc.) and occupancy value. Vanpools, when observed, were always recorded as vanpool/mini-van vehicle class with a 4+ occupancy value. For every vanpool, an occupancy value of 4.5 persons/vehicle was assigned in the steps outlined in previous chapters. However, vanpools can carry more (or fewer, in a few cases) individuals than 4.5 persons/vehicle. To account for vanpool passenger throughput, an additional processing step was added to the person throughput methodology, similar to the express bus correction process. For each site, the vanpools traversing the corridor are assumed to have been present in the van throughput split evenly between the Express Lane (if there is any) and the general purposed lane (even chances of traveling on each lane). For each vanpool traversing the corridor, 4.5 persons are removed from the person total and the estimated number of persons carried by each vanpool is added to the person total.

The number of passengers that need to be added back (i.e., the average vehicle occupancy of the vanpool) needs to be consistent with the field occupancy collection, based on the corresponding collection dates (average vehicle occupancy presented in the previous section). This process increases the total number of commuters and average vehicle occupancy for Old Peachtree Road at I-85 for AM peak in 2019, and all sites for PM peak in 2018 and 2019, except for Hamilton Mill Road at I-85 where no vanpools traversed in 2019, as shown in Table 29 (AM Peak) and Table 30 (PM Peak). Note that the AVO values presented in earlier chapters had not yet not accounted for the actual number of vanpool passengers and express bus passengers (this chapter for vanpools and last chapter for express buses). The adjustments presented in the tables that follow address the difference between recorded vehicle occupancy (4+ persons, or 4.5 persons per vehicle) and the actual occupancy of the vanpools.

The analytical results show that the impacts of vanpools on average vehicle occupancy are not significant (less than 0.01 persons/vehicle), which is not surprising given that there are relatively few vanpools and the actual occupancy is not too far from 4.5 persons per vanpool. The impact of actual express bus occupancy on average occupancy and person throughput is much larger than for vanpools, given that the actual number of bus riders is much higher than 4.5 passenger/bus. Chapters 9 and 10 summarize the final corrected occupancy results and the vehicle and final person throughput on each corridor level.

Table 29 – Adjustment of Average Occupancy with Substitution of Vanpools, AM Peak (7-10 AM)

Lane	Year	AVO Before Adjustment	AVO After Adjustment	Difference (Adjustment Impact)
CHS_GP1	2018	1.10	1.10	0.00
CHS_GP2	2018	1.14	1.14	0.00
CHS_GP1	2019	1.07	1.07	0.00
CHS_GP2	2019	1.14	1.14	0.00
CHS_ML1	2019	1.04	1.04	0.00
HIC_GP1	2018	1.15	1.15	0.00
HIC_GP2	2018	1.11	1.11	0.00
HIC_GP3	2018	1.13	1.13	0.00
HIC_GP4	2018	1.11	1.11	0.00
HIC_GP1	2019	1.11	1.11	0.00
HIC_GP2	2019	1.13	1.13	0.00
HIC_GP3	2019	1.09	1.09	0.00
HIC_GP4	2019	1.09	1.09	0.00
HIC_ML1	2019	1.06	1.06	0.00
HAM_GP1	2018	1.09	1.09	0.00
HAM_GP2	2018	1.11	1.11	0.00
HAM_GP1	2019	1.06	1.06	0.00
HAM_GP2	2019	1.09	1.09	0.00
HAM_GP3	2019	1.01	1.01	0.00
IND_GP1	2018	1.11	1.11	0.00
IND_GP2	2018	1.13	1.13	0.00
IND_GP3	2018	1.13	1.13	0.00
IND_GP4	2018	1.12	1.12	0.00
IND_GP5	2018	1.12	1.12	0.00
IND_ML1	2018	1.18	1.18	0.00
IND_GP1	2019	1.09	1.09	0.00
IND_GP2	2019	1.09	1.09	0.00
IND_GP3	2019	1.09	1.08	0.00
IND_GP4	2019	1.05	1.05	0.00
IND_GP5	2019	1.09	1.09	0.00
IND_ML1	2019	1.12	1.12	0.00
OPT_GP1	2018	1.18	1.18	0.00
OPT_GP2	2018	1.14	1.14	0.00
OPT_GP3	2018	1.07	1.07	0.00
OPT_GP4	2018	1.08	1.08	0.00
OPT_ML1	2018	1.22	1.22	0.00
OPT_GP1	2019	1.07	1.07	0.00
OPT_GP2	2019	1.08	1.08	0.00
OPT_GP3	2019	1.08	1.08	0.00
OPT_GP4	2019	1.08	1.08	0.00
OPT_ML1	2019	1.13	1.12	0.00

Table 30 – Adjustment of Average Occupancy with Substitution of Vanpools, PM Peak (4-7 PM)

Lane	Year	AVO Before Adjustment	AVO After Adjustment	Difference (Adjustment Impact)
CHS_GP1	2018	1.14	1.14	0.00
CHS_GP2	2018	1.19	1.19	0.00
CHS_GP1	2019	1.16	1.16	0.00
CHS_GP2	2019	1.14	1.14	0.00
CHS_ML1	2019	1.06	1.06	0.00
HIC_GP1	2018	1.15	1.15	0.00
HIC_GP2	2018	1.22	1.22	0.00
HIC_GP3	2018	1.14	1.14	0.00
HIC_GP1	2019	1.13	1.13	0.00
HIC_GP2	2019	1.14	1.14	0.00
HIC_GP3	2019	1.12	1.12	0.00
HIC_ML1	2019	1.10	1.10	0.00
HAM_GP1	2018	1.16	1.16	0.00
HAM_GP2	2018	1.17	1.17	0.00
HAM_GP1	2019	1.11	1.11	0.00
HAM_GP2	2019	1.11	1.11	0.00
IND_GP1	2018	1.15	1.15	0.00
IND_GP2	2018	1.14	1.14	0.00
IND_GP3	2018	1.17	1.17	0.00
IND_GP4	2018	1.17	1.17	0.00
IND_GP5	2018	1.12	1.12	0.00
IND_ML1	2018	1.30	1.30	0.00
IND_GP1	2019	1.10	1.10	0.00
IND_GP2	2019	1.11	1.11	0.00
IND_GP3	2019	1.13	1.13	0.00
IND_GP4	2019	1.12	1.12	0.00
IND_GP5	2019	1.12	1.12	0.00
IND_ML1	2019	1.17	1.17	0.00
OPT_GP1	2018	1.26	1.26	0.00
OPT_GP2	2018	1.17	1.17	0.00
OPT_GP3	2018	1.13	1.13	0.00
OPT_GP4	2018	1.12	1.12	0.00
OPT_ML1	2018	1.26	1.26	0.00
OPT_GP1	2019	1.12	1.12	0.00
OPT_GP2	2019	1.11	1.11	0.00
OPT_GP3	2019	1.08	1.08	0.00
OPT_GP4	2019	1.10	1.10	0.00
OPT_ML1	2019	1.17	1.17	0.00

8.4 Vehicle and Person Throughput of Vanpools

The vanpool throughput by site is presented in Figure 58 and Figure 59, and the person throughput of vanpool is shown in Figure 60 and Figure 61. The 2018 vanpool throughput at Hamilton Mill Road at I-85 was not available due to a lack of Georgia NaviGAtor traffic volume data at or near the data collection location (and no vanpools were reported in 2019 at Hamilton Mill Road at I-85). Vanpool variability is heavily dependent on individual leasing. The research team is not surprised that more vanpool passengers move through the I-85 corridor than the I-75/I-575 NWC, given that so few vanpools actually operate on the NWC (incentives designed to encourage vanpool operations in the NWC may be worth pursuing). The Indian Trail Lilburn Road at I-85 has the largest vehicle and person throughput of vanpools, followed by Old Peachtree Road, and then by Hickory Grove Road at I-75. The vanpool throughput findings are similar to the express bus throughput findings with respect to variability across the sites, likely the result of similar commute demands.

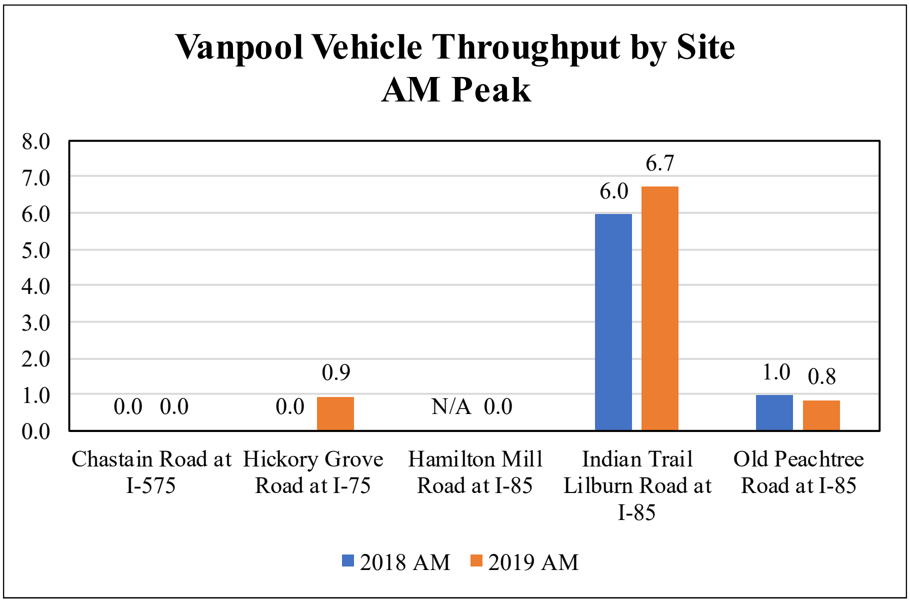


Figure 58 – Vanpool Vehicle Throughput, AM Peak (7-10 AM), Per Session

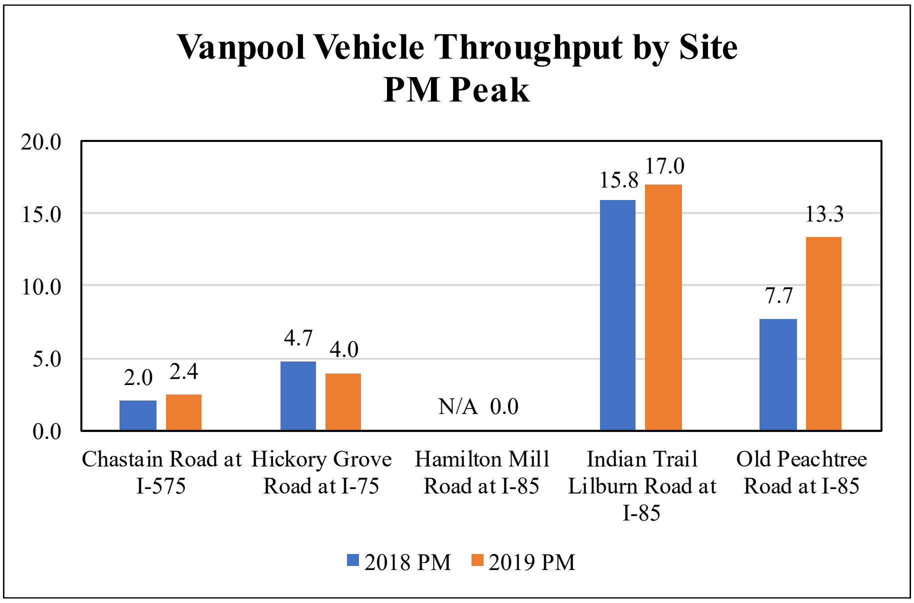


Figure 59 – Vanpool Vehicle Throughput, PM Peak (4-7 PM), Per Session

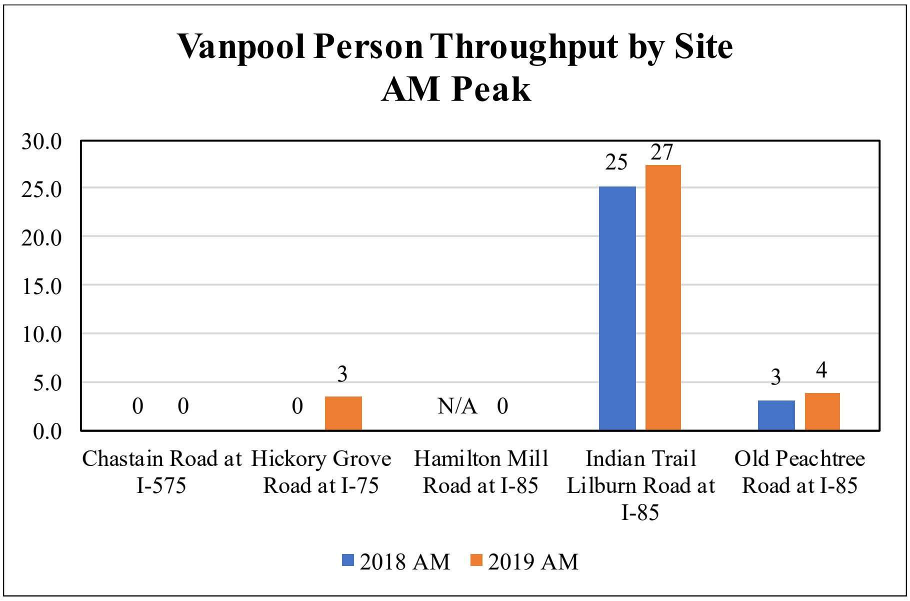


Figure 60 – Vanpool Person Throughput, AM Peak (7-10 AM), Per Session

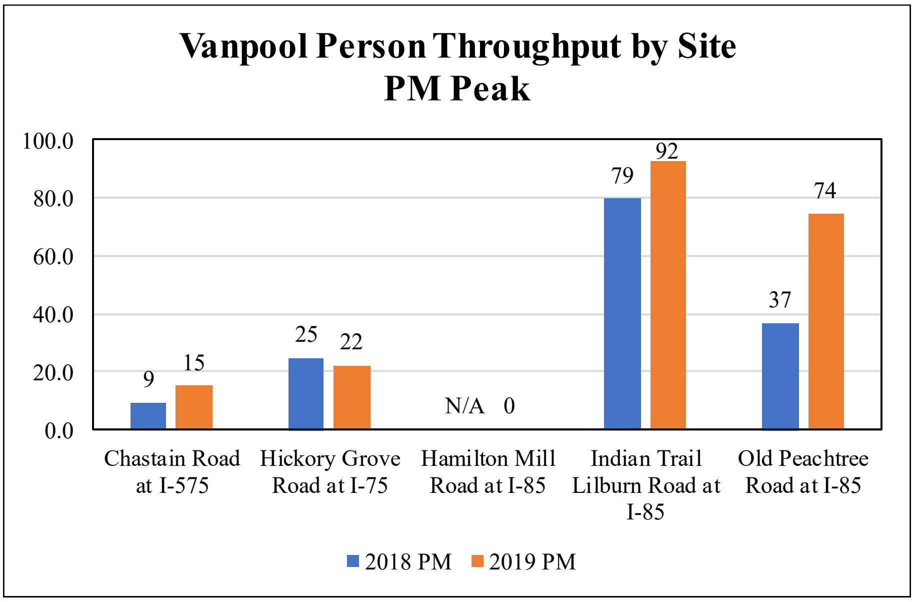


Figure 61 – Vanpool Person Throughput, PM Peak (4-7 PM), Per Session

Although minor increases and decreases in vanpool throughput and occupancy were noted across different sites, the overall vanpool data indicate a small increase in vanpool throughput and vanpool passenger throughput has occurred since the opening of the Express Lanes/Express Lane Extension. However, this increase is very small relative to total corridor throughput. Unfortunately, there is no way to confirm whether the opening of new facilities influenced this minor increase.

8.5 Vanpool Occupancy and Throughput Discussion

As will be seen in the forthcoming vehicle and passenger throughput assessment chapter, vanpools represent less than 0.01% of corridor vehicle throughput during the morning peak period and carry about 0.02% of the person throughput given their higher occupancy (average vehicle occupancy of around 4.0 to 4.5 persons per vanpool). Vanpools represent only about 0.06% of corridor vehicle throughput during the afternoon peak period (about 0.27% of the person throughput) given their higher average occupancy of about 6.0 persons per vehicle.

The increase in vanpool formation and ridership after the implementation was probably smaller than anticipated, considering the high speeds of the Express Lane and the toll exemption for registered vanpools. However, the vanpool business model, where groups first must agree to form a vanpool and then lease the vans, is not necessarily conducive to vanpool formation without implementation of a more proactive planning process. More vanpools will likely form over time; however, there may be a need for a partnership between state and local agencies and the business community to increase vanpool formation and retention.

9 Overall Vehicle Occupancy Results

The research team assembled all of the field-collected vehicle occupancy data in a database for use in calculating person throughput across the corridors, along with the substitution of vanpools and express buses. The 2018 and 2019 data employed in the analyses presented in this Chapter have been QA/QC-processed and adjusted based on the average vehicle occupancy profiles of vanpools and Express buses, as described in Chapter 5, Chapter 7, and Chapter 8. Section 9.1 presents tables summarizing the occupancy data from the Fall 2018 (pre-opening) field efforts (Table 31 through Table 40). Section 9.2 presents the same data in graphic format, broken down by vehicle class (Figure 62 through Figure 75). Section 9.3 presents tables summarizing the occupancy data from the Fall 2019 (post-opening) field efforts (Table 41 through Table 50). Section 9.4 presents the same data in graphic format, broken down by vehicle class (Figure 76 through Figure 93). Section 9.5 compares the before-and-after changes in vehicle occupancy for the NWC and I-85 Extension corridors.

It is important to note the percentages presented in this Chapter are rounded to one decimal place for presentation purposes, and that the rounding was performed separately for each cell. The team did not implement any post-processing to make the rounded percentages sum to 100% (e.g., the sum could be 99.9% or 100.1% instead of 100.0%), so that all numbers match the values in the full Excel spreadsheet that accompanies this report. All sums are actually 100.0% (i.e., any mismatch of sum is due to the rounding in the cells), and the audience can refer to the Excel spreadsheet for verification. Similarly, the occupancy data presented in this Chapter is rounded to two decimal places, and all sums in the spreadsheet total to 100.0%. Any percent changes reported in the tables are based upon the spreadsheet data, not on the rounded values that may appear in adjacent cells.

9.1 Pre-Opening (2018) Observed Occupancy Results

The breakdown of vehicle occupancy observation data for all sites is presented in Table 31 through Table 40. Each lane is coded by site name, lane type, and lane ID (numbered from inside lane to outside lane). Please note that although the ramp of Hamilton Mill Road is marked as Lane 3, it is not directly adjacent to the two general purpose lanes (see the Hamilton Mill Road site plan). The observed average vehicle occupancy results for each lane in the tables are derived by calculating total person throughput (vehicles multiplied by persons/vehicle for each observation class) and dividing by total number of vehicles.

The occupancy of vehicles using the GP lanes is very close to one person per vehicle, given the large percentage of single-occupant vehicles using these lanes. The lanes with the highest percentage of carpooling are either the second lane from the inside, or the third lane from the inside: Chastain Road GP2, Hickory Grove GP2, Hamilton Mill GP2, Indian Trail GP2 (AM)/GP3 (PM), and Old Peachtree GP2. The average occupancy of the two Express Lanes was only slightly higher than their adjacent GP lanes. The occupancy results have not changed markedly from those of I-85 and Center Way in 2010-2012 (Guensler, et al., 2013a).

Table 31 – Observed Occupancy Fraction and AVO by Lane, Chastain Road at I-575, Pre-Opening (2018), AM Peak (7-10 AM)

Occupancy	CHS_GP1	CHS_GP2
1	90.1%	87.4%
2	9.5%	12.0%
3	0.2%	0.4%
4	0.1%	0.1%
4+	0.0%	0.2%
Observed AVO	1.10	1.14
Adjusted AVO	1.10	1.14

Table 32 – Observed Occupancy Fraction and AVO by Lane, Hickory Grove Road at I-75, Pre-Opening (2018), AM Peak (7-10 AM)

Occupancy	HIC_GP1	HIC_GP2	HIC_GP3	HIC_GP4
1	86.0%	89.2%	87.6%	89.2%
2	13.4%	10.5%	11.9%	10.4%
3	0.4%	0.2%	0.2%	0.3%
4	0.1%	0.0%	0.0%	0.0%
4+	0.0%	0.2%	0.2%	0.1%
Observed AVO	1.15	1.11	1.13	1.11
Adjusted AVO	1.15	1.11	1.15	1.11

Table 33 – Observed Occupancy Fraction and AVO by Lane, Hamilton Mill Road at I-85 at I-85, Pre-Opening (2018), AM Peak (7-10 AM)

Occupancy	HAM_GP1	HAM_GP2
1	91.6%	89.7%
2	8.0%	9.9%
3	0.2%	0.4%
4	0.0%	0.0%
4+	0.2%	0.0%
Observed AVO	1.09	1.11
Adjusted AVO	N/A	N/A

Table 34 – Observed Occupancy Fraction and AVO by Lane
Indian Trail/Lilburn Road at I-85 at I-75, Pre-Opening (2018), AM Peak (7-10 AM)

Occupancy	IND_ML1	IND_GP2	IND_GP3	IND_GP4	IND_GP5	IND_GP6
1	86.7%	89.7%	87.8%	87.3%	88.4%	88.7%
2	11.1%	9.9%	11.8%	12.3%	11.1%	10.9%
3	0.7%	0.2%	0.4%	0.3%	0.4%	0.3%
4	0.2%	0.1%	0.0%	0.1%	0.1%	0.1%
4+	1.4%	0.1%	0.0%	0.1%	0.0%	0.0%
Observed AVO	1.18	1.11	1.13	1.13	1.12	1.12
Adjusted AVO	1.31	1.11	1.13	1.13	1.12	1.12

Table 35 – Observed Occupancy Fraction and AVO by Lane,
Old Peachtree Road at I-85, Pre-Opening (2018), AM Peak (7-10 AM)

Occupancy	OPT_ML1	OPT_GP2	OPT_GP3	OPT_GP4	OPT_GP5
1	82.7%	83.4%	86.4%	93.2%	92.0%
2	15.1%	15.6%	13.1%	6.4%	7.6%
3	0.5%	0.7%	0.3%	0.1%	0.3%
4	0.0%	0.1%	0.0%	0.1%	0.1%
4+	1.7%	0.2%	0.1%	0.1%	0.0%
Observed AVO	1.22	1.18	1.14	1.07	1.08
Adjusted AVO	1.50	1.18	1.14	1.07	1.08

Table 36 – Observed Occupancy Fraction and AVO by Lane,
Chastain Road at I-575, Pre-Opening (2018), PM Peak (4-7 PM)

Occupancy	CHS_GP1	CHS_GP2
1	87.1%	83.2%
2	12.0%	15.6%
3	0.7%	0.9%
4	0.1%	0.2%
4+	0.1%	0.2%
Observed AVO	1.14	1.19
Adjusted AVO	1.14	1.20

Table 37 – Observed Occupancy Fraction and AVO by Lane, Hickory Grove Road at I-75, Pre-Opening (2018), PM Peak (4-7 PM)

Occupancy	HIC_GP1	HIC_GP2	HIC_GP3
1	86.3%	80.4%	86.8%
2	13.1%	17.9%	12.4%
3	0.4%	1.4%	0.5%
4	0.1%	0.1%	0.1%
4+	0.1%	0.2%	0.2%
Observed AVO	1.15	1.22	1.14
Adjusted AVO	1.15	1.22	1.19

Table 38 – Observed Occupancy Fraction and AVO by Lane, Hamilton Mill Road at I-85, Pre-Opening (2018), PM Peak (4-7 PM)

Occupancy	HAM_GP1	HAM_GP2
1	85.5%	85.2%
2	13.6%	13.5%
3	0.7%	1.0%
4	0.1%	0.2%
4+	0.1%	0.1%
Observed AVO	1.16	1.17
Adjusted AVO	N/A	N/A

Table 39 – Observed Occupancy Fraction and AVO by Lane, Indian Trail/Lilburn Road at I-85, Pre-Opening (2018), PM Peak (4-7 PM)

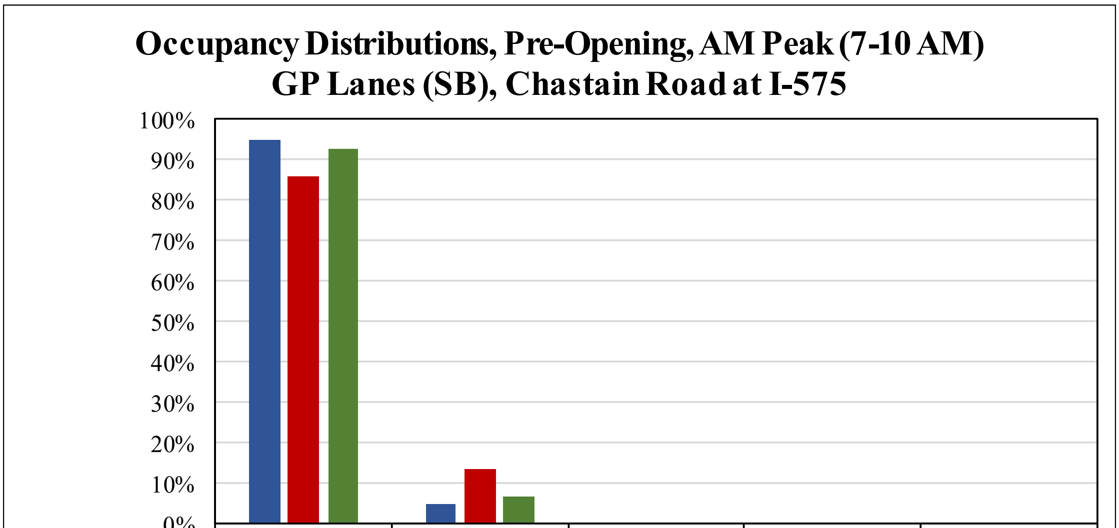
Occupancy	IND_ML1	IND_GP2	IND_GP3	IND_GP4	IND_GP5	IND_GP6
1	79.8%	85.9%	86.3%	84.7%	83.5%	88.7%
2	16.0%	13.5%	13.2%	14.3%	15.8%	10.9%
3	0.4%	0.5%	0.3%	0.8%	0.4%	0.3%
4	0.4%	0.1%	0.1%	0.2%	0.1%	0.0%
4+	3.3%	0.0%	0.1%	0.1%	0.1%	0.1%
Observed AVO	1.30	1.15	1.14	1.17	1.17	1.12
Adjusted AVO	1.55	1.15	1.14	1.17	1.17	1.12

Table 40 – Observed Occupancy Fraction and AVO by Lane, Old Peachtree Road at I-85, Pre-Opening (2018), PM Peak (4-7 PM)

Occupancy	OPT_ML1	OPT_GP2	OPT_GP3	OPT_GP4	OPT_GP5
1	80.7%	76.9%	83.9%	87.6%	88.7%
2	16.0%	20.8%	15.0%	11.9%	10.6%
3	0.9%	1.9%	0.8%	0.3%	0.6%
4	0.4%	0.3%	0.2%	0.1%	0.1%
4+	2.0%	0.1%	0.1%	0.1%	0.1%
Observed AVO	1.26	1.26	1.17	1.13	1.12
Adjusted AVO	1.43	1.26	1.17	1.13	1.12

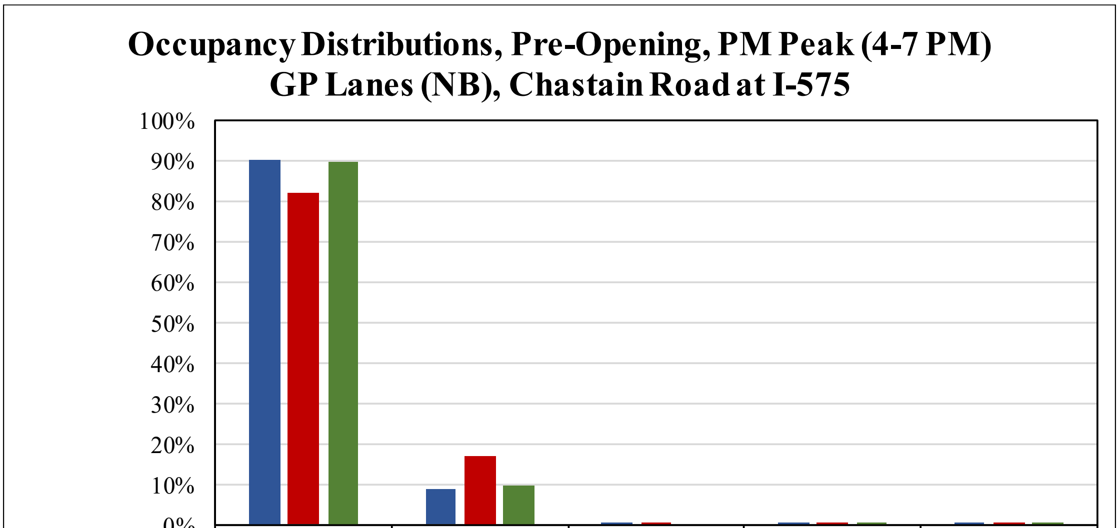
9.2 Pre-Opening (2018) Observed Occupancy Results by Vehicle Class

The research team further disaggregated occupancy observations by vehicle class, and the distributions of passenger car LDVs, SUVs, and large HDVs (GP lanes only). Occupancy results by vehicle classes are shown in Figure 62 through Figure 75. Generally, large HDVs include only the driver, yielding the highest SOV percentage of the vehicle classes. Passenger car LDVs have the second highest SOVs fractions, and SUVs have the lowest among the three vehicle classes. Not surprisingly, a comparison of AM and PM sessions indicates that more carpools are on the road during PM peaks for all of the vehicle classes, which is not surprising to the team given that morning commuters are more time-sensitive and are less likely to carpool in sacrifice of travel time. For I-85, the Express Lanes did not denote significantly different patterns regarding the SOV fractions with the GP lanes.



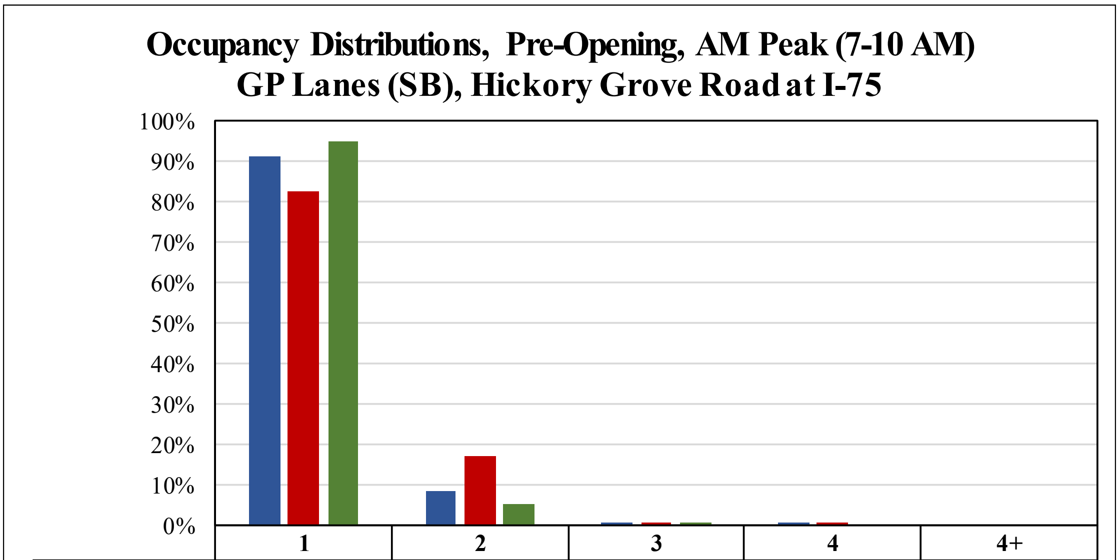
	1	2	3	4	4+
Passenger Car	94.9%	4.9%	0.2%	0.0%	0.0%
SUV	85.7%	13.8%	0.3%	0.1%	0.0%
Large HDV	92.6%	7.0%	0.2%	0.2%	0.0%

**Figure 62 – Vehicle Occupancy Distribution,
Chastain Road at I-575, Pre-Opening (2018), AM Peak (7-10 AM), GP Lanes**



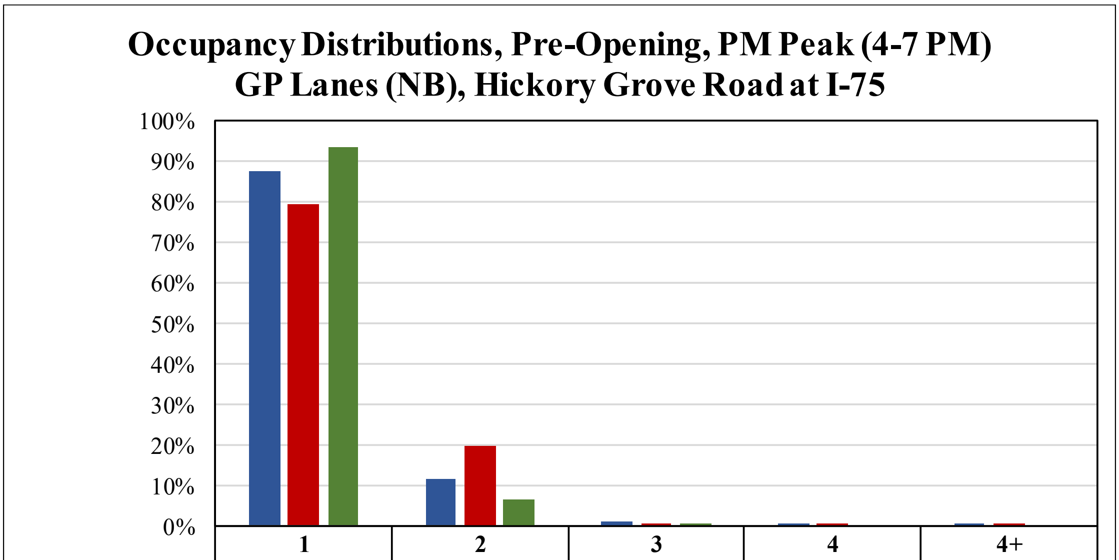
	1	2	3	4	4+
Passenger Car	90.4%	9.0%	0.5%	0.1%	0.0%
SUV	82.0%	16.9%	0.9%	0.2%	0.0%
Large HDV	89.9%	9.7%	0.0%	0.2%	0.2%

**Figure 63 – Vehicle Occupancy Distribution,
Chastain Road at I-575, Pre-Opening (2018), PM Peak (4-7 PM), GP Lanes**



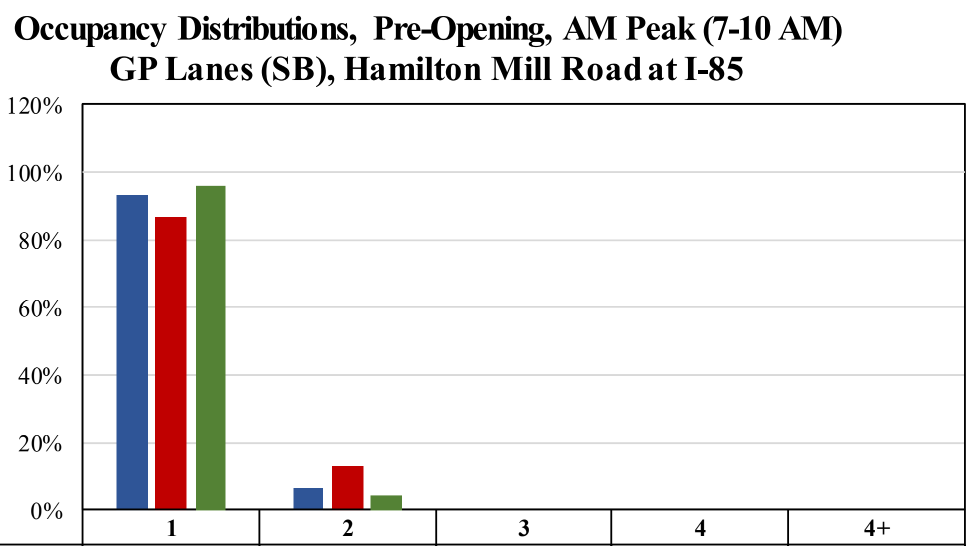
	1	2	3	4	4+
Passenger Car	91.0%	8.4%	0.5%	0.1%	0.0%
SUV	82.5%	17.2%	0.2%	0.1%	0.0%
Large HDV	95.0%	5.0%	0.0%	0.0%	0.0%

Figure 64 – Vehicle Occupancy Distribution,
Hickory Grove Road at I-75, Pre-Opening (2018), AM Peak (7-10 AM), GP Lanes



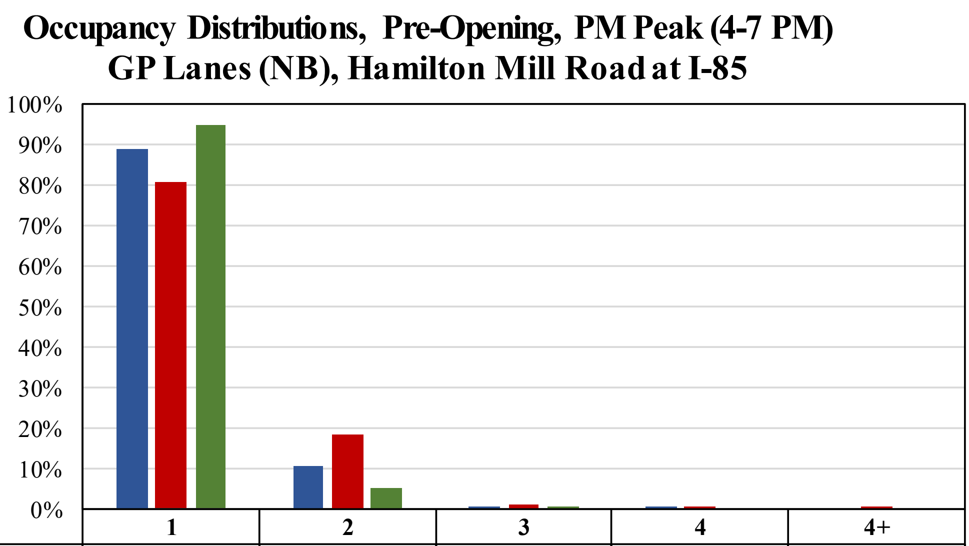
	1	2	3	4	4+
Passenger Car	87.3%	11.4%	1.1%	0.2%	0.0%
SUV	79.4%	19.7%	0.8%	0.1%	0.0%
Large HDV	93.3%	6.7%	0.0%	0.0%	0.0%

Figure 65 – Vehicle Occupancy Distribution,
Hickory Grove Road at I-75, Pre-Opening (2018), PM Peak (4-7 PM), GP Lanes



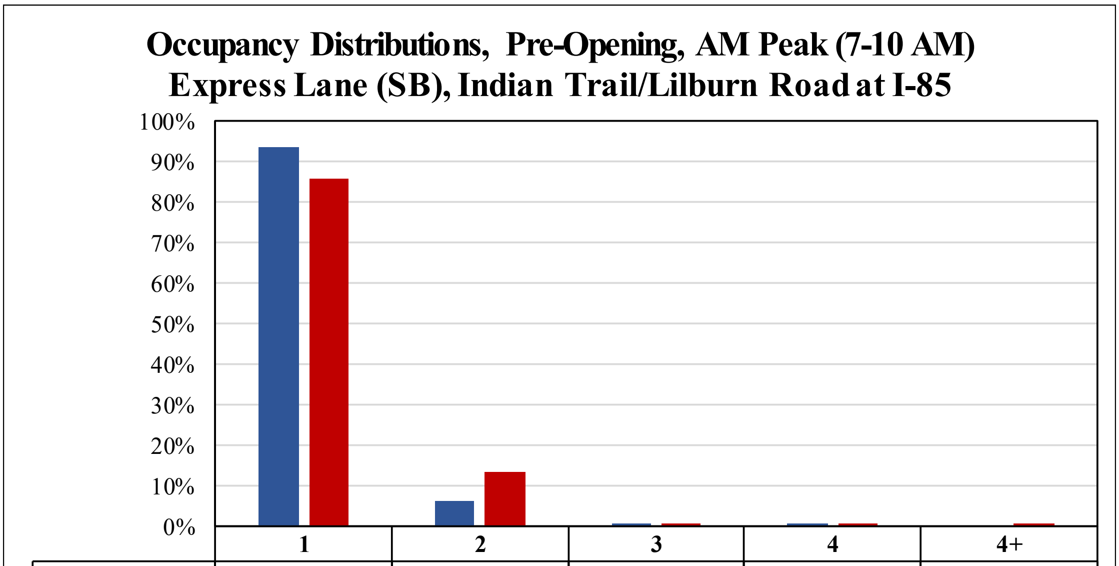
	1	2	3	4	4+
Passenger Car	93.1%	6.6%	0.3%	0.0%	0.0%
SUV	86.6%	13.0%	0.4%	0.1%	0.0%
Large HDV	95.8%	4.2%	0.0%	0.0%	0.0%

Figure 66 – Vehicle Occupancy Distribution,
Hamilton Mill Road at I-85, Pre-Opening (2018), AM Peak (7-10 AM), GP Lanes



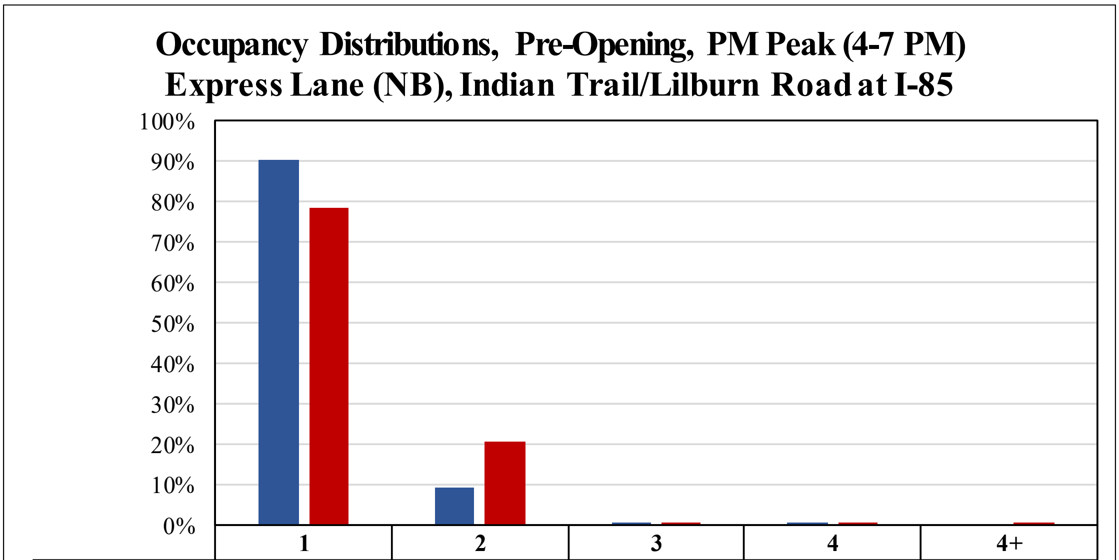
	1	2	3	4	4+
Passenger Car	88.7%	10.5%	0.6%	0.1%	0.0%
SUV	80.5%	18.3%	1.0%	0.2%	0.0%
Large HDV	94.6%	5.3%	0.1%	0.0%	0.0%

Figure 67 – Vehicle Occupancy Distribution,
Hamilton Mill Road at I-85, Pre-Opening (2018), PM Peak (4-7 PM), GP Lanes



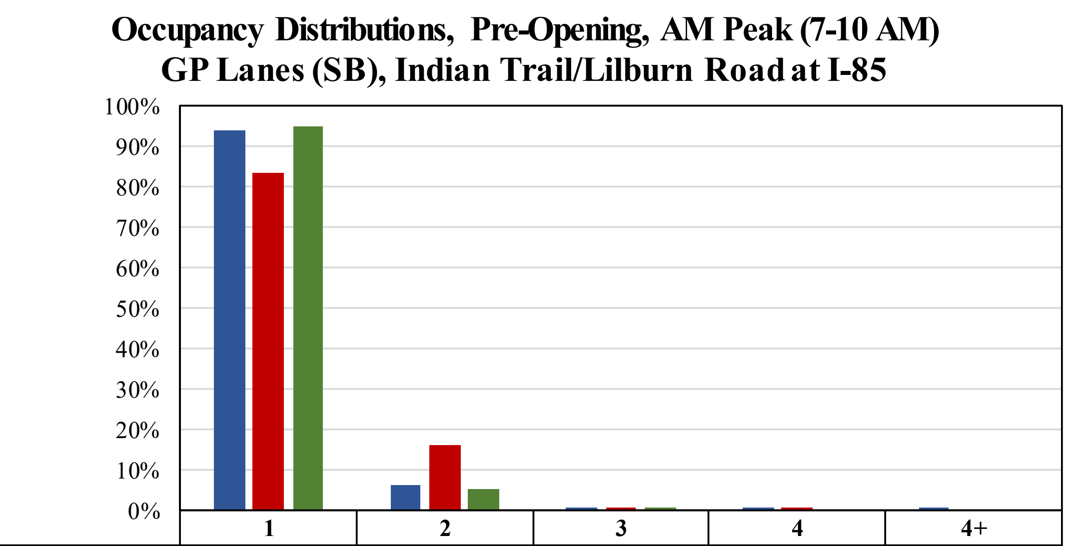
	1	2	3	4	4+
Passenger Car	93.2%	6.0%	0.7%	0.0%	0.0%
SUV	85.6%	13.6%	0.5%	0.3%	0.1%

Figure 68 – Vehicle Occupancy Distribution,
Indian Trail/Lilburn Road at I-85, Pre-Opening (2018), AM Peak (7-10 AM), Express Lane



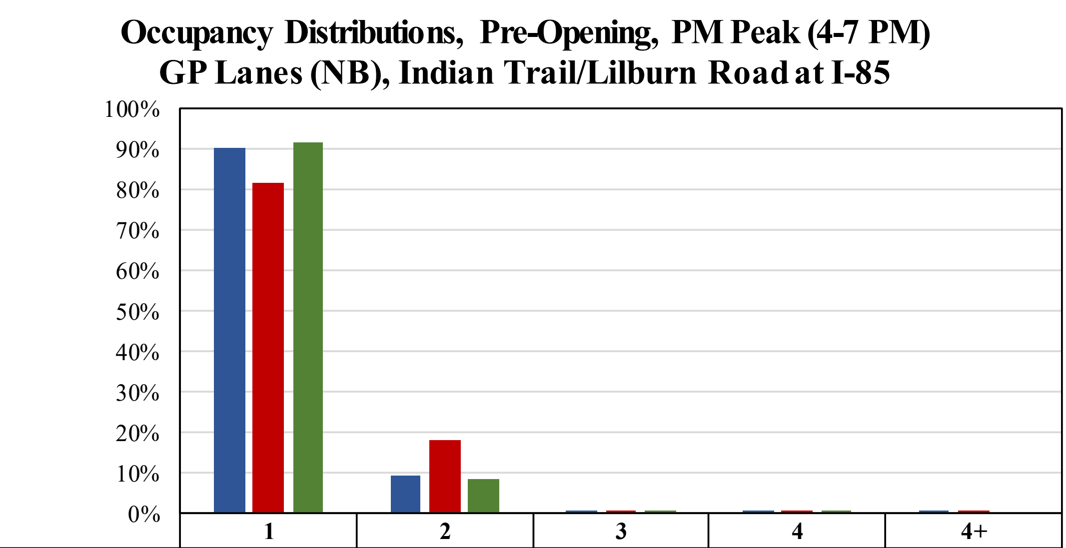
	1	2	3	4	4+
Passenger Car	90.3%	9.1%	0.5%	0.1%	0.0%
SUV	78.3%	20.7%	0.4%	0.4%	0.2%

Figure 69 – Vehicle Occupancy Distribution,
Indian Trail/Lilburn Road at I-85, Pre-Opening (2018), PM Peak (4-7 PM), Express Lane



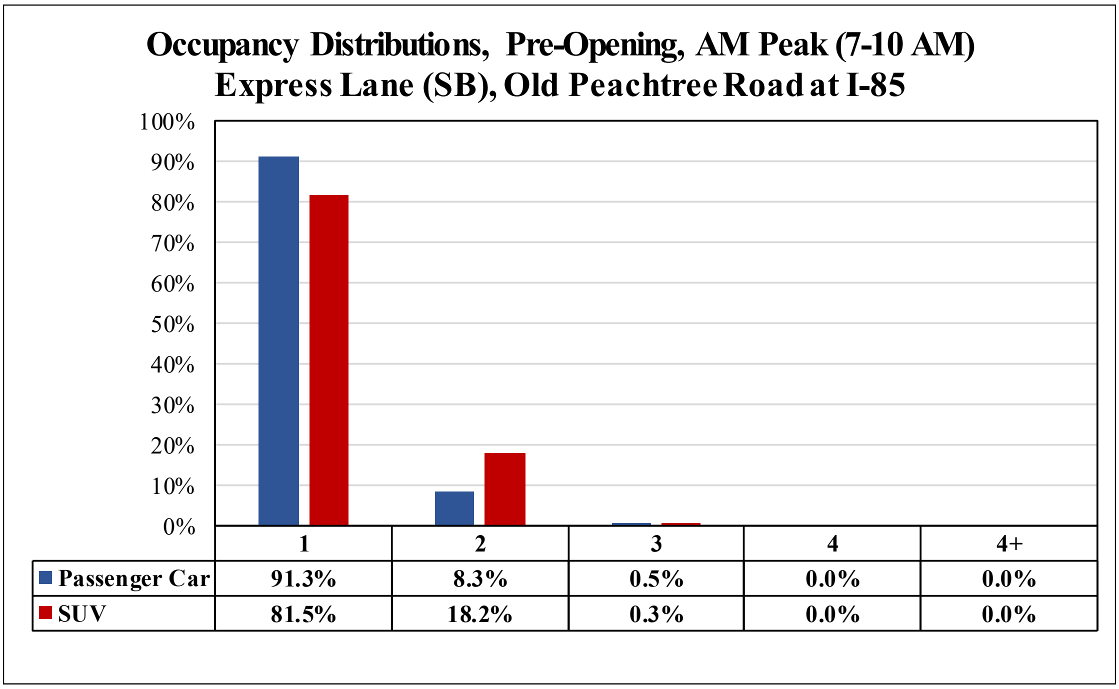
	1	2	3	4	4+
Passenger Car	93.8%	6.0%	0.2%	0.0%	0.0%
SUV	83.4%	16.0%	0.5%	0.2%	0.0%
Large HDV	94.9%	5.0%	0.0%	0.0%	0.0%

Figure 70 – Vehicle Occupancy Distribution,
Indian Trail/Lilburn Road at I-85, Pre-Opening (2018), AM Peak (7-10 AM), GP Lanes



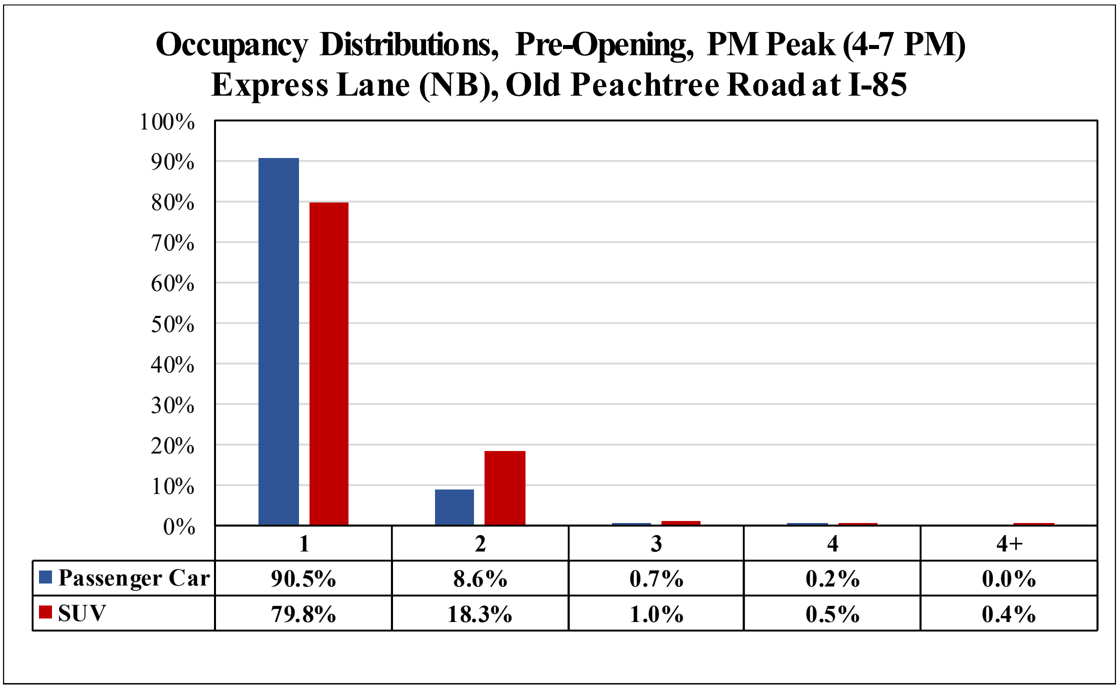
	1	2	3	4	4+
Passenger Car	90.2%	9.3%	0.5%	0.1%	0.0%
SUV	81.5%	17.9%	0.4%	0.1%	0.1%
Large HDV	91.4%	8.5%	0.0%	0.0%	0.0%

Figure 71 – Vehicle Occupancy Distribution,
Indian Trail/Lilburn Road at I-85, Pre-Opening (2018), PM Peak (4-7 PM), GP Lanes



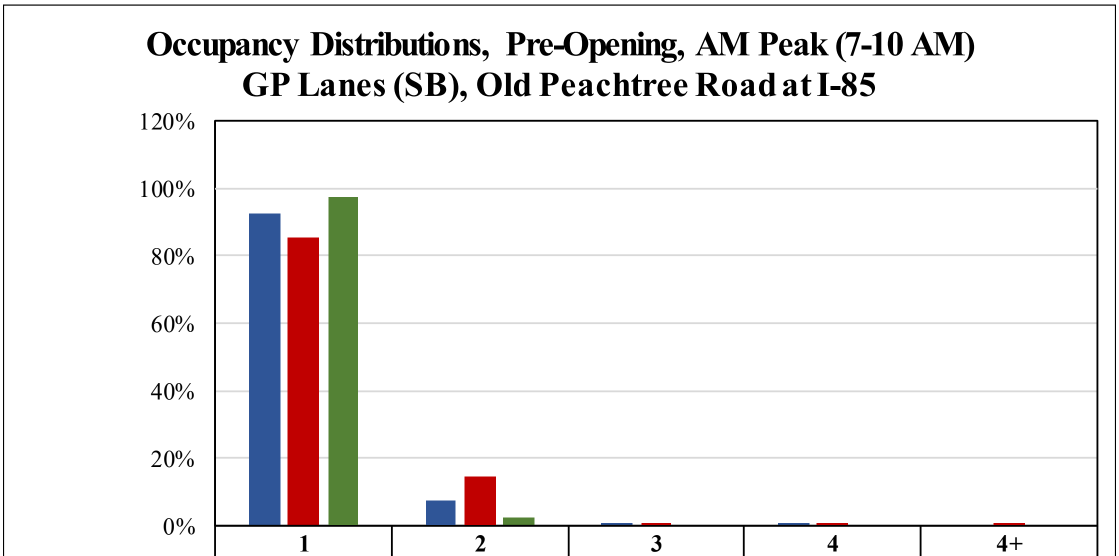
	1	2	3	4	4+
Passenger Car	91.3%	8.3%	0.5%	0.0%	0.0%
SUV	81.5%	18.2%	0.3%	0.0%	0.0%

**Figure 72 – Vehicle Occupancy Distribution,
Old Peachtree Road at I-85, Pre-Opening (2018), AM Peak (7-10 AM), Express Lane**



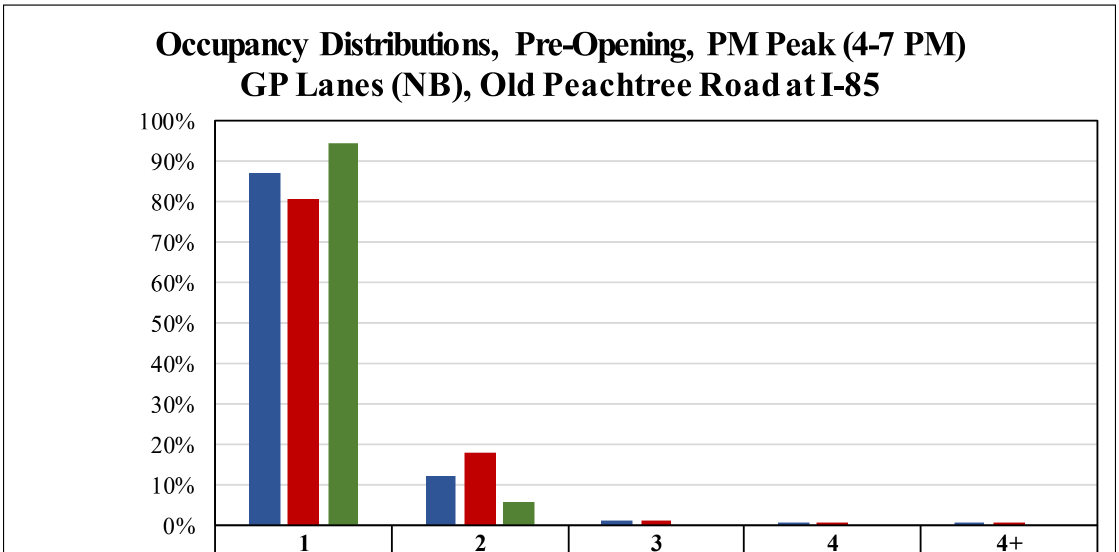
	1	2	3	4	4+
Passenger Car	90.5%	8.6%	0.7%	0.2%	0.0%
SUV	79.8%	18.3%	1.0%	0.5%	0.4%

**Figure 73 – Vehicle Occupancy Distribution,
Old Peachtree Road at I-85, Pre-Opening (2018), PM Peak (4-7 PM), Express Lane**



	1	2	3	4	4+
Passenger Car	92.3%	7.1%	0.5%	0.1%	0.0%
SUV	85.2%	14.4%	0.3%	0.1%	0.0%
Large HDV	97.5%	2.5%	0.0%	0.0%	0.0%

Figure 74 – Vehicle Occupancy Distribution,
Old Peachtree Road at I-85, Pre-Opening (2018), AM Peak (7-10 AM), GP Lanes



	1	2	3	4	4+
Passenger Car	86.9%	12.0%	0.9%	0.2%	0.0%
SUV	80.9%	17.9%	1.0%	0.2%	0.0%
Large HDV	94.4%	5.6%	0.0%	0.0%	0.0%

Figure 75 – Vehicle Occupancy Distribution,
Old Peachtree Road at I-85, Pre-Opening (2018), PM Peak (4-7 PM), GP Lanes

9.3 Post-Opening (2019) Observed Occupancy Results

The breakdown of vehicle occupancy observation data of all sites are presented in Table 41 through Table 50. Each lane is coded with the combination of the abbreviated site name, lane type and lane ID (numbered from inside to outside). Although the ramps are coded continuously with the GP lanes, they are not necessarily adjacent to the GP lanes (see site plans of Chastain Road, Hickory Grove Road, and Hamilton Mill Road). The lane numbers in this section are coded with the Fall 2019 layout when the post-opening data collection was conducted and are not necessarily the same with the Fall 2018 ones. For example, Chastain GP2 in Fall 2019 refers to the second lane from the inside at the site of Chastain Road, which is the first general purpose lane from inside (while the Express Lane is coded as Chastain ML1). Chastain GP2 in Fall 2018 referred to the second general purpose lane from inside, since there was no managed lane in 2018 data collection sessions.

The observed average vehicle occupancy results for each lane in the tables are derived by calculating total throughput (sum of vehicles × persons/vehicle for each observation class) and dividing by total vehicles. The average vehicle occupancy of vanpool and express buses was integrated as described in Chapter 7 and Chapter 8.

For sites along I-85, the occupancy of vehicles using the general purpose lanes are very close to one person per vehicle, given the large percentage of single-occupant vehicles using these lanes. The average occupancy of the two Express Lanes of I-85 was only slightly higher than their adjacent general purpose lanes, which has not changed from 2018. For sites along the I-75 NWC, the average occupancy of the Express Lanes is lower than the GP lanes.

The lanes with highest percentage of carpooling are the second lane, the third lane, or the fourth lane (for Indian Trail Lilburn Road PM peaks only) from the inside: Chastain GP3 (AM)/GP2 (PM), Hickory GP3, Hamilton GP2, Indian GP2 (AM)/GP4 (PM), and Old Peachtree GP3 (AM)/GP2 (PM).

Table 41 – Observed Occupancy and AVO by Lane, Chastain Road at I-575, Post-Opening (2019), AM Peak (7-10 AM)

Occupancy	CHS_ML1	CHS_GP2	CHS_GP3
1	96.1%	93.4%	86.8%
2	3.7%	6.4%	12.3%
3	0.1%	0.2%	0.7%
4	0.0%	0.0%	0.1%
4+	0.1%	0.0%	0.1%
Observed AVO	1.04	1.07	1.14
Adjusted AVO	1.05	1.07	1.14

Table 42 – Observed Occupancy and AVO by Lane, Hickory Grove Road at I-75, Post-Opening (2019), AM Peak (7-10 AM)

Occupancy	HIC_ML1	HIC_GP2	HIC_GP3	HIC_GP4	HIC_GP5
1	94.6%	89.0%	87.9%	91.8%	91.5%
2	5.0%	10.7%	11.7%	7.9%	8.2%
3	0.1%	0.2%	0.4%	0.2%	0.2%
4	0.1%	0.0%	0.0%	0.0%	0.0%
4+	0.3%	0.0%	0.0%	0.0%	0.0%
Observed AVO	1.06	1.11	1.13	1.09	1.09
Adjusted AVO	1.12	1.11	1.13	1.09	1.09

Table 43 – Observed Occupancy and AVO by Lane,
Hamilton Mill Road at I-85, Post-Opening (2019), AM Peak (7-10 AM)

Occupancy	HAM_GP1	HAM_GP2	HAM_GP3*
1	94.1%	91.3%	99.0%
2	5.7%	8.3%	1.0%
3	0.1%	0.3%	0.0%
4	0.0%	0.0%	0.0%
4+	0.0%	0.1%	0.0%
Observed AVO	1.06	1.09	1.01
Adjusted AVO	1.06	1.09	1.01

* Note: Very small sample size due to low traffic volume at the outside lane (the observation occurs near the starting of this lane).

Table 44 – Observed Occupancy and AVO by Lane,
Indian Trail/Lilburn Road at I-85, Post-Opening (2019), AM Peak (7-10 AM)

Occupancy	IND_ML1	IND_GP2	IND_GP3	IND_GP4	IND_GP5	IND_GP6
1	91.4%	91.4%	91.6%	91.8%	95.2%	91.9%
2	7.2%	8.5%	8.1%	8.1%	4.7%	7.7%
3	0.2%	0.1%	0.3%	0.1%	0.0%	0.3%
4	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
4+	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Observed AVO	1.12	1.09	1.09	1.09	1.05	1.09
Adjusted AVO	1.24	1.09	1.09	1.08	1.05	1.09

Table 45 – Observed Occupancy and AVO by Lane,
Old Peachtree Road at I-85, Post-Opening (2019), AM Peak (7-10 AM)

Occupancy	OPT_ML1	OPT_GP2	OPT_GP3	OPT_GP4	OPT_GP5
1	90.3%	93.5%	92.6%	92.8%	92.6%
2	8.3%	6.4%	7.0%	6.7%	7.0%
3	0.4%	0.1%	0.3%	0.3%	0.3%
4	0.1%	0.0%	0.0%	0.0%	0.0%
4+	0.9%	0.0%	0.0%	0.1%	0.0%
Observed AVO	1.13	1.07	1.08	1.08	1.08
Adjusted AVO	1.36	1.07	1.08	1.08	1.08

Table 46 – Observed Occupancy and AVO by Lane, Chastain Road at I-575, Post-Opening (2019), PM Peak (4-7 PM)

Occupancy	CHS_HOT1	CHS_GP2	CHS_GP3
1	94.4%	85.1%	87.1%
2	5.4%	14.2%	12.3%
3	0.0%	0.6%	0.5%
4	0.0%	0.1%	0.2%
4+	0.2%	0.0%	0.1%
Observed AVO	1.06	1.16	1.14
Adjusted AVO	1.07	1.16	1.14

Table 47 – Observed Occupancy and AVO by Lane, Hickory Grove Road at I-75, Post-Opening (2019), PM Peak (4-7 PM)

Occupancy	HIC_ML1	HIC_GP2	HIC_GP3	HIC_GP4
1	92.2%	87.4%	87.2%	89.5%
2	6.6%	12.0%	11.7%	9.3%
3	0.3%	0.5%	0.8%	0.7%
4	0.1%	0.0%	0.2%	0.3%
4+	0.7%	0.0%	0.1%	0.1%
Observed AVO	1.10	1.13	1.14	1.12
Adjusted AVO	1.20	1.13	1.14	1.12

Table 48 – Observed Occupancy and AVO by Lane, Hamilton Mill Road at I-85, Post-Opening (2019), PM Peak (4-7 PM)

Occupancy	HAM_GP1	HAM_GP2
1	90.4%	89.5%
2	9.0%	10.1%
3	0.5%	0.3%
4	0.1%	0.1%
4+	0.2%	0.1%
Observed AVO	1.11	1.11
Adjusted AVO	1.11	1.11

Table 49 – Observed Occupancy and AVO by Lane, Indian Trail/Lilburn Road at I-85, Post-Opening (2019), PM Peak (4-7 PM)

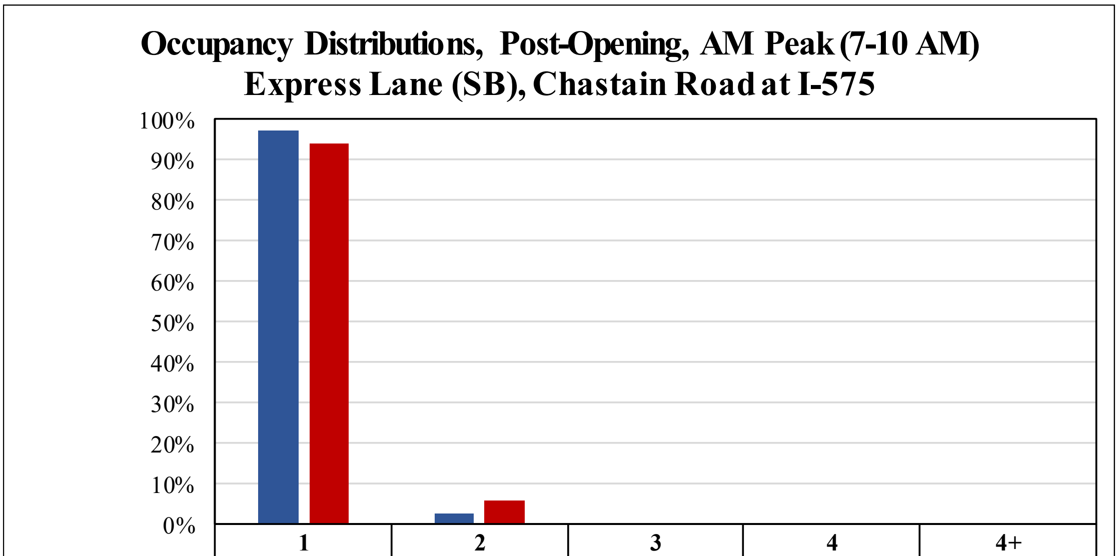
Occupancy	IND_ML1	IND_GP2	IND_GP3	IND_GP4	IND_GP5	IND_GP6
1	88.2%	90.7%	89.6%	87.8%	88.8%	89.1%
2	9.4%	8.8%	9.8%	11.3%	10.4%	10.3%
3	0.4%	0.3%	0.3%	0.6%	0.6%	0.4%
4	0.2%	0.1%	0.2%	0.3%	0.1%	0.1%
4+	1.7%	0.0%	0.1%	0.0%	0.1%	0.1%
Observed AVO	1.17	1.10	1.11	1.13	1.12	1.12
Adjusted AVO	1.41	1.10	1.11	1.13	1.12	1.12

Table 50 – Observed Occupancy and AVO by Lane, Old Peachtree Road at I-85, Post-Opening (2019), PM Peak (4-7 PM)

Occupancy	OPT_ML1	OPT_GP2	OPT_GP3	OPT_GP4	OPT_GP5
1	87.9%	88.6%	89.3%	92.2%	91.1%
2	9.7%	10.8%	10.2%	7.6%	8.0%
3	0.6%	0.4%	0.4%	0.1%	0.5%
4	0.2%	0.1%	0.1%	0.0%	0.2%
4+	1.6%	0.1%	0.1%	0.0%	0.1%
Observed AVO	1.17	1.12	1.11	1.08	1.10
Adjusted AVO	1.37	1.12	1.11	1.08	1.10

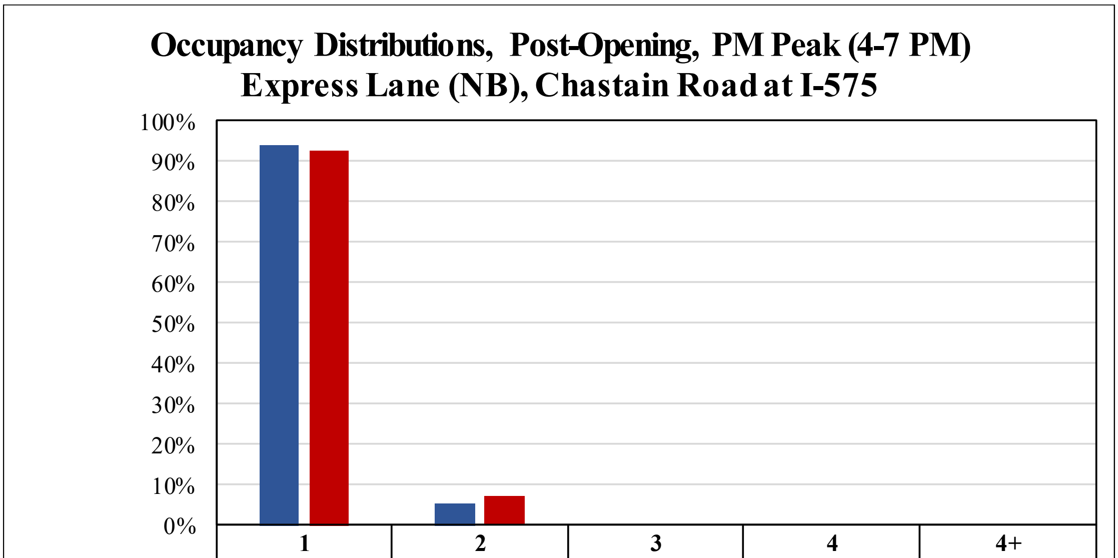
9.4 Post-Opening (2019) Observed Occupancy Results by Vehicle Class

The research team further disaggregated occupancy observations by vehicle class, and the distributions of passenger car LDVs, SUVs, and large HDVs (GP lanes only) are shown in Figure 76 through Figure 93. As seen in the baseline year of 2018, most large HDVs include only the driver, yielding the highest SOV percentage of the vehicle classes. Passenger car LDVs have the second highest SOVs fractions, and SUVs have the lowest among the three vehicle classes. A comparison of AM and PM sessions also indicates that more carpools are on the road during PM peaks for all of the vehicle classes. For the recently opened Express Lanes on I-75/575 NWC, SOV fractions are larger than those of the GP lanes. More discussions on the throughput changes on NWC are provided in Chapter 10.



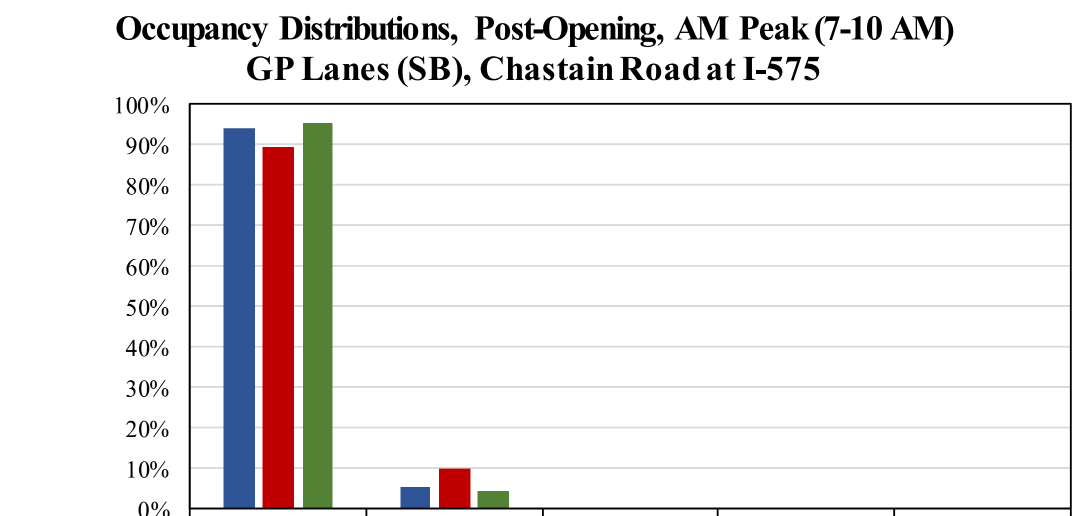
	1	2	3	4	4+
Passenger Car	97.3%	2.6%	0.0%	0.0%	0.0%
SUV	94.0%	5.8%	0.1%	0.1%	0.0%

Figure 76 – Vehicle Occupancy Distribution,
Chastain Road at I-575, Post-Opening (2019) AM Peak (7-10 AM), Express Lane



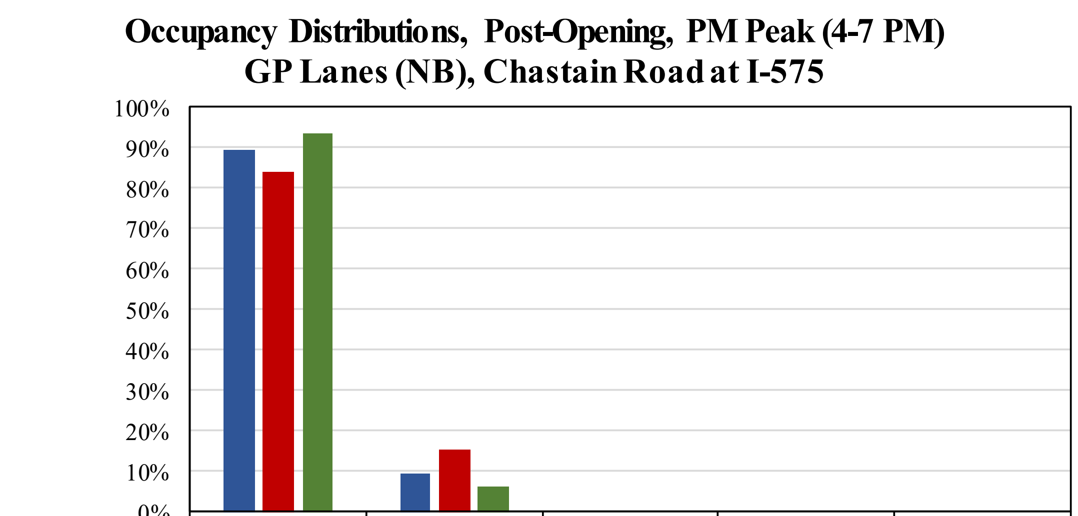
	1	2	3	4	4+
Passenger Car	94.0%	5.6%	0.3%	0.1%	0.0%
SUV	92.5%	7.0%	0.3%	0.1%	0.0%

Figure 77 – Vehicle Occupancy Distribution,
Chastain Road at I-575, Post-Opening (2019), PM Peak (4-7 PM), Express Lane



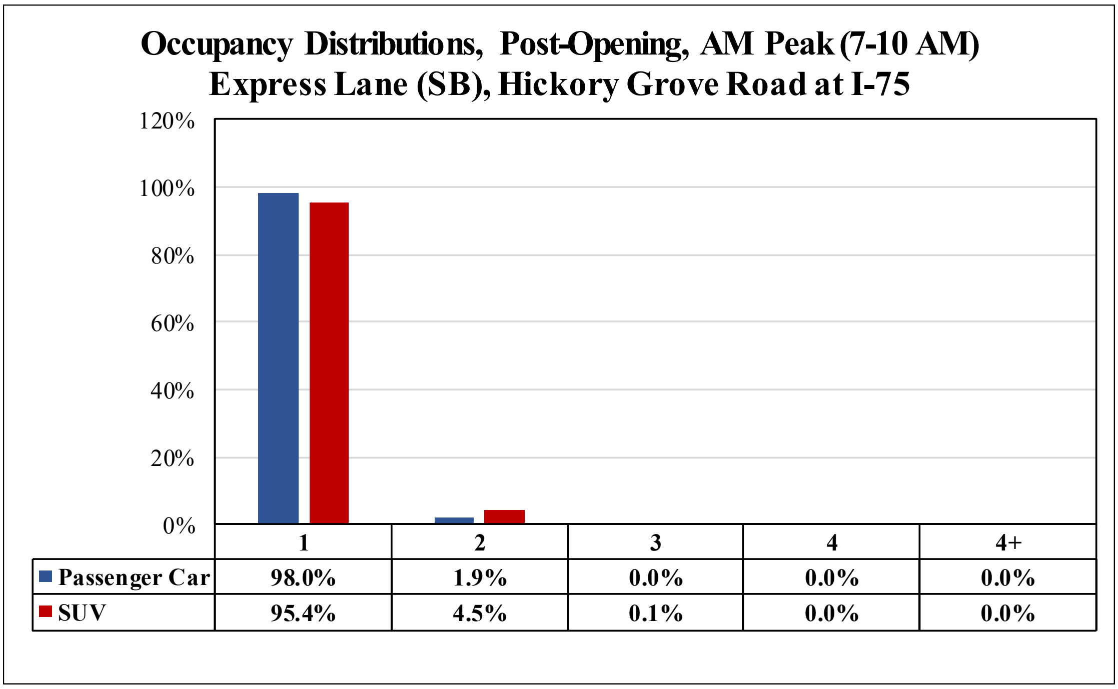
	1	2	3	4	4+
Passenger Car	94.3%	5.4%	0.3%	0.0%	0.0%
SUV	89.7%	10.0%	0.2%	0.0%	0.1%
Large HDV	95.3%	4.6%	0.2%	0.0%	0.0%

Figure 78 – Vehicle Occupancy Distribution,
Chastain Road at I-575, Post-Opening (2019), AM Peak (7-10 AM), GP Lanes



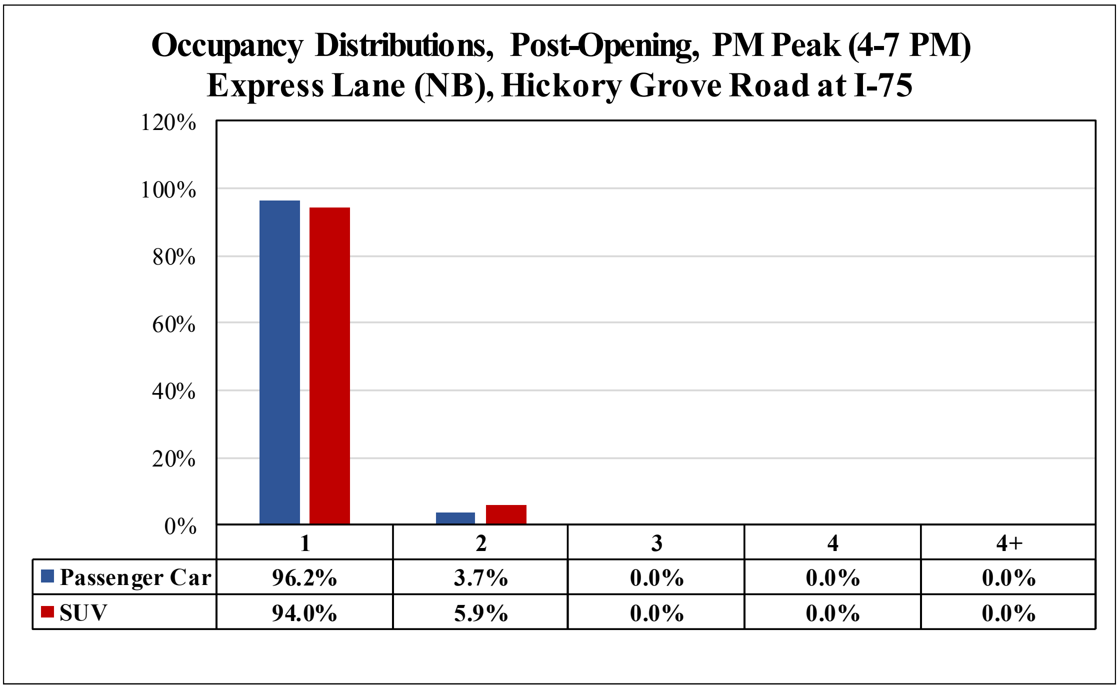
	1	2	3	4	4+
Passenger Car	89.6%	9.7%	0.5%	0.1%	0.0%
SUV	84.0%	15.4%	0.4%	0.1%	0.0%
Large HDV	93.6%	6.4%	0.0%	0.0%	0.0%

Figure 79 – Vehicle Occupancy Distribution,
Chastain Road at I-575, Post-Opening (2019), PM Peak (4-7 PM), GP Lanes



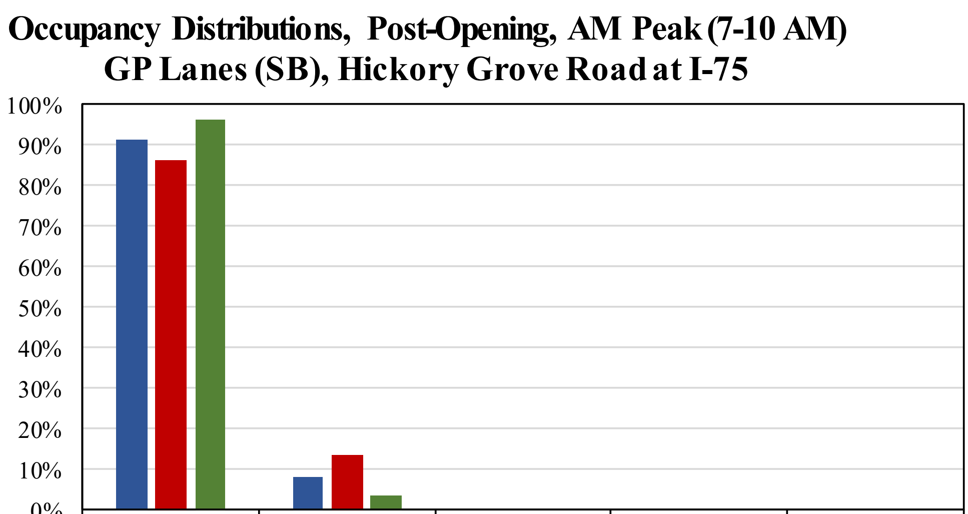
	1	2	3	4	4+
Passenger Car	98.0%	1.9%	0.0%	0.0%	0.0%
SUV	95.4%	4.5%	0.1%	0.0%	0.0%

Figure 80 – Vehicle Occupancy Distribution,
Hickory Grove Road at I-575, Post-Opening (2019), AM Peak (7-10 AM), Express Lane



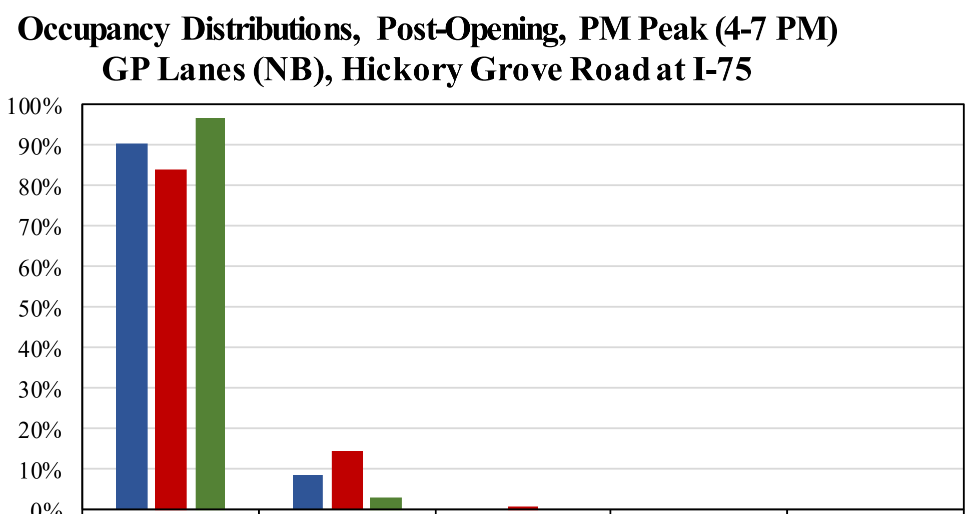
	1	2	3	4	4+
Passenger Car	96.2%	3.7%	0.0%	0.0%	0.0%
SUV	94.0%	5.9%	0.0%	0.0%	0.0%

Figure 81 – Vehicle Occupancy Distribution,
Hickory Grove Road at I-575, Post-Opening (2019), PM Peak (4-7 PM), Express Lane



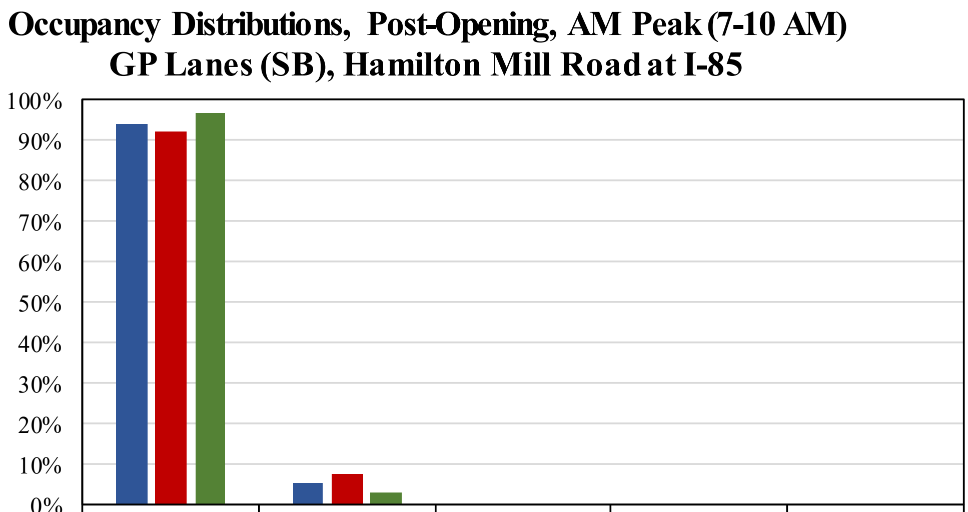
	1	2	3	4	4+
Passenger Car	91.5%	8.1%	0.4%	0.0%	0.0%
SUV	86.3%	13.5%	0.2%	0.0%	0.0%
Large HDV	96.5%	3.4%	0.0%	0.0%	0.0%

Figure 82 – Vehicle Occupancy Distribution, Hickory Grove Road at I-75, Post-Opening (2019), AM Peak (7-10 AM), GP Lanes



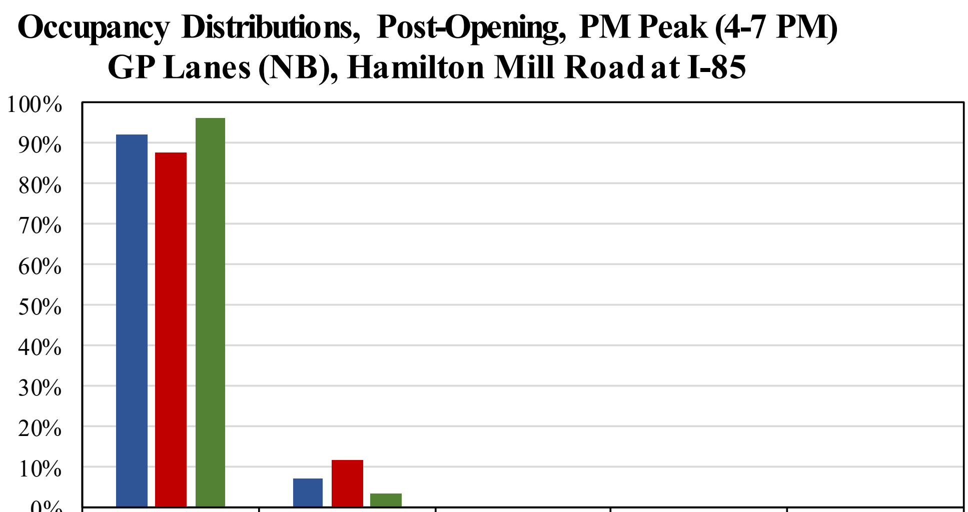
	1	2	3	4	4+
Passenger Car	90.6%	8.5%	0.6%	0.3%	0.0%
SUV	84.2%	14.7%	0.8%	0.2%	0.0%
Large HDV	96.6%	3.4%	0.0%	0.0%	0.0%

Figure 83 – Vehicle Occupancy Distribution, Hickory Grove Road at I-75, Post-Opening (2019), PM Peak (4-7 PM), GP Lanes



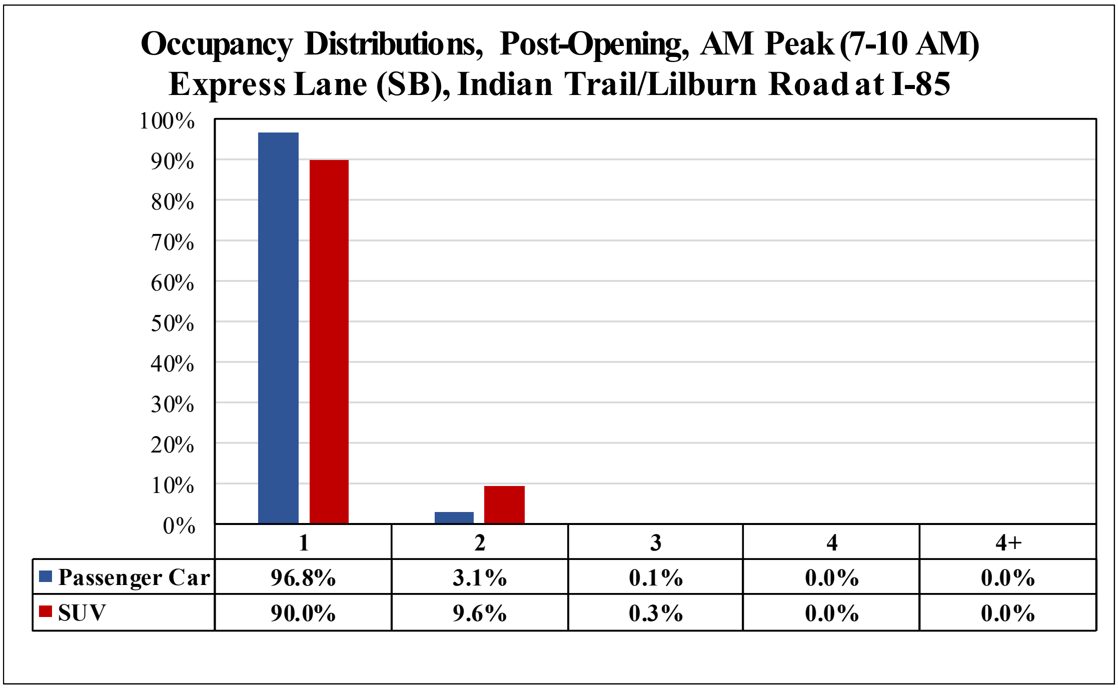
	1	2	3	4	4+
Passenger Car	94.1%	5.6%	0.2%	0.0%	0.0%
SUV	92.4%	7.6%	0.1%	0.0%	0.0%
Large HDV	96.7%	3.2%	0.1%	0.0%	0.0%

Figure 84 – Vehicle Occupancy Distribution,
Hamilton Mill Road at I-85, Post- Opening (2019), AM Peak (7-10 AM), GP Lanes



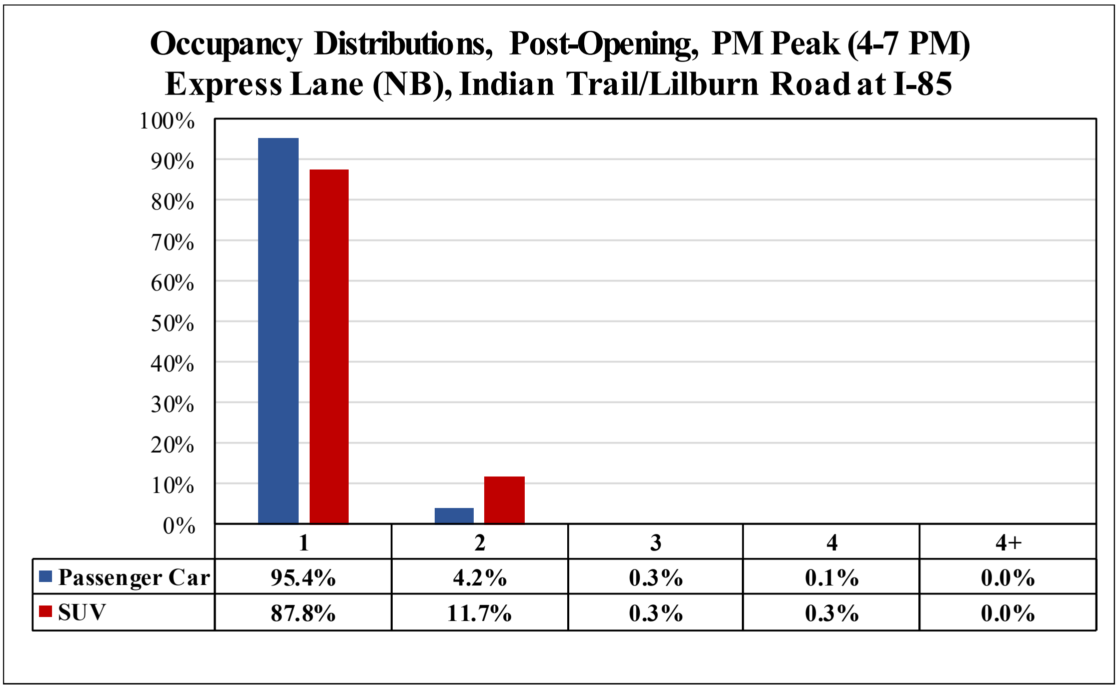
	1	2	3	4	4+
Passenger Car	92.2%	7.4%	0.4%	0.1%	0.0%
SUV	87.5%	12.0%	0.4%	0.1%	0.0%
Large HDV	96.4%	3.6%	0.0%	0.0%	0.0%

Figure 85 – Vehicle Occupancy Distribution,
Hamilton Mill Road at I-85, Post- Opening (2019), PM Peak (4-7 PM), GP Lanes



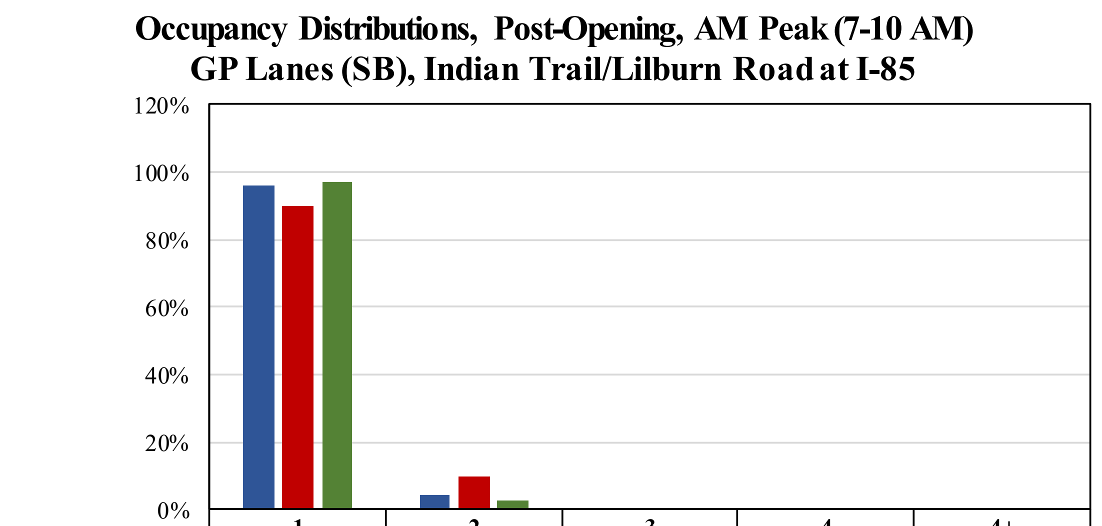
	1	2	3	4	4+
Passenger Car	96.8%	3.1%	0.1%	0.0%	0.0%
SUV	90.0%	9.6%	0.3%	0.0%	0.0%

Figure 86 – Vehicle Occupancy Distribution,
Indian Trail/Lilburn Road at I-85, Post- Opening (2019), AM Peak (7-10 AM), Express Lane



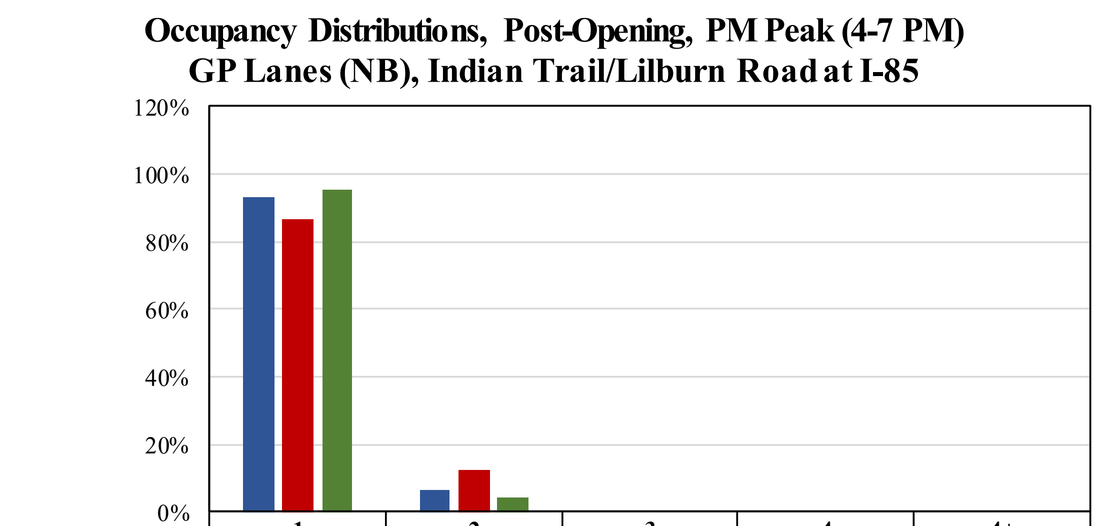
	1	2	3	4	4+
Passenger Car	95.4%	4.2%	0.3%	0.1%	0.0%
SUV	87.8%	11.7%	0.3%	0.3%	0.0%

Figure 87 – Vehicle Occupancy Distribution,
Indian Trail/Lilburn Road at I-85, Post- Opening (2019), PM Peak (4-7 PM), Express Lane



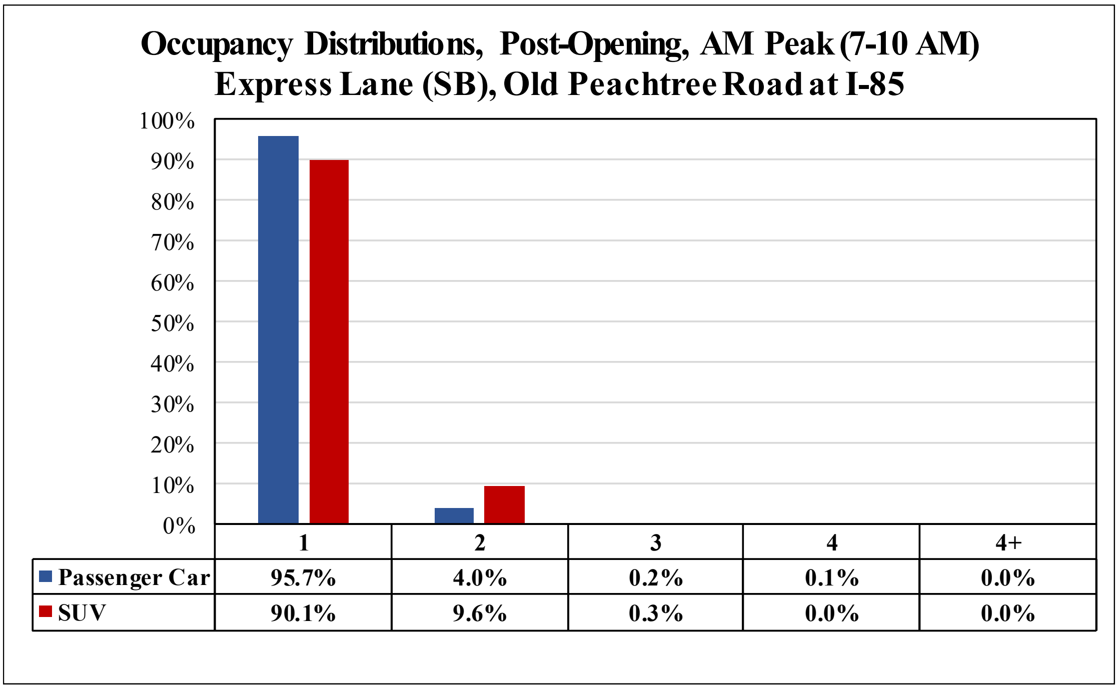
	1	2	3	4	4+
Passenger Car	95.7%	4.1%	0.1%	0.0%	0.0%
SUV	89.8%	9.9%	0.2%	0.1%	0.0%
Large HDV	97.1%	2.9%	0.1%	0.0%	0.0%

Figure 88 – Vehicle Occupancy Distribution,
Indian Trail/Lilburn Road at I-85, Post- Opening (2019), AM Peak (7-10 AM), GP Lanes



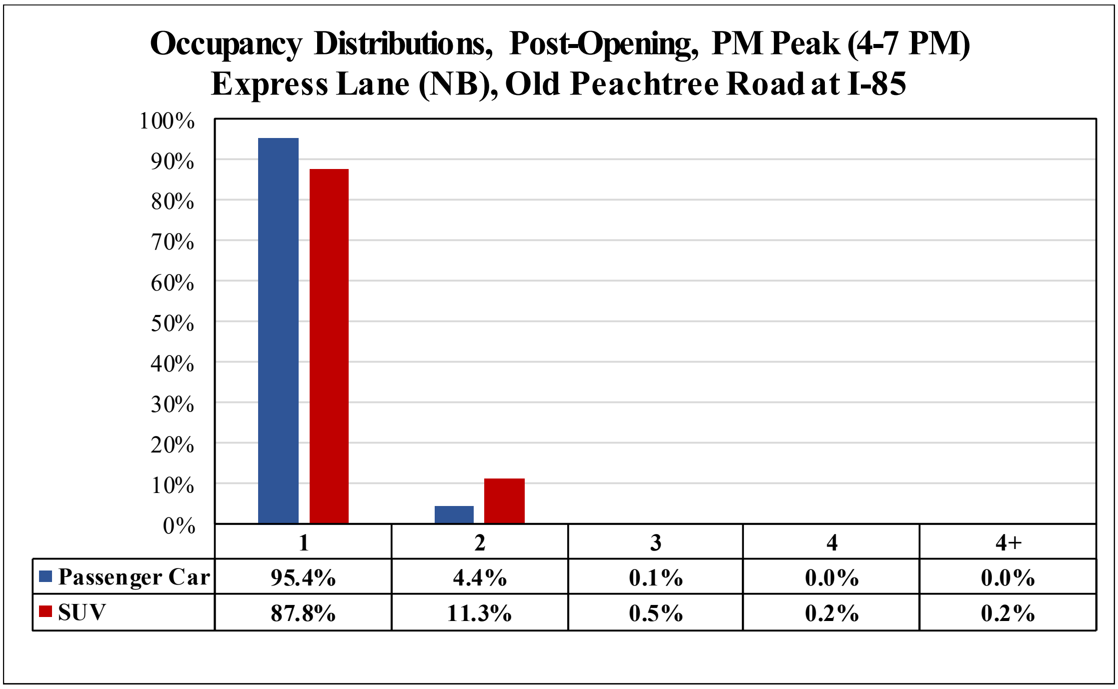
	1	2	3	4	4+
Passenger Car	93.1%	6.4%	0.4%	0.1%	0.0%
SUV	86.7%	12.7%	0.4%	0.2%	0.0%
Large HDV	95.4%	4.5%	0.1%	0.0%	0.0%

Figure 89 – Vehicle Occupancy Distribution,
Indian Trail/Lilburn Road at I-85, Post- Opening (2019), PM Peak (4-7 PM), GP Lanes



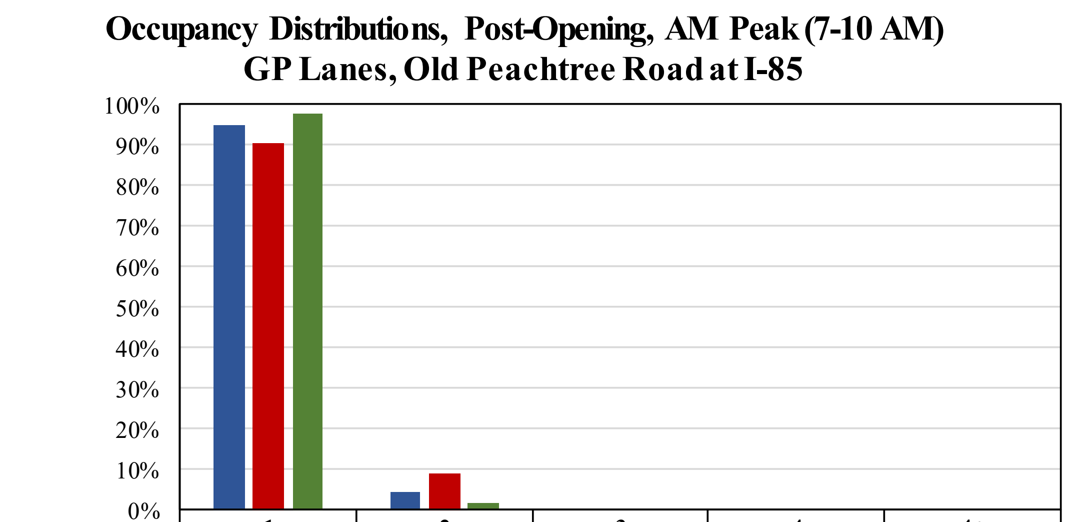
	1	2	3	4	4+
Passenger Car	95.7%	4.0%	0.2%	0.1%	0.0%
SUV	90.1%	9.6%	0.3%	0.0%	0.0%

Figure 90 – Vehicle Occupancy Distribution,
Old Peachtree Road at I-85, Post- Opening (2019), AM Peak (7-10 AM), Express Lane



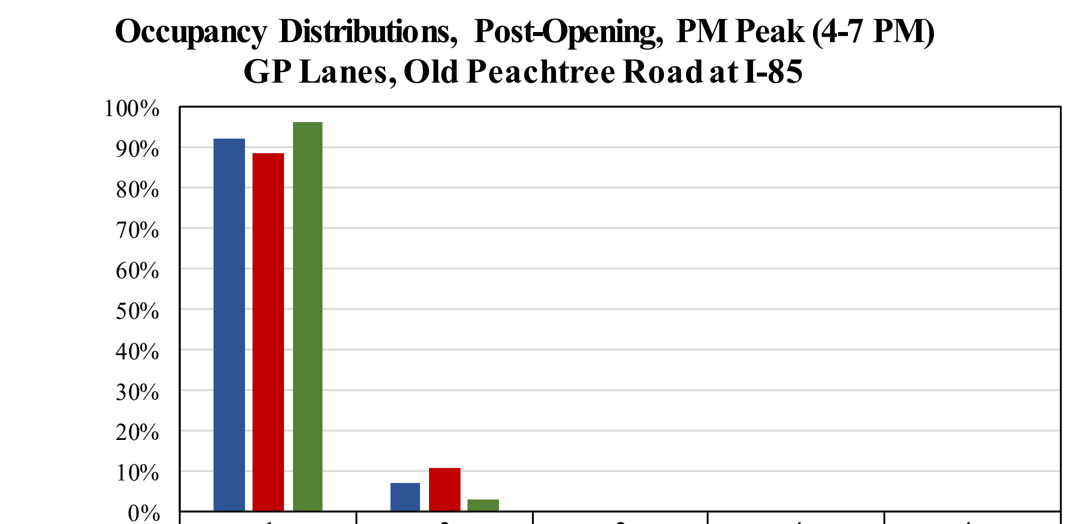
	1	2	3	4	4+
Passenger Car	95.4%	4.4%	0.1%	0.0%	0.0%
SUV	87.8%	11.3%	0.5%	0.2%	0.2%

Figure 91 – Vehicle Occupancy Distribution,
Old Peachtree Road at I-85, Post- Opening (2019), PM Peak (4-7 PM), Express Lane



	1	2	3	4	4+
Passenger Car	95.2%	4.5%	0.3%	0.0%	0.0%
SUV	90.5%	9.2%	0.2%	0.0%	0.0%
Large HDV	97.9%	2.0%	0.1%	0.0%	0.0%

Figure 92 – Vehicle Occupancy Distribution,
Old Peachtree Road at I-85, Post- Opening (2019), AM Peak (7-10 AM), GP Lanes



	1	2	3	4	4+
Passenger Car	92.3%	7.3%	0.3%	0.1%	0.0%
SUV	88.5%	11.1%	0.3%	0.1%	0.0%
Large HDV	96.6%	3.4%	0.0%	0.0%	0.0%

Figure 93 – Vehicle Occupancy Distribution,
Old Peachtree Road at I-85, Post- Opening (2019), PM Peak (4-7 PM), GP Lanes

9.5 Changes in Observed Average Vehicle Occupancy

The changes in observed and adjusted vehicle occupancy by lane are presented in Table 51 (AM peak) and Table 52 (PM peak). As noted before, all changes were calculated in the Excel spreadsheet and then placed in the tables, at which time the data were rounded to fit into the cells. The audience can refer to the Excel spreadsheet for the full data.

All lanes experienced a decrease of average occupancy, except the second GP lane at Hickory Grove Road at I-75 for morning peak (0.01 persons per vehicle increased), and first GP lane at Chastain for evening peak (0.02 persons per vehicle increased) where a slight increase is observed. The occupancy decreases on I-85 corridor are generally larger than those on the NWC, except for Hamilton Mill Road at I-85. Overall, the occupancy decrease on Express Lanes is larger than the GP lanes, and the decreases on the first GP lane from inside are larger than the rest of the GP lanes. This could imply the changes (increase fractions of SOV vehicles) were associated with faster travel (use of the Express Lane and the inside GP lane) to avoid congestion, but the team cannot draw conclusions as to whether these decreases in occupancy are related only to the opening of the Express Lanes facilities, or if other factors are in play.

The NWC Express Lanes tend to have lower average occupancy than the parallel GP lanes, while the Express Lanes on I-85 have higher average occupancy than the GP lanes. A larger percentage of carpools are operating on the I-85 Express Lanes and express buses are carrying more passengers on I-85 than on the NWC. Perhaps the higher carpool fractions are in part because the I-85 HOT lanes allow registered 3-person carpools to travel toll-free. Alternatively, the severe congestion on the NWC before the Express Lanes opened may also have induced single-occupant vehicles to divert into the corridor once congestion declined (given the improved travel times), depressing average vehicle occupancy. Supplemental travel behavior studies are needed to assess the specific reasons for these differences.

The changes in observed vehicle occupancy do not necessarily indicate similar changes in person throughput on the NWC and I-85 Corridor. Average vehicle occupancy profiles need to be integrated with vehicle throughput data to provide an assessment of vehicle and person throughput by occupancy category (SOV, HOV2, HOV3+, express bus, and vanpool) and by lane type (GP lanes vs. Express Lane). These results are presented in the following Chapter.

Table 51 – Changes in Observed and Adjusted Vehicle Occupancy by Lane, AM Peak

Lane	Observed AVO Pre-Opening	Observed AVO Post-Opening	Change in Observed AVO	Adjusted AVO Pre-Opening	Adjusted AVO Post-Opening	Change in Adjusted AVO
CHS_ML1	N/A	1.04	N/A	N/A	1.05	N/A
CHS_GP1	1.10	1.07	-0.04	1.10	1.07	-0.04
CHS_GP2	1.14	1.14	0.01	1.14	1.14	0.00
HIC_ML1	N/A	1.06	N/A	N/A	1.12	N/A
HIC_GP1	1.15	1.11	-0.03	1.15	1.11	-0.03
HIC_GP2	1.11	1.13	0.01	1.11	1.13	0.01
HIC_GP3	1.13	1.09	-0.05	1.15	1.09	-0.06
HIC_GP4	1.11	1.09	-0.03	1.11	1.09	-0.03
HAM_GP1	1.09	1.06	-0.03	N/A	1.06	N/A
HAM_GP2	1.11	1.09	-0.01	N/A	1.09	N/A
HAM_GP3	N/A	1.01	N/A	N/A	1.01	N/A
IND_ML1	1.18	1.12	-0.06	1.31	1.24	-0.06
IND_GP1	1.11	1.09	-0.02	1.11	1.09	-0.02
IND_GP2	1.13	1.09	-0.04	1.13	1.09	-0.04
IND_GP3	1.13	1.09	-0.05	1.13	1.08	-0.05
IND_GP4	1.12	1.05	-0.07	1.12	1.05	-0.07
IND_GP5	1.12	1.09	-0.03	1.12	1.09	-0.03
OPT_ML1	1.22	1.13	-0.10	1.50	1.36	-0.14
OPT_GP1	1.18	1.07	-0.11	1.18	1.07	-0.11
OPT_GP2	1.14	1.08	-0.06	1.14	1.08	-0.06
OPT_GP3	1.07	1.08	0.00	1.07	1.08	0.00
OPT_GP4	1.08	1.08	-0.01	1.08	1.08	-0.01

Table 52 – Changes in Observed and Adjusted Vehicle Occupancy by Lane, PM Peak

Lane	Observed AVO Pre-Opening	Observed AVO Post-Opening	Change in Observed AVO	Adjusted AVO Pre-Opening	Adjusted AVO Post-Opening	Change in Adjusted AVO
CHS_ML1	N/A	1.06	N/A	N/A	1.07	N/A
CHS_GP1	1.14	1.16	0.02	1.14	1.16	0.02
CHS_GP2	1.19	1.14	-0.05	1.20	1.14	-0.06
HIC_ML1	N/A	1.10	N/A	N/A	1.20	N/A
HIC_GP1	1.15	1.13	-0.01	1.15	1.13	-0.01
HIC_GP2	1.22	1.14	-0.07	1.22	1.14	-0.07
HIC_GP3	1.14	1.12	-0.02	1.19	1.12	-0.06
HAM_GP1	1.16	1.11	-0.05	N/A	1.11	N/A
HAM_GP2	1.17	1.11	-0.05	N/A	1.11	N/A
IND_ML1	1.30	1.17	-0.13	1.55	1.41	-0.14
IND_GP1	1.15	1.10	-0.05	1.15	1.10	-0.05
IND_GP2	1.14	1.11	-0.03	1.14	1.11	-0.03
IND_GP3	1.17	1.13	-0.03	1.17	1.13	-0.03
IND_GP4	1.17	1.12	-0.05	1.17	1.12	-0.05
IND_GP5	1.12	1.12	0.00	1.12	1.12	0.00
OPT_ML1	1.26	1.17	-0.09	1.50	1.37	-0.13
OPT_GP1	1.26	1.12	-0.14	1.26	1.12	-0.14
OPT_GP2	1.17	1.11	-0.06	1.17	1.11	-0.06
OPT_GP3	1.13	1.08	-0.05	1.13	1.08	-0.05
OPT_GP4	1.12	1.10	-0.02	1.12	1.10	-0.02

10 Person and Vehicle Throughput Results

Corridor vehicle and person throughput are assessed at all data collection sites (excluding Hamilton Mill Road, where no nearby NaviGAtor station was available for 2018). Vehicle throughput is monitored by video-based vehicle detection system (VDS) stations on the NaviGAtor system. A seven-month period from February through August was analyzed for the pre-opening (2018) period and for the post-opening (2019) period, and the reported traffic volume profiles of 6:00 AM to 10:00 AM (morning peak), and of 3:00 PM to 7:00 PM (evening peak) were processed as input to throughput assessment as described in Chapter 3. The months were the same as the previous project, except that September was removed because the Express Lanes on NWC opened in September. The throughput analysis covers Tuesday-Thursday, consistent with the field observation of vehicle occupancy.

Person throughput is a function of traffic flow coupled with observed vehicle occupancy, as outlined in previous chapters. The lane-by-lane volumes are first broken into vehicle classes (light duty vehicles, small HDV, large HDV, bus, et al.) following the distributions obtained from field observations to provide vehicle throughput by vehicle class. Person throughput for each vehicle class is calculated by multiplying the vehicle throughput with its corresponding average vehicle occupancy. Vehicle and person throughput (unsubstituted) by lane, by lane type (GP lanes vs. managed lane), and of the corridor (all lanes) can be calculated by summing up all vehicle classes accordingly.

The substitution of vanpool and express bus passengers is included in these analyses (presented as separate categories with ordinary SOV, HOV2, and HOV3+), following the methodologies described in Chapter 7 (express buses) and Chapter 8 (vanpools). The express bus vehicle throughput (scheduled Xpress, CobbLinc, and GCT buses) are assigned to the Express Lane (if one is present) or the outside GP lane (if there is no Express Lane) in substituting actual vehicle occupancy for HOV "4+" buses. Vanpools were assigned evenly across all lanes for each corridor in substituting actual vehicle occupancy for HOV "4+" vans. For each vanpool/Xpress bus/CobbLinc bus/GCT bus substituted, 4.5 persons are removed from the person throughput of that lane, and the corresponding number of persons (average vehicle occupancy) is added to the person throughput. The final vehicle and person throughput for each site (corridor) are obtained by aggregating the throughput results. Person throughput calculation examples (occupancy by SOV, HOV2, HOV3, HOV4, and HOV4+ and volumes by vehicle class) are provided in Appendix E, and step-by-step results of the throughput substitutions (all sites) can be found in Appendix F.

The percentages presented in the tables in this Chapter are rounded to one decimal place, and vehicle and person throughput is rounded to integer values. No further modification was made to these numbers (i.e., no revision was made for rounded fractions to summed to 100.0%) so that the tables remain consistent with the companion Excel spreadsheet. Hence, if a column adds up to 99.9% or 100.1%, be reassured that the total is 100.0% in the spreadsheet. The before and after comparisons and the percent change in vehicle throughput and person throughput for all sites are presented in Table 53. Because NaviGAtor data did not exist for Hamilton Mill Road at I-85 in 2018, the assessment was not performed for 2018 nor are changes assessed (however, the post-opening results are still presented for 2019).

Table 53 – Percent Changes in Vehicle and Person Throughput by Site and Lane Type

AM/ PM	Site/Corridor	Lane Type	Pre-Opening Vehicle Throughput	Post-Opening Vehicle Throughput	Percent Change in Vehicle Throughput	Pre-Opening Person Throughput	Post-Opening Person Throughput	Percent Change in Person Throughput
AM	Chastain Road at I-575	All	11,417	16,304	+42.8%	12,796	17,761	+38.80%
AM	Chastain Road at I-575	GP	11,417	12,804	+12.1%	12,796	14,076	+10.00%
AM	Chastain Road at I-575	ML	N/A	3,500	N/A	N/A	3,685	N/A
AM	Hickory Grove Road at I-75	All	15,189	18,496	+21.8%	17,214	20,509	+19.10%
AM	Hickory Grove Road at I-75	GP	15,189	16,480	+8.5%	17,214	18,256	+6.10%
AM	Hickory Grove Road at I-75	ML	N/A	2,016	N/A	N/A	2,253	N/A
AM	Indian Trail/Lilburn Rd. at I-85	All	33,874	35,756	+5.6%	39,104	39,594	+1.30%
AM	Indian Trail/Lilburn Rd. at I-85	GP	27,970	29,623	+5.9%	31,387	31,976	+1.90%
AM	Indian Trail/Lilburn Rd. at I-85	ML	5,904	6,133	+3.9%	7,717	7,618	-1.30%
AM	Old Peachtree Road at I-85	All	20,531	21,993	+7.2%	23,603	24,155	+2.30%
AM	Old Peachtree Road at I-85	GP	19,132	20,259	+5.9%	21,503	21,782	+1.30%
AM	Old Peachtree Road at I-85	ML	1,399	1,733	+23.9%	2,100	2,373	+13.00%

AM/ PM	Site/ Corridor	Lane Type	Pre-Opening Vehicle Throughput	Post-Opening Vehicle Throughput	Percent Change in Vehicle Throughput	Pre-Opening Person Throughput	Post-Opening Person Throughput	Percent Change in Person Throughput
PM	**Chastain Road at I-575**	**All**	**10,815**	**15,179**	**+40.4%**	**12,619**	**17,107**	**+35.60%**
PM	**Chastain Road at I-575**	**GP**	**10,815**	**10,726**	**-0.8%**	**12,619**	**12,327**	**-2.30%**
PM	**Chastain Road at I-575**	**ML**	**N/A**	**4,453**	**N/A**	**N/A**	**4,780**	**N/A**
PM	**Hickory Grove Road at I-75**	**All**	**17,477**	**18,454**	**+5.6%**	**20,602**	**21,013**	**+2.00%**
PM	**Hickory Grove Road at I-75**	**GP**	**17,477**	**16,878**	**-3.4%**	**20,602**	**19,130**	**-7.10%**
PM	**Hickory Grove Road at I-75**	**ML**	**N/A**	**1,576**	**N/A**	**N/A**	**1,883**	**N/A**
PM	**Indian Trail/Lilburn Rd. at I-85**	**All**	**28,686**	**31,297**	**+9.1%**	**34,879**	**36,374**	**+4.30%**
PM	**Indian Trail/Lilburn Rd. at I-85**	**GP**	**23,903**	**26,414**	**+10.5%**	**27,483**	**29,489**	**+7.30%**
PM	**Indian Trail/Lilburn Rd. at I-85**	**ML**	**4,783**	**4,883**	**+2.1%**	**7,396**	**6,885**	**-6.90%**
PM	**Old Peachtree Road at I-85**	**All**	**21,768**	**23,882**	**+9.7%**	**26,462**	**27,316**	**+3.20%**
PM	**Old Peachtree Road at I-85**	**GP**	**18,457**	**20,567**	**+11.4%**	**21,734**	**22,758**	**+4.70%**
PM	**Old Peachtree Road at I-85**	**ML**	**3,311**	**3,315**	**+0.1%**	**4,728**	**4,558**	**-3.60%**

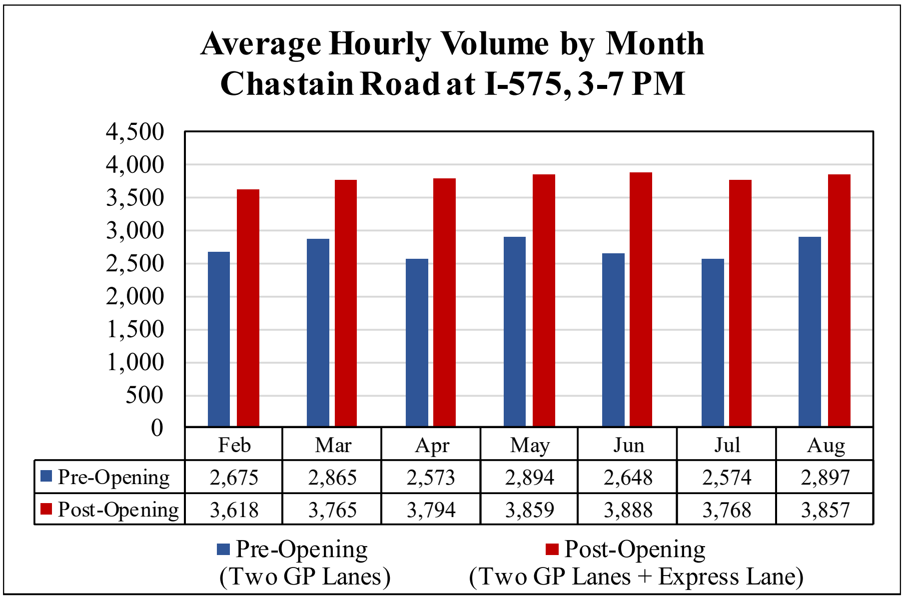
Note: Throughput in every cell is rounded to integers without further modification (i.e., the rounded ML and GP values might not sum to the value of ALL, but the total before rounding equals to the sum of these unrounded values).

Overall, a much larger increase in vehicle and person throughput was observed on the I-75/I-575 NWC compared with the I-85 corridor. The large increase is likely due to the opening of Express Lanes. The increased capacity reduced corridor congestion, which likely attracted commuters from other facilities (e.g., local arterial commute paths), may have attracted users from a larger geographic area), or may have attracted users back to the facility who may have diverted to other routes during facility construction (commuters who diverted to other facilities due to construction diverted back). The team conducted a supplemental QA/QC process on the input to NWC throughput assessment, which will be described in the following section. The throughput changes of Old Peachtree Road and those of Indian Trail/Lilburn Road at I-85 for PM peak are as anticipated by the research team (smaller than 10% change of vehicle throughput, and smaller than 5% change of person throughput). There is a decrease of Express Lane person throughput (1.3% for the AM peak and 6.9% for the PM peak) at Indian Trail/Lilburn Road at I-85, but these changes could be irrelevant or hardly influenced by the opening of the extension, due to the distance from Indian Trail/Lilburn Road to the extension location. For I-85, the changes for PM peak hours are greater compared with those of AM peak hours both in vehicle and person throughput, while for NWC larger increases are observed in the morning peaks. It may be that the opening of NWC Express Lane facilities relived congestion, and the corridor subsequently attracted additional morning commuters who formerly made their commute during the shoulder of peak period.

10.1 Verification of Throughput Changes at I-75/I-575 NWC

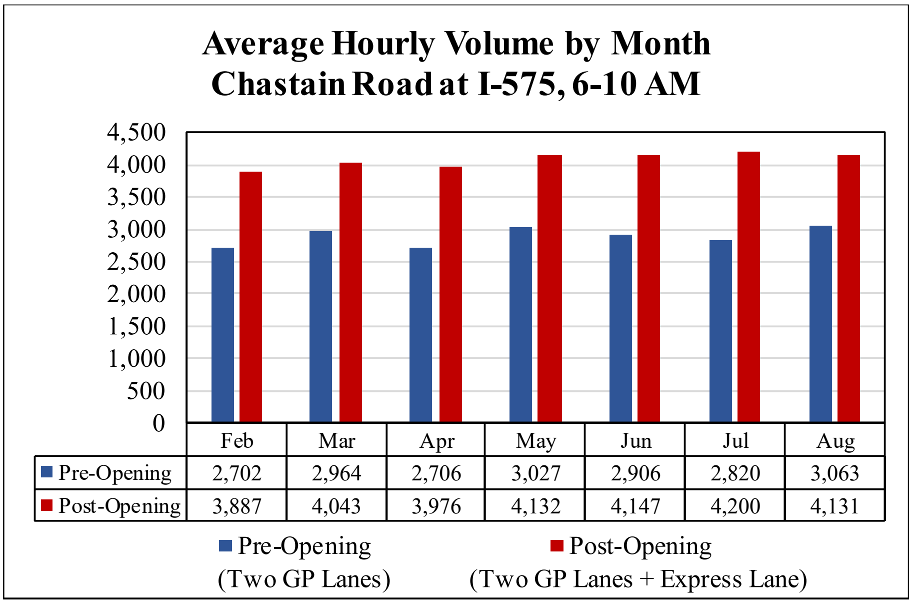
The research team noticed the large increase in vehicle volumes at Chastain Road at I-575 for both 6-10 AM (38.8%) and 3-7 PM (35.6%) and at Hickory Grove Road at I-75 for 6-10 AM (19.1%). The large increase was initially suspected of being a data issue, perhaps associated with a NaviGAtor Express Lane device mismatch, poor data quality, etc. However, it also might have meant that the post-opening scenario resulted in a large portion of increase in commute travel demand on I-75/I-575. It was important to investigate the source of the large throughput increase, and to conduct a supplemental QA/QC process to make sure the input data were valid. This section describes the assessment efforts and the conclusion that the traffic volumes and person throughput did indeed increase.

Figure 94 (Chastain Road at I-575, AM peak), Figure 95 (Chastain Road at I-575, PM peak), and Figure 96 (Hickory Grove Road at I-75, AM peak) illustrate the large increase in average hourly vehicle volume (i.e., input to the vehicle throughput assessment) on the NWC, from the GA NaviGAtor database. The hourly volume for Chastain Road at I-575 increased by approximately 41.2% in the morning peak, and 38.8% in the evening peak, and the traffic volumes at Hickory Grove Road at I-75 increased by approximately 20.5%.



	Feb	Mar	Apr	May	Jun	Jul	Aug
Pre-Opening	2,675	2,865	2,573	2,894	2,648	2,574	2,897
Post-Opening	3,618	3,765	3,794	3,859	3,888	3,768	3,857

Figure 94 – Hourly Traffic Volume (Tuesday, Wednesday and Thursday) by Month, Chastain Road at I-575, AM Peak (6-10 AM), All Lanes



	Feb	Mar	Apr	May	Jun	Jul	Aug
Pre-Opening	2,702	2,964	2,706	3,027	2,906	2,820	3,063
Post-Opening	3,887	4,043	3,976	4,132	4,147	4,200	4,131

Figure 95 – Hourly Traffic Volume (Tuesday, Wednesday and Thursday) by Month, Chastain Road at I-575, PM Peak (3-7 PM), All Lanes

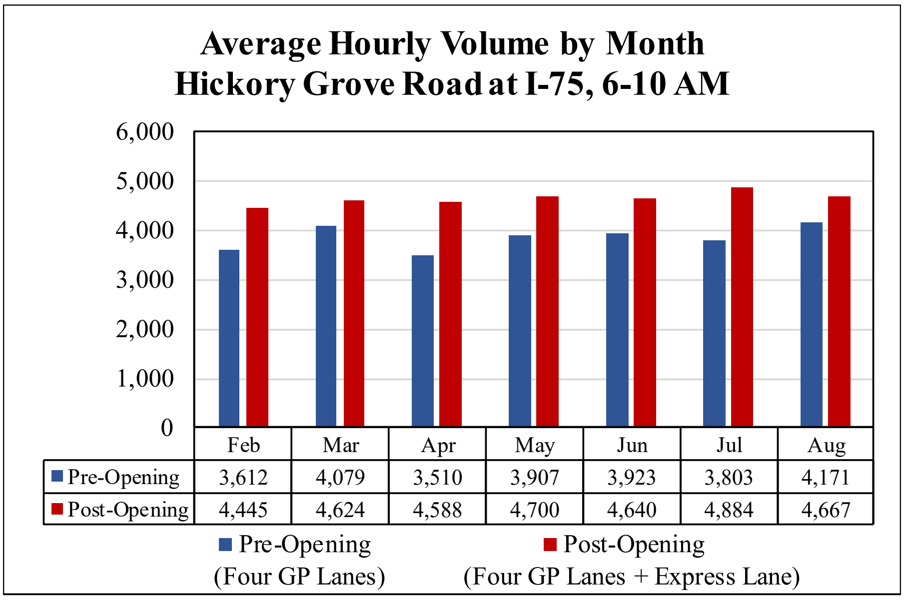


Figure 96 – Hourly Traffic Volume (Tuesday, Wednesday and Thursday) by Month, Hickory Grove Road at I-75, AM Peak (6-10 AM), All Lanes

GDOT constructed additional VDS devices to accommodate the facility change, separated from the existing devices that capture the flow of the GP lanes, and these new devices for the Express Lane were used to further verify the change in traffic operations. The following steps were implemented to validate the volume profiles as input to the throughput assessment of I-75/I-575 NWC.

1. Review of QA/QC and Imputation Methodology

All the 20-second speed and volume profiles were thoroughly reviewed to make sure they were processed following the QA/QC procedure described in Section 3.3. The imputation was also checked to make sure it strictly followed the proposed methodology. The time-series of speed and volumes at 5-minute bins were also reviewed for potential extreme values. No errors or misconduct was found in this step.

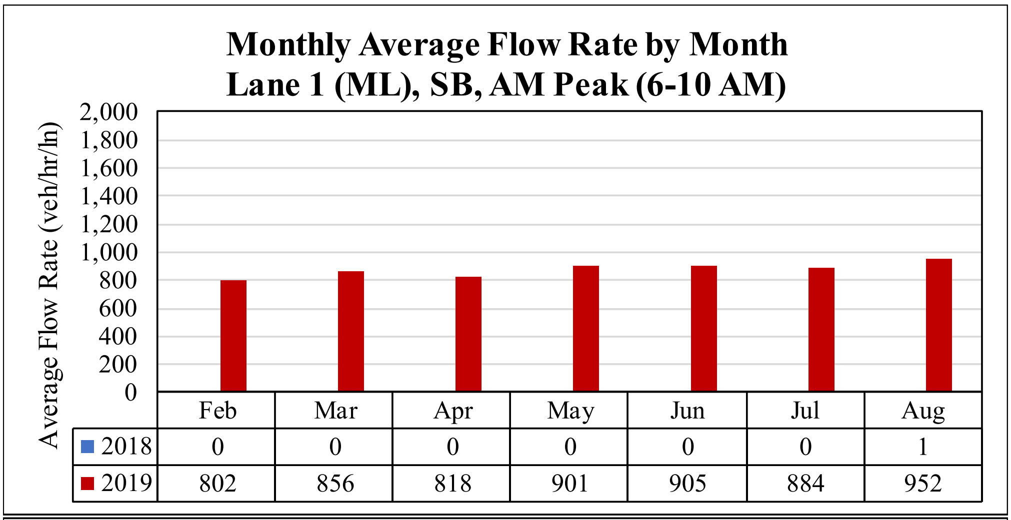
2. Review of Lane-by-Lane Average Flow Rate by Month

The flow rates data (hourly volume per lane) of Chastain Road at I-575 were reviewed on a lane-by-lane basis for the year of 2018 (pre-opening) and 2019 (post-opening). From a perspective of traffic engineering and traffic flow theory, flow rates of a specific lane usually fall into a common range. Also, the managed lane usually has a lower capacity than the adjacent GP lanes. Figure 97 and Figure 98 present the monthly average flow for AM peaks (6-10 AM) and PM peaks (3-7 PM), respectively, in vehicle/hour/lane.

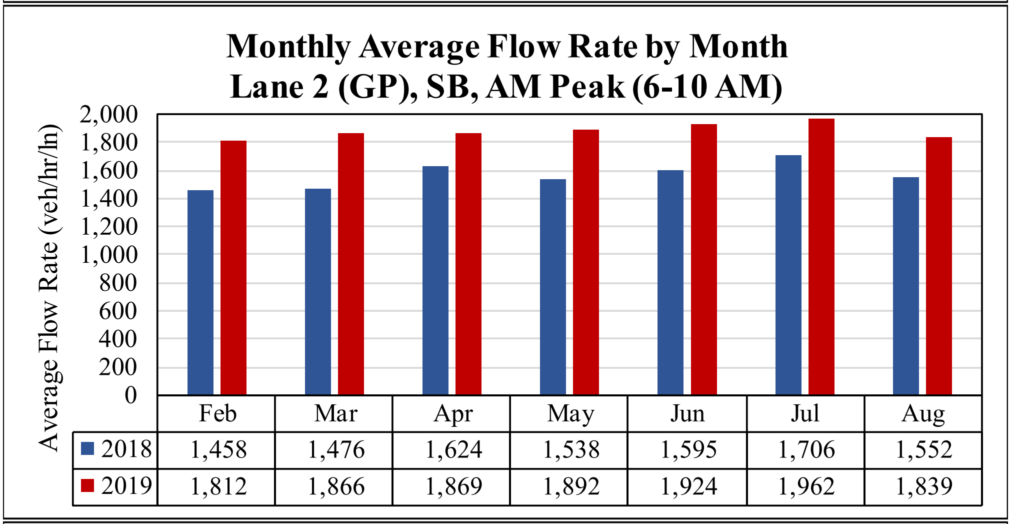
With respect to the average flow rate for the Express Lane (Lane #1), the managed lanes in both directions were major contributors to the large increase in corridor traffic volumes. The average monthly flow rate of the Express Lane ranges from 802 to 952 vehicles/hour/lane for Southbound (AM peak), and from 1,049 to 1,193 vehicles/hour/lane for Northbound (PM peak). As noted above, Express Lane volumes and speeds were measured by independent NaviGAtor devices that are separated from the GP lanes. While the managed lane devices might have been over-counting the traffic volumes (e.g., poor calibration or using inappropriate Express-Lane devices to pair with GP-lane devices), this seems unlikely given that the average flow rates of the Express Lane are less than those of the GP lanes. The team did not identify any bias or error in the volumes of the Express Lane. Additional ground truth data would be required for further cross-validation.

The second finding lies in the significant volume increase of Lane #2 (the inside GP lane). Although the average flow rate after the increase is still considered within a reasonable range (approximately 1,900 vehicles/hour/lane). The increase might have resulted from a re-calibration of the VDS device, but there were no obvious signs that this would be likely. It seems more likely that traffic diverted from other routes or the shoulder of the peak into the primary morning peak once congestion declined.

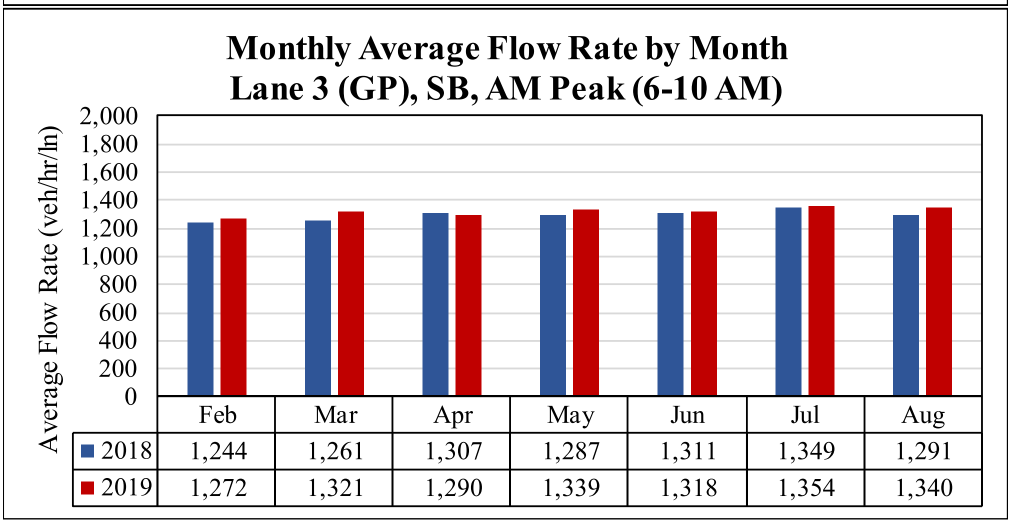
To address these concerns, the team then implemented a cross validation of nearby devices (one parallel I-75 station and upstream and downstream stations of the same corridor), followed by a manual count of traffic volumes from the field recorded video profiles.



	Feb	Mar	Apr	May	Jun	Jul	Aug
2018	0	0	0	0	0	0	1
2019	802	856	818	901	905	884	952

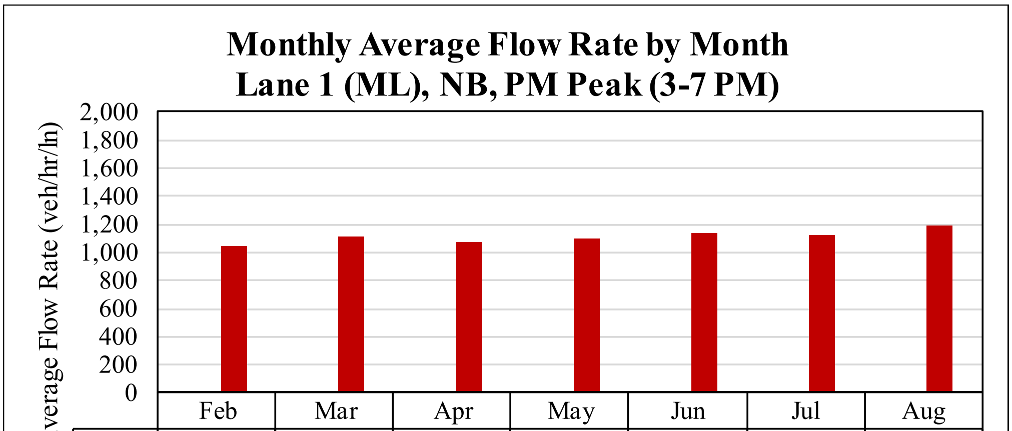


	Feb	Mar	Apr	May	Jun	Jul	Aug
2018	1,458	1,476	1,624	1,538	1,595	1,706	1,552
2019	1,812	1,866	1,869	1,892	1,924	1,962	1,839

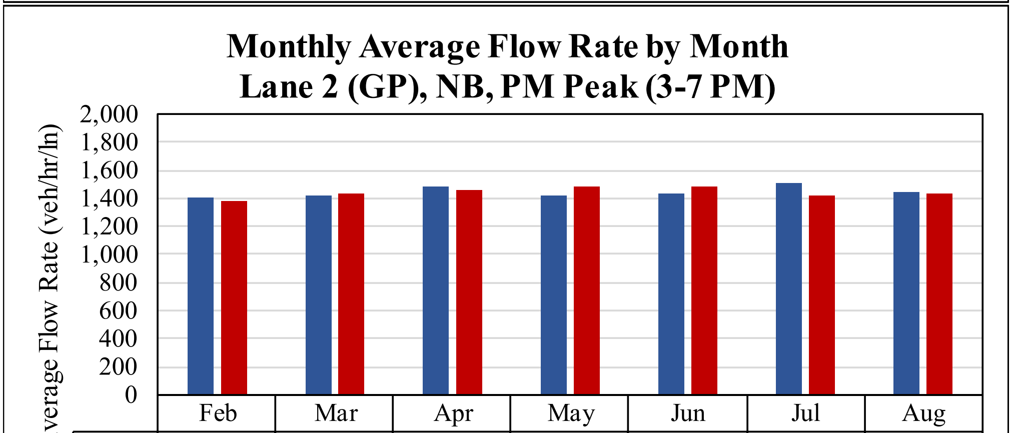


	Feb	Mar	Apr	May	Jun	Jul	Aug
2018	1,244	1,261	1,307	1,287	1,311	1,349	1,291
2019	1,272	1,321	1,290	1,339	1,318	1,354	1,340

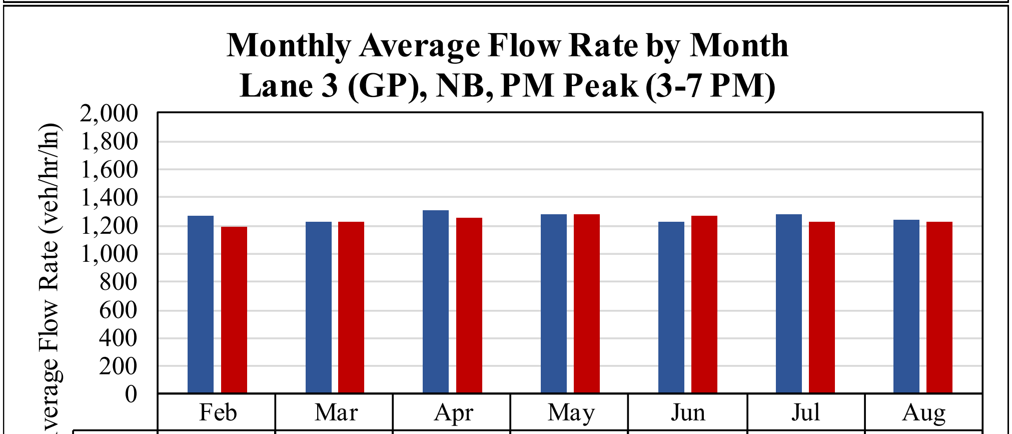
Figure 97 – Average Flow Rate by Month,
Chastain Road at I-575, AM Peak (6-10 AM)



	Feb	Mar	Apr	May	Jun	Jul	Aug
2018	0	0	0	0	0	0	1
2019	1,049	1,109	1,078	1,100	1,135	1,127	1,193



	Feb	Mar	Apr	May	Jun	Jul	Aug
2018	1,411	1,413	1,482	1,422	1,425	1,504	1,441
2019	1,385	1,432	1,463	1,484	1,488	1,413	1,436



	Feb	Mar	Apr	May	Jun	Jul	Aug
2018	1,264	1,232	1,305	1,279	1,223	1,285	1,247
2019	1,184	1,225	1,253	1,276	1,265	1,228	1,228

Figure 98 – Average Flow Rate by Month, Chastain Road at I-575, PM Peak (3-7 PM)

3. Cross Validation using the Parallel Site at I-75

As mentioned above, the large increase could be due to the diversion from I-75. The data of a pair of NaviGAtor devices were retrieved to provide the volumes of Chastain Road at I-75 (as shown in Figure 99), to be compared with the studied site of Chastain at I-575.

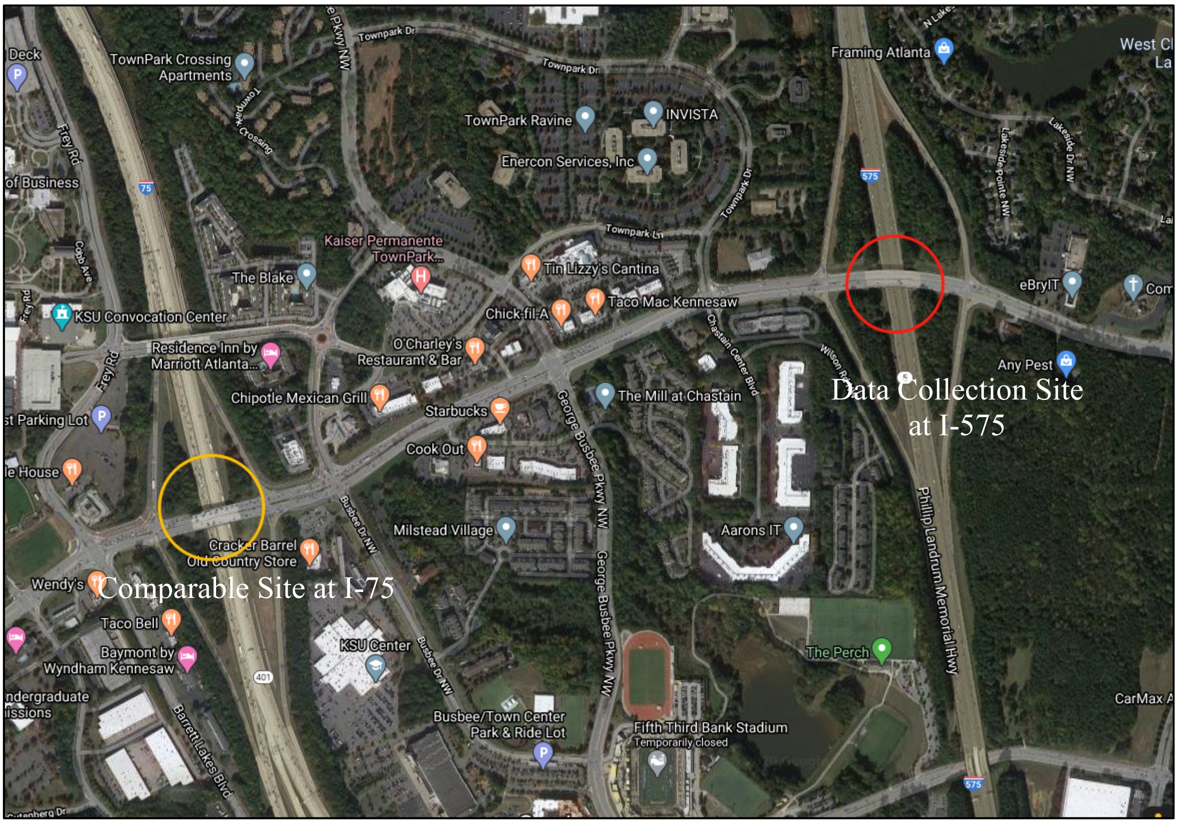


Figure 99 – Comparable Site of Chastain Road at I-75
(Source: https://www.google.com/maps)

The comparable site was also found to have significant increase in volumes from 2018 to 2019 (same peak hours of the same months), as shown in Table 54. The volume increases of I-75 are not as large as those of I-575, but they are still large increases, especially in the AM peak (41.4% increase in the AM peaks and 18.2% increase in the PM peaks). Hence, a large increase in volume also occurred on the parallel I-75 corridor. The I-575 and I-75 Express Lane both opened in September 2018, and flows are measured by different stations on these corridors.

Table 54 – Changes of Daily Vehicle Throughput of the Comparable Site, Chastain Road at I-75, February-August

Direction	Lane Type	Pre-HOT Volume	Post-HOT Volume	Volume Change	Percent Change
Southbound (AM Peak)	GP	13,595	16,053	2,458	18.1%
Southbound (AM Peak)	ML	N/A	3,168	N/A	N/A
Southbound (AM Peak)	Total	13,595	19,221	5,626	41.4%
Northbound (PM Peak)	GP	17,273	16,524	-749	-4.3%
Northbound (PM Peak)	ML	N/A	3,891	N/A	N/A
Northbound (PM Peak)	Total	17,273	20,415	3,142	18.2%

4. Review of Upstream and Downstream NaviGAtor Devices

The traffic flow along the Interstate increases/decreases with the entrance and exit ramps as vehicles enter and leave the restricted highway. However, the traffic volumes at a given location can be (to some extent) reflected by analyzing both upstream and downstream traffic flow. In this step, for both directions, three adjacent NaviGAtor devices were compared with the studied site, as presented in Table 55.

Table 55 – Selected Upstream and Downstream NaviGAtor Devices

ID	Direction	Downstream/ Upstream	Description (Relative to the Studied Site)
Northbound Device #1	Northbound (PM Peaks)	Upstream	1 Mile Upstream
Northbound Device #2	Northbound (PM Peaks)	Upstream	0.6 Mile Upstream
Northbound Device #3	Northbound (PM Peaks)	Downstream	0.2 Mile Downstream
Southbound Device #1	Southbound (AM Peaks)	Upstream	1.5 Miles Upstream
Southbound Device #2	Southbound (AM Peaks)	Downstream	0.6 Mile Downstream
Southbound Device #3	Southbound (AM Peaks)	Downstream	1 Mile Downstream

The volume increases of these upstream/downstream devices from 2018 to 2019 (same peak hours and same months) are shown in Figure 100.

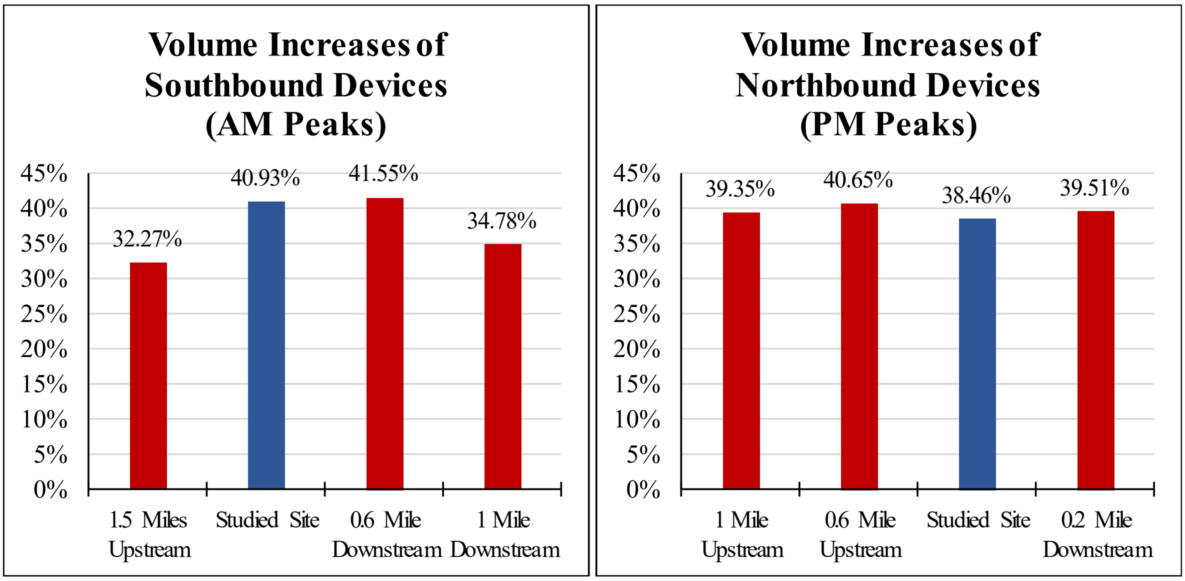


Figure 100 – Percent Changes in Vehicle Throughput of Upstream and Downstream Sites

All upstream and downstream devices show an increase in volumes greater than 32%. However, this cannot be considered solid evidence to prove the data quality of the studied site for following reasons. I) Again, the Express Lane of all these sites were measured by devices separate from GP lanes, and the Express Lane devices could share the same bias or error. II) There are entrance/exit ramps between these devices and the sites, indicating traffic may enter or leave the restricted highway in between. III) The previous study (Castrillon, et al., 2012) has indicated that upstream and downstream devices may have different biases and they cannot be used for cross-site calibration.

5. Video Count Quality Assurance/Quality Control (QA/QC) with Manual Count Effort and NaviGator Data

To verify the NaviGAtor profiles with respect to number of vehicles, the team conducted a comparison between manual count vs. provided traffic volumes based on samples of video profiles. The team randomly sampled one three-hour AM peak session on Chastain Road at I-575, and manually counted the number of vehicles by lane to compare with the NaviGAtor traffic volume (pre-processed following the methodology in section 3.3). The major objective of this QA/QC process is to verify the volume of the Express Lane (main cause of the large throughput increase), and the three-hour sample indicates a non-trivia contribution of the Express Lane traffic to the corridor.

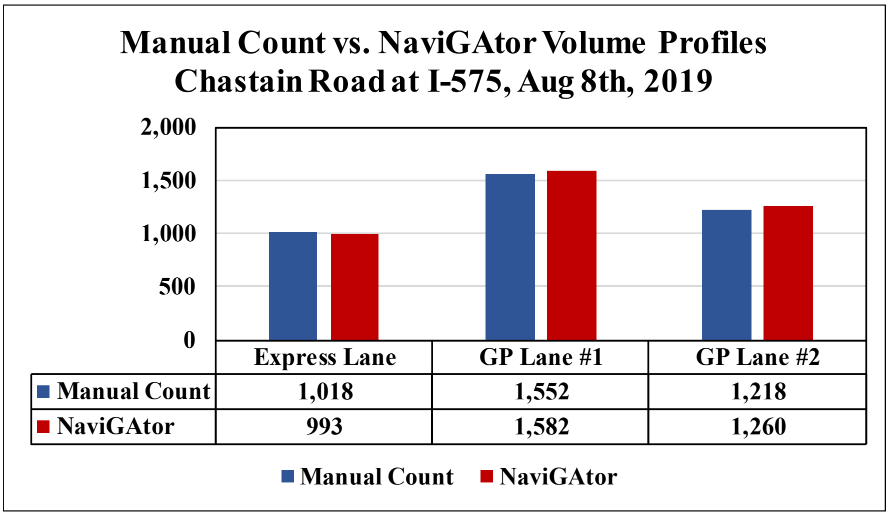


Figure 101 – Verification of NaviGAtor Volume of the Express Lane, Chastain Road at I-575 (Sample of Aug 8th, 2019)

The team also sampled three other 10-minute sessions across all dates for the other GP lanes and found similar results as shown in Figure 102. The comparison between manual vehicle count vs. NaviGAtor did not identify any bias (i.e., any systematic overestimation or underestimation) that leads to the large throughput increase due to NaviGAtor data quality, although some of the sessions indicate a little over-counting and some under-counting, which could be due to the location discrepancy between the overpass to capture the video vs. the poles installed with NaviGAtor devices (in which case these differences can cancel each other off in a larger time period).

The results of the comparisons indicate the validity of the findings with respect to the large increase on the NWC. The large increase is likely associated with the opening of Express Lanes, which may have attracted commuters from a larger region, captured drivers previously using arterial facilities (perhaps a significant share of which are commuters who diverted to other facilities due to construction and then diverted back), or induced new trips. Given that no significant expansion of the commutershed was observed (Guensler, et al. 2021), it seems unlikely that the new Express Lanes are attracting commuters from a larger region. Given that the increase is noted in the morning commute period, it seems unlikely that the new facility is inducing significant numbers of new trips (morning peak travel is primarily composed of commute trips). The most likely explanation is that the congestion relief on the corridor resulted in diversion of trips from arterials to the freeway corridor and perhaps trips previously made on the shoulder of the peak into the peak after congestion decreased. The increased throughput likely represents baseline period potential users of the Interstate who previously chose alternative arterial routes or departure times until congestion declined. Survey efforts are needed to obtain more detailed data from users about the reasons for the observed travel changes.

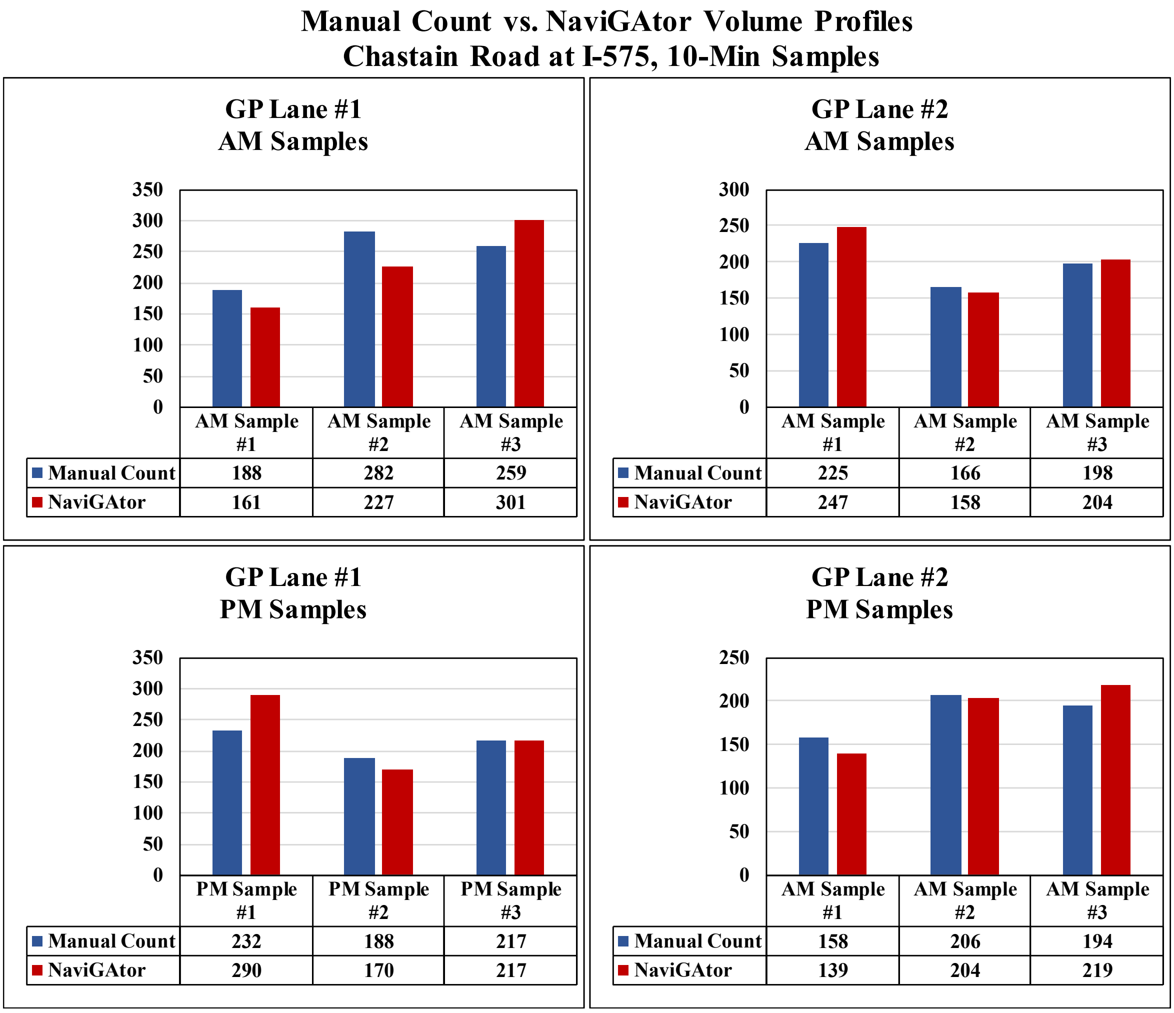


Figure 102 – Manual Count vs. NaviGAtor Volume Profiles with 10-Min Samples, Chastain Road at I-575

10.2 Changes in Vehicle Throughput by Lane and Mode

After the opening of the Express Lane facilities, the research team anticipated changes in traffic volumes and occupancy in both the morning and afternoon peak periods. The assessment of person throughput on the corridor in the next sections necessarily involves the application of corridor vehicle occupancy results to monthly volumes by lane which were extracted from the VDS system as described in Chapter 3.

A detailed breakdown of vehicle throughput by occupancy mode (Table 58 through Table 65) and by occupancy mode plus lane type (Table 66 through Table 75) are presented in this section. A large increase similar to (although not as large as) Chastain Road was identified as Hickory Grove Road at I-75. The throughput changes of Old Peachtree Road are more as anticipated by the research team (smaller than 10% change of vehicle throughput, and smaller than 1% change of person throughput).

Overall, the decrease of carpool activities (HOV2 and HOV3+) occur at all sites for both morning peaks and evening peaks. The only exceptions are the HOV3+ increase of Chastain Road at I-575 for morning peaks, and the HOV2 and HOV3+ increase of Hickory Grove Road at I-75 for morning peaks (there is also an increase in SOV of Hickory Grove Road at I-75 for morning peaks at the same time). Also, more three-person carpools are using the GP lanes rather than the managed lanes, as also noted in the 2010-2012 project. That project (Guensler, et al., 2013b) indicated that in the afternoon peak, there were actually more HOV2+ vehicles using the I-85 GP lanes than the total number of vehicles using the HOT lane, but this no longer appears to be true nearly ten years later.

Table 56 – Vehicle Throughput per Session by Occupancy Mode, Chastain Road at I-575, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Volume	Pre-Opening Mode %	Post-Opening Volume	Post-Opening Mode %	Volume Change	Percent Change
SOV	10,148	88.9%	14,975	91.8%	4,827	47.6%
HOV2	1,214	10.6%	1,261	7.7%	47	3.8%
HOV3+	54	0.5%	67	0.4%	13	25.1%
Vanpool	0	0.0%	0	0.0%	0	N/A
Xpress	2	0.0%	2	0.0%	0	8.8%
CobbLinc	0	0.0%	0	0.0%	0	N/A
GCT	0	0.0%	0	0.0%	0	N/A
Total	11,417	100.0%	16,304	100.0%	4,887	42.8%

* The percent changes are calculated based on unrounded results of vehicle and person throughput.

Table 57 – Vehicle Throughput per Session by Occupancy Mode, Chastain Road at I-575, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Volume	Pre-Opening Mode %	Post-Opening Volume	Post-Opening Mode %	Volume Change	Percent Change
SOV	9,222	85.3%	13,429	88.5%	4,207	45.6%
HOV2	1,476	13.6%	1,666	11.0%	190	12.9%
HOV3+	111	1.0%	78	0.5%	-33	-29.5%
Vanpool	2	0.0%	2	0.0%	0	20.8%
Xpress	4	0.0%	3	0.0%	0	-9.3%
CobbLinc	0	0.0%	0	0.0%	0	N/A
GCT	0	0.0%	0	0.0%	0	N/A
Total	10,815	100.0%	15,179	100.0%	4,365	40.4%

Table 58 – Vehicle Throughput per Session by Occupancy Mode, Hickory Grove Road at I-75, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Volume	Pre-Opening Mode %	Post-Opening Volume	Post-Opening Mode %	Volume Change	Percent Change
SOV	13,326	87.7%	16,671	90.1%	3,345	25.1%
HOV2	1,797	11.8%	1,765	9.5%	-32	-1.8%
HOV3+	61	0.4%	54	0.3%	-7	-11.3%
Vanpool	0	0.0%	1	0.0%	1	N/A
Xpress	2	0.0%	2	0.0%	0	5.6%
CobbLinc	3	0.0%	4	0.0%	0	4.1%
GCT	0	0.0%	0	0.0%	0	N/A
Total	15,189	100.0%	18,496	100.0%	3,307	21.8%

Table 59 – Vehicle Throughput per Session by Occupancy Mode, Hickory Grove Road at I-75, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Volume	Pre-Opening Mode %	Post-Opening Volume	Post-Opening Mode %	Volume Change	Percent Change
SOV	14,754	84.4%	16,281	88.2%	1,527	10.4%
HOV2	2,540	14.5%	1,999	10.8%	-540	-21.3%
HOV3+	167	1.0%	159	0.9%	-8	-4.9%
Vanpool	5	0.0%	4	0.0%	-1	-16.0%
Xpress	5	0.0%	4	0.0%	-1	-11.4%
CobbLinc	7	0.0%	6	0.0%	-1	-11.8%
GCT	0	0.0%	0	0.0%	0	N/A
Total	17,477	100.0%	18,454	100.0%	977	5.6%

Table 60 – Vehicle Throughput per Session by Occupancy Mode,
Indian Trail/Lilburn Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Volume	Pre-Opening Mode %	Post-Opening Volume	Post-Opening Mode %	Volume Change	Percent Change
SOV	29,835	88.1%	32,960	92.2%	3,125	10.5%
HOV2	3,784	11.2%	2,646	7.4%	-1,138	-30.1%
HOV3+	210	0.6%	103	0.3%	-107	-50.8%
Vanpool	6	0.0%	7	0.0%	1	13.1%
Xpress	19	0.1%	19	0.1%	0	1.1%
CobbLinc	0	0.0%	0	0.0%	0	N/A
GCT	20	0.1%	21	0.1%	1	5.0%
Total	33,874	100.0%	35,756	100.0%	1,882	5.6%

Table 61 – Vehicle Throughput per Session by Occupancy Mode,
Indian Trail/Lilburn Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Volume	Pre-Opening Mode %	Post-Opening Volume	Post-Opening Mode %	Volume Change	Percent Change
SOV	24,343	84.9%	27,894	89.1%	3,552	14.6%
HOV2	3,994	13.9%	3,121	10.0%	-873	-21.8%
HOV3+	278	1.0%	206	0.7%	-72	-25.8%
Vanpool	16	0.1%	17	0.1%	1	7.4%
Xpress	30	0.1%	31	0.1%	1	1.9%
CobbLinc	0	0.0%	0	0.0%	0	N/A
GCT	25	0.1%	27	0.1%	2	8.0%
Total	28,686	100.0%	31,297	100.0%	2,611	9.1%

Table 62 – Vehicle Throughput per Session by Occupancy Mode, Old Peachtree Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Volume	Pre-Opening Mode %	Post-Opening Volume	Post-Opening Mode %	Volume Change	Percent Change
SOV	18,068	88.00%	20,388	92.68%	2,321	12.84%
HOV2	2,330	11.35%	1,515	6.89%	-815	-34.98%
HOV3+	113	0.55%	74	0.34%	-39	-34.30%
Vanpool	1	0.00%	1	0.00%	0	-13.64%
Xpress	14	0.07%	15	0.07%	1	9.52%
CobbLinc	0	0.00%	0	0.00%	0	N/A
GCT	6	0.03%	6	0.03%	0	0.00%
Total	20,531	100.00%	21,999	100.00%	1,468	7.15%

Table 63 – Vehicle Throughput per Session by Occupancy Mode, Old Peachtree Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Volume	Pre-Opening Mode %	Post-Opening Volume	Post-Opening Mode %	Volume Change	Percent Change
SOV	18,141	83.34%	21,448	89.81%	3,307	18.23%
HOV2	3,291	15.12%	2,251	9.43%	-1,040	-31.60%
HOV3+	302	1.39%	136	0.57%	-166	-55.00%
Vanpool	8	0.04%	13	0.06%	6	73.28%
Xpress	18	0.08%	24	0.10%	6	31.43%
CobbLinc	0	0.00%	0	0.00%	0	N/A
GCT	8	0.04%	10	0.04%	2	25.00%
Total	21,768	100.00%	23,882	100.00%	2,114	9.71%

Table 64 – Vehicle Throughput per Session by Occupancy Mode, Hamilton Mill Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Volume	Pre-Opening Mode %	Post-Opening Volume	Post-Opening Mode %	Volume Change	Percent Change
SOV	NA	NA	11,204	95.3%	NA	NA
HOV2	NA	NA	533	4.5%	NA	NA
HOV3+	NA	NA	21	0.2%	NA	NA
Vanpool	NA	NA	0	0.0%	NA	NA
Xpress	NA	NA	0	0.0%	NA	NA
CobbLinc	NA	NA	0	0.0%	NA	NA
GCT	NA	NA	0	0.0%	NA	NA
Total	NA	NA	11,758	100.0%	NA	NA

Table 65 – Vehicle Throughput per Session by Occupancy Mode, Hamilton Mill Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Volume	Pre-Opening Mode %	Post-Opening Volume	Post-Opening Mode %	Volume Change	Percent Change
SOV	NA	NA	7,527	89.9%	NA	NA
HOV2	NA	NA	807	9.6%	NA	NA
HOV3+	NA	NA	42	0.5%	NA	NA
Vanpool	NA	NA	0	0.0%	NA	NA
Xpress	NA	NA	0	0.0%	NA	NA
CobbLinc	NA	NA	0	0.0%	NA	NA
GCT	NA	NA	0	0.0%	NA	NA
Total	NA	NA	8,377	100.0%	NA	NA

Table 66 – Vehicle Throughput per Session by Occupancy Mode and Lane Type, Chastain Road at I-575, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Volume	Post-Opening Volume	Volume Change	Percent Change
SOV-GP	10,148	11,612	1,464	14.4%
HOV2-GP	1,214	1,131	-83	-6.9%
HOV3+-GP	54	62	8	15.7%
SOV-ML	0	3,363	3,363	N/A
HOV2-ML	0	130	130	N/A
HOV3+-ML	0	5	5	N/A
Vanpool	0	0	0	N/A
Xpress	2	2	0	8.8%
CobbLinc	0	0	0	N/A
GCT	0	0	0	N/A
Total	11,417	16,304	4,887	42.8%

Table 67 – Vehicle Throughput per Session by Occupancy Mode and Lane Type, Chastain Road at I-575, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Volume	Post-Opening Volume	Volume Change	Percent Change
SOV-GP	9,222	9,224	3	0.0%
HOV2-GP	1,476	1,426	-50	-3.4%
HOV3+-GP	111	74	-37	-33.3%
SOV-ML	0	4,205	4,205	N/A
HOV2-ML	0	240	240	N/A
HOV3+-ML	0	4	4	N/A
Vanpool	2	2	0	20.8%
Xpress	4	3	0	-9.3%
CobbLinc	0	0	0	N/A
GCT	0	0	0	N/A
Total	10,815	15,179	4,365	40.4%

Table 68 – Vehicle Throughput per Session by Occupancy Mode and Lane Type, Hickory Grove Road at I-75, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Volume	Post-Opening Volume	Volume Change	Percent Change
SOV-GP	13,326	14,765	1,438	10.8%
HOV2-GP	1,797	1,665	-132	-7.3%
HOV3+-GP	61	50	-11	-18.0%
SOV-ML	0	1,906	1,906	N/A
HOV2-ML	0	100	100	N/A
HOV3+-ML	0	4	4	N/A
Vanpool	0	1	1	N/A
Xpress	2	2	0	5.6%
CobbLinc	3	4	0	4.1%
GCT	0	0	0	N/A
Total	15,189	18,496	3,307	21.8%

Table 69 – Vehicle Throughput per Session by Occupancy Mode and Lane Type, Hickory Grove Road at I-75, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Volume	Post-Opening Volume	Volume Change	Percent Change
SOV-GP	14,754	14,829	75	0.5%
HOV2-GP	2,540	1,895	-645	-25.4%
HOV3+-GP	167	151	-16	-9.8%
SOV-ML	0	1,452	1,452	N/A
HOV2-ML	0	104	104	N/A
HOV3+-ML	0	8	8	N/A
Vanpool	5	4	-1	-16.0%
Xpress	5	4	-1	-11.4%
CobbLinc	7	6	-1	-11.8%
GCT	0	0	0	N/A
Total	17,477	18,454	977	5.6%

Table 70 – Vehicle Throughput per Session by Occupancy Mode and Lane Type, Indian Trail/Lilburn Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Volume	Post-Opening Volume	Volume Change	Percent Change
SOV-GP	24,717	27,352	2,636	10.7%
HOV2-GP	3,130	2,205	-925	-29.5%
HOV3+-GP	118	60	-58	-49.4%
SOV-ML	5,119	5,608	489	9.6%
HOV2-ML	654	440	-213	-32.6%
HOV3+-ML	92	43	-48	-52.7%
Vanpool	6	7	1	13.1%
Xpress	19	19	0	1.1%
CobbLinc	0	0	0	N/A
GCT	20	21	1	5.0%
Total	33,874	35,756	1,882	5.6%

Table 71 – Vehicle Throughput per Session by Occupancy Mode and Lane Type, Indian Trail/Lilburn Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Volume	Post-Opening Volume	Volume Change	Percent Change
SOV-GP	20,527	23,585	3,058	14.9%
HOV2-GP	3,227	2,660	-566	-17.5%
HOV3+-GP	137	154	18	12.9%
SOV-ML	3,816	4,309	494	12.9%
HOV2-ML	768	461	-306	-39.9%
HOV3+-ML	142	52	-89	-63.2%
Vanpool	16	17	1	7.4%
Xpress	30	31	1	1.9%
CobbLinc	0	0	0	N/A
GCT	25	27	2	8.0%
Total	28,686	31,297	2,611	9.1%

Table 72 – Vehicle Throughput per Session by Occupancy Mode and Lane Type, Old Peachtree Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Volume	Post-Opening Volume	Volume Change	Percent Change
SOV-GP	16,911	18,823	1,912	11.3%
HOV2-GP	2,118	1,372	-747	-35.3%
HOV3+-GP	102	64	-37	-36.6%
SOV-ML	1,157	1,565	409	35.4%
HOV2-ML	211	143	-68	-32.2%
HOV3+-ML	11	10	-2	-13.6%
Vanpool	1	1	0	-13.6%
Xpress	14	15	1	9.5%
CobbLinc	0	0	0	N/A
GCT	6	6	0	0.0%
Total	20,531	21,999	1,468	7.2%

Table 73 – Vehicle Throughput per Session by Occupancy Mode and Lane Type, Old Peachtree Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Volume	Post-Opening Volume	Volume Change	Percent Change
SOV-GP	15,468	18,533	3,065	19.8%
HOV2-GP	2,762	1,930	-831	-30.1%
HOV3+-GP	221	93	-128	-58.0%
SOV-ML	2,673	2,915	241	9.0%
HOV2-ML	529	321	-208	-39.4%
HOV3+-ML	81	43	-38	-46.8%
Vanpool	8	13	6	73.3%
Xpress	18	24	6	31.4%
CobbLinc	0	0	0	N/A
GCT	8	10	2	25.0%
Total	21,768	23,882	2,114	9.7%

Table 74 – Vehicle Throughput per Session by Occupancy Mode and Lane Type, Hamilton Mill Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Volume	Post-Opening Volume	Volume Change	Percent Change
SOV-GP	NA	11,204	NA	NA
HOV2-GP	NA	533	NA	NA
HOV3+-GP	NA	21	NA	NA
SOV-ML	NA	0	NA	NA
HOV2-ML	NA	0	NA	NA
HOV3+-ML	NA	0	NA	NA
Vanpool	NA	0	NA	NA
Xpress	NA	0	NA	NA
CobbLinc	NA	0	NA	NA
GCT	NA	0	NA	NA
Total	NA	11,758	NA	NA

Table 75 – Vehicle Throughput per Session by Occupancy Mode and Lane Type, Hamilton Mill Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Volume	Post-Opening Volume	Volume Change	Percent Change
SOV-GP	NA	7,527	NA	NA
HOV2-GP	NA	807	NA	NA
HOV3+-GP	NA	42	NA	NA
SOV-ML	NA	0	NA	NA
HOV2-ML	NA	0	NA	NA
HOV3+-ML	NA	0	NA	NA
Vanpool	NA	0	NA	NA
Xpress	NA	0	NA	NA
CobbLinc	NA	0	NA	NA
GCT	NA	0	NA	NA
Total	NA	8,377	NA	NA

10.3 Changes in Person Throughput by Lane and Mode

After the opening of the HOT lanes, the anticipated change of traffic volumes occurred concurrently with the decrease in vehicle occupancy rates. Table 76 through Table 85 break the corridor person throughput into occupancy classifications. Overall, since the carpooling fraction decreases for all sites (smaller average occupancy), any person throughput increases are smaller than those for vehicle throughput.

Table 76 – Person Throughput per Session by Occupancy Mode, Chastain Road at I-575, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Persons	Pre-Opening Mode %	Post-Opening Persons	Post-Opening Mode %	Person Change	Percent Change
SOV	10,148	79.3%	14,975	84.3%	4,827	47.6%
HOV2	2,428	19.0%	2,521	14.2%	93	3.8%
HOV3+	185	1.4%	221	1.2%	37	19.8%
Vanpool	0	0.0%	0	0.0%	0	N/A
Xpress	35	0.3%	44	0.2%	9	26.0%
CobbLinc	0	0.0%	0	0.0%	0	N/A
GCT	0	0.0%	0	0.0%	0	N/A
Total	12,796	100.0%	17,761	100.0%	4,966	38.8%

Table 77 – Person Throughput per Session by Occupancy Mode, Chastain Road at I-575, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Persons	Pre-Opening Mode %	Post-Opening Persons	Post-Opening Mode %	Person Change	Percent Change
SOV	9,222	73.1%	13,429	78.5%	4,207	45.6%
HOV2	2,951	23.4%	3,331	19.5%	380	12.9%
HOV3+	367	2.9%	258	1.5%	-109	-29.6%
Vanpool	9	0.1%	15	0.1%	6	63.7%
Xpress	70	0.6%	73	0.4%	3	5.0%
CobbLinc	0	0.0%	0	0.0%	0	N/A
GCT	0	0.0%	0	0.0%	0	N/A
Total	12,619	100.0%	17,107	100.0%	4,488	35.6%

Table 78 – Person Throughput per Session by Occupancy Mode, Hickory Grove Road at I-75, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Persons	Pre-Opening Mode %	Post-Opening Persons	Post-Opening Mode %	Person Change	Percent Change
SOV	13,326	77.4%	16,671	81.3%	3,345	25.1%
HOV2	3,593	20.9%	3,530	17.2%	-63	-1.8%
HOV3+	210	1.2%	174	0.8%	-36	-17.1%
Vanpool	0	0.0%	3	0.0%	3	N/A
Xpress	50	0.3%	53	0.3%	2	4.8%
CobbLinc	33	0.2%	78	0.4%	44	132.0%
GCT	0	0.0%	0	0.0%	0	N/A
Total	17,214	100.0%	20,509	100.0%	3,295	19.1%

Table 79 – Person Throughput per Session by Occupancy Mode, Hickory Grove Road at I-75, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Persons	Pre-Opening Mode %	Post-Opening Persons	Post-Opening Mode %	Person Change	Percent Change
SOV	14,754	71.6%	16,281	77.5%	1,527	10.4%
HOV2	5,079	24.7%	3,999	19.0%	-1,081	-21.3%
HOV3+	545	2.6%	522	2.5%	-23	-4.3%
Vanpool	25	0.1%	22	0.1%	-3	-11.2%
Xpress	126	0.6%	109	0.5%	-17	-13.5%
CobbLinc	73	0.4%	80	0.4%	7	10.3%
GCT	0	0.0%	0	0.0%	0	N/A
Total	20,602	100.0%	21,013	100.0%	411	2.0%

Table 80 – Person Throughput per Session by Occupancy Mode, Indian Trail/Lilburn Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Persons	Pre-Opening Mode %	Post-Opening Persons	Post-Opening Mode %	Person Change	Percent Change
SOV	29,835	76.3%	32,960	83.2%	3,125	10.5%
HOV2	7,568	19.4%	5,292	13.4%	-2,276	-30.1%
HOV3+	735	1.9%	364	0.9%	-371	-50.5%
Vanpool	25	0.1%	27	0.1%	2	8.4%
Xpress	559	1.4%	586	1.5%	27	4.9%
CobbLinc	0	0.0%	0	0.0%	0	N/A
GCT	382	1.0%	365	0.9%	-17	-4.4%
Total	39,104	100.0%	39,594	100.0%	490	1.3%

Table 81 – Person Throughput per Session by Occupancy Mode, Indian Trail/Lilburn Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Persons	Pre-Opening Mode %	Post-Opening Persons	Post-Opening Mode %	Person Change	Percent Change
SOV	24,343	69.8%	27,894	76.7%	3,552	14.6%
HOV2	7,988	22.9%	6,243	17.2%	-1,745	-21.8%
HOV3+	1,032	3.0%	709	2.0%	-323	-31.3%
Vanpool	79	0.2%	92	0.3%	13	16.2%
Xpress	806	2.3%	853	2.3%	47	5.8%
CobbLinc	0	0.0%	0	0.0%	0	N/A
GCT	630	1.8%	581	1.6%	-49	-7.7%
Total	34,879	100.0%	36,374	100.0%	1,494	4.3%

Table 82 – Person Throughput per Session by Occupancy Mode, Old Peachtree Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Persons	Pre-Opening Mode %	Post-Opening Persons	Post-Opening Mode %	Person Change	Percent Change
SOV	18,068	76.5%	20,388	84.4%	2,321	12.8%
HOV2	4,659	19.7%	3,029	12.5%	-1,630	-35.0%
HOV3+	393	1.7%	245	1.0%	-148	-37.7%
Vanpool	3	0.0%	4	0.0%	1	23.7%
Xpress	407	1.7%	424	1.8%	17	4.1%
CobbLinc	0	0.0%	0	0.0%	0	N/A
GCT	73	0.3%	65	0.3%	-8	-10.7%
Total	23,603	100.0%	24,155	100.0%	552	2.3%

Table 83 – Person Throughput per Session by Occupancy Mode, Old Peachtree Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Persons	Pre-Opening Mode %	Post-Opening Persons	Post-Opening Mode %	Person Change	Percent Change
SOV	18,141	68.6%	21,448	78.5%	3,307	18.2%
HOV2	6,582	24.9%	4,502	16.5%	-2,080	-31.6%
HOV3+	1,028	3.9%	466	1.7%	-562	-54.7%
Vanpool	37	0.1%	74	0.3%	38	103.2%
Xpress	527	2.0%	655	2.4%	128	24.4%
CobbLinc	0	0.0%	0	0.0%	0	N/A
GCT	148	0.6%	171	0.6%	23	15.5%
Total	26,462	100.0%	27,316	100.0%	854	3.2%

Table 84 – Person Throughput per Session by Occupancy Mode, Hamilton Mill Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Persons	Pre-Opening Mode %	Post-Opening Persons	Post-Opening Mode %	Person Change	Percent Change
SOV	NA	NA	11,204	90.8%	NA	NA
HOV2	NA	NA	1,067	8.6%	NA	NA
HOV3+	NA	NA	72	0.6%	NA	NA
Vanpool	NA	NA	0	0.0%	NA	NA
Xpress	NA	NA	0	0.0%	NA	NA
CobbLinc	NA	NA	0	0.0%	NA	NA
GCT	NA	NA	0	0.0%	NA	NA
Total	NA	NA	12,343	100.0%	NA	NA

Table 85 – Person Throughput per Session by Occupancy Mode, Hamilton Mill Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Persons	Pre-Opening Mode %	Post-Opening Persons	Post-Opening Mode %	Person Change	Percent Change
SOV	NA	NA	7,527	81.1%	NA	NA
HOV2	NA	NA	1,615	17.4%	NA	NA
HOV3+	NA	NA	145	1.6%	NA	NA
Vanpool	NA	NA	0	0.0%	NA	NA
Xpress	NA	NA	0	0.0%	NA	NA
CobbLinc	NA	NA	0	0.0%	NA	NA
GCT	NA	NA	0	0.0%	NA	NA
Total	NA	NA	9,287	100.0%	NA	NA

Table 86 – Person Throughput per Session by Occupancy Mode and Lane Type, Chastain Road at I-575, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Persons	Post-Opening Persons	Person Change	Percent Change
SOV-GP	10,148	11,612	1,464	14.4%
HOV2-GP	2,428	2,261	-166	-6.9%
HOV3+-GP	185	203	18	9.7%
SOV-ML	0	3,363	3,363	N/A
HOV2-ML	0	260	260	N/A
HOV3+-ML	0	19	19	N/A
Vanpool	0	0	0	N/A
Xpress	35	44	9	26.0%
CobbLinc	0	0	0	N/A
GCT	0	0	0	N/A
Total	12,796	17,761	4,966	38.8%

Table 87 – Person Throughput per Session by Occupancy Mode and Lane Type, Chastain Road at I-575, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Persons	Post-Opening Persons	Person Change	Percent Change
SOV-GP	9,222	9,224	3	0.0%
HOV2-GP	2,951	2,851	-100	-3.4%
HOV3+-GP	367	241	-126	-34.4%
SOV-ML	0	4,205	4,205	N/A
HOV2-ML	0	480	480	N/A
HOV3+-ML	0	17	17	N/A
Vanpool	9	15	6	63.7%
Xpress	70	73	3	5.0%
CobbLinc	0	0	0	N/A
GCT	0	0	0	N/A
Total	12,619	17,107	4,488	35.6%

Table 88 – Person Throughput per Session by Occupancy Mode and Lane Type, Hickory Grove Road at I-75, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Persons	Post-Opening Persons	Person Change	Percent Change
SOV-GP	13,326	14,765	1,438	10.8%
HOV2-GP	3,593	3,329	-264	-7.3%
HOV3+-GP	210	160	-51	-24.1%
SOV-ML	0	1,906	1,906	N/A
HOV2-ML	0	200	200	N/A
HOV3+-ML	0	15	15	N/A
Vanpool	0	3	3	N/A
Xpress	50	53	2	4.8%
CobbLinc	33	78	44	132.0%
GCT	0	0	0	N/A
Total	17,214	20,509	3,295	19.1%

Table 89 – Person Throughput per Session by Occupancy Mode and Lane Type, Hickory Grove Road at I-75, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Persons	Post-Opening Persons	Person Change	Percent Change
SOV-GP	14,754	14,829	75	0.5%
HOV2-GP	5,079	3,790	-1,289	-25.4%
HOV3+-GP	545	494	-51	-9.4%
SOV-ML	0	1,452	1,452	N/A
HOV2-ML	0	209	209	N/A
HOV3+-ML	0	28	28	N/A
Vanpool	25	22	-3	-11.2%
Xpress	126	109	-17	-13.5%
CobbLinc	73	80	7	10.3%
GCT	0	0	0	N/A
Total	20,602	21,013	411	2.0%

Table 90 – Person Throughput per Session by Occupancy Mode and Lane Type, Indian Trail/Lilburn Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Persons	Post-Opening Persons	Person Change	Percent Change
SOV-GP	24,717	27,352	2,636	10.66%
HOV2-GP	6,260	4,411	-1,849	-29.54%
HOV3+-GP	389	191	-198	-50.99%
SOV-ML	5,119	5,608	489	9.55%
HOV2-ML	1,308	881	-427	-32.64%
HOV3+-ML	346	173	-173	-49.92%
Vanpool	25	27	2	8.37%
Xpress	559	586	27	4.92%
CobbLinc	0	0	0	N/A
GCT	382	365	-17	-4.40%
Total	39,104	39,594	490	1.25%

Table 91 – Person Throughput per Session by Occupancy Mode and Lane Type, Indian Trail/Lilburn Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Persons	Post-Opening Persons	Person Change	Percent Change
SOV-GP	20,527	23,585	3,058	14.90%
HOV2-GP	6,453	5,321	-1,132	-17.55%
HOV3+-GP	437	506	70	15.97%
SOV-ML	3,816	4,309	494	12.93%
HOV2-ML	1,535	922	-613	-39.91%
HOV3+-ML	596	203	-393	-65.90%
Vanpool	79	92	13	16.16%
Xpress	806	853	47	5.81%
CobbLinc	0	0	0	N/A
GCT	630	581	-49	-7.75%
Total	34,879	36,374	1,494	4.28%

Table 92 – Person Throughput per Session by Occupancy Mode and Lane Type, Old Peachtree Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Persons	Post-Opening Persons	Person Change	Percent Change
SOV-GP	16,911	18,823	1,912	11.30%
HOV2-GP	4,237	2,743	-1,494	-35.25%
HOV3+-GP	353	213	-140	-39.61%
SOV-ML	1,157	1,565	409	35.36%
HOV2-ML	422	286	-136	-32.23%
HOV3+-ML	40	32	-8	-20.86%
Vanpool	3	4	1	23.71%
Xpress	407	424	17	4.12%
CobbLinc	0	0	0	N/A
GCT	73	65	-8	-10.66%
Total	23,603	24,155	552	2.34%

Table 93 – Person Throughput per Session by Occupancy Mode and Lane Type, Old Peachtree Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Persons	Post-Opening Persons	Person Change	Percent Change
SOV-GP	15,468	18,533	3,065	19.82%
HOV2-GP	5,523	3,861	-1,663	-30.11%
HOV3+-GP	713	305	-408	-57.22%
SOV-ML	2,673	2,915	241	9.03%
HOV2-ML	1,059	642	-417	-39.37%
HOV3+-ML	314	161	-154	-48.89%
Vanpool	37	74	38	103.24%
Xpress	527	655	128	24.40%
CobbLinc	0	0	0	N/A
GCT	148	171	23	15.54%
Total	26,462	27,316	854	3.23%

Table 94 – Person Throughput per Session by Occupancy Mode and Lane Type, Hamilton Mill Road at I-85, February-August, AM Peak (6-10 AM)

Mode	Pre-Opening Persons	Post-Opening Persons	Person Change	Percent Change
SOV-GP	NA	11,204	NA	NA
HOV2-GP	NA	1,067	NA	NA
HOV3+-GP	NA	72	NA	NA
SOV-ML	NA	0	NA	NA
HOV2-ML	NA	0	NA	NA
HOV3+-ML	NA	0	NA	NA
Vanpool	NA	0	NA	NA
Xpress	NA	0	NA	NA
CobbLinc	NA	0	NA	NA
GCT	NA	0	NA	NA
Total	NA	12,343	NA	NA

Table 95 – Person Throughput per Session by Occupancy Mode and Lane Type, Hamilton Mill Road at I-85, February-August, PM Peak (3-7 PM)

Mode	Pre-Opening Persons	Post-Opening Persons	Person Change	Percent Change
SOV-GP	NA	7,527	NA	NA
HOV2-GP	NA	1,615	NA	NA
HOV3+-GP	NA	145	NA	NA
SOV-ML	NA	0	NA	NA
HOV2-ML	NA	0	NA	NA
HOV3+-ML	NA	0	NA	NA
Vanpool	NA	0	NA	NA
Xpress	NA	0	NA	NA
CobbLinc	NA	0	NA	NA
GCT	NA	0	NA	NA
Total	NA	9,287	NA	NA

10.4 Vehicle and Person Throughput by Occupancy Mode and by Lane Type

The vehicle and person throughput results by occupancy mode (SOV, HOV2, HOV3+, Vanpool, Xpress, and CobbLinc) and by lane type (general purpose lanes, managed lane, and corridor) are shown in from Table 96 through Table 99.

Table 96 – Vehicle Throughput by Occupancy Mode and by Lane Type, Feb–Aug 2018, 6–10 AM

2018 AM		% of Vehicle Throughput	% of Person Throughput	% of Vehicle Throughput	% of Person Throughput	% of Vehicle Throughput	% of Person Throughput
Data Collection Site	Mode	GP Lanes	GP Lanes	Express Lane	Express Lane	Corridor	Corridor
Chastain Road at I-575	SOV	88.9%	79.3%	N/A	N/A	88.9%	79.3%
Chastain Road at I-575	HOV2	10.6%	19.0%	N/A	N/A	10.6%	19.0%
Chastain Road at I-575	HOV3+	0.5%	1.4%	N/A	N/A	0.5%	1.4%
Chastain Road at I-575	Vanpool	0.0%	0.0%	N/A	N/A	0.0%	0.0%
Chastain Road at I-575	Xpress	0.0%	0.3%	N/A	N/A	0.0%	0.3%
Chastain Road at I-575	CobbLinc	0.0%	0.0%	N/A	N/A	0.0%	0.0%
Chastain Road at I-575	GCT	0.0%	0.0%	N/A	N/A	0.0%	0.0%
Chastain Road at I-575	Total	100.0%	100.0%	N/A	N/A	100.0%	100.0%
Hickory Grove Road at I-75	SOV	87.7%	77.4%	N/A	N/A	87.7%	77.4%
Hickory Grove Road at I-75	HOV2	11.8%	20.9%	N/A	N/A	11.8%	20.9%
Hickory Grove Road at I-75	HOV3+	0.4%	1.2%	N/A	N/A	0.4%	1.2%

Hickory Grove Road at I-75	**Vanpool**	**0.0%**	**0.0%**	**N/A**	**N/A**	**0.0%**	**0.0%**
Hickory Grove Road at I-75	**Xpress**	**0.0%**	**0.3%**	**N/A**	**N/A**	**0.0%**	**0.3%**
Hickory Grove Road at I-75	**CobbLinc**	**0.0%**	**0.2%**	**N/A**	**N/A**	**0.0%**	**0.2%**
Hickory Grove Road at I-75	**GCT**	**0.0%**	**0.0%**	**N/A**	**N/A**	**0.0%**	**0.0%**
Hickory Grove Road at I-75	**Total**	**100.0%**	**100.0%**	**N/A**	**N/A**	**100.0%**	**100.0%**
Old Peachtree Road at I-85	**SOV**	**88.4%**	**78.6%**	**82.7%**	**55.1%**	**88.0%**	**76.5%**
Old Peachtree Road at I-85	**HOV2**	**11.1%**	**19.7%**	**15.1%**	**20.1%**	**11.3%**	**19.7%**
Old Peachtree Road at I-85	**HOV3+**	**0.5%**	**1.6%**	**0.8%**	**1.9%**	**0.5%**	**1.7%**
Old Peachtree Road at I-85	**Vanpool**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Old Peachtree Road at I-85	**Xpress**	**0.0%**	**0.0%**	**1.0%**	**19.4%**	**0.1%**	**1.7%**
Old Peachtree Road at I-85	**CobbLinc**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Old Peachtree Road at I-85	**GCT**	**0.0%**	**0.0%**	**0.4%**	**3.5%**	**0.0%**	**0.3%**
Old Peachtree Road at I-85	**Total**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Indian Trail/Lilburn Road at I-85	**SOV**	**88.4%**	**78.7%**	**86.7%**	**66.3%**	**88.1%**	**76.3%**
Indian Trail/Lilburn Road at I-85	**HOV2**	**11.2%**	**19.9%**	**11.1%**	**16.9%**	**11.2%**	**19.4%**
Indian Trail/Lilburn Road at I-85	**HOV3+**	**0.4%**	**1.2%**	**1.6%**	**4.5%**	**0.6%**	**1.9%**
Indian Trail/Lilburn Road at I-85	**Vanpool**	**0.0%**	**0.1%**	**0.0%**	**0.1%**	**0.0%**	**0.1%**
Indian Trail/Lilburn Road at I-85	**Xpress**	**0.0%**	**0.0%**	**0.3%**	**7.2%**	**0.1%**	**1.4%**
Indian Trail/Lilburn Road at I-85	**CobbLinc**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Indian Trail/Lilburn Road at I-85	**GCT**	**0.0%**	**0.0%**	**0.3%**	**4.9%**	**0.1%**	**1.0%**
Indian Trail/Lilburn Road at I-85	**Total**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 97 – Vehicle Throughput by Occupancy Mode and by Lane Type, Feb– Aug 2018, 3–7 PM

2018 PM		% of Vehicle Throughput	% of Person Throughput	% of Vehicle Throughput	% of Person Throughput	% of Vehicle Throughput	% of Person Throughput
Data Collection Site	Mode	GP Lanes	GP Lanes	Express Lane	Express Lane	Corridor	Corridor
Chastain Road at I-575	SOV	85.3%	73.1%	N/A	N/A	85.3%	73.1%
Chastain Road at I-575	HOV2	13.6%	23.4%	N/A	N/A	13.6%	23.4%
Chastain Road at I-575	HOV3+	1.0%	2.9%	N/A	N/A	1.0%	2.9%
Chastain Road at I-575	Vanpool	0.0%	0.1%	N/A	N/A	0.0%	0.1%
Chastain Road at I-575	Xpress	0.0%	0.6%	N/A	N/A	0.0%	0.6%
Chastain Road at I-575	CobbLinc	0.0%	0.0%	N/A	N/A	0.0%	0.0%
Chastain Road at I-575	GCT	0.0%	0.0%	N/A	N/A	0.0%	0.0%
Chastain Road at I-575	Total	100.0%	100.0%	N/A	N/A	100.0%	100.0%
Hickory Grove Road at I-75	SOV	84.4%	71.6%	N/A	N/A	84.4%	71.6%
Hickory Grove Road at I-75	HOV2	14.5%	24.7%	N/A	N/A	14.5%	24.7%
Hickory Grove Road at I-75	HOV3+	1.0%	2.6%	N/A	N/A	1.0%	2.6%

Hickory Grove Road at I-75	**Vanpool**	**0.0%**	**0.1%**	**N/A**	**N/A**	**0.0%**	**0.1%**
Hickory Grove Road at I-75	**Xpress**	**0.0%**	**0.6%**	**N/A**	**N/A**	**0.0%**	**0.6%**
Hickory Grove Road at I-75	**CobbLinc**	**0.0%**	**0.4%**	**N/A**	**N/A**	**0.0%**	**0.4%**
Hickory Grove Road at I-75	**GCT**	**0.0%**	**0.0%**	**N/A**	**N/A**	**0.0%**	**0.0%**
Hickory Grove Road at I-75	**Total**	**100.0%**	**100.0%**	**N/A**	**N/A**	**100.0%**	**100.0%**
Old Peachtree Road at I-85	**SOV**	**83.8%**	**71.2%**	**80.7%**	**56.5%**	**83.3%**	**68.6%**
Old Peachtree Road at I-85	**HOV2**	**15.0%**	**25.4%**	**16.0%**	**22.4%**	**15.1%**	**24.9%**
Old Peachtree Road at I-85	**HOV3+**	**1.2%**	**3.3%**	**2.4%**	**6.6%**	**1.4%**	**3.9%**
Old Peachtree Road at I-85	**Vanpool**	**0.0%**	**0.1%**	**0.0%**	**0.2%**	**0.0%**	**0.1%**
Old Peachtree Road at I-85	**Xpress**	**0.0%**	**0.0%**	**0.6%**	**11.1%**	**0.1%**	**2.0%**
Old Peachtree Road at I-85	**CobbLinc**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Old Peachtree Road at I-85	**GCT**	**0.0%**	**0.0%**	**0.2%**	**3.1%**	**0.0%**	**0.6%**
Old Peachtree Road at I-85	**Total**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Indian Trail/Lilburn Road at I-85	**SOV**	**85.9%**	**74.7%**	**79.8%**	**51.6%**	**84.9%**	**69.8%**
Indian Trail/Lilburn Road at I-85	**HOV2**	**13.5%**	**23.5%**	**16.0%**	**20.8%**	**13.9%**	**22.9%**
Indian Trail/Lilburn Road at I-85	**HOV3+**	**0.6%**	**1.6%**	**3.0%**	**8.1%**	**1.0%**	**3.0%**
Indian Trail/Lilburn Road at I-85	**Vanpool**	**0.1%**	**0.2%**	**0.1%**	**0.2%**	**0.1%**	**0.2%**
Indian Trail/Lilburn Road at I-85	**Xpress**	**0.0%**	**0.0%**	**0.6%**	**10.9%**	**0.1%**	**2.3%**
Indian Trail/Lilburn Road at I-85	**CobbLinc**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Indian Trail/Lilburn Road at I-85	**GCT**	**0.0%**	**0.0%**	**0.5%**	**8.5%**	**0.1%**	**1.8%**
Indian Trail/Lilburn Road at I-85	**Total**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 98 – Vehicle Throughput by Occupancy Mode and by Lane Type, Feb–Aug 2019, 6–10 AM

2019 AM		% of Vehicle Throughput	% of Person Throughput	% of Vehicle Throughput	% of Person Throughput	% of Vehicle Throughput	% of Person Throughput
Data Collection Site	Mode	GP Lanes	GP Lanes	Express Lane	Express Lane	Corridor	Corridor
Chastain Road at I-575	SOV	90.7%	82.5%	96.1%	91.3%	91.8%	84.3%
Chastain Road at I-575	HOV2	8.8%	16.1%	3.7%	7.1%	7.7%	14.2%
Chastain Road at I-575	HOV3+	0.5%	1.4%	0.1%	0.5%	0.4%	1.2%
Chastain Road at I-575	Vanpool	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Chastain Road at I-575	Xpress	0.0%	0.0%	0.1%	1.2%	0.0%	0.2%
Chastain Road at I-575	CobbLinc	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Chastain Road at I-575	GCT	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Chastain Road at I-575	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Hickory Grove Road at I-75	SOV	89.6%	80.9%	94.5%	84.6%	90.1%	81.3%
Hickory Grove Road at I-75	HOV2	10.1%	18.2%	5.0%	8.9%	9.5%	17.2%
Hickory Grove Road at I-75	HOV3+	0.3%	0.9%	0.2%	0.7%	0.3%	0.8%

Hickory Grove Road at I-75	**Vanpool**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Hickory Grove Road at I-75	**Xpress**	**0.0%**	**0.0%**	**0.1%**	**2.3%**	**0.0%**	**0.3%**
Hickory Grove Road at I-75	**CobbLinc**	**0.0%**	**0.0%**	**0.2%**	**3.4%**	**0.0%**	**0.4%**
Hickory Grove Road at I-75	**GCT**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Hickory Grove Road at I-75	**Total**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Old Peachtree Road at I-85	**SOV**	**92.9%**	**86.4%**	**90.3%**	**66.0%**	**92.7%**	**84.4%**
Old Peachtree Road at I-85	**HOV2**	**6.8%**	**12.6%**	**8.3%**	**12.1%**	**6.9%**	**12.5%**
Old Peachtree Road at I-85	**HOV3+**	**0.3%**	**1.0%**	**0.2%**	**1.3%**	**0.3%**	**1.0%**
Old Peachtree Road at I-85	**Vanpool**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Old Peachtree Road at I-85	**Xpress**	**0.0%**	**0.0%**	**0.9%**	**17.9%**	**0.1%**	**1.8%**
Old Peachtree Road at I-85	**CobbLinc**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Old Peachtree Road at I-85	**GCT**	**0.0%**	**0.0%**	**0.3%**	**2.8%**	**0.0%**	**0.3%**
Old Peachtree Road at I-85	**Total**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Indian Trail/Lilburn Road at I-85	**SOV**	**92.3%**	**85.5%**	**91.4%**	**73.6%**	**92.2%**	**83.2%**
Indian Trail/Lilburn Road at I-85	**HOV2**	**7.4%**	**13.8%**	**7.2%**	**11.6%**	**7.4%**	**13.4%**
Indian Trail/Lilburn Road at I-85	**HOV3+**	**0.2%**	**0.6%**	**0.7%**	**2.3%**	**0.3%**	**0.9%**
Indian Trail/Lilburn Road at I-85	**Vanpool**	**0.0%**	**0.1%**	**0.0%**	**0.1%**	**0.0%**	**0.1%**
Indian Trail/Lilburn Road at I-85	**Xpress**	**0.0%**	**0.0%**	**0.3%**	**7.7%**	**0.1%**	**1.5%**
Indian Trail/Lilburn Road at I-85	**CobbLinc**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Indian Trail/Lilburn Road at I-85	**GCT**	**0.0%**	**0.0%**	**0.3%**	**4.8%**	**0.1%**	**0.9%**
Indian Trail/Lilburn Road at I-85	**Total**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Hamilton Mill Road at I-85	**SOV**	**95.3%**	**90.8%**	**N/A**	**N/A**	**95.3%**	**90.8%**
Hamilton Mill Road at I-85	**HOV2**	**4.5%**	**8.6%**	**N/A**	**N/A**	**4.5%**	**8.6%**

Hamilton Mill Road at I-85	**HOV3+**	**0.2%**	**0.6%**	**N/A**	**N/A**	**0.2%**	**0.6%**
Hamilton Mill Road at I-85	**Vanpool**	**0.0%**	**0.0%**	**N/A**	**N/A**	**0.0%**	**0.0%**
Hamilton Mill Road at I-85	**Xpress**	**0.0%**	**0.0%**	**N/A**	**N/A**	**0.0%**	**0.0%**
Hamilton Mill Road at I-85	**CobbLinc**	**0.0%**	**0.0%**	**N/A**	**N/A**	**0.0%**	**0.0%**
Hamilton Mill Road at I-85	**GCT**	**0.0%**	**0.0%**	**N/A**	**N/A**	**0.0%**	**0.0%**
Hamilton Mill Road at I-85	**Total**	**100.0%**	**100.0%**	**N/A**	**N/A**	**100.0%**	**100.0%**

Table 99 – Vehicle Throughput by Occupancy Mode and by Lane Type, Feb–Aug, 2019, 3–7 PM

2019 PM		% of Vehicle Throughput	% of Person Throughput	% of Vehicle Throughput	% of Person Throughput	% of Vehicle Throughput	% of Person Throughput
Data Collection Site	Mode	GP Lanes	GP Lanes	Express Lane	Express Lane	Corridor	Corridor
Chastain Road at I-575	SOV	86.0%	74.8%	94.4%	88.0%	88.5%	78.5%
Chastain Road at I-575	HOV2	13.3%	23.1%	5.4%	10.0%	11.0%	19.5%
Chastain Road at I-575	HOV3+	0.7%	2.0%	0.1%	0.4%	0.5%	1.5%
Chastain Road at I-575	Vanpool	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%
Chastain Road at I-575	Xpress	0.0%	0.0%	0.1%	1.5%	0.0%	0.4%
Chastain Road at I-575	CobbLinc	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Chastain Road at I-575	GCT	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Chastain Road at I-575	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Hickory Grove Road at I-75	SOV	87.9%	77.5%	92.1%	77.1%	88.2%	77.5%
Hickory Grove Road at I-75	HOV2	11.2%	19.8%	6.6%	11.1%	10.8%	19.0%

Hickory Grove Road at I-75	**HOV3+**	**0.9%**	**2.6%**	**0.5%**	**1.5%**	**0.9%**	**2.5%**
Hickory Grove Road at I-75	**Vanpool**	**0.0%**	**0.1%**	**0.1%**	**0.3%**	**0.0%**	**0.1%**
Hickory Grove Road at I-75	**Xpress**	**0.0%**	**0.0%**	**0.3%**	**5.8%**	**0.0%**	**0.5%**
Hickory Grove Road at I-75	**CobbLinc**	**0.0%**	**0.0%**	**0.4%**	**4.3%**	**0.0%**	**0.4%**
Hickory Grove Road at I-75	**GCT**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Hickory Grove Road at I-75	**Total**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Old Peachtree Road at I-85	**SOV**	**90.1%**	**81.4%**	**87.9%**	**63.9%**	**89.8%**	**78.5%**
Old Peachtree Road at I-85	**HOV2**	**9.4%**	**17.0%**	**9.7%**	**14.1%**	**9.4%**	**16.5%**
Old Peachtree Road at I-85	**HOV3+**	**0.5%**	**1.3%**	**1.3%**	**3.5%**	**0.6%**	**1.7%**
Old Peachtree Road at I-85	**Vanpool**	**0.1%**	**0.3%**	**0.1%**	**0.3%**	**0.1%**	**0.3%**
Old Peachtree Road at I-85	**Xpress**	**0.0%**	**0.0%**	**0.7%**	**14.4%**	**0.1%**	**2.4%**

Old Peachtree Road at I-85	**CobbLinc**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Old Peachtree Road at I-85	**GCT**	**0.0%**	**0.0%**	**0.3%**	**3.8%**	**0.0%**	**0.6%**
Old Peachtree Road at I-85	**Total**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Indian Trail/Lilburn Road at I-85	**SOV**	**89.3%**	**80.0%**	**88.2%**	**62.6%**	**89.1%**	**76.7%**
Indian Trail/Lilburn Road at I-85	**HOV2**	**10.1%**	**18.0%**	**9.4%**	**13.4%**	**10.0%**	**17.2%**
Indian Trail/Lilburn Road at I-85	**HOV3+**	**0.6%**	**1.7%**	**1.1%**	**3.0%**	**0.7%**	**2.0%**
Indian Trail/Lilburn Road at I-85	**Vanpool**	**0.1%**	**0.3%**	**0.1%**	**0.2%**	**0.1%**	**0.3%**
Indian Trail/Lilburn Road at I-85	**Xpress**	**0.0%**	**0.0%**	**0.6%**	**12.4%**	**0.1%**	**2.3%**
Indian Trail/Lilburn Road at I-85	**CobbLinc**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Indian Trail/Lilburn Road at I-85	**GCT**	**0.0%**	**0.0%**	**0.6%**	**8.4%**	**0.1%**	**1.6%**

Indian Trail/Lilburn Road at I-85	**Total**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Hamilton Mill Road at I-85	**SOV**	**89.9%**	**81.1%**	**N/A**	**N/A**	**89.9%**	**81.1%**
Hamilton Mill Road at I-85	**HOV2**	**9.6%**	**17.4%**	**N/A**	**N/A**	**9.6%**	**17.4%**
Hamilton Mill Road at I-85	**HOV3+**	**0.5%**	**1.6%**	**N/A**	**N/A**	**0.5%**	**1.6%**
Hamilton Mill Road at I-85	**Vanpool**	**0.0%**	**0.0%**	**N/A**	**N/A**	**0.0%**	**0.0%**
Hamilton Mill Road at I-85	**Xpress**	**0.0%**	**0.0%**	**N/A**	**N/A**	**0.0%**	**0.0%**
Hamilton Mill Road at I-85	**CobbLinc**	**0.0%**	**0.0%**	**N/A**	**N/A**	**0.0%**	**0.0%**
Hamilton Mill Road at I-85	**GCT**	**0.0%**	**0.0%**	**N/A**	**N/A**	**0.0%**	**0.0%**
Hamilton Mill Road at I-85	**Total**	**100.0%**	**100.0%**	**N/A**	**N/A**	**100.0%**	**100.0%**

10.5 Remaining Carpool Activities Post Opening

As noted earlier, all sites experienced decreases in carpool (HOV2 plus HOV3+) mode percentage, while there are still significant portions of carpool activities. The total post-implementation carpool mode share (both HOV2 and HOV3+) are presented in Table 100.

It is demonstrated that 4.7% to 9.9% the corridor vehicle throughput in the AM peak consists of HOV2 and HOV3+ personal vehicles, and 10.1% to 11.8% in the PM peak. These vehicles carry an even greater share of passengers; 9.2% to 18.7% of the corridor person throughput in the AM peak is carried by HOV2 and HOV3+ personal vehicles, and 18.9% to 23.3% of persons in the PM peak. Evening peak periods generally include more high occupancy vehicles than the morning peak periods. As described in previous chapters, evening peak period trips generally include more non-work trips (e.g., shopping, recreation, etc.), which have higher occupancy. Some evening commuters may also be less time-sensitive and more willing to carpool at the cost of slightly longer travel times, but additional research is needed in this area.

Table 101 shows the post-implementation carpool mode split by site and by lane type. Note that the percentages here represent the shares within each lane type rather than the whole site.

A significant fraction of carpools (even more than the lately opened Express Lanes) are still using the general purpose lanes during both the morning and afternoon peak periods on the NWC and these vehicles are handling a large share of corridor person throughput. For the I-85 Corridor, more carpool activities were found on the Express Lanes than on the GP lanes, which is not surprising to the team. These differences of carpool percentages by lane type for NWC vs. I-85 could be related to the large volume increase at NWC, which indicates that NWC commuters are attracted to the Express Lanes.

As proposed with the previous project (Guensler, et al., 2013b), with these volumes and throughput values in mind, additional research should be conducted on the feasibility of converting the inside GP lane on I-85 to a carpool lane. Another alternative is to convert the inside GP lane to a second HOT lane and to reduce the carpool requirement on the resulting two managed lanes from HOT3+ to HOT2+. Assessment of the demand for such a change requires a tolling and revenue analysis based upon hourly vehicle demand by lane and occupancy mode. Costs of such a change would include restriping and may require new gantry installation, as the final design of the system did not include gantries spanning all lanes. An increase in Express Lane capacity by adding the second lane might also reduce peak toll rates for both lanes, depending upon peak demand.

Table 100 – Carpool (HOV2 and HOV3+) Mode Percentages, Post-Opening (2019)

Site	AM Carpool Vehicle Throughput Mode %	AM Carpool Person Throughput Mode %	PM Carpool Vehicle Throughput Mode %	PM Carpool Person Throughput Mode %
Chastain Road at I-575	8.2%	15.7%	11.5%	21.5%
Hickory Grove Road at I-75	9.9%	18.7%	11.8%	22.5%
Old Peachtree Road at I-85	7.3%	15.6%	10.2%	21.5%
Indian Trail/Lilburn Road at I-85	7.8%	16.8%	10.9%	23.3%
Hamilton Mill Road at I-85	4.7%	9.2%	10.1%	18.9%

Table 101 – Throughput Mode Percentage of Carpool (HOV2 and HOV3+), Post-Opening (2019)

Site	Lane Type	AM Carpool Vehicle Throughput Mode %	AM Carpool Person Throughput Mode %	PM Carpool Vehicle Throughput Mode %	PM Carpool Person Throughput Mode %
Chastain Road at I-575	GP	9.3%	17.5%	14.0%	25.2%
Chastain Road at I-575	ML	3.9%	8.7%	5.6%	12.0%
Hickory Grove Road at I-75	GP	10.4%	19.1%	12.1%	22.5%
Hickory Grove Road at I-75	ML	5.5%	15.4%	7.9%	22.9%
Old Peachtree Road at I-85	GP	7.1%	13.6%	9.9%	18.6%
Old Peachtree Road at I-85	ML	9.7%	34.0%	12.1%	36.1%
Indian Trail/Lilburn Road at I-85	GP	7.7%	14.5%	10.7%	20.0%
Indian Trail/Lilburn Road at I-85	ML	8.6%	26.4%	11.8%	37.4%
Hamilton Mill Road at I-85	GP	4.7%	9.2%	10.1%	18.9%
Hamilton Mill Road at I-85	ML	N/A	N/A	N/A	N/A

10.6 Express Bus and Vanpool Throughput

As noted in the 2010-2012 project (Guensler, et al., 2013b), vanpool and express bus carry much higher share of person throughput compared with their vehicle throughput. This is intuitively expected, considering the large average vehicle occupancy of vanpool (typically larger than 4 passenger/vanpool and 26 passenger/bus).

Table 102 lists the mode share (post-opening) of vanpool in vehicle and person throughput, as well as the before-and-after percent changes. For Old Peachtree Road and Indian Trail/Lilburn Road at I-85, vanpool carry approximately 0.3% of the person throughput while it only makes approximately 0.1% of the vehicle throughput during evening peak. The average vehicle occupancy of these two sites during evening peak are both larger than 5.0 passenger/vehicle. Express bus operations are more vehicle-efficient, but also service limited locations. Vanpool serves as a beneficial supplement of express bus with respect to encouragement of carpooling, and could have a larger impact on managed lane throughput if ridership can be significantly stimulated.

The change of vanpool vehicle throughput is not significant considering the small volumes, even though the percent change can be larger than 10%. However, Old Peachtree Road experienced a large change in vanpool vehicle throughput and person throughput. It is difficult to conclude if these changes are due to the impact of the opening of the Express Lane facilities or other factors such as initiatives or change of vanpool route, given that the vanpool lease varies significantly depending on lease demand.

Table 102 – Throughput Mode Percentage of Vanpool, Post-Opening/Extension (2019)

Session	Site	Mode Share of Vehicle Throughput Post-Opening (2019)	Mode Share of Person Throughput Post-Opening (2019)	Percent Change in Vehicle Throughput	Percent Change in Person Throughput
AM	Chastain Road at I-575	0.0%	0.0%	N/A*	N/A*
AM	Hickory Grove Road at I-75	0.0%	0.0%	N/A*	N/A*
AM	Old Peachtree Road at I-85	0.0%	0.0%	-13.6%	23.7%
AM	Indian Trail/Lilburn Road at I-85	0.0%	0.1%	13.1%	8.4%
AM	Hamilton Mill Road at I-85	0.0%	0.0%	N/A*	N/A*
PM	Chastain Road at I-575	0.0%	0.1%	20.8%	63.7%
PM	Hickory Grove Road at I-75	0.0%	0.1%	-16.0%	-11.2%
PM	Old Peachtree Road at I-85	0.1%	0.3%	73.3%	103.2%
PM	Indian Trail/Lilburn Road at I-85	0.1%	0.3%	7.4%	16.2%
PM	Hamilton Mill Road at I-85	0.0%	0.0%	N/A	N/A

* N/A indicates no vanpool activity during the studied time of year. Some of the other percentages in this table are smaller than 0.05% and are rounded to 0.0%, but they are not zero (percent change available).

Table 103 lists the mode share (post-opening) of express buses (Xpress, CobbLinc, and GCT) in vehicle and person throughput, as well as the before-and-after percent changes. Express buses carry even higher percent of person throughput (approximately 0.2% to 3.0%) compared with its mode share (approximately 0.2% or even smaller). For the I-85 Corridor, the person throughput carried by express buses can be larger than 2.0% for morning peak and larger than 3.0% for evening peak, which is reasonable given the greater ridership. More discussions on the express bus throughput can be found in section 7.6.

Table 103 – Throughput Mode Percentage of Express Bus (Xpress plus CobbLinc), Post-Opening/Extension (2019)

Session	Site	Mode Share of Vehicle Throughput	Mode Share of Person Throughput	Percent Change in Vehicle Throughput	Percent Change in Person Throughput
AM	Chastain Road at I-575	0.0%	0.2%	8.8%	26.0%
AM	Hickory Grove Road at I-75	0.0%	0.6%	4.6%	55.7%
AM	Old Peachtree Road at I-85	0.1%	2.0%	6.6%	1.9%
AM	Indian Trail Lilburn Road at I-85	0.1%	2.4%	3.1%	1.1%
AM	Hamilton Mill Road at I-85	0.0%	0.0%	N/A*	N/A*
PM	Chastain Road at I-575	0.0%	0.4%	-9.3%	5.0%
PM	Hickory Grove Road at I-75	0.1%	0.9%	-11.6%	-4.8%
PM	Old Peachtree Road at I-85	0.1%	3.0%	29.5%	22.5%
PM	Indian Trail Lilburn Road at I-85	0.2%	3.9%	4.7%	-0.1%
PM	Hamilton Mill Road at I-85	0.0%	0.0%	N/A*	N/A*

* N/A indicates no express bus activity traverse Hamilton Mill Road at I-85.

10.7 Discussion and Caveats

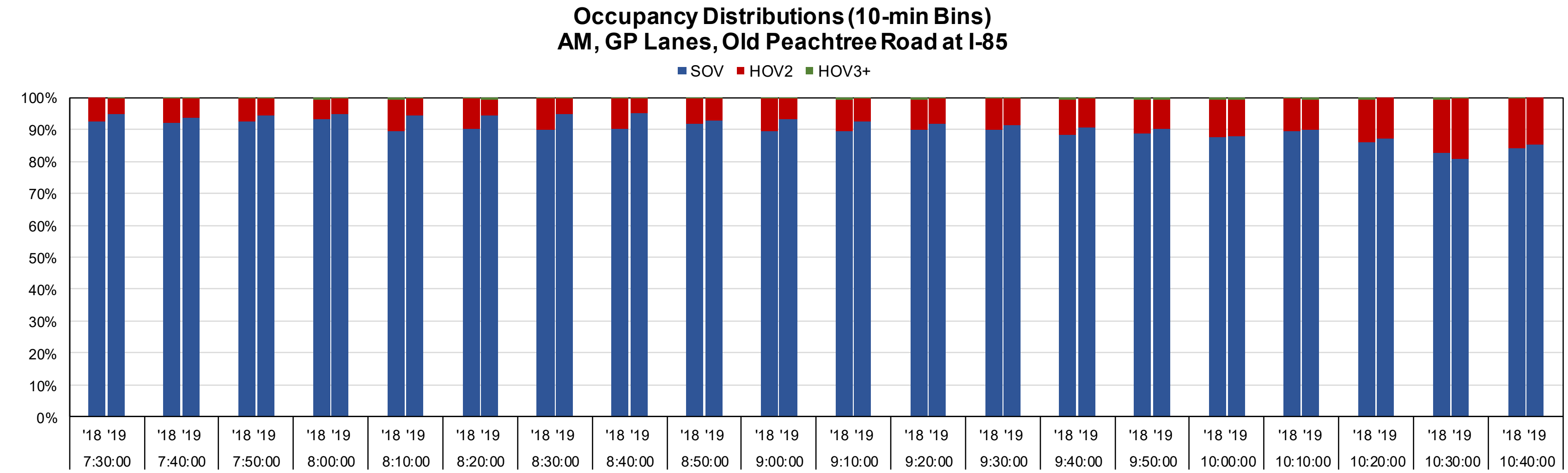
The underlying data and results of this chapter indicate a large increase in travel demand on the NWC freeway facilities, especially for Chastain Road at I-575. This increase is likely related to the implementation of the Express Lane. The increase likely came from diversion of travel on arterials to the less congested corridors, or from the shoulder of the peak to the peak, once the Express Lanes opened and congestion declined. Corridor demand is not independent of corridor performance, and the opening of the NWC Express Lane may have led some travelers to drive longer distances so that they could save travel time.

In the process of performing the assessment, the research team determined that the existing sources of vehicle activity data were still not as reliable as desired (e.g., difficult to find the exact location of the pole where the detection device is installed, due to offset in the archive

GPS coordinates). Future studies should supplement existing VDS data sources with more accurate systems for vehicle counts, speeds, and travel times. The team also experienced a lack of secondary data verification sources when the VDS data indicated potentially suspicious results. Publicly available traffic counts are often limited by coverage both temporally and spatially, and are heavily dependent on estimations based on historical data. For a possible drastic change in traffic volumes, such as due to the facility change, these data are usually not representative. For future Express Lane corridors, the team recommends that supplemental monitoring systems be deployed at least one year prior to the implementation (e.g., procurement of cell phone tracking data and multiple vehicle detection stations for traffic counts). The systems should include new VDS systems that are carefully placed with respect to height and viewing angle to cover a limited number of lanes and ensure lane-by-lane count accuracy (requiring multiple cameras at specific benchmark locations). High-resolution video cameras can be used with new tracking technologies at these same locations to calibrate views (Toth, et al., 2012; Toth, et al., 2013). Data users without access to the raw video profiles, however, may need to collect additional volume/speed data for VDS calibration so that the traffic operations are spatially representative. Loop detectors might also be recommended at specific locations. Finally, systems that allow for positive identification and re-identification of vehicles later in the corridor, such as Bluetooth or RFID, should be deployed. Deployment of the full span RFID gantry systems should be deployed one year in advance of toll lane openings, along with free RFID tags to future users.

As with the previous project, more three-person carpools are using the general purpose lanes than the Express Lanes on I-85. For both morning peaks and evening peaks, a decrease in HOV3+ fractions was observed, except for the AM peak at Chastain Road at I-575. This is not surprising because three-person carpools are difficult to form and retain, and vehicle ownership generally increases over time. Hence, the research team anticipated seeing a slow, natural increase in SOV fractions over time, assuming no traffic control and management measures were implemented. With the opening of the NWC Express Lanes, the AM peak HOV3+ mode share did increase in volume for Chastain Road at I-575, but it decreased as a percent (from 0.5% to 0.4%). Despite the observed decreases, implementing the Express Lane still provides an incentive for carpooling with three or more people. To quantify that carpool formation incentive in the future, control sites need to be selected to accommodate the change in SOV fractions without facility changes, and a comparative analysis is required for both morning and evening peak hours.

The 2010-2012 project report proposed an analysis of the occupancy distributions changes over time of day, as the managed lanes may be needed more at the peak-of-peak hours. An example of the occupancy distributions (passenger car LDVs and SUVs) by time of day at 10-minute bins is shown in Figure 103, where a slight increase of carpooling is observed over time for both 2018 and 2019. The research team is working on a more comprehensive time-series analysis with respect to changes of occupancy distributions.



	7:30:00 '18	7:30:00 '19	7:40:00 '18	7:40:00 '19	7:50:00 '18	7:50:00 '19	8:00:00 '18	8:00:00 '19	8:10:00 '18	8:10:00 '19	8:20:00 '18	8:20:00 '19	8:30:00 '18	8:30:00 '19	8:40:00 '18	8:40:00 '19	8:50:00 '18	8:50:00 '19	9:00:00 '18	9:00:00 '19
SOV	92.7%	94.7%	92.3%	93.8%	92.4%	94.4%	93.3%	94.6%	89.4%	94.6%	90.4%	94.5%	89.7%	94.7%	90.2%	95.1%	91.6%	93.0%	89.5%	93.3%
HOV2	7.3%	5.2%	7.6%	5.9%	7.2%	5.5%	6.1%	5.2%	10.0%	5.2%	9.2%	4.9%	10.2%	5.2%	9.4%	4.7%	8.0%	6.8%	10.2%	6.3%
HOV3+	0.0%	0.2%	0.2%	0.3%	0.4%	0.1%	0.7%	0.2%	0.6%	0.2%	0.4%	0.6%	0.1%	0.1%	0.4%	0.3%	0.4%	0.2%	0.4%	0.4%

	9:10:00 '18	9:10:00 '19	9:20:00 '18	9:20:00 '19	9:30:00 '18	9:30:00 '19	9:40:00 '18	9:40:00 '19	9:50:00 '18	9:50:00 '19	10:00:00 '18	10:00:00 '19	10:10:00 '18	10:10:00 '19	10:20:00 '18	10:20:00 '19	10:30:00 '18	10:30:00 '19	10:40:00 '18	10:40:00 '19
SOV	89.6%	92.7%	90.1%	91.7%	89.9%	91.4%	88.5%	90.6%	88.7%	90.2%	87.6%	88.2%	89.5%	90.0%	86.2%	87.4%	82.7%	81.0%	84.1%	85.4%
HOV2	9.9%	6.9%	9.3%	7.9%	9.6%	8.3%	10.8%	8.9%	10.7%	9.2%	11.8%	11.2%	10.2%	9.2%	13.2%	12.6%	16.7%	18.8%	15.4%	14.6%
HOV3+	0.6%	0.4%	0.7%	0.5%	0.5%	0.3%	0.7%	0.5%	0.6%	0.6%	0.6%	0.7%	0.3%	0.8%	0.7%	0.0%	0.6%	0.3%	0.4%	0.0%

Figure 103 – Occupancy Distributions by 10-Minute Bins, Old Peachtree Road at I-85, AM Peak (7-10 AM)

11 Conclusions

This report summarizes the research conducted by the Georgia Institute of Technology for the Georgia State Road and Tollway Authority (SRTA) to quantify the changes in vehicle throughput and person throughput between 2018 and 2020 on SRTA's four managed lanes systems in the Atlanta (Georgia) Metropolitan Area. The managed lane facilities studied included the Northwest Corridor (NWC) Express Lanes (reversible toll lanes on I-75 and I-575), the I-85 Express Lanes (HOT Lanes, from I-285 to Old Peachtree Road), the I-85 Express Lanes Extension (HOT Lanes, from Old Peachtree Road to Hamilton Mill), and the I-75 South Metro Express Lanes. The team observed large increases in vehicle and person throughput on the NWC after the Express Lanes opened. Increases in person throughput were observed on I-575 at Chastain Road (more than 35% for both morning and evening peaks) and also on I-75 at Hickory Grove Road (approximately 19%) for PM peaks. On the I-85 corridor, minor to moderate changes in vehicle and person throughput were observed after the I-85 Express Lane Extension opened. Unfortunately, the COVID-19 pandemic prevented the collection of vehicle occupancy data in spring 2020 and an assessment of changes in person throughput. Given the large unanticipated increase in traffic volumes on the NWC, the team conducted a supplemental QA/QC comparison using GDOT NaviGAtor data (both upstream and downstream of data collection sites) and confirmed the large increases in vehicle throughput.

On the NWC, all lanes experienced a decrease of average occupancy after the Express Lanes opened, except the second GP lane on I-75 at Hickory Grove Road in the morning peak (only an increase of 0.01 persons per vehicle), and the first GP lane at Chastain in the evening peak (only an increase of 0.02 persons per vehicle). The increase in vehicle throughput was so large that the decrease in average vehicle occupancy still led to an increase in person throughput. The average vehicle occupancy on the Express Lanes was lower than the GP lanes for the NWC (on both the I-75 and I-575 sections). While certainly some carpools were discontinued and some new carpools were formed, the number of total carpools using the corridor did not decline significantly, and carpools still carry a large share of the corridor's person throughput. The decrease in average vehicle occupancy appears to result from the dilution of carpools within the traffic stream. That is, vehicles that began using the corridor after the Express Lanes opened likely had significantly lower occupancy on average than the vehicles that were already using the freeway corridor. It does not seem reasonable that the increase in traffic volume resulted from new commute, shopping, or recreation trips in the morning peak. Hence, the study likely saw a shift of single-occupant vehicles from local arterials onto the facility, once congestion declined (the result of enhanced freeway corridor capacity), and perhaps the addition of some drivers who no longer needed to shift their departure times to the shoulders of the peak to avoid congestion. Supplemental survey efforts are needed to obtain input from users about the reasons for the observed travel changes. Although major increases in personal vehicle use (automobiles, SUVs, light-duty trucks, etc.) were noted, express bus throughput at Hickory Grove Road at I-75 did not change much. Express bus volumes decreased slightly, from 11.5 to 10.2 vehicles/session in the evening peaks (approximately 11.3%), but the impact on person throughput was not significant.

For the I-85 Express Lanes and I-85 Express Lanes Extension, significant increases in person throughput were observed. SOV fractions within the GP lanes did not differ significantly after the opening of the I-85 Express Lanes Extension. The average vehicle occupancy of the Express Lanes on I-85 was only slightly higher than the adjacent GP lanes, and remains relatively unchanged from 2018 before the I-85 Express Lanes Extension opened. Observed vanpool vehicle throughput increased slightly on I-85 at Old Peachtree Road during the evening peaks, which resulted in a minor increase in person throughput. Vanpool throughput is, however, inconsequential compared to express bus and personal vehicle throughput (vanpools comprise only about 0.1% of vehicle throughput and carry only about 0.3% of the person throughput). Express buses carry a much higher percent of person throughput (approximately 2.0% to 3.9% along the I-85 corridor) compared with its mode share of vehicle throughput (approximately 0.2% or even smaller), which is not surprising given that the average occupancy of an express bus is typically greater than 26 passengers. Changes in express bus throughput were small along the I-85 corridor, indicating no significant impact of the new facilities on ridership. Express bus operations are the most vehicle-efficient for carrying passengers, but routes serve a limited number of locations. Vanpools can likely serve as a beneficial supplement for express bus operations (in terms of encouraging carpooling), and may have a large impact on Express Lane throughput if ridership is significantly stimulated.

Overall, several trends were observed in vehicle and person throughput after the opening of the Express Lanes facilities. The research team observed that occupancy of vehicles using the GP lanes is very close to one person per vehicle at most sites due to the very high percentage of single-occupant vehicles using the lanes. Occupancy on the NWC Express Lanes is lower than that of the GP lanes (even though express buses are using the Express Lanes), because so many carpools are using the GP lanes. Whereas, occupancy on the I-85 Express Lanes is greater than on the parallel GP lanes. The observed occupancy decrease on the I-85 Express Lanes was larger than noted on the adjacent I-85 GP lanes, and the decreases in occupancy in the first GP lane (the fast lane) was typically larger than on the rest of the GP lanes. Given the large increase in morning peak period activity on the NWC, and because morning trips are predominantly commute and school trips, it seems unlikely that the increased traffic volume represents new person-trips (i.e., trips that were not made before the Express Lanes were constructed). It seems more likely that a decrease in occupancy results from changes in carpooling behavior, or from single-occupant vehicles diverting into the corridor from parallel arterial routes after congestion decreased (or perhaps from earlier or later travel times). There also may have been some impact of trip diversion that rebounded from arterials onto the corridor after multi-year construction efforts were concluded.

Despite observed decreases in vehicle occupancy, the increased vehicle throughput along the corridors resulted in an increase in person throughput at every field site. Vehicle throughput on the I-85 corridor increased by about 5-7% and person throughput increased by 1-2% in the morning peak (typically associated with commute activity); vehicle and person throughput increased by around 10% and 5% respectively in the evening peak (where trips include commuting, shopping, social, recreation, and other trip purposes). On I-575, vehicle throughput increased by more than 35% in the AM and PM peaks, and increased by about the same percentage on I-75 in the AM peaks.

While the increased single-occupancy vehicle throughput did not result in a significant decrease in the number of carpool, vanpool, or express buses, the share of carpool as a mode decreased significantly after the opening of the Express Lanes. The opening of the Express Lanes did not appear to lead to any significant impact on the throughput of express buses at any of the field sites. While all sites were observed to have decreases in carpools carrying 2 or more persons as a mode percentage, significant portions of carpool activities were still observed, with 4.7% to 9.9% of corridor vehicle throughput in the AM peak consisting of HOV2 and HOV3+ personal vehicles, and 10.1% to 11.8% in the PM peak. These carpool vehicles carry an even greater share of passengers: 9.2% to 18.7% of the corridor person throughput in the AM peak is carried by HOV2 and HOV3+ personal vehicles, and 18.9% to 23.3% of persons in the PM peak. Evening peaks were observed to carry significantly higher carpool vehicle and person throughput compared to morning peaks due to the larger share of non-commute trips, which is not surprising given that the occupancy of non-commute trips (represented in the PM peak trip mix) generally have higher vehicle occupancy.

The general decrease in carpool mode share, decrease in vehicle occupancy, and increase in vehicle throughput suggest that the opening of the I-75 NWC Express Lanes did change vehicle activity on the corridor. Whether the facility increased travel demand or trip distribution (the location of destinations chosen) cannot be ascertained from the data collected. It is also not clear whether mode choice (propensity to carpool) was affected by the Express Lane opening. The observational data indicate that traffic volumes on the NWC corridor increased, the numbers of carpools remained steady, and the average occupancy per vehicle declined. However, the research team cannot conclude from the data whether the share of carpools decreased because Express Lanes incentivized single-occupant vehicle activity (e.g., contributed to the breakup of existing carpools), or whether a significant number of new single-occupant vehicles started using the corridor after congestion declined and diluted the carpool share (e.g., diverted single-occupant vehicle activity from local roads to the freeway corridor), or if some combination of the two impacts occurred. Future studies should consider including household-level commute travel tracking and surveys to monitor mode choice behavior. Additional incentives may be necessary to stimulate vanpool and carpool activity in the Express Lanes along the I-75 NWC, as these modes have demonstrated a disproportionately larger share of person throughput to their share of vehicle throughput. Increased carpooling, vanpooling, and express bus activity would likely enhance the throughput efficiency of the Express Lanes.

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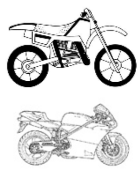
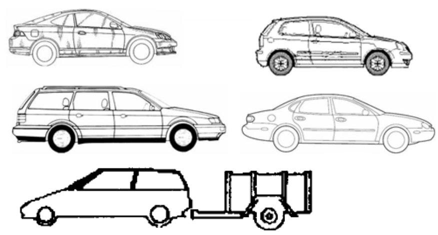
13 Appendix A: Vehicle Class Definitions

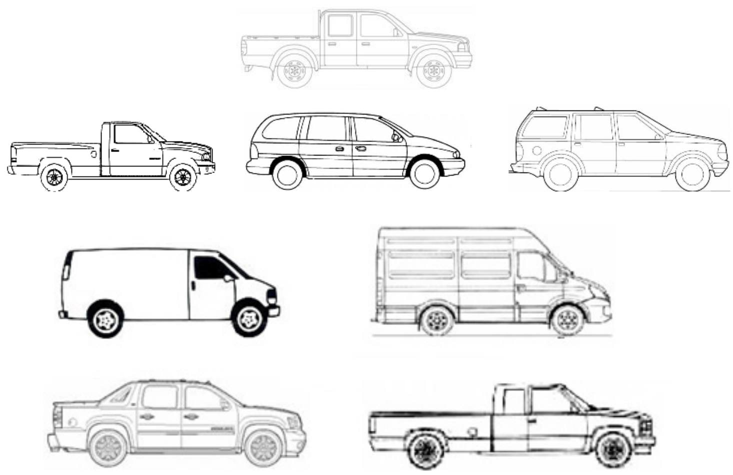
Motorcycle



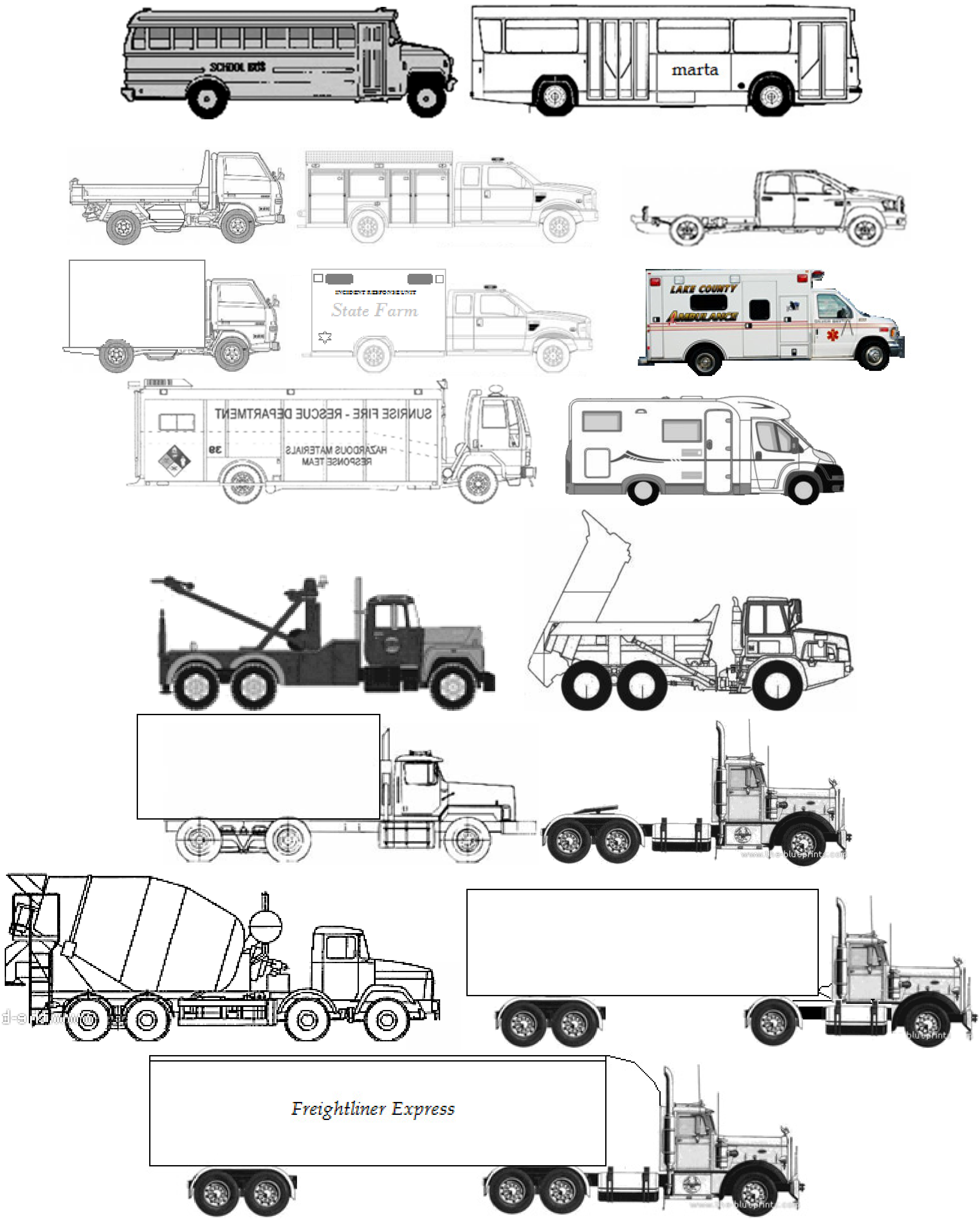
Light Duty Vehicles (LDVs)



Sport Utility Vehicles and Light Utility Trucks (SUV)



Heavy-Duty Vehicles (HDV) - Buses, RVs, Single-unit Trucks, Large Trucks



14 Appendix B: Regression Tree Analysis for SOV and '3+' Vehicle Percentages to Identify Potential Data Collector Bias

After screening the average occupancy, the research team conducted a series of regression tree analyses to identify potential data collector bias based on the portions of SOV and '3+' HOV. This appendix presents the four analyses (ten iterations in total) on SOV/ '3+' HOV portions of general purpose lanes and managed lanes. This part of QA/QC is based on allocated occupancy records (see section 4.3). A detailed description of the methodology can be found in section 5.4.

Analysis 1: SOV Portion Analysis on General Purpose Lanes

The first analysis was to assess the biased sessions based on the SOV portions on general purpose lanes. The analysis was conducted separately on the passenger car LDVs and SUVs.

1) SOV Passenger Car LDVs

The records of SOV portions of passenger car LDVs on general purpose lanes enter the first iteration as shown in Figure 104. The first split of the tree was between AM sessions versus PM sessions. The two major branches after the first split are shown in Figure 105.

In the previous research, the records with extremely high or low SOV portions were examined manually. In this analysis, the overall average SOV portion is 90.982% for passenger car LDVs on general purpose lanes. The extreme low values were manually reviewed, and no collector data was suspected of introducing errors. The extremely high SOV portions (larger than 99%) were also manually reviewed, as indicated in Figure 104 and Figure 105 (a). Data from the three suspect nodes were inconsistent across different sessions within the same lane and also different from other data collector data. These data were removed from the dataset and the remaining data was inputted into the next iteration of regression tree analysis.

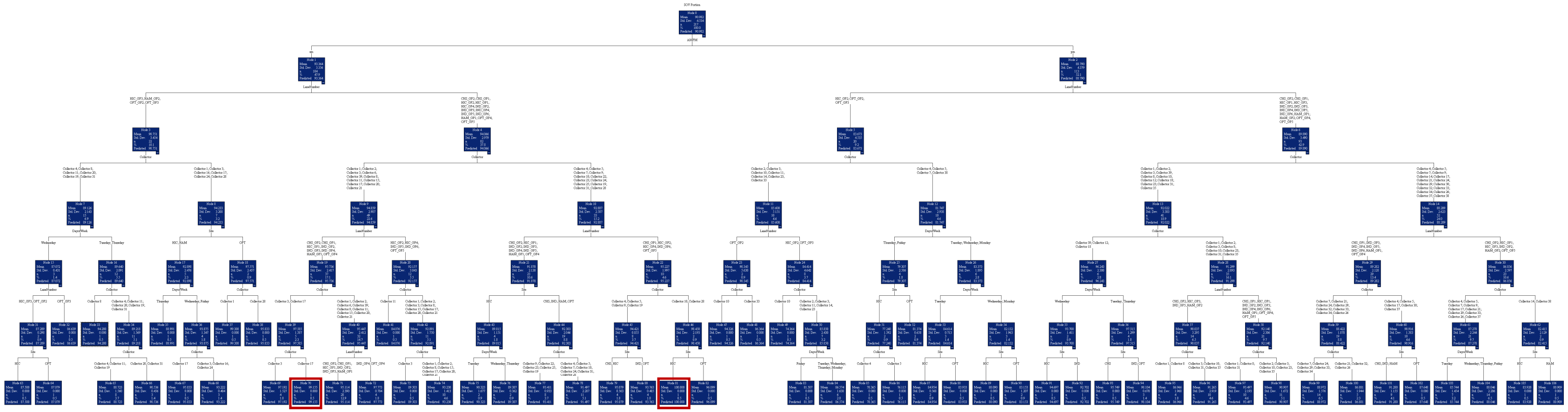
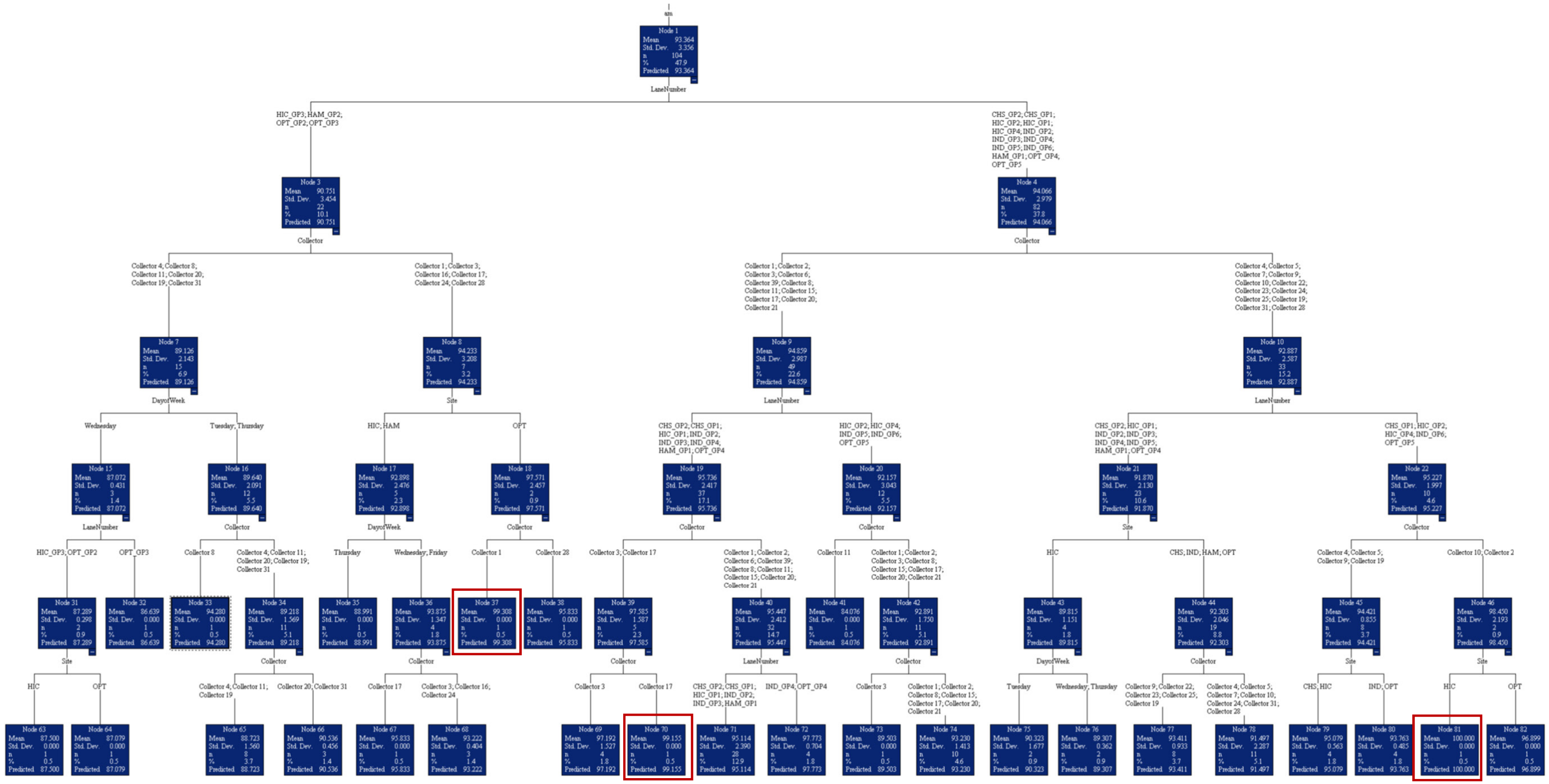
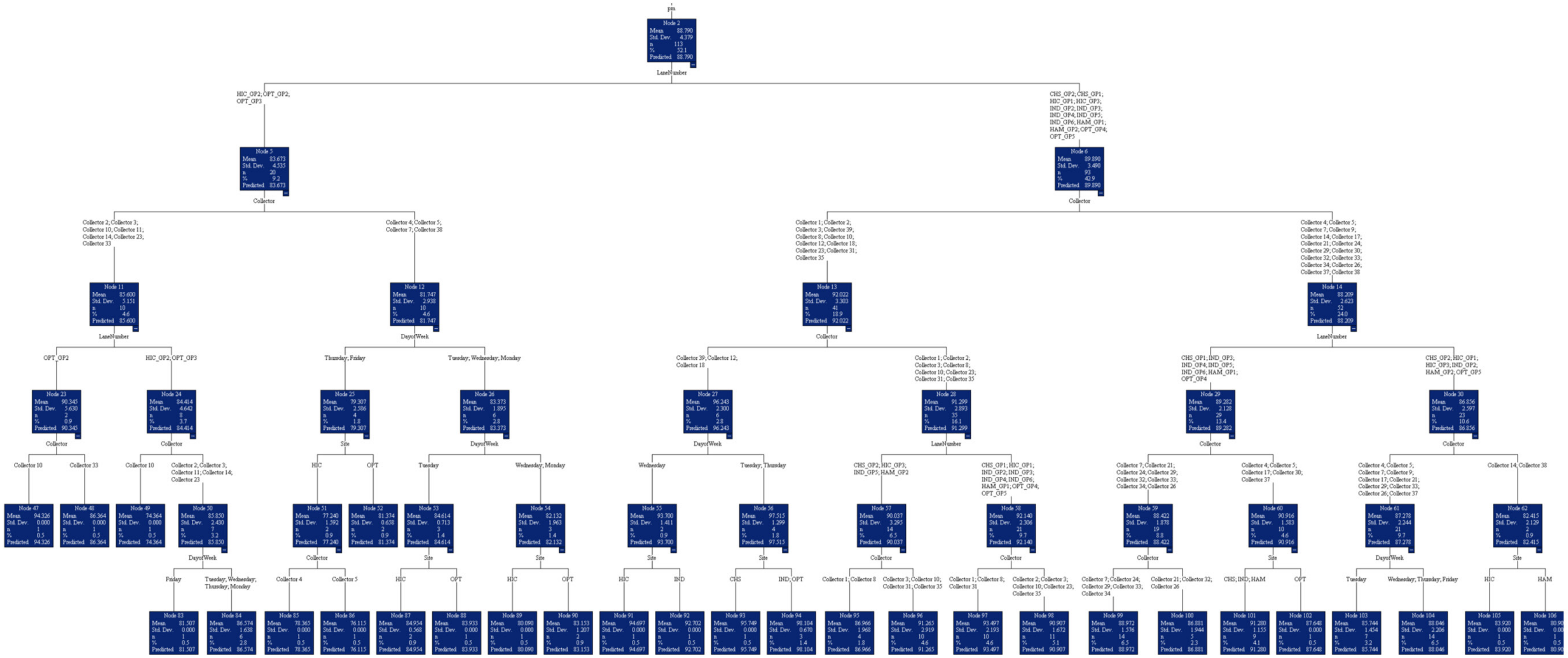


Figure 104 – Iteration 1 of SOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes



(a) Left Branch of Iteration 1 of SOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes



(b) Right Branch of Iteration 1 of SOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes

Figure 105 – Left and Right Branches, Iteration 1, SOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes

The next regression tree is shown in Figure 106, with the left/right branches shown in Figure 107. Again, the nodes with extremely low portions were checked and no suspect sessions were identified. The extreme high portions with values larger than 99% (marked in red squares) were also manually reviewed, and no inconsistency in these data were found across other sessions on the same lane and from other collectors. Therefore, these data were retained in the dataset.

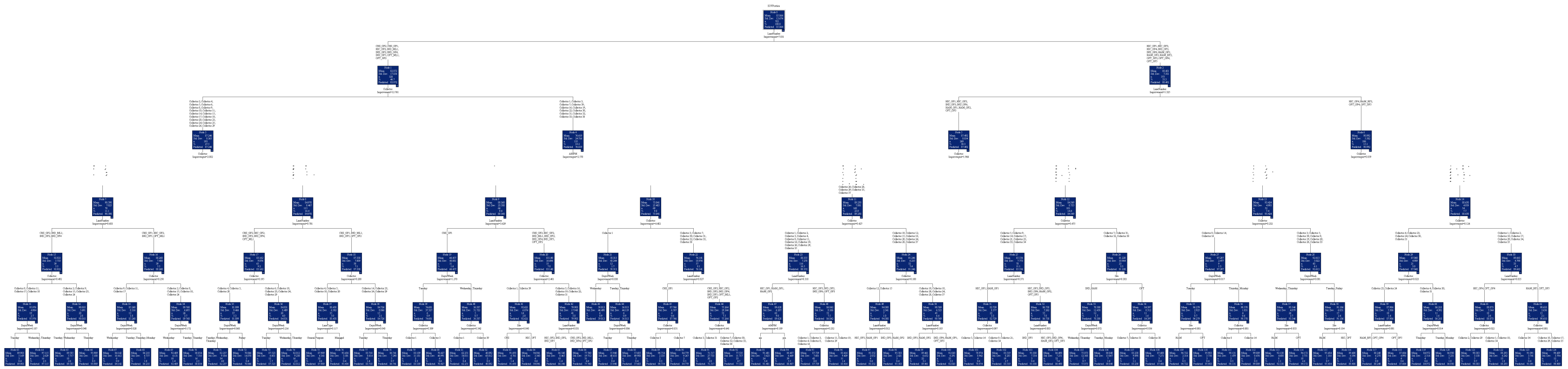
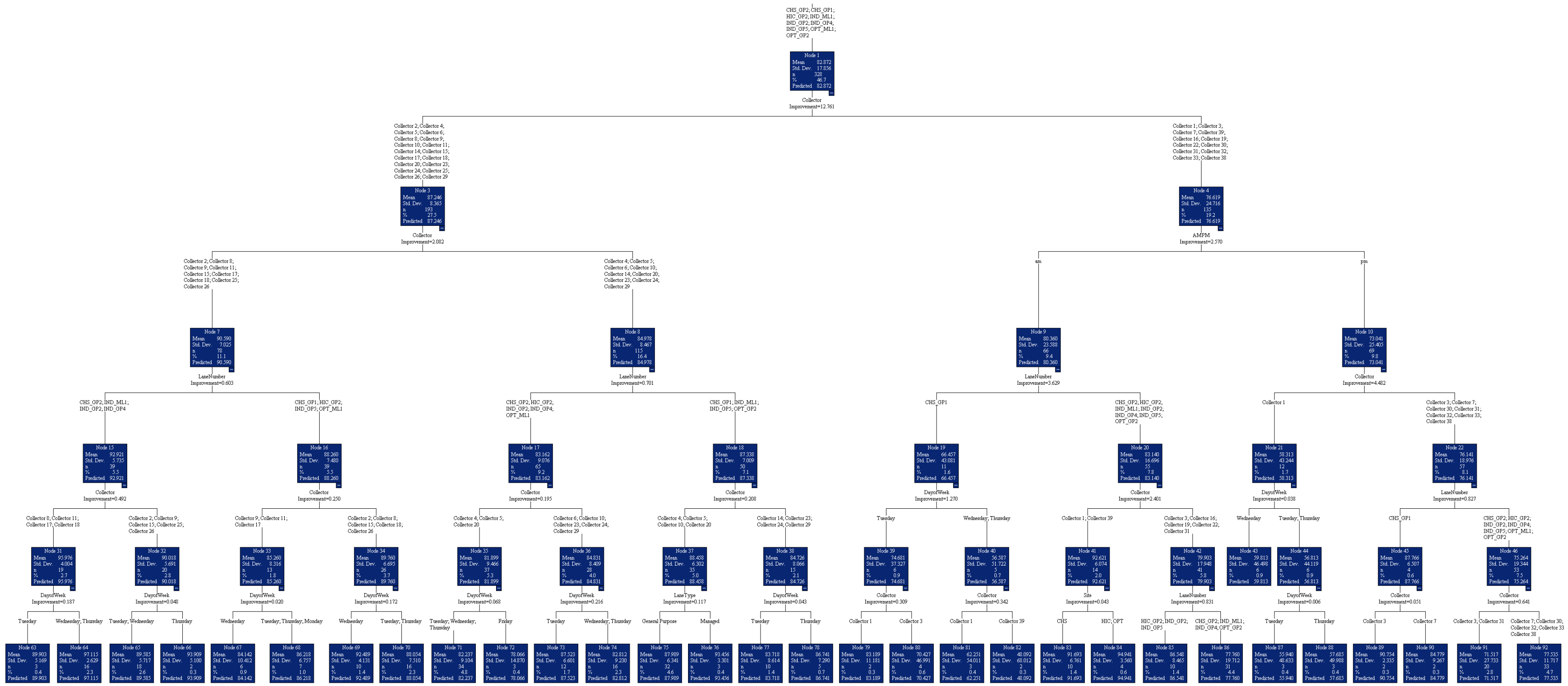
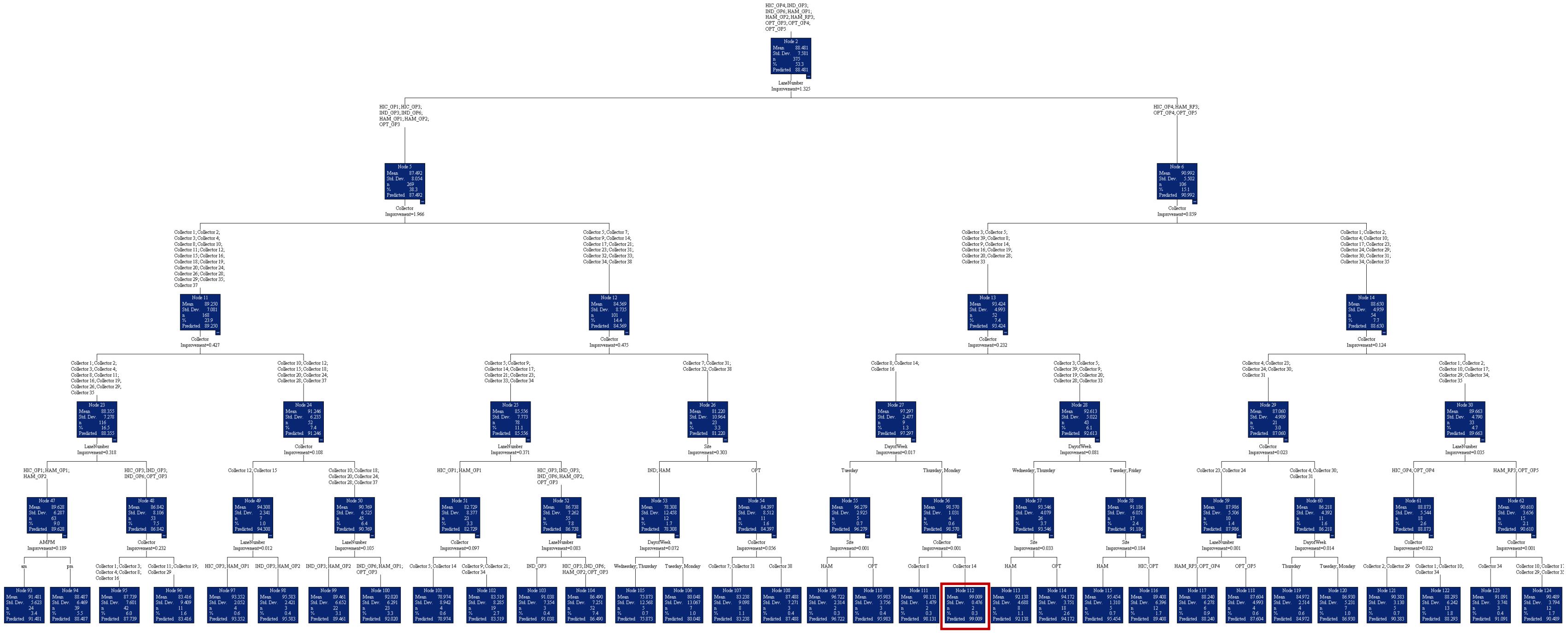


Figure 106 – Iteration 2 of SOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes



(a) Left Branch of Iteration 1 of SOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes



(b) Right Branch of Iteration 1 of SOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes

Figure 107 – Left and Right Branches of Iteration 2 of SOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes

2) SOV SUVs

Figure 108 presents the regression tree run for SOV portions of SUVs on the general purpose lanes. The first split was due to the differences across the lanes, and Figure 109 shows the left and right branches. The extreme low and high values were manually reviewed, and no suspect nodes were identified. Therefore, all the data in this iteration were retained.

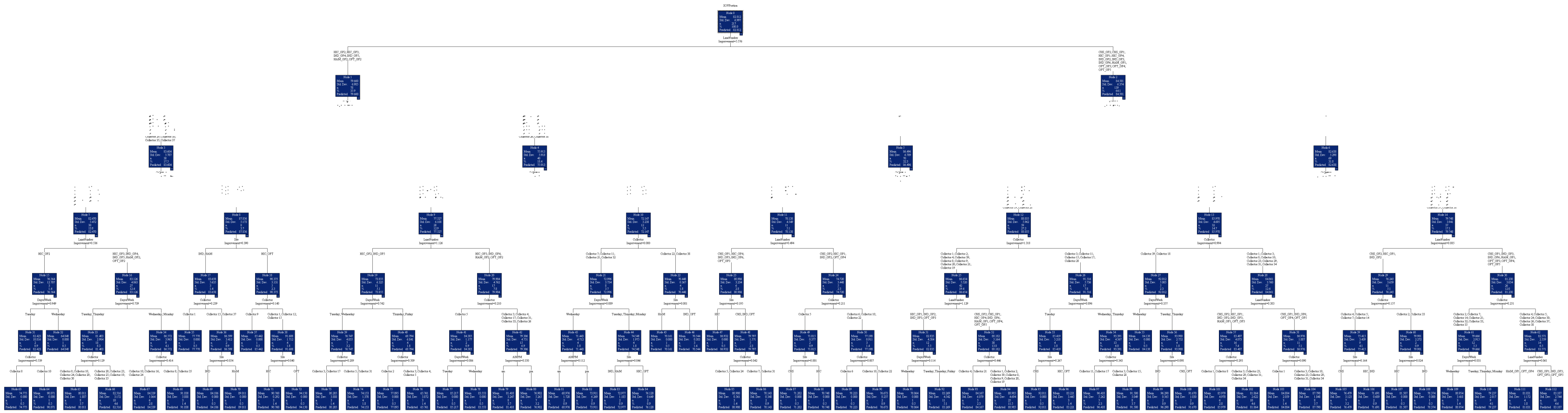
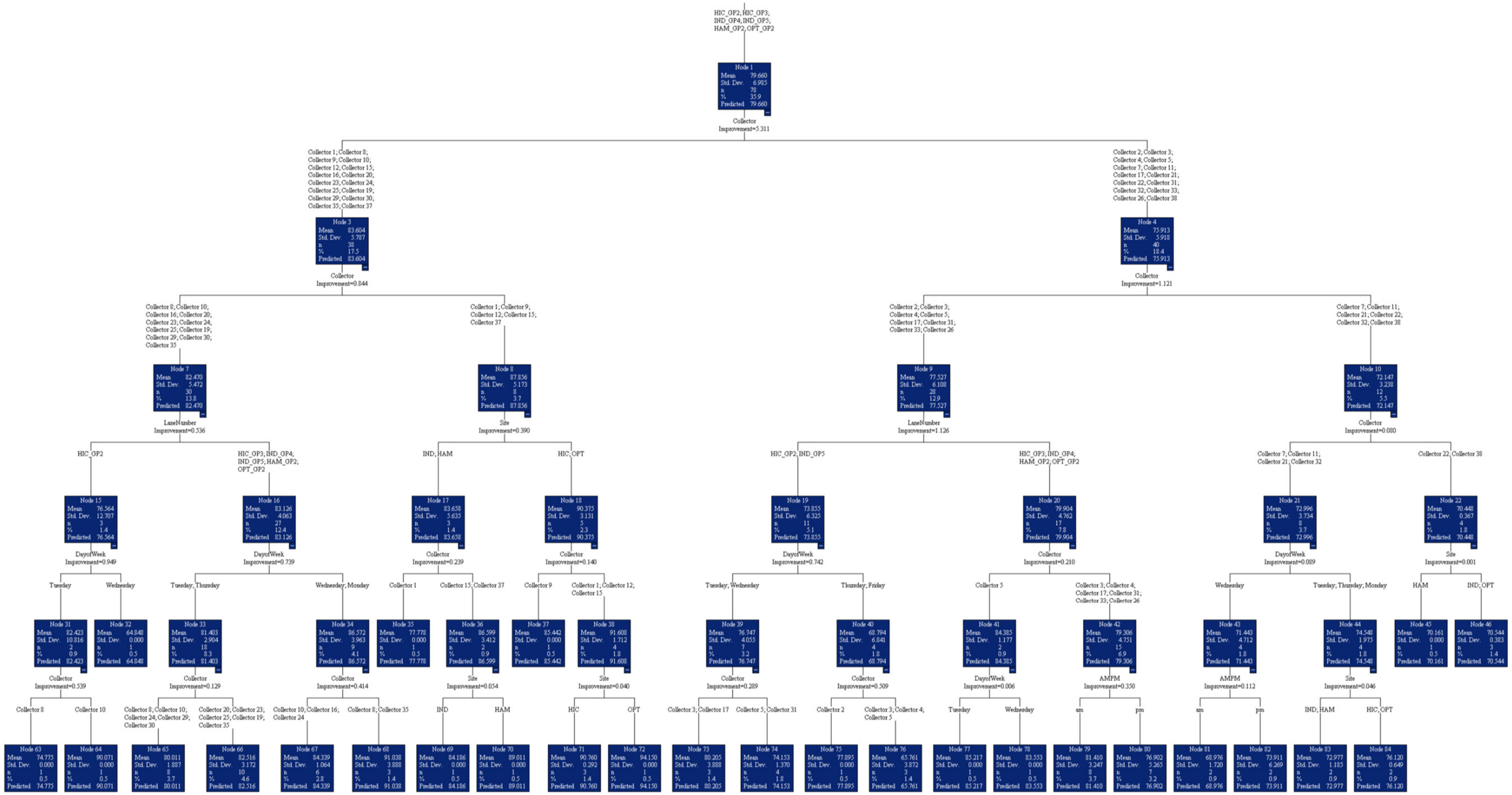
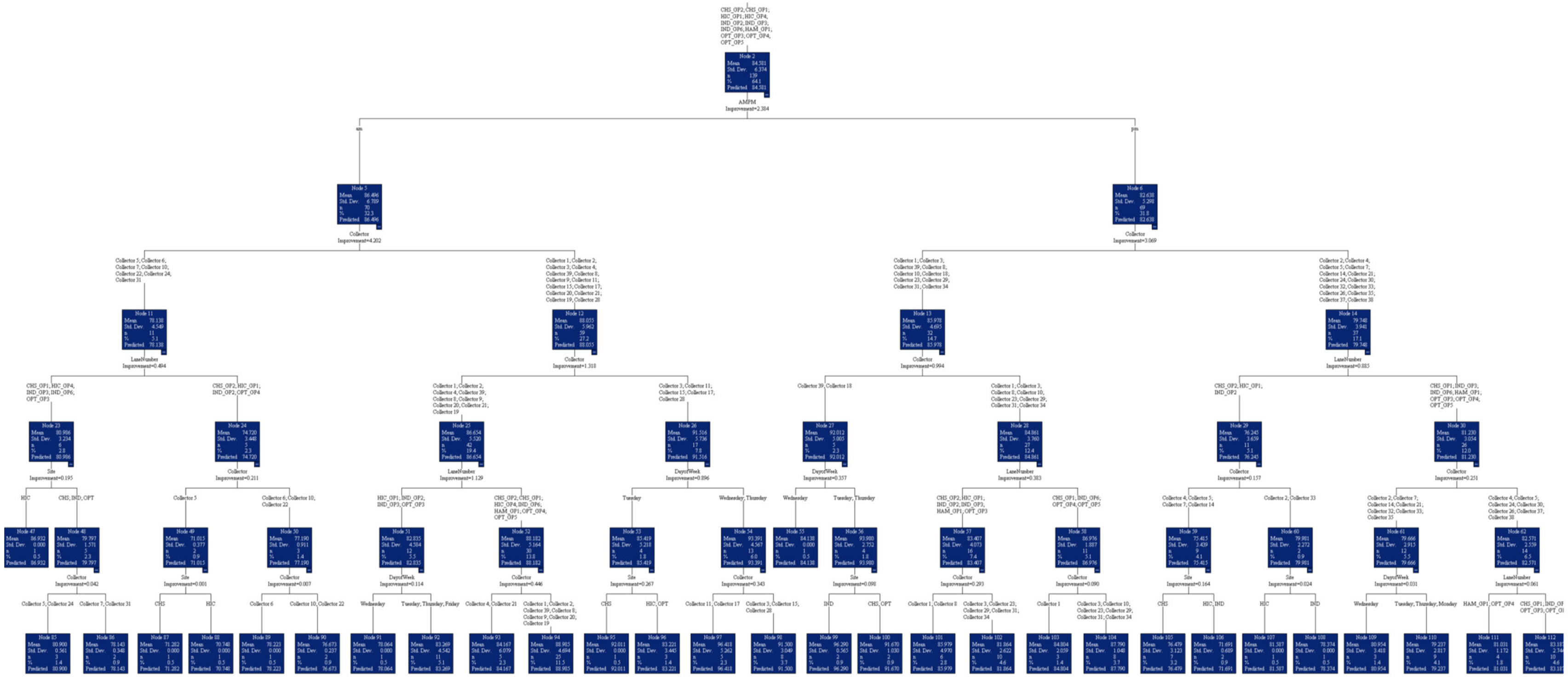


Figure 108 – Iteration 1 of SOV Portions of SUVs, Pre-Opening/Extension (Fall 2018), GP Lanes



(a) Left Branch of Iteration 1 of SOV Portions of SUVs, Pre-Opening/Extension (Fall 2018), GP Lanes



(b) Right Branch of Iteration 1 of SOV Portions of SUVs, Pre-Opening/Extension (Fall 2018), GP Lanes

Figure 109 – Left and Right Branches, Iteration 1, SOV Portions of SUVs, Pre-Opening/Extension (Fall 2018), GP Lanes

Analysis 2: SOV Portion Analysis on Managed Lanes

1) Passenger Car LDVs

Figure 110 shows the regression tree for the SOV portions of passenger car LDVs on managed lanes, with an overall average of 91.6%. No extreme low values were identified as suspect after the manual review. For records with extreme high values, data from Node 8 were identified as suspect with an average of 100%. The team found the records to be inconsistent across the other sessions on the same lane, and different with other collectors. Therefore, records of Node 8 were removed from the dataset.

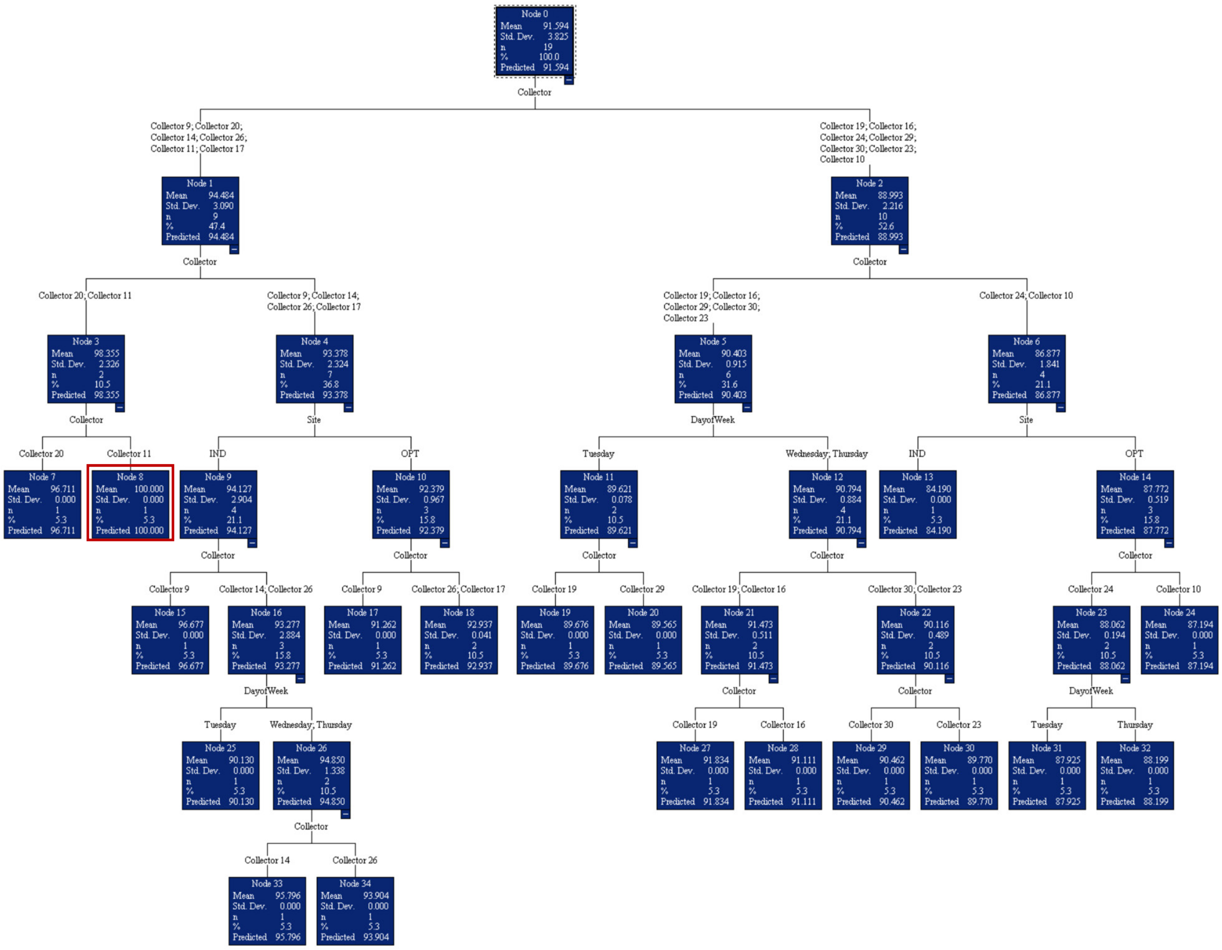


Figure 110 – Iteration 1 of SOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), Managed Lanes

The next iteration is shown in Figure 111. In this iteration, the research team found no suspect nodes after manually reviewing the records for extreme high/low values. Therefore, all the data were retained in this iteration.

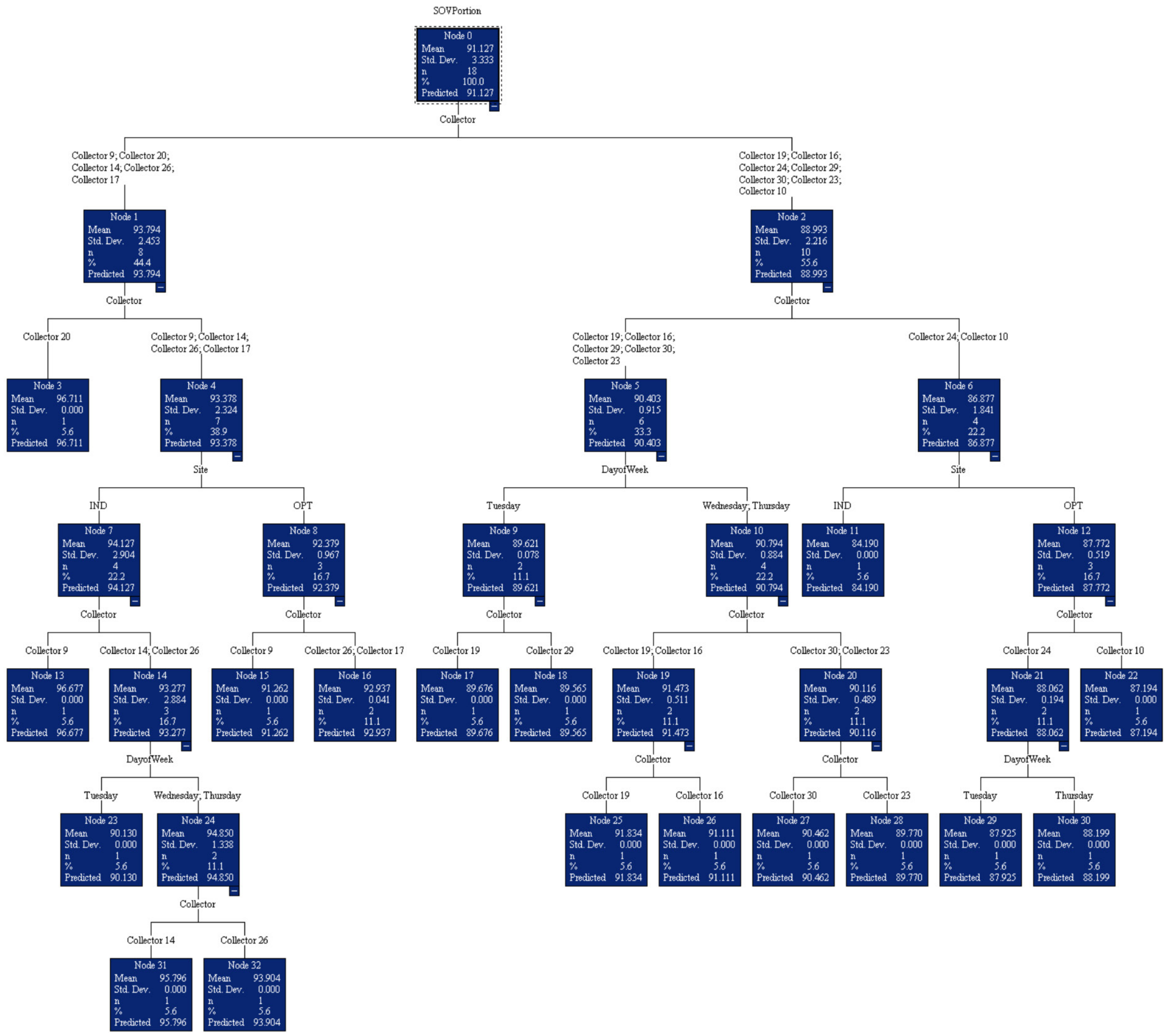


Figure 111 – Iteration 2 of SOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), Managed Lanes

2) SUVs

Figure 112 shows the regression tree for the SOV portions of SUVs on managed lanes, with an average of 82.1%. The research team conducted the manual review of the records with extreme low/high values, and no suspect was identified. Therefore, all the data were retained in this iteration.

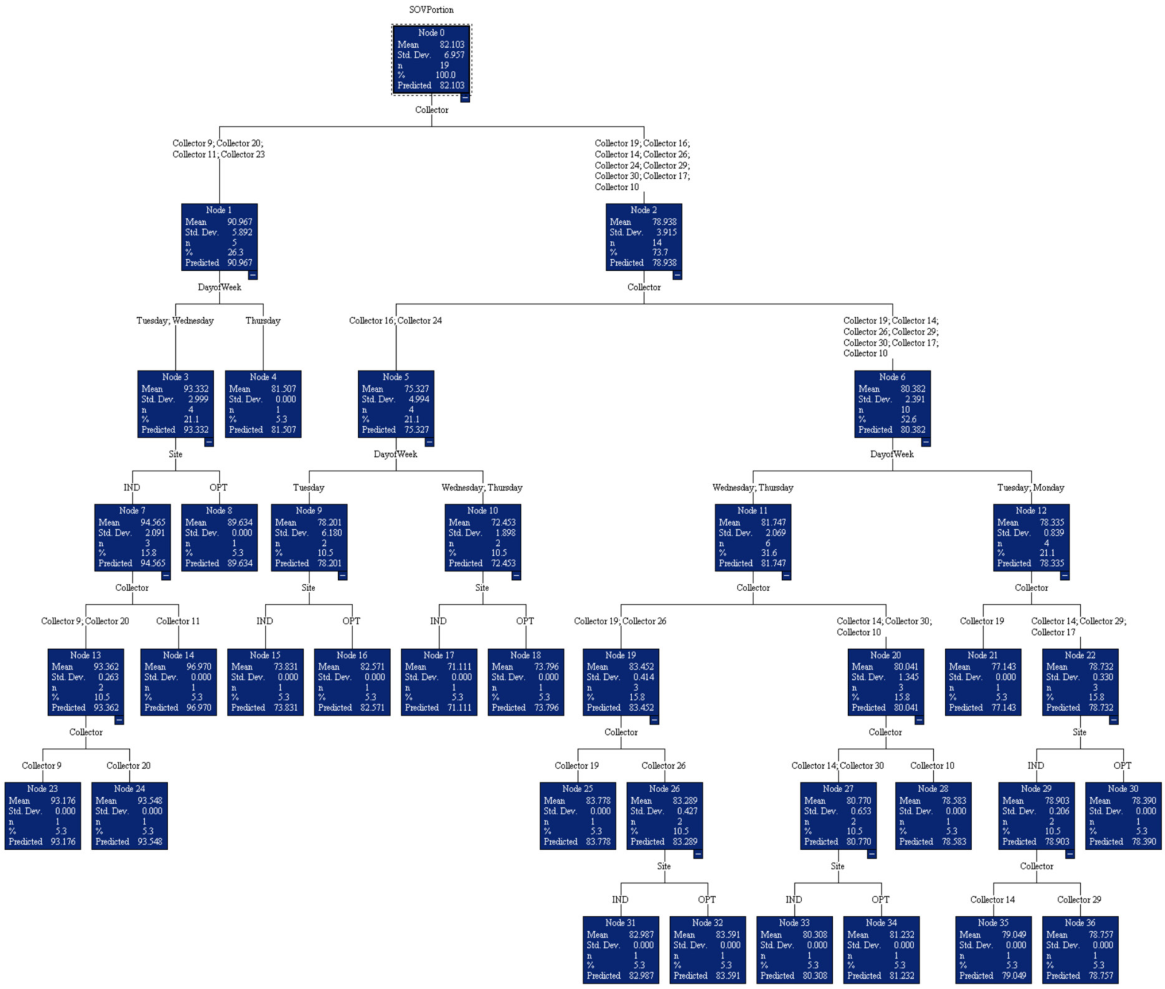


Figure 112 – Iteration 1 of SOV Portions of SUVs, Pre-Opening/Extension (Fall 2018), Managed Lanes

<u>Analysis 3: '3+' HOV Portion Analysis on General Purpose Lanes</u>

The regression tree in this step was to identify the biased collector/sessions based on the portion of vehicles with larger occupancy values of 3 and more. Similar to the analysis of the SOV portions, the analysis was conducted separately on general purpose lanes and managed lanes.

1) Passenger Car LDVs

Figure 113 shows the regression tree for the '3+' HOV portions of passenger car LDVs on general purpose lanes. The first split was due to AM sessions versus PM sessions. Figure 114 shows the left and right branch after the first split. The data with extreme high values were reviewed by the team, and no node was identified as suspect. The data from Node 45 with an average of 0% was identified as suspect due to the complete absence of '3+' HOV records in the whole sessions. However, the overall average of the tree is only 0.570, indicating that extreme low records do not cause a large variance. The manual review of these records indicated that the same data collector was repeatedly assigned to the same lane, while the collector's data were not significantly different across the other sessions on the same lane and from other collectors. Therefore, these data were retained in the analysis.

2) SUVs

Figure 115 shows the regression tree for the '3+' HOV portions of passenger car LDVs on general purpose lanes. The first split was between AM and PM sessions. Figure 116 shows the two branches of the tree after the first split. Again, the extreme portions were manually examined, and no suspect data were identified in this iteration. Therefore, all the data were retained.

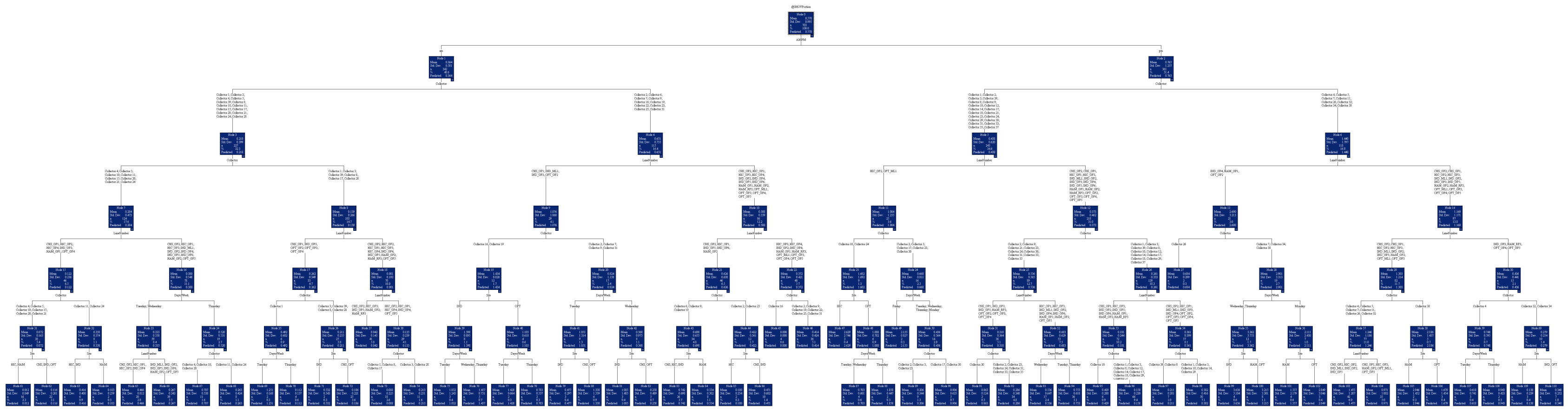
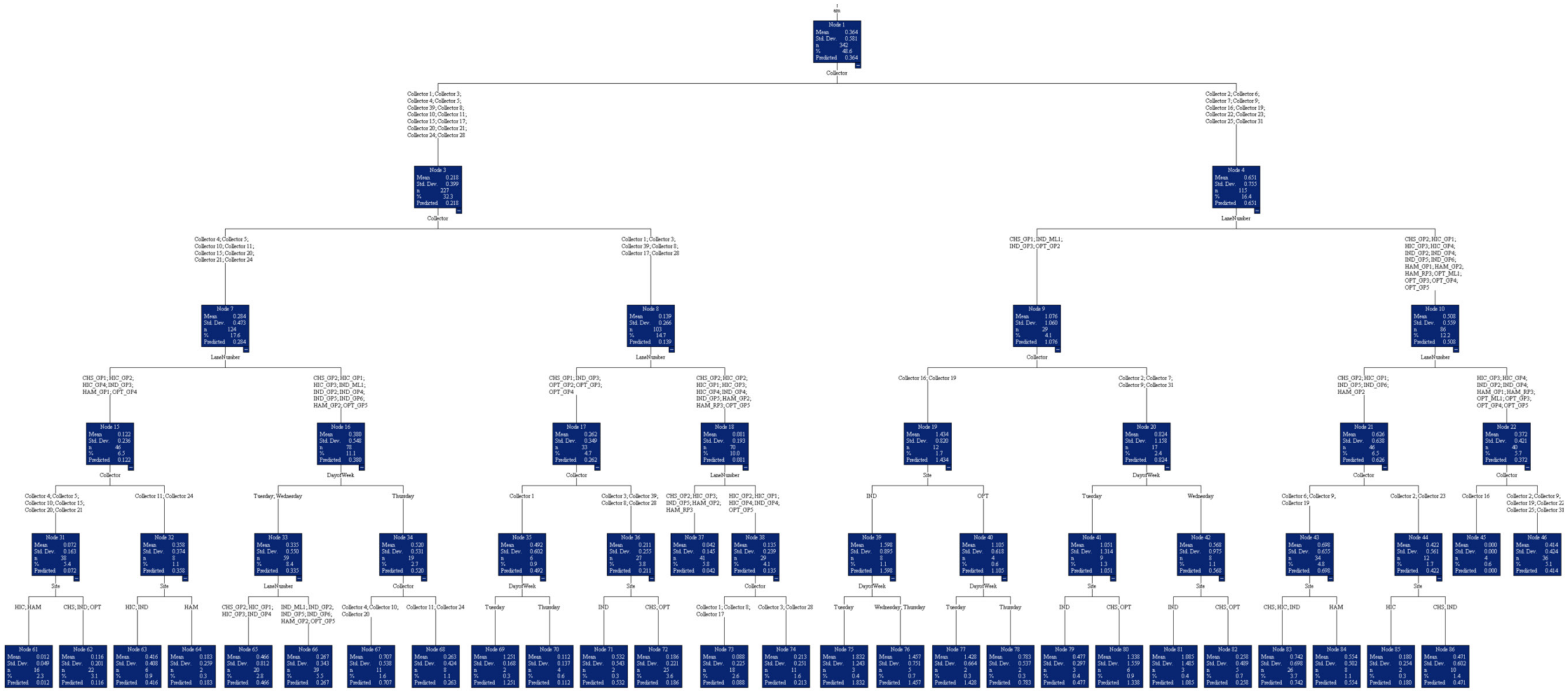
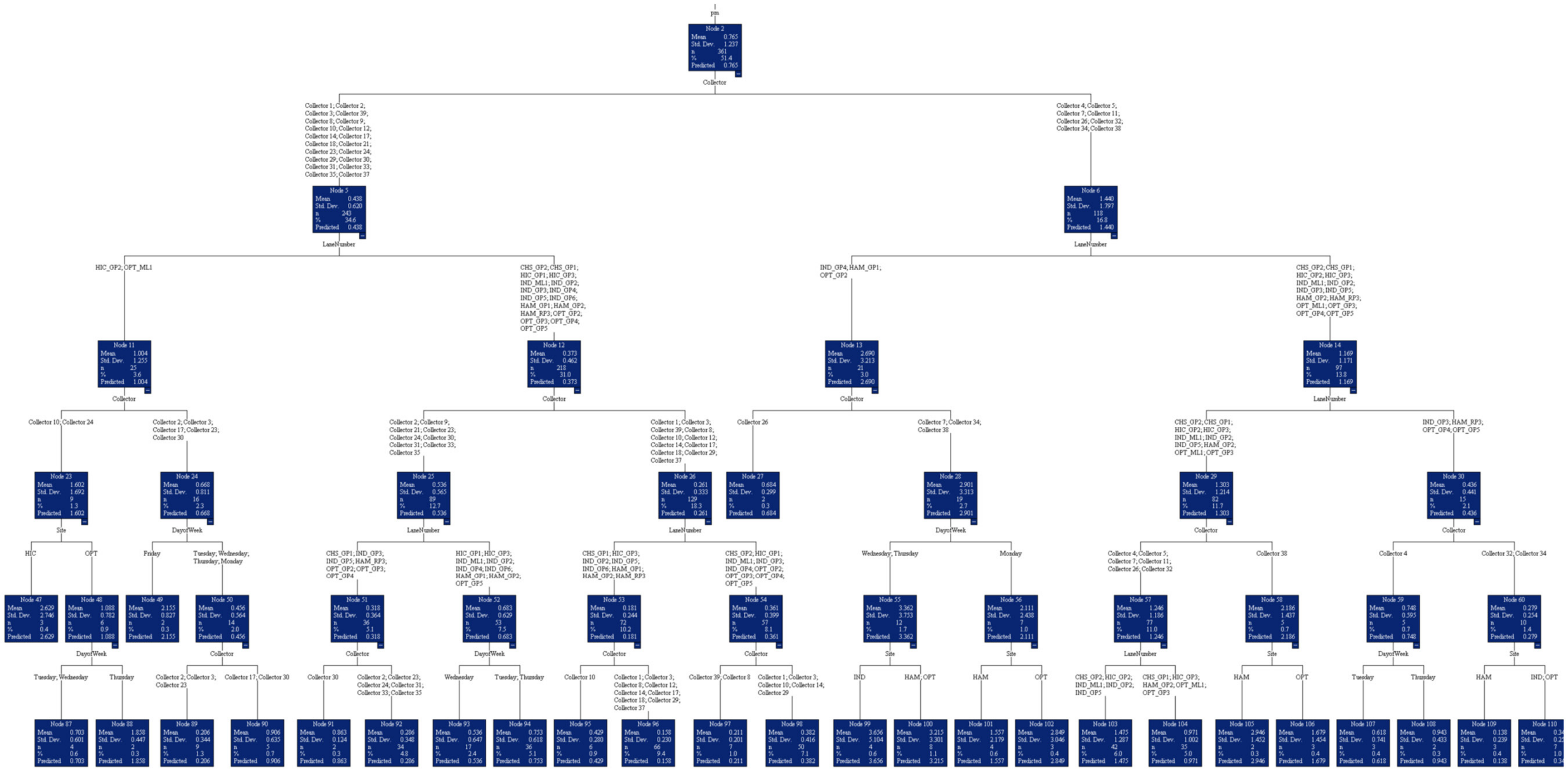


Figure 113 – Iteration 1 of '3+' HOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes



(a) Left Branch of Iteration 1 of Iteration 1 of ‘3+’ HOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes



(b) Right Branch of Iteration 1 of '3+' HOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes

Figure 114 – Left and Right Branches, Iteration 1, '3+' HOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), GP Lanes

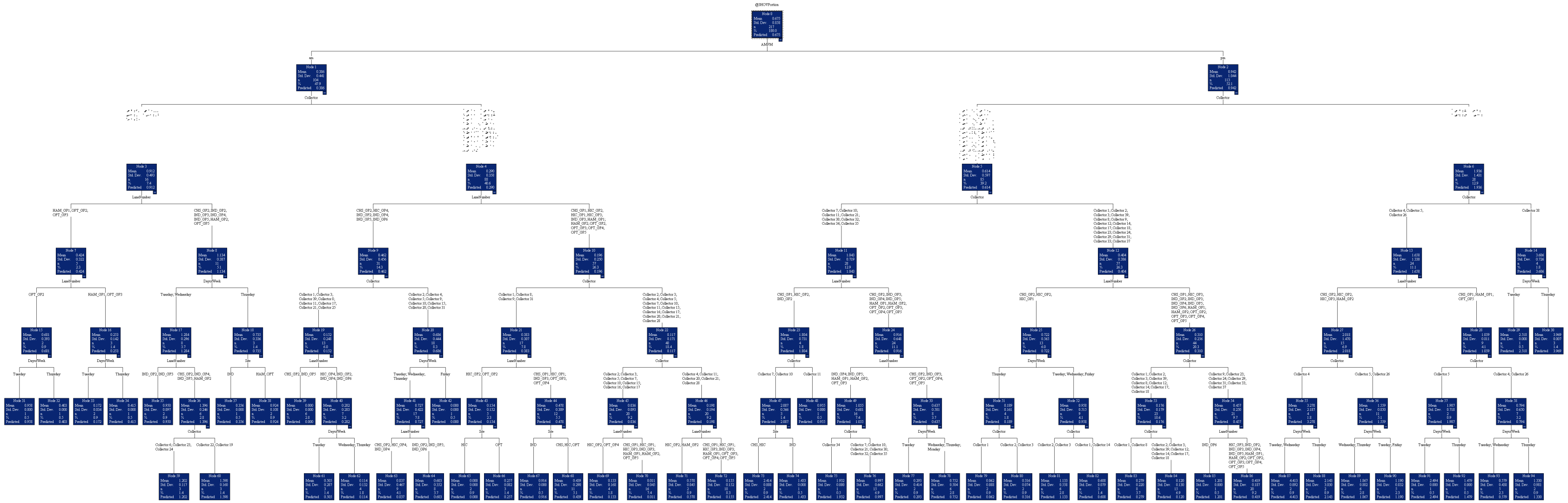
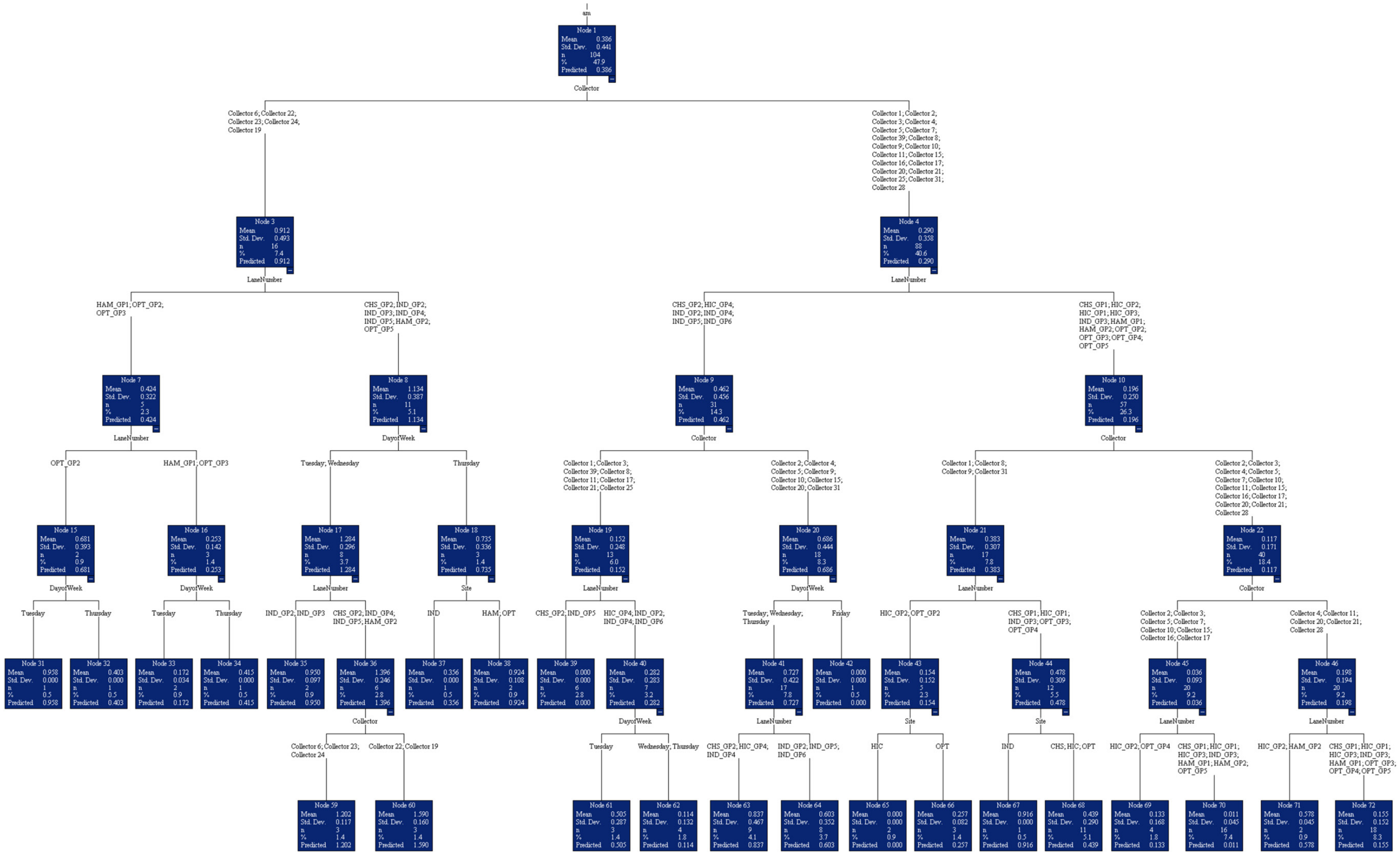
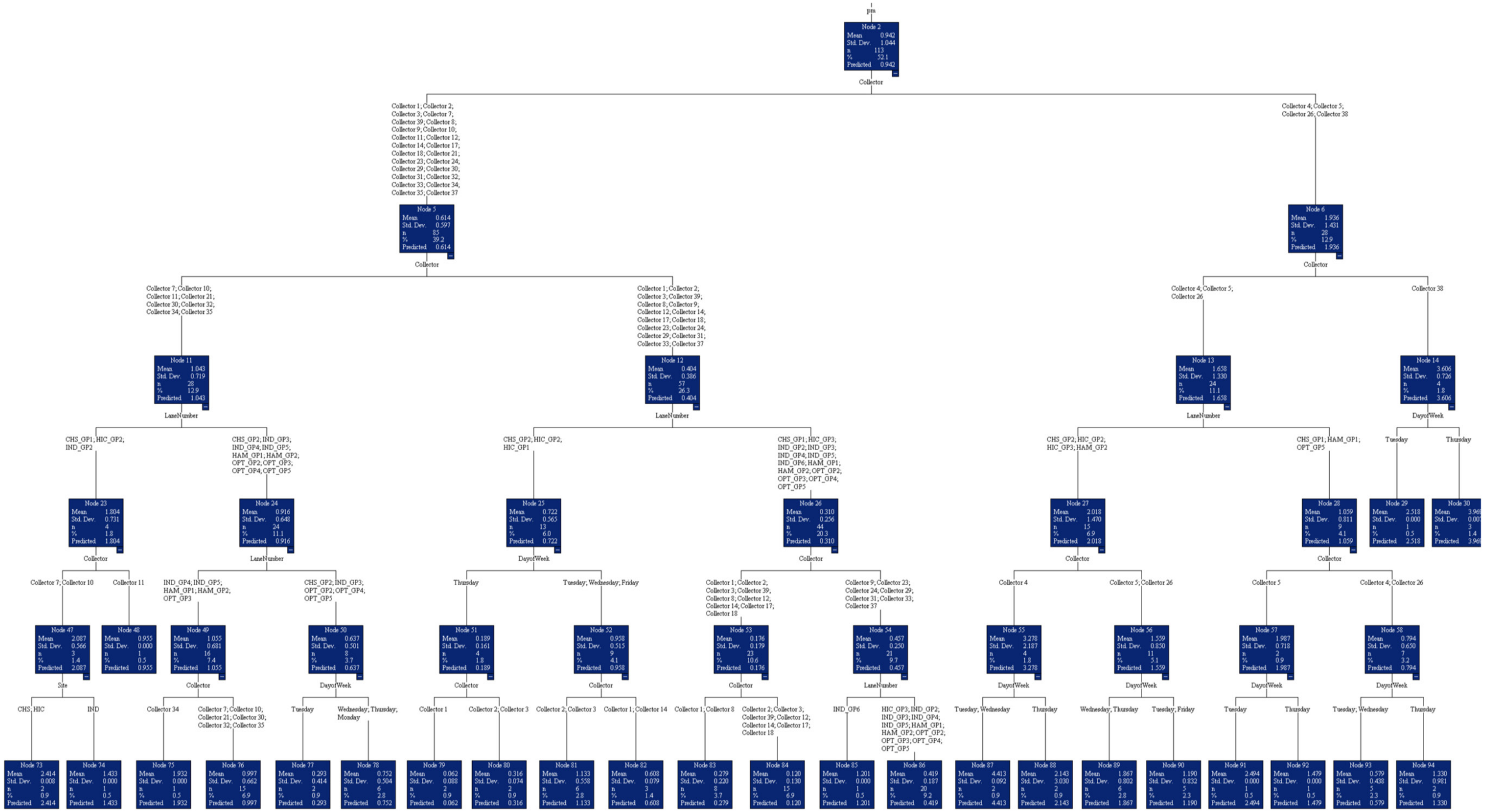


Figure 115 – Iteration 1 of '3+' HOV Portions of SUVs, Pre-Opening/Extension (Fall 2018), GP Lanes



(a) Left Branch of Iteration 1 of '3+' HOV Portions of SUVs, Pre-Opening/Extension (Fall 2018), GP Lanes



(b) Right Branch of Iteration 1 of '3+' HOV Portions of SUVs, Pre-Opening/Extension (Fall 2018), GP Lanes

Figure 116 – Left and Right Branches, Iteration 1, '3+' HOV Portions of SUVs, Pre-Opening/Extension (Fall 2018), GP Lanes

Analysis 3: '3+' HOV Portion Analysis on Managed Lanes

The '3+' HOV portions on managed lanes were entered into the regression tree analysis using the same methodology in Analysis 3. Figure 117 shows the tree of passenger car LDVs, and Figure 118 shows the trees for SUVs. The research team reviewed the two trees to identify potential biased sessions, and no suspect was found after examining the records with extreme high/low values. Therefore, in this analysis, all the data were retained.

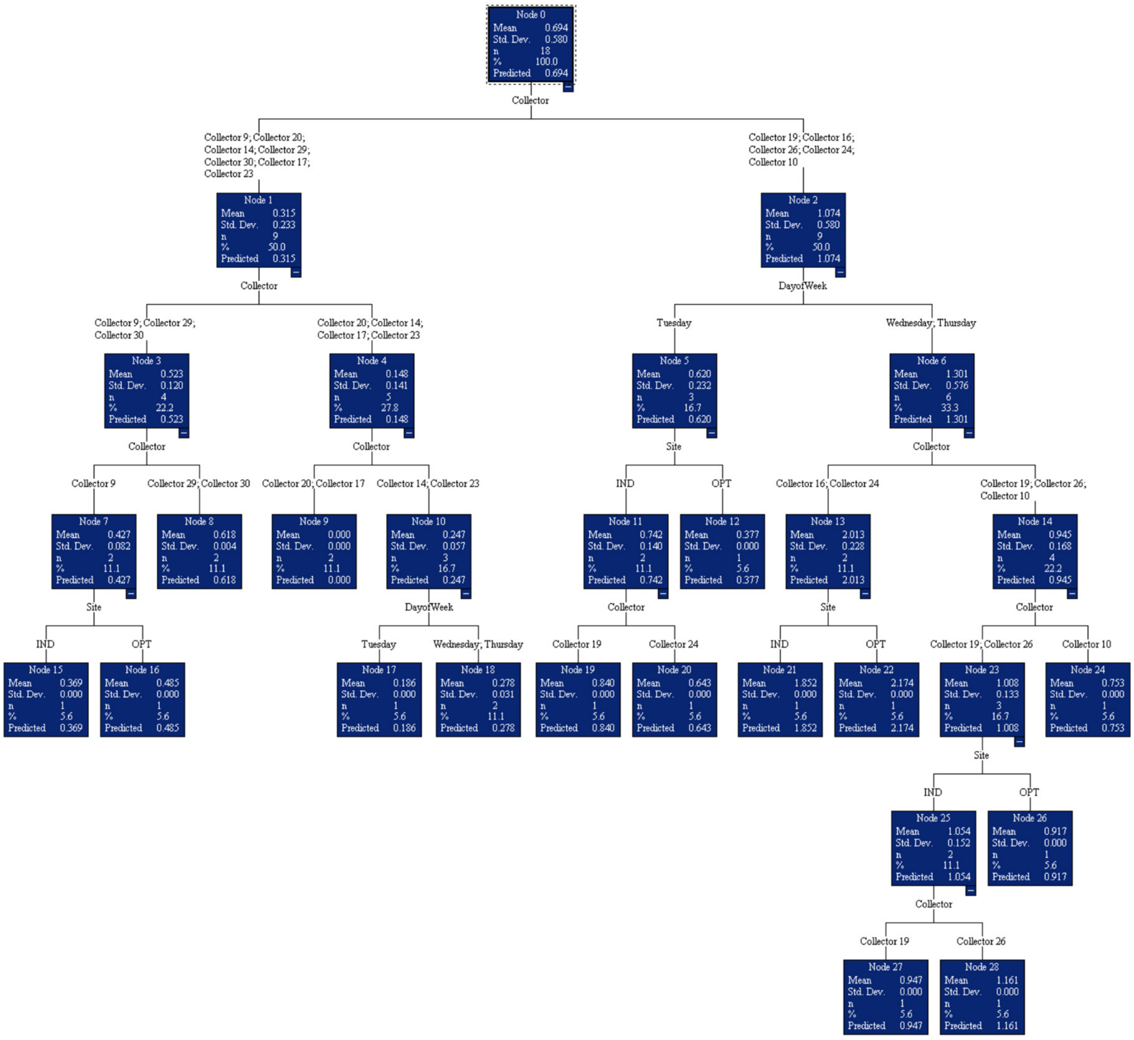


Figure 117 – Iteration 1 of '3+' HOV Portions of Passenger Car LDVs, Pre-Opening/Extension (Fall 2018), Managed Lanes

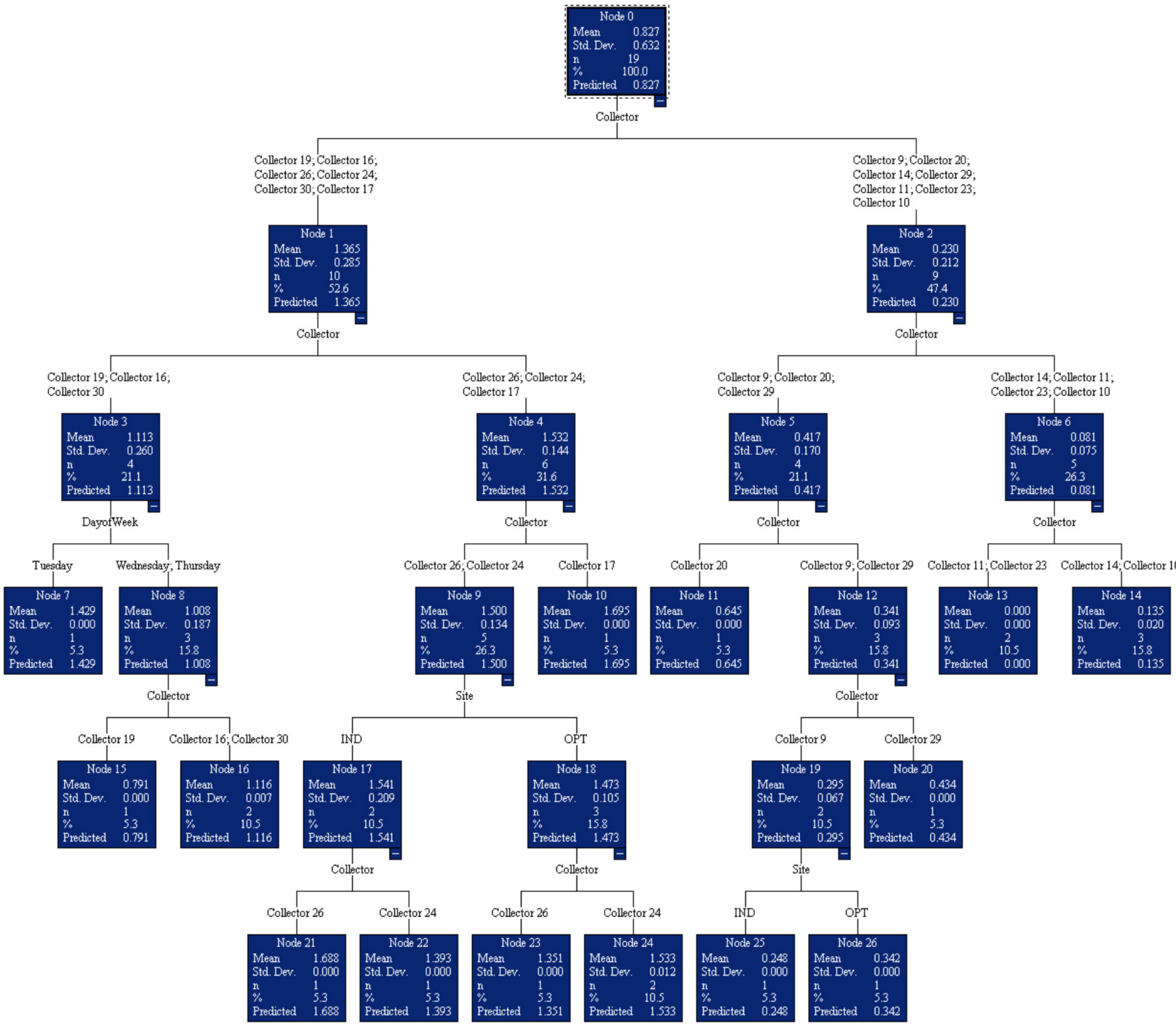


Figure 118 – Iteration 1 of '3+' HOV Portions of SUVs, Pre-Opening/Extension (Fall 2018), Managed Lanes

15 Appendix C: Regression Tree Analysis of the Occupancy Data of Spring 2019

The regression tree analysis aimed to identify potential biases in the occupancy data caused by day of the week, particular collector, etc. This appendix provides the regression tree analysis process of Spring 2019 which follows the same methodology described in Chapter 5. The net reduction in sample size and net impact on average occupancy can be found in Table 14, Table 18, and Table 19.

15.1 Day-of-Week Analysis

The team did not schedule any field sessions for Monday and Friday for Spring 2019 to avoid any potential bias in occupancy. That is, all data collected in Spring 2019 were from Tuesday, Wednesday, and Thursday. The team also avoided the first/last workday before/after a state holiday. The team generated the regression tree with the input variables of vehicle type, session (AM/PM), lane information, and day of the week, as shown in Figure 119. The day of the week variable did not enter the tree to cause a split, indicating that the day of week and session for the data collected do not influence vehicle occupancy. The team concluded that all data would remain in the dataset for further analysis.

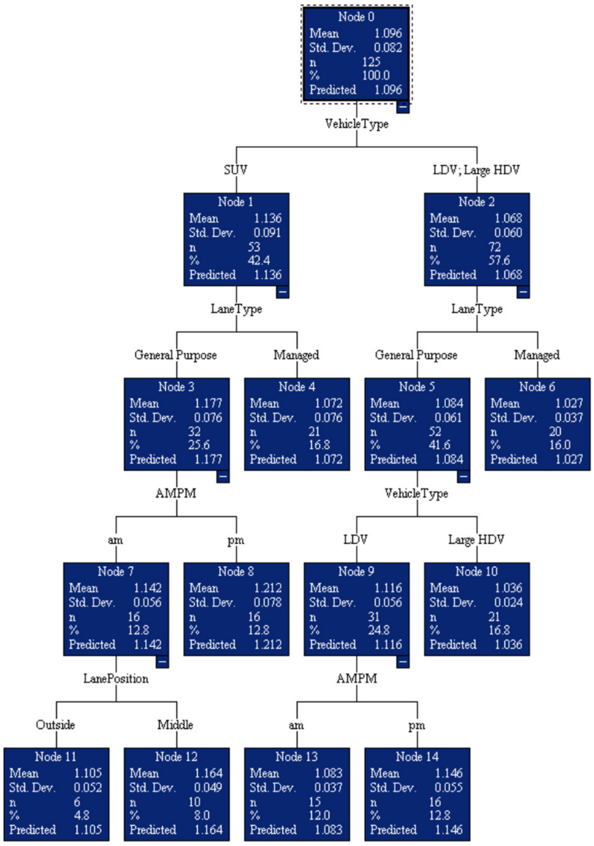


Figure 119 – Regression Tree to Identify Day of Week Impacts, Baseline (Spring 2019)

15.2 Average Vehicle Occupancy and Potential Data Collector Bias

The research team then conducted more regression tree iterations with the input variables of lane information, vehicle class, AM/PM, and collector ID to identify potential data collector bias. The analysis only included Jodeco Road at I-75 for Spring 2019, so no site information was specified (all lanes are still numbered starting with "JOD"). Note that data collector IDs were re-indexed (some URAs left the project and new members were hired); hence, data collector IDs are different across the 2018 and 2019 analysis.

The first iteration is shown in Figure 120. All nodes with a smaller sample size of 8/125 records were manually examined. Then, the team compared the data from all sessions in which these data collectors were active to the sessions of other data collectors. In this iteration, three records (of one session) from Collector 19, two records (of one session) from Collector 2, and two records (of one session) from Collector 9 were excluded. The second regression tree iteration is shown in Figure 121. After reviewing all terminal nodes, the team found no collector that presented significantly different patterns with respect to average occupancy, and thus decided to exclude no record for this iteration.

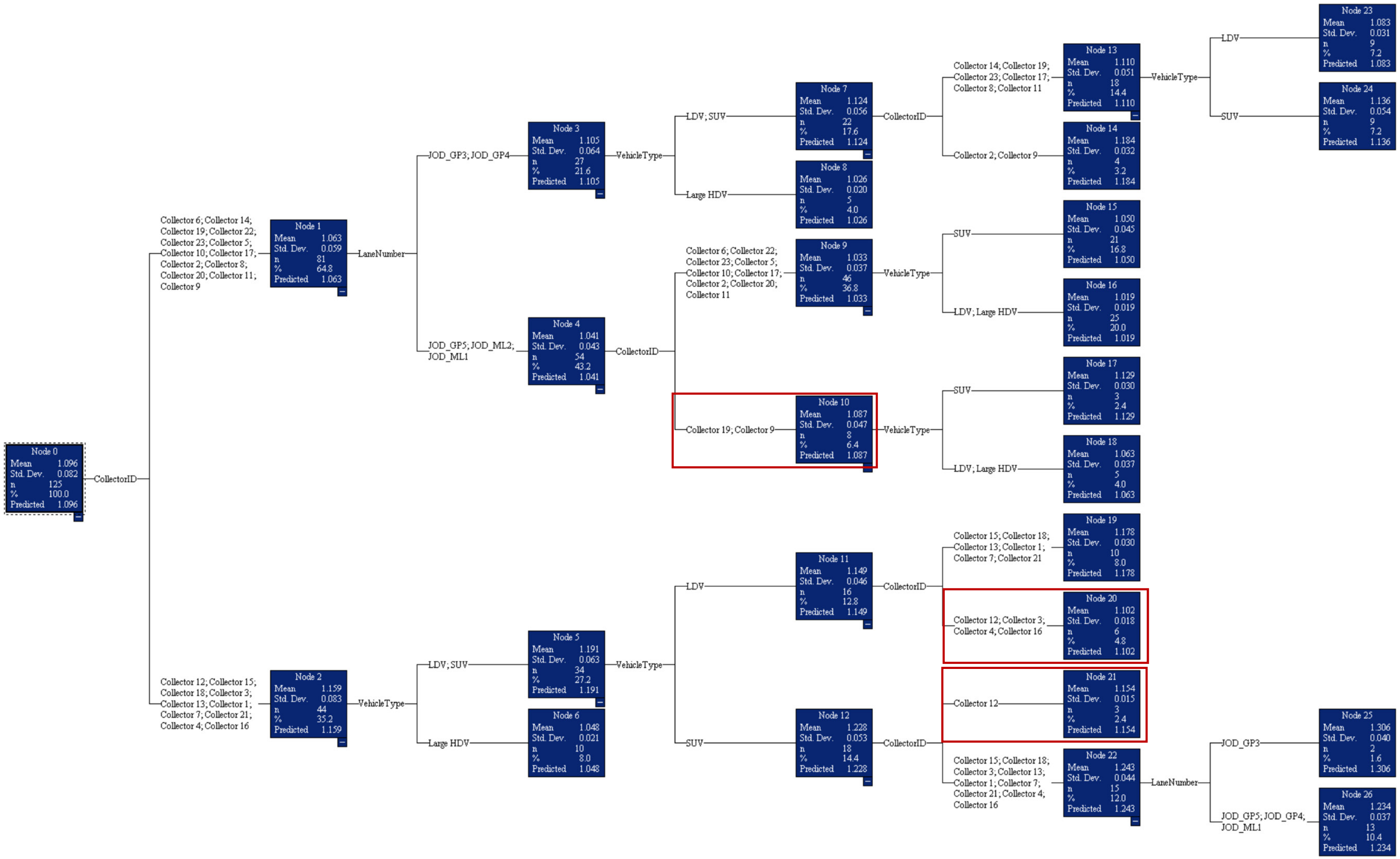


Figure 120 – First Iteration Regression Tree to Identify Potential Data Collector Bias, Baseline (Spring 2019)

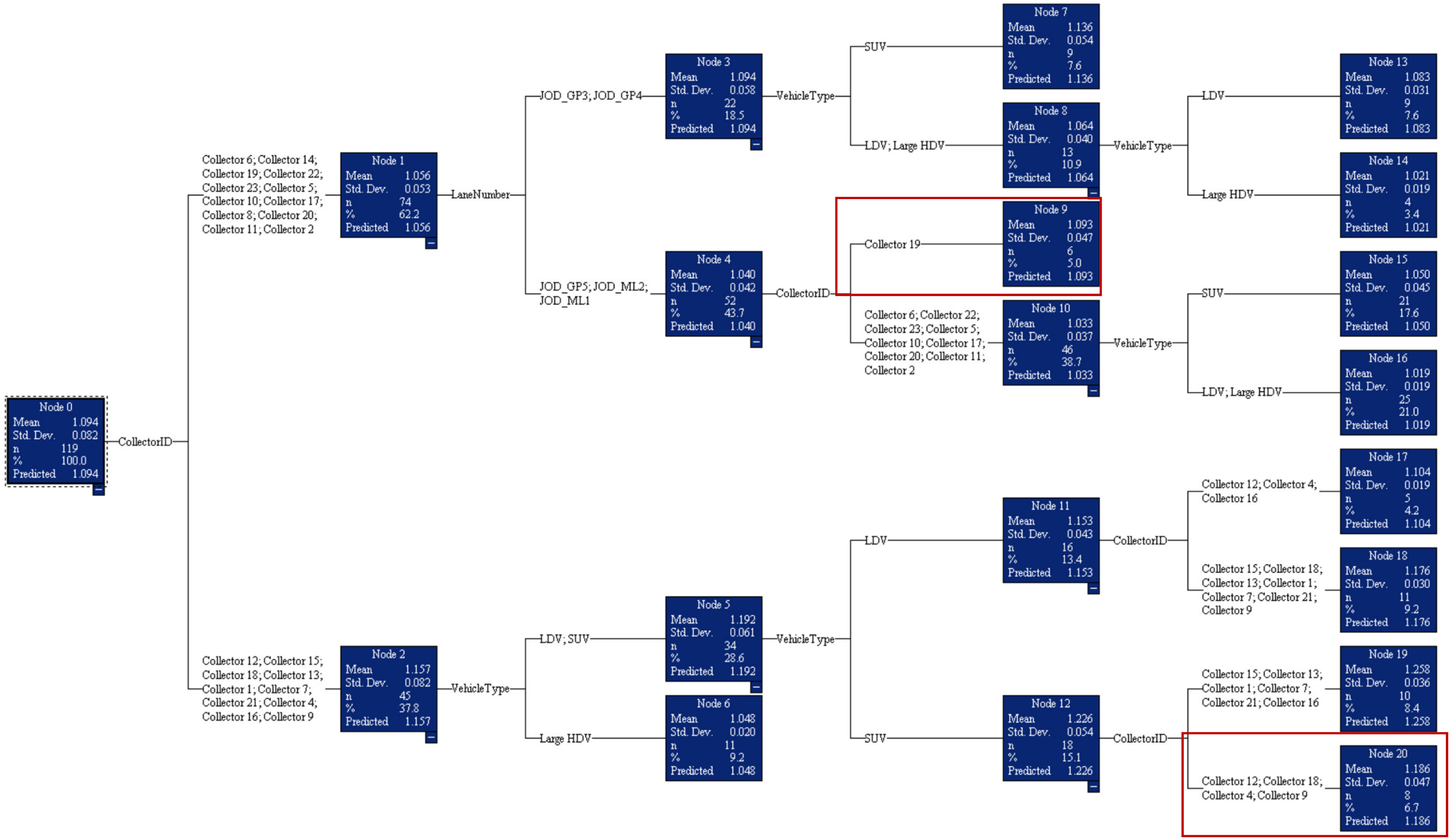


Figure 121 – Second Iteration Regression Tree to Identify Potential Data Collector Bias, Baseline (Spring 2019)

15.3 SOV and '3+' Vehicle Percentages and Potential Data Collector Bias

After screening average occupancy, the research team conducted a series of regression tree analyses to identify potential data collector bias based on the portions of SOV and '3+' HOV. This section presents the four analyses with the same methodology described in Appendix B. The four analyses include the regression trees of SOV portions of passenger car LDVs, SOV portions of SUVs, '3+' HOV portions of passenger car LDVs, and '3+' HOV portions of SUV.

The research team manually examined all terminal nodes that may be significantly different from other nodes. For the nodes with larger than 99% of SOV portions on the managed lanes, the research team decided to keep them in the dataset, as the average SOV portions on managed lanes are very high (97.32% for passenger car LDVs, and 94.81% for SUVs). The research team excluded no record in these analyses. The generated trees are shown in Figure 122 to Figure 125.

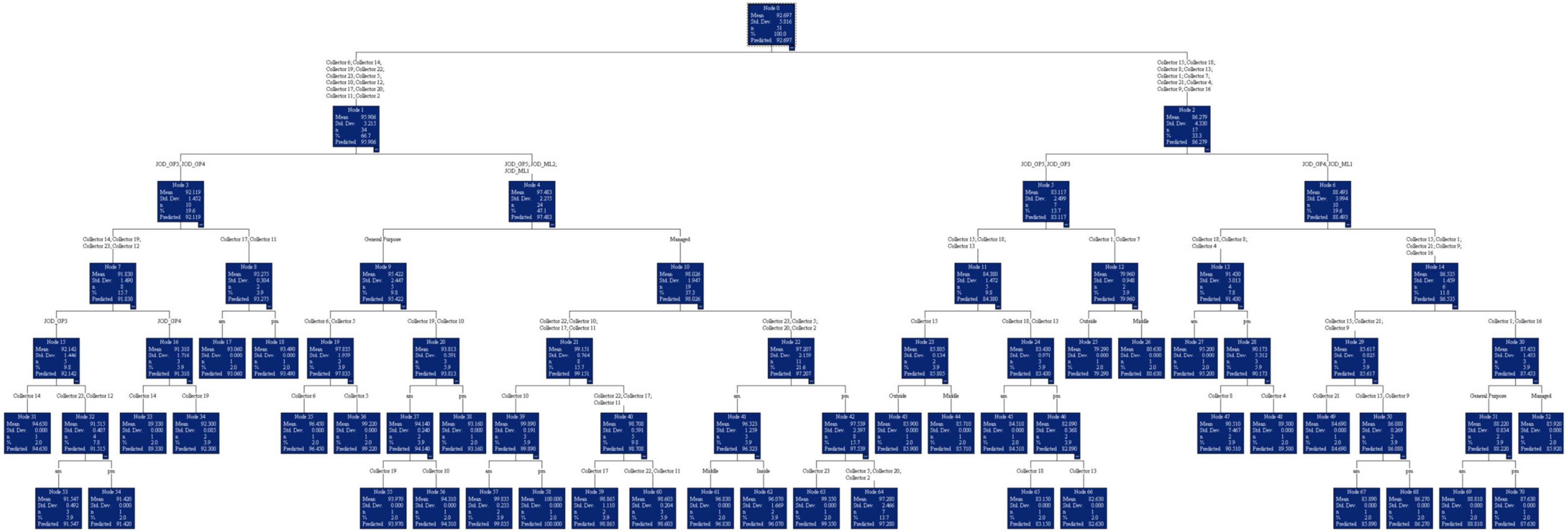


Figure 122 – Regression Tree of SOV Portions of Passenger Car LDVs, Baseline (Spring 2019)

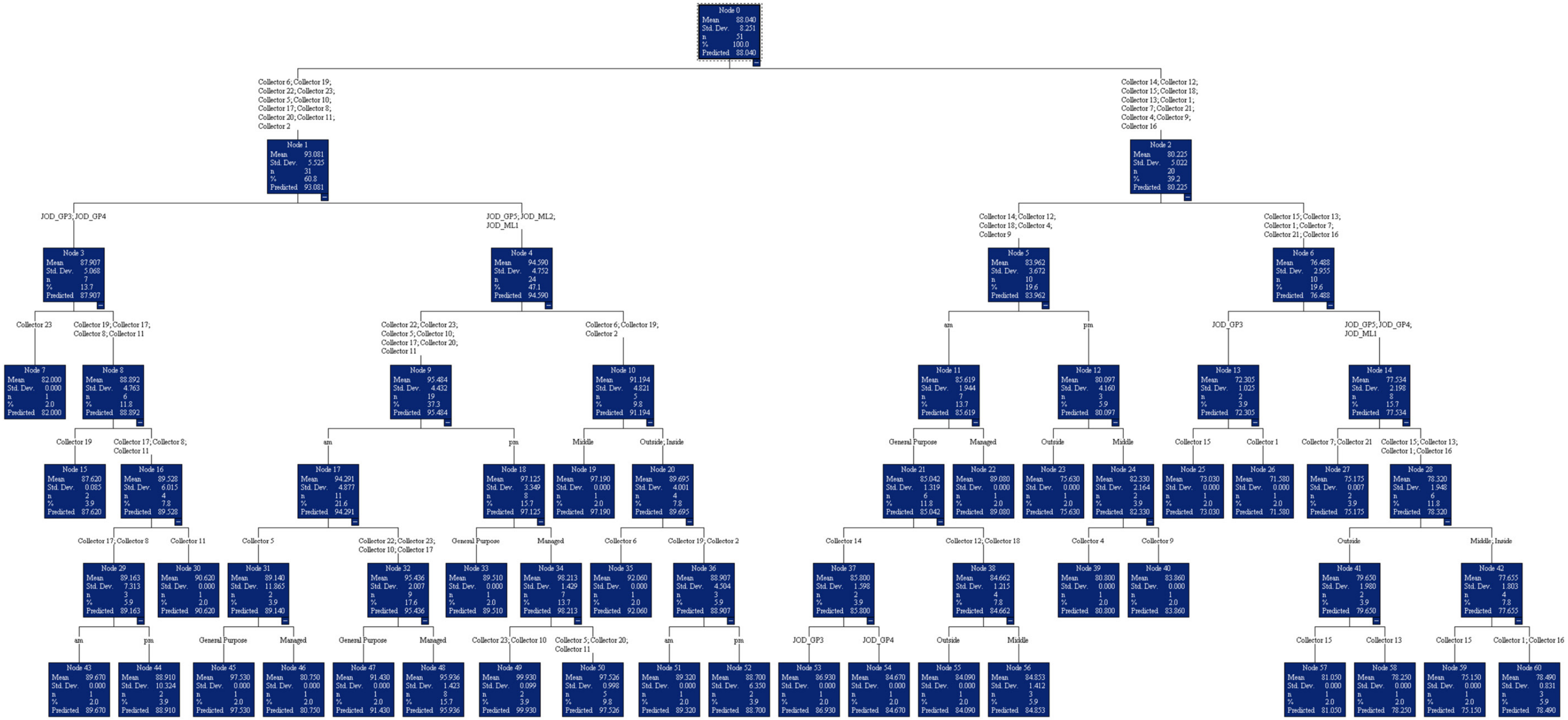


Figure 123 – Regression Tree of SOV Portions of SUVs, Baseline (Spring 2019)

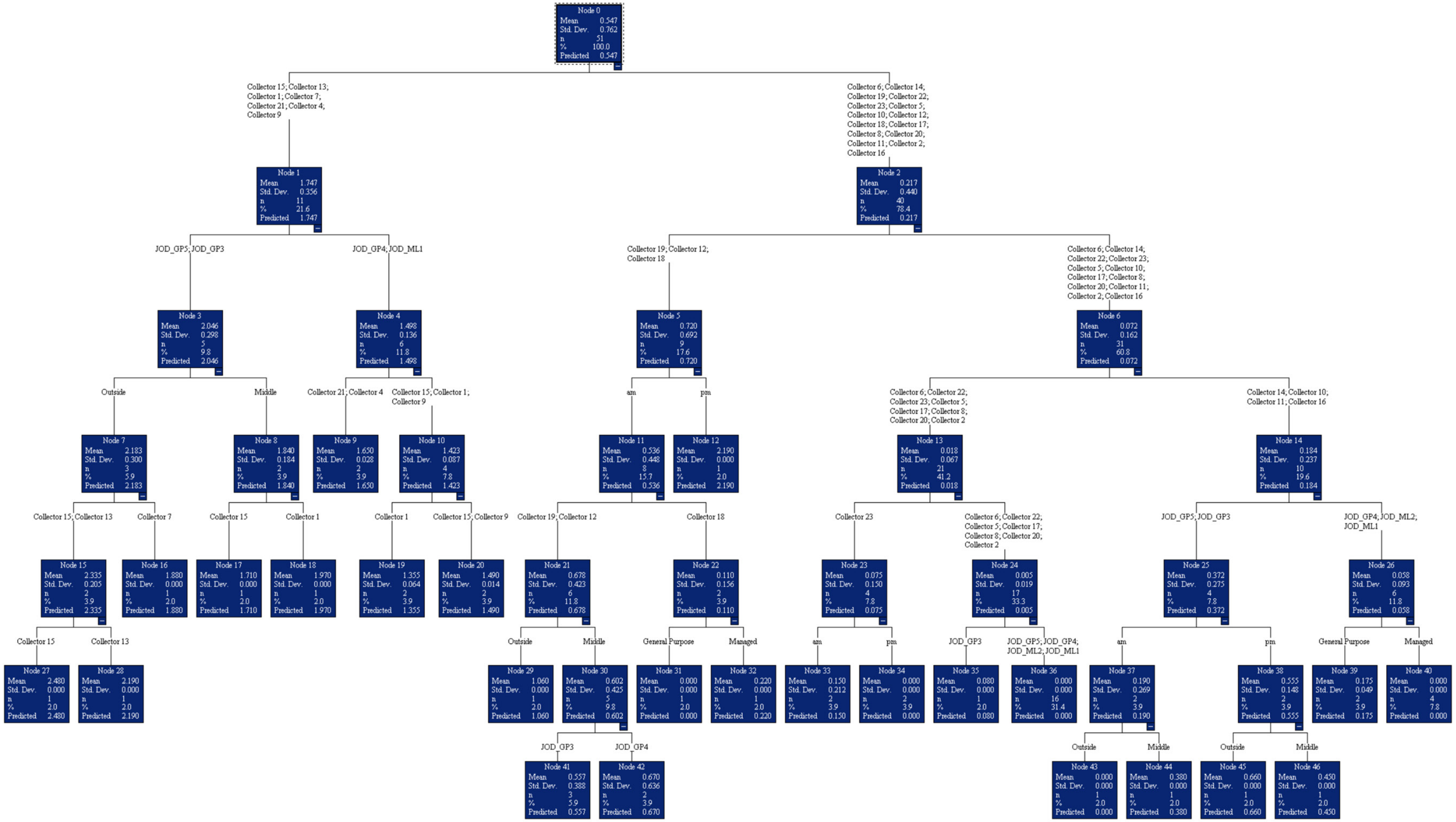


Figure 124– Regression Tree of '3+' HOV Portions of Passenger Car LDVs, Baseline (Spring 2019)

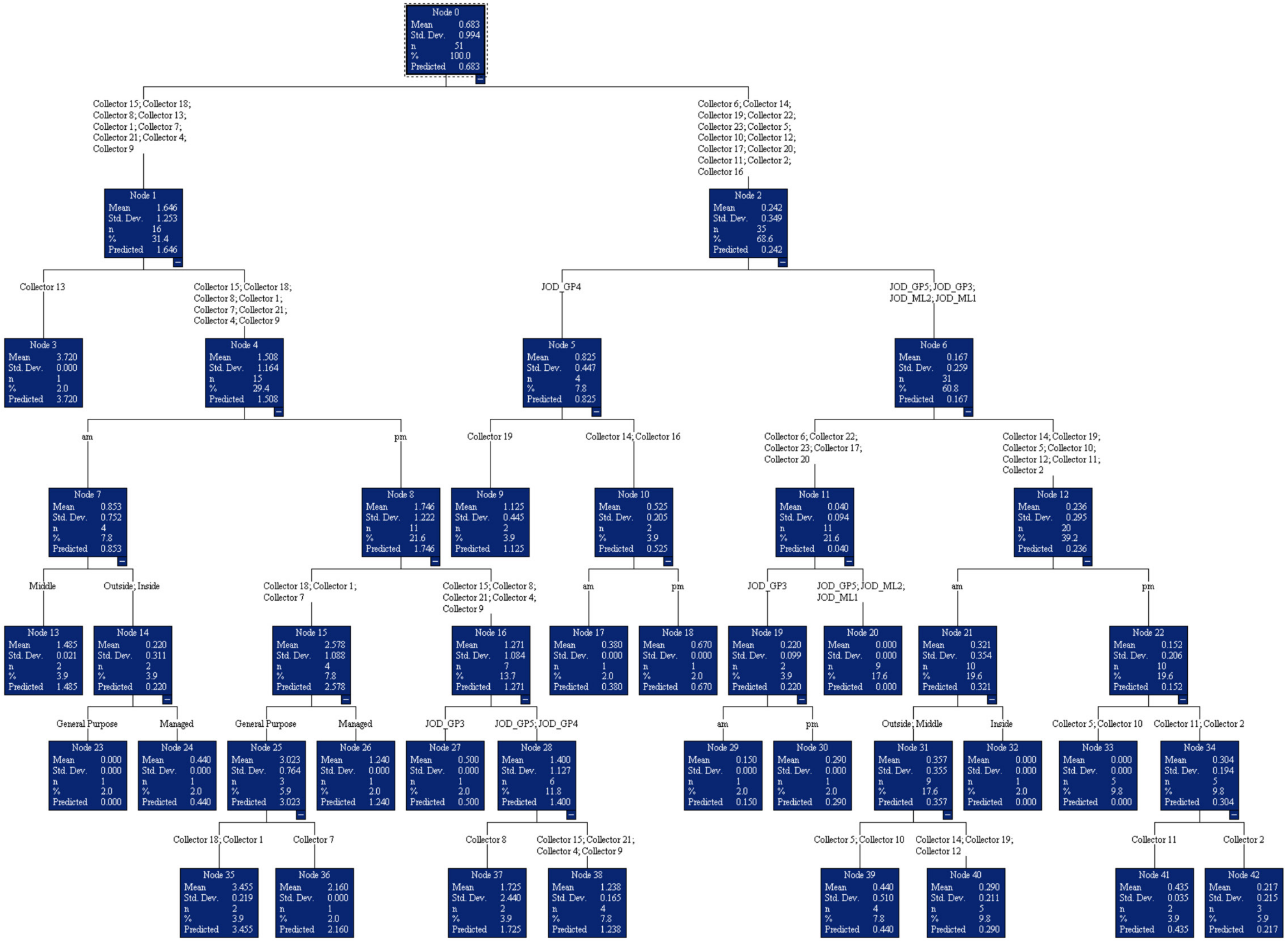


Figure 125– Regression Tree of '3+' HOV Portions of SUVs, Baseline (Spring 2019)

16 Appendix D: Regression Tree Analysis of the Occupancy Data of Fall 2019

The regression tree analysis serves to identify potential bias in the occupancy data caused by day of the week, individual data collector, etc. This appendix provides the regression tree analysis process for Fall 2019 data, which follows the same methodology described in Chapter 5. The net reduction in sample size and net impact on average occupancy can be found in Table 15, Table 20, and Table 21.

16.1 Day-of-Week Analysis

As with Spring 2019, the team did not schedule any Monday/Friday sessions for field occupancy collection, nor on any first/last workday after/before a holiday. The team generated the regression tree with input variables for site, vehicle type, session (AM/PM), lane information, and day of the week, as shown in Figure 126. The variable of day of the week actually did not enter the tree to cause any split, indicating that it is not a significant affecting factor on the average occupancy. The team concluded that all data would remain in the dataset for further analysis.

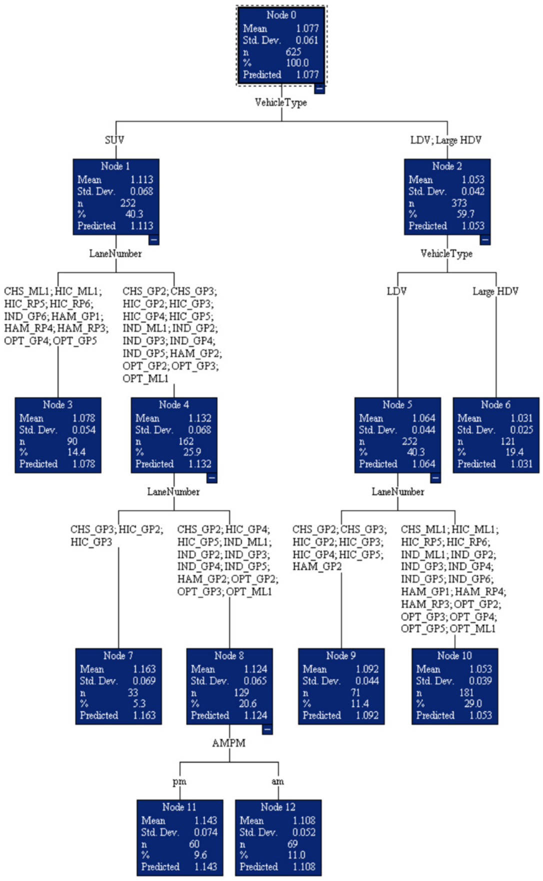


Figure 126 – Regression Tree to Identify Day of Week Impacts, Post-Opening/Extension (Fall 2019)

16.2 Average Vehicle Occupancy and Potential Data Collector Bias

The research team then conducted more regression tree iterations with the input variables of site, lane information, vehicle class, AM/PM, and collector ID to identify potential data collector bias. Data collector IDs were re-indexed (some URAs left the project and new team members were hired); hence, data collector IDs are different in the 2018 and 2019 analyses.

The first iteration is shown in Figure 127. All nodes with a sample size smaller than 29/625 records were manually examined. Then, the team compared the data from all sessions in which these data collectors were active to the sessions of other data collectors. In this iteration, two records (of one session) from Collector 22 and two records (of one session) from Collector 19 were excluded. The second regression tree iteration is shown in Figure 128, in which 13 records (of five sessions) from Collector 42 were excluded. The third iteration is shown in Figure 129. After reviewing all terminal nodes, the team found no collector that presented significantly different patterns with respect to average occupancy, and thus decided to exclude no records for this iteration.

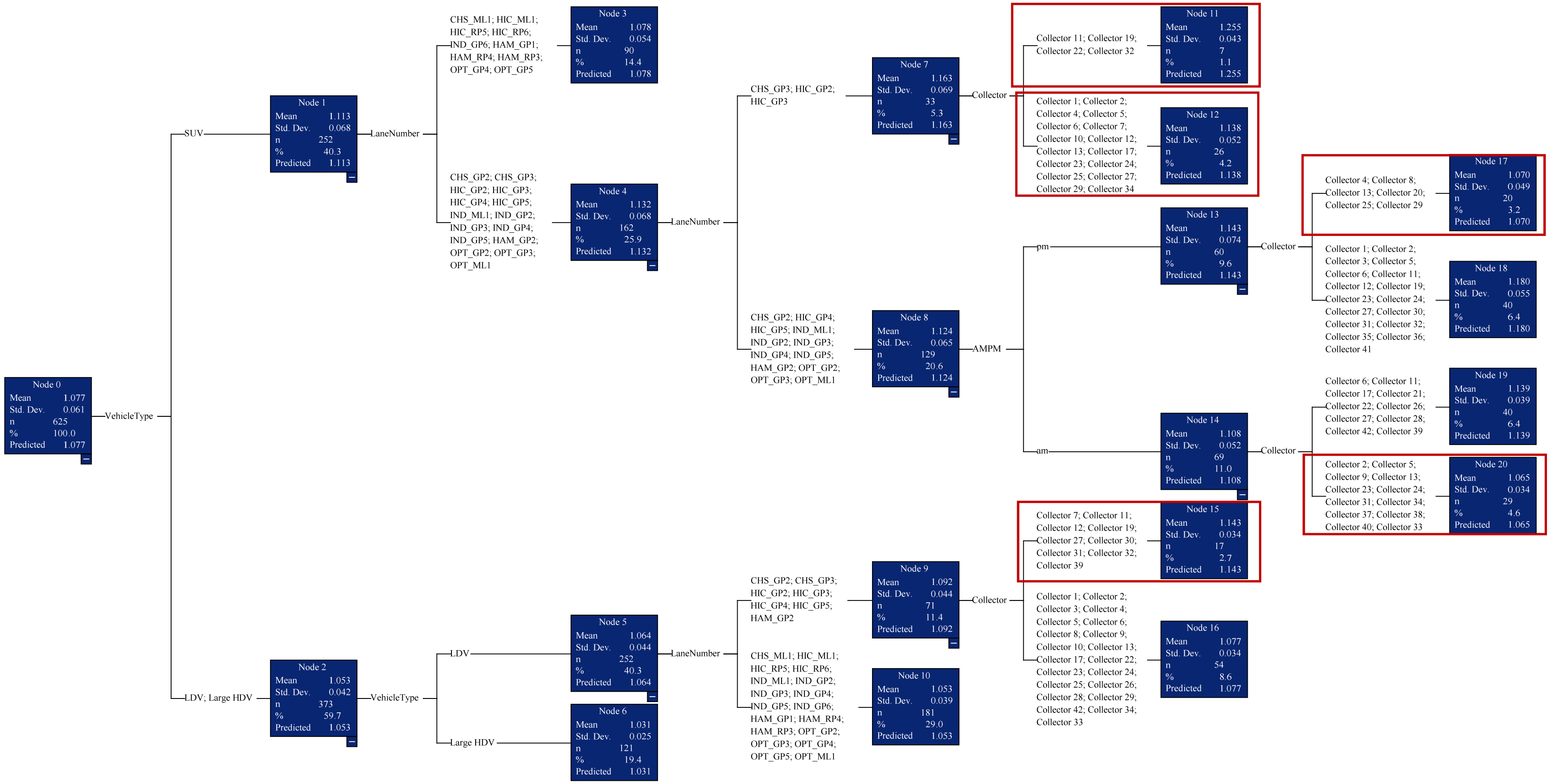


Figure 127 – First Iteration Regression Tree to Identify Potential Data Collector Bias, Post-Opening/Extension (Fall 2019)

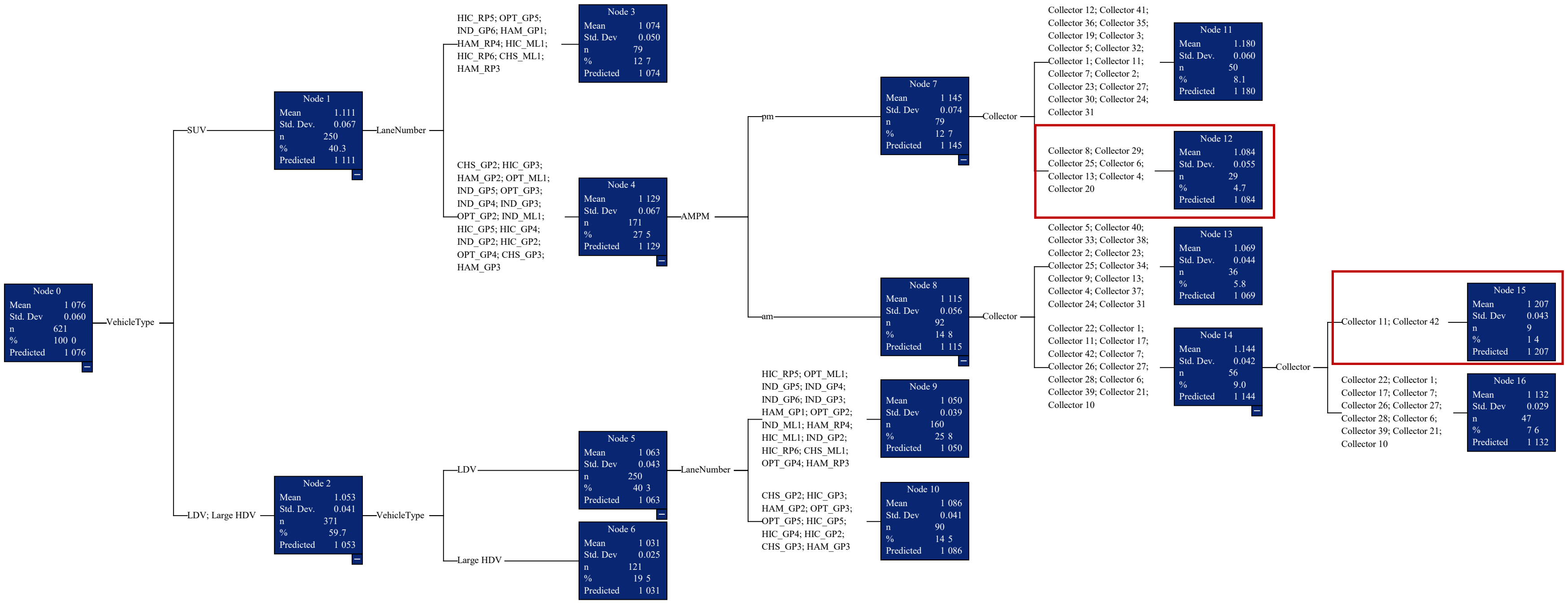


Figure 128 –Second Iteration Regression Tree to Identify Potential Data Collector Bias, Post-Opening/Extension (Fall 2019)

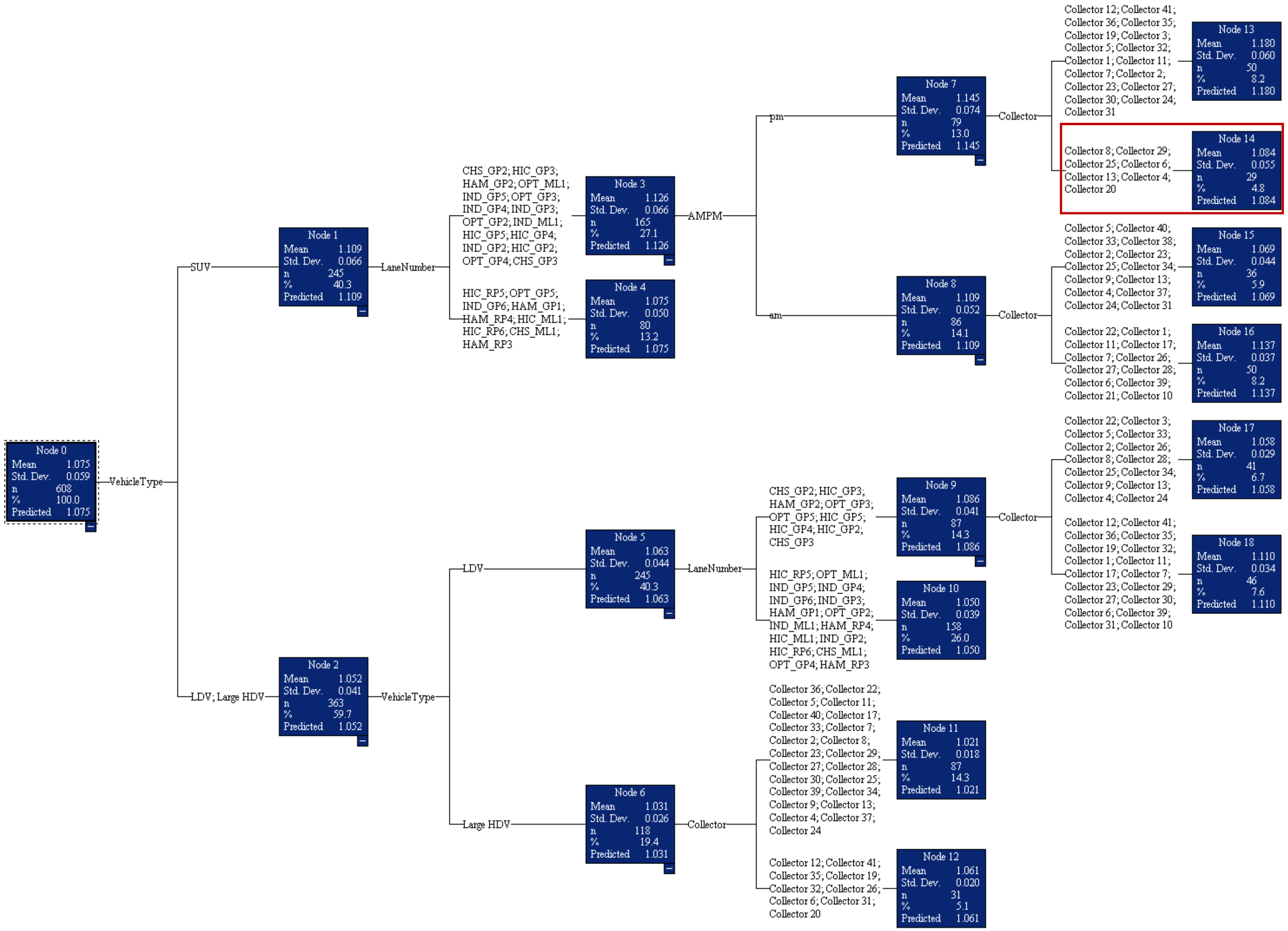


Figure 129 –Third Iteration Regression Tree to Identify Potential Data Collector Bias, Post-Opening/Extension (Fall 2019)

16.3 SOV and '3+' Vehicle Percentages and Potential Data Collector Bias

After screening the average occupancy, the research team conducted a series of regression tree analyses to identify potential data collector bias based on the portions of SOV and '3+' HOV. This section presents the eight analyses (four for general purpose lanes, and four for managed lanes) with the same methodology described in Appendix B. The research team manually examined all terminal nodes that may be significantly different from other nodes. For the nodes with larger than 99% of SOV portions on the managed lanes and on the 3rd general purpose lane on Hamilton Mill Road, the research team decided to keep them in the dataset, as the average SOV portions on these lanes are very high. The generated trees are shown in Figure 130 to Figure 139.

In the first iteration of the SOV portions of passenger car LDVs on the GP lanes, the research team excluded two sessions from Collector 24, and two sessions from Collector 25. In the first iteration of the SOV portions of SUVs on the GP lanes, the research team excluded another two sessions from Collector 24, and one session from collector 25. These sessions by Collector 24 and Collector 25 all had large SOV portions (larger than 99%) that were significantly different from other collectors. No other records were excluded.

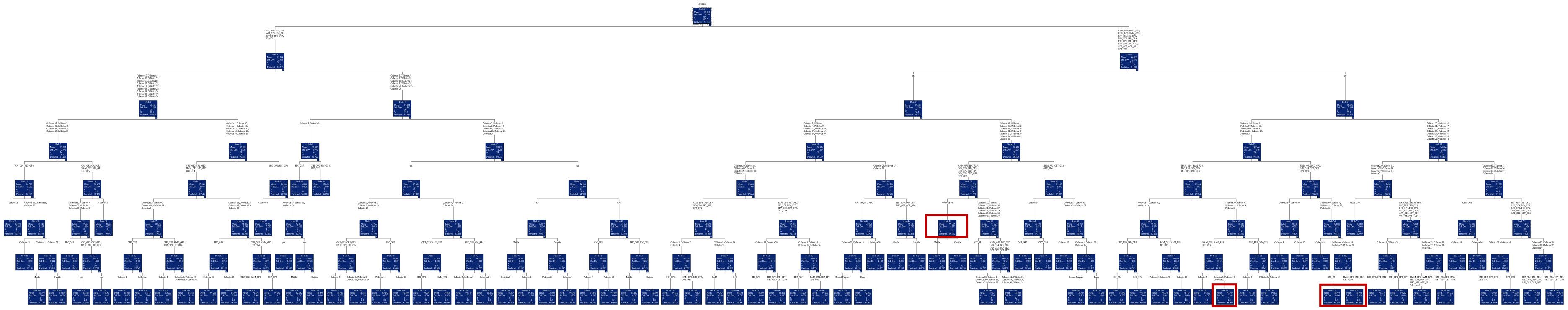


Figure 130 – Iteration 1 of SOV Portions of Passenger Car LDVs, Post-Opening/Extension (Fall 2019), GP Lanes

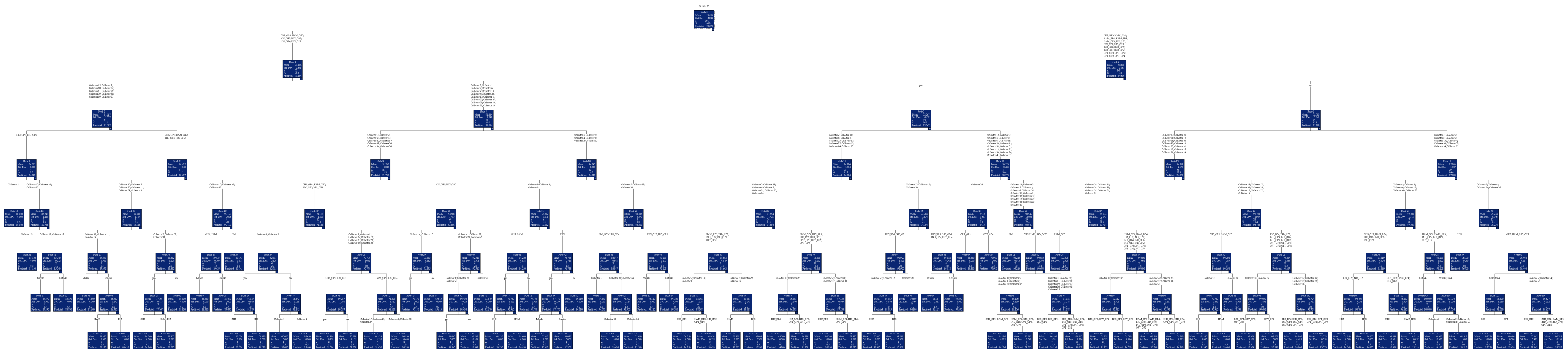


Figure 131 – Iteration 2 of SOV Portions of Passenger Car LDVs, Post-Opening/Extension (Fall 2019), GP Lanes

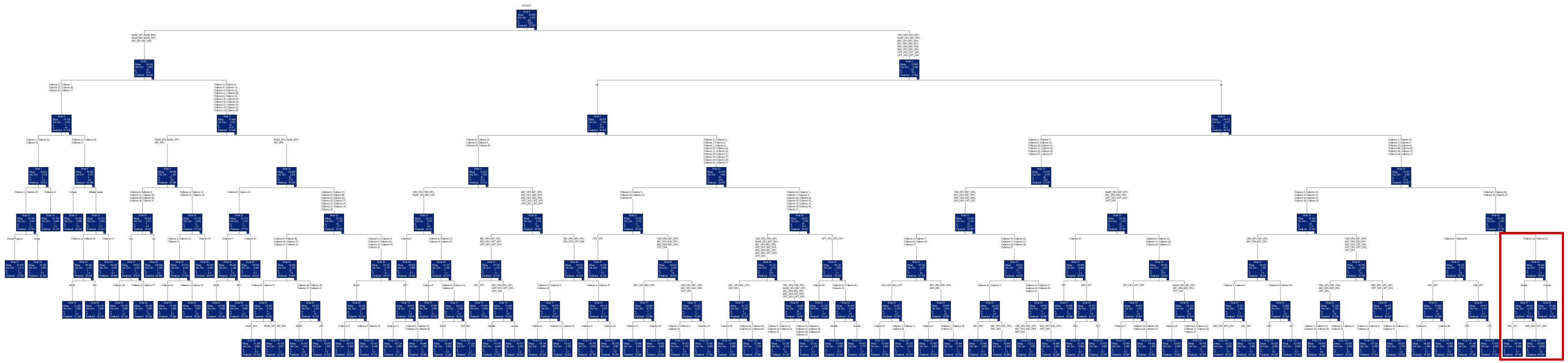


Figure 132 – Iteration 1 of SOV Portions of SUVs, Post-Opening/Extension (Fall 2019), GP Lanes

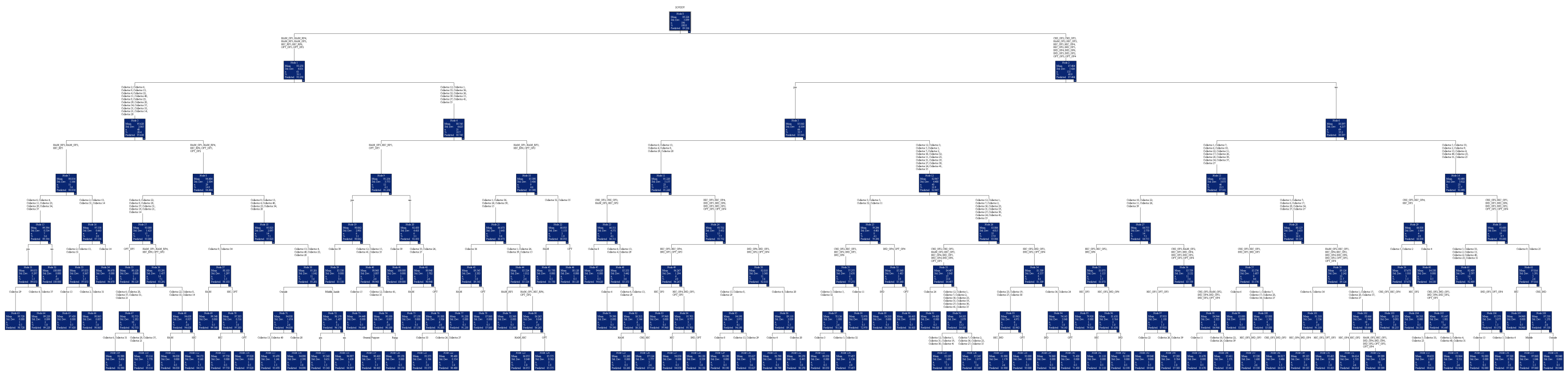


Figure 133 – Iteration 2 of SOV Portions of SUVs, Post-Opening/Extension (Fall 2019), GP Lanes

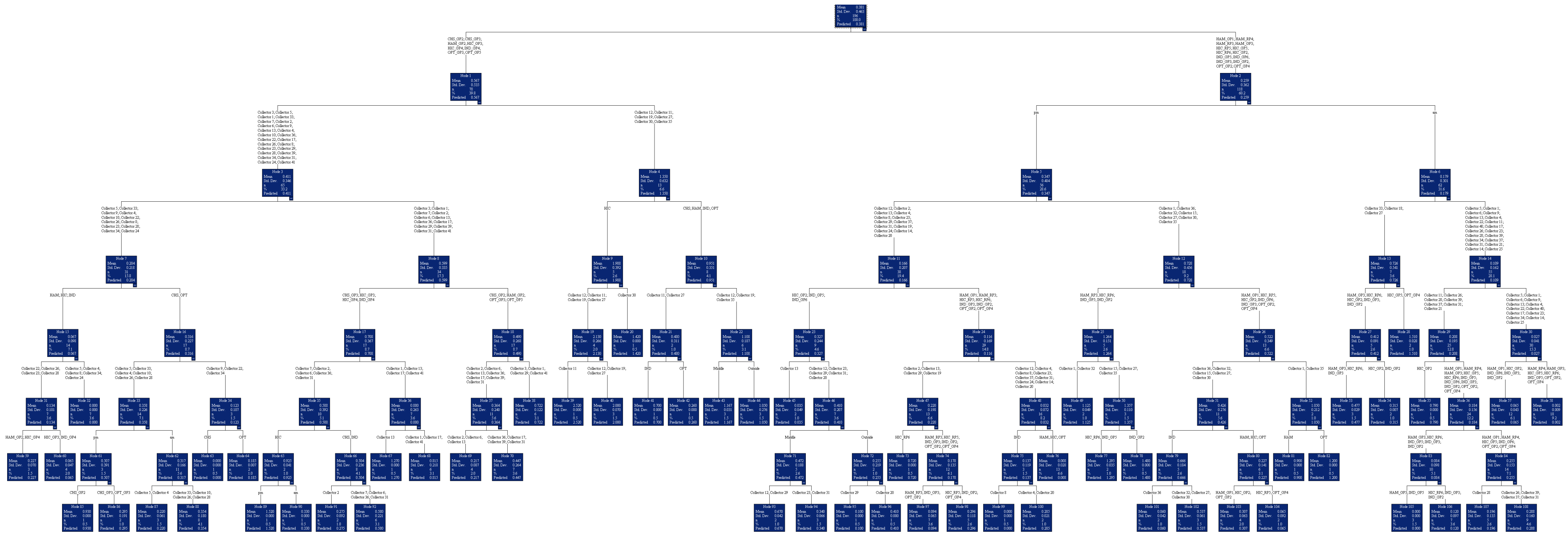


Figure 134 – Regression Tree of '3+' HOV Portions of Passenger Car LDVs, Post-Opening/Extension (Fall 2019), GP Lanes

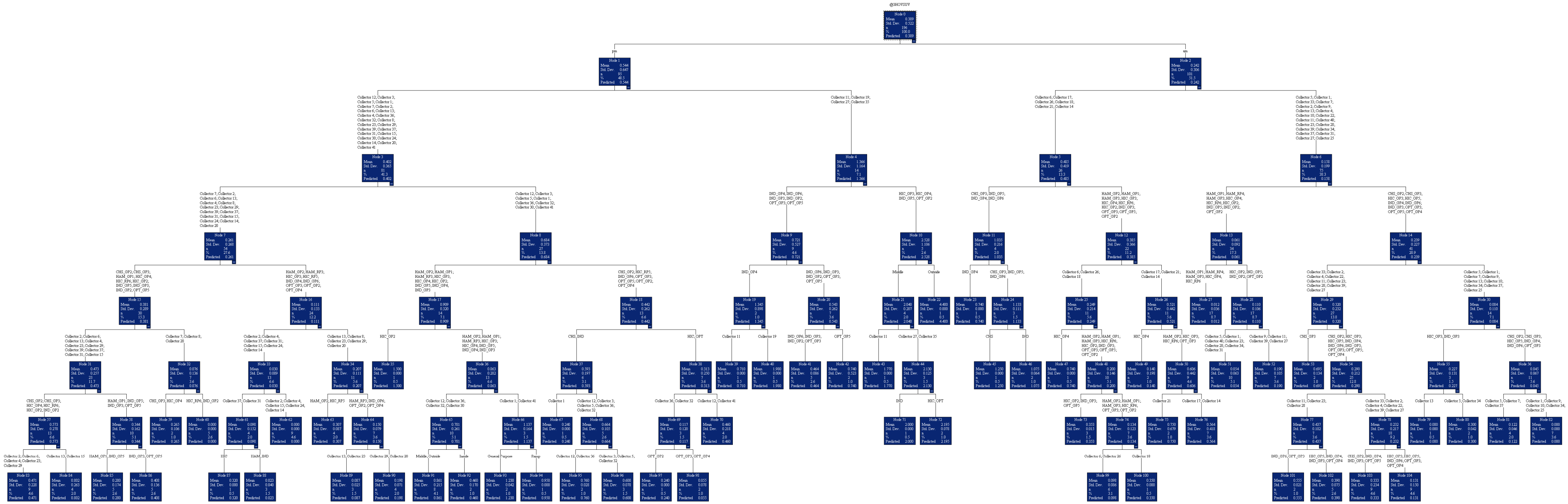


Figure 135 – Regression Tree of '3+' HOV Portions of SUVs, Post-Opening/Extension (Fall 2019), GP Lanes

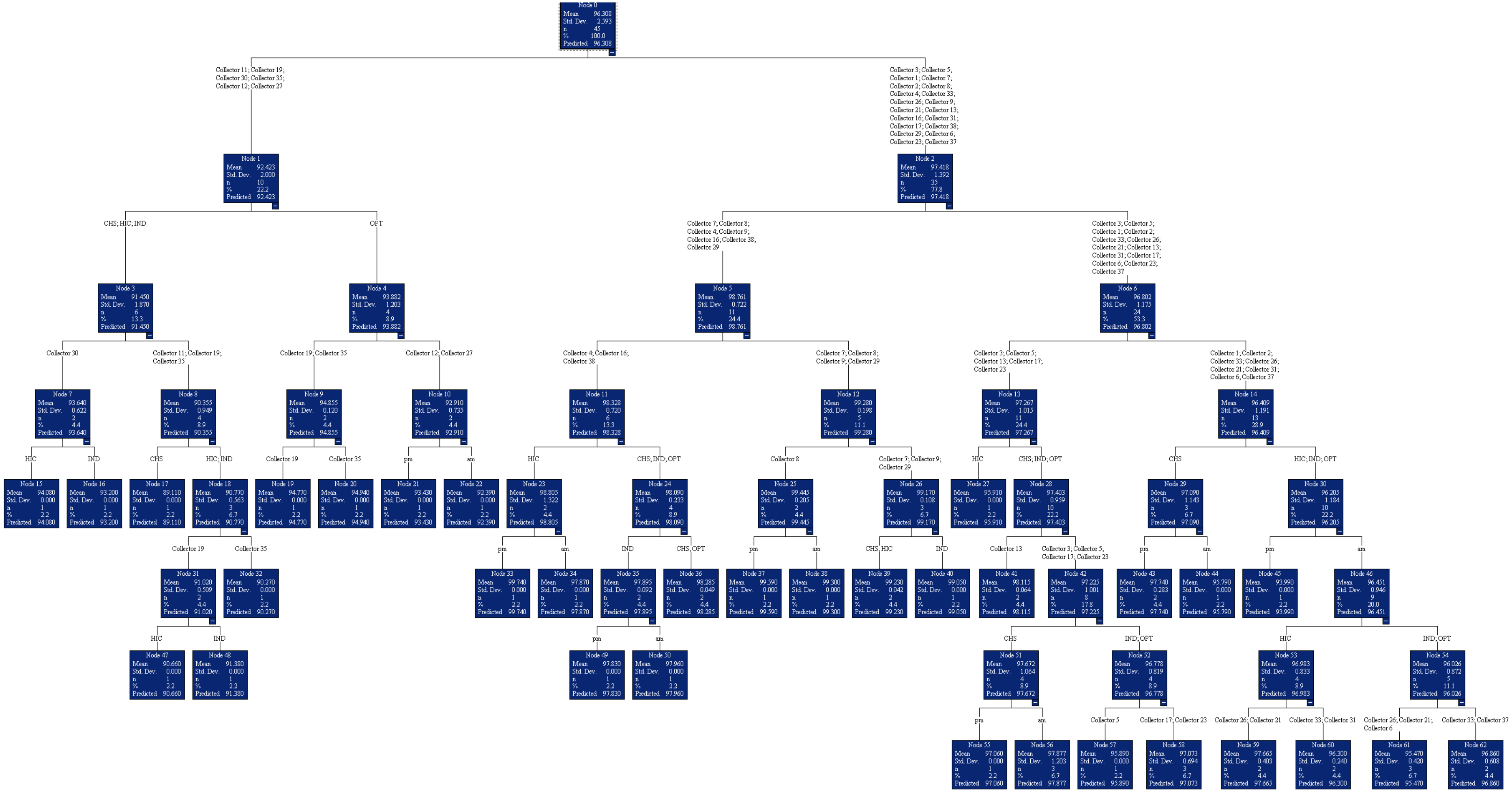


Figure 136 – Regression Tree of SOV Portions of Passenger Car LDVs, Post-Opening/Extension (Fall 2019), Managed Lanes

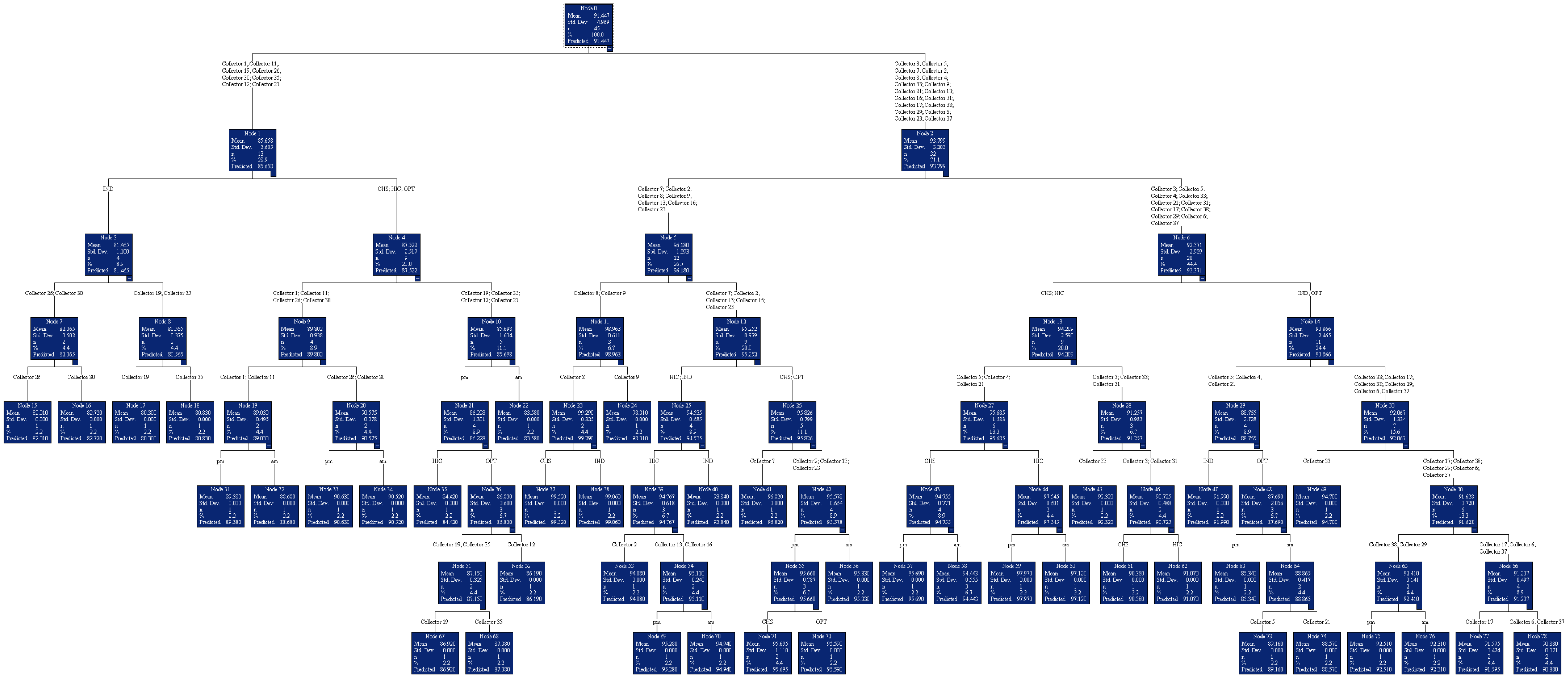


Figure 137 – Regression Tree of SOV Portions of SUVs, Post-Opening/Extension (Fall 2019), Managed Lanes

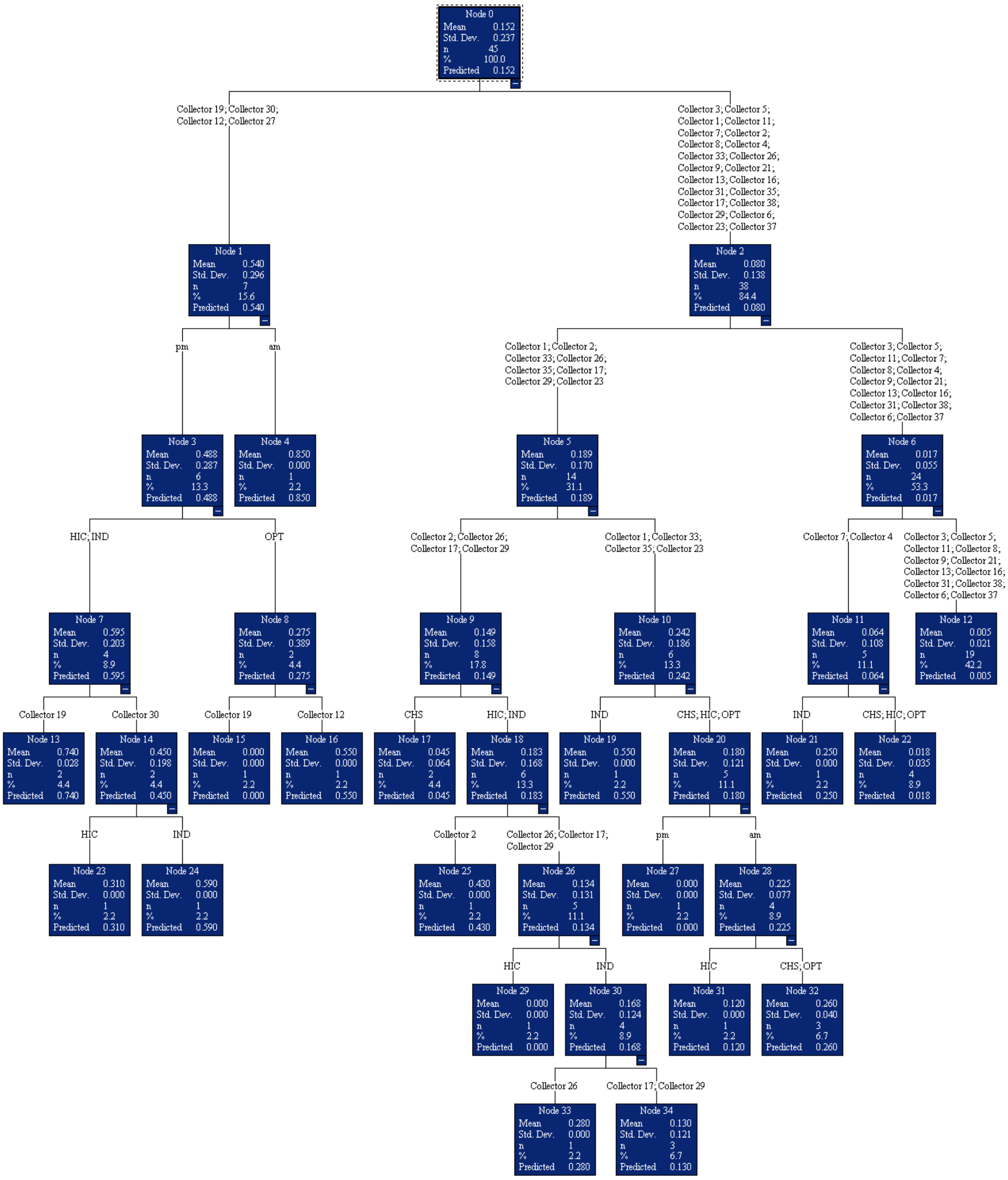


Figure 138 – Regression Tree of '3+' HOV Portions of Passenger Car LDVs, Post-Opening/Extension (Fall 2019), Managed Lanes

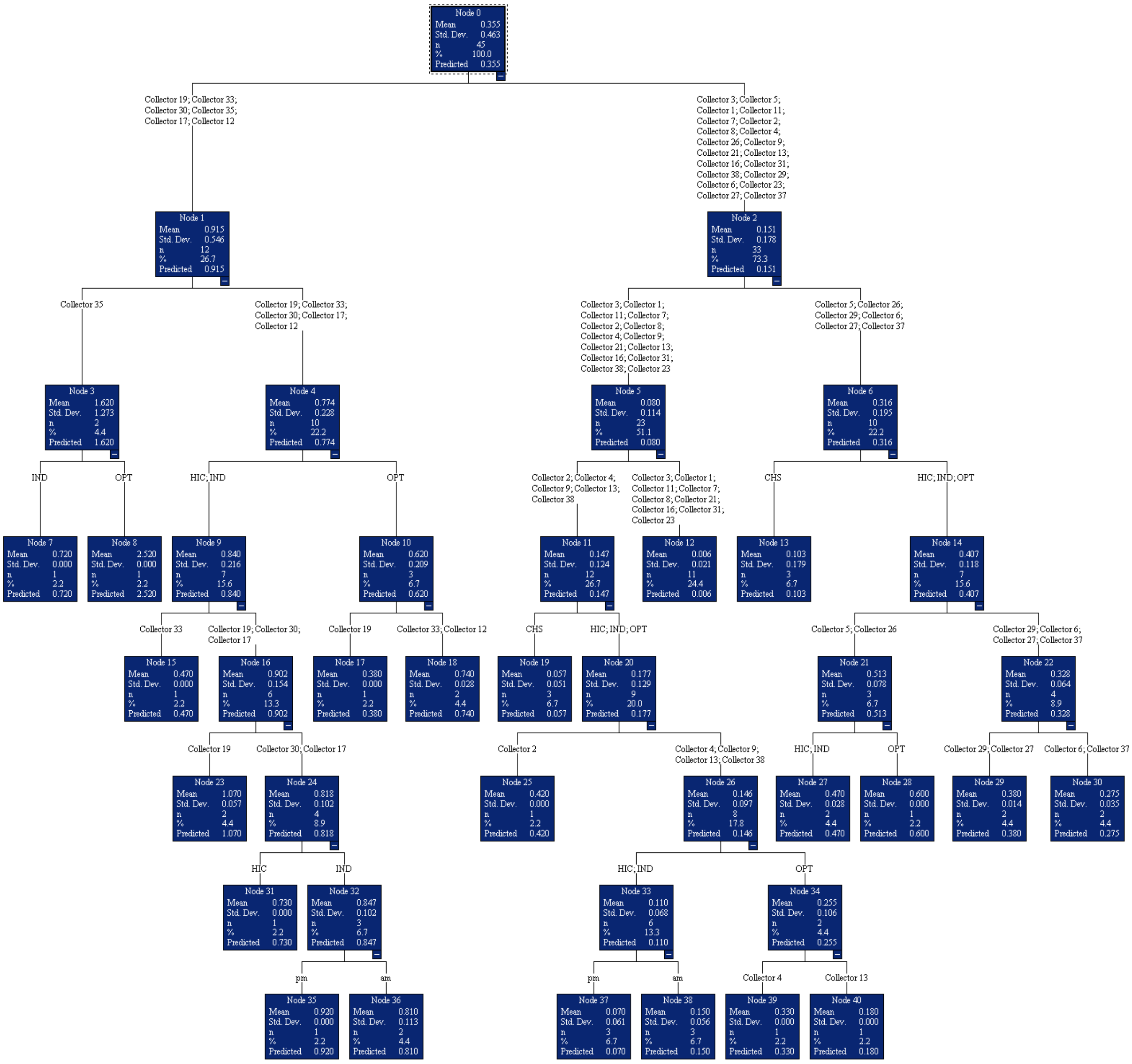


Figure 139 – Regression Tree of '3+' HOV Portions of SUVs, Post-Opening/Extension (Fall 2019), Managed Lanes

17 Appendix E: Sample Step-by-Step Calculation for Occupancy Substitution and Throughput Assessment

The post-opening (2019) morning peak of Old Peachtree Road at I-85 is presented as a sample to show each step of the adjustment of average occupancy, vehicle throughput, and person throughput in substitution of vanpool and express buses ridership profiles. This Appendix starts with the substitution of express buses, followed by the substitution of vanpools, and presents at the end the substituted occupancy and throughput outcomes, with the input data, formulas, step-by-step results, and final outputs of the calculation. Please note that decimals are not omitted in the step-by-step results (although in certain cases it makes more sense to use integers, such as vehicle throughput and person throughput) to minimize in-process rounding errors (only final results are rounded). The team did not implement any post-processing to make the rounded percentages sum to 100% (e.g., the sum could be 99.9% or 100.1% instead of 100.0%), so that all numbers match with the Excel spreadsheet attached with this report. All sums are essentially 100.0% (i.e., any mismatch of sum is due to the rounding), and the audience can refer to the Excel spreadsheet for validation. Similarly, the occupancy data presented in this Chapter is rounded to two decimal places, and any changes (differences) were based on the raw values before rounding to be consistent with the spreadsheet. Therefore, it could be that the changes do not pair with the presented before-and-after occupancy (rounded), and these mismatches are not erroneous.

Adjustment of average vehicle occupancy, vehicle throughput, and person throughput to accommodate the ridership of express buses and vanpools follows the methodology described in Chapter 7 and Chapter 8. The express buses were recorded as HOV4+ buses (which includes both regular and express buses), and vanpools as HOV4+ vans (which includes both mini vans and vanpools) during field observations of vehicle occupancy, and the number of vanpools (based on the SRTA-reported vanpool operations), Xpress, CobbLinc and GCT buses (based on the express bus schedules) were taken from the observed number of buses in the adjustment. For each vanpool and express bus taken, 4.5 persons were subtracted from the total person throughput, and the number of passengers from the operation data (provided by the contractors) was added back to the person total. The substitution of Old Peachtree Road at I-85, post-opening (2019) AM peak is presented as an example of the calculation, and the adjustment of all sites can be found in the attached spreadsheet.

1. Unadjusted Vehicle and Person Throughput by Class

There are four GP lanes (numbered as GP lane #1 to GP lane #4 from inside to outside) at Old Peachtree Road at I-85 Southbound (AM peak observations capture Southbound traffic), along with the Southbound Express Lane. The vehicle throughput was first broken into vehicles classes by lane, based on the NaviGAtor traffic volumes and the field observed vehicle class distributions, as shown in Table 104. The unadjusted person throughput was calculated by multiplying the number of vehicles (by class) with the observed average occupancy (shown in Table 105), as shown in Table 106.

Table 104 – Unadjusted Vehicle Throughput by Class and by Lane, Old Peachtree Road at I-85, Post-Opening (2019), AM Peak (6-10 AM)

Vehicle Class	GP Lane #1	GP Lane #2	GP Lane #3	GP Lane #4	Express Lane	All Lanes
Passenger Car LDVs	2,910.67	2,497.46	1,454.19	1,727.03	661.50	9,250.86
SUV	2,166.95	2,362.00	1,750.14	1,412.90	900.67	8,592.65
Bus (Regular and Express Buses)	2.40	7.97	9.12	5.71	24.53	49.72
Van (Mini Van and Vanpool)	297.73	298.82	216.34	280.23	114.47	1,207.59
Large HDV	18.01	584.36	1,046.44	435.95	0.82	2,085.57
Small HDV	226.30	102.26	252.80	163.10	18.40	762.86
MC	5.40	5.31	3.65	1.34	12.27	27.97
Other	2.40	3.32	4.25	4.70	0.82	15.49
Total	5,629.86	5,861.50	4,736.91	4,030.97	1,733.47	21,992.71

Table 105 – Observed Average Vehicle Occupancy by Class and by Lane, Old Peachtree Road at I-85, Post-Opening (2019), AM Peak (6-10 AM)

Vehicle Class	GP Lane #1	GP Lane #2	GP Lane #3	GP Lane #4	Express Lane	All Lanes
Passenger Car LDVs	1.04	1.06	1.06	1.06	1.05	1.05
SUV	1.09	1.10	1.11	1.09	1.10	1.10
Bus (Regular and Express Buses)	1.00	1.00	2.00	1.79	3.26	2.52
Van (Mini Van and Vanpool)	1.15	1.15	1.19	1.16	1.27	1.17
Large HDV	1.17	1.02	1.01	1.03	1.00	1.02
Small HDV	1.10	1.06	1.14	1.17	1.49	1.14
MC	1.00	1.00	1.17	1.00	1.00	1.02
Other	1.00	1.00	1.00	1.07	1.00	1.03
Total	1.07	1.08	1.08	1.08	1.13	1.08

Table 106 – Unadjusted Person Throughput by Class and by Lane, Old Peachtree Road at I-85, Post-Opening (2019), AM Peak (6-10 AM)

Vehicle Class	GP Lane #1	GP Lane #2	GP Lane #3	GP Lane #4	Express Lane	All Lanes
Passenger Car LDVs	3,018	2,648	1,537	1,825	692	9,720
SUV	2,366	2,605	1,937	1,542	993	9,443
Bus (Regular and Express Buses)	2	8	18	10	80	119
Van (Mini Van and Vanpool)	344	343	258	326	146	1,415
Large HDV	21	595	1,061	449	1	2,127
Small HDV	248	109	289	191	27	865
MC	5	5	4	1	12	29
Other	2	3	4	5	1	16
Total	6,007	6,317	5,109	4,349	1,952	23,733

2. Throughput Adjustment of Express Buses

The processed express bus operation data (from SRTA) is used to substitute the number of Xpress, CobbLinc and GCT Express Commuter Buses that need to be taken from the bus vehicle throughput, as shown in Table 107. CobbLinc routes do not traverse Old Peachtree Road at I-85 (zero vehicle count and vehicle occupancy), and all Xpress and GCT buses are assigned to the Express Lane. For Chastain Road at I-575 and Hickory Grove Road at I-75 before the opening of the new NWC Express Lane (2018), all express buses are assigned to the outside GP lane, as described in Chapter 7.

For each Xpress and GCT bus, 4.5 persons are taken from the person total, and the express bus passengers are added back, as shown in Table 108. The person throughput that needs to be added back is the number of express bus multiplied by its average vehicle occupancy (e.g., 15.00 vehicles × 28.27 persons/vehicle = 424.00 persons for the Xpress buses on the Express Lane, and 6.00 vehicles × 10.90 persons/vehicle = 65.40 persons for the GCT buses on the Express Lane). The vehicle and person throughput of regular buses is calculated by bus (regular and express buses) throughput minus express bus throughput, and when the initial person throughput is not large enough to subtract 4.5 times the number of express buses without leaving 1.0 persons per vehicle in the remaining vehicles, an extra vehicle must be manually added (with 4.5 persons) to compensate. In this sample, after manually reviewing the vehicle and person throughput cells, 6.0 HOV4+ buses (each with a person throughput of 4.5 persons) need to be added back to make sure regular buses have an average occupancy of at least 1.0 person/vehicle (i.e., larger person throughput of regular buses than the vehicle throughput). The change of vehicle throughput after the adjustment will be the number of HOV4+ buses to be added (in this case 6.0 vehicles), and the change of person throughput after the adjustment is the HOV4+ passengers taken (4.5 persons multiplied by the number of HOV4+ buses taken) plus the added HOV4+ passengers (4.5 persons multiplied by the number of HOV4+ buses added) and plus the express passengers, which is -4.5 persons/vehicle × 15.00 vehicles (Xpress buses taken) - 4.5 persons/vehicle × 6.00 vehicles (GCT buses taken) + 4.5 persons/vehicle × 6.00 vehicles (HOV4+ buses added) + 424.00 persons (Xpress passengers) + 65.40 persons (GCT passengers) = 421.90 persons. Again, all the calculations were based on raw values (no rounding), and a mismatch in the step-by-step results is not erroneous.

Table 107 – SRTA-Reported Express Bus Operation Data by Lane, Old Peachtree Road at I-85, Pre-Opening (2018), AM Peak (6-10 AM)

Vehicle Class	GP Lane #1	GP Lane #2	GP Lane #3	GP Lane #4	Express Lane	All Lanes
Xpress Bus Count per Morning Peak Session from SRTA (6-10AM)	0.00	0.00	0.00	0.00	15.00	15.00
Xpress Bus Average Vehicle Occupancy for Throughput Calculation (6-10AM)	28.27	28.27	28.27	28.27	28.27	28.27
CobbLinc Bus Count per Morning Peak Session from SRTA (6-10AM)	0.00	0.00	0.00	0.00	0.00	0.00
CobbLinc Bus Average Vehicle Occupancy for Throughput Calculation (6-10AM)	0.00	0.00	0.00	0.00	0.00	0.00
GCT Bus Count per Morning Peak Session from SRTA (6-10AM)	0.00	0.00	0.00	0.00	6.00	6.00
GCT Bus Average Vehicle Occupancy for Throughput Calculation (6-10AM)	10.90	10.90	10.90	10.90	10.90	10.90
Xpress Bus Count per Morning Peak Session from SRTA (6-10AM)	0.00	0.00	0.00	0.00	15.00	15.00
Xpress Bus Average Vehicle Occupancy for Throughput Calculation (6-10AM)	28.27	28.27	28.27	28.27	28.27	28.27
CobbLinc Bus Count per Morning Peak Session from SRTA (6-10AM)	0.00	0.00	0.00	0.00	0.00	0.00

Table 108 – Throughput Adjustment with Substitution of Express Buses, Old Peachtree Road at I-85, Pre-Opening (2018), AM Peak (6-10 AM)

Vehicle Class	GP Lane #1	GP Lane #2	GP Lane #3	GP Lane #4	Express Lane	All Lanes
Xpress Person Throughput after Adjustment (6-10AM)	0.00	0.00	0.00	0.00	424.00	424.00
CobbLinc Person Throughput after Adjustment (6-10AM)	0.00	0.00	0.00	0.00	0.00	0.00
GCT Person Throughput after Adjustment (6-10AM)	0.00	0.00	0.00	0.00	65.40	65.40
Changes of Vehicle Throughput after Adjustment for Express Buses (6-10AM)	0.00	0.00	0.00	0.00	6.00	6.00
Changes of Person Throughput after Adjustment for Express Buses (6-10AM)	0.00	0.00	0.00	0.00	421.90	421.90
Regular Bus Vehicle Throughput after Adjustment (6-10AM)	2.40	7.97	9.12	5.71	9.53	34.72
Regular Bus Person Throughput after Adjustment (6-10AM)	2.40	7.97	18.23	10.24	12.43	51.26

3. Throughput Adjustment of Vanpools

The vanpool operation data (from SRTA) was pre-processed as described in Chapter 8 to allocate the vanpool routes to each observation site, and the processed vanpool operation data are presented in Table 109.

All vanpools are allocated evenly across all lanes (GP lanes and the Express Lane). For each vanpool, 4.5 persons are taken from the person total, and the vanpool passengers are added back, as shown in Table 110. The person throughput that needs to be added back is the number of vans multiplied by its average vehicle occupancy (i.e., 0.17 vehicles × 4.53 persons/vehicle = 0.75 persons for each lane). The vehicle and person throughput of mini vans is calculated by vans (mini vans and vanpool) throughput minus vanpool throughput, and when the initial person throughput is not large enough to subtract 4.5 times the number of vanpools without leaving 1.0 persons per vehicle in the remaining vehicles, an extra vehicle must be manually added (with 4.5 persons) to compensate. No manual adjustment was needed for any lane across all sites on this (change of vehicle throughput after the adjustment is all zero), and the change of person throughput after the adjustment is the HOV4+ passengers taken (4.5 persons multiplied by the number of HOV4+ vans taken) plus the added HOV4+ passengers (zero in this and any other case) and plus the vanpool passengers, which is -4.5 persons/vehicle × 0.17 vehicles (HOV4+ vans taken) + 4.5 persons/vehicle × 0.00 vehicles (HOV4+ vans added) + 0.75 persons (vanpools passengers) = 0.02 persons. Again, all the calculations were based on raw values (no rounding), and a mismatch in the step-by-step results is not erroneous.

Table 109 – SRTA-Reported Express Bus Operation Data by Lane, Old Peachtree Road at I-85, Pre-Opening (2018), AM Peak (6-10 AM)

Vehicle Class	GP Lane #1	GP Lane #2	GP Lane #3	GP Lane #4	Express Lane	All Lanes
Vanpool Count per Morning Peak Session from SRTA (6-10AM)	0.17	0.17	0.17	0.17	0.17	0.83
Vanpool Average Vehicle Occupancy for Throughput Calculation (6-10PM)	4.53	4.53	4.53	4.53	4.53	4.53

Table 110 – Throughput Adjustment with Substitution of Express Buses, Old Peachtree Road at I-85, Pre-Opening (2018), AM Peak (6-10 AM)

Vehicle Class	GP Lane #1	GP Lane #2	GP Lane #3	GP Lane #4	Express Lane	All Lanes
Vanpool Person Throughput after Adjustment (6-10AM)	0.75	0.75	0.75	0.75	0.75	3.74
Changes of Vehicle Throughput after Adjustment for Vanpools (6-10AM)	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment for Vanpools (6-10AM)	0.00	0.00	0.00	0.00	0.00	0.02
Mini Van Vehicle Throughput after Adjustment (6-10AM)	297.57	298.65	216.17	280.07	114.31	1,206.77
Mini Van Person Throughput after Adjustment (6-10AM)	342.91	342.23	256.92	324.79	144.80	1,411.65
Vanpool Person Throughput after Adjustment (6-10AM)	0.75	0.75	0.75	0.75	0.75	3.74

4. Throughput and Average Occupancy after Adjustment

The adjusted vehicle throughput is presented in Table 111, and the adjusted person throughput presented in Table 112. The adjusted average occupancy is calculated as person throughput divided by vehicle throughput, as shown in Table 113.

Table 111 – Adjusted Vehicle Throughput by Class and by Lane, Old Peachtree Road at I-85, Post-Opening (2019), AM Peak (6-10 AM)

Vehicle Class	GP Lane #1	GP Lane #2	GP Lane #3	GP Lane #4	Express Lane	All Lanes
Passenger Car LDVs	2,911	2,497	1,454	1,727	661	9,251
SUV	2,167	2,362	1,750	1,413	901	8,593
Regular Bus	2	8	9	6	10	35
Xpress	0	0	0	0	15	15
CobbLinc	0	0	0	0	0	0
GCT	0	0	0	0	6	6
Mini Van	298	299	216	280	114	1,207
Vanpool	0	0	0	0	0	1
Large HDV	18	584	1,046	436	1	2,086
Small HDV	226	102	253	163	18	763
Motorcycle	5	5	4	1	12	28
Other	2	3	4	5	1	15
Total	5,630	5,861	4,737	4,031	1,739	21,999

Table 112 – Adjusted Person Throughput by Class and by Lane, Old Peachtree Road at I-85, Post-Opening (2019), AM Peak (6-10 AM)

Vehicle Class	GP Lane #1	GP Lane #2	GP Lane #3	GP Lane #4	Express Lane	All Lanes
Passenger Car LDVs	3,018	2,648	1,537	1,825	692	9,720
SUV	2,366	2,605	1,937	1,542	993	9,443
Regular Bus	2	8	18	10	12	51
Xpress	0	0	0	0	424	424
CobbLinc	0	0	0	0	0	0
GCT	0	0	0	0	65	65
Mini Van	343	342	257	325	145	1,412
Vanpool	1	1	1	1	1	4
Large HDV	21	595	1,061	449	1	2,127
Small HDV	248	109	289	191	27	865
Motorcycle	5	5	4	1	12	29
Other	2	3	4	5	1	16
Total	6,007	6,317	5,109	4,349	2,373	24,155

**Table 113 – Adjusted Average Vehicle Occupancy by Lane,
Old Peachtree Road at I-85, Pre-Opening (2018), AM Peak (6-10 AM)**

Vehicle Class	GP Lane #1	GP Lane #2	GP Lane #3	GP Lane #4	Express Lane	All Lanes
Adjusted Average Occupancy with Substitution of Vanpools	1.07	1.08	1.08	1.08	1.12	1.08
Adjusted Average Occupancy with Substitution of Express Buses	1.07	1.08	1.08	1.08	1.36	1.10
Adjusted Average Occupancy with Substitution of Vanpools and Express Buses	1.07	1.08	1.08	1.08	1.36	1.10

18 Appendix F: Input Data Tables and Step-by-Step Results for Assessment of Vehicle Occupancy, Vehicle Throughput, and Person Throughput

This appendix provides data tables that allow readers to follow and replicate all essential calculations employed in this project. No rounding of data was employed during the calculation process, but decimal place rounding was applied to fit data to table cell size. Hence, the sum of some table columns presented may show as 99.9% or 100.1%, instead of 100%, but the values in these columns do actually sum to 100.0%. A full spreadsheet is available that allows the reader to see the full data and the equations.

Table 114 through Table 133 are employed in the calculation of vehicle occupancy distributions by vehicle type and lane. Table 134 through Table 143 illustrate average occupancy results from the data in the preceding tables. Table 144 and Table 145 provide the express bus and vanpool activity data that are needed to replace field-observed 4+ occupancy data with actual occupancy for these modes as described in Chapter 7 (express buses) and Chapter 8 (vanpools). Table 146 through Table 155 show the throughput calculations with the substitution of express bus and vanpool occupancy data.

Table 114 – Observed Occupancy Distributions by Vehicle Type, Chastain Road at I-575, Pre-Opening (2018) AM Peak (7-10 AM)

Occupancy Breakup of Chastain Road at I-575, AM Peak	Occu. Category	Count of GP Lane 1, Pre-Opening (2018)	Fraction of GP Lane 1, Pre-Opening (2018)	Count of GP Lane 2, Pre-Opening (2018)	Fraction of GP Lane 2, Pre-Opening (2018)	Count of All Lanes, Pre-Opening (2018)	Fraction of All Lanes, Pre-Opening (2018)
Total	1	11,500	90.1%	7,860	87.4%	19,360	89.0%
Total	2	1,215	9.5%	1,077	12.0%	2,292	10.5%
Total	3	28	0.2%	35	0.4%	63	0.3%
Total	4	12	0.1%	8	0.1%	20	0.1%
Total	4+	5	0.0%	15	0.2%	20	0.1%
Total	Total	12,760	100.0%	8,995	100.0%	21,755	100.0%
Pass. Cars	1	4,971	95.4%	3,008	94.1%	7,979	94.9%
Pass. Cars	2	232	4.5%	184	5.8%	416	4.9%
Pass. Cars	3	9	0.2%	4	0.1%	13	0.2%
Pass. Cars	4	0	0.0%	0	0.0%	0	0.0%
Pass. Cars	4+	0	0.0%	0	0.0%	0	0.0%
Pass. Cars	Subtotal	5,212	100.0%	3,196	100.0%	8,408	100.0%
SUV	1	5,696	87.1%	3,691	83.7%	9,387	85.7%
SUV	2	826	12.6%	687	15.6%	1,513	13.8%
SUV	3	11	0.2%	25	0.6%	36	0.3%
SUV	4	3	0.0%	6	0.1%	9	0.1%
SUV	4+	0	0.0%	3	0.1%	3	0.0%
SUV	Subtotal	6,536	100.0%	4,412	100.0%	10,948	100.0%
Bus	1	1	25.0%	6	33.3%	7	31.8%
Bus	2	0	0.0%	2	11.1%	2	9.1%
Bus	3	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%
Bus	4+	3	75.0%	10	55.6%	13	59.1%
Bus	Subtotal	4	100.0%	18	100.0%	22	100.0%
Van	1	380	80.0%	310	75.6%	690	78.0%
Van	2	85	17.9%	95	23.2%	180	20.3%
Van	3	4	0.8%	3	0.7%	7	0.8%
Van	4	4	0.8%	0	0.0%	4	0.5%
Van	4+	2	0.4%	2	0.5%	4	0.5%
Van	Subtotal	475	100.0%	410	100.0%	885	100.0%
Large HDV	1	169	88.5%	614	93.7%	783	92.6%
Large HDV	2	18	9.4%	41	6.3%	59	7.0%
Large HDV	3	2	1.0%	0	0.0%	2	0.2%
Large HDV	4	2	1.0%	0	0.0%	2	0.2%
Large HDV	4+	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	191	100.0%	655	100.0%	846	100.0%
Small HDV	1	244	80.5%	215	74.7%	459	77.7%
Small HDV	2	54	17.8%	68	23.6%	122	20.6%
Small HDV	3	2	0.7%	3	1.0%	5	0.8%
Small HDV	4	3	1.0%	2	0.7%	5	0.8%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%
Small HDV	Subtotal	303	100.0%	288	100.0%	591	100.0%
MC	1	36	100.0%	13	100.0%	49	100.0%
MC	2	0	0.0%	0	0.0%	0	0.0%
MC	3	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	36	100.0%	13	100.0%	49	100.0%
Other	1	3	100.0%	3	100.0%	6	100.0%
Other	2	0	0.0%	0	0.0%	0	0.0%
Other	3	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	3	100.0%	3	100.0%	6	100.0%

Table 115 - Observed Occupancy Distributions by Vehicle Type, Chastain Road at I-575, Post-Opening (2019), AM Peak (7-10 AM)

Occupancy Breakup of Chastain Road at I-575, AM Peak	Occu. Category	Count of GP Lane 1, Post-Opening (2019)	Fraction of GP Lane 1, Post-Opening (2019)	Count of GP Lane 2, Post-Opening (2019)	Fraction of GP Lane 2, Post-Opening (2019)	Count of Express Lane 1, Post-Opening (2019)	Fraction of Express Lane 1, Post-Opening (2019)	Count of All Lanes, Post-Opening (2019)	Fraction of All Lanes, Post-Opening (2019)
Total	1	21,124	93.4%	12,260	86.8%	14,807	96.1%	48,191	92.4%
Total	2	1,443	6.4%	1,740	12.3%	572	3.7%	3,755	7.2%
Total	3	41	0.2%	95	0.7%	10	0.1%	146	0.3%
Total	4	2	0.0%	9	0.1%	6	0.0%	17	0.0%
Total	4+	6	0.0%	18	0.1%	15	0.1%	39	0.1%
Total	Total	22,616	100.0%	14,122	100.0%	15,410	100.0%	52,148	100.0%
Pass. Cars	1	9,812	95.9%	5,180	91.3%	7,545	98.0%	22,537	95.5%
Pass. Cars	2	397	3.9%	460	8.1%	148	1.9%	1,005	4.3%
Pass. Cars	3	18	0.2%	30	0.5%	3	0.0%	51	0.2%
Pass. Cars	4	1	0.0%	3	0.1%	0	0.0%	4	0.0%
Pass. Cars	4+	0	0.0%	2	0.0%	0	0.0%	2	0.0%
Pass. Cars	Subtotal	10,228	100.0%	5,675	100.0%	7,696	100.0%	23,599	100.0%
SUV	1	9,904	92.2%	5,305	85.5%	6,583	95.4%	21,792	91.4%
SUV	2	828	7.7%	860	13.9%	309	4.5%	1,997	8.4%
SUV	3	14	0.1%	23	0.4%	5	0.1%	42	0.2%
SUV	4	1	0.0%	6	0.1%	0	0.0%	7	0.0%
SUV	4+	0	0.0%	12	0.2%	0	0.0%	12	0.1%
SUV	Subtotal	10,747	100.0%	6,206	100.0%	6,897	100.0%	23,850	100.0%
Bus	1	0	0.0%	13	76.5%	7	25.0%	20	41.7%
Bus	2	0	0.0%	1	5.9%	0	0.0%	1	2.1%
Bus	3	0	0.0%	1	5.9%	0	0.0%	1	2.1%
Bus	4	0	0.0%	0	0.0%	6	21.4%	6	12.5%
Bus	4+	3	100.0%	2	11.8%	15	53.6%	20	41.7%
Bus	Subtotal	3	100.0%	17	100.0%	28	100.0%	48	100.0%
Van	1	1,059	85.1%	900	75.4%	589	87.3%	2,548	81.9%
Van	2	178	14.3%	277	23.2%	85	12.6%	540	17.3%
Van	3	5	0.4%	15	1.3%	1	0.1%	21	0.7%
Van	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Van	4+	3	0.2%	1	0.1%	0	0.0%	4	0.1%
Van	Subtotal	1,245	100.0%	1,193	100.0%	675	100.0%	3,113	100.0%
Large HDV	1	160	96.4%	467	94.9%	0	N/A	627	95.3%
Large HDV	2	6	3.6%	24	4.9%	0	N/A	30	4.6%
Large HDV	3	0	0.0%	1	0.2%	0	N/A	1	0.2%
Large HDV	4	0	0.0%	0	0.0%	0	N/A	0	0.0%
Large HDV	4+	0	0.0%	0	0.0%	0	N/A	0	0.0%
Large HDV	Subtotal	166	100.0%	492	100.0%	0	N/A	658	100.0%
Small HDV	1	154	80.6%	349	72.1%	74	71.2%	577	74.1%
Small HDV	2	33	17.3%	109	22.5%	29	27.9%	171	22.0%
Small HDV	3	4	2.1%	25	5.2%	1	1.0%	30	3.9%
Small HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	4+	0	0.0%	1	0.2%	0	0.0%	1	0.1%
Small HDV	Subtotal	191	100.0%	484	100.0%	104	100.0%	779	100.0%
MC	1	35	97.2%	18	90.0%	8	100.0%	61	95.3%
MC	2	1	2.8%	2	10.0%	0	0.0%	3	4.7%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	36	100.0%	20	100.0%	8	100.0%	64	100.0%
Other	1	0	N/A	28	80.0%	1	50.0%	29	78.4%
Other	2	0	N/A	7	20.0%	1	50.0%	8	21.6%
Other	3	0	N/A	0	0.0%	0	0.0%	0	0.0%
Other	4	0	N/A	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	N/A	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	0	N/A	35	100.0%	2	100.0%	37	100.0%

Table 116 - Observed Occupancy Distributions by Vehicle Type, Chastain Road at I-575, Pre-Opening (2018), PM Peak (4-7 PM)

Occupancy Breakup of Chastain Road at I-575, PM Peak	Occu. Category	Count of GP Lane 1, Pre-Opening (2018)	Fraction of GP Lane 1, Pre-Opening (2018)	Count of GP Lane 2, Pre-Opening (2018)	Fraction of GP Lane 2, Pre-Opening (2018)	Count of All Lanes, Pre-Opening (2018)	Fraction of All Lanes, Pre-Opening (2018)
Total	1	10,847	87.1%	11,062	83.2%	21,909	85.1%
Total	2	1,490	12.0%	2,070	15.6%	3,560	13.8%
Total	3	86	0.7%	114	0.9%	200	0.8%
Total	4	12	0.1%	31	0.2%	43	0.2%
Total	4+	15	0.1%	25	0.2%	40	0.2%
Total	Total	12,450	100.0%	13,302	100.0%	25,752	100.0%
Pass. Cars	1	4,740	92.1%	5,000	88.8%	9,740	90.4%
Pass. Cars	2	382	7.4%	587	10.4%	969	9.0%
Pass. Cars	3	24	0.5%	35	0.6%	59	0.5%
Pass. Cars	4	1	0.0%	8	0.1%	9	0.1%
Pass. Cars	4+	0	0.0%	2	0.0%	2	0.0%
Pass. Cars	Subtotal	5,147	100.0%	5,632	100.0%	10,779	100.0%
SUV	1	5,762	84.5%	5,370	79.5%	11,132	82.0%
SUV	2	998	14.6%	1,301	19.3%	2,299	16.9%
SUV	3	49	0.7%	68	1.0%	117	0.9%
SUV	4	9	0.1%	16	0.2%	25	0.2%
SUV	4+	4	0.1%	2	0.0%	6	0.0%
SUV	Subtotal	6,822	100.0%	6,757	100.0%	13,579	100.0%
Bus	1	2	22.2%	9	37.5%	11	33.3%
Bus	2	0	0.0%	0	0.0%	0	0.0%
Bus	3	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%
Bus	4+	7	77.8%	15	62.5%	22	66.7%
Bus	Subtotal	9	100.0%	24	100.0%	33	100.0%
Van	1	161	71.2%	228	74.0%	389	72.8%
Van	2	53	23.5%	79	25.6%	132	24.7%
Van	3	8	3.5%	0	0.0%	8	1.5%
Van	4	0	0.0%	0	0.0%	0	0.0%
Van	4+	4	1.8%	1	0.3%	5	0.9%
Van	Subtotal	226	100.0%	308	100.0%	534	100.0%
Large HDV	1	81	92.0%	282	89.2%	363	89.9%
Large HDV	2	7	8.0%	32	10.1%	39	9.7%
Large HDV	3	0	0.0%	0	0.0%	0	0.0%
Large HDV	4	0	0.0%	1	0.3%	1	0.2%
Large HDV	4+	0	0.0%	1	0.3%	1	0.2%
Large HDV	Subtotal	88	100.0%	316	100.0%	404	100.0%
Small HDV	1	66	54.5%	143	61.6%	209	59.2%
Small HDV	2	48	39.7%	68	29.3%	116	32.9%
Small HDV	3	5	4.1%	11	4.7%	16	4.5%
Small HDV	4	2	1.7%	6	2.6%	8	2.3%
Small HDV	4+	0	0.0%	4	1.7%	4	1.1%
Small HDV	Subtotal	121	100.0%	232	100.0%	353	100.0%
MC	1	31	96.9%	26	92.9%	57	95.0%
MC	2	1	3.1%	2	7.1%	3	5.0%
MC	3	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	32	100.0%	28	100.0%	60	100.0%
Other	1	4	80.0%	4	80.0%	8	80.0%
Other	2	1	20.0%	1	20.0%	2	20.0%
Other	3	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	5	100.0%	5	100.0%	10	100.0%

Table 117 - Observed Occupancy Distributions by Vehicle Type, Chastain Road at I-575, Post-Opening (2019), PM Peak (4-7 PM)

Occupancy Breakup of Chastain Road at I-575, PM Peak	Occu. Category	Count of GP Lane 1, Post-Opening (2019)	Fraction of GP Lane 1, Post-Opening (2019)	Count of GP Lane 2, Post-Opening (2019)	Fraction of GP Lane 2, Post-Opening (2019)	Count of Express Lane 1, Post-Opening (2019)	Fraction of Express Lane 1, Post-Opening (2019)	Count of All Lanes, Post-Opening (2019)	Fraction of All Lanes, Post-Opening (2019)
Total	1	11,409	85.1%	12,991	87.1%	10,499	94.4%	34,899	88.5%
Total	2	1,902	14.2%	1,828	12.3%	599	5.4%	4,329	11.0%
Total	3	80	0.6%	69	0.5%	3	0.0%	152	0.4%
Total	4	13	0.1%	23	0.2%	0	0.0%	36	0.1%
Total	4+	5	0.0%	9	0.1%	18	0.2%	32	0.1%
Total	Total	13,409	100.0%	14,920	100.0%	11,119	100.0%	39,448	100.0%
Pass. Cars	1	5,319	89.1%	6,424	90.1%	4,535	96.2%	16,278	91.4%
Pass. Cars	2	605	10.1%	668	9.4%	176	3.7%	1,449	8.1%
Pass. Cars	3	40	0.7%	30	0.4%	1	0.0%	71	0.4%
Pass. Cars	4	6	0.1%	8	0.1%	0	0.0%	14	0.1%
Pass. Cars	4+	0	0.0%	1	0.0%	0	0.0%	1	0.0%
Pass. Cars	Subtotal	5,970	100.0%	7,131	100.0%	4,712	100.0%	17,813	100.0%
SUV	1	5,425	82.7%	5,530	85.3%	5,540	94.0%	16,495	87.1%
SUV	2	1,093	16.7%	918	14.2%	350	5.9%	2,361	12.5%
SUV	3	31	0.5%	21	0.3%	2	0.0%	54	0.3%
SUV	4	6	0.1%	8	0.1%	0	0.0%	14	0.1%
SUV	4+	2	0.0%	3	0.0%	0	0.0%	5	0.0%
SUV	Subtotal	6,557	100.0%	6,480	100.0%	5,892	100.0%	18,929	100.0%
Bus	1	0	0.0%	11	84.6%	3	16.7%	14	43.8%
Bus	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4+	1	100.0%	2	15.4%	15	83.3%	18	56.3%
Bus	Subtotal	1	100.0%	13	100.0%	18	100.0%	32	100.0%
Van	1	485	74.7%	597	76.4%	352	83.4%	1,434	77.4%
Van	2	157	24.2%	167	21.4%	67	15.9%	391	21.1%
Van	3	5	0.8%	10	1.3%	0	0.0%	15	0.8%
Van	4	0	0.0%	5	0.6%	0	0.0%	5	0.3%
Van	4+	2	0.3%	2	0.3%	3	0.7%	7	0.4%
Van	Subtotal	649	100.0%	781	100.0%	422	100.0%	1,852	100.0%
Large HDV	1	66	95.7%	181	92.8%	2	100.0%	249	93.6%
Large HDV	2	3	4.3%	14	7.2%	0	0.0%	17	6.4%
Large HDV	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	69	100.0%	195	100.0%	2	100.0%	266	100.0%
Small HDV	1	73	62.9%	222	75.8%	41	87.2%	336	73.7%
Small HDV	2	38	32.8%	60	20.5%	6	12.8%	104	22.8%
Small HDV	3	4	3.4%	8	2.7%	0	0.0%	12	2.6%
Small HDV	4	1	0.9%	2	0.7%	0	0.0%	3	0.7%
Small HDV	4+	0	0.0%	1	0.3%	0	0.0%	1	0.2%
Small HDV	Subtotal	116	100.0%	293	100.0%	47	100.0%	456	100.0%
MC	1	35	100.0%	20	100.0%	18	100.0%	73	100.0%
MC	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	35	100.0%	20	100.0%	18	100.0%	73	100.0%
Other	1	6	50.0%	6	85.7%	8	100.0%	20	74.1%
Other	2	6	50.0%	1	14.3%	0	0.0%	7	25.9%
Other	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	12	100.0%	7	100.0%	8	100.0%	27	100.0%

Table 118 - Observed Occupancy Distributions by Vehicle Type, Hickory Grove Road at I-75, Pre-Opening (2018), AM Peak (7-10 AM)

Occupancy Breakup of Hickory Grove Road at I-75, AM Peak	Occu. Category	Count of GP Lane 1, Pre-Opening (2018)	Fraction of GP Lane 1, Pre-Opening (2018)	Count of GP Lane 2, Pre-Opening (2018)	Fraction of GP Lane 2, Pre-Opening (2018)	Count of GP Lane 3, Pre-Opening (2018)	Fraction of GP Lane 3, Pre-Opening (2018)	Count of GP Lane 4, Pre-Opening (2018)	Fraction of GP Lane 4, Pre-Opening (2018)	Count of All Lanes, Pre-Opening (2018)	Fraction of All Lanes, Pre-Opening (2018)
Total	1	7,807	86.0%	2,917	89.2%	4,169	87.6%	1,581	89.2%	16,474	87.3%
Total	2	1,218	13.4%	344	10.5%	568	11.9%	185	10.4%	2,315	12.3%
Total	3	37	0.4%	5	0.2%	10	0.2%	5	0.3%	57	0.3%
Total	4	13	0.1%	0	0.0%	0	0.0%	0	0.0%	13	0.1%
Total	4+	3	0.0%	5	0.2%	10	0.2%	2	0.1%	20	0.1%
Total	Total	9,078	100.0%	3,271	100.0%	4,757	100.0%	1,773	100.0%	18,879	100.0%
Pass. Cars	1	3,690	90.8%	781	91.7%	1,016	90.3%	575	92.9%	6,062	91.0%
Pass. Cars	2	342	8.4%	70	8.2%	101	9.0%	44	7.1%	557	8.4%
Pass. Cars	3	23	0.6%	1	0.1%	8	0.7%	0	0.0%	32	0.5%
Pass. Cars	4	7	0.2%	0	0.0%	0	0.0%	0	0.0%	7	0.1%
Pass. Cars	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pass. Cars	Subtotal	4,062	100.0%	852	100.0%	1,125	100.0%	619	100.0%	6,658	100.0%
SUV	1	3,680	82.6%	1,043	83.2%	1,166	79.7%	657	86.3%	6,546	82.5%
SUV	2	758	17.0%	209	16.7%	295	20.2%	101	13.3%	1,363	17.2%
SUV	3	11	0.2%	2	0.2%	2	0.1%	3	0.4%	18	0.2%
SUV	4	4	0.1%	0	0.0%	0	0.0%	0	0.0%	4	0.1%
SUV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
SUV	Subtotal	4,453	100.0%	1,254	100.0%	1,463	100.0%	761	100.0%	7,931	100.0%
Bus	1	4	66.7%	4	44.4%	0	0.0%	0	0.0%	8	32.0%
Bus	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4+	2	33.3%	5	55.6%	8	100.0%	2	100.0%	17	68.0%
Bus	Subtotal	6	100.0%	9	100.0%	8	100.0%	2	100.0%	25	100.0%
Van	1	357	75.5%	99	76.7%	122	72.2%	31	72.1%	609	74.8%
Van	2	110	23.3%	30	23.3%	45	26.6%	10	23.3%	195	24.0%
Van	3	3	0.6%	0	0.0%	0	0.0%	2	4.7%	5	0.6%
Van	4	2	0.4%	0	0.0%	0	0.0%	0	0.0%	2	0.2%
Van	4+	1	0.2%	0	0.0%	2	1.2%	0	0.0%	3	0.4%
Van	Subtotal	473	100.0%	129	100.0%	169	100.0%	43	100.0%	814	100.0%
Large HDV	1	15	100.0%	869	97.5%	1,639	94.3%	261	90.9%	2,784	95.0%
Large HDV	2	0	0.0%	21	2.4%	99	5.7%	26	9.1%	146	5.0%
Large HDV	3	0	0.0%	1	0.1%	0	0.0%	0	0.0%	1	0.0%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	15	100.0%	891	100.0%	1,738	100.0%	287	100.0%	2,931	100.0%
Small HDV	1	44	84.6%	108	88.5%	217	88.9%	51	92.7%	420	88.8%
Small HDV	2	8	15.4%	13	10.7%	27	11.1%	4	7.3%	52	11.0%
Small HDV	3	0	0.0%	1	0.8%	0	0.0%	0	0.0%	1	0.2%
Small HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	Subtotal	52	100.0%	122	100.0%	244	100.0%	55	100.0%	473	100.0%
MC	1	17	100.0%	9	90.0%	9	90.0%	6	100.0%	41	95.3%
MC	2	0	0.0%	1	10.0%	1	10.0%	0	0.0%	2	4.7%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	17	100.0%	10	100.0%	10	100.0%	6	100.0%	43	100.0%
Other	1	0	N/A	4	100.0%	0	N/A	0	N/A	4	100.0%
Other	2	0	N/A	0	0.0%	0	N/A	0	N/A	0	0.0%
Other	3	0	N/A	0	0.0%	0	N/A	0	N/A	0	0.0%
Other	4	0	N/A	0	0.0%	0	N/A	0	N/A	0	0.0%
Other	4+	0	N/A	0	0.0%	0	N/A	0	N/A	0	0.0%
Other	Subtotal	0	N/A	4	100.0%	0	N/A	0	N/A	4	100.0%

Table 119 - Observed Occupancy Distributions by Vehicle Type, Hickory Grove Road at I-75, Post-Opening (2019), AM Peak (7-10 AM)

Occupancy Breakup of Hickory Grove Road at I-75, AM Peak	Occu. Category	Count of GP Lane 1, Post-Opening (2019)	Fraction of GP Lane 1, Post-Opening (2019)	Count of GP Lane 2, Post-Opening (2019)	Fraction of GP Lane 2, Post-Opening (2019)	Count of GP Lane 3, Post-Opening (2019)	Fraction of GP Lane 3, Post-Opening (2019)	Count of GP Lane 4, Post-Opening (2019)	Fraction of GP Lane 4, Post-Opening (2019)	Count of Express Lane 1, Post-Opening (2019)	Fraction of Express Lane 1, Post-Opening (2019)	Count of All Lanes, Post-Opening (2019)	Fraction of All Lanes, Post-Opening (2019)
Total	1	9,439	89.0%	7,833	87.9%	9,947	91.8%	4,710	91.5%	6,696	94.6%	38,625	90.7%
Total	2	1,139	10.7%	1,045	11.7%	856	7.9%	421	8.2%	352	5.0%	3,813	9.0%
Total	3	17	0.2%	34	0.4%	26	0.2%	11	0.2%	7	0.1%	95	0.2%
Total	4	3	0.0%	1	0.0%	3	0.0%	2	0.0%	5	0.1%	14	0.0%
Total	4+	4	0.0%	1	0.0%	4	0.0%	1	0.0%	19	0.3%	29	0.1%
Total	Total	10,602	100.0%	8,914	100.0%	10,836	100.0%	5,145	100.0%	7,079	100.0%	42,576	100.0%
Pass. Cars	1	4,411	92.4%	3,603	89.4%	2,945	92.6%	1,845	92.3%	2,799	97.3%	15,603	92.5%
Pass. Cars	2	354	7.4%	408	10.1%	220	6.9%	147	7.4%	76	2.6%	1,205	7.1%
Pass. Cars	3	9	0.2%	21	0.5%	12	0.4%	7	0.4%	1	0.0%	50	0.3%
Pass. Cars	4	1	0.0%	0	0.0%	2	0.1%	1	0.1%	0	0.0%	4	0.0%
Pass. Cars	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pass. Cars	Subtotal	4,775	100.0%	4,032	100.0%	3,179	100.0%	2,000	100.0%	2,876	100.0%	16,862	100.0%
SUV	1	4,442	86.9%	2,134	81.1%	2,698	88.0%	1,592	89.3%	3,362	94.0%	14,228	88.0%
SUV	2	662	12.9%	487	18.5%	360	11.7%	186	10.4%	206	5.8%	1,901	11.8%
SUV	3	7	0.1%	8	0.3%	4	0.1%	2	0.1%	5	0.1%	26	0.2%
SUV	4	0	0.0%	1	0.0%	1	0.0%	1	0.1%	3	0.1%	6	0.0%
SUV	4+	1	0.0%	0	0.0%	2	0.1%	1	0.1%	0	0.0%	4	0.0%
SUV	Subtotal	5,112	100.0%	2,630	100.0%	3,065	100.0%	1,782	100.0%	3,576	100.0%	16,165	100.0%
Bus	1	2	40.0%	13	92.9%	30	85.7%	5	83.3%	5	19.2%	55	64.0%
Bus	2	1	20.0%	0	0.0%	3	8.6%	1	16.7%	2	7.7%	7	8.1%
Bus	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	3.8%	1	1.2%
Bus	4+	2	40.0%	1	7.1%	2	5.7%	0	0.0%	18	69.2%	23	26.7%
Bus	Subtotal	5	100.0%	14	100.0%	35	100.0%	6	100.0%	26	100.0%	86	100.0%
Van	1	439	80.7%	391	79.3%	476	88.0%	162	82.7%	261	85.3%	1,729	83.1%
Van	2	101	18.6%	98	19.9%	59	10.9%	33	16.8%	43	14.1%	334	16.1%
Van	3	1	0.2%	4	0.8%	6	1.1%	1	0.5%	1	0.3%	13	0.6%
Van	4	2	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.1%
Van	4+	1	0.2%	0	0.0%	0	0.0%	0	0.0%	1	0.3%	2	0.1%
Van	Subtotal	544	100.0%	493	100.0%	541	100.0%	196	100.0%	306	100.0%	2,080	100.0%
Large HDV	1	21	100.0%	1,407	97.8%	3,234	95.9%	927	96.7%	9	90.0%	5,598	96.5%
Large HDV	2	0	0.0%	31	2.2%	136	4.0%	32	3.3%	1	10.0%	200	3.4%
Large HDV	3	0	0.0%	0	0.0%	1	0.0%	0	0.0%	0	0.0%	1	0.0%

Large HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	21	100.0%	1,438	100.0%	3,371	100.0%	959	100.0%	10	100.0%	5,799	100.0%
Small HDV	1	90	81.8%	270	93.1%	540	87.2%	149	87.6%	235	90.7%	1,284	88.7%
Small HDV	2	20	18.2%	19	6.6%	76	12.3%	20	11.8%	23	8.9%	158	10.9%
Small HDV	3	0	0.0%	1	0.3%	3	0.5%	1	0.6%	0	0.0%	5	0.3%
Small HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.4%	1	0.1%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	Subtotal	110	100.0%	290	100.0%	619	100.0%	170	100.0%	259	100.0%	1,448	100.0%
MC	1	29	100.0%	12	100.0%	11	100.0%	29	100.0%	10	100.0%	91	100.0%
MC	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	29	100.0%	12	100.0%	11	100.0%	29	100.0%	10	100.0%	91	100.0%
Other	1	5	83.3%	3	60.0%	13	86.7%	1	33.3%	15	93.8%	37	82.2%
Other	2	1	16.7%	2	40.0%	2	13.3%	2	66.7%	1	6.3%	8	17.8%
Other	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	6	100.0%	5	100.0%	15	100.0%	3	100.0%	16	100.0%	45	100.0%

Table 120 - Observed Occupancy Distributions by Vehicle Type, Hickory Grove Road at I-75, Pre-Opening (2018), PM Peak (4-7 PM)

Occupancy Breakup of Hickory Grove Road at I-75, PM Peak	Occu. Category	Count of GP Lane 1, Pre-Opening (2018)	Fraction of GP Lane 1, Pre-Opening (2018)	Count of GP Lane 2, Pre-Opening (2018)	Fraction of GP Lane 2, Pre-Opening (2018)	Count of GP Lane 3, Pre-Opening (2018)	Fraction of GP Lane 3, Pre-Opening (2018)	Count of All Lanes, Pre-Opening (2018)	Fraction of All Lanes, Pre-Opening (2018)
Total	1	5,997	86.3%	7,170	80.4%	7,237	86.8%	20,404	84.3%
Total	2	911	13.1%	1,598	17.9%	1,030	12.4%	3,539	14.6%
Total	3	27	0.4%	123	1.4%	45	0.5%	195	0.8%
Total	4	5	0.1%	12	0.1%	11	0.1%	28	0.1%
Total	4+	10	0.1%	15	0.2%	13	0.2%	38	0.2%
Total	Total	6,950	100.0%	8,918	100.0%	8,336	100.0%	24,204	100.0%
Pass. Cars	1	2,676	91.1%	2,302	82.0%	2,402	88.7%	7,380	87.3%
Pass. Cars	2	247	8.4%	431	15.4%	286	10.6%	964	11.4%
Pass. Cars	3	12	0.4%	65	2.3%	17	0.6%	94	1.1%
Pass. Cars	4	1	0.0%	8	0.3%	4	0.1%	13	0.2%
Pass. Cars	4+	1	0.0%	1	0.0%	0	0.0%	2	0.0%
Pass. Cars	Subtotal	2,937	100.0%	2,807	100.0%	2,709	100.0%	8,453	100.0%
SUV	1	3,127	82.8%	2,571	72.5%	2,546	83.1%	8,244	79.4%
SUV	2	628	16.6%	920	25.9%	495	16.2%	2,043	19.7%
SUV	3	15	0.4%	52	1.5%	15	0.5%	82	0.8%
SUV	4	4	0.1%	4	0.1%	7	0.2%	15	0.1%
SUV	4+	1	0.0%	1	0.0%	1	0.0%	3	0.0%
SUV	Subtotal	3,775	100.0%	3,548	100.0%	3,064	100.0%	10,387	100.0%
Bus	1	4	33.3%	22	73.3%	15	55.6%	41	59.4%
Bus	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4+	8	66.7%	8	26.7%	12	44.4%	28	40.6%
Bus	Subtotal	12	100.0%	30	100.0%	27	100.0%	69	100.0%
Van	1	119	80.4%	114	61.0%	154	77.0%	387	72.3%
Van	2	29	19.6%	68	36.4%	44	22.0%	141	26.4%
Van	3	0	0.0%	0	0.0%	2	1.0%	2	0.4%
Van	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Van	4+	0	0.0%	5	2.7%	0	0.0%	5	0.9%
Van	Subtotal	148	100.0%	187	100.0%	200	100.0%	535	100.0%
Large HDV	1	9	75.0%	1,973	94.0%	1,901	92.8%	3,883	93.3%
Large HDV	2	3	25.0%	127	6.0%	147	7.2%	277	6.7%
Large HDV	3	0	0.0%	0	0.0%	1	0.0%	1	0.0%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	12	100.0%	2,100	100.0%	2,049	100.0%	4,161	100.0%
Small HDV	1	28	90.3%	168	77.4%	194	74.6%	390	76.8%
Small HDV	2	3	9.7%	43	19.8%	56	21.5%	102	20.1%
Small HDV	3	0	0.0%	6	2.8%	10	3.8%	16	3.1%
Small HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	Subtotal	31	100.0%	217	100.0%	260	100.0%	508	100.0%
MC	1	33	100.0%	16	94.1%	19	100.0%	68	98.6%
MC	2	0	0.0%	1	5.9%	0	0.0%	1	1.4%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	33	100.0%	17	100.0%	19	100.0%	69	100.0%
Other	1	1	50.0%	4	33.3%	6	75.0%	11	50.0%
Other	2	1	50.0%	8	66.7%	2	25.0%	11	50.0%
Other	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	2	100.0%	12	100.0%	8	100.0%	22	100.0%

Table 121 - Observed Occupancy Distributions by Vehicle Type, Hickory Grove Road at I-75, Post-Opening (2019), PM Peak (4-7 PM)

Occupancy Breakup of Hickory Grove Road at I-75, PM Peak	Occu. Category	Count of GP Lane 1, Post-Opening (2019)	Fraction of GP Lane 1, Post-Opening (2019)	Count of GP Lane 2, Post-Opening (2019)	Fraction of GP Lane 2, Post-Opening (2019)	Count of GP Lane 3, Post-Opening (2019)	Fraction of GP Lane 3, Post-Opening (2019)	Count of Express Lane 1, Post-Opening (2019)	Fraction of Express Lane 1, Post-Opening (2019)	Count of All Lanes, Post-Opening (2019)	Fraction of All Lanes, Post-Opening (2019)
Total	1	12,252	87.4%	10,293	87.2%	7,887	89.5%	6,979	92.2%	37,411	88.7%
Total	2	1,680	12.0%	1,379	11.7%	819	9.3%	502	6.6%	4,380	10.4%
Total	3	70	0.5%	97	0.8%	66	0.7%	25	0.3%	258	0.6%
Total	4	7	0.0%	29	0.2%	29	0.3%	10	0.1%	75	0.2%
Total	4+	7	0.0%	6	0.1%	8	0.1%	53	0.7%	74	0.2%
Total	Total	14,016	100.0%	11,804	100.0%	8,809	100.0%	7,569	100.0%	42,198	100.0%
Pass. Cars	1	5,422	92.4%	3,129	87.2%	2,718	91.1%	3,008	94.0%	14,277	91.3%
Pass. Cars	2	428	7.3%	403	11.2%	231	7.7%	180	5.6%	1,242	7.9%
Pass. Cars	3	16	0.3%	38	1.1%	22	0.7%	8	0.3%	84	0.5%
Pass. Cars	4	2	0.0%	17	0.5%	13	0.4%	3	0.1%	35	0.2%
Pass. Cars	4+	2	0.0%	1	0.0%	1	0.0%	1	0.0%	5	0.0%
Pass. Cars	Subtotal	5,870	100.0%	3,588	100.0%	2,985	100.0%	3,200	100.0%	15,643	100.0%
SUV	1	6,235	83.9%	3,302	82.8%	2,937	86.5%	3,723	92.5%	16,197	86.0%
SUV	2	1,138	15.3%	634	15.9%	407	12.0%	283	7.0%	2,462	13.1%
SUV	3	50	0.7%	41	1.0%	33	1.0%	12	0.3%	136	0.7%
SUV	4	4	0.1%	9	0.2%	15	0.4%	6	0.1%	34	0.2%
SUV	4+	4	0.1%	1	0.0%	2	0.1%	1	0.0%	8	0.0%
SUV	Subtotal	7,431	100.0%	3,987	100.0%	3,394	100.0%	4,025	100.0%	18,837	100.0%
Bus	1	4	100.0%	12	92.3%	3	50.0%	2	4.1%	21	29.2%
Bus	2	0	0.0%	0	0.0%	1	16.7%	0	0.0%	1	1.4%
Bus	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4+	0	0.0%	1	7.7%	2	33.3%	47	95.9%	50	69.4%
Bus	Subtotal	4	100.0%	13	100.0%	6	100.0%	49	100.0%	72	100.0%
Van	1	390	78.0%	425	71.5%	252	79.7%	195	81.6%	1,262	76.5%
Van	2	104	20.8%	153	25.8%	54	17.1%	36	15.1%	347	21.0%
Van	3	4	0.8%	13	2.2%	7	2.2%	4	1.7%	28	1.7%
Van	4	1	0.2%	1	0.2%	1	0.3%	0	0.0%	3	0.2%
Van	4+	1	0.2%	2	0.3%	2	0.6%	4	1.7%	9	0.5%
Van	Subtotal	500	100.0%	594	100.0%	316	100.0%	239	100.0%	1,649	100.0%
Large HDV	1	61	96.8%	2,809	96.7%	1,759	96.4%	4	100.0%	4,633	96.6%
Large HDV	2	2	3.2%	95	3.3%	65	3.6%	0	0.0%	162	3.4%
Large HDV	3	0	0.0%	1	0.0%	0	0.0%	0	0.0%	1	0.0%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	63	100.0%	2,905	100.0%	1,824	100.0%	4	100.0%	4,796	100.0%
Small HDV	1	79	91.9%	585	86.2%	209	76.3%	23	82.1%	896	84.0%
Small HDV	2	7	8.1%	87	12.8%	60	21.9%	3	10.7%	157	14.7%
Small HDV	3	0	0.0%	4	0.6%	4	1.5%	1	3.6%	9	0.8%
Small HDV	4	0	0.0%	2	0.3%	0	0.0%	1	3.6%	3	0.3%
Small HDV	4+	0	0.0%	1	0.1%	1	0.4%	0	0.0%	2	0.2%
Small HDV	Subtotal	86	100.0%	679	100.0%	274	100.0%	28	100.0%	1,067	100.0%
MC	1	55	98.2%	25	96.2%	9	100.0%	19	100.0%	108	98.2%
MC	2	1	1.8%	1	3.8%	0	0.0%	0	0.0%	2	1.8%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	56	100.0%	26	100.0%	9	100.0%	19	100.0%	110	100.0%
Other	1	6	100.0%	6	50.0%	0	0.0%	5	100.0%	17	70.8%
Other	2	0	0.0%	6	50.0%	1	100.0%	0	0.0%	7	29.2%
Other	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	6	100.0%	12	100.0%	1	100.0%	5	100.0%	24	100.0%

Table 122 - Observed Occupancy Distributions by Vehicle Type, Indian Trail Lilburn Road at I-85, Pre-Extension (2018), AM Peak (7-10 AM)

Occupancy Breakup of Indian Trail/Lilburn Road at I-85, AM Peak	Occu. Category	Count of GP Lane 1, Pre-Extension (2018)	Fraction of GP Lane 1, Pre-Extension (2018)	Count of GP Lane 2, Pre-Extension (2018)	Fraction of GP Lane 2, Pre-Extension (2018)	Count of GP Lane 3, Pre-Extension (2018)	Fraction of GP Lane 3, Pre-Extension (2018)	Count of GP Lane 4, Pre-Extension (2018)	Fraction of GP Lane 4, Pre-Extension (2018)	Count of GP Lane 5, Pre-Extension (2018)	Fraction of GP Lane 5, Pre-Extension (2018)	Count of HOT Lane 1, Pre-Extension (2018)	Fraction of HOT Lane 1, Pre-Extension (2018)	Count of All Lanes, Pre-Extension (2018)	Fraction of All Lanes, Pre-Extension (2018)
Total	1	7,624	89.7%	6,017	87.8%	8,082	87.3%	7,149	88.4%	8,571	88.7%	6,693	86.7%	44,136	88.1%
Total	2	837	9.9%	806	11.8%	1,136	12.3%	900	11.1%	1,058	10.9%	855	11.1%	5,592	11.2%
Total	3	21	0.2%	26	0.4%	26	0.3%	32	0.4%	29	0.3%	53	0.7%	187	0.4%
Total	4	6	0.1%	1	0.0%	8	0.1%	7	0.1%	9	0.1%	14	0.2%	45	0.1%
Total	4+	9	0.1%	2	0.0%	10	0.1%	1	0.0%	0	0.0%	105	1.4%	127	0.3%
Total	Total	8,497	100.0%	6,852	100.0%	9,262	100.0%	8,089	100.0%	9,667	100.0%	7,720	100.0%	50,087	100.0%
Pass. Cars	1	4,599	94.5%	2,994	94.2%	2,885	93.2%	2,739	92.8%	3,854	93.8%	3,078	93.2%	20,149	93.7%
Pass. Cars	2	261	5.4%	178	5.6%	199	6.4%	205	6.9%	244	5.9%	199	6.0%	1,286	6.0%
Pass. Cars	3	6	0.1%	6	0.2%	8	0.3%	8	0.3%	9	0.2%	24	0.7%	61	0.3%
Pass. Cars	4	0	0.0%	0	0.0%	2	0.1%	1	0.0%	0	0.0%	1	0.0%	4	0.0%
Pass. Cars	4+	1	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.0%
Pass. Cars	Subtotal	4,867	100.0%	3,178	100.0%	3,094	100.0%	2,953	100.0%	4,107	100.0%	3,302	100.0%	21,501	100.0%
SUV	1	2,529	85.3%	2,189	82.2%	2,565	81.0%	2,092	82.3%	3,047	85.4%	3,179	85.6%	15,601	83.8%
SUV	2	418	14.1%	460	17.3%	582	18.4%	429	16.9%	501	14.0%	505	13.6%	2,895	15.6%
SUV	3	11	0.4%	12	0.5%	16	0.5%	16	0.6%	13	0.4%	17	0.5%	85	0.5%
SUV	4	6	0.2%	1	0.0%	5	0.2%	6	0.2%	5	0.1%	10	0.3%	33	0.2%
SUV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.1%	2	0.0%
SUV	Subtotal	2,964	100.0%	2,662	100.0%	3,168	100.0%	2,543	100.0%	3,566	100.0%	3,713	100.0%	18,616	100.0%
Bus	1	5	41.7%	3	60.0%	1	11.1%	3	60.0%	3	100.0%	23	18.3%	38	23.8%
Bus	2	0	0.0%	0	0.0%	0	0.0%	1	20.0%	0	0.0%	0	0.0%	1	0.6%
Bus	3	1	8.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.6%
Bus	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	2.4%	3	1.9%
Bus	4+	6	50.0%	2	40.0%	8	88.9%	1	20.0%	0	0.0%	100	79.4%	117	73.1%
Bus	Subtotal	12	100.0%	5	100.0%	9	100.0%	5	100.0%	3	100.0%	126	100.0%	160	100.0%
Van	1	417	73.9%	250	68.7%	351	71.1%	400	72.5%	639	75.1%	329	71.1%	2,386	72.6%
Van	2	143	25.4%	108	29.7%	141	28.5%	148	26.8%	208	24.4%	123	26.6%	871	26.5%
Van	3	3	0.5%	6	1.6%	0	0.0%	4	0.7%	2	0.2%	8	1.7%	23	0.7%
Van	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.2%	0	0.0%	2	0.1%
Van	4+	1	0.2%	0	0.0%	2	0.4%	0	0.0%	0	0.0%	3	0.6%	6	0.2%
Van	Subtotal	564	100.0%	364	100.0%	494	100.0%	552	100.0%	851	100.0%	463	100.0%	3,288	100.0%
Large HDV	1	10	83.3%	437	95.4%	1,953	93.4%	1,642	96.4%	698	96.0%	1	100.0%	4,741	94.9%
Large HDV	2	2	16.7%	21	4.6%	139	6.6%	60	3.5%	29	4.0%	0	0.0%	251	5.0%
Large HDV	3	0	0.0%	0	0.0%	0	0.0%	2	0.1%	0	0.0%	0	0.0%	2	0.0%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	12	100.0%	458	100.0%	2,092	100.0%	1,704	100.0%	727	100.0%	1	100.0%	4,994	100.0%
Small HDV	1	54	80.6%	139	77.2%	316	80.2%	270	82.6%	318	79.9%	44	59.5%	1,141	79.2%
Small HDV	2	13	19.4%	39	21.7%	75	19.0%	55	16.8%	73	18.3%	26	35.1%	281	19.5%
Small HDV	3	0	0.0%	2	1.1%	2	0.5%	2	0.6%	5	1.3%	4	5.4%	15	1.0%
Small HDV	4	0	0.0%	0	0.0%	1	0.3%	0	0.0%	2	0.5%	0	0.0%	3	0.2%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	Subtotal	67	100.0%	180	100.0%	394	100.0%	327	100.0%	398	100.0%	74	100.0%	1,440	100.0%
MC	1	10	100.0%	2	100.0%	4	100.0%	0	N/A	2	100.0%	39	100.0%	57	100.0%
MC	2	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%	0	0.0%	0	0.0%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	10	100.0%	2	100.0%	4	100.0%	0	N/A	2	100.0%	39	100.0%	57	100.0%
Other	1	0	0.0%	3	100.0%	7	100.0%	3	60.0%	10	76.9%	0	0.0%	23	74.2%
Other	2	0	0.0%	0	0.0%	0	0.0%	2	40.0%	3	23.1%	2	100.0%	7	22.6%
Other	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4+	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	3.2%
Other	Subtotal	1	100.0%	3	100.0%	7	100.0%	5	100.0%	13	100.0%	2	100.0%	31	100.0%

Table 123 - Observed Occupancy Distributions by Vehicle Type, Indian Trail Lilburn Road at I-85, Post-Extension (2019), AM Peak (7-10 AM)

Occupancy Breakup of Indian Trail Lilburn Road at I-85, AM Peak	Occu. Category	Count of GP Lane 1, Post-Extension (2019)	Fraction of GP Lane 1, Post-Extension (2019)	Count of GP Lane 2, Post-Extension (2018)	Fraction of GP Lane 2, Post-Extension (2018)	Count of GP Lane 3, Post-Extension (2018)	Fraction of GP Lane 3, Post-Extension (2018)	Count of GP Lane 4, Post-Extension (2018)	Fraction of GP Lane 4, Post-Extension (2018)	Count of GP Lane 5, Post-Extension (2018)	Fraction of GP Lane 5, Post-Extension (2018)	Count of HOT Lane 1, Post-Extension (2019)	Fraction of HOT Lane 1, Post-Extension (2019)	Count of All Lanes, Post-Extension (2019)	Fraction of All Lanes, Post-Extension (2019)
Total	1	11,838	91.4%	11,882	91.6%	9,248	91.8%	13,415	95.2%	13,550	91.9%	14,450	91.4%	74,383	92.2%
Total	2	1,096	8.5%	1,050	8.1%	813	8.1%	664	4.7%	1,136	7.7%	1,135	7.2%	5,894	7.3%
Total	3	18	0.1%	33	0.3%	11	0.1%	7	0.0%	42	0.3%	36	0.2%	147	0.2%
Total	4	2	0.0%	4	0.0%	4	0.0%	4	0.0%	8	0.1%	3	0.0%	25	0.0%
Total	4+	1	0.0%	3	0.0%	3	0.0%	2	0.0%	4	0.0%	179	1.1%	192	0.2%
Total	Total	12,955	100.0%	12,972	100.0%	10,079	100.0%	14,092	100.0%	14,740	100.0%	15,803	100.0%	80,641	100.0%
Pass. Cars	1	5,813	95.1%	5,394	95.2%	3,989	95.0%	6,517	97.4%	5,613	95.5%	7,507	96.8%	34,833	96.0%
Pass. Cars	2	287	4.7%	264	4.7%	209	5.0%	171	2.6%	253	4.3%	240	3.1%	1,424	3.9%
Pass. Cars	3	8	0.1%	10	0.2%	2	0.0%	0	0.0%	9	0.2%	8	0.1%	37	0.1%
Pass. Cars	4	2	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.1%	0	0.0%	5	0.0%
Pass. Cars	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pass. Cars	Subtotal	6,110	100.0%	5,668	100.0%	4,200	100.0%	6,688	100.0%	5,878	100.0%	7,755	100.0%	36,299	100.0%
SUV	1	5,051	89.5%	4,733	90.0%	2,648	87.5%	3,650	92.0%	5,366	89.8%	5,862	90.0%	27,310	89.9%
SUV	2	588	10.4%	509	9.7%	368	12.2%	311	7.8%	583	9.8%	624	9.6%	2,983	9.8%
SUV	3	7	0.1%	14	0.3%	7	0.2%	5	0.1%	21	0.4%	18	0.3%	72	0.2%
SUV	4	0	0.0%	2	0.0%	4	0.1%	2	0.1%	5	0.1%	3	0.0%	16	0.1%
SUV	4+	0	0.0%	1	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.0%	4	0.0%
SUV	Subtotal	5,646	100.0%	5,259	100.0%	3,027	100.0%	3,968	100.0%	5,975	100.0%	6,510	100.0%	30,385	100.0%
Bus	1	3	100.0%	5	71.4%	8	72.7%	9	69.2%	11	78.6%	66	27.2%	102	35.1%
Bus	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	1.2%	3	1.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%	2	15.4%	0	0.0%	0	0.0%	2	0.7%
Bus	4+	0	0.0%	2	28.6%	3	27.3%	2	15.4%	3	21.4%	174	71.6%	184	63.2%
Bus	Subtotal	3	100.0%	7	100.0%	11	100.0%	13	100.0%	14	100.0%	243	100.0%	291	100.0%
Van	1	585	78.2%	863	80.8%	563	79.5%	758	87.1%	982	81.7%	793	77.3%	4,544	80.8%
Van	2	160	21.4%	199	18.6%	145	20.5%	112	12.9%	211	17.6%	229	22.3%	1,056	18.8%
Van	3	2	0.3%	6	0.6%	0	0.0%	0	0.0%	8	0.7%	4	0.4%	20	0.4%
Van	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Van	4+	1	0.1%	0	0.0%	0	0.0%	0	0.0%	1	0.1%	0	0.0%	2	0.0%
Van	Subtotal	748	100.0%	1,068	100.0%	708	100.0%	870	100.0%	1,202	100.0%	1,026	100.0%	5,622	100.0%
Large HDV	1	14	93.3%	613	97.8%	1,795	97.0%	1,713	97.9%	1,071	95.5%	8	47.1%	5,214	96.9%
Large HDV	2	1	6.7%	13	2.1%	53	2.9%	36	2.1%	50	4.5%	9	52.9%	162	3.0%
Large HDV	3	0	0.0%	1	0.2%	2	0.1%	0	0.0%	1	0.1%	0	0.0%	4	0.1%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	15	100.0%	627	100.0%	1,850	100.0%	1,749	100.0%	1,122	100.0%	17	100.0%	5,380	100.0%
Small HDV	1	360	85.5%	270	79.6%	238	86.2%	753	95.6%	497	92.2%	133	79.2%	2,251	88.9%
Small HDV	2	60	14.3%	65	19.2%	38	13.8%	33	4.2%	39	7.2%	31	18.5%	266	10.5%
Small HDV	3	1	0.2%	2	0.6%	0	0.0%	2	0.3%	3	0.6%	3	1.8%	11	0.4%
Small HDV	4	0	0.0%	2	0.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.1%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.6%	1	0.0%
Small HDV	Subtotal	421	100.0%	339	100.0%	276	100.0%	788	100.0%	539	100.0%	168	100.0%	2,531	100.0%
MC	1	10	100.0%	3	100.0%	4	100.0%	5	83.3%	4	100.0%	64	98.5%	90	97.8%
MC	2	0	0.0%	0	0.0%	0	0.0%	1	16.7%	0	0.0%	1	1.5%	2	2.2%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	10	100.0%	3	100.0%	4	100.0%	6	100.0%	4	100.0%	65	100.0%	92	100.0%
Other	1	2	100.0%	1	100.0%	3	100.0%	10	100.0%	6	100.0%	17	89.5%	39	95.1%
Other	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.3%	1	2.4%
Other	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.3%	1	2.4%
Other	Subtotal	2	100.0%	1	100.0%	3	100.0%	10	100.0%	6	100.0%	19	100.0%	41	100.0%

Table 124 - Observed Occupancy Distributions by Vehicle Type, Indian Trail Lilburn Road at I-85, Pre-Extension (2018), PM Peak (4-7 PM)

Occupancy Breakup of Indian Trail Lilburn Road at I-85, PM Peak	Occu. Category	Count of GP Lane 1, Pre-Extension (2018)	Fraction of GP Lane 1, Pre-Extension (2018)	Count of GP Lane 2, Pre-Extension (2018)	Fraction of GP Lane 2, Pre-Extension (2018)	Count of GP Lane 3, Pre-Extension (2018)	Fraction of GP Lane 3, Pre-Extension (2018)	Count of GP Lane 4, Pre-Extension (2018)	Fraction of GP Lane 4, Pre-Extension (2018)	Count of GP Lane 5, Pre-Extension (2018)	Fraction of GP Lane 5, Pre-Extension (2018)	Count of HOT Lane 1, Pre-Extension (2018)	Fraction of HOT Lane 1, Pre-Extension (2018)	Count of All Lanes, Pre-Extension (2018)	Fraction of All Lanes, Pre-Extension (2018)
Total	1	8,441	85.9%	6,941	86.3%	6,150	84.7%	8,914	83.5%	7,955	88.7%	6,388	79.8%	44,789	84.9%
Total	2	1,328	13.5%	1,065	13.2%	1,036	14.3%	1,689	15.8%	974	10.9%	1,285	16.0%	7,377	14.0%
Total	3	49	0.5%	24	0.3%	55	0.8%	48	0.4%	30	0.3%	36	0.4%	242	0.5%
Total	4	11	0.1%	6	0.1%	15	0.2%	14	0.1%	3	0.0%	32	0.4%	81	0.2%
Total	4+	2	0.0%	5	0.1%	7	0.1%	6	0.1%	5	0.1%	266	3.3%	291	0.6%
Total	Total	9,831	100.0%	8,041	100.0%	7,263	100.0%	10,671	100.0%	8,967	100.0%	8,007	100.0%	52,780	100.0%
Pass. Cars	1	4,563	90.6%	3,815	89.8%	2,779	89.3%	4,163	88.9%	3,500	92.3%	3,018	90.3%	21,838	90.2%
Pass. Cars	2	444	8.8%	422	9.9%	305	9.8%	486	10.4%	275	7.3%	305	9.1%	2,237	9.2%
Pass. Cars	3	27	0.5%	12	0.3%	21	0.7%	23	0.5%	13	0.3%	18	0.5%	114	0.5%
Pass. Cars	4	3	0.1%	1	0.0%	8	0.3%	8	0.2%	2	0.1%	3	0.1%	25	0.1%
Pass. Cars	4+	0	0.0%	0	0.0%	0	0.0%	1	0.0%	0	0.0%	0	0.0%	1	0.0%
Pass. Cars	Subtotal	5,037	100.0%	4,250	100.0%	3,113	100.0%	4,681	100.0%	3,790	100.0%	3,344	100.0%	24,215	100.0%
SUV	1	3,099	80.9%	2,450	83.1%	1,940	78.8%	2,816	78.0%	3,065	86.2%	3,093	78.3%	16,463	80.9%
SUV	2	704	18.4%	483	16.4%	501	20.3%	772	21.4%	475	13.4%	818	20.7%	3,753	18.4%
SUV	3	17	0.4%	8	0.3%	13	0.5%	14	0.4%	15	0.4%	14	0.4%	81	0.4%
SUV	4	8	0.2%	5	0.2%	5	0.2%	5	0.1%	1	0.0%	17	0.4%	41	0.2%
SUV	4+	2	0.1%	2	0.1%	3	0.1%	2	0.1%	0	0.0%	6	0.2%	15	0.1%
SUV	Subtotal	3,830	100.0%	2,948	100.0%	2,462	100.0%	3,609	100.0%	3,556	100.0%	3,948	100.0%	20,353	100.0%
Bus	1	3	100.0%	1	33.3%	2	33.3%	5	62.5%	13	86.7%	3	1.2%	27	9.2%
Bus	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	10	3.8%	10	3.4%
Bus	4+	0	0.0%	2	66.7%	4	66.7%	3	37.5%	2	13.3%	247	95.0%	258	87.5%
Bus	Subtotal	3	100.0%	3	100.0%	6	100.0%	8	100.0%	15	100.0%	260	100.0%	295	100.0%
Van	1	410	72.3%	266	72.1%	224	64.7%	292	60.3%	354	74.8%	129	45.3%	1,675	66.4%
Van	2	152	26.8%	102	27.6%	107	30.9%	183	37.8%	114	24.1%	139	48.8%	797	31.6%
Van	3	5	0.9%	1	0.3%	14	4.0%	9	1.9%	2	0.4%	4	1.4%	35	1.4%
Van	4	0	0.0%	0	0.0%	1	0.3%	0	0.0%	0	0.0%	2	0.7%	3	0.1%
Van	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.6%	11	3.9%	14	0.6%
Van	Subtotal	567	100.0%	369	100.0%	346	100.0%	484	100.0%	473	100.0%	285	100.0%	2,524	100.0%
Large HDV	1	277	97.2%	317	92.7%	1,033	92.1%	1,414	89.0%	798	92.8%	3	100.0%	3,842	91.5%
Large HDV	2	8	2.8%	23	6.7%	88	7.8%	175	11.0%	62	7.2%	0	0.0%	356	8.5%
Large HDV	3	0	0.0%	2	0.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.0%
Large HDV	4	0	0.0%	0	0.0%	1	0.1%	0	0.0%	0	0.0%	0	0.0%	1	0.0%

Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	285	100.0%	342	100.0%	1,122	100.0%	1,589	100.0%	860	100.0%	3	100.0%	4,201	100.0%
Small HDV	1	84	80.8%	90	70.9%	166	80.2%	214	74.6%	215	82.4%	34	58.6%	803	76.9%
Small HDV	2	20	19.2%	35	27.6%	34	16.4%	70	24.4%	46	17.6%	23	39.7%	228	21.8%
Small HDV	3	0	0.0%	1	0.8%	7	3.4%	2	0.7%	0	0.0%	0	0.0%	10	1.0%
Small HDV	4	0	0.0%	0	0.0%	0	0.0%	1	0.3%	0	0.0%	0	0.0%	1	0.1%
Small HDV	4+	0	0.0%	1	0.8%	0	0.0%	0	0.0%	0	0.0%	1	1.7%	2	0.2%
Small HDV	Subtotal	104	100.0%	127	100.0%	207	100.0%	287	100.0%	261	100.0%	58	100.0%	1,044	100.0%
MC	1	5	100.0%	2	100.0%	5	100.0%	5	100.0%	2	100.0%	108	99.1%	127	99.2%
MC	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.9%	1	0.8%
MC	Subtotal	5	100.0%	2	100.0%	5	100.0%	5	100.0%	2	100.0%	109	100.0%	128	100.0%
Other	1	0	N/A	0	N/A	1	50.0%	5	62.5%	8	80.0%	0	N/A	14	70.0%
Other	2	0	N/A	0	N/A	1	50.0%	3	37.5%	2	20.0%	0	N/A	6	30.0%
Other	3	0	N/A	0	N/A	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%
Other	4	0	N/A	0	N/A	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%
Other	4+	0	N/A	0	N/A	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%
Other	Subtotal	0	N/A	0	N/A	2	100.0%	8	100.0%	10	100.0%	0	N/A	20	100.0%

Table 125 - Observed Occupancy Distributions by Vehicle Type, Indian Trail Lilburn Road at I-85, Post-Extension (2019), PM Peak (4-7 PM)

Occupancy Breakup of Indian Trail Lilburn Road at I-85, PM Peak	Occu. Category	Count of GP Lane 1, Post-Extension (2019)	Fraction of GP Lane 1, Post-Extension (2019)	Count of GP Lane 2, Post-Extension (2019)	Fraction of GP Lane 2, Post-Extension (2019)	Count of GP Lane 3, Post-Extension (2019)	Fraction of GP Lane 3, Post-Extension (2019)	Count of GP Lane 4, Post-Extension (2019)	Fraction of GP Lane 4, Post-Extension (2019)	Count of GP Lane 5, Post-Extension (2019)	Fraction of GP Lane 5, Post-Extension (2019)	Count of HOT Lane 1, Post-Extension (2019)	Fraction of HOT Lane 1, Post-Extension (2019)	Count of All Lanes, Post-Extension (2019)	Fraction of All Lanes, Post-Extension (2019)
Total	1	15,417	90.7%	17,751	89.6%	11,696	87.8%	16,139	88.8%	14,840	89.1%	14,520	88.2%	90,363	89.1%
Total	2	1,503	8.8%	1,945	9.8%	1,508	11.3%	1,888	10.4%	1,713	10.3%	1,554	9.4%	10,111	10.0%
Total	3	59	0.3%	54	0.3%	74	0.6%	109	0.6%	63	0.4%	60	0.4%	419	0.4%
Total	4	19	0.1%	39	0.2%	34	0.3%	16	0.1%	24	0.1%	34	0.2%	166	0.2%
Total	4+	7	0.0%	12	0.1%	3	0.0%	21	0.1%	9	0.1%	286	1.7%	338	0.3%
Total	Total	17,005	100.0%	19,801	100.0%	13,315	100.0%	18,173	100.0%	16,649	100.0%	16,454	100.0%	101,397	100.0%
Pass. Cars	1	7,950	94.6%	8,703	93.3%	4,953	91.8%	7,037	92.4%	6,775	92.9%	6,272	95.4%	41,690	93.5%
Pass. Cars	2	408	4.9%	596	6.4%	402	7.4%	532	7.0%	483	6.6%	277	4.2%	2,698	6.0%
Pass. Cars	3	31	0.4%	17	0.2%	29	0.5%	36	0.5%	23	0.3%	17	0.3%	153	0.3%
Pass. Cars	4	12	0.1%	10	0.1%	12	0.2%	6	0.1%	12	0.2%	6	0.1%	58	0.1%
Pass. Cars	4+	0	0.0%	0	0.0%	0	0.0%	5	0.1%	1	0.0%	1	0.0%	7	0.0%
Pass. Cars	Subtotal	8,401	100.0%	9,326	100.0%	5,396	100.0%	7,616	100.0%	7,294	100.0%	6,573	100.0%	44,606	100.0%
SUV	1	6,729	88.3%	7,453	86.7%	3,856	84.0%	5,555	86.1%	5,920	87.1%	7,407	87.8%	36,920	86.9%
SUV	2	862	11.3%	1,085	12.6%	689	15.0%	849	13.2%	846	12.4%	984	11.7%	5,315	12.5%
SUV	3	21	0.3%	32	0.4%	31	0.7%	37	0.6%	18	0.3%	22	0.3%	161	0.4%
SUV	4	6	0.1%	21	0.2%	15	0.3%	4	0.1%	11	0.2%	24	0.3%	81	0.2%
SUV	4+	3	0.0%	2	0.0%	1	0.0%	6	0.1%	1	0.0%	2	0.0%	15	0.0%
SUV	Subtotal	7,621	100.0%	8,593	100.0%	4,592	100.0%	6,451	100.0%	6,796	100.0%	8,439	100.0%	42,492	100.0%
Bus	1	2	66.7%	5	83.3%	4	66.7%	6	85.7%	26	83.9%	50	15.1%	93	24.2%
Bus	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	10	3.0%	10	2.6%
Bus	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4+	1	33.3%	1	16.7%	2	33.3%	1	14.3%	5	16.1%	272	81.9%	282	73.2%
Bus	Subtotal	3	100.0%	6	100.0%	6	100.0%	7	100.0%	31	100.0%	332	100.0%	385	100.0%
Van	1	621	75.9%	532	73.2%	599	73.3%	800	72.5%	735	72.5%	574	67.5%	3,861	72.4%
Van	2	188	23.0%	178	24.5%	206	25.2%	272	24.6%	267	26.3%	245	28.8%	1,356	25.4%
Van	3	6	0.7%	3	0.4%	7	0.9%	22	2.0%	11	1.1%	18	2.1%	67	1.3%
Van	4	0	0.0%	5	0.7%	5	0.6%	2	0.2%	1	0.1%	4	0.5%	17	0.3%
Van	4+	3	0.4%	9	1.2%	0	0.0%	8	0.7%	0	0.0%	9	1.1%	29	0.5%
Van	Subtotal	818	100.0%	727	100.0%	817	100.0%	1,104	100.0%	1,014	100.0%	850	100.0%	5,330	100.0%
Large HDV	1	25	92.6%	724	97.3%	1,804	95.1%	2,049	94.9%	1,011	95.8%	4	100.0%	5,617	95.4%
Large HDV	2	2	7.4%	20	2.7%	91	4.8%	108	5.0%	43	4.1%	0	0.0%	264	4.5%
Large HDV	3	0	0.0%	0	0.0%	1	0.1%	2	0.1%	0	0.0%	0	0.0%	3	0.1%
Large HDV	4	0	0.0%	0	0.0%	1	0.1%	0	0.0%	0	0.0%	0	0.0%	1	0.0%

Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.1%	0	0.0%	1	0.0%
Large HDV	Subtotal	27	100.0%	744	100.0%	1,897	100.0%	2,159	100.0%	1,055	100.0%	4	100.0%	5,886	100.0%
Small HDV	1	74	63.2%	328	82.2%	475	78.9%	675	82.5%	355	80.7%	85	71.4%	1,992	79.8%
Small HDV	2	41	35.0%	66	16.5%	120	19.9%	126	15.4%	74	16.8%	32	26.9%	459	18.4%
Small HDV	3	1	0.9%	2	0.5%	6	1.0%	12	1.5%	11	2.5%	2	1.7%	34	1.4%
Small HDV	4	1	0.9%	3	0.8%	1	0.2%	4	0.5%	0	0.0%	0	0.0%	9	0.4%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%	1	0.1%	0	0.0%	0	0.0%	1	0.0%
Small HDV	Subtotal	117	100.0%	399	100.0%	602	100.0%	818	100.0%	440	100.0%	119	100.0%	2,495	100.0%
MC	1	12	85.7%	5	100.0%	4	100.0%	8	100.0%	6	100.0%	118	100.0%	153	98.7%
MC	2	2	14.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	1.3%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	14	100.0%	5	100.0%	4	100.0%	8	100.0%	6	100.0%	118	100.0%	155	100.0%
Other	1	4	100.0%	1	100.0%	1	100.0%	9	90.0%	12	92.3%	10	52.6%	37	77.1%
Other	2	0	0.0%	0	0.0%	0	0.0%	1	10.0%	0	0.0%	6	31.6%	7	14.6%
Other	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.3%	1	2.1%
Other	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	7.7%	2	10.5%	3	6.3%
Other	Subtotal	4	100.0%	1	100.0%	1	100.0%	10	100.0%	13	100.0%	19	100.0%	48	100.0%

Table 126 - Observed Occupancy Distributions by Vehicle Type, Old Peachtree Road at I-85, Pre-Extension (2018), AM Peak (7-10 AM)

Occupancy Breakup of Old Peachtree Road at I-85, AM Peak	Occu. Category	Count of GP Lane 1, Pre-Extension (2018)	Fraction of GP Lane 1, Pre-Extension (2018)	Count of GP Lane 2, Pre-Extension (2018)	Fraction of GP Lane 2, Pre-Extension (2018)	Count of GP Lane 3, Pre-Extension (2018)	Fraction of GP Lane 3, Pre-Extension (2018)	Count of GP Lane 4, Pre-Extension (2018)	Fraction of GP Lane 4, Pre-Extension (2018)	Count of HOT Lane 1, Pre-Extension (2018)	Fraction of HOT Lane 1, Pre-Extension (2018)	Count of All Lanes, Pre-Extension (2018)	Fraction of All Lanes, Pre-Extension (2018)
Total	1	4,250	83.4%	5,913	86.4%	6,972	93.2%	6,146	92.0%	482	82.7%	23,763	89.1%
Total	2	797	15.6%	898	13.1%	482	6.4%	510	7.6%	88	15.1%	2,775	10.4%
Total	3	35	0.7%	18	0.3%	10	0.1%	17	0.3%	3	0.5%	83	0.3%
Total	4	7	0.1%	1	0.0%	6	0.1%	4	0.1%	0	0.0%	18	0.1%
Total	4+	9	0.2%	10	0.1%	9	0.1%	2	0.0%	10	1.7%	40	0.1%
Total	Total	5,098	100.0%	6,840	100.0%	7,479	100.0%	6,679	100.0%	583	100.0%	26,679	100.0%
Pass. Cars	1	1,913	88.2%	2,266	91.2%	2,163	95.2%	2,443	94.4%	188	91.3%	8,973	92.3%
Pass. Cars	2	228	10.5%	213	8.6%	101	4.4%	137	5.3%	17	8.3%	696	7.2%
Pass. Cars	3	24	1.1%	7	0.3%	5	0.2%	8	0.3%	1	0.5%	45	0.5%
Pass. Cars	4	4	0.2%	0	0.0%	2	0.1%	0	0.0%	0	0.0%	6	0.1%
Pass. Cars	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pass. Cars	Subtotal	2,169	100.0%	2,486	100.0%	2,271	100.0%	2,588	100.0%	206	100.0%	9,720	100.0%
SUV	1	2,105	81.5%	2,759	83.5%	1,955	88.0%	2,155	89.1%	238	81.5%	9,212	85.1%
SUV	2	467	18.1%	538	16.3%	258	11.6%	253	10.5%	53	18.2%	1,569	14.5%
SUV	3	9	0.3%	8	0.2%	5	0.2%	6	0.2%	1	0.3%	29	0.3%
SUV	4	3	0.1%	1	0.0%	2	0.1%	4	0.2%	0	0.0%	10	0.1%
SUV	4+	0	0.0%	0	0.0%	1	0.0%	0	0.0%	0	0.0%	1	0.0%
SUV	Subtotal	2,584	100.0%	3,306	100.0%	2,221	100.0%	2,418	100.0%	292	100.0%	10,821	100.0%
Bus	1	3	25.0%	4	30.8%	7	46.7%	12	85.7%	3	23.1%	29	43.3%
Bus	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4+	9	75.0%	9	69.2%	8	53.3%	2	14.3%	10	76.9%	38	56.7%
Bus	Subtotal	12	100.0%	13	100.0%	15	100.0%	14	100.0%	13	100.0%	67	100.0%
Van	1	176	65.7%	349	79.5%	402	87.2%	425	86.7%	40	72.7%	1,392	81.3%
Van	2	90	33.6%	87	19.8%	58	12.6%	63	12.9%	14	25.5%	312	18.2%
Van	3	2	0.7%	2	0.5%	0	0.0%	2	0.4%	1	1.8%	7	0.4%
Van	4	0	0.0%	0	0.0%	1	0.2%	0	0.0%	0	0.0%	1	0.1%
Van	4+	0	0.0%	1	0.2%	0	0.0%	0	0.0%	0	0.0%	1	0.1%
Van	Subtotal	268	100.0%	439	100.0%	461	100.0%	490	100.0%	55	100.0%	1,713	100.0%
Large HDV	1	4	80.0%	397	93.0%	2,198	98.2%	808	97.8%	0	N/A	3,407	97.5%
Large HDV	2	1	20.0%	30	7.0%	40	1.8%	18	2.2%	0	N/A	89	2.5%
Large HDV	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%

Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%
Large HDV	Subtotal	5	100.0%	427	100.0%	2,238	100.0%	826	100.0%	0	N/A	3,496	100.0%
Small HDV	1	31	81.6%	122	79.7%	237	90.5%	293	88.0%	8	66.7%	691	86.6%
Small HDV	2	7	18.4%	30	19.6%	24	9.2%	39	11.7%	4	33.3%	104	13.0%
Small HDV	3	0	0.0%	1	0.7%	0	0.0%	1	0.3%	0	0.0%	2	0.3%
Small HDV	4	0	0.0%	0	0.0%	1	0.4%	0	0.0%	0	0.0%	1	0.1%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	Subtotal	38	100.0%	153	100.0%	262	100.0%	333	100.0%	12	100.0%	798	100.0%
MC	1	16	100.0%	12	100.0%	5	100.0%	5	100.0%	5	100.0%	43	100.0%
MC	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	16	100.0%	12	100.0%	5	100.0%	5	100.0%	5	100.0%	43	100.0%
Other	1	2	33.3%	4	100.0%	5	83.3%	5	100.0%	0	N/A	16	76.2%
Other	2	4	66.7%	0	0.0%	1	16.7%	0	0.0%	0	N/A	5	23.8%
Other	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	N/A	0	0.0%
Other	Subtotal	6	100.0%	4	100.0%	6	100.0%	5	100.0%	0	N/A	21	100.0%

Table 127 - Observed Occupancy Distributions by Vehicle Type, Old Peachtree Road at I-85, Post-Extension (2019), AM Peak (7-10 AM)

Occupancy Breakup of Old Peachtree Road at I-85, AM Peak	Occu. Category	Count of GP Lane 1, Post-Extension (2019)	Fraction of GP Lane 1, Post-Extension (2019)	Count of GP Lane 2, Post-Extension (2018)	Fraction of GP Lane 2, Post-Extension (2018)	Count of GP Lane 3, Post-Extension (2018)	Fraction of GP Lane 3, Post-Extension (2018)	Count of GP Lane 4, Post-Extension (2018)	Fraction of GP Lane 4, Post-Extension (2018)	Count of HOT Lane 1, Post-Extension (2019)	Fraction of HOT Lane 1, Post-Extension (2019)	Count of All Lanes, Post-Extension (2019)	Fraction of All Lanes, Post-Extension (2019)
Total	1	8,769	93.5%	8,178	92.6%	7,233	92.8%	11,123	92.6%	3,829	90.3%	39,132	92.6%
Total	2	597	6.4%	620	7.0%	526	6.7%	840	7.0%	350	8.3%	2,933	6.9%
Total	3	9	0.1%	23	0.3%	25	0.3%	39	0.3%	19	0.4%	115	0.3%
Total	4	2	0.0%	3	0.0%	3	0.0%	4	0.0%	3	0.1%	15	0.0%
Total	4+	2	0.0%	3	0.0%	8	0.1%	5	0.0%	39	0.9%	57	0.1%
Total	Total	9,379	100.0%	8,827	100.0%	7,795	100.0%	12,011	100.0%	4,240	100.0%	42,252	100.0%
Pass. Cars	1	4,678	96.5%	3,551	94.4%	2,270	94.9%	4,869	94.6%	1,549	95.7%	16,917	95.2%
Pass. Cars	2	165	3.4%	198	5.3%	109	4.6%	262	5.1%	64	4.0%	798	4.5%
Pass. Cars	3	5	0.1%	8	0.2%	14	0.6%	15	0.3%	4	0.2%	46	0.3%
Pass. Cars	4	0	0.0%	3	0.1%	0	0.0%	0	0.0%	1	0.1%	4	0.0%
Pass. Cars	4+	1	0.0%	1	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.0%
Pass. Cars	Subtotal	4,849	100.0%	3,761	100.0%	2,393	100.0%	5,146	100.0%	1,618	100.0%	17,767	100.0%
SUV	1	3,284	91.0%	3,202	90.0%	2,582	89.7%	3,840	91.2%	1,985	90.1%	14,893	90.5%
SUV	2	322	8.9%	345	9.7%	290	10.1%	357	8.5%	211	9.6%	1,525	9.3%
SUV	3	2	0.1%	9	0.3%	6	0.2%	12	0.3%	7	0.3%	36	0.2%
SUV	4	2	0.1%	0	0.0%	2	0.1%	1	0.0%	0	0.0%	5	0.0%
SUV	4+	0	0.0%	1	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.0%
SUV	Subtotal	3,610	100.0%	3,557	100.0%	2,880	100.0%	4,210	100.0%	2,203	100.0%	16,460	100.0%
Bus	1	4	100.0%	12	100.0%	10	66.7%	13	76.5%	20	33.3%	59	54.6%
Bus	2	0	0.0%	0	0.0%	1	6.7%	0	0.0%	0	0.0%	1	0.9%
Bus	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	5.0%	3	2.8%
Bus	4	0	0.0%	0	0.0%	0	0.0%	1	5.9%	0	0.0%	1	0.9%
Bus	4+	0	0.0%	0	0.0%	4	26.7%	3	17.6%	37	61.7%	44	40.7%
Bus	Subtotal	4	100.0%	12	100.0%	15	100.0%	17	100.0%	60	100.0%	108	100.0%
Van	1	424	85.5%	391	86.9%	299	84.0%	707	84.7%	215	76.8%	2,036	84.2%
Van	2	69	13.9%	53	11.8%	52	14.6%	124	14.9%	58	20.7%	356	14.7%
Van	3	2	0.4%	5	1.1%	1	0.3%	2	0.2%	4	1.4%	14	0.6%
Van	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.4%	1	0.0%
Van	4+	1	0.2%	1	0.2%	4	1.1%	2	0.2%	2	0.7%	10	0.4%
Van	Subtotal	496	100.0%	450	100.0%	356	100.0%	835	100.0%	280	100.0%	2,417	100.0%
Large HDV	1	25	83.3%	865	98.3%	1,698	98.6%	1,262	97.2%	2	100.0%	3,852	97.9%
Large HDV	2	5	16.7%	14	1.6%	24	1.4%	36	2.8%	0	0.0%	79	2.0%
Large HDV	3	0	0.0%	1	0.1%	0	0.0%	1	0.1%	0	0.0%	2	0.1%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	30	100.0%	880	100.0%	1,722	100.0%	1,299	100.0%	2	100.0%	3,933	100.0%
Small HDV	1	341	90.5%	144	93.5%	362	87.0%	415	85.4%	26	57.8%	1,288	87.1%
Small HDV	2	36	9.5%	10	6.5%	49	11.8%	60	12.3%	17	37.8%	172	11.6%
Small HDV	3	0	0.0%	0	0.0%	4	1.0%	9	1.9%	1	2.2%	14	0.9%
Small HDV	4	0	0.0%	0	0.0%	1	0.2%	2	0.4%	1	2.2%	4	0.3%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	Subtotal	377	100.0%	154	100.0%	416	100.0%	486	100.0%	45	100.0%	1,478	100.0%
MC	1	9	100.0%	8	100.0%	5	83.3%	4	100.0%	30	100.0%	56	98.2%
MC	2	0	0.0%	0	0.0%	1	16.7%	0	0.0%	0	0.0%	1	1.8%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	9	100.0%	8	100.0%	6	100.0%	4	100.0%	30	100.0%	57	100.0%
Other	1	4	100.0%	5	100.0%	7	100.0%	13	92.9%	2	100.0%	31	96.9%
Other	2	0	0.0%	0	0.0%	0	0.0%	1	7.1%	0	0.0%	1	3.1%
Other	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	4	100.0%	5	100.0%	7	100.0%	14	100.0%	2	100.0%	32	100.0%

Table 128 - Observed Occupancy Distributions by Vehicle Type, Old Peachtree Road at I-85, Pre-Extension (2018), PM Peak (4-7 PM)

Occupancy Breakup of Old Peachtree Road at I-85, PM Peak	Occu. Category	Count of GP Lane 1, Pre-Extension (2018)	Fraction of GP Lane 1, Pre-Extension (2018)	Count of GP Lane 2, Pre-Extension (2018)	Fraction of GP Lane 2, Pre-Extension (2018)	Count of GP Lane 3, Pre-Extension (2018)	Fraction of GP Lane 3, Pre-Extension (2018)	Count of GP Lane 4, Pre-Extension (2018)	Fraction of GP Lane 4, Pre-Extension (2018)	Count of HOT Lane 1, Pre-Extension (2018)	Fraction of HOT Lane 1, Pre-Extension (2018)	Count of All Lanes, Pre-Extension (2018)	Fraction of All Lanes, Pre-Extension (2018)
Total	1	5,596	76.9%	7,182	83.9%	7,723	87.6%	5,940	88.7%	3,464	80.7%	29,905	83.9%
Total	2	1,513	20.8%	1,282	15.0%	1,049	11.9%	709	10.6%	686	16.0%	5,239	14.7%
Total	3	137	1.9%	68	0.8%	29	0.3%	40	0.6%	37	0.9%	311	0.9%
Total	4	25	0.3%	18	0.2%	8	0.1%	5	0.1%	19	0.4%	75	0.2%
Total	4+	8	0.1%	7	0.1%	9	0.1%	4	0.1%	85	2.0%	113	0.3%
Total	Total	7,279	100.0%	8,557	100.0%	8,818	100.0%	6,698	100.0%	4,291	100.0%	35,643	100.0%
Pass. Cars	1	2,608	82.9%	2,993	84.9%	2,857	89.6%	2,629	90.5%	1,377	90.5%	12,464	87.3%
Pass. Cars	2	485	15.4%	485	13.8%	310	9.7%	256	8.8%	131	8.6%	1,667	11.7%
Pass. Cars	3	49	1.6%	34	1.0%	14	0.4%	17	0.6%	10	0.7%	124	0.9%
Pass. Cars	4	4	0.1%	12	0.3%	4	0.1%	4	0.1%	3	0.2%	27	0.2%
Pass. Cars	4+	0	0.0%	0	0.0%	3	0.1%	0	0.0%	0	0.0%	3	0.0%
Pass. Cars	Subtotal	3,146	100.0%	3,524	100.0%	3,188	100.0%	2,906	100.0%	1,521	100.0%	14,285	100.0%
SUV	1	2,759	73.0%	2,927	81.3%	2,788	84.6%	2,300	86.8%	1,855	79.8%	12,629	80.7%
SUV	2	921	24.4%	638	17.7%	493	15.0%	337	12.7%	426	18.3%	2,815	18.0%
SUV	3	80	2.1%	29	0.8%	9	0.3%	11	0.4%	23	1.0%	152	1.0%
SUV	4	20	0.5%	6	0.2%	4	0.1%	1	0.0%	11	0.5%	42	0.3%
SUV	4+	2	0.1%	0	0.0%	0	0.0%	0	0.0%	10	0.4%	12	0.1%
SUV	Subtotal	3,782	100.0%	3,600	100.0%	3,294	100.0%	2,649	100.0%	2,325	100.0%	15,650	100.0%
Bus	1	2	40.0%	2	33.3%	0	0.0%	21	77.8%	11	12.5%	36	27.7%
Bus	2	0	0.0%	0	0.0%	2	50.0%	2	7.4%	0	0.0%	4	3.1%
Bus	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	5.7%	5	3.8%
Bus	4+	3	60.0%	4	66.7%	2	50.0%	4	14.8%	72	81.8%	85	65.4%
Bus	Subtotal	5	100.0%	6	100.0%	4	100.0%	27	100.0%	88	100.0%	130	100.0%
Van	1	180	66.2%	326	76.3%	296	77.5%	137	81.1%	145	56.9%	1,084	72.0%
Van	2	80	29.4%	98	23.0%	81	21.2%	29	17.2%	105	41.2%	393	26.1%
Van	3	8	2.9%	0	0.0%	1	0.3%	3	1.8%	3	1.2%	15	1.0%
Van	4	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.1%
Van	4+	3	1.1%	3	0.7%	4	1.0%	0	0.0%	2	0.8%	12	0.8%
Van	Subtotal	272	100.0%	427	100.0%	382	100.0%	169	100.0%	255	100.0%	1,505	100.0%
Large HDV	1	13	86.7%	778	97.3%	1,596	93.6%	721	93.5%	12	75.0%	3,120	94.3%
Large HDV	2	2	13.3%	22	2.8%	110	6.4%	50	6.5%	4	25.0%	188	5.7%
Large HDV	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	15	100.0%	800	100.0%	1,706	100.0%	771	100.0%	16	100.0%	3,308	100.0%
Small HDV	1	29	54.7%	154	77.8%	163	75.1%	123	75.0%	21	52.5%	490	72.9%
Small HDV	2	24	45.3%	39	19.7%	50	23.0%	32	19.5%	18	45.0%	163	24.3%
Small HDV	3	0	0.0%	5	2.5%	4	1.8%	9	5.5%	1	2.5%	19	2.8%
Small HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	Subtotal	53	100.0%	198	100.0%	217	100.0%	164	100.0%	40	100.0%	672	100.0%
MC	1	5	83.3%	2	100.0%	7	100.0%	8	88.9%	41	100.0%	63	96.9%
MC	2	1	16.7%	0	0.0%	0	0.0%	1	11.1%	0	0.0%	2	3.1%
MC	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	6	100.0%	2	100.0%	7	100.0%	9	100.0%	41	100.0%	65	100.0%
Other	1	0	N/A	0	N/A	16	80.0%	1	33.3%	2	40.0%	19	67.9%
Other	2	0	N/A	0	N/A	3	15.0%	2	66.7%	2	40.0%	7	25.0%
Other	3	0	N/A	0	N/A	1	5.0%	0	0.0%	0	0.0%	1	3.6%
Other	4	0	N/A	0	N/A	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	N/A	0	N/A	0	0.0%	0	0.0%	1	20.0%	1	3.6%
Other	Subtotal	0	N/A	0	N/A	20	100.0%	3	100.0%	5	100.0%	28	100.0%

Table 129 - Observed Occupancy Distributions by Vehicle Type, Old Peachtree Road at I-85, Post-Extension (2019), PM Peak (4-7 PM)

Occupancy Breakup of Old Peachtree Road at I-85, PM Peak	Occu. Category	Count of GP Lane 1, Post-Extension (2019)	Fraction of GP Lane 1, Post-Extension (2019)	Count of GP Lane 2, Post-Extension (2019)	Fraction of GP Lane 2, Post-Extension (2019)	Count of GP Lane 3, Post-Extension (2019)	Fraction of GP Lane 3, Post-Extension (2019)	Count of GP Lane 4, Post-Extension (2019)	Fraction of GP Lane 4, Post-Extension (2019)	Count of HOT Lane 1, Post-Extension (2019)	Fraction of HOT Lane 1, Post-Extension (2019)	Count of All Lanes, Post-Extension (2019)	Fraction of All Lanes, Post-Extension (2019)
Total	1	10,545	88.6%	8,422	89.3%	11,406	92.2%	10,672	91.1%	6,175	87.9%	47,220	90.0%
Total	2	1,290	10.8%	965	10.2%	944	7.6%	942	8.0%	680	9.7%	4,821	9.2%
Total	3	42	0.4%	34	0.4%	14	0.1%	60	0.5%	43	0.6%	193	0.4%
Total	4	16	0.1%	5	0.1%	4	0.0%	22	0.2%	12	0.2%	59	0.1%
Total	4+	11	0.1%	5	0.1%	2	0.0%	17	0.1%	114	1.6%	149	0.3%
Total	Total	11,904	100.0%	9,431	100.0%	12,370	100.0%	11,713	100.0%	7,024	100.0%	52,442	100.0%
Pass. Cars	1	5,024	92.1%	3,330	92.5%	3,949	91.4%	4,356	93.1%	2,425	95.4%	19,084	92.7%
Pass. Cars	2	413	7.6%	245	6.8%	365	8.4%	290	6.2%	113	4.4%	1,426	6.9%
Pass. Cars	3	10	0.2%	20	0.6%	3	0.1%	23	0.5%	3	0.1%	59	0.3%
Pass. Cars	4	5	0.1%	2	0.1%	3	0.1%	8	0.2%	0	0.0%	18	0.1%
Pass. Cars	4+	1	0.0%	2	0.1%	0	0.0%	4	0.1%	1	0.0%	8	0.0%
Pass. Cars	Subtotal	5,453	100.0%	3,599	100.0%	4,320	100.0%	4,681	100.0%	2,542	100.0%	20,595	100.0%
SUV	1	4,893	86.2%	3,792	87.1%	3,819	90.6%	4,515	90.7%	3,370	87.8%	20,389	88.4%
SUV	2	752	13.2%	551	12.6%	390	9.3%	438	8.8%	434	11.3%	2,565	11.1%
SUV	3	20	0.4%	9	0.2%	6	0.1%	16	0.3%	18	0.5%	69	0.3%
SUV	4	7	0.1%	3	0.1%	0	0.0%	8	0.2%	7	0.2%	25	0.1%
SUV	4+	4	0.1%	1	0.0%	0	0.0%	2	0.0%	8	0.2%	15	0.1%
SUV	Subtotal	5,676	100.0%	4,356	100.0%	4,215	100.0%	4,979	100.0%	3,837	100.0%	23,063	100.0%
Bus	1	3	50.0%	1	50.0%	7	77.8%	28	87.5%	10	9.8%	49	32.5%
Bus	2	0	0.0%	0	0.0%	1	11.1%	1	3.1%	1	1.0%	3	2.0%
Bus	3	3	50.0%	0	0.0%	0	0.0%	0	0.0%	3	2.9%	6	4.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bus	4+	0	0.0%	1	50.0%	1	11.1%	3	9.4%	88	86.3%	93	61.6%
Bus	Subtotal	6	100.0%	2	100.0%	9	100.0%	32	100.0%	102	100.0%	151	100.0%
Van	1	296	72.4%	384	77.6%	406	83.7%	470	82.3%	282	65.7%	1,838	76.9%
Van	2	96	23.5%	109	22.0%	78	16.1%	84	14.7%	108	25.2%	475	19.9%
Van	3	7	1.7%	1	0.2%	1	0.2%	8	1.4%	17	4.0%	34	1.4%
Van	4	4	1.0%	0	0.0%	0	0.0%	3	0.5%	5	1.2%	12	0.5%
Van	4+	6	1.5%	1	0.2%	0	0.0%	6	1.1%	17	4.0%	30	1.3%
Van	Subtotal	409	100.0%	495	100.0%	485	100.0%	571	100.0%	429	100.0%	2,389	100.0%
Large HDV	1	42	93.3%	719	96.1%	2,482	97.8%	1,052	94.2%	4	100.0%	4,299	96.6%
Large HDV	2	3	6.7%	29	3.9%	56	2.2%	62	5.6%	0	0.0%	150	3.4%
Large HDV	3	0	0.0%	0	0.0%	0	0.0%	2	0.2%	0	0.0%	2	0.0%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%	1	0.1%	0	0.0%	1	0.0%

Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	45	100.0%	748	100.0%	2,538	100.0%	1,117	100.0%	4	100.0%	4,452	100.0%
Small HDV	1	246	90.1%	182	84.3%	742	92.5%	239	75.4%	32	59.3%	1,441	86.7%
Small HDV	2	25	9.2%	30	13.9%	54	6.7%	63	19.9%	20	37.0%	192	11.6%
Small HDV	3	2	0.7%	4	1.9%	4	0.5%	11	3.5%	2	3.7%	23	1.4%
Small HDV	4	0	0.0%	0	0.0%	1	0.1%	2	0.6%	0	0.0%	3	0.2%
Small HDV	4+	0	0.0%	0	0.0%	1	0.1%	2	0.6%	0	0.0%	3	0.2%
Small HDV	Subtotal	273	100.0%	216	100.0%	802	100.0%	317	100.0%	54	100.0%	1,662	100.0%
MC	1	22	95.7%	10	100.0%	0	N/A	4	100.0%	39	100.0%	75	98.7%
MC	2	1	4.3%	0	0.0%	0	N/A	0	0.0%	0	0.0%	1	1.3%
MC	3	0	0.0%	0	0.0%	0	N/A	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	N/A	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	N/A	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	23	100.0%	10	100.0%	0	N/A	4	100.0%	39	100.0%	76	100.0%
Other	1	19	100.0%	4	80.0%	1	100.0%	8	66.7%	13	76.5%	45	83.3%
Other	2	0	0.0%	1	20.0%	0	0.0%	4	33.3%	4	23.5%	9	16.7%
Other	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	19	100.0%	5	100.0%	1	100.0%	12	100.0%	17	100.0%	54	100.0%

Table 130 – Observed Occupancy Distributions by Vehicle Type, Hamilton Mill Road at I-85, Pre-Opening (2018) AM Peak (7-10 AM)

Occupancy Breakup of Hamilton Mill Road at I-85, AM Peak	Occu. Category	Count of GP Lane 1, Pre-Opening (2018)	Fraction of GP Lane 1, Pre-Opening (2018)	Count of GP Lane 2, Pre-Opening (2018)	Fraction of GP Lane 2, Pre-Opening (2018)	Count of All Lanes, Pre-Opening (2018)	Fraction of All Lanes, Pre-Opening (2018)
Total	1	7,263	91.6%	5,903	89.7%	13,166	90.7%
Total	2	631	8.0%	650	9.9%	1,281	8.8%
Total	3	16	0.2%	25	0.4%	41	0.3%
Total	4	2	0.0%	2	0.0%	4	0.0%
Total	4+	15	0.2%	3	0.0%	18	0.1%
Total	Total	7,927	100.0%	6,583	100.0%	14,510	100.0%
Pass. Cars	1	3,417	93.9%	1,157	90.8%	4,574	93.1%
Pass. Cars	2	211	5.8%	111	8.7%	322	6.6%
Pass. Cars	3	9	0.2%	6	0.5%	15	0.3%
Pass. Cars	4	1	0.0%	0	0.0%	1	0.0%
Pass. Cars	4+	1	0.0%	0	0.0%	1	0.0%
Pass. Cars	Subtotal	3,639	100.0%	1,274	100.0%	4,913	100.0%
SUV	1	2,890	89.2%	1,498	81.9%	4,388	86.6%
SUV	2	343	10.6%	314	17.2%	657	13.0%
SUV	3	5	0.2%	15	0.8%	20	0.4%
SUV	4	1	0.0%	2	0.1%	3	0.1%
SUV	4+	0	0.0%	0	0.0%	0	0.0%
SUV	Subtotal	3,239	100.0%	1,829	100.0%	5,068	100.0%
Bus	1	0	0.0%	10	66.7%	10	35.7%
Bus	2	0	0.0%	2	13.3%	2	7.1%
Bus	3	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%
Bus	4+	13	100.0%	3	20.0%	16	57.1%
Bus	Subtotal	13	100.0%	15	100.0%	28	100.0%
Van	1	341	85.7%	230	78.5%	571	82.6%
Van	2	54	13.6%	62	21.2%	116	16.8%
Van	3	2	0.5%	1	0.3%	3	0.4%
Van	4	0	0.0%	0	0.0%	0	0.0%
Van	4+	1	0.3%	0	0.0%	1	0.1%
Van	Subtotal	398	100.0%	293	100.0%	691	100.0%
Large HDV	1	386	97.0%	2,433	95.6%	2,819	95.8%
Large HDV	2	12	3.0%	112	4.4%	124	4.2%
Large HDV	3	0	0.0%	1	0.0%	1	0.0%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%
Large HDV	4+	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	398	100.0%	2,546	100.0%	2,944	100.0%
Small HDV	1	213	95.1%	567	91.9%	780	92.7%
Small HDV	2	11	4.9%	48	7.8%	59	7.0%
Small HDV	3	0	0.0%	2	0.3%	2	0.2%
Small HDV	4	0	0.0%	0	0.0%	0	0.0%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%
Small HDV	Subtotal	224	100.0%	617	100.0%	841	100.0%
MC	1	15	100.0%	5	100.0%	20	100.0%
MC	2	0	0.0%	0	0.0%	0	0.0%
MC	3	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	15	100.0%	5	100.0%	20	100.0%
Other	1	1	100.0%	3	75.0%	4	80.0%
Other	2	0	0.0%	1	25.0%	1	20.0%
Other	3	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	1	100.0%	4	100.0%	5	100.0%

Table 131 - Observed Occupancy Distributions by Vehicle Type, Hamilton Mill Road at I-85, Post-Opening (2019), AM Peak (7-10 AM)

Occupancy Breakup of Hamilton Mill Road at I-85, AM Peak	Occu. Category	Count of GP Lane 1, Post-Opening (2019)	Fraction of GP Lane 1, Post-Opening (2019)	Count of GP Lane 2, Post-Opening (2019)	Fraction of GP Lane 2, Post-Opening (2019)	Count of GP Lane 3, Post-Opening (2019)	Fraction of GP Lane 3, Post-Opening (2019)	Count of All Lanes, Post-Opening (2019)	Fraction of All Lanes, Post-Opening (2019)
Total	1	12,291	94.1%	5,440	91.3%	199	99.0%	17,930	93.3%
Total	2	745	5.7%	492	8.3%	2	1.0%	1,239	6.4%
Total	3	13	0.1%	17	0.3%	0	0.0%	30	0.2%
Total	4	2	0.0%	2	0.0%	0	0.0%	4	0.0%
Total	4+	5	0.0%	8	0.1%	0	0.0%	13	0.1%
Total	Total	13,056	100.0%	5,959	100.0%	201	100.0%	19,216	100.0%
Pass. Cars	1	4,958	95.5%	1,519	89.9%	41	97.6%	6,518	94.1%
Pass. Cars	2	226	4.4%	163	9.6%	1	2.4%	390	5.6%
Pass. Cars	3	8	0.2%	8	0.5%	0	0.0%	16	0.2%
Pass. Cars	4	2	0.0%	0	0.0%	0	0.0%	2	0.0%
Pass. Cars	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pass. Cars	Subtotal	5,194	100.0%	1,690	100.0%	42	100.0%	6,926	100.0%
SUV	1	5,568	93.5%	1,326	87.5%	59	100.0%	6,953	92.4%
SUV	2	383	6.4%	186	12.3%	0	0.0%	569	7.6%
SUV	3	2	0.0%	2	0.1%	0	0.0%	4	0.1%
SUV	4	0	0.0%	2	0.1%	0	0.0%	2	0.0%
SUV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
SUV	Subtotal	5,953	100.0%	1,516	100.0%	59	100.0%	7,528	100.0%
Bus	1	3	33.3%	6	46.2%	0	N/A	9	40.9%
Bus	2	0	0.0%	0	0.0%	0	N/A	0	0.0%
Bus	3	1	11.1%	0	0.0%	0	N/A	1	4.5%
Bus	4	0	0.0%	0	0.0%	0	N/A	0	0.0%
Bus	4+	5	55.6%	7	53.8%	0	N/A	12	54.5%
Bus	Subtotal	9	100.0%	13	100.0%	0	N/A	22	100.0%
Van	1	582	87.8%	281	84.6%	7	100.0%	870	86.8%
Van	2	79	11.9%	46	13.9%	0	0.0%	125	12.5%
Van	3	2	0.3%	4	1.2%	0	0.0%	6	0.6%
Van	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Van	4+	0	0.0%	1	0.3%	0	0.0%	1	0.1%
Van	Subtotal	663	100.0%	332	100.0%	7	100.0%	1,002	100.0%
Large HDV	1	534	97.4%	2,087	96.4%	80	100.0%	2,701	96.7%
Large HDV	2	14	2.6%	74	3.4%	0	0.0%	88	3.2%
Large HDV	3	0	0.0%	3	0.1%	0	0.0%	3	0.1%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	548	100.0%	2,164	100.0%	80	100.0%	2,792	100.0%
Small HDV	1	598	93.6%	200	90.1%	12	92.3%	810	92.7%
Small HDV	2	41	6.4%	22	9.9%	1	7.7%	64	7.3%
Small HDV	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Small HDV	Subtotal	639	100.0%	222	100.0%	13	100.0%	874	100.0%
MC	1	42	100.0%	6	100.0%	0	N/A	48	100.0%
MC	2	0	0.0%	0	0.0%	0	N/A	0	0.0%
MC	3	0	0.0%	0	0.0%	0	N/A	0	0.0%
MC	4	0	0.0%	0	0.0%	0	N/A	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	N/A	0	0.0%
MC	Subtotal	42	100.0%	6	100.0%	0	N/A	48	100.0%
Other	1	6	75.0%	15	93.8%	0	N/A	21	87.5%
Other	2	2	25.0%	1	6.3%	0	N/A	3	12.5%
Other	3	0	0.0%	0	0.0%	0	N/A	0	0.0%
Other	4	0	0.0%	0	0.0%	0	N/A	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	N/A	0	0.0%
Other	Subtotal	8	100.0%	16	100.0%	0	N/A	24	100.0%

Table 132 - Observed Occupancy Distributions by Vehicle Type, Hamilton Mill Road at I-85, Pre-Opening (2018), PM Peak (4-7 PM)

Occupancy Breakup of Hamilton Mill Road at I-85, PM Peak	Occu. Category	Count of GP Lane 1, Pre-Opening (2018)	Fraction of GP Lane 1, Pre-Opening (2018)	Count of GP Lane 2, Pre-Opening (2018)	Fraction of GP Lane 2, Pre-Opening (2018)	Count of All Lanes, Pre-Opening (2018)	Fraction of All Lanes, Pre-Opening (2018)
Total	1	12,915	85.5%	7,925	85.2%	20,840	85.4%
Total	2	2,056	13.6%	1,252	13.5%	3,308	13.6%
Total	3	102	0.7%	94	1.0%	196	0.8%
Total	4	16	0.1%	20	0.2%	36	0.1%
Total	4+	17	0.1%	10	0.1%	27	0.1%
Total	Total	15,106	100.0%	9,301	100.0%	24,407	100.0%
Pass. Cars	1	5,297	89.5%	2,448	87.1%	7,745	88.7%
Pass. Cars	2	586	9.9%	334	11.9%	920	10.5%
Pass. Cars	3	27	0.5%	25	0.9%	52	0.6%
Pass. Cars	4	6	0.1%	4	0.1%	10	0.1%
Pass. Cars	4+	0	0.0%	0	0.0%	0	0.0%
Pass. Cars	Subtotal	5,916	100.0%	2,811	100.0%	8,727	100.0%
SUV	1	5,671	81.8%	2,558	77.8%	8,229	80.5%
SUV	2	1,210	17.5%	655	19.9%	1,865	18.3%
SUV	3	48	0.7%	55	1.7%	103	1.0%
SUV	4	4	0.1%	14	0.4%	18	0.2%
SUV	4+	0	0.0%	4	0.1%	4	0.0%
SUV	Subtotal	6,933	100.0%	3,286	100.0%	10,219	100.0%
Bus	1	11	45.8%	7	87.5%	18	56.3%
Bus	2	0	0.0%	0	0.0%	0	0.0%
Bus	3	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%
Bus	4+	13	54.2%	1	12.5%	14	43.8%
Bus	Subtotal	24	100.0%	8	100.0%	32	100.0%
Van	1	478	69.6%	235	77.8%	713	72.1%
Van	2	174	25.3%	56	18.5%	230	23.3%
Van	3	25	3.6%	5	1.7%	30	3.0%
Van	4	6	0.9%	1	0.3%	7	0.7%
Van	4+	4	0.6%	5	1.7%	9	0.9%
Van	Subtotal	687	100.0%	302	100.0%	989	100.0%
Large HDV	1	1,271	96.2%	2,440	93.7%	3,711	94.6%
Large HDV	2	49	3.7%	160	6.1%	209	5.3%
Large HDV	3	1	0.1%	3	0.1%	4	0.1%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%
Large HDV	4+	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	1,321	100.0%	2,603	100.0%	3,924	100.0%
Small HDV	1	137	80.1%	215	81.7%	352	81.1%
Small HDV	2	33	19.3%	41	15.6%	74	17.1%
Small HDV	3	1	0.6%	6	2.3%	7	1.6%
Small HDV	4	0	0.0%	1	0.4%	1	0.2%
Small HDV	4+	0	0.0%	0	0.0%	0	0.0%
Small HDV	Subtotal	171	100.0%	263	100.0%	434	100.0%
MC	1	45	100.0%	19	95.0%	64	98.5%
MC	2	0	0.0%	1	5.0%	1	1.5%
MC	3	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	45	100.0%	20	100.0%	65	100.0%
Other	1	3	37.5%	2	100.0%	5	50.0%
Other	2	5	62.5%	0	0.0%	5	50.0%
Other	3	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	8	100.0%	2	100.0%	10	100.0%

Table 133 - Observed Occupancy Distributions by Vehicle Type, Hamilton Mill Road at I-85, Post-Opening (2019), PM Peak (4-7 PM)

Occupancy Breakup of Hamilton Mill Road at I-85, PM Peak	Occu. Category	Count of GP Lane 1, Post-Opening (2019)	Fraction of GP Lane 1, Post-Opening (2019)	Count of GP Lane 2, Post-Opening (2019)	Fraction of GP Lane 2, Post-Opening (2019)	Count of All Lanes, Post-Opening (2019)	Fraction of All Lanes, Post-Opening (2019)
Total	1	11,835	90.4%	10,235	89.5%	22,070	89.9%
Total	2	1,176	9.0%	1,159	10.1%	2,335	9.5%
Total	3	59	0.5%	29	0.3%	88	0.4%
Total	4	7	0.1%	7	0.1%	14	0.1%
Total	4+	22	0.2%	7	0.1%	29	0.1%
Total	Total	13,099	100.0%	11,437	100.0%	24,536	100.0%
Pass. Cars	1	4,661	93.2%	2,541	90.3%	7,202	92.2%
Pass. Cars	2	323	6.5%	257	9.1%	580	7.4%
Pass. Cars	3	17	0.3%	12	0.4%	29	0.4%
Pass. Cars	4	1	0.0%	3	0.1%	4	0.1%
Pass. Cars	4+	0	0.0%	0	0.0%	0	0.0%
Pass. Cars	Subtotal	5,002	100.0%	2,813	100.0%	7,815	100.0%
SUV	1	6,313	89.1%	3,387	84.8%	9,700	87.5%
SUV	2	737	10.4%	593	14.8%	1,330	12.0%
SUV	3	35	0.5%	11	0.3%	46	0.4%
SUV	4	4	0.1%	4	0.1%	8	0.1%
SUV	4+	0	0.0%	1	0.0%	1	0.0%
SUV	Subtotal	7,089	100.0%	3,996	100.0%	11,085	100.0%
Bus	1	11	55.0%	6	66.7%	17	58.6%
Bus	2	0	0.0%	0	0.0%	0	0.0%
Bus	3	0	0.0%	0	0.0%	0	0.0%
Bus	4	0	0.0%	0	0.0%	0	0.0%
Bus	4+	9	45.0%	3	33.3%	12	41.4%
Bus	Subtotal	20	100.0%	9	100.0%	29	100.0%
Van	1	358	75.7%	439	81.4%	797	78.8%
Van	2	94	19.9%	96	17.8%	190	18.8%
Van	3	6	1.3%	2	0.4%	8	0.8%
Van	4	2	0.4%	0	0.0%	2	0.2%
Van	4+	13	2.7%	2	0.4%	15	1.5%
Van	Subtotal	473	100.0%	539	100.0%	1,012	100.0%
Large HDV	1	333	96.5%	3,316	96.3%	3,649	96.4%
Large HDV	2	12	3.5%	126	3.7%	138	3.6%
Large HDV	3	0	0.0%	0	0.0%	0	0.0%
Large HDV	4	0	0.0%	0	0.0%	0	0.0%
Large HDV	4+	0	0.0%	0	0.0%	0	0.0%
Large HDV	Subtotal	345	100.0%	3,442	100.0%	3,787	100.0%
Small HDV	1	112	91.1%	526	85.3%	638	86.2%
Small HDV	2	10	8.1%	86	13.9%	96	13.0%
Small HDV	3	1	0.8%	4	0.6%	5	0.7%
Small HDV	4	0	0.0%	0	0.0%	0	0.0%
Small HDV	4+	0	0.0%	1	0.2%	1	0.1%
Small HDV	Subtotal	123	100.0%	617	100.0%	740	100.0%
MC	1	23	100.0%	18	100.0%	41	100.0%
MC	2	0	0.0%	0	0.0%	0	0.0%
MC	3	0	0.0%	0	0.0%	0	0.0%
MC	4	0	0.0%	0	0.0%	0	0.0%
MC	4+	0	0.0%	0	0.0%	0	0.0%
MC	Subtotal	23	100.0%	18	100.0%	41	100.0%
Other	1	24	100.0%	2	66.7%	26	96.3%
Other	2	0	0.0%	1	33.3%	1	3.7%
Other	3	0	0.0%	0	0.0%	0	0.0%
Other	4	0	0.0%	0	0.0%	0	0.0%
Other	4+	0	0.0%	0	0.0%	0	0.0%
Other	Subtotal	24	100.0%	3	100.0%	27	100.0%

Table 134 – Average Occupancy Results, Chastain Road at I-575, AM Peak (7-10 AM)

Occupancy Breakup of Chastain Road at I-575, AM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	Express Lane 1, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Passenger Car LDVs	1.05	1.06	1.05	1.04	1.09	1.02	1.05
SUV	1.13	1.17	1.15	1.08	1.16	1.05	1.09
Bus	3.63	3.06	3.16	4.50	1.59	3.52	2.90
Van (Mini Van and Vanpool)	1.24	1.26	1.25	1.16	1.26	1.13	1.19
Large HDV	1.15	1.06	1.08	1.04	1.05	N/A	1.05
Small HDV	1.22	1.28	1.25	1.21	1.34	1.30	1.30
MC	1.00	1.00	1.00	1.03	1.10	1.00	1.05
Other	1.00	1.00	1.00	N/A	1.20	1.50	1.22
Observed Average Occupancy	1.10	1.14	1.12	1.07	1.14	1.04	1.08
Adjusted Average Occupancy with Substitution of Vanpools	1.10	1.14	1.12	1.07	1.14	1.04	1.09
Adjusted Average Occupancy with Substitution of Express Buses	1.10	1.14	1.12	1.07	1.14	1.05	1.09
Adjusted Average Occupancy with Substitution of Vanpools and Express Buses	1.10	1.14	1.12	1.07	1.14	1.05	1.09

Table 135 – Average Occupancy Results, Chastain Road at I-575, PM Peak (4-7 PM)

Occupancy Breakup of Chastain Road at I-575, PM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	Express Lane 1, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Passenger Car LDVs	1.08	1.12	1.10	1.12	1.11	1.04	1.09
SUV	1.17	1.22	1.19	1.18	1.15	1.06	1.13
Bus	3.72	3.19	3.33	4.50	1.54	3.92	2.97
Van (Mini Van and Vanpool)	1.37	1.27	1.31	1.27	1.27	1.18	1.25
Large HDV	1.08	1.12	1.11	1.04	1.07	1.00	1.06
Small HDV	1.53	1.53	1.53	1.42	1.29	1.13	1.31
MC	1.03	1.07	1.05	1.00	1.00	1.00	1.00
Other	1.20	1.20	1.20	1.50	1.14	1.00	1.26
Observed Average Occupancy	1.14	1.19	1.16	1.16	1.14	1.06	1.12
Adjusted Average Occupancy with Substitution of Vanpools	1.14	1.19	1.16	1.16	1.14	1.06	1.12
Adjusted Average Occupancy with Substitution of Express Buses	1.14	1.20	1.17	1.16	1.14	1.07	1.13
Adjusted Average Occupancy with Substitution of Vanpools and Express Buses	1.14	1.20	1.17	1.16	1.14	1.07	1.13

Table 136 – Average Occupancy Results, Hickory Grove Road at I-75, AM Peak (7-10 AM)

Occupancy Breakup of Hickory Grove Road at I-75, AM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	GP Lane 3, Pre-Opening (2018)	GP Lane 4, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	GP Lane 3, Post-Opening (2019)	GP Lane 4, Post-Opening (2019)	Express Lane 1, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Passenger Car LDVs	1.10	1.08	1.10	1.07	1.10	1.08	1.11	1.08	1.08	1.03	1.08
SUV	1.18	1.17	1.20	1.14	1.18	1.13	1.19	1.12	1.11	1.06	1.12
Bus	2.17	2.94	4.50	4.50	3.38	2.60	1.25	1.29	1.17	3.62	2.05
Van (Mini Van and Vanpool)	1.27	1.23	1.31	1.33	1.27	1.21	1.22	1.13	1.18	1.16	1.18
Large HDV	1.00	1.03	1.06	1.09	1.05	1.00	1.02	1.04	1.03	1.10	1.03
Small HDV	1.15	1.12	1.11	1.07	1.11	1.18	1.07	1.13	1.13	1.10	1.12
MC	1.00	1.10	1.10	1.00	1.05	1.00	1.00	1.00	1.00	1.00	1.00
Other	N/A	1.00	N/A	N/A	1.00	1.17	1.40	1.13	1.67	1.06	1.18
Observed Average Occupancy	1.15	1.11	1.13	1.11	1.13	1.11	1.13	1.09	1.09	1.06	1.10
Adjusted Average Occupancy with Substitution of Vanpools	1.15	1.11	1.13	1.11	1.13	1.11	1.13	1.09	1.09	1.06	1.10
Adjusted Average Occupancy with Substitution of Express Buses	1.15	1.11	1.15	1.11	1.13	1.11	1.13	1.09	1.09	1.12	1.11
Adjusted Average Occupancy with Substitution of Vanpools and Express Buses	1.15	1.11	1.15	1.11	1.13	1.11	1.13	1.09	1.09	1.12	1.11

Table 137 – Average Occupancy Results, Hickory Grove Road at I-75, PM Peak (4-7 PM)

Occupancy Breakup of Hickory Grove Road at I-75, PM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	GP Lane 3, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	GP Lane 3, Post-Opening (2019)	Express Lane 1, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Passenger Car LDVs	1.09	1.21	1.12	1.14	1.08	1.15	1.11	1.07	1.10
SUV	1.18	1.29	1.18	1.22	1.17	1.19	1.15	1.08	1.15
Bus	3.33	1.93	2.56	2.42	1.00	1.27	2.33	4.36	3.44
Van (Mini Van and Vanpool)	1.20	1.46	1.24	1.30	1.24	1.32	1.25	1.24	1.27
Large HDV	1.25	1.06	1.07	1.07	1.03	1.03	1.04	1.00	1.03
Small HDV	1.10	1.25	1.29	1.26	1.08	1.15	1.26	1.29	1.18
MC	1.00	1.06	1.00	1.01	1.02	1.04	1.00	1.00	1.02
Other	1.50	1.67	1.25	1.50	1.00	1.50	2.00	1.00	1.29
Observed Average Occupancy	1.15	1.22	1.14	1.17	1.13	1.14	1.12	1.10	1.13
Adjusted Average Occupancy with Substitution of Vanpools	1.15	1.22	1.14	1.17	1.13	1.14	1.12	1.10	1.13
Adjusted Average Occupancy with Substitution of Express Buses	1.15	1.22	1.18	1.18	1.13	1.14	1.12	1.19	1.14
Adjusted Average Occupancy with Substitution of Vanpools and Express Buses	1.15	1.22	1.19	1.18	1.13	1.14	1.12	1.20	1.14

Table 138 – Average Occupancy Results, Indian Trail Lilburn Road at I-85, AM Peak (7-10 AM)

Occupancy Breakup of Indian Trail Lilburn Road at I-85, AM Peak	GP Lane 1, Pre-Extension (2018)	GP Lane 2, Pre-Extension (2018)	GP Lane 3, Pre-Extension (2018)	GP Lane 4, Pre-Extension (2018)	GP Lane 5, Pre-Extension (2018)	Express Lane 1, Pre-Extension (2018)	All Lanes, Pre-Extension (2018)	GP Lane 1, Post-Extension (2019)	GP Lane 2, Post-Extension (2019)	GP Lane 3, Post-Extension (2019)	GP Lane 4, Post-Extension (2019)	GP Lane 5, Post-Extension (2019)	Express Lane 1, Post-Extension (2019)	All Lanes, Post-Extension (2019)
Passenger Car LDVs	1.06	1.06	1.07	1.08	1.06	1.08	1.07	1.05	1.05	1.05	1.03	1.05	1.03	1.04
SUV	1.15	1.18	1.20	1.19	1.15	1.16	1.17	1.11	1.10	1.13	1.08	1.11	1.10	1.10
Bus	2.92	2.40	4.11	1.90	1.00	3.85	3.63	1.00	2.00	1.95	2.00	1.75	3.53	3.25
Van (Mini Van and Vanpool)	1.27	1.33	1.30	1.28	1.26	1.32	1.29	1.22	1.20	1.20	1.13	1.19	1.23	1.20
Large HDV	1.17	1.05	1.07	1.04	1.04	1.00	1.05	1.07	1.02	1.03	1.02	1.05	1.53	1.03
Small HDV	1.19	1.24	1.21	1.18	1.22	1.46	1.22	1.15	1.22	1.14	1.05	1.08	1.24	1.12
MC	1.00	1.00	1.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.17	1.00	1.02	1.02
Other	4.50	1.00	1.00	1.40	1.23	2.00	1.34	1.00	1.00	1.00	1.00	1.00	1.24	1.11
Observed Average Occupancy	1.11	1.13	1.13	1.12	1.12	1.18	1.13	1.09	1.09	1.09	1.05	1.09	1.12	1.09
Adjusted Average Occupancy with Substitution of Vanpools	1.11	1.13	1.13	1.12	1.12	1.18	1.13	1.09	1.09	1.08	1.05	1.09	1.12	1.09
Adjusted Average Occupancy with Substitution of Express Buses	1.11	1.13	1.13	1.12	1.12	1.31	1.15	1.09	1.09	1.09	1.05	1.09	1.24	1.11
Adjusted Average Occupancy with Substitution of Vanpools and Express Buses	1.11	1.13	1.13	1.12	1.12	1.31	1.15	1.09	1.09	1.08	1.05	1.09	1.24	1.11

Table 139 – Average Occupancy Results, Indian Trail Lilburn Road at I-85, PM Peak (4-7 PM)

Occupancy Breakup of Indian Trail Lilburn Road at I-85, PM Peak	GP Lane 1, Pre-Extension (2018)	GP Lane 2, Pre-Extension (2018)	GP Lane 3, Pre-Extension (2018)	GP Lane 4, Pre-Extension (2018)	GP Lane 5, Pre-Extension (2018)	Express Lane 1, Pre-Extension (2018)	All Lanes, Pre-Extension (2018)	GP Lane 1, Post-Extension (2019)	GP Lane 2, Post-Extension (2019)	GP Lane 3, Post-Extension (2019)	GP Lane 4, Post-Extension (2019)	GP Lane 5, Post-Extension (2019)	Express Lane 1, Post-Extension (2019)	All Lanes, Post-Extension (2019)
Passenger Car LDVs	1.10	1.11	1.12	1.12	1.08	1.10	1.11	1.06	1.07	1.09	1.08	1.08	1.05	1.07
SUV	1.20	1.18	1.22	1.23	1.14	1.23	1.20	1.12	1.14	1.17	1.15	1.14	1.13	1.14
Bus	1.00	3.33	3.33	2.31	1.47	4.44	4.16	2.17	1.58	2.17	1.50	1.56	3.90	3.59
Van (Mini Van and Vanpool)	1.29	1.28	1.40	1.42	1.27	1.67	1.37	1.26	1.32	1.29	1.32	1.29	1.38	1.31
Large HDV	1.03	1.08	1.08	1.11	1.07	1.00	1.09	1.07	1.03	1.05	1.05	1.04	1.00	1.05
Small HDV	1.19	1.32	1.23	1.27	1.18	1.46	1.25	1.39	1.20	1.22	1.20	1.22	1.30	1.22
MC	1.00	1.00	1.00	1.00	1.00	1.03	1.03	1.14	1.00	1.00	1.00	1.00	1.00	1.01
Other	N/A	N/A	1.50	1.38	1.20	N/A	1.30	1.00	1.00	1.00	1.10	1.27	1.79	1.41
Observed Average Occupancy	1.15	1.14	1.17	1.17	1.12	1.30	1.17	1.10	1.11	1.13	1.12	1.12	1.17	1.12
Adjusted Average Occupancy with Substitution of Vanpools	1.15	1.14	1.17	1.17	1.12	1.30	1.17	1.10	1.11	1.13	1.12	1.12	1.17	1.12
Adjusted Average Occupancy with Substitution of Express Buses	1.15	1.14	1.17	1.17	1.12	1.55	1.22	1.10	1.11	1.13	1.12	1.12	1.41	1.16
Adjusted Average Occupancy with Substitution of Vanpools and Express Buses	1.15	1.14	1.17	1.17	1.12	1.55	1.22	1.10	1.11	1.13	1.12	1.12	1.41	1.16

Table 140 – Average Occupancy Results, Old Peachtree Road at I-85, AM Peak (7-10 AM)

Occupancy Breakup of Old Peachtree Road at I-85, AM Peak	GP Lane 1, Pre-Extension (2018)	GP Lane 2, Pre-Extension (2018)	GP Lane 3, Pre-Extension (2018)	GP Lane 4, Pre-Extension (2018)	Express Lane 1, Pre-Extension (2018)	All Lanes, Pre-Extension (2018)	GP Lane 1, Post-Extension (2019)	GP Lane 2, Post-Extension (2019)	GP Lane 3, Post-Extension (2019)	GP Lane 4, Post-Extension (2019)	Express Lane 1, Post-Extension (2019)	All Lanes, Post-Extension (2019)
Passenger Car LDVs	1.13	1.09	1.05	1.06	1.09	1.08	1.04	1.06	1.06	1.06	1.05	1.05
SUV	1.19	1.17	1.12	1.11	1.19	1.15	1.09	1.10	1.11	1.09	1.10	1.10
Bus	3.63	3.42	2.87	1.50	3.69	2.99	1.00	1.00	2.00	1.79	3.26	2.52
Van (Mini Van and Vanpool)	1.35	1.22	1.13	1.14	1.29	1.19	1.15	1.15	1.19	1.16	1.27	1.17
Large HDV	1.20	1.07	1.02	1.02	N/A	1.03	1.17	1.02	1.01	1.03	1.00	1.02
Small HDV	1.18	1.21	1.10	1.12	1.33	1.14	1.10	1.06	1.14	1.17	1.49	1.14
MC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.17	1.00	1.00	1.02
Other	1.67	1.00	1.17	1.00	N/A	1.24	1.00	1.00	1.00	1.07	1.00	1.03
Observed Average Occupancy	1.18	1.14	1.07	1.08	1.22	1.12	1.07	1.08	1.08	1.08	1.13	1.08
Adjusted Average Occupancy with Substitution of Vanpools	1.18	1.14	1.07	1.08	1.22	1.13	1.07	1.08	1.08	1.08	1.12	1.08
Adjusted Average Occupancy with Substitution of Express Buses	1.18	1.14	1.07	1.08	1.50	1.15	1.07	1.08	1.08	1.08	1.36	1.10
Adjusted Average Occupancy with Substitution of Vanpools and Express Buses	1.18	1.14	1.07	1.08	1.50	1.15	1.07	1.08	1.08	1.08	1.36	1.10

Table 141 – Average Occupancy Results, Old Peachtree Road at I-85, PM Peak (4-7 PM)

Occupancy Breakup of Old Peachtree Road at I-85, PM Peak	GP Lane 1, Pre-Extension (2018)	GP Lane 2, Pre-Extension (2018)	GP Lane 3, Pre-Extension (2018)	GP Lane 4, Pre-Extension (2018)	Express Lane 1, Pre-Extension (2018)	All Lanes, Pre-Extension (2018)	GP Lane 1, Post-Extension (2019)	GP Lane 2, Post-Extension (2019)	GP Lane 3, Post-Extension (2019)	GP Lane 4, Post-Extension (2019)	Express Lane 1, Post-Extension (2019)	All Lanes, Post-Extension (2019)
Passenger Car LDVs	1.19	1.17	1.11	1.10	1.11	1.14	1.08	1.08	1.09	1.08	1.05	1.08
SUV	1.30	1.20	1.16	1.14	1.23	1.21	1.15	1.13	1.10	1.10	1.14	1.12
Bus	3.10	3.33	3.25	1.59	4.03	3.43	2.00	2.75	1.50	1.36	4.09	3.25
Van (Mini Van and Vanpool)	1.40	1.25	1.25	1.21	1.46	1.31	1.35	1.23	1.16	1.23	1.50	1.29
Large HDV	1.13	1.03	1.06	1.06	1.25	1.06	1.07	1.04	1.02	1.06	1.00	1.04
Small HDV	1.45	1.25	1.27	1.30	1.50	1.30	1.11	1.18	1.09	1.31	1.44	1.15
MC	1.17	1.00	1.00	1.11	1.00	1.03	1.04	1.00	N/A	1.00	1.00	1.01
Other	N/A	N/A	1.25	1.67	2.10	1.45	1.00	1.20	1.00	1.33	1.24	1.17
Observed Average Occupancy	1.26	1.17	1.13	1.12	1.26	1.18	1.12	1.11	1.08	1.10	1.17	1.11
Adjusted Average Occupancy with Substitution of Vanpools	1.26	1.17	1.13	1.12	1.26	1.19	1.12	1.11	1.08	1.10	1.17	1.12
Adjusted Average Occupancy with Substitution of Express Buses	1.26	1.17	1.13	1.12	1.43	1.22	1.12	1.11	1.08	1.10	1.37	1.14
Adjusted Average Occupancy with Substitution of Vanpools and Express Buses	1.26	1.17	1.13	1.12	1.43	1.22	1.12	1.11	1.08	1.10	1.37	1.14

Table 142 – Average Occupancy Results, Hamilton Mill Road at I-75, AM Peak (7-10 AM)

Occupancy Breakup of Hamilton Mill Road at I-75, AM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	GP Lane 3, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Passenger Car LDVs	1.06	1.10	1.07	1.05	1.11	1.02	1.06
SUV	1.11	1.19	1.14	1.07	1.13	1.00	1.08
Bus	4.50	1.83	3.07	3.17	2.88	N/A	3.00
Van (Mini Van and Vanpool)	1.15	1.22	1.18	1.13	1.17	1.00	1.14
Large HDV	1.03	1.04	1.04	1.03	1.04	1.00	1.03
Small HDV	1.05	1.08	1.07	1.06	1.10	1.08	1.07
MC	1.00	1.00	1.00	1.00	1.00	N/A	1.00
Other	1.00	1.25	1.20	1.25	1.06	N/A	1.13
Observed Average Occupancy	1.09	1.11	1.10	1.06	1.09	1.01	1.07
Adjusted Average Occupancy with Substitution of Vanpools	N/A	N/A	N/A	1.06	1.09	1.01	1.05
Adjusted Average Occupancy with Substitution of Express Buses	N/A	N/A	N/A	1.06	1.09	1.01	1.05
Adjusted Average Occupancy with Substitution of Vanpools and Express Buses	N/A	N/A	N/A	1.06	1.09	1.01	1.05

Table 143 – Average Occupancy Results, Hamilton Mill Road at I-75, PM Peak (4-7 PM)

Occupancy Breakup of Hamilton Mill Road at I-75, PM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Passenger Car LDVs	1.11	1.14	1.12	1.07	1.10	1.08
SUV	1.19	1.25	1.21	1.12	1.16	1.13
Bus	2.90	1.44	2.53	2.58	2.17	2.45
Van (Mini Van and Vanpool)	1.37	1.29	1.35	1.33	1.20	1.26
Large HDV	1.04	1.06	1.06	1.03	1.04	1.04
Small HDV	1.20	1.21	1.21	1.10	1.16	1.15
MC	1.00	1.05	1.02	1.00	1.00	1.00
Other	1.63	1.00	1.50	1.00	1.33	1.04
Observed Average Occupancy	1.16	1.17	1.16	1.11	1.11	1.11
Adjusted Average Occupancy with Substitution of Vanpools	N/A	N/A	N/A	1.11	1.11	1.11
Adjusted Average Occupancy with Substitution of Express Buses	N/A	N/A	N/A	1.11	1.11	1.11
Adjusted Average Occupancy with Substitution of Vanpools and Express Buses	N/A	N/A	N/A	1.11	1.11	1.11

Table 144 – Scheduled Routes (Number of Vehicles) of Express Buses and Vanpools per Session

Year	Site (Overpass)	Vanpool, AM Peak	Xpress, AM Peak	CobbLinc, AM Peak	GCT, AM Peak	Vanpool, PM Peak	Xpress, PM Peak	CobbLinc, PM Peak	GCT, PM Peak
2018	Chastain	0.00	1.84	0.00	0.00	2.01	3.68	0.00	0.00
2018	Hamilton Mill	0.00	0.00	0.00	0.00	1.40	0.00	0.00	0.00
2018	Hickory Grove	0.00	1.86	3.43	0.00	4.72	4.66	6.86	0.00
2018	Indian Trail	5.95	19.00	0.00	20.00	15.82	30.16	0.00	25.00
2018	Old Peachtree	0.96	13.70	0.00	6.00	7.68	18.26	0.00	8.00
2019	Chastain	0.00	2.00	0.00	0.00	2.42	3.33	0.00	0.00
2019	Hamilton Mill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	Hickory Grove	0.95	1.97	3.57	0.00	3.97	4.13	6.05	0.00
2019	Indian Trail	6.73	19.21	0.00	21.00	16.99	30.73	0.00	27.00
2019	Old Peachtree	0.83	15.00	0.00	6.00	13.31	24.00	0.00	10.00

Table 145 – Average Vehicle Occupancy of Express Buses and Vanpools per Session

Year	Site (Overpass)	Vanpool, AM Peak	Xpress, AM Peak	CobbLinc, AM Peak	GCT, AM Peak	Vanpool, PM Peak	Xpress, PM Peak	CobbLinc, PM Peak	GCT, PM Peak
2018	Chastain	N/A	19.00	N/A	N/A	4.54	19.00	N/A	N/A
2018	Hamilton Mill	N/A	N/A	N/A	N/A	7.00	N/A	N/A	N/A
2018	Hickory Grove	N/A	27.02	9.76	N/A	5.25	27.02	10.59	N/A
2018	Indian Trail	4.24	29.40	N/A	19.09	5.02	26.73	N/A	25.21
2018	Old Peachtree	3.16	29.73	N/A	12.20	4.76	28.83	N/A	18.50
2019	Chastain	N/A	22.00	N/A	N/A	6.16	22.00	N/A	N/A
2019	Hamilton Mill	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2019	Hickory Grove	3.54	26.81	21.76	N/A	5.55	26.38	13.24	N/A
2019	Indian Trail	4.07	30.51	N/A	17.38	5.43	27.77	N/A	21.53
2019	Old Peachtree	4.53	28.27	N/A	10.90	5.58	27.29	N/A	17.10

Table 146 – Step-by-Step Results of Throughput Assessment, Chastain Road at I-575, AM Peak (6-10 AM)

Chastain Road at I-575, AM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	Express Lane 1, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Observed Vehicle Count	12,760.00	8,995.00	21,755.00	22,616.00	14,122.00	15,410.00	52,148.00
SOV Fraction	90.13%	87.38%	88.88%	93.40%	86.81%	96.09%	91.85%
HOV2 Fraction	9.52%	11.97%	10.63%	6.38%	12.32%	3.71%	7.73%
HOV3+ Fraction	0.35%	0.64%	0.48%	0.22%	0.86%	0.20%	0.42%
Total Vehicle Throughput	6,248.08	5,169.24	11,417.32	7,524.25	5,280.08	3,499.80	16,304.13
Unsubstituted Total Person Throughput	6,896.63	5,872.36	12,768.99	8,040.59	6,035.33	3,650.26	17,726.19
Vanpool Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vanpool Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Vehicle Throughput after Adjustment of Vanpool	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Vanpool	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Xpress Vehicle Throughput	0.00	1.84	1.84	0.00	0.00	2.00	2.00
CobbLinc Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Xpress Person Throughput	0.00	34.93	34.93	0.00	0.00	44.00	44.00
CobbLinc Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Vehicle Throughput after Adjustment of Express Buses	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Express Buses	0.00	26.66	26.66	0.00	0.00	35.00	35.00
Total Vehicle Throughput after Adjustment	6,248.08	5,169.24	11,417.32	7,524.25	5,280.08	3,499.80	16,304.13
Total Person Throughput after Adjustment	6,896.63	5,899.02	12,795.65	8,040.59	6,035.33	3,685.26	17,761.19

Table 147 – Step-by-Step Results of Throughput Assessment, Chastain Road at I-575, PM Peak (3-7 PM)

Chastain Road at I-575, PM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	Express Lane 1, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Observed Vehicle Count	12,450.00	13,302.00	25,752.00	13,409.00	14,920.00	11,119.00	39,448.00
SOV Fraction	87.12%	83.16%	85.27%	85.08%	87.07%	94.42%	88.47%
HOV2 Fraction	11.97%	15.56%	13.65%	14.18%	12.25%	5.39%	10.97%
HOV3+ Fraction	0.91%	1.28%	1.08%	0.73%	0.68%	0.19%	0.55%
Total Vehicle Throughput	5,765.60	5,048.92	10,814.52	5,774.72	4,951.20	4,453.23	15,179.15
Unsubstituted Total Person Throughput	6,576.26	5,989.66	12,565.92	6,687.07	5,636.97	4,720.77	17,044.80
Vanpool Vehicle Throughput	1.00	1.00	2.01	0.81	0.81	0.81	2.42
Vanpool Person Throughput	4.56	4.56	9.11	4.97	4.97	4.97	14.92
Changes of Vehicle Throughput after Adjustment of Vanpool	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Vanpool	0.04	0.04	0.09	1.34	1.34	1.34	4.02
Xpress Vehicle Throughput	0.00	3.68	3.68	0.00	0.00	3.33	3.33
CobbLinc Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Xpress Person Throughput	0.00	69.86	69.86	0.00	0.00	73.33	73.33
CobbLinc Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Vehicle Throughput after Adjustment of Express Buses	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Express Buses	0.00	53.31	53.31	0.00	0.00	58.33	58.33
Total Vehicle Throughput after Adjustment	5,765.60	5,048.92	10,814.52	5,774.72	4,951.20	4,453.23	15,179.15
Total Person Throughput after Adjustment	6,576.30	6,043.01	12,619.32	6,688.41	5,638.31	4,780.44	17,107.15

Table 148 – Step-by-Step Results of Throughput Assessment, Hickory Grove Road at I-75, AM Peak (6-10 AM)

Hickory Grove Road at I-75, AM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	GP Lane 3, Pre-Opening (2018)	GP Lane 4, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	GP Lane 3, Post-Opening (2019)	GP Lane 4, Post-Opening (2019)	Express Lane 1, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Observed Vehicle Count	9,078.00	3,271.00	4,757.00	1,773.00	18,879.00	10,602.00	8,914.00	10,836.00	5,145.00	7,079.00	42,576.00
SOV Fraction	86.00%	89.18%	87.64%	89.17%	87.73%	89.03%	87.87%	91.80%	91.55%	94.59%	90.14%
HOV2 Fraction	13.42%	10.52%	11.94%	10.43%	11.83%	10.74%	11.72%	7.90%	8.18%	4.97%	9.54%
HOV3+ Fraction	0.58%	0.31%	0.42%	0.39%	0.44%	0.23%	0.40%	0.30%	0.27%	0.44%	0.32%
Total Vehicle Throughput	5,122.34	4,813.65	3,653.54	1,599.76	15,189.29	5,362.52	5,378.85	4,082.38	1,656.40	2,015.36	18,495.50
Unsubstituted Total Person Throughput	5,879.29	5,360.36	4,132.03	1,782.02	17,153.70	5,967.46	6,054.37	4,433.13	1,802.08	2,142.76	20,399.79
Vanpool Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.19	0.19	0.19	0.19	0.19	0.95
Vanpool Person Throughput	0.00	0.00	0.00	0.00	0.00	0.67	0.67	0.67	0.67	0.67	3.36
Changes of Vehicle Throughput after Adjustment of Vanpool	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Vanpool	0.00	0.00	0.00	0.00	0.00	-0.18	-0.18	-0.18	-0.18	-0.18	-0.91
Xpress Vehicle Throughput	0.00	0.00	1.86	0.00	1.86	0.00	0.00	0.00	0.00	1.97	1.97
CobbLinc Vehicle Throughput	0.00	0.00	3.43	0.00	3.43	0.00	0.00	0.00	0.00	3.57	3.57
GCT Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Xpress Person Throughput	0.00	0.00	50.34	0.00	50.34	0.00	0.00	0.00	0.00	52.78	52.78
CobbLinc Person Throughput	0.00	0.00	33.49	0.00	33.49	0.00	0.00	0.00	0.00	77.71	77.71
GCT Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Changes of Vehicle Throughput after Adjustment of Express Buses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
Changes of Person Throughput after Adjustment of Express Buses	0.00	0.00	60.01	0.00	60.01	0.00	0.00	0.00	0.00	110.06	110.06
Total Vehicle Throughput after Adjustment	5,122.34	4,813.65	3,653.54	1,599.76	15,189.29	5,362.52	5,378.85	4,082.38	1,656.40	2,016.36	18,496.50
Total Person Throughput after Adjustment	5,879.29	5,360.36	4,192.04	1,782.02	17,213.70	5,967.27	6,054.19	4,432.94	1,801.90	2,252.64	20,508.95

Table 149 – Step-by-Step Results of Throughput Assessment, Hickory Grove Road at I-75, PM Peak (3-7 PM)

Hickory Grove Road at I-75, PM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	GP Lane 3, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	GP Lane 3, Post-Opening (2019)	Express Lane 1, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Observed Vehicle Count	6,950.00	8,918.00	8,336.00	24,204.00	14,016.00	11,804.00	8,809.00	7,569.00	42,198.00
SOV Fraction	86.29%	80.40%	86.82%	84.45%	87.41%	87.20%	89.53%	92.21%	88.23%
HOV2 Fraction	13.11%	17.92%	12.36%	14.54%	11.99%	11.68%	9.30%	6.63%	10.84%
HOV3+ Fraction	0.60%	1.68%	0.83%	1.02%	0.60%	1.12%	1.17%	1.16%	0.93%
Total Vehicle Throughput	7,585.11	5,823.11	4,062.62	17,470.84	7,142.45	5,606.02	4,129.47	1,574.72	18,452.66
Unsubstituted Total Person Throughput	8,692.86	7,084.96	4,646.72	20,424.54	8,093.09	6,404.37	4,629.18	1,734.40	20,861.05
Vanpool Vehicle Throughput	1.57	1.57	1.57	4.72	0.99	0.99	0.99	0.99	3.97
Vanpool Person Throughput	8.26	8.26	8.26	24.79	5.50	5.50	5.50	5.50	22.02
Changes of Vehicle Throughput after Adjustment of Vanpool	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Vanpool	1.18	1.18	1.18	3.53	1.04	1.04	1.04	1.04	4.16
Xpress Vehicle Throughput	0.00	0.00	4.66	4.66	0.00	0.00	0.00	4.13	4.13
CobbLinc Vehicle Throughput	0.00	0.00	6.86	6.86	0.00	0.00	0.00	6.05	6.05
GCT Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Xpress Person Throughput	0.00	0.00	125.85	125.85	0.00	0.00	0.00	108.89	108.89
CobbLinc Person Throughput	0.00	0.00	72.63	72.63	0.00	0.00	0.00	80.12	80.12
GCT Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Changes of Vehicle Throughput after Adjustment of Express Buses	0.00	0.00	6.00	6.00	0.00	0.00	0.00	1.00	1.00
Changes of Person Throughput after Adjustment of Express Buses	0.00	0.00	173.65	173.65	0.00	0.00	0.00	147.71	147.71
Total Vehicle Throughput after Adjustment	7,585.11	5,823.11	4,068.62	17,476.84	7,142.45	5,606.02	4,129.47	1,575.72	18,453.66
Total Person Throughput after Adjustment	8,694.04	7,086.14	4,821.54	20,601.72	8,094.13	6,405.41	4,630.23	1,883.15	21,012.92

Table 150 – Step-by-Step Results of Throughput Assessment, Indian Trail Lilburn Road at I-85, AM Peak (6-10 AM)

Indian Trail Lilburn Road at I-85, AM Peak	GP Lane 1, Pre-Extension (2018)	GP Lane 2, Pre-Extension (2018)	GP Lane 3, Pre-Extension (2018)	GP Lane 4, Pre-Extension (2018)	GP Lane 5, Pre-Extension (2018)	Express Lane 1, Pre-Extension (2018)	All Lanes, Pre-Extension (2018)	GP Lane 1, Post-Extension (2019)	GP Lane 2, Post-Extension (2019)	GP Lane 3, Post-Extension (2019)	GP Lane 4, Post-Extension (2019)	GP Lane 5, Post-Extension (2019)	Express Lane 1, Post-Extension (2019)	All Lanes, Post-Extension (2019)
Observed Vehicle Count	8,497.00	6,852.00	9,262.00	8,089.00	9,667.00	7,720.00	50,087.00	12,955.00	12,972.00	10,079.00	14,092.00	14,740.00	15,803.00	80,641.00
SOV Fraction	89.73%	87.81%	87.26%	88.38%	88.66%	86.70%	88.08%	91.38%	91.60%	91.76%	95.20%	91.93%	91.44%	92.18%
HOV2 Fraction	9.85%	11.76%	12.27%	11.13%	10.94%	11.08%	11.17%	8.46%	8.09%	8.07%	4.71%	7.71%	7.18%	7.40%
HOV3+ Fraction	0.42%	0.42%	0.48%	0.49%	0.39%	2.23%	0.75%	0.16%	0.31%	0.18%	0.09%	0.37%	1.38%	0.42%
Total Vehicle Throughput	5,690.74	6,050.61	5,442.01	5,361.65	5,425.08	5,904.32	33,874.41	6,048.72	6,362.14	6,054.33	5,661.15	5,497.00	6,132.91	35,756.23
Unsubstituted Total Person Throughput	6,312.59	6,817.09	6,174.70	6,016.86	6,066.52	6,952.50	38,340.26	6,581.68	6,920.52	6,569.42	5,941.16	5,966.14	6,847.95	38,826.87
Vanpool Vehicle Throughput	0.99	0.99	0.99	0.99	0.99	0.99	5.95	1.12	1.12	1.12	1.12	1.12	1.12	6.73
Vanpool Person Throughput	4.21	4.21	4.21	4.21	4.21	4.21	25.26	4.56	4.56	4.56	4.56	4.56	4.56	27.37
Changes of Vehicle Throughput after Adjustment of Vanpool	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Vanpool	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-1.52	-0.48	-0.48	-0.48	-0.48	-0.48	-0.48	-2.90
Xpress Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	19.00	19.00	0.00	0.00	0.00	0.00	0.00	19.21	19.21
CobbLinc Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	20.00	20.00	0.00	0.00	0.00	0.00	0.00	21.00	21.00
Xpress Person Throughput	0.00	0.00	0.00	0.00	0.00	558.60	558.60	0.00	0.00	0.00	0.00	0.00	586.07	586.07

CobbLinc Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Person Throughput	0.00	0.00	0.00	0.00	0.00	381.80	381.80	0.00	0.00	0.00	0.00	0.00	365.00	365.00
Changes of Vehicle Throughput after Adjustment of Express Buses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Express Buses	0.00	0.00	0.00	0.00	0.00	764.90	764.90	0.00	0.00	0.00	0.00	0.00	770.14	770.14
Total Vehicle Throughput after Adjustment	5,690.74	6,050.61	5,442.01	5,361.65	5,425.08	5,904.32	33,874.41	6,048.72	6,362.14	6,054.33	5,661.15	5,497.00	6,132.91	35,756.23
Total Person Throughput after Adjustment	6,312.34	6,816.84	6,174.45	6,016.60	6,066.27	7,717.14	39,103.64	6,581.20	6,920.03	6,568.93	5,940.67	5,965.66	7,617.61	39,594.11

Table 151 – Step-by-Step Results of Throughput Assessment,
Indian Trail Lilburn Road at I-85, PM Peak (3-7 PM)

Indian Trail Lilburn Road at I-85, PM Peak	GP Lane 1, Pre-Extension (2018)	GP Lane 2, Pre-Extension (2018)	GP Lane 3, Pre-Extension (2018)	GP Lane 4, Pre-Extension (2018)	GP Lane 5, Pre-Extension (2018)	Express Lane 1, Pre-Extension (2018)	All Lanes, Pre-Extension (2018)	GP Lane 1, Post-Extension (2019)	GP Lane 2, Post-Extension (2019)	GP Lane 3, Post-Extension (2019)	GP Lane 4, Post-Extension (2019)	GP Lane 5, Post-Extension (2019)	Express Lane 1, Post-Extension (2019)	All Lanes, Post-Extension (2019)
Observed Vehicle Count	9,831.00	8,041.00	7,263.00	10,671.00	8,967.00	8,007.00	52,780.00	17,005.00	19,801.00	13,315.00	18,173.00	16,649.00	16,454.00	101,397.00
SOV Fraction	85.86%	86.32%	84.68%	83.53%	88.71%	79.78%	84.86%	90.66%	89.65%	87.84%	88.81%	89.13%	88.25%	89.13%
HOV2 Fraction	13.51%	13.24%	14.26%	15.83%	10.86%	16.05%	13.92%	8.84%	9.82%	11.33%	10.39%	10.29%	9.44%	9.97%
HOV3+ Fraction	0.63%	0.44%	1.06%	0.64%	0.42%	4.17%	1.22%	0.50%	0.53%	0.83%	0.80%	0.58%	2.31%	0.90%
Total Vehicle Throughput	5,223.32	5,760.40	4,435.60	4,103.30	4,380.72	4,782.69	28,686.02	5,839.07	5,973.48	4,862.45	4,746.71	4,991.99	4,883.11	31,296.81
Unsubstituted Total Person Throughput	6,002.22	6,583.16	5,177.92	4,813.91	4,898.81	6,206.68	33,682.69	6,423.66	6,640.79	5,508.28	5,328.52	5,574.43	5,707.25	35,182.93
Vanpool Vehicle Throughput	2.64	2.64	2.64	2.64	2.64	2.64	15.82	2.83	2.83	2.83	2.83	2.83	2.83	16.99
Vanpool Person Throughput	13.24	13.24	13.24	13.24	13.24	13.24	79.44	15.38	15.38	15.38	15.38	15.38	15.38	92.28
Changes of Vehicle Throughput after Adjustment of Vanpool	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Vanpool	1.37	1.37	1.37	1.37	1.37	1.37	8.24	2.64	2.64	2.64	2.64	2.64	2.64	15.84
Xpress Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	30.16	30.16	0.00	0.00	0.00	0.00	0.00	30.73	30.73
CobbLinc Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	25.00	25.00	0.00	0.00	0.00	0.00	0.00	27.00	27.00
Xpress Person Throughput	0.00	0.00	0.00	0.00	0.00	806.38	806.38	0.00	0.00	0.00	0.00	0.00	853.26	853.26

CobbLinc Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Person Throughput	0.00	0.00	0.00	0.00	0.00	630.24	630.24	0.00	0.00	0.00	0.00	0.00	581.40	581.40
Changes of Vehicle Throughput after Adjustment of Express Buses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Express Buses	0.00	0.00	0.00	0.00	0.00	1,188.39	1,188.39	0.00	0.00	0.00	0.00	0.00	1,174.88	1,174.88
Total Vehicle Throughput after Adjustment	5,223.32	5,760.40	4,435.60	4,103.30	4,380.72	4,782.69	28,686.02	5,839.07	5,973.48	4,862.45	4,746.71	4,991.99	4,883.11	31,296.81
Total Person Throughput after Adjustment	6,003.60	6,584.53	5,179.29	4,815.28	4,900.18	7,396.44	34,879.32	6,426.30	6,643.43	5,510.92	5,331.16	5,577.07	6,884.77	36,373.65

Table 152 – Step-by-Step Results of Throughput Assessment, Old Peachtree Road at I-85, AM Peak (6-10 AM)

Old Peachtree Road at I-85, AM Peak	GP Lane 1, Pre-Extension (2018)	GP Lane 2, Pre-Extension (2018)	GP Lane 3, Pre-Extension (2018)	GP Lane 4, Pre-Extension (2018)	Express Lane 1, Pre-Extension (2018)	All Lanes, Pre-Extension (2018)	GP Lane 1, Post-Extension (2019)	GP Lane 2, Post-Extension (2019)	GP Lane 3, Post-Extension (2019)	GP Lane 4, Post-Extension (2019)	Express Lane 1, Post-Extension (2019)	All Lanes, Post-Extension (2019)
Observed Vehicle Count	5,098.00	6,840.00	7,479.00	6,679.00	583.00	26,679.00	9,379.00	8,827.00	7,795.00	12,011.00	4,240.00	42,252.00
SOV Fraction	83.37%	86.45%	93.22%	92.02%	82.68%	88.00%	93.50%	92.65%	92.79%	92.61%	90.31%	92.70%
HOV2 Fraction	15.63%	13.13%	6.44%	7.64%	15.09%	11.35%	6.37%	7.02%	6.75%	6.99%	8.25%	6.89%
HOV3+ Fraction	1.00%	0.42%	0.33%	0.34%	2.23%	0.65%	0.14%	0.33%	0.46%	0.40%	1.44%	0.41%
Total Vehicle Throughput	4,924.66	5,794.13	4,578.27	3,834.73	1,398.87	20,530.67	5,629.86	5,861.50	4,736.91	4,030.97	1,733.47	21,992.71
Unsubstituted Total Person Throughput	5,812.89	6,617.51	4,915.87	4,157.97	1,708.40	23,212.65	6,006.83	6,316.70	5,109.42	4,348.96	1,951.58	23,733.49
Vanpool Vehicle Throughput	0.19	0.19	0.19	0.19	0.19	0.96	0.17	0.17	0.17	0.17	0.17	0.83
Vanpool Person Throughput	0.60	0.60	0.60	0.60	0.60	3.02	0.75	0.75	0.75	0.75	0.75	3.74
Changes of Vehicle Throughput after Adjustment of Vanpool	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Vanpool	-0.26	-0.26	-0.26	-0.26	-0.26	-1.28	0.00	0.00	0.00	0.00	0.00	0.02
Xpress Vehicle Throughput	0.00	0.00	0.00	0.00	13.70	13.70	0.00	0.00	0.00	0.00	15.00	15.00
CobbLinc Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Vehicle Throughput	0.00	0.00	0.00	0.00	6.00	6.00	0.00	0.00	0.00	0.00	6.00	6.00
Xpress Person Throughput	0.00	0.00	0.00	0.00	407.22	407.22	0.00	0.00	0.00	0.00	424.00	424.00

CobbLinc Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Person Throughput	0.00	0.00	0.00	0.00	73.20	73.20	0.00	0.00	0.00	0.00	65.40	65.40
Changes of Vehicle Throughput after Adjustment of Express Buses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	6.00
Changes of Person Throughput after Adjustment of Express Buses	0.00	0.00	0.00	0.00	391.79	391.79	0.00	0.00	0.00	0.00	421.90	421.90
Total Vehicle Throughput after Adjustment	4,924.66	5,794.13	4,578.27	3,834.73	1,398.87	20,530.67	5,629.86	5,861.50	4,736.91	4,030.97	1,739.47	21,998.71
Total Person Throughput after Adjustment	5,812.64	6,617.26	4,915.62	4,157.72	2,099.93	23,603.16	6,006.83	6,316.71	5,109.43	4,348.96	2,373.49	24,155.41

Table 153 – Step-by-Step Results of Throughput Assessment, Old Peachtree Road at I-85, PM Peak (3-7 PM)

Old Peachtree Road at I-85, PM Peak	GP Lane 1, Pre-Extension (2018)	GP Lane 2, Pre-Extension (2018)	GP Lane 3, Pre-Extension (2018)	GP Lane 4, Pre-Extension (2018)	Express Lane 1, Pre-Extension (2018)	All Lanes, Pre-Extension (2018)	GP Lane 1, Post-Extension (2019)	GP Lane 2, Post-Extension (2019)	GP Lane 3, Post-Extension (2019)	GP Lane 4, Post-Extension (2019)	Express Lane 1, Post-Extension (2019)	All Lanes, Post-Extension (2019)
Observed Vehicle Count	7,279.00	8,557.00	8,818.00	6,698.00	4,291.00	35,643.00	11,904.00	9,431.00	12,370.00	11,713.00	7,024.00	52,442.00
SOV Fraction	76.88%	83.93%	87.58%	88.68%	80.73%	83.34%	88.58%	89.30%	92.21%	91.11%	87.91%	89.81%
HOV2 Fraction	20.79%	14.98%	11.90%	10.59%	15.99%	15.12%	10.84%	10.23%	7.63%	8.04%	9.68%	9.43%
HOV3+ Fraction	2.34%	1.09%	0.52%	0.73%	3.29%	1.54%	0.58%	0.47%	0.16%	0.85%	2.41%	0.77%
Total Vehicle Throughput	5,171.01	5,082.96	4,355.69	3,846.99	3,311.44	21,768.09	6,085.65	5,742.65	4,768.50	3,969.95	3,315.35	23,882.12
Unsubstituted Total Person Throughput	6,513.67	5,971.90	4,929.91	4,316.81	4,171.52	25,903.80	6,832.30	6,391.45	5,150.52	4,372.44	3,882.23	26,628.94
Vanpool Vehicle Throughput	1.54	1.54	1.54	1.54	1.54	7.68	2.66	2.66	2.66	2.66	2.66	13.31
Vanpool Person Throughput	7.31	7.31	7.31	7.31	7.31	36.53	14.85	14.85	14.85	14.85	14.85	74.24
Changes of Vehicle Throughput after Adjustment of Vanpool	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Vanpool	0.39	0.39	0.39	0.39	0.39	1.96	2.87	2.87	2.87	2.87	2.87	14.35
Xpress Vehicle Throughput	0.00	0.00	0.00	0.00	18.26	18.26	0.00	0.00	0.00	0.00	24.00	24.00
CobbLinc Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Vehicle Throughput	0.00	0.00	0.00	0.00	8.00	8.00	0.00	0.00	0.00	0.00	10.00	10.00
Xpress Person Throughput	0.00	0.00	0.00	0.00	526.52	526.52	0.00	0.00	0.00	0.00	655.00	655.00
CobbLinc Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Person Throughput	0.00	0.00	0.00	0.00	148.00	148.00	0.00	0.00	0.00	0.00	171.00	171.00

Changes of Vehicle Throughput after Adjustment of Express Buses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Express Buses	0.00	0.00	0.00	0.00	556.35	556.35	0.00	0.00	0.00	0.00	673.00	673.00
Total Vehicle Throughput after Adjustment	5,171.01	5,082.96	4,355.69	3,846.99	3,311.44	21,768.09	6,085.65	5,742.65	4,768.50	3,969.95	3,315.35	23,882.12
Total Person Throughput after Adjustment	6,514.06	5,972.29	4,930.31	4,317.20	4,728.26	26,462.12	6,835.17	6,394.32	5,153.39	4,375.31	4,558.10	27,316.29

Table 154 – Step-by-Step Results of Throughput Assessment, Hamilton Mill Road at I-85, AM Peak (6-10 AM)

Hamilton Mill Road at I-85, AM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	GP Lane 3, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Observed Vehicle Count	7,927.00	6,583.00	14,510.00	13,056.00	5,959.00	201.00	19,216.00
SOV Fraction	91.62%	89.67%	N/A	94.14%	91.29%	99.00%	95.29%
HOV2 Fraction	7.96%	9.87%	N/A	5.71%	8.26%	1.00%	4.54%
HOV3+ Fraction	0.42%	0.46%	N/A	0.15%	0.45%	0.00%	0.17%
Total Vehicle Throughput	N/A	N/A	N/A	3,892.69	3,209.69	4,656.00	11,758.37
Unsubstituted Total Person Throughput	N/A	N/A	N/A	4,129.57	3,511.32	4,702.33	12,343.22
Vanpool Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vanpool Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Vehicle Throughput after Adjustment of Vanpool	N/A	N/A	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Vanpool	N/A	N/A	0.00	0.00	0.00	0.00	0.00
Xpress Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CobbLinc Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Xpress Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CobbLinc Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCT Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Vehicle Throughput after Adjustment of Express Buses	N/A	N/A	0.00	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Express Buses	N/A	N/A	0.00	0.00	0.00	0.00	0.00
Total Vehicle Throughput after Adjustment	N/A	N/A	N/A	3,892.69	3,209.69	4,656.00	11,758.37
Total Person Throughput after Adjustment	N/A	N/A	N/A	4,129.57	3,511.32	4,702.33	12,343.22

Table 155 – Step-by-Step Results of Throughput Assessment, Hamilton Mill Road at I-85, PM Peak (3-7 PM)

Hamilton Mill Road at I-85, PM Peak	GP Lane 1, Pre-Opening (2018)	GP Lane 2, Pre-Opening (2018)	All Lanes, Pre-Opening (2018)	GP Lane 1, Post-Opening (2019)	GP Lane 2, Post-Opening (2019)	All Lanes, Post-Opening (2019)
Observed Vehicle Count	15,106.00	9,301.00	24,407.00	13,099.00	11,437.00	24,536.00
SOV Fraction	85.50%	85.21%	N/A	90.35%	89.49%	89.86%
HOV2 Fraction	13.61%	13.46%	N/A	8.98%	10.13%	9.64%
HOV3+ Fraction	0.89%	1.33%	N/A	0.67%	0.38%	0.50%
Total Vehicle Throughput	N/A	N/A	N/A	3,586.19	4,790.78	8,376.97
Unsubstituted Total Person Throughput	N/A	N/A	N/A	3,967.29	5,319.62	9,286.91
Vanpool Vehicle Throughput	0.70	0.70	1.40	0.00	0.00	0.00
Vanpool Person Throughput	4.90	4.90	9.80	0.00	0.00	0.00
Changes of Vehicle Throughput after Adjustment of Vanpool	N/A	N/A	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Vanpool	N/A	N/A	0.00	0.00	0.00	0.00
Xpress Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00
CobbLinc Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00
GCT Vehicle Throughput	0.00	0.00	0.00	0.00	0.00	0.00
Xpress Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00
CobbLinc Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00
GCT Person Throughput	0.00	0.00	0.00	0.00	0.00	0.00
Changes of Vehicle Throughput after Adjustment of Express Buses	N/A	N/A	0.00	0.00	0.00	0.00
Changes of Person Throughput after Adjustment of Express Buses	N/A	N/A	0.00	0.00	0.00	0.00
Total Vehicle Throughput after Adjustment	N/A	N/A	N/A	3,586.19	4,790.78	8,376.97
Total Person Throughput after Adjustment	N/A	N/A	N/A	3,967.29	5,319.62	9,286.91

19 Appendix G: License Plate Processing Method Overview

This appendix describes the license plate processing methodologies employed in this project (a mix of manual and machine vision techniques) to obtain vehicle class and license plate information from video captured at the overpass of each data collection site. Video recording of traffic stream was performed at each site. Three hours of video was recorded per session for each morning and afternoon peak, taped concurrent with vehicle occupancy collection. In the laboratory, vehicle and license plate images must be either manually processed by eye, or extracted from each video frame and processed with machine vision techniques. Verification of manual and automated vehicle classes and license plates is also performed for QA/QC purposes (additional human labor to verify a sample of AI-processed plate data). Four license plate processing methods were adopted (with various levels of automation):

1) Method I is a completely manual process that employs undergraduate and graduate labor to view the video images and manually record license plate state, license plate number, and vehicle class into a license plate entry user interface.

2) Method II is a combination of manual and automated processes that first employs manual cropping of vehicle pictures from each video image (two vehicles per video frame). Graduate research assistants cropped images of all vehicles (drawing boxes) using a manual boxing user interface (drawing a box around the vehicle in the video image and pressing a button to record the image). Facebook Detectron2 algorithms were used for automatic vehicle class identification and for license plate shape recognition within the image. Machine vision techniques (ALPR) were then used to capture license plate data (state and plate number) from the license plate in the cropped vehicle image. Human labor was employed to verify and correct AI-processed information (via a manual verification user interface).

3) Method III is an automated process that employs automatic vehicle image cropping, automated plate recognition, and automated license plate data extraction using ALPR, followed by manual verification. Facebook Detectron2 algorithms were adopted to identify and crop the images of each vehicle, to identify vehicle class (same approach as in Method II), and to find and capture the plate image within the vehicle image. ALPR was used to convert the plate image to alphanumeric results. The verification was conducted with human labor using manual verification user interface (the same verification interface used in Method II).

4) Method IV: This method is the same as Method III (full automation with automatic cropping and plate identification using ALPR), but without the manual verification. Once the verification efforts were completed using Method III data and the high accuracy of license plate processing by machine vision was confirmed, the team was able to continue using the Facebook Detectron2 and ALPR method without additional verification labor.

Method I (manual process) employs the manual entry user interface developed by the team, which embedded OpenVLC to control playing of the video (play/pause/stop and play speed), as shown in Figure 140. Each video file is coded by the team with the observation site, data collection date, session (morning vs. evening peak), lane numbers, etc., and the user interface automatically reads the video coding when the user opens the file. The user needs to first switch to the lane of traffic (i.e., left lane or right lane), and pause playback when each vehicle passes the central line, so that the input of all vehicles remain consistent with the timestamp. If the vehicle is partially blocked and the system cannot identify its class or see the plate number, the user can pause when the vehicle and plate can be identified, as long as the sequence of vehicles in data entry remains correct. Even when the plate cannot be identified, users enter the vehicle class (keeping a traffic flow count). After the entry of one lane is finished, the user needs to start the video over, and switch to the other lane (no lane switch during the entry is allowed, to avoid miscoding the lane number). The major disadvantages of Method I include:

- Method I is time-consuming because it is limited by human efficiency in entering the license plate. The user has to wait until the right moment to pause the video (to see the plate), and input efficiency is also limited by the typing speed of the user. Although the research team did multiple tests and training sessions before each user started working, students could only process about six vehicles per minute, which resulted in high labor costs.

- Video quality (poor or extreme light condition, vibration due to strong wind, etc.) or loss of user concentration can lead to misidentification of plate characters and typos are common. Users have to stay focused during the whole entering process, which results in fatigue (consequently errors in input) and the need for frequent breaks (loss of efficiency).

- Plate numbers can be difficult to read by nature. For example, it is difficult to distinguish “O” vs. “Q”, “P” vs. “R”, etc. (GA plate numbering rule). It is also difficult and time consuming to identify non-Georgia plates (requires frequent lookups in auxiliary cheat-sheet and extra training).

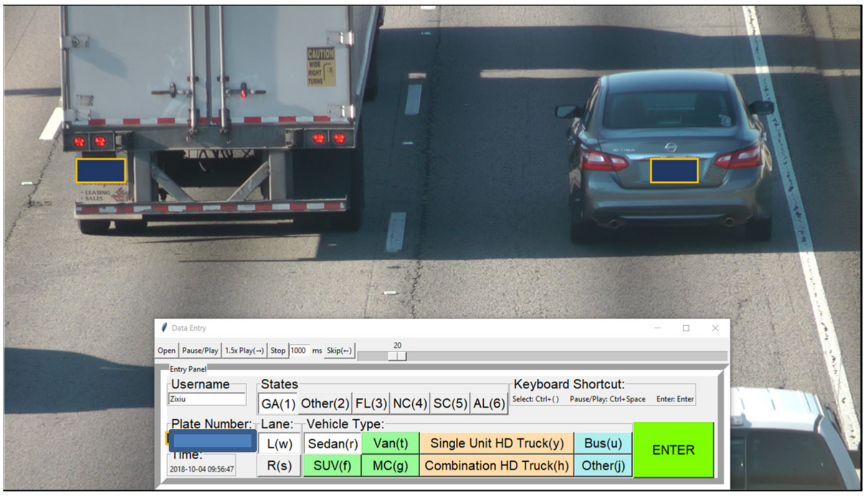


Figure 140 – Manual Entry User Interface

Method II (manual cropping and AI-identification) requires human labor to crop the image for each vehicle observed in the video profiles (one image for each vehicle), so that vehicle class and license plate information were identified by ALPR from the cropped images. The manual box user interface (shown in Figure 141) was developed for the team members to draw a box around each vehicle when it passes the centerline (if the plate is not blocked by another vehicle), or when the plate can be read. The user needs to draw an auxiliary line at the start of each video file that follows the dashed line on the ground, and the lane number of each vehicle is automatically identified when the image is cropped. For each cropped vehicle, the machine vision algorithm identifies and prints the plate number from the zoomed-in vehicle image. Graduate and undergraduate assistants then verified these data and corrected those inaccurate plate entries, using the manual verification user interface, as shown in Figure 142.

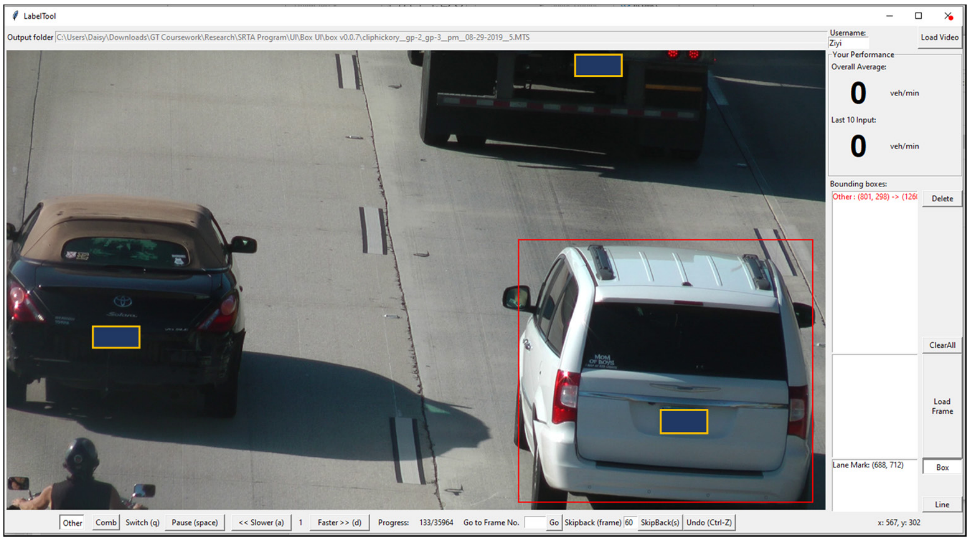


Figure 141 – Manual Box User Interface

Figure 142 – Manual Verification User Interface

Method III and Method IV employ full automation to identify and crop the image of each vehicle (as shown in Figure 143) and process license plate identification using Facebook Detectron2 machine vision algorithms. Various cropped images states (i.e., valid, duplicate/non-vehicle, re-cropping needed, and verification needed) are labeled using colors in the history window of the automation user interface (Figure 144). Each valid vehicle is identified with a green box, any duplicate image or non-vehicle image was indicated with a red box, any image requiring re-cropping is labeled with a yellow box, and each image to be verified manually had no box. Method III also used the same manual verification process as Method II.

The speed of license plate processing improved from six vehicles per minute to around twenty vehicles per minute after transferring from full manual processing (Method I) to automated processing with manual verification (method III). Full automation (Method IV) can further increase the processing speed to thirty to forty vehicles per minute. It is important to note that auto processing can be implemented on a computer continuously (24 hours a day and 7 days a week), while students need a lot more down time (frequent breaks to maintain concentration). The machine vision algorithms process the video profiles on a frame-by-frame basis (regardless how many lanes are captured), while manual work has to input each lane one at a time (to avoid miscoding the lanes). Full automation results in a huge decrease in plate processing labor.

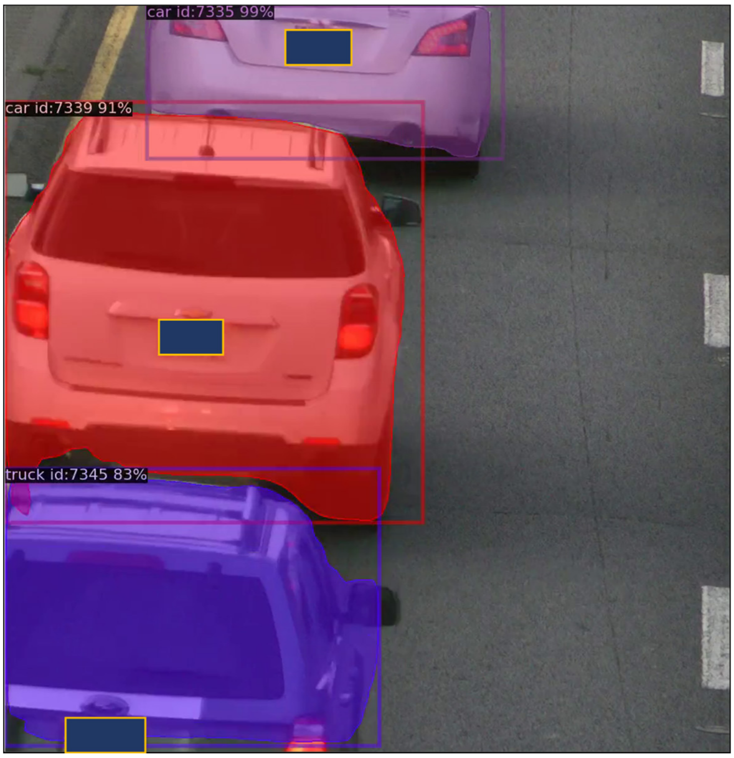


Figure 143 – Auto Crop of Images with Confidence Level by Machine Vision

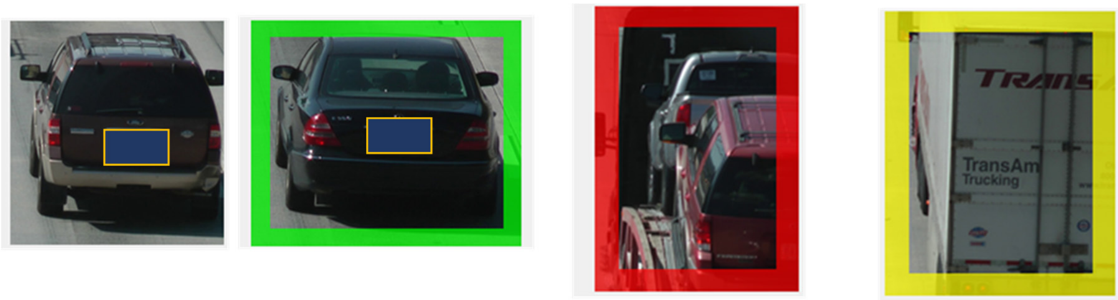


Figure 144 – Various Cropped Image States