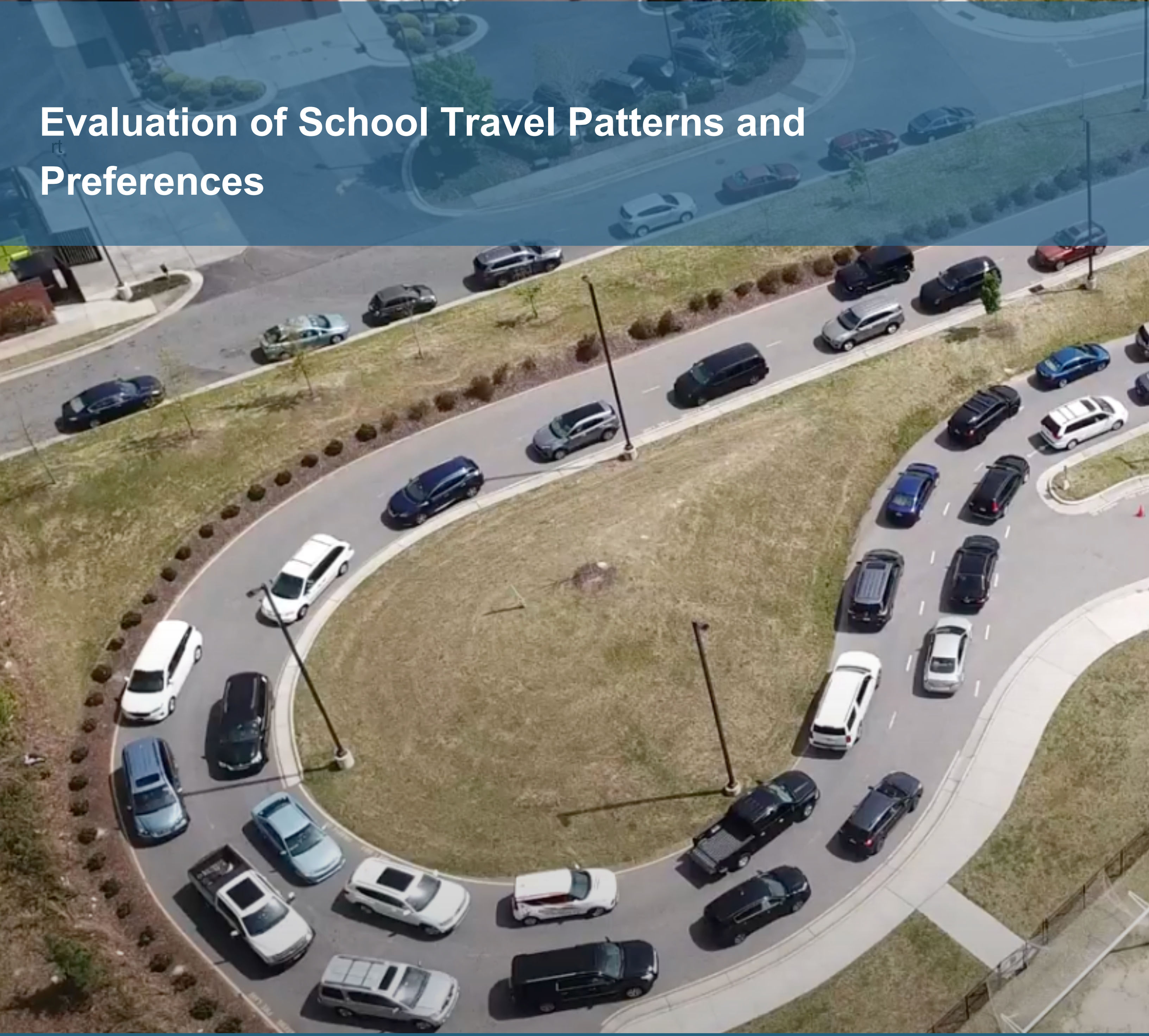
Evaluation of School Travel Patterns and Preferences



NCDOT Research Project 2021-15
RP 2021-15

June 2023

NC STATE UNIVERSITY
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Emeline McCaleb, Brendan Kearns, Joy Davis, Shoaib Samandar, Christopher Vaughan, Daniel Coble, Evan Arnold, Craig Baird, Thomas Dudley, Kihyun Pyo, Lisa Callister, Kaitlyn Zych, Daniel Findley

RESEARCH & DEVELOPMENT

Technical Report Documentation Page

1. Report No. NCDOT/NC/2021-15	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Evaluation of School Travel Patterns and Preferences		5. Report Date June 30, 2023 6. Performing Organization Code
7. Author(s) Emeline McCaleb, Brendan Kearns, Joy Davis, Shoaib Samandar, Christopher Vaughan, Daniel Coble, Evan Arnold, Craig Baird, Thomas Dudley, Kihyun Pyo, Lisa Callister, Kaitlyn Zych, and Daniel Findley		8. Performing Organization Report No.
9. Performing Organization Name and Address Institute for Transportation Research and Education North Carolina State University Centennial Campus Box 8601 Raleigh, NC		10. Work Unit No. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address North Carolina Department of Transportation Research and Development 1020 Birch Ridge Drive Raleigh, North Carolina 27610		13. Type of Report and Period Covered Final Report January 2021 to June 2023 14. Sponsoring Agency Code NCDOT/NC/2021-15
Supplementary Notes:		

16. Abstract

The primary objective of this project was to gather new data to supplement the NCDOT School Traffic Calculator (STC), specifically focusing on estimating vehicular rates and queue length. School travel data was collected from various schools in different regions of North Carolina. The state is experiencing population growth, particularly in urban areas, leading to a rapid construction of new schools. Additionally, existing schools in North Carolina and the entire United States are witnessing an increase in child passenger pick-up and drop-off activities, irrespective of the school's age or location (NHTSA, 2009). Therefore, it is crucial to accurately estimate queue length requirements and trip generation rates at school sites to enhance transportation safety in North Carolina's communities. The research team expanded the existing school travel data by incorporating observations from diverse school types found across the state of North Carolina.

This research provides enhanced accuracy for school travel mode and queue length estimation through updates to the STC calculator. An increased accuracy in queue length needs can improve school site design and traffic management plans.

17. Key Words School, Trip Generation, Queue Length	18. Distribution Statement

19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 74	22. Price

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

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Acknowledgments

The research team wishes to thank the many individuals of the North Carolina Department of Transportation who contributed to the project. Special appreciation is given to the Steering and Implementation Committee for their valuable support of the study.

Research Team

Emeline McCaleb

Brendan Kearns

Joy Davis, M.P.A., PMP

Shoaib Samandar, Ph.D.

Christopher Vaughan

Daniel Coble

Evan Arnold

Craig Baird

Thomas Dudley

Kihyun Pyo

Lisa Callister

Kaitlyn Zych

Daniel Findley, Ph.D., P.E.

Executive Summary

The primary objective of this project is to gather new data to supplement the NCDOT School Traffic Calculator (STC), specifically focusing on estimating vehicular rates and queue length. The research team expanded the existing school travel data by incorporating observations from diverse school types found across the state of North Carolina. This work builds upon NCDOT Research Project 2019-27: School Traffic Trip Generation Calculator Evaluation and Data Collection. Overall, school travel data was collected at 36 schools in various regions of North Carolina.

Accurately estimating queue length requirements and trip generation rates at school sites is key element of enhancing transportation safety in North Carolina communities. The state is experiencing population growth, particularly in urban areas, leading to the rapid construction of new schools. Additionally, existing schools in North Carolina are witnessing an increase in child passenger pick-up and drop-off activities. It's estimated that over 50 million children traveled to school in 2017, 54% of those were driven in private passenger vehicles (National Household Travel Survey (NHTS), 2019).

A key goal of this additional research is to expand the STC draft calculator, updated through NCDOT Research Project 2019-27: School Traffic Trip Generation Calculator Evaluation and Data Collection to include more charter and private school data. Public and charter schools were selected deterministically based on school interest. In alignment with secondary goals, efforts were also made to grow the diversity of the school regions and grade levels included in the calculator dataset.

An initial round of surveys was sent out to schools that desired to participate in the study, and among those that responded with the requested metadata (i.e. number of students, staff, buses, and additional site considerations), sites were chosen based on efficiency, geographic dispersion, and school type. Schools throughout the state were strategically selected to help fill gaps in the existing calculator dataset. Based on the data collected through this and the previous study, the calculator was updated. The proposed updated calculator dataset consists of partial or complete data from 85 schools (based on the two studies completed by ITRE for NCDOT), including information about 33 morning (AM) carpool queues, 63 afternoon (PM) carpool queues, and 28 full-day arrival and departure counts.

Ultimately, this research provides enhanced accuracy for school travel mode and queue length estimation through updates to the STC calculator, with increased accuracy in queue length needs providing the potential for improved school site design and traffic management plans.

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Introduction

A school site's capacity for managing traffic during intensive, peak intervals is a traffic safety issue that has efficiency and safety implications for all modes involved in school travel. In North Carolina, the NCDOT Municipal School Transportation Assistance (MSTA) group reviews Transportation Impact Assessments (TIA) submitted during school site planning for public, private, and charter school systems. Each TIA includes estimates of queue length needs from the MSTA School Traffic Calculator. These estimates are derived from school-specific factors, such as type of school (e.g. Public, Urban Charter, Non-Urban Charter, Private) and student population size. NCDOT approval of proposed school site plans often depends on the projected campus storage capacity to accommodate TIA-estimated passenger vehicle queue lengths and school bus parking.

To support the school siting process, the NCDOT MSTA group developed the School Traffic Calculator (STC) to help predict the vehicle-trips and high-demand queue lengths that will be generated by a new school. The STC is also used to evaluate trip generation and queue lengths following expansions or changes to an existing school site if local data is not available. The highly-utilized planning tool is embedded in the NCDOT approval process for proposed school sites in North Carolina. However, the STC was developed on a dataset with more public than charter or private schools. Additionally, the data collected has future applications, and can encourage users to monitor school travel trends to ensure they are still consistent with previous observations. North Carolina General Statute 136-18(29a)[1] guides the work of the MSTA group.

RP 2021-15: Evaluation of School Travel Patterns and Preferences builds on the work and findings of RP 2019-27: School Traffic Trip Generation Calculator Evaluation and Data Collection by improving data collection methods, expanding the number of schools observed, and further refining the STC based on feedback from NCDOT.

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[1] The introduction of North Carolina General Statute 136-18(29a) includes:

To coordinate with all public and private entities planning schools to provide written recommendations and evaluations of driveway access and traffic operational and safety impacts on the State highway system resulting from the development of the proposed sites. All public and private entities shall, upon acquiring land for a new school or prior to beginning construction of a new school, relocating a school, or expanding an existing school, request from the Department a written evaluation and written recommendations to ensure that all proposed access points comply with the criteria in the current North Carolina Department of Transportation "Policy on Street and Driveway Access."

Literature and Data Review

School arrival and departure is a traffic safety and operational design that relies on transportation infrastructure (e.g., driveways, unloading and loading zones, parking lots, walkways, etc.) on the school's campus to manage traffic during intensive, peak intervals. All modes of school travel – pedestrians, bicyclists, school buses, and passenger vehicles, must be accounted for to ensure arrival and departure are accurately measured. Designing school sites capable of safely managing passenger vehicle traffic is a key factor in the safety of all students traveling to and from school. It's estimated that over 50 million children between the ages of 5 and 17 traveled to school in 2017; more than half of those (54%) were driven in a private passenger vehicle, 33% traveled by school bus, and 10% walked or biked (NHTS, 2019). Moreover, 80% of children in homes less than a quarter mile from their school walked or biked and over half (56%) of those in homes between a quarter mile and half of a mile walked or biked to school. Between 2011 and 2020, there were 1,009 fatal school-transportation-related crashes nationwide and 218 of those were school-age children (NHTSA, 2022). Fatalities among pedestrians were 1.6 times more likely than occupants of school transportation vehicles. Accordingly, the planning, selection, and design of a school site should reflect safety considerations for all students.

Passenger Vehicles and School Safety

When schools face an increase in the number of passenger vehicles that extends beyond their intended capacity, concerns about transportation safety can also increase (Isebrands, 2007). Passenger vehicles can pose two specific threats to school safety. First, congestion on school grounds can lead to accidents involving pedestrians, as pedestrian walkways may intersect with areas where passenger vehicles queue or enter the school premises. Second, the ability of a school to handle the influx of passenger vehicles during peak periods directly affects the safety of nearby roads, as queue spillback onto the roadways can hinder roadway functionality and elevate safety risks. This is particularly true during afternoon pick-up when student release coincides with the afternoon commute and a concentrated flow of vehicles (Tsai et al., 2004).

While school buses have designated loading and unloading zones, managing child passenger pick-up and drop-off can demand a significant portion of a school's space to accommodate lengthy queues, especially during afternoon dismissal. Although traffic engineers and planners generally comprehend the importance of adequate queue length and its impact on traffic safety, many school sites lack the capacity to meet the demands of arrival and dismissal (Isebrands, 2007). The further the distance is between the school and an intersection, roadway capacity can decrease and congestion can rise in combination with limited parking (Liu et al., 2022). This can be attributed to variations between predicted and actual travel behavior, instances of school overcrowding, and rapid population growth in certain regions.

State Travel Trends

The Triangle Regional Model (TRM)[2] is a travel demand model that represents the transportation system and the travel choices that users make as they travel within the greater Triangle region of North Carolina. One of the many data inputs that has helped build and update the TRM is information from household surveys which informs analysts' understanding of the travel choices individuals make within the region. Household survey data are available for the years: 1995, 2006, 2016, and 2018. This wealth of longitudinal data provides snapshots of information, each containing unique insights into temporal travel behavior trends in the region.

Speaking specifically to to-school and from-school travel for Kindergarten through 12th grade students, the TRM household surveys contain information for approximately 7,300 K-12 trips. The total observation count for all trip types

[2] TRM is part of the Institute for Transportation Research and Education.

and across all datasets is 116,000 trips, making K-12 related trips only 6% of trips reported. This rate is lower than expected given that demographically a large portion of the region's population is school-aged, and in school.

The by-mode breakdown of the data across the four survey periods provides several insights. See Table 1, below. A clarification of note is that school bus ridership would be categorized as "Transit" in these tables.

Table 1. **Travel mode choices count from Triangle Regional Model respondent surveys for K-12 associated trips**

			Survey Year			
			1995	2006	2016	2018
Mode	Auto	Count	579	2211	1544	456
		Percent	53.0%	64.5%	72.5%	69.3%
	Bike	Count	7	8	9	3
		Percent	0.6%	0.2%	0.4%	0.5%
	Motorcycle	Count	0	1	0	0
		Percent	0.0%	0.0%	0.0%	0.0%
	Transit	Count	415	1080	517	161
		Percent	38.0%	31.5%	24.3%	24.5%
	Walk	Count	79	119	60	35
		Percent	7.2%	3.5%	2.8%	5.3%
	Other	Count	13	8	0	3
		Percent	1.2%	0.2%	0.0%	0.5%

In general, this data shows that both rates of active travel to school and busing have been declining while the rate of school travel by personal automobile is increasing. The data show a comparatively small sample size for active travel to school, but at a high level, several trends emerge on the topic. (Here active travel includes the Biking and Walking survey responses.)

Tying together data from the TRM with the scholarly literature on the subject reinforces the perception that student-to-school distance has increased over this period (1995-2018). This may be related to a decline in active travel as well, although there is likely a more complex combination of factors leading to the observed increase in personal vehicle travel. However, it is not feasible to draw more than broad conclusions with this data, is it included fewer than 300 active travel trips across the four years. Looking forward into the future of school travel there some unknowns. The latest survey dataset analyzed here is from 2018, making all of the data pre-COVID-19. Although data on the subject is limited, anecdotal evidence from across the U.S. since then suggests bus ridership declined during the COVID-19 pandemic due to a mixture of school closures, a nationwide bus driver shortage, and other factors. School transportation professionals have shared that their experienced a rebound in bus ridership slowly after schools reopened and that they expect car ridership levels will continue to be elevated for years to come, as an increase in car riders was already underway prior to the pandemic.

Safe Routes to Schools North Carolina Travel Data

Data collected by the National Center for Safe Routes to Schools (National Center) provides further insights into North Carolina-specific school travel trends. The National Center compiled a comprehensive dataset focused on the mode of transportation chosen by students in a sample of North Carolina schools. To determine student mode of travel on the day of data collection, homeroom teachers conducted surveys among their students regarding their transportation choices to and from school. The dataset includes information collected by schools, such as the month and year of data collection, the weather conditions reported by the teachers, the time of day, and the number of students utilizing different modes of transportation for their school commutes.

The research team received data on the schools that participated in the data collection process courtesy of the National Center, for periods ranging from one to five years, between 2007 and 2019. By utilizing the tally dataset in conjunction with school population data, the research team estimated the distribution of student transportation modes during morning drop-off and afternoon release periods at the schools. The average mode split by grade was determined based on the reported transportation choices of students in their respective homerooms. This information was then utilized to estimate the total number of students using each transportation mode within the school. The methodology employed to calculate the estimated mode split for each school is detailed in NCDOT Research Project 2019-27: School Traffic Trip Generation Calculator Evaluation and Data Collection. The frequency of student school travel by mode (Figure 1) shows that the highest proportion of PM trips are made by bus (average of approximately 50% of trips), followed closely by personal vehicle trips (average of approximately 40% of trips). Non-motorized trips represent approximately 10% of trips, on average.

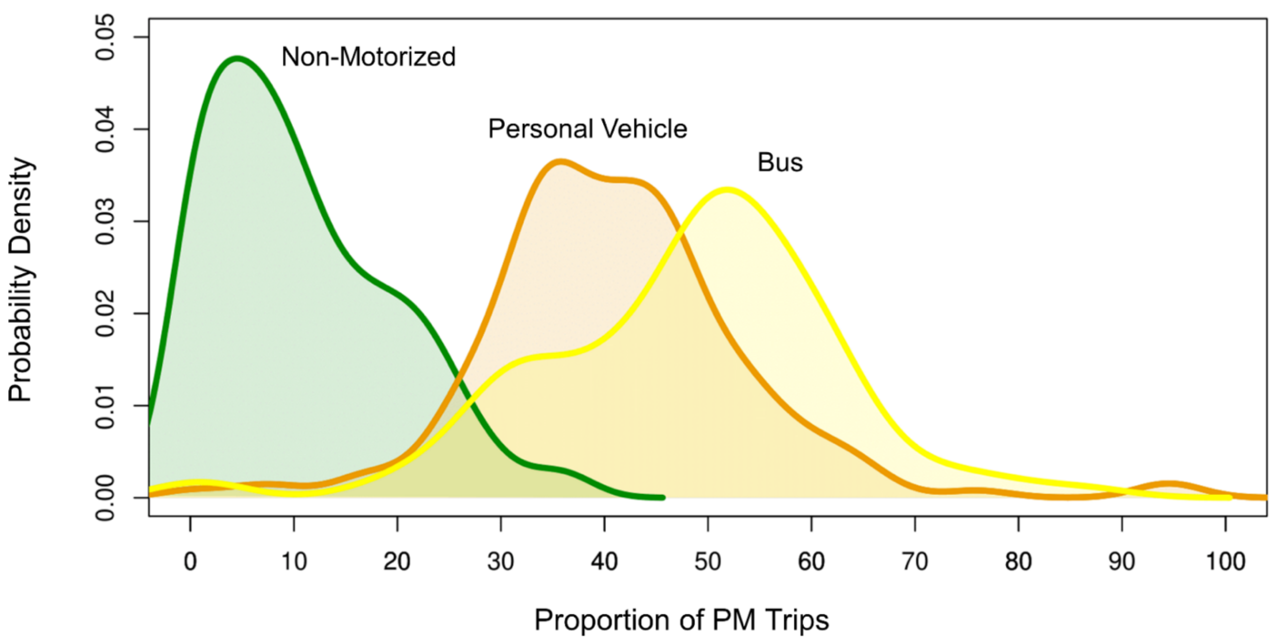


Figure 1. Frequency of Student School Travel by Mode in North Carolina [Non-Motorized, Personal Vehicle, and Bus]

Methodology

School Site Identification and Sample Selection

RP 2019-27: School Traffic Trip Generation Calculator Evaluation and Data Collection

The research team selected a geographically diverse sample of public and charter schools across the state to develop a field-validated dataset which builds upon past iterations of the research project. Public schools were selected prior to the COVID-19 pandemic using a multi-stage sampling process. Records of public schools were extracted from the North Carolina Department of Public Instruction (DPI)'s Educational Directory and Demographical Information Exchange (EDDIE) database. These records were combined with DPI's average daily membership data to estimate the number of students at each school. The population of public schools was further reduced using several criteria, including:

1. Only public schools teaching grades K-5, 6-8, or 9-12, without any overlap between the categories or missing years, were sampled.
2. Only schools following the traditional calendar (as opposed to year-round or hybrid calendars) were sampled.
3. Vocational, alternative education, and hospital schools were excluded.
4. Fully or partially virtual schools were excluded.

Out of 2,704 total schools in EDDIE, 1,556 public schools were eligible for data collection based on this initial filtration step. From this sample, the following process was used to develop a reasonable distribution based on geographic location with the goal of developing a smaller, targeted sample of eligible schools:

1. North Carolina was divided into western, central, and eastern regions. The number of eligible elementary, middle, and high schools in each region was divided by the total number of eligible schools in EDDIE to determine what proportion of the 60-school sample would be drawn from each combination of region and school type.
2. Within each region, two counties were deterministically selected based on feasibility and urban/rural status.
3. The eligible schools within both counties were pooled, then stratified by elementary, middle, and high school. Within each school type stratum, the final set of schools was selected by simple random sample. A selection of backup schools was also chosen in case any of the sampled schools could not be investigated.

Charter and private schools were not included in this sampling process. Schools in these two categories were selected deterministically based on each school's location and willingness to participate in the study. The traditional-calendar and non-virtual restrictions were relaxed for charter schools due to limited sample size. Two schools, one with a year-round calendar and non-virtual instruction and one with a traditional calendar classified as SUPPVIRTUAL instruction, were included in the final draft calculator as a result of these relaxed sampling requirements. Neither contributed AM peak queue length, PM peak queue length, or full-day count data.

The research team initially sampled public schools in six counties (Franklin, Mecklenburg, New Hanover, Rowan, Wake, and Wayne) as well as nine charter schools. Data collection efforts after March 2020 were discontinued because of COVID-19 and the resulting transition from in-person to online school instruction. As a result, the public schools sampled from Mecklenburg County were not visited and data were therefore not collected for these schools, however, schools from Mecklenburg County were observed when data collection resumed. A total of 27 afternoon carpool queues were collected during RP 2019-27, including 13 public elementary school, 7 public middle school, and 4 public high school data points, with the remaining three classified under various grades of urban and non-urban charter schools.

RP 2021-15: Evaluation of School Travel Patterns and Preferences

A key goal of this additional research is to expand the STC draft calculator, updated through RP 2019-27: School Traffic Trip Generation Calculator Evaluation and Data Collection to include more charter and private school data. Public and charter schools were selected deterministically based on school interest. An initial round of surveys was sent to schools that indicated a desire to participate in the study. Among those that responded with the requested metadata (i.e. number of students, staff, buses, and additional site considerations), sites were chosen based on efficiency, geographic dispersion, and school type. Schools were distributed among 18 counties, with the greatest concentration in Wake County (n=6) and Johnston County (n=5). A total of 36 schools were visited during RP 2021-15: 3 public elementary, 5 public middle, 7 public high, 20 charter, and 1 private school. Morning carpool queue lengths were observed at 33 of the 36, and afternoon carpool queue lengths were observed at all sites. All sites visited are listed in Table 2.

Figure 2 displays the locations of all schools contributing data to the calculator during both phases of the project, including locations where carpool queues were not observed. Metadata were collected through the survey and incorporated into the calculator. Sites in red are from the first phase of the project, and sites in blue are from the second phase of the project.

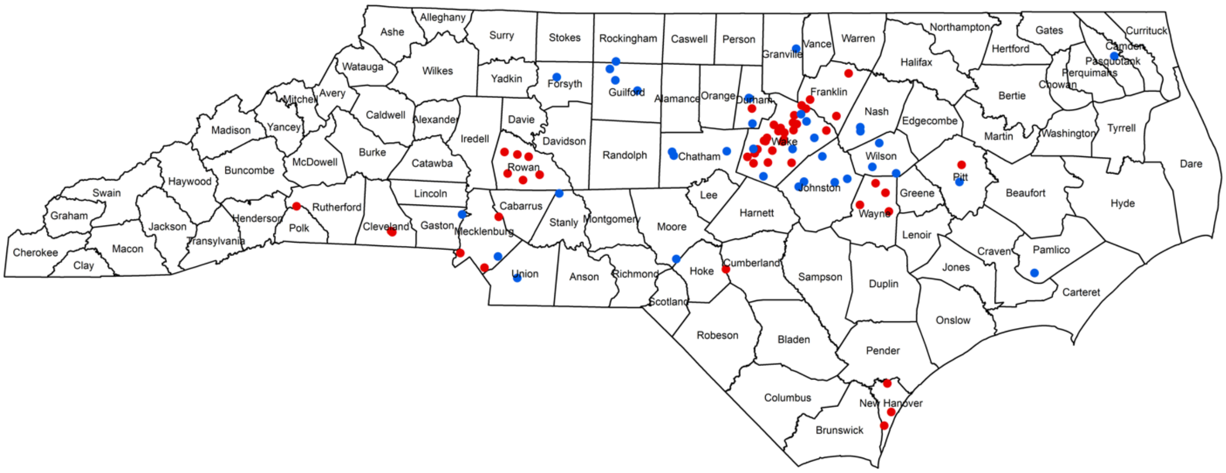


Figure 2. Locations of all schools contributing data. Sites in red are from first phase; sites in blue are from second phase.

Table 2. School Data Collection Information

School Name	EDDIE School ID	City	AM Queue (Ft)[3]	PM Queue (Ft)	Total Trips
Peak Charter Academy	93M000	Apex	5871	5375	1923
Greensboro Academy	41B000	Greensboro	2656	4050	2063
Summerfield Charter Academy	41J000	Summerfield	2054	3305	2119
Forsyth Academy	34F000	Winston-Salem	444	4002	1738
PreEminent Charter School	92M000	Raleigh	993	2761	1788
Northeast Academy for Aerospace & Advanced Technologies	70A000	Elizabeth City	179	1350	2004
The Academy of Moore County	63A000	Aberdeen	794	2498	1130
Rolesville Charter Academy	93P000	Rolesville	1027	3780	1839
Gate City Charter Academy	41L000	Greensboro	1496	3157	1859
Bethany Community School	79A000	Summerfield	192	1635	
Apprentice Academy High School of North Carolina	90F000	Monroe	837	360	720
Telra Institute	62L000	Matthews	316	1392	
Arapahoe Charter School	69A000	Arapahoe	415	524	517
Research Triangle High School	32N000	Durham	639	1153	1555
Oxford Preparatory School	39B000	Oxford	412	1988	2135
Voyager Academy (Elementary campus only)	32L000	Durham	285	3786	
Excelsior Classical Academy CFA	32R000	Durham	3194	2360	1591
East Wake High School	920411	Wendell	2017	1478	
Fuquay-Varina Middle	920424	Fuquay-Varina	1416	2944	
Southern Nash Middle	640362	Spring Hope	1950	2672	
Selma Middle School	510390	Selma	40	592	574
Chatham School of Science & Engineering	190501	Siler City	0	0	
North Johnston High	510368	Kenly	632	1176	1790
Cleveland High School	510327	Clayton	2019	1838	4061
West Johnston High	510406	Benson	2051	878	3318
Southern Nash High	640364	Bailey	N/A	1581	1887
Lucama Elementary	980352	Lucama	352	1047	839
Gray Stone Day School	84B000	Misenheimer	N/A	5386	1738
Mountain Island Charter School Inc	36C000	Mt. Holly	3802	1964	3335
Stantonsburg Elementary	980388	Stantonsburg	0	220	369
New Hope Elementary	980360	Wilson	567	1478	1114
Chatham Middle	190312	Siler City	N/A	902	991
Seaforth High School	190349	Pittsboro	712	1429	2189

[3] AM queue length was not collected in RP 2019-27, and is marked with “N/A.”

School Name	EDDIE School ID	City	AM Queue (Ft)[3]	PM Queue (Ft)	Total Trips
Archer Lodge Middle	510364	Wendell	704	2847	1957
Winterville Charter Academy	74C000	Winterville	1336	3157	1539
Thales Academy of Wake Forest	A0902540*	Wake Forest	2629	3012	
West Rowan Elementary	800406	Cleveland	N/A	2080	
Harold D Isenberg Elementary	800358	Salisbury	N/A	952	
Charles C Erwin Middle School	800314	Salisbury	N/A	1344	
West Rowan Middle School	800410	Salisbury	N/A	1358	
Lynn Road Elementary	920488	Raleigh	N/A	1410	
Wildwood Forest Elementary	920618	Raleigh	N/A	1491	
Wakelon Elementary	920597	Zebulon	N/A	1206	
York Elementary	920628	Raleigh	N/A	1850	
Bryan Road Elementary	920349	Garner	N/A	1454	
Laurel Mill Elementary	350330	Louisburg	N/A	517	
Bunn Elementary	350304	Bunn	N/A	1733	
Northwoods Elementary	920520	Cary	N/A	1139	
Richland Creek Elementary School	920543	Wake Forest	N/A	1579	
Apex Friendship High	920317	Apex	N/A	2064	
Wakefield High	920595	Raleigh	N/A	1701	
Apex High	920316	Apex	N/A	1210	
Wakefield Middle	920594	Raleigh	N/A	1238	
East Millbrook Middle	920408	Raleigh	N/A	840	
Leesville Road Middle	920471	Raleigh	N/A	944	
Reedy Creek Middle	920400	Cary	N/A	2108	
Edwin A Anderson Elementary	650323	Wilmington	N/A	1868	
Walter L Parsley Elementary	650380	Wilmington	N/A	1294	
Eastern Wayne High School	960330	Goldsboro	N/A	1121	
Holly Shelter Middle School	650343	Castle Hayne	N/A	1558	
Ignite Innovation Academy - Pitt	74B000	Greenville	N/A	322	
Lake Lure Classical Academy	81B000	Lake Lure	N/A	852	
Pinnacle Classical Academy (Lower Elem Campus)	23A000	Shelby	N/A	2562	

* No EDDIE ID; identified by NCDS School ID

School Traffic Data Collection

After determining which schools would be sampled, the research team contacted the relevant school district offices (when applicable) to notify them of the data collection intentions and gain approval for the data collection effort. Once the school districts approved the data collection effort, individual schools were contacted approximately two weeks prior to data collection to notify them of the dates and times that researchers would be at the school to install and remove camera equipment. Vehicles that did not travel through the designated queuing area were capturedcaptured in the full-day count of arrivals and departures at schools where full-day counts were observed, but were not included in the queue length. The research team also worked with each school to gather information regarding any pertinent scheduling conflicts that could affect the data collection or result in atypical drop-off or pick-up behavior, such as holidays or special events. During the initial phone call with individual schools, the research team was able to ask about the queue length and queuing process, which allowed for ideal queue observation during data collection. A summary of the data collection process is presented in Figure 3, below.

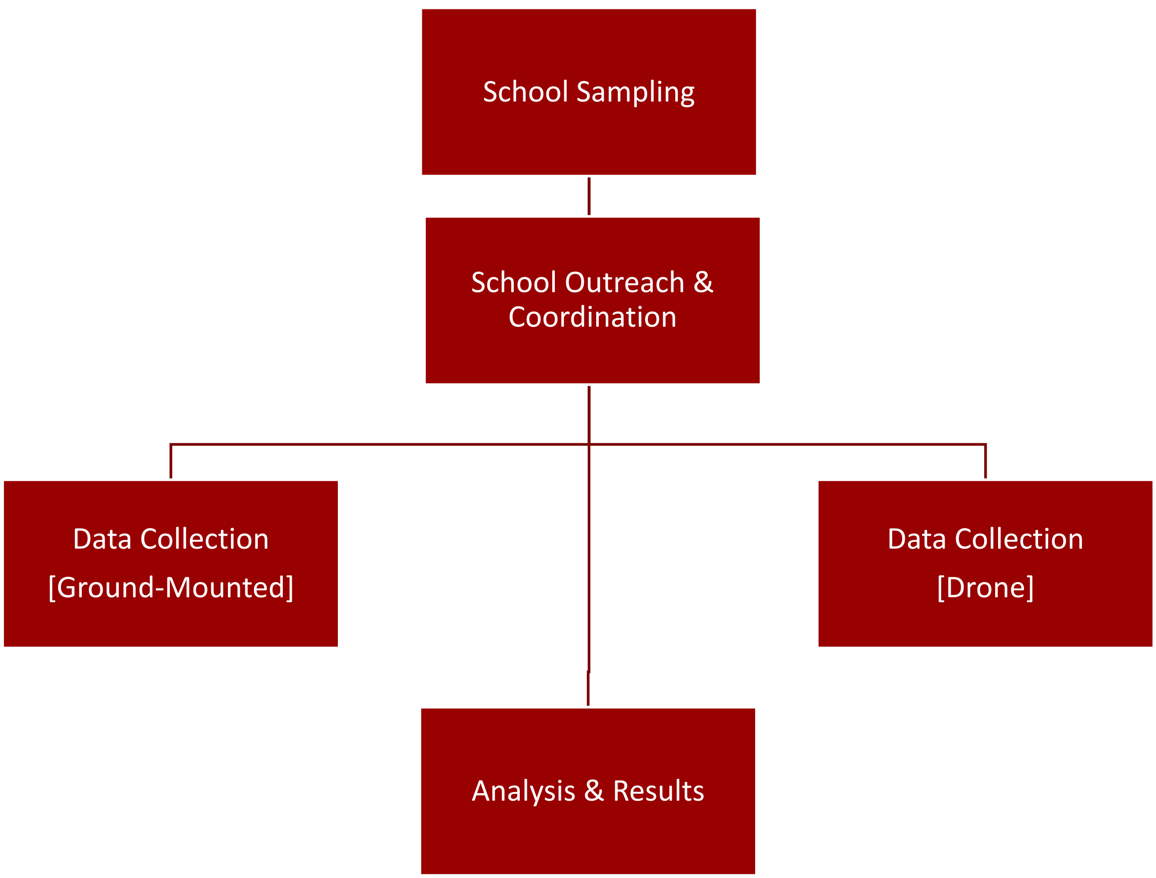


Figure 3. School Traffic Data Collection Process

A reminder email was sent to schools the day before data collection with information regarding the monitoring equipment installation process and the planned length of collection. Many schools sent email notifications to parents to inform them of the research team's presence on campus, per school or district protocol. However, no equipment was installed or removed during the drop-off or pick-up process at any schools. The video camera installation process typically occurred during mid-morning or late afternoon, when parents and/or students were not arriving to or leaving from the school campus area. If only using static cameras for data collection, the data collection team was not on campus during the drop-off or pick-up times. When a drone was used for data collection at a school, research team members were on or near campus during these times to operate the drone, but team members were always at a distance from the vehicle queue.

To avoid any abnormal behavior related to the weekend plans of students or their families, data was not collected on Monday mornings or Friday afternoons. Data was most often collected on Tuesdays, Wednesdays and Thursdays. Most often, cameras were installed at the beginning of the week for all schools to be observed that week, generally on Monday or Tuesday. The cameras were uninstalled at the end of the week, typically Thursday or Friday. Once the video cameras were picked up and brought back to the research team's office, data were downloaded from the video cameras for the Tuesday, Wednesday and Thursday schools. At most, three schools were observed each week (when proximity and schedules allowed), while most data collection weeks consisted of data collection at two schools.

Drone data collection was was added as a supplementary form of data collection for this study. Therefore, data at each school was collected via a combination of drone and static cameras. Standard ground-mounted video cameras were used to supplement drone data collection by recording entries and exits at all roadwayroadway access points to each school, as the drone pilot could not fly all day at the schools due to drone battery limitations, but all trips to and from the school were necessary for this research.

For ground-mounted video, static cameras were installed on either light posts or trees at or around each campus. These cameras were positioned to ensure, whenever necessary, capture of the entire queue. The cameras were fixed to objects using hose clamps that are adjustable and do not require permanent changes to the environment. Each camera was initially positioned with an approximate field of view and was further calibrated after the camera was securely attached to the pole or tree.

After attaching the camera to the pole or tree, settings could be adjusted using a computer connected to the camera via ethernet. Generally, the only settings that needed adjustment were the recording schedule (depending on the arrival and departure times of students), the infrared settings (if the morning drop-off started before or during the dawn hours), and the image quality (to ensure that no faces or vehicle license plates were identifiable, while still being able to adequately observe the drop-off or pick-up process). The video recordings were stored on an SD card inserted into the camera housing. Once the camera settings were adjusted as needed, the box holding the camera batteries was closed, locked, and chained to a fixed object nearby for security purposes. This box is low profile and inconspicuous. An example of a typical camera installation is shown in Figure 4, while Figure 5 shows the typical views from the ground-mounted cameras.

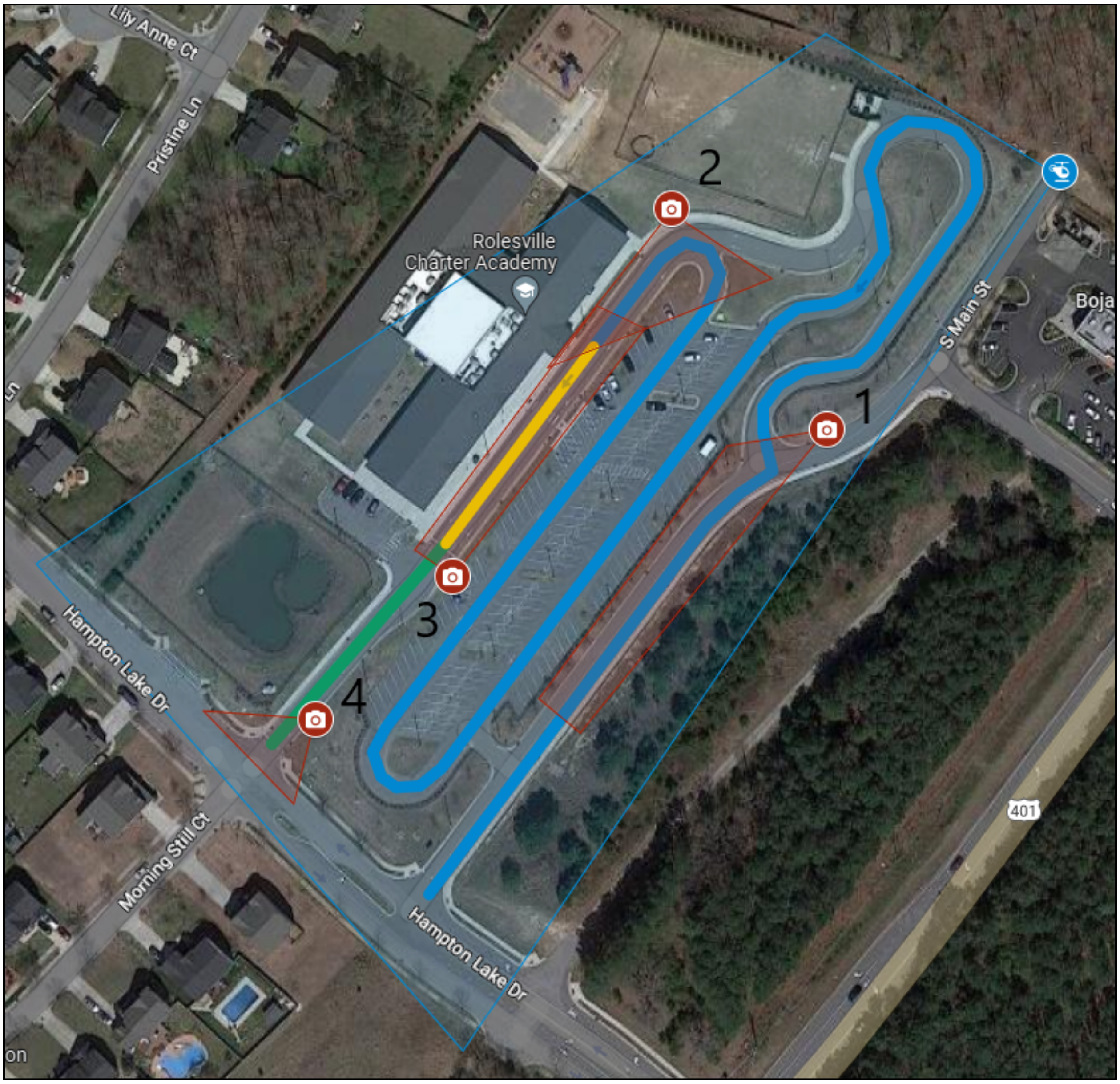
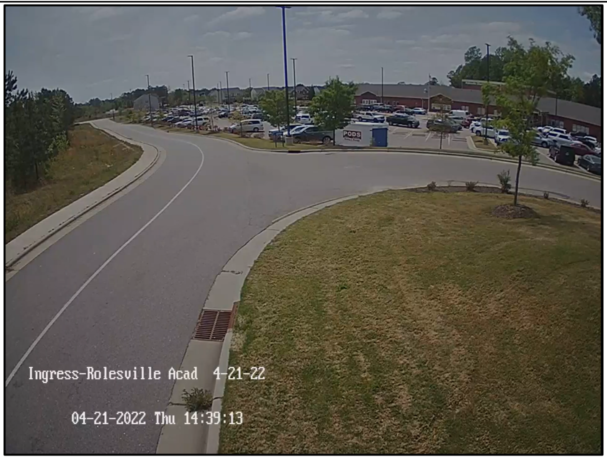


Figure 4. Typical Camera Installation



Camera 1

Camera 2

Camera 3

Camera 4

Figure 5. Typical camera views

The data collection team selected an inconspicuous location to fly the drone to avoid confusion from parents, which could potentially impact the drop-off or pick-up process. The data collection team would deploy the drone as queueing began and, when possible, would not bring the drone down until the queue had completely dissipated, except to swap batteries, if necessary. Each drone was connected to the ground with an FAA-licensed pilot who operated the drone throughout the duration of the data collection. Compared to ground-based cameras, drones offered substantial improvements to visual continuity. The use of drones also reduced data collection installation time. Figure 6 shows an example of the view from the drone during data collection. In total of the 63 schools contributing queue data to the draft calculator, 27 were observed using ground mounted cameras only during RP 2019-27, and an additional 36 observed using drones during RP 2021-15.

Figure 6. Example Drone View

For both ground-based camera and drone data collection, efforts were made to avoid capturing identifiable information like faces and vehicle details as much as possible. In the case of drones, the research team was able to position the drones in locations farther away from the actual pick-up and drop-off locations, such as athletic fields and sidewalks.

Once data collection for a school was complete, individual video files representing separate camera views were combined into one video for analysis using physical cues and time stamps in the videos to ensure accurate synchronization of the views. An online map was created for each school so the research team could document and communicate what each camera observed.[4]

Data Analysis – RP 2019-27

An analyst watched one or more ground-mounted camera videos to capture vehicles entering and exiting the carpool queue, recording the timestamp of each arrival and departure. Vehicle were recorded as entering when they reached the back of the queue and marked as exiting when they passed from the queue to the loading zone.

After the timestamps of the entrances and exits were collected, the total number of entrances and exits were compared to identify if any errors occurred during data collection. These were recorded as the “Total In” and “Total Out” fields in the RP 2019-27 calculator, respectively. The cumulative arrival and departure totals across time were compared to determine the maximum queue length in cars, and recorded in the “Max Q (Cars)” field. The maximum queue length in feet was estimated by locating the furthest extent of the queue observed on camera on Google Earth and tracing the path of the queue to the loading zone, then measuring the resulting polygon.

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[4] Online maps are available for view on Google Drive: https://drive.google.com/drive/folders/1Eps8SBYEe5ibCZGQwC5glpGeQfb96Hsn?usp=share_link

Data collectors did not record student attendance on the day of field data collection. Estimates of student attendance were made using NC DPI records, based on the lowest monthly average daily membership (ADM) record of the school year. At the end of the project, schools were contacted to retrieve student counts on the day of data collection where available. 11 schools provided either head counts or estimates.

Data Analysis – RP 2021-15

An analyst watched one or more ground-mounted cameras to capture full-day vehicle arrivals to and departures from campus, recording the timestamp of each arrival and departure. The arrival and departure records for all ingress and egress points at a given school were combined, and the arrivals and departures grouped into five-minute bins.

Queue lengths were captured in the field by a drone. The maximum queue length in feet was estimated by tracing the queue at its maximum extent, as observed in the drone footage, using online mapping software and recording the resulting polygon lengths. Loading zone lengths were estimated using the same procedure. The same analyst observed the queue lengths and loading zone lengths at all sites to avoid inter-rater variance.

Student population was estimated from enrollment reported by electronic survey of the schools visited at 33 locations, by head count reported by electronic survey of the school visited at one location, by ADM estimate (using the same methodology as RP 2019-27) at one location, and by e-mail confirmation with NCDOT staff at the final location. The surveys were completed by principals, vice principals, and other school administrators.

Analysis of Loading Zones

The performance of loading zones was assessed at a subset of the schools where full-day arrival and departure counts were obtained. Maximum departure rate from the loading zone, in vehicles per minute, was used as the primary measure of efficiency.

Egress rates from campus were used as a proxy for departure rates from the loading zone; all public high schools and charter or private schools instructing grades 11 and 12 were excluded to prevent student drivers from skewing results as they cannot be distinguished from parents (remaining sample size: n = 16). The maximum departure rates were calculated by evaluating five-minute and fifteen-minute windows, with start and end points constrained to five-minute increments (i.e. 6:00 AM, 6:05 AM, 6:10 AM…), adding up the total number of vehicles that departed within the window, and normalizing to a per-minute rate. Plots of these maximum average departure rates are displayed below.

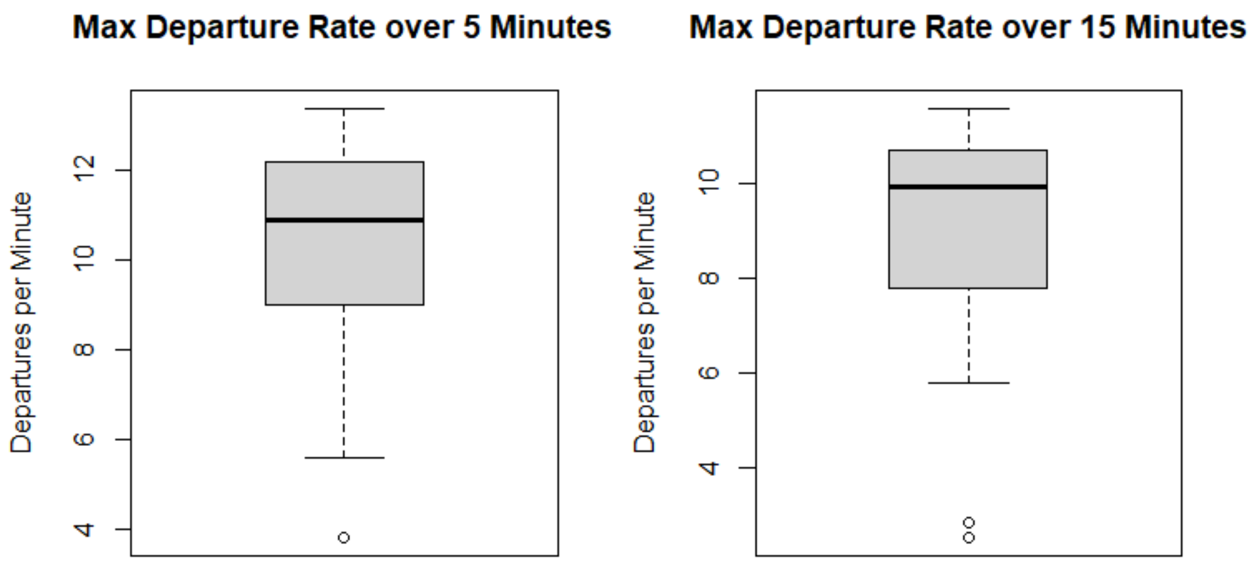


Figure 7. Maximum departure rate over 5 minutes and 15 minutes

Stantonsburg Elementary is an outlier in both cases (3.8 cars/min departure rate over a five-minute window; 2.5 cars/min departure rate over a fifteen-minute window.) It has the lowest attendance of any school in the loading zone analysis sample, with only 210 students. It is plausible that this impacted results. Selma Middle School is an outlier over a fifteen-minute window (2.9 cars/minute). Selma Middle School has the highest bus ridership of any school in the sample, reported at 92.1% (348 of 378 students). This likely led to fewer carpool vehicles than normal.

Schools' use of technology or software to assist with the student loading and unloading process was assessed by an electronic survey. Respondents were asked to describe any technology or software used to assist with the process in a free-response format; as a result, nonresponse may not be correlate perfectly to "no technology."

Urban charter schools were very likely to use the Driveline app as a logistics aid. One public school used Google Forms to assist with dismissal, but most public schools did not use an app or equivalent. The results of the survey are summarized below.

Table 3. Logistics aid use by school type

School Type	App or Equivalent	No Technology Mentioned	Unable to Determine
Urban Charter	7	0	1*
Private or Non-Urban Charter	0	2**	0
Public	1	5***	0

*School was about to start using SchoolPass; not known if use started before data collection.
**One non-urban charter school in this category indicated using walkie-talkies.
***One public school in this category uses Here Comes the Bus, an app which appears to be used primarily for allowing students and parents to track bus locations in real-time, rather than queue management.

There is not statistically significant evidence ($t = 2.1859$, on 7.1302 degrees of freedom; p-value = 0.06437) of a true difference in average maximum departure rates over a five-minute window between schools that use an app and schools that do not. There is also not statistically significant evidence ($t = 2.0241$, on 7.1152 degrees of freedom; p-value = 0.08197) of a true difference in average maximum departure rates over a fifteen-minute window between schools that use an app and schools that do not. This should be interpreted with caution due to small sample size (eight locations with app use, seven without). The sample means are shown in the table below.

Table 4. Sample means of departure rates for schools that did and did not utilize logistics aid

	App	No App
5-Minute Window	11.70 cars/min	9.00 cars/min
15-Minute Window	10.17 cars/min	7.79 cars/min

Data Collection Considerations

A variety of factors may be useful when considering whether to use ground-mounted video cameras or a drone to collect school queueing and trip information. For short-duration counts, drones can provide lower set-up costs and data processing (due to one, seamless camera view during post-processing). Drones also provide a more flexible setup with a camera angle that can be adjusted in real-time as the operational conditions change. However, for longer duration counts, ground-mounted cameras may be advantageous because they can be left unattended for an extended time period (for example, for daily counts into and out of a school).

Calculator Design

The front-end components of the proposed revised calculator are almost identical to the current MSTA calculator, and many major design features are similar:

- Schools are divided into public, private/non-urban charter, and urban charter categories. The breakdown of grades within each category is unchanged:
  - Public: Elementary (PK-5), Middle (6-8), and High (9-12)
  - Private/Non-Urban Charter: PK-K, Grades K-10, Grade 11, and Grade 12
  - Urban Charter: Grades K-10, Grade 11, Grade 12
- Carpool queue lengths for each category are calculated based on the sample mean queue length by school type and grade, with a user-adjustable highhigh-demand length factor applied to the total queue.

Changes include:

- The revised calculator back-end has been reorganized into a database-like format:
  - The “Schools” tab contains one row for each school in the calculator, with a unique identifier, name, EDDIE school ID, address, and school type.
  - The “School Metadata” tab contains all observational and survey data, including queue lengths, student attendance, staff, and bus data, with the exception of full-day arrival and departure counts.
  - The “Trip Gen Counts” tab contains full-day arrival and departure counts.
  - The “Calculations” tab contains intermediate results from reducing data from the “School Metadata” and “Trip Gen Counts” tab to a per-student basis.

- The “CalcSummary” tab contains the aggregated and weighted per-student estimates that are used to generate queue length and trip generation estimates.

- Peak-hour traffic volume estimates based on a percentage of the ADT have been replaced by five-minute-resolution trip generation estimates for two hours before and after the start of school, and three hours before and after the end of school, based on trips captured using ground mounted cameras during the second phase of the project. Full-day arrival and departure counts were also used to estimate uniform-rate approximations for trips before the proposed AM peak period, after the PM peak period, and between the AM and PM peak periods.
- AM carpool vehicles are estimated from full-day counts based on the number of departures from campus during the morning peak, under the assumption that staff and student drivers will stay on campus after arrival.
- PM carpool vehicles are estimated from full-day counts based on the number of arrivals to campus during the afternoon peak, since drivers and staff are already on campus.
- AM and PM maximum queue lengths are calculated based on the average length in feet per student, without intermediate calculations of vehicle length, number of carpool vehicles, or proportion of carpool vehicles present at once.
- High-demand queue length is not adjusted based on the number of student drivers.
- Schools falling into one or more grade categories are allocated among categories based on population per grade. This is explained in more detail in the section below.

Grade Categorization

Every public school sampled by the research team fit neatly into a single grade category (i.e. grades K-5 for public elementary schools, or 9-12 for public high schools.) However, the private/non-urban charter and urban charter schools generally did not. For example, one school instructed grades 3-11. A weighting algorithm was developed such that schools that were “more representative” of a given category would be weighted more heavily. For each category, the school’s weight was calculated as the number of students instructed in that category divided by the number of students instructed by the school.

Given a school of type $s \in$ {Public, Private/Non-Urban Charter, Urban Charter}, instructing a number of students per grade $G_i,\ 0 \leq i \leq 12$, where both pre-kindergarten and kindergarten evaluate to Grade 0 and all other grades are evaluated as their numeric equivalent, the weight W for each category can be calculated as:

$$\mathrm{W(Public\ Elementary)} = \begin{cases} \dfrac{\sum_{i=0}^{5} G_i}{\sum_{i=0}^{12} G_i} & s = \text{Public} \\ 0 & s \neq \text{Public} \end{cases}$$

$$\mathrm{W(Public\ Middle)} = \begin{cases} \dfrac{\sum_{i=6}^{8} G_i}{\sum_{i=0}^{12} G_i} & s = \text{Public} \\ 0 & s \neq \text{Public} \end{cases}$$

$$\mathrm{W(Public\ High)} = \begin{cases} \dfrac{\sum_{i=9}^{12} G_i}{\sum_{i=0}^{12} G_i} & s = \text{Public} \\ 0 & s \neq \text{Public} \end{cases}$$

Analogous equations apply to private/non-urban charter and urban charter school grade categories. The sum of category weights at a given school always adds up to 1. For example, the urban charter school instructing grades 3-11 introduced above would be weighted as shown in Table 5.

Table 5. Example weighting design

Category	Students	Weight
Urban Charter Grades K-10	502	0.947169811
Urban Charter Grade 11	28	0.052830189
Urban Charter Grade 12	0	0

Queue Length and Trip Generation Results

School Traffic Data Analysis

The proposed calculator dataset consists of partial or complete data at 85 schools, including 33 morning (AM) carpool queues, 63 afternoon (PM) carpool queues, and 28 full-day arrival and departure counts. All schools in the proposed calculator were observed during the first and second phases of this study. The tables below compare this dataset to the existing MSTA calculator.

Several schools generated queues with parallel lines of vehicles throughout some length of the queue. Additionally, some schools served afternoon carpool traffic with multiple separate loading zones. In both cases, the maximum queue lengths in feet from all component queues were added together, under the assumption that a length of queue equivalent to the combined maximums would be generated if only a single loading zone was available (i.e. a worst-case combination was created, regardless of time offsets).

Table 6, below, shows the predicted maximum queue length in feet per student for the proposed calculator AM and PM queue. By default, a 30% factor of safety is added in the calculator; the factor of safety has not been applied in the table below. Sample sizes are given as weights, where the total weights across all grade categories adds up to the total number of schools visited (or surveyed), and as sites visited, where every distinct location that was visited and contributed to a grade category is counted as an observation.

Table 6. Predicted maximum queue length in feet per student

Category	Sample Size AM Queue	Max AM Queue (Feet/Student)	Sample Size PM Queue	Max PM Queue (Feet/Student)
Public Elem	3.000 (3)	0.771	16.000 (16)	2.710
Public Middle	4.000 (4)	1.077	12.000 (12)	1.923
Public High	6.000 (6)	0.904	11.000 (11)	0.995
Private PK-K	0.811 (6)	2.215	1.234 (8)	4.952
Private Grades 1-10	5.617 (7)	1.653	7.834 (10)	3.758
Private Grade 11	0.339 (4)	0.921	0.519 (6)	3.448
Private Grade 12	0.233 (4)	1.142	0.413 (6)	3.487
Urban Charter Grades K-10	11.917 (13)	2.360	12.917 (14)	4.629
Urban Charter Grade 11	0.644 (3)	1.764	0.644 (3)	1.715
Urban Charter Grade 12	0.438 (3)	1.778	0.438 (3)	1.719

Table 7, below, compares the predicted maximum queue lengths from the existing and proposed calculator. For this table, the default 30% factor of safety is applied, and for the existing MSTA calculator, all suggested values for buses, staff, and student drivers were entered (this appears to affect predicted queue for private and urban charter schools.)

Predicted queue lengths for private/non-urban charter and urban charter schools are likely greater due to many charter and private schools (about half in our sample) not providing buses for their students. The presence of student drivers is the most likely cause for lower per-student carpool queue lengths for high school students.

Table 7. Comparison of predicted maximum queue lengths from existing and proposed calculator

Category	Existing Calculator Maximum Queue (Feet/Student)	Proposed Calculator Maximum Queue (Feet/Student)	Percent Change
Public Elem	3.281	3.523	7.4%
Public Middle	2.451	2.500	2.0%
Public High	1.875	1.293	-31.0%
Private PK-K	5.498	6.437	17.1%
Private Grades 1-10	2.849	4.885	71.5%
Private Grade 11	4.624	4.482	-3.1%
Private Grade 12	2.253	4.533	101.2%
Urban Charter Grades K-10	5.498	6.017	9.4%
Urban Charter Grade 11	4.624	2.294	-50.4%
Urban Charter Grade 12	2.253	2.312	2.6%

Table 8, below, compares the predicted number of staff per student from the existing and proposed calculator.

Table 8. Comparison of predicted number of staff per student from existing and proposed calculator

Category	Existing Staff/Student	Proposed Staff/Student	Proposed Calculator Sample Size	Percent Change
Public Elem	0.118	0.145	20.000 (20)	23%
Public Middle	0.102	0.114	9.000 (9)	12%
Public High	0.092	0.113	11.000 (11)	22%
Private PK-K	0.131	0.110	1.213 (8)	-16%
Private Grades 1-10	0.131	0.106	7.855 (10)	-19%
Private Grade 11	0.114	0.100	0.519 (6)	-12%
Private Grade 12	0.103	0.104	0.413 (6)	1%
Urban Charter Grades K-10	0.125	0.101	15.799 (17)	-19%
Urban Charter Grade 11	0.114	0.101	0.735 (5)	-11%
Urban Charter Grade 12	0.103	0.098	0.466 (4)	-5%

Table 9 compares the predicted number of student drivers per student from the existing and proposed calculator.

Table 9. Comparison of predicted number of student drivers per student from existing and proposed calculator

Category	Existing Student Drivers per Student	Proposed Student Drivers per Student	Proposed Calculator Sample Size	Percent Change
Public High	0.160	0.187	10.000 (10)	17%
Private Grade 11	0.320	0.719	0.519 (6)	125%
Private Grade 12	0.850	0.725	0.413 (6)	-15%
Urban Charter Grade 11	0.320	0.352	0.735 (5)	10%
Urban Charter Grade 12	0.850	0.242	0.466 (4)	-72%

The proposed calculator is equipped with drop-down tabs to indicate “With Buses” or “Without Buses” for private/non-urban charter and urban charter schools, in addition to public schools. It is assumed that school planners will know beforehand whether their school will be serviced by bus routes or not. Table 8 compares the predicted number of buses per student in the existing calculator to the predicted number of buses per student in the proposed calculator. Predicted buses for the proposed calculator in the table below are conditional on the school being served by buses (i.e. schools with no buses were excluded from the average.)

The apparent decrease in bus ridership follows the aforementioned trends towards a decrease in bus ridership and an increase in car ridership over the last several years before the COVID-19 pandemic. This trend was seen in TRM data and the literature, as well as from conversations with school transportation professionals

Table 10. Comparison of predicted number of buses per student from existing and proposed calculator

Category	Existing Buses/Student	Proposed Buses/Student	Proposed Calculator Sample Size	Percent Change
Public Elem	0.0140	0.0124	19.000 (19)	-12%
Public Middle	0.0217	0.0149	8.000 (8)	-31%
Public High	0.0158	0.0213	10.000 (10)	35%
Private PK-K	0.0140	0.0081	0.520 (4)	-42%
Private Grades 1-10	0.0140	0.0091	4.009 (5)	-35%
Private Grade 11	0.0217	0.0106	0.273 (3)	-51%
Private Grade 12	0.0158	0.0110	0.198 (3)	-30%
Urban Charter Grades K-10	0.0140	0.0115	5.917 (7)	-18%
Urban Charter Grade 11	0.0217	0.0071	0.644 (3)	-67%
Urban Charter Grade 12	0.0158	0.0067	0.438 (3)	-58%

Trip Generation

Under typical circumstances, schools are substantial trip attractors twice a day, during the morning arrival and afternoon dismissal. The full-day arrival and departure counts collected during Phase 2 of the project were used to create trip generation models, based on the following observations:

- AM peak periods generally began no earlier than 2 hours before the start of school and ended no later than 2 hours after the start of school. In some cases, we started observing the AM peak less than 2 hours before the start of school due to data collection constraints. In most cases, this window was much wider than required to capture all AM peak trips.
- PM peak periods generally began no earlier than 3 hours before the start of dismissal and ended no later than 3 hours after the end of dismissal. In most cases, this window was much wider than required to capture all PM peak trips.

- With rare exceptions for sports events or similar late-night attractors, trips to and from a school were almost entirely concentrated in the morning and afternoon peaks. As a result, all traffic before the AM peak period began, all traffic in mid-day between peak periods, and all traffic after the PM peak were treated as uniform arrivals and departures.

A graphical tool was added to the front-facing Public, Private/Non-Urban Charter, and Urban Charter tabs, showing projected trips every five minutes during the AM and PM peaks. Tables are also provided on each tab if a more accurate numerical analysis is desired.

Figure 8, below, displays trip generation rates in five-minute intervals (i.e. how many arrivals and departures combined are expected to occur within five minutes), per student, for all combinations of school and grade.

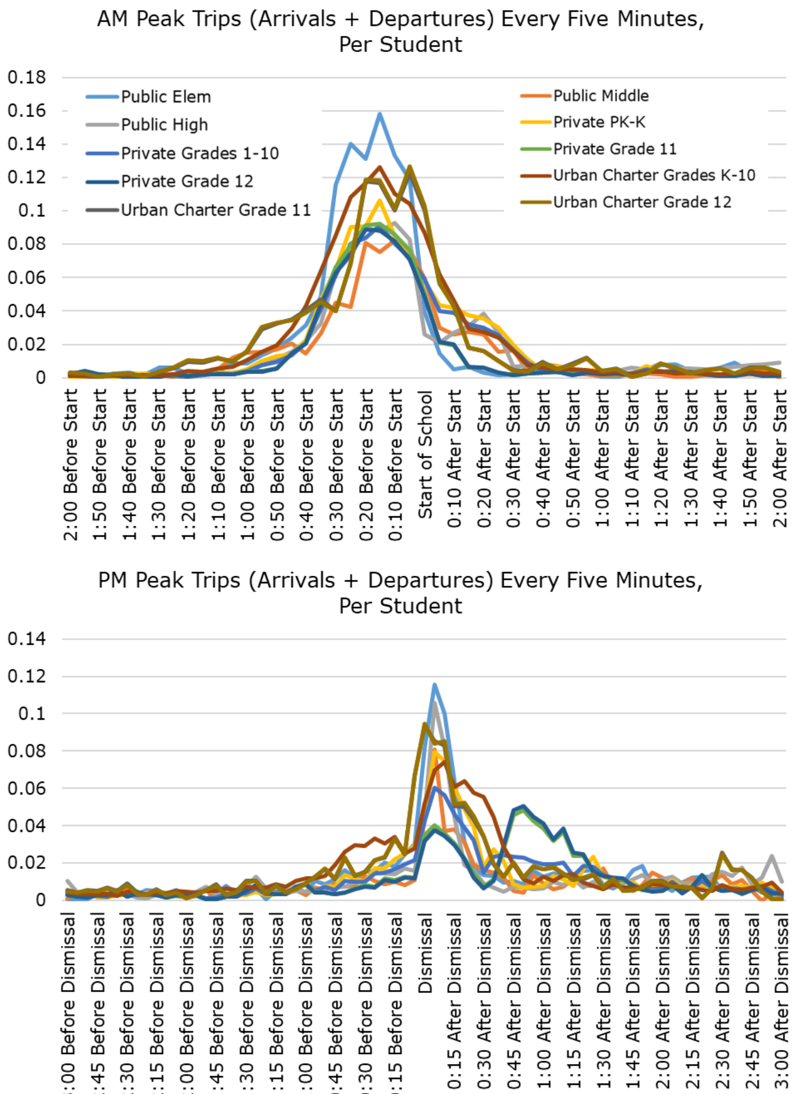


Figure 8. Trip generation rates in five-minute intervals

Peak Hour and Anti-Peak Hour Factor

Peak Hour Factor

The Peak Hour Factor (PHF) determines the fluctuations in the peaking behavior of the traffic flow within the peak hour. The Highway Capacity Manual defines the PHF as the hourly volume during the maximum-volume hour of the day divided by the peak 15-minutes flow rate within the peak hour, a measure showing the demand variation within the peak hour.

For school planning and design purposes, it is necessary to evaluate the PHF for projected volumes (the opening year for the new schools and target year for existing schools). Accurate estimation of the PHF is crucial in capacity and Level of Service (LOS) analysis. Past research has indicated that the PHF has a substantial impact on traffic analysis results.

As part of the NCDOT Research Project 2021-15: Evaluation of School Travel Patterns and Preferences, the research team is tasked to evaluate school locations in Synchro/SimTraffic to calibrate the software with actual school operations data. The focus of the task is on the peak hour factor for intersections impacted by school traffic during school drop-off and pick-up.

Importance of PHF when modeling schools

When modeling traffic for schools, the Peak Hour Factor (PHF) emerges as an integral component. It provides a measure of the variability in traffic demand within the peak hour, generally corresponding to school drop-off and pick-up times. With multiple intersections in the vicinity of schools, each possessing its unique PHF, we are presented with a complex interplay of traffic patterns. Accurate determination of the PHF allows for a precise representation of these patterns, thereby contributing significantly to the efficacy of the traffic model.

Moreover, the PHF has a bearing on crucial aspects such as the level of congestion, queue lengths, and the overall Level of Service (LOS) at intersections. The correct specification of the PHF value is therefore imperative, as it influences the subsequent traffic management strategies and infrastructure planning around schools. Thus, incorporating the PHF into traffic modeling for schools not only enhances the model's accuracy but also supports informed decision-making in the context of school traffic management.

In the scope of this project, our goal was to assess the impact of PHF values on the traffic performance at various intersections around schools. We aimed to explore the implications of PHF fluctuations on the traffic analysis results, thereby emphasizing the need for an accurate estimation of the PHF. This goal was pursued through an in-depth study of multiple intersections located near schools, each evaluated at different levels of PHF.

Data

The research team acquired geographical, demographic, and operational data for 34 schools located throughout North Carolina. The dataset includes a total of 46 features, including intersection (control type, approach PHF, overall PHF, peak hour volume, impacted approach, etc.), school (type, name, coordinate, address, level, number of students, number of staff, etc.), and roadway (AADT, road name, etc.) characteristics. Of particular interest for this analysis is the turning movement counts, AADT, hourly volume, and PHF at intersections in the vicinity of schools whose operation was impacted by the presence of schools. The dataset includes a total of 627 observations of PHF. The following tables provide an overview of some of the numerical features along with their descriptive statistics for the impacted and non-impacted sites.

Impacted

	PHF	Peak Volume (vph)	AADT	Total Students and teachers
count	287.00	287.00	89.00	279.00
mean	0.56	396.90	5602.25	1005.06
std	0.17	408.83	5180.03	416.16
min	0.25	3.00	1200.00	511.50
25%	0.43	111.50	2200.00	595.25
50%	0.55	247.00	3600.00	823.90
75%	0.69	573.50	7700.00	1397.40
max	0.98	2189.00	23000.00	1726.64

Table 11. Impacted sites

Non-Impacted

	PHF	Peak Volume (vph)	AADT	Total Students and teachers
count	250.00	250.00	142.00	250.00
mean	0.80	711.32	13450.00	677.52
std	0.15	782.57	12238.81	453.50
min	0.25	1.00	1500.00	192.93
25%	0.75	230.00	5200.00	256.25
50%	0.83	449.50	9850.00	559.78
75%	0.91	954.25	17575.00	823.90
max	0.99	5921.00	105000.00	1726.64

Table 12. Non-impacted sites

Analysis and Results

IMPACTED VS. NON-IMPACTED INTERSECTION APPROACHES

Visual observations were conducted to investigate the impact of school traffic on intersections in the vicinity of schools by creating scatter matrix plots of the data. The Kernel Density Estimate (KDE) and violin plots for the PHF of impacted and non-impacted approaches showed a stark contrast between approaches affected by school traffic and those not affected by the school traffic. The KDE and violin plots are shown below in Figure 9.

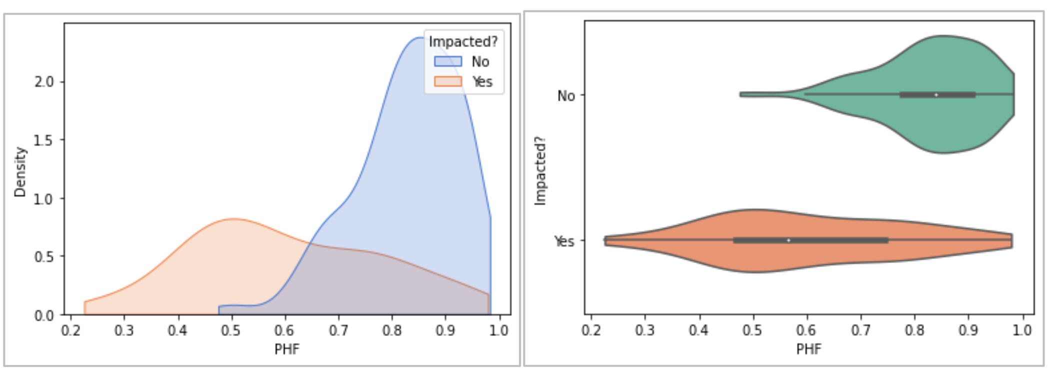


Figure 9. KDE and Violin Plots for Impacted and Non-impacted approaches of intersections

The violin plot depicts distributions of numeric data for the two groups (impacted and un-impacted) using density curves. The width of each curve corresponds with the approximate frequency of data points in each region. Densities are accompanied by an overlaid box plot showing the minimum (left most point of the black line within the violin), maximum (right most point of the black line within the violin), average (white dot in the middle of the black box), and the interquartile range (IQR) (black box within the violin) of the PHFs.

Focusing on the mean value of the PHF for the two distributions, we can clearly see that approaches impacted by school traffic have an average PHF of 0.56, while those not impacted by the school traffic have an average value of about 0.8.

Visual observations of the figure shown above indicate that the distribution of PHFs for approaches impacted by the school traffic is significantly shifted towards zero compared to the non-impacted approaches. Kolmogorov–Smirnov test revealed that the two distributions were sampled from populations with different distributions. The populations differ in median, variability, and the shape of the distribution.

SCHOOL LOCALE IMPACT

Among the many features collected for PHF analysis, particular attention was given to the school locale as it was thought to have a significant impact on determining the value of PHF for a site. Four levels of locale were present in the collected data: city, rural, suburb, and town. Figure 10 shows the violin plot of PHFs for approaches not impacted by school traffic. Observations of the figure indicate that the IQR of the rural, suburb, and town sites are above 0.8. However, the violin plot for the city sites shows a wider range of values compared to the other three locales and ranges between 0.4 and 1. It is worth mentioning that 41, 56, 29, and 16 samples were available for city, rural, suburb, and town, respectively.

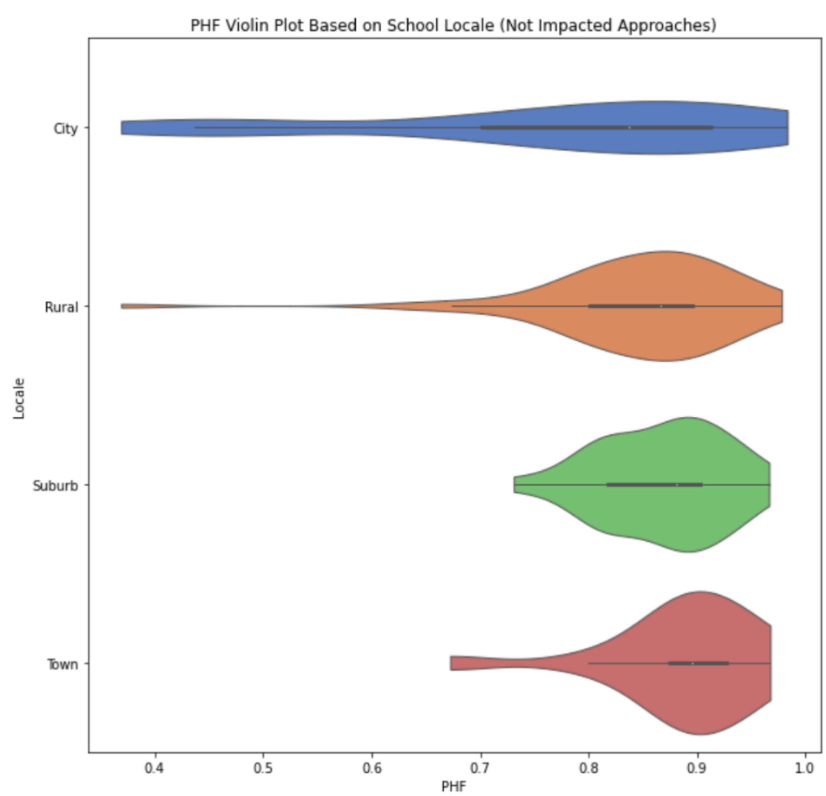


Figure 10. Violin Plots of Non-Impacted Approaches based on School Locale

Violin plots of the PHF for the impacted school locales are shown in Figure 3. Visual observations of the figure indicate a significant difference between the violin plots of impacted (shown in Figure 11) and those of non-impacted locales (shown in Figure 10). Particularly, stark differences can be observed between rural and town sites. City sites show a slight shift towards the left side indicating that the PHF values at these sites are lower compared to the non-impacted sites. However, suburb sites show a similar trend as the non-impacted sites. Care should be exercised when making generalized conclusions from these plots since the number of samples for some of the impacted sites is on the lower side compared to the non-impacted sites. There were 8, 75, 5, and 3 data points for city, rural, suburb, and town, respectively.

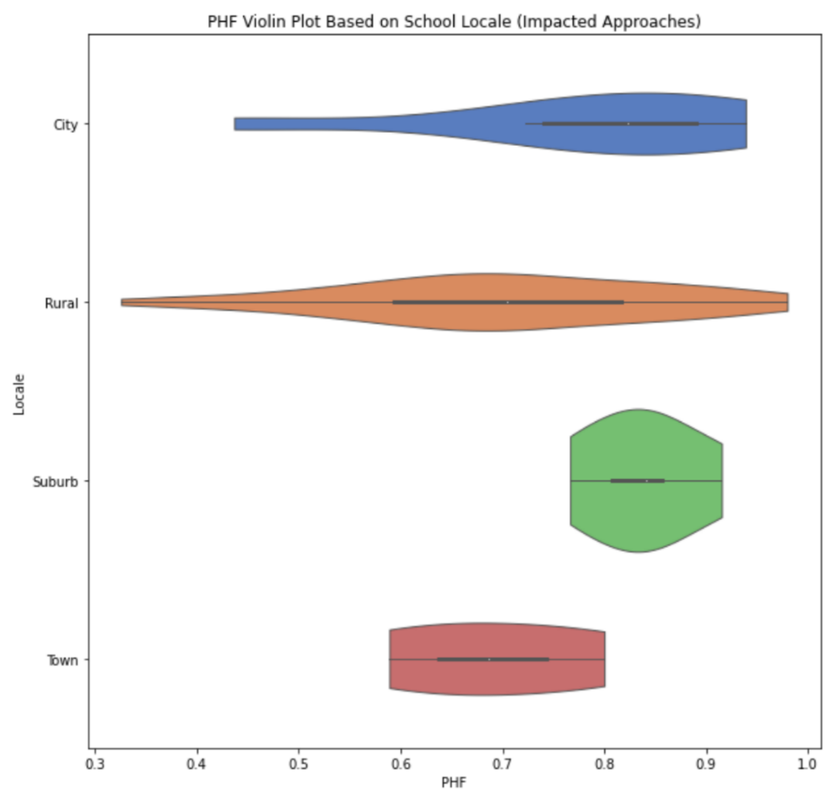


Figure 11. Violin Plots of Impacted Approaches based on School Locale

Predicting Peak Hour Factors

This study uses four algorithms, including a) Linear regression, b) K-Nearest Neighbor (KNN), c) Random Forest (RF), and d) Artificial Neural Network (ANN) for prediction of the value of PHF based on the available data points and related features. The team initially explored simpler predictive models, like regression, but found them inadequate for accurately predicting the Peak Hour Factor (PHF). This led to investigating more complex models such as ANN and Random Forest. ANN and Random Forest are complex in their formulation, and applying them is not trivial for an analyst. Their complex structures make them less accessible for straightforward application in typical traffic analysis tasks without specialized knowledge.

This section includes a brief description of the fusion algorithms and the model tuning process. In the last subsection, the output of fusion algorithms is evaluated based on R-squared values.

LINEAR REGRESSION

Linear regression is a straightforward approach for supervised learning. It is a valuable tool for predicting a quantitative response. Linear regression predicts quantitative response Y based on a single or multiple predictor variable X. Mathematically, one can write this linear relationship as

$y = \beta_0 + \beta_1 x$

Where β_0 is the constant term andβ_1 is the regression slope.

Linear regression, by definition, only examines linear relationships between dependent and independent variables. That is, it assumes a straight-line relationship exists between them. Therefore, it cannot consider non-linear relationships. Since this model does not require hyper-parameter tuning, all training data is used to fit a regression line and is tested with a test dataset. The independent variables used for linear regression in this project are AADT, Total Number of Students, and Peak Hour Volume.

ARTIFICIAL NEURAL NETWORKS

An artificial neural network (ANN) is a branch of machine learning (ML) that mimics the functioning of the human brain by processing data with a specified logical structure. The multiple layers in deep neural networks allow models to learn complex features more efficiently and perform more intensive computational tasks. An ANN model is a feed-forward artificial neural network with more than one hidden layer. ANN models process the information through weighted connections through a series of fully connected layers associated with other layers. Each node, called a neuron, transforms the input with a nonlinear function to create a decision boundary. Each neuron can be considered a non-linear computational unit that applies an activation function (e.g., sigmoid, Exponential Linear Unit (ELU), and Rectified Linear Unit (ReLU) function).

Each neuron can be defined as:

$a^{l+1} = f(W^l a^l + b^l)$

Where a^l and a^{l+1} denote the activation value in levels l and l+1, respectively, W^l is a weight matrix, b^l is the bias, and $f(.)$ represents the activation function. The particular case is l=1, which denotes the input layer, and we mean it by a^l= x.

ANN mainly consists of seven parameters 1) Optimizer 2) Learning rate 3) Initializer 4)Dropout rate 5)Number of neurons 6)Batch size and epochs, and 7)Activation function. For an efficient ANN model, the parameters need to be hyper-tuned. For finding the optimal hyperparameters, cross-validation and grid search method were used. Data features used by this algorithm include Peak Hour Volume, Impacted vs. Non-impacted, AADT, Locale, Total Students, and School Size.

RANDOM FOREST

Random forest builds multiple decision trees and merges them to get a more accurate and stable prediction. Random forest adds randomness to the model while the trees grow. When splitting a node, it looks for the best feature among a random subset of features rather than the most crucial element. As a result, there is a greater variety, which leads to a better model. The algorithm for splitting a node in a random forest considers only a random subset of the features. Users can make trees more random by using arbitrary thresholds for each element instead of looking for the best possible thresholds (like a normal decision tree does). The hyperparameters in the random forest are either used to increase the predictive power (number of trees, number of estimators, minimum number of leaves, the maximum number of features random forest considers splitting a node) of the model or to make the model efficient (number of iterations, random forest cross-validation).

Among the hyperparameters mentioned earlier, the number of trees, minimum number of split and leaf, the maximum number of features for split, and the maximum depth of tree were searched with cross-validation to optimize the model through a grid search method. Data features used by this algorithm include Peak Hour Volume, Impacted vs. Non-impacted, AADT, Locale, Total Students, and School Size.

K-NEAREST NEIGHBORS

The K-Nearest Neighbors (KNN) approach is one of the most extensively utilized methods. It enables the construction of a general framework for flexible imputation, it can deal with any type of variable (continuous, categorical, or textual), and it allows the use of the same neighbor table for different grafting operations rather than estimating different models for each operation, and it allows confidentiality to be maintained on specific variables because the imputation can be performed independently of the neighbor search. It obtains conditional imputations on common variables, decreasing bias and retaining the relationship between particular and common variables. It also ensures coherent imputations to avoid nonsensical values, and it can allow imputation by random draws from a predictive distribution to replicate actual data, followed by numerous imputations to account for imputation uncertainty.

KNN uses a lazy and non-parametric learning algorithm for prediction. Non-parametric means that no assumptions are made about the underlying data distribution. The dataset determines the KNN model structure, which is extremely useful in practice, as most real-world datasets do not adhere to mathematical theoretical assumptions. A lazy algorithm does not require any training data points for model generation. In KNN, K is the number of nearest neighbors. The number of neighbors is the core deciding factor. The workflow of KNN is as follows: 1) Calculate distance, 2) Find closest neighbors, 3) Vote for labels.

The number of K is a crucial parameter in the KNN model. If a small number of K is selected, the model relies on a few neighbor's data points, but it can miss essential information in a neighbor with a high number of K. Thus, a selection of the appropriate number of K is necessary for KNN model. Besides the number of K, the distance unit and weight for distance can be adjusted to improve the model.

Although it is not necessary for KNN to have a separate training dataset, the use of a test dataset for searching for optimal K leads to overfitting in the specific dataset. Thus, cross-validation is conducted with a training dataset in the setting of Euclidean distance, weight for distance, and various K. Data features used by this algorithm include Peak Hour Volume, Impacted vs. Non-impacted, AADT, Locale, Total Students, and School Size.

Model Performance

Figure 4 shows the performance of the four models detailed in the section above. Linear regression is shown to have the worst R^2 value among the algorithms. This is expected because the dataset violates the homoscedasticity, and normality assumptions of linear regression. While none of the algorithms has a high R^2 value that can make it useful for the purposes of PHF prediction, ANN is relatively doing a better job followed by Random Forest.

Figure 12. Model Performance

Future directions for this research will involve the exploration and testing of novel algorithms, along with the refinement of the current four predictive models, tailored specifically for estimating the Peak Hour Factor (PHF) at intersections near schools. While the present effort has primarily zeroed in on the intersections directly impacted by school-related traffic, it is essential to develop versatile models that can effectively analyze both impacted and non-impacted approaches.

The challenge of comprehensively addressing traffic issues around schools extends beyond those intersections directly influenced by school schedules. Thus, future research can also delve into intersections indirectly affected or non-impacted, broadening the scope of the investigation. This expanded focus is an essential step towards creating a comprehensive solution for traffic management around schools, enabling more precise planning and efficient operations. The development of such inclusive models will be a pivotal part of any future research endeavors.

Anti-Peak Hour Factor

In addition to enlarging the school data sample and revising the MSTA calculator, the research team investigated the potential for applying an Anti-Peak Hour Factor (Anti-PHF) when examining the impacts a school could have on surrounding traffic. Anti-PHF is the inverse of the Peak Hour Factor (PHF), which is used to flatten the volumes during the off-peak intervals of the analysis period (1). The PHF quantifies the intensity of traffic flow during the peak 15-minutes of the peak hour, compared to the rest of the hour. The Anti-PHF is a SimTraffic simulation parameter that can be used during an analysis period (the setting is binary).

SimTraffic can simulate multiple time intervals with different traffic volumes within a single simulation run. The simulation settings, which can be accessed through “Options/intervals and volumes,” enables the analyst to modify parameter values related to vehicles, drivers, intervals, and data options. One of the many parameters for volume adjustment is the Anti-PHF. Unlike the PHF, which is a continuous variable, the Anti-PHF is a binary parameter that can only be turned on (Yes) and off (No).

The SimTraffic simulation period (analysis hour) is usually divided into four intervals (warm-up, pre-peak, peak, and recovery). The PHF is typically applied during the peak 15-minute period of the simulation interval, while the Anti-PHF is used during the pre-peak and recovery intervals. The literature is scarce on the impact of the Anti-PHF on key measures such as intersection delay and queue length. This is likely because the Anti-PHF is a native simulation parameter in SimTraffic and is not available in other simulation platforms used by transportation practitioners.

Sensitivity Analysis

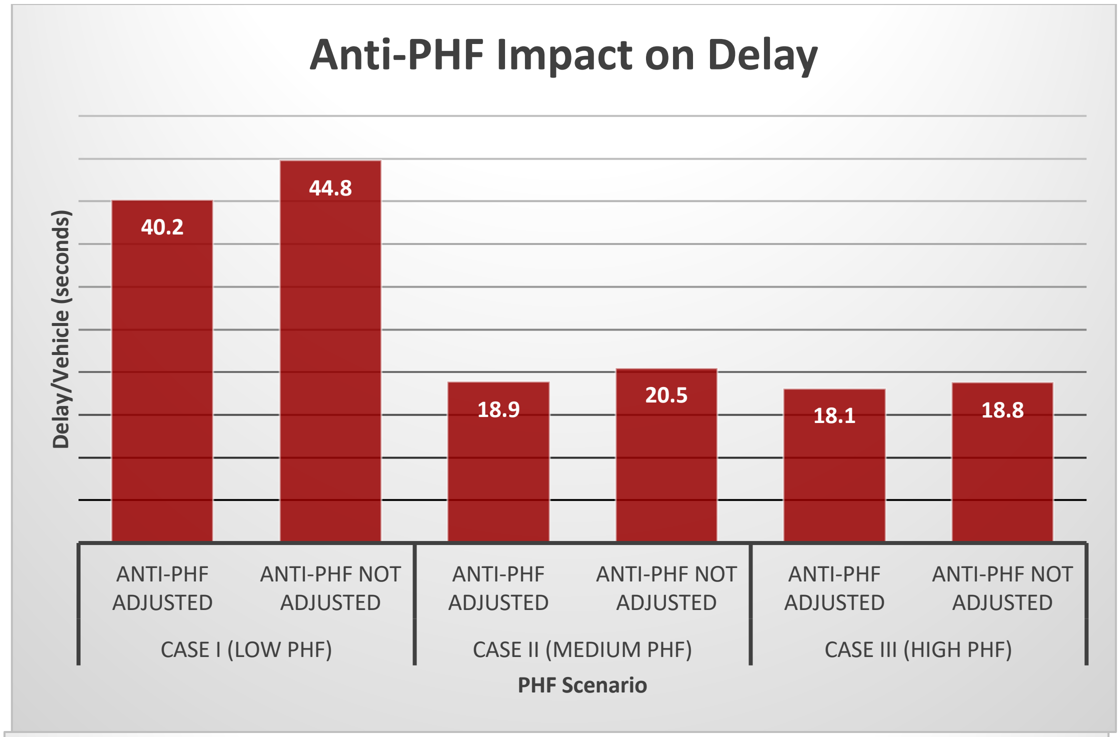
Sensitivity analyses were conducted to investigate the impact of Anti-PHF on system delay and average queue length for an intersection impacted by school traffic via sensitivity analyses. The analyses are conducted considering multiple PHF scenarios (low, medium, and high values).

The analyses were conducted for the signalized intersection of NC 210 & Harnett Central Rd., located adjacent to Harnett Central Middle School. The rural site was chosen randomly from the available options provided to the research team. The choice of a rural location aligns with the experiment's scope, which was to demonstrate the impact of Anti-PHF in a general sense, without delving into the differences between urban and rural settings as recommended by the MSTA.

Three PHF scenarios were considered with varying levels of PHF (0.5, 0.75, and 0.9). For each scenario, 30 runs were conducted to capture the simulation's stochasticity and to stabilize the results. The intersection of interest was simulated as part of a model for Harnett Central Middle School, which includes multiple intersections and pickup/drop-off locations for staff and parents. The results of the simulation study are presented in the following section.

Results

Figure 13 shows the impact of Anti-PHF adjustment on intersection delay. Three scenarios of low, medium, and high PHF are shown along with the Anti-PHF adjustment for each scenario. The analysis of the figure reveals that the Anti-PHF has a discernible impact on the delay per vehicle. The implementation of Anti-PHF adjustments results in a relative reduction of delay per vehicle across all observed scenarios. However, the extent of this reduction is found to be inversely related to the value of the PHF, with a higher magnitude of reduction evident at lower values of the PHF. Moreover, the effectiveness of Anti-PHF adjustments in reducing delay per vehicle is attributed to its ability to mitigate the impacts of peak traffic demand, which is a primary cause of congestion and delays.



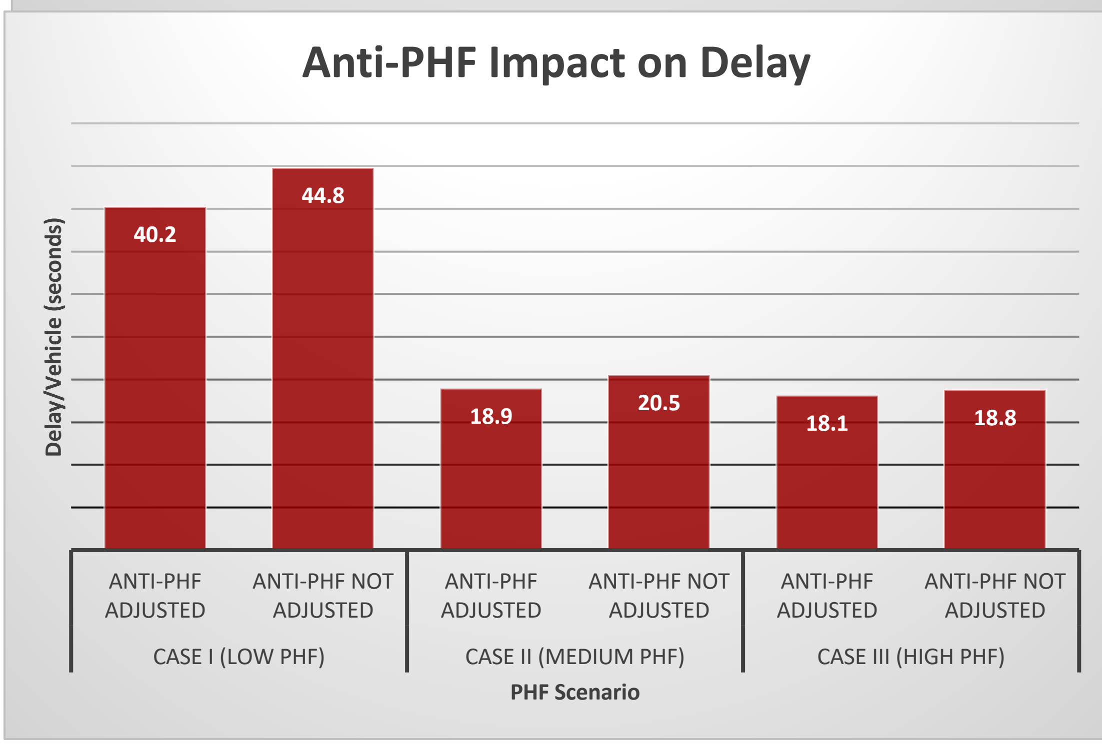


Figure 13. Impact of Anti-PHF on Delay/Vehicle (sec)

Figure 14 shows the impact of Anti-PHF on queue length at the intersection of interest. Visual observations of the figure indicate that the Anti-PHF does impact the average queue length under all scenarios. When the Anti-PHF is adjusted, the average queue length is lower than when it is not adjusted. Furthermore, the decrease resulting from turning on the Anti-PHF is inversely related to the value of the PHF – the lower the PHF, the higher the reduction in the average queue length.

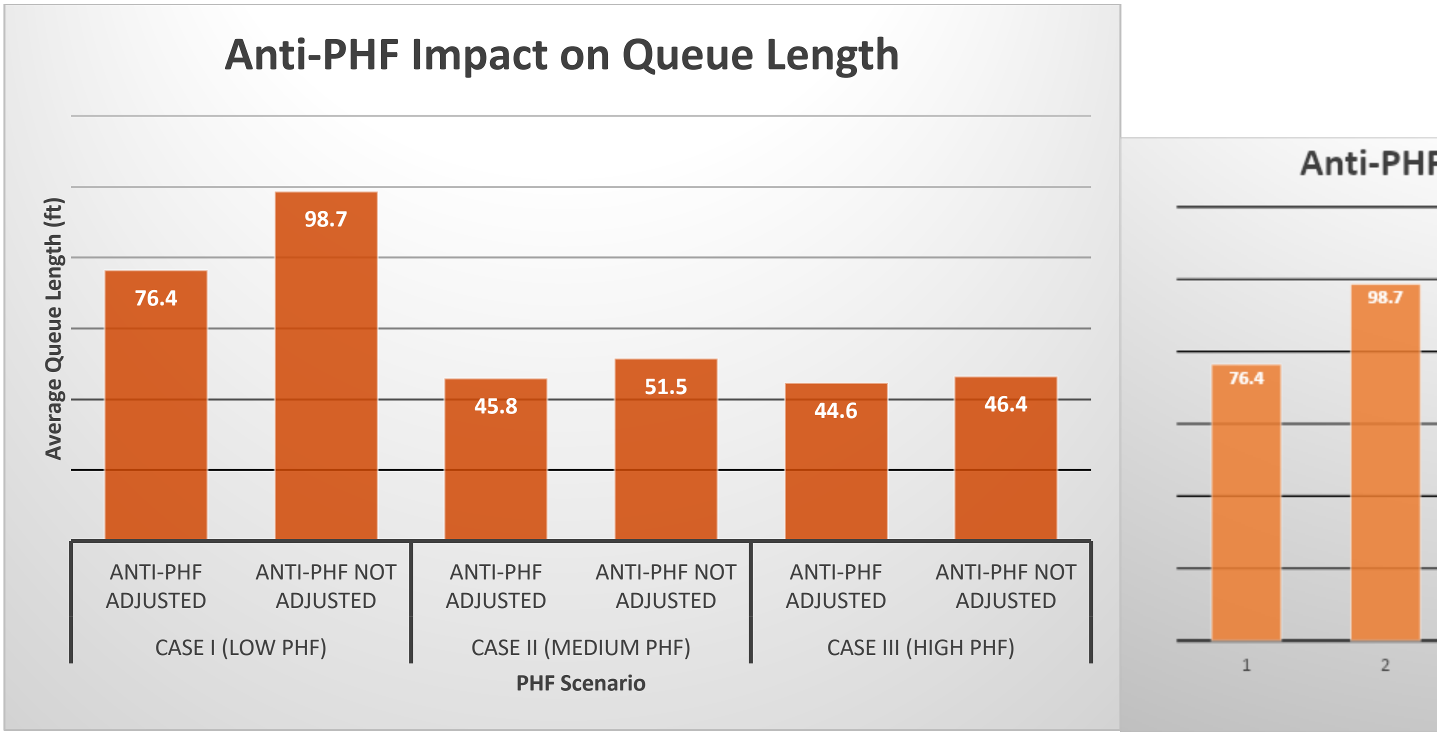


Figure 14. Impact of Anti-PHF on Average Queue Length

Summary

The Anti-PHF is one of SimTraffic's simulation parameters used to modify the variation of traffic volumes within a simulation run. Notably, the parameter is used to reverse the impact of the PHF on simulation intervals of interest. This study investigated the effect of enabling the Anti-PHF and studied its impact on delay per vehicle and average queue length for an intersection in the vicinity of a school in North Carolina. The study's findings show that enabling the Anti-PHF reduces the delay per vehicle and average queue length and that the decrease is inversely related to the value of PHF. The use of the anti-PHF resulted in reductions in delay per vehicle at varying levels of PHF: low (10% reduction), medium (8% reduction), and high (4% reduction). Similarly, the application of the anti-PHF resulted in reductions in average queue length at varying levels of PHF: low (23% reduction), medium (11% reduction), and high (4% reduction). Therefore, the impact of the anti-PHF is the greatest for low values of PHF (a value of 0.5 was tested in this study) and as a result, should be used cautiously at low PHF values. Our findings indicate that the implementation of Anti-PHF adjustments can reduce the estimated delay per vehicle, especially at lower values of the PHF. This reduction can be attributed to the Anti-PHF's ability to mitigate peak traffic demand, which is a primary cause of congestion and delays at signalized intersections in the vicinity of schools. Additionally, we found that implementing Anti-PHF adjustments resulted in a shorter average queue length, which was inversely related to the PHF value.

These results suggest that the Anti-PHF adjustment reduces delay and average queue length in traffic simulations. Thus, transportation practitioners should consider using the Anti-PHF in SimTraffic simulations, especially in scenarios where traffic flow is highly sensitive to peak traffic demand, largely in high traffic or urban areas. However, it is crucial to be careful when adjusting the Anti-PHF for intersections impacted by school traffic. Analysts must consider the significant impact of school traffic on traffic volume, particularly during the start and dismissal times, and adjust the Anti-PHF accordingly to ensure accurate simulation results.

Furthermore, it is important to note that adjustments to the Anti-PHF should be made with careful consideration of the traffic conditions and patterns for the specific intersection being modeled. Adjusting the Anti-PHF only for specific periods, such as the pre-peak and recovery intervals, should also be approached with caution as it may lead to inaccuracies in the simulation results, especially if the traffic demand during those periods is not representative of the overall traffic flow.

In summary, our study highlights the impact of the Anti-PHF adjustment in reducing delay and average queue length in traffic simulations. We encourage future research to explore the applicability of the Anti-PHF in other simulation platforms and different traffic scenarios. Additionally, investigating the impact of Anti-PHF adjustments on other performance measures, such as travel time and fuel consumption, could provide a more comprehensive understanding of the impact of using this parameter in traffic simulations.

Summary

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Conclusions and Recommendations

North Carolina is witnessing rapid population growth, particularly in urban areas, which has led to a surge in the construction of schools. Nationally, tens of millions of school-aged children travel to school each year, and long vehicle queue lengths and vehicle delays can affect the safety of those travelling (NHTSA, 2022; Liu et al., 2022). Consequently, accurately estimating the required queue length at school sites and the rates of trip generation becomes crucial for enhancing the transportation safety of North Carolina's communities. This research holds significant importance for NCDOT as it has the potential to improve the precision of estimating school travel modes and queue lengths. By achieving higher accuracy in assessing queue length requirements, better school site design and traffic management plans can be developed to cater to the demands and corresponding needs of school travel. This, in turn, will facilitate more effective accommodation of passenger vehicles, leading to enhanced traffic safety and smoother operations in communities throughout North Carolina, both in newly constructed schools and existing ones facing challenges of queue spillback onto surrounding roadways.

The research team sampled public schools in six counties (Franklin, Mecklenburg, New Hanover, Rowan, Wake, and Wayne) as well as nine charter schools. A total of 27 afternoon carpool queues were collected during RP 2019-27, including 13 public elementary school, 7 public middle school, and 4 public high school data points, with the remaining three classified under various grades of urban and non-urban charter schools.

To expand the draft calculator's charter and private school dataset, these schools were selected deterministically based on school interest. Sites were chosen based on efficiency, geographic dispersion, and school type. Schools were distributed among 18 counties, with the greatest concentration in Wake County (n=6) and Johnston County (n=5). A total of 36 schools were visited during RP 2021-15, at 3 public elementary, 5 public middle, 7 public high, 20 charter, and 1 private school. Morning carpool queue lengths were observed at 33 of the 36, and afternoon carpool queue lengths were observed at all of them.

To the extent possible, field data collection excluded holidays, school events, early-release days, and Fridays, but other atypical activities that the research team was unaware of may have influenced the observed values. This research project was completed during the COVID-19 pandemic. However, efforts were made to collect data after schools returned to more normal operations. Additionally, data collection during RP 2019-27 was completed before school impacts from the pandemic. The exception is a small data collection effort specifically focused on exploring the impacts of the pandemic, for which data is not included in this analysis.[5]

This research aimed to measure demand for student drop-off and pick-up, which is most directly expressed in terms of the queue length and trips generated. However, student drop-off and pick-up activities can also occur in locations other than the areas designated by the school, such as nearby parking locations, curbs, and other areas that students can walk to and from campus to avoid the queuing process. The research team counted trips generated in this manner as much as possible but due to the nature of these unapproved

[5] Schools include: Richland Creek Elementary (12/9/2019, 12/15/2020);
Abbotts Creek Elementary (12/4/2019, 12/10/2020);
Bryan Road Elementary (12/12/2019, 12/17/2020);
Envision Science Academy (3/7/2019, 3/23/2021)

activities, some of this travel was likely unobserved and is therefore not included in the project data. In the future, additional data can be added to the calculator to ensure research stays up to date and accurate.

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Appendices

Appendix A: User Guide

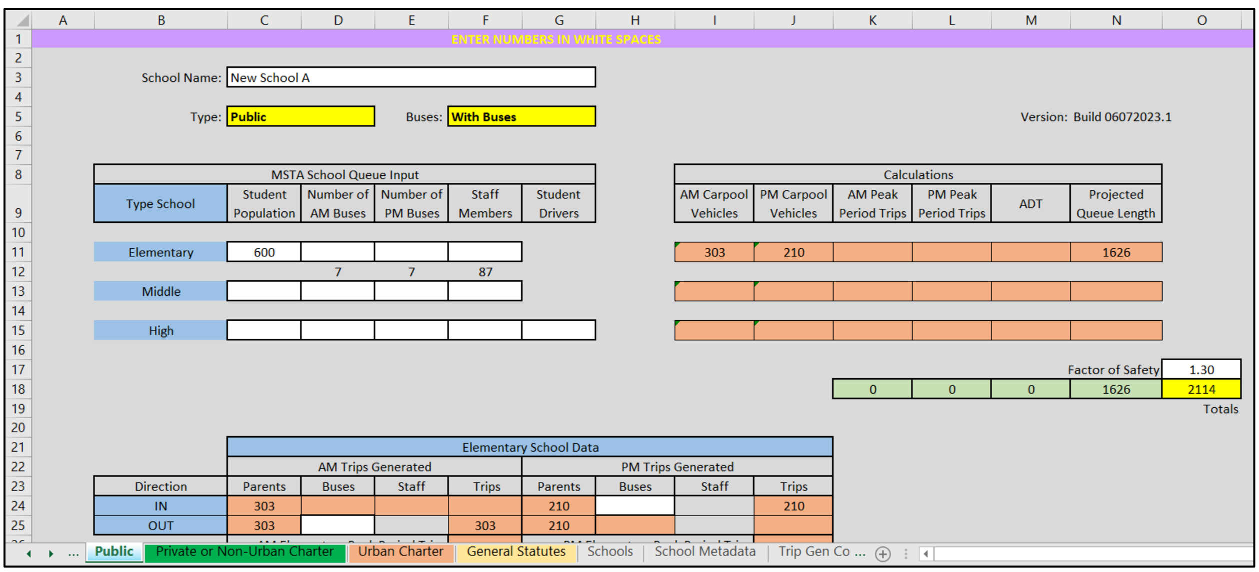
This section of the report serves as a user guide for the proposed School Traffic Calculator. An expanded discussion of the design assumptions and decisions made during the design is also provided.

User Interface

Almost all analyst interaction with the STC occurs on the Public, Private or Non-Urban Charter, or Urban Charter calculation tabs. These tabs provide three primary outputs:

- The predicted maximum carpool queue length in feet.
- Predicted AM peak period trips, PM peak period trips, and total ADT.
- Predicted arrivals and departures on a five-minute basis during the morning and afternoon peaks. Early-morning, mid-day, and late-evening periods are summarized into a single rate instead of five-minute intervals.

The tab layout is best demonstrated by example. Consider the design of a new 600-student public elementary school. Buses will be provided. Based on these inputs, the Public tab should be selected.



The top left of the page contains input blocks for student population, number of AM buses, number of PM buses, number of staff members, and number of student drivers. Of these, the only value the analyst must know initially is the student population. Estimates of the other fields will be provided based on average values from other schools, normalized to a per-student basis. If exact numbers are known, they should be entered; otherwise, the estimates should be entered.

Inputs are divided by grade type. If a school fits into more than one category (e.g. a school instructs kindergarten through eighth grade), multiple rows should be used, with the total student population divided between the rows to match predicted allocation among grades. None of the fields in a grade type row should be left blank if that row's student population is not zero; otherwise, a value of zero for the given field will be assumed.

School Name: New School A

Type: **Public** Buses: **With Buses**

MSTA School Queue Input					
Type School	Student Population	Number of AM Buses	Number of PM Buses	Staff Members	Student Drivers
Elementary	600	7	7	87	
		7	7	87	
Middle					
High					

Predicted Values

The “Buses” drop-down option is provided as a data-entry convenience, but does not impact the calculations. If it is known that a school does not provide buses, this option can be adjusted to change all bus predictions to zero.

The section below, Elementary School Data, must be filled out to ensure an accurate peak period trip estimate. The number of parents (or, more accurately, carpool vehicles), bus, and staff trips to and from school are calculated, generating a total number of trips in the morning and afternoon. Most of these cells auto-calculate. However, the number of “Out” bus trips must be entered by the user. This value represents the number of buses that arrive in the morning, but do not stay on campus all day (i.e. they leave to serve another school or park somewhere off-campus after dropping off students.)

	Elementary School Data							
	AM Trips Generated				PM Trips Generated			
Direction	Parents	Buses	Staff	Trips	Parents	Buses	Staff	Trips
IN	303	7	87	397	210			210
OUT	303			303	210	7		217
	AM Elementary Peak Period Trips			699	PM Elementary Peak Period Trips			426

If this value is not known, the most conservative option is to enter the full number of “In” buses. This will generate the largest number of peak period trips and corresponding ADT. In most cases, bus trips make up a small percentage of total trips in and out of a school. As with the previous section, these cells should not be left blank, or the total trip volume will be underestimated.

	Elementary School Data							
	AM Trips Generated				PM Trips Generated			
Direction	Parents	Buses	Staff	Trips	Parents	Buses	Staff	Trips
IN	303	7	87	397	210	7		217
OUT	303	7		310	210	7		217
	AM Elementary Peak Period Trips			706	PM Elementary Peak Period Trips			433

The upper-right of the page displays the predicted number of AM and PM peak period trips, total trips, and predicted maximum queue length. Values are estimated for each grade type (in this case, elementary, middle, and high school students) and totaled in the row below.

Calculations						
AM Carpool Vehicles	PM Carpool Vehicles	AM Peak Period Trips	PM Peak Period Trips	ADT	Projected Queue Length	
303	210	706	433	1227	1626	
					Factor of Safety	1.30
		706	433	1227	1626	2114
						Totals

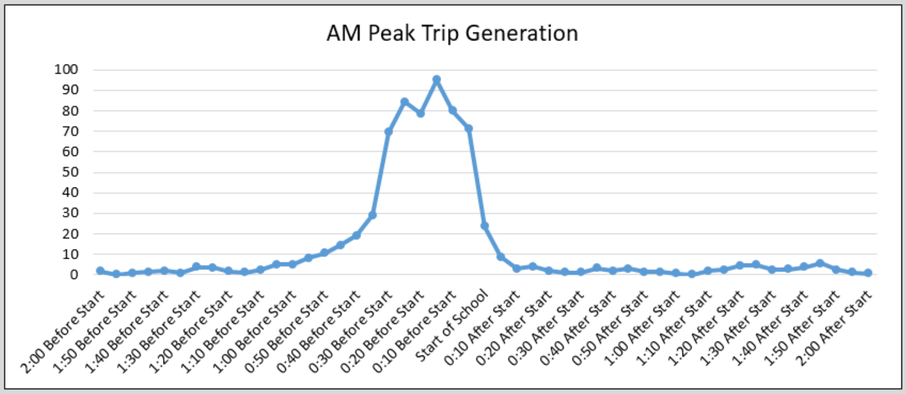
The raw projected queue length is provided in the green cell below the "Projected Queue Length" column, and with a factor of safety applied in the yellow cell immediately to its right. We recommend only using the adjusted value after the factor of safety has been applied. The queue calculation, and all other calculated values, are based on sample means. Without the application of a factor of safety, the calculator would underestimate queue lengths at a large number of locations. The factor of safety is only applied to projected queue length, not trip predictions.

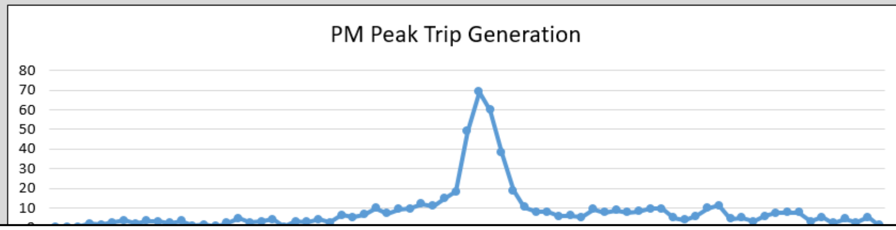
The Peak Period Traffic Volumes tool, located at the bottom of the page, predicts the number of vehicles arriving in each five-minute window during the morning and afternoon. Predictions are provided for two hours before and after the start of school, and three hours before and after the end of school. A base arrival rate is also provided for early-morning arrivals prior to two hours before the start of school, mid-day arrivals more than two hours after the start of school but more than three hours before the end of school, and late-night arrivals more than three hours after afternoon dismissal. These predictions rely on the assumption of a single arrival and dismissal time; this was true at 24 of the 28 schools used to construct the prediction model.

At schools with multiple start and end times, we recommend creating separate runs of the calculator for each set of grades served by each start and end time if it is known with a high degree of certainty that queues will disperse between the different arrival or dismissal times. Trip generation counts may need to be overlaid and added manually depending on how far apart the start or end times are. The most conservative approach is to add maximum queues and trips generated; if queue failure or network failure will have severe consequences, that is likely the safest approach.

Peak Period Traffic Volumes

Arrivals + Departures per 5 Minutes	
Early Morning Arrivals	0.5966192
2:00 Before Start	1.545914
1:55 Before Start	0
1:50 Before Start	0.6960557
1:45 Before Start	1.4164181
1:40 Before Start	1.8804552
1:35 Before Start	0.9280742
1:30 Before Start	3.712297
1:25 Before Start	3.5558652
1:20 Before Start	1.4946465
1:15 Before Start	1.0306094
1:10 Before Start	2.4227207
1:05 Before Start	5.0748184
1:00 Before Start	5.0505117
0:55 Before Start	8.0641114
0:50 Before Start	10.462525
0:45 Before Start	14.350303
0:40 Before Start	19.009672
0:35 Before Start	29.129669
0:30 Before Start	69.577018
0:25 Before Start	84.240234
0:20 Before Start	78.652815
0:15 Before Start	94.980775





The design of the Public, Private or Non-Urban Charter, and Urban Charter tabs are generally similar. However, the private and non-urban charter tab provides the option to omit pre-kindergarten and kindergarten students from the carpool queue. In some cases, parents of these students will park and walk their students in, bypassing the carpool line. This option should only be selected if sufficient parking spots are provided to serve the pre-kindergarten and kindergarten parents, and it is expected that they will actually use them. The example below shows a private elementary school where PK/K students have been dropped from queue calculations.

Type: Private or Non-Urban Charter

Version: Build 06072023.1

PK & K Park and Walk: Yes

Buses: Without Buses

MSTA School Queue Input						Calculations					
Grade Level	Student Population	Number of AM Buses	Number of PM Buses	Staff Members	Student Drivers	AM Carpool Vehicles	PM Carpool Vehicles	AM Peak Period Trips	PM Peak Period Trips	ADT	Projected Queue Length
PK & K	50	0	0	5		22	15	48	30	83	0
		0	0	5							
Grades 1-10	300	0	0	32		112	83	257	167	455	1127
		0	0	32							
Grade 11											
		0	0								
Grade 12											
		0	0								

	AM Peak Period Trips	PM Peak Period Trips	ADT	Projected Queue Length	Factor of Safety 1.30
Totals	305	196	538	1127	1466

Database

In most cases, the sampled schools' metadata does not need to be reviewed by the analyst. However, some familiarity with the design paradigm used to structure the STC back-end may provide analysts with a greater understanding of how the calculator's queue length and trip generation predictions are derived.

SCHOOLS TAB

The Schools sheet contains one record for every school in the School Traffic Calculator. The columns are:

- sch_ID: Unique identifier for each school.
- SchoolName:
- EDDIESchoolID: A shorthand code taken from the NC DPI EDDIE database; not necessarily unique for multi-campus schools. There was one private school without an EDDIE record; in that case, the NCDS School ID was used instead.
    - The NC DPI EDDIE database was used to separate schools into public and charter categories. Charter schools were divided into non-urban or urban categories based on the 2010 Census Urban Areas map (1).
- Address
- County
- SchoolType: Either Public, Private/Non-Urban Charter, or Urban Charter.
- MSTAProject: Either RP 2019-27 or RP 2021-15; indicates which research project the school was observed under.
- Notes

The image below shows the first few columns of the Schools spreadsheet.

	A	B	C	D	E	F	G	
1	sch_ID	SchoolName	EDDIESchoolID	Address	County	SchoolType	MSTAProject	Notes
2	1	Peak Charter Academy	93M000	1601 Orchard Villas Ave, Apex, NC 27502	Wake	UrbanCharter	RP 2021-15	
3	2	Greensboro Academy	41B000	4049 Battleground Ave, Greensboro, NC 27410	Guilford	UrbanCharter	RP 2021-15	
4	3	Summerfield Charter Academy	41J000	5303 US-220, Summerfield, NC 27358	Guilford	UrbanCharter	RP 2021-15	
5	4	Forsyth Academy	34F000	5426 Shattalon Drive, Winston-Salem, NC 27106	Forsyth	UrbanCharter	RP 2021-15	
6	5	PreEminent Charter School	92M000	3815 Rock Quarry Road, Raleigh, NC 27610	Wake	UrbanCharter	RP 2021-15	
7	6	Northeast Academy for Aerospace & Advanced Technologies	70A000	1413 W Ehringhaus St, Elizabeth City, NC 27909	Pasquotank	UrbanCharter	RP 2021-15	
8	7	The Academy of Moore County	63A000	12588 HWY 15-501 South, Aberdeen, NC 28315	Moore	Private_or_NonUrbanCharter	RP 2021-15	
9	8	Rolesville Charter Academy	93P000	908 Eagle Scholars Drive, Rolesville, NC 27571	Wake	UrbanCharter	RP 2021-15	
10	9	Gate City Charter Academy	41L000	123 Flemingfield Road, Greensboro, NC 27405	Guilford	Private_or_NonUrbanCharter	RP 2021-15	
11	10	Bethany Community School	79A000	1288 Hudson Rd, Summerfield, NC 27358	Rockingham	Private_or_NonUrbanCharter	RP 2021-15	
12	11	Apprentice Academy High School of North Carolina	90F000	2505 Weddington Rd, Monroe, NC 28110	Union	UrbanCharter	RP 2021-15	
13	12	Telra Institute	62L000	807 S. Trade St., Matthews, NC 28105	Mecklenburg	UrbanCharter	RP 2021-15	
14	13	Arapahoe Charter School	69A000	9005 NC Hwy 306 S, Arapahoe, NC 28510	Pamlico	Private_or_NonUrbanCharter	RP 2021-15	
15	14	Research Triangle High School	32N000	3106 East NC Highway 54, Durham, NC 27709	Durham	UrbanCharter	RP 2021-15	Classified as Pr
16	15	Oxford Preparatory School	39B000	6041B Landis Rd, Oxford, NC 27565	Granville	Private_or_NonUrbanCharter	RP 2021-15	
17	16	Voyager Academy	32L000	101 Hock Parc Drive, Durham, NC 27704	Durham	UrbanCharter	RP 2021-15	Contains eleme
18	17	Excelsior Classical Academy CFA	32R000	4100 N Roxboro Street, Durham, NC 27704	Durham	UrbanCharter	RP 2021-15	
19	18	East Wake High School	920411	5101 Rolesville Rd, Wendell, NC 27591	Wake	Public	RP 2021-15	
20	19	Fuquay-Varina Middle	920424	109 N Ennis Street, Fuquay-Varina, NC 27526	Wake	Public	RP 2021-15	
21	20	Southern Nash Middle	640362	5301 South NC Highway 581, Spring Hope, NC 27882	Nash	Public	RP 2021-15	
22	21	Selma Middle School	510390	1533 Hwy 301 N, Selma, NC 27576	Johnston	Public	RP 2021-15	
23	22	Chatham School of Science & Engineering	190501	501 Martin Luther King Jr Blvd, Siler City, NC 27344	Chatham	Public	RP 2021-15	
24	23	North Johnston High	510368	5915 US Hwy 301 N, Kenly, NC 27542	Johnston	Public	RP 2021-15	
25	24	Cleveland High School	510327	1892 Polenta Rd, Clayton, NC 27520	Johnston	Public	RP 2021-15	
26	25	West Johnston High	510406	5935 Raleigh Road, Benson, NC 27504	Johnston	Public	RP 2021-15	
27	26	Southern Nash High	640364	6446 Southern Nash High Road, Bailey, NC 27807	Nash	Public	RP 2021-15	
28	27	Lucama Elementary	980352	6260 Blalock Road, Lucama, NC 27851	Wilson	Public	RP 2021-15	

SCHOOL METADATA TAB

The School Metadata sheet contains one row for every combination of survey and field visit that was included in our final dataset. While we did not include duplicate visits to any schools, the indexing system is set up such that additional visits to a given school can be recorded.

- metadata_ID: Unique identifier for each row (field visit and survey; in some cases, only a field visit, or only a survey.)
- sch_ID: Identifier for each school (see Schools tab.)

- SchoolName
- ObservationDate: Date of field visit.
- SurveyCompletion: Date e-mail survey was completed.
- SchoolYear: School year that field visit and survey were completed.
- Program: Calendar schedule type (Regular Calendar, Year Round, Modified Year Round, or Early College). Our model does not differentiate between calendar types for calculation purposes.
- PK/K: Number of Pre-K and kindergarten students at school. Head counts used where available; otherwise, enrollment reported by survey or average daily membership (ADM) estimate were used.
- 1, 2, 3, …, 11, 12: Number of students in grade corresponding to column at school. Head counts used where available; otherwise, enrollment reported by survey or average daily membership (ADM) estimate were used.
- Grades_Instructed: Text field describing grades instructed at school.
- TotalStudents: Total number of students at school. Head counts used where available; otherwise, enrollment reported by survey or average daily membership (ADM) estimate were used.
- PopCollectionMethod: How student attendance was derived. Either head count, reported by school over e-mail or phone, reported by e-mail survey, or ADM estimate.
- Start_1: School start time, or first start time if there are multiple start times. For example, a charter school might have grades 6-8 start at 8:00 AM and K-5 start at 8:30 AM.
- End_1: School end time, or first end time if there are multiple dismissal times.
- Start_2: Second school start time, if there are multiple start times.
- End_2: Second school end time, if there are multiple dismissal times.
- TimeNotes: Text field describing start and end times (Start_1, End_1, Start_2, End_2).
- SchoolStaff: Number of staff at school, reported by e-mail survey.
- StudentsWhoTakeBus: Number of students who take bus to school, reported by e-mail survey.
- AM_Buses: Number of school buses used to drop-off students in the morning each day
- PM_Buses: Number of school buses used to pick-up students in the afternoon each day
- StudentDrivers_Grade10: Number of 10th graders who drive to school each day
- StudentDrivers_Grade11: Number of 11th graders who drive to school each day
- StudentDrivers_Grade12: Number of 12th graders who drive to school each day
- StudentDrivers_Total: Total number of student drivers, or student drivers with parking permits
- StudentsWhoWalk: Number of students who walk to and from school each day

- StudentsWhoBike: Number of students who bike to and from school each day

- GreenwayOrSidewalk: Whether there is an established walking path (such as a sidewalk or a greenway) that leads to your school. Based on Google Maps reviews, this field is of limited validity; some schools have sidewalks immediately in front of the school property without connectivity to nearby neighborhoods.

- AM Queue (Feet): Maximum morning queue in feet, observed by ground camera (RP 2019-27) or drone (RP 2021-15).

- PM Queue (Feet): Maximum afternoon queue in feet, observed by ground camera (RP 2019-27) or drone (RP 2021-15).

- Loading Zone (Feet): Estimated loading zone length in feet. Loading zones were not included in queue estimates.

- Notes

The image below shows the first few columns and rows of the School Metadata tab.

metadata_ID	sch_ID	SchoolName	ObservationDate	SurveyCompletion	SchoolYear	Program	PK/K
1	1	Peak Charter Academy	3/3/2022	2/8/22 9:43	2021-2022	Regular Calendar	90
2	2	Greensboro Academy	3/15/2022	2/9/22 6:39	2021-2022	Regular Calendar	84
3	3	Summerfield Charter Academy	3/22/2022	2/16/22 12:51	2021-2022	Regular Calendar	89
4	4	Forsyth Academy	3/29/2022	2/9/22 8:57	2021-2022	Regular Calendar	93
5	5	PreEminent Charter School	4/6/2022	2/17/22 7:00	2021-2022	Regular Calendar	91
6	6	Northeast Academy for Aerospace & Advanced Technologies	4/12/2022	2/18/22 8:21	2021-2022	Regular Calendar	
7	7	The Academy of Moore County	4/19/2022	2/18/22 9:21	2021-2022	Year Round	104
8	8	Rolesville Charter Academy	4/21/2022	2/11/22 14:57	2021-2022	Regular Calendar	88
9	9	Gate City Charter Academy	4/27/2022	2/8/22 10:27	2021-2022	Regular Calendar	100
10	10	Bethany Community School	4/28/2022	2/23/22 15:15	2021-2022	Regular Calendar	
11	11	Apprentice Academy High School of North Carolina	5/3/2022	2/18/22 17:22	2021-2022	Regular Calendar	
12	12	Telra Institute	5/5/2022	2/22/22 6:39	2021-2022	Regular Calendar	78
13	13	Arapahoe Charter School	5/10/2022	2/21/22 6:10	2021-2022	Regular Calendar	46
14	14	Research Triangle High School	5/11/2022	3/7/22 14:44	2021-2022	Regular Calendar	

TRIP GEN COUNTS TAB

The Trip Gen Counts sheet contains full-day vehicle arrivals and departures on campus. Cameras were set up for about 14 hours at ingress and egress points to capture all or almost all trips to and from campus.

- metadata_ID: Two rows appear for each metadata ID, one for arrivals and one for departures. These are meant as foreign keys to the primary key metadata ID on the School Metadata tab.

- SchoolName

- ObservationDate: Date of ground camera observations.

- Arrivals/Departures: Indicates whether the row of observations is arrivals to or departures from campus.

- 0:00, 0:05, …, 23:50, 23:55: Number of arrivals between the time listed and the start of the next bin.

The image below shows the first few columns and rows of the Trip Gen Counts tab.

metadata_ID	SchoolName	ObservationDate	Arrivals/Departures	5:00	5:05	5:10	5:15	5:20	5:25	5:30
1	Peak Charter Academy	3/3/2022	Arrivals							
1	Peak Charter Academy	3/3/2022	Departures							
2	Greensboro Academy	3/15/2022	Arrivals							
2	Greensboro Academy	3/15/2022	Departures							
3	Summerfield Charter Academy	3/22/2022	Arrivals			1	0	0	0	0
3	Summerfield Charter Academy	3/22/2022	Departures			0	0	1	0	0
4	Forsyth Academy	3/29/2022	Arrivals							
4	Forsyth Academy	3/29/2022	Departures							
5	PreEminent Charter School	4/6/2022	Arrivals							
5	PreEminent Charter School	4/6/2022	Departures							
6	Northeast Academy for Aerospace & Advanced Technologies	4/12/2022	Arrivals							
6	Northeast Academy for Aerospace & Advanced Technologies	4/12/2022	Departures							
7	The Academy of Moore County	4/19/2022	Arrivals							
7	The Academy of Moore County	4/19/2022	Departures							
8	Rolesville Charter Academy	4/21/2022	Arrivals							

CALCULATIONS

The Calculations tab contains weights for each school, per-student values used for maximum queue modeling, and per-student values used for trip generation modeling. From left to right, the groupings are:

- Metadata ID: Contains one column, with metadata IDs matching records to rows on the School Metadata tab.

- Weights: Each school's weights (or, more precisely, each observation at a given school's weights) sums to 1. The weights are divided among the following grade groups:

School Type	Grade Group
Public	Public Elem
Public	Public Middle
Public	Public High
Private / Non-Urban Charter	Private PK-K
Private / Non-Urban Charter	Private Grades 1-10
Private / Non-Urban Charter	Private Grade 11
Private / Non-Urban Charter	Private Grade 12
Urban Charter	Urban Charter Grades K-10
Urban Charter	Urban Charter Grade 11
Urban Charter	Urban Charter Grade 12

- Queue and Trip Modeling: This section contains school data, normalized to a per-student basis, that will be used to generate maximum queue length estimations. Data in this section also contributes to average daily trip predictions.

    - Staff per Student

    - Student Drivers per HS/Grade 11-12 Student: For public schools, the number of student drivers divided by the number of 9th-12th grade students; for charter and private schools, the number of student drivers divided by the number of 11th and 12th grade students. Note that this ratio may be greater than 1 (if there are a large number of tenth-grade drivers), and is constrained to be the same for 11th and 12th grade under our estimation technique.

    - AM has_buses: Zero if the school does not provide morning buses, one otherwise.

- AM Buses per Student: Number of school buses used to drop-off students in the morning each day, divided by number of students at school.

- AM Parents: Legacy field; not currently used. Total number of AM carpool vehicles is estimated based on all vehicles arriving on campus between 2 hours before to 2 hours after start of school.

- AM Cars per Student: Legacy field; not currently used.

- AM Avg Car Length: Legacy field; not currently used.

- AM % Parents at Once: Legacy field; not currently used.

- AM Queue (Feet) per Student: Maximum morning queue in feet divided by number of students at school.

- PM has_buses: Zero if the school does not provide morning buses, one otherwise.

- PM Buses per Student: Number of school buses used to pick-up students in the afternoon each day, divided by number of students at school.

- PM Parents: Legacy field; not currently used. Total number of PM carpool vehicles is estimated based on all vehicles arriving on campus between 2 hours before to 1 hour after dismissal.

- PM Cars per Student: Legacy field; not currently used.

- PM Avg Car Length: Legacy field; not currently used.

- PM % Parents at Once: Legacy field; not currently used.

- PM Queue (Feet) per Student: Maximum afternoon queue in feet divided by number of students at school.

- Full Day Trip Generation - Arrivals, in 5-minute Blocks, per Student: Arrival counts are grouped into five-minute bins on the Trip Gen Counts tab. Arrivals for two hours before and after the school start time and three hours before and after the school end time are converted to a per-student basis at five-minute resolution. Counts before the AM period are averaged into a single rate of "predicted early-morning arrivals per five minutes, per student." Equivalent averages are established for the mid-day period between two hours after school start and three hours before school dismissal, and the late-afternoon period more than three hours after school dismissal.

    - In cases where schools have multiple start or end times, all counts between the first and last start time or first and last end time are averaged into the "Start of School" and "Dismissal" columns. Only four schools met this criteria.

- Full Day Trip Generation - Departures, in 5-minute Blocks, per Student: Same general setup as "Arrivals", but with departures in the equivalent time periods.

The image below shows the first few columns and rows of the Calculations tab.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	Metadata ID	Weights										Max Queue Modeling																	
2	metadata_ID	Public Elem	Public Middle	Public High	Private PK-K	Private Grades 1-10	Private Grade 11	Private Grade 12	Urban Charter Grades K-10	Urban Charter Grade 11	Urban Charter Grade 12	Staff per Student	Student Drivers per HS/Grade 11-12 Student	AM has_buses	AM Buses per Student	AM Parents	AM Cars per Student	AM Avg Car Length	AM % Parents at Once	AM Queue (Feet) per Student	PM has_buses	PM Buses per Student	PM Parents	PM Cars per Student	PM Avg Car Length	PM % Parents at Once	PM Queue (Feet) per Student	Early Morning Arrivals	2:00 Before Start
3	1	0	0	0	0	0	0	0	1			0.074324324		0	0					7.9	0	0					7.3		
4	2	0	0	0	0	0	0	0	1			0.072751323		0	0					3.5	0	0					5.4		
5	3	0	0	0	0	0	0	0	1			0.077619664		0	0					2.7	0	0					4.3	0	0
6	4	0	0	0	0	0	0	0	1			0.092329545								0.6							5.7		
7	5	0	0	0	0	0	0	0	1			0.110782866		0	0					1.5	0	0					4.1		
8	6	0	0	0	0	0	0	0	0.8	0.1	0.1	0.09833795	0.2	1	0					0.2	1	0					1.9	0	0
9	7	0	0	0	0.2	0.8			0	0	0	0.105042017		1	0					1.7	1	0					5.2	0	0
10	8	0	0	0	0	0	0	0	1			0.068212824		0	0					1.4	0	0					5.2		
11	9	0	0	0	0.1	0.9			0	0	0	0.085526316		1	0					2	1	0					4.2		
12	10	0	0	0		0.8	0.1	0.1	0	0	0	0.077989601	0.6	1	0					0.3	1	0					2.8		
13	11	0	0	0	0	0	0	0	0.6	0.2	0.2	0.108	0.2	1	0					3.3	1	0					1.4	0	0

CALCSUMMARY

The CalcSummary sheet contains the public, private/non-urban charter, and urban charter per-student average values by grade type that are used by the user interface tabs. The following calculations are generated:

- Staff per Student
- Student Drivers per Student
- AM Buses per Student
- AM Cars per Student: Legacy field; not used.
- AM Queue Length (Feet) per Student
- PM Buses per Student
- PM Cars per Student: Legacy field; not used.
- PM Queue Length (Feet) per Student
- Arrivals during the early-morning, AM peak, mid-day, PM peak, and late evening.
- Departures during the early morning, AM peak, mid-day, PM peak, and late evening.

The image below shows the first few columns and rows of the CalcSummary tab.

A	B	C	D	E	F	G	H	I	J	K	L
	Max Queue Modeling										
Category	Staff per Student	Student Drivers per Student	AM Buses per Student	AM Cars per Student	AM Queue Length (Feet) per Student	PM Buses per Student	PM Cars per Student	PM Queue Length (Feet) per Student	Early Morning Arrivals	2:00 Before Start	1:55 Before Start
Public Elem	0.15	0	0.01		0.77	0.01		2.71	0.0010	0.0014	0.0000
Public Middle	0.11		0.01		1.08	0.01		1.92	0.0013	0.0013	0.0004
Public High	0.11	0.19	0.02		0.9	0.02		0.99	0.0013	0.0009	0.0008
Private PK-K	0.11	0	0.01		2.22	0.01		4.95	0.0008	0.0006	0.0006
Private Grades 1-10	0.11	0	0.01		1.65	0.01		3.76	0.0009	0.0010	0.0010
Private Grade 11	0.1	0.72	0.01		0.92	0.01		3.45	0.0010	0.0020	0.0020
Private Grade 12	0.1	0.73	0.01		1.14	0.01		3.49	0.0010	0.0020	0.0020
Urban Charter Grades K-10	0.1	0	0.01		2.36	0.01		4.63	0.0012	0.0003	0.0007
Urban Charter Grade 11	0.1	0.35	0.01		1.76	0.01		1.71	0.0024	0.0004	0.0010
Urban Charter Grade 12	0.1	0.24	0.01		1.78	0.01		1.72	0.0025	0.0004	0.0010

Appendix B1: Table of Observed Schools

Appendix B: Table of Observed Schools

School ID	School Name	EDDIE School ID	Address	County	SchoolType	MSTAProject	Notes
1	Peak Charter Academy	93M000	1601 Orchard Villas Ave, Apex, NC 27502	Wake	UrbanCharter	RP 2021-15	
2	Greensboro Academy	41B000	4049 Battleground Ave, Greensboro, NC 27410	Guilford	UrbanCharter	RP 2021-15	
3	Summerfield Charter Academy	41J000	5303 US-220, Summerfield, NC 27358	Guilford	UrbanCharter	RP 2021-15	
4	Forsyth Academy	34F000	5426 Shattalon Drive, Winston-Salem, NC 27106	Forsyth	UrbanCharter	RP 2021-15	
5	PreEminent Charter School	92M000	3815 Rock Quarry Road, Raleigh, NC 27610	Wake	UrbanCharter	RP 2021-15	
6	Northeast Academy for Aerospace & Advanced Technologies	70A000	1413 W Ehringhaus St, Elizabeth City, NC 27909	Pasquotank	UrbanCharter	RP 2021-15	
7	The Academy of Moore County	63A000	12588 HWY 15-501 South, Aberdeen, NC 28315	Moore	Private_or_NonUrbanCharter	RP 2021-15	
8	Rolesville Charter Academy	93P000	908 Eagle Scholars Drive, Rolesville, NC 27571	Wake	UrbanCharter	RP 2021-15	
9	Gate City Charter Academy	41L000	123 Flemingfield Road, Greensboro, NC 27405	Guilford	Private_or_NonUrbanCharter	RP 2021-15	
10	Bethany Community School	79A000	1288 Hudson Rd, Summerfield, NC 27358	Rockingham	Private_or_NonUrbanCharter	RP 2021-15	
11	Apprentice Academy High School of North Carolina	90F000	2505 Weddington Rd, Monroe, NC 28110	Union	UrbanCharter	RP 2021-15	
12	Telra Institute	62L000	807 S. Trade St., Matthews, NC 28105	Mecklenburg	UrbanCharter	RP 2021-15	
13	Arapahoe Charter School	69A000	9005 NC Hwy 306 S, Arapahoe, NC 28510	Pamlico	Private_or_NonUrbanCharter	RP 2021-15	
14	Research Triangle High School	32N000	3106 East NC Highway 54, Durham, NC 27709	Durham	UrbanCharter	RP 2021-15	Classified as Private_or_NonUrbanCharter in RP 2019-27
15	Oxford Preparatory School	39B000	6041B Landis Rd, Oxford, NC 27565	Granville	Private_or_NonUrbanCharter	RP 2021-15	
16	Voyager Academy	32L000	101 Hock Parc Drive, Durham, NC 27704	Durham	UrbanCharter	RP 2021-15	Contains elementary, middle, and high school. Data only observed at Voyager Academy Elementary School
17	Excelsior Classical Academy CFA	32R000	4100 N Roxboro Street, Durham, NC 27704	Durham	UrbanCharter	RP 2021-15	
18	East Wake High School	920411	5101 Rolesville Rd, Wendell, NC 27591	Wake	Public	RP 2021-15	
19	Fuquay-Varina Middle	920424	109 N Ennis Street, Fuquay-Varina, NC 27526	Wake	Public	RP 2021-15	
20	Southern Nash Middle	640362	5301 South NC Highway 581, Spring Hope, NC 27882	Nash	Public	RP 2021-15	
21	Selma Middle School	510390	1533 Hwy 301 N, Selma, NC 27576	Johnston	Public	RP 2021-15	
22	Chatham School of Science & Engineering	190501	501 Martin Luther King Jr Blvd, Siler City, NC 27344	Chatham	Public	RP 2021-15	
23	North Johnston High	510368	5915 US Hwy 301 N, Kenly, NC 27542	Johnston	Public	RP 2021-15	
24	Cleveland High School	510327	1892 Polenta Rd, Clayton, NC 27520	Johnston	Public	RP 2021-15	
25	West Johnston High	510406	5935 Raleigh Road, Benson, NC 27504	Johnston	Public	RP 2021-15	
26	Southern Nash High	640364	6446 Southern Nash High Road, Bailey, NC 27807	Nash	Public	RP 2021-15	
27	Lucama Elementary	980352	6260 Blalock Road, Lucama, NC 27851	Wilson	Public	RP 2021-15	
28	Gray Stone Day School	84B000	49464 Merner Terrace, Misenheimer, NC 28109	Stanly	Private_or_NonUrbanCharter	RP 2021-15	
29	Mountain Island Charter School Inc	36C000	13440 Lucia Riverbend Highway, Mt. Holly, NC 28120	Gaston	Private_or_NonUrbanCharter	RP 2021-15	
30	Stantonsburg Elementary	980388	409 S Main St, Stantonsburg, NC 27883	Wilson	Public	RP 2021-15	
31	New Hope Elementary	980360	4826 Packhouse Rd, Wilson, NC 27896	Wilson	Public	RP 2021-15	
32	Chatham Middle	190312	2025 South 2nd Avenue Ext, Siler City, NC 27344	Chatham	Public	RP 2021-15	
33	Seaforth High School	190349	444 Seaforth Rd, Pittsboro NC 27312	Chatham	Public	RP 2021-15	
34	Archer Lodge Middle	510364	762 Wendell Rd, Wendell, NC 27591	Johnston	Public	RP 2021-15	
35	Winterville Charter Academy	74C000	4160 Bayswater Road, Winterville, NC 28590	Pitt	UrbanCharter	RP 2021-15	
36	Thales Academy of Wake Forest	A0902540	3106 Heritage Trade Dr, Wake Forest, NC 27587	Wake	Private_or_NonUrbanCharter	RP 2021-15	No EDDIE ID; used NCDS School ID
37	West Rowan Elementary	800406	480 Mimosa St, Cleveland, NC 27013	Rowan	Public	RP 2019-27	
38	Winget Park Elementary	600588	12235 Winget Rd, Charlotte, NC 28278	Mecklenburg	Public	RP 2019-27	
39	Harold D Isenberg Elementary	800358	2800 Jake Alexander Blvd N, Salisbury, NC 28147	Rowan	Public	RP 2019-27	
40	Hawk Ridge Elementary	600406	9201 Bryant Farms Rd, Charlotte, NC 28277	Mecklenburg	Public	RP 2019-27	
41	Jesse C Carson High School	800361	290 Kress Venture Dr, China Grove, NC 28023	Rowan	Public	RP 2019-27	

School ID	School Name	EDDIE School ID	Address	County	SchoolType	MSTAProject	Notes
42	Charles C Erwin Middle School	800314	170 St Luke's Church Rd, Salisbury, NC 28146	Rowan	Public	RP 2019-27	
43	West Rowan Middle School	800410	5925 Statesville Blvd, Salisbury, NC 28147	Rowan	Public	RP 2019-27	
44	Lynn Road Elementary	920488	1601 Lynn Rd, Raleigh, NC 27612	Wake	Public	RP 2019-27	
45	Yates Mill Elementary	920626	5993 Yates Mill Pond Road, Raleigh, NC 27606	Wake	Public	RP 2019-27	
46	Wildwood Forest Elementary	920618	8401 Wildwood Forest Drive, Raleigh, NC 27616	Wake	Public	RP 2019-27	
47	Wakelon Elementary	920597	8921 Pippin Rd, Zebulon, NC 27597	Wake	Public	RP 2019-27	
48	York Elementary	920628	5201 Brookhaven Dr, Raleigh, NC 27612	Wake	Public	RP 2019-27	
49	Apex Elementary	920308	700 Tingen Road, Apex, NC 27502	Wake	Public	RP 2019-27	
50	Underwood Elementary	920572	1614 Glenwood Avenue, Raleigh, NC 27608	Wake	Public	RP 2019-27	
51	Bryan Road Elementary	920349	8317 Bryan Rd , Garner, NC 27529	Wake	Public	RP 2019-27	
52	Oakview Elementary School	920521	11500 Holly Springs New Hill Rd, Apex, NC 27539	Wake	Public	RP 2019-27	
53	Abbotts Creek Elementary School	920303	9900 Durant Road, Raleigh, NC 27614	Wake	Public	RP 2019-27	
54	Laurel Mill Elementary	350330	730 Laurel Mill Road, Louisburg, NC 27549	Franklin	Public	RP 2019-27	
55	Bunn Elementary	350304	686 Bunn Elem School Road, Bunn, NC 27508	Franklin	Public	RP 2019-27	
56	Northwoods Elementary	920520	8850 Chapel Hill Road, Cary, NC 27513	Wake	Public	RP 2019-27	
57	Richland Creek Elementary School	920543	840 Wallridge Drive, Wake Forest, NC 27587	Wake	Public	RP 2019-27	
58	Kingswood Elementary	920460	200 E. Johnson Street, Cary, NC 27513	Wake	Public	RP 2019-27	
59	Apex Friendship High	920317	7801 Humie Olive Rd, Apex, NC 27502	Wake	Public	RP 2019-27	
60	Middle Creek High	920495	123 Middle Creek Park Avenue, Apex, NC 27539	Wake	Public	RP 2019-27	
61	Wakefield High	920595	2200 Wakefield Pines Drive, Raleigh, NC 27614	Wake	Public	RP 2019-27	
62	Apex High	920316	1501 Laura Duncan Rd, Apex, NC 27502	Wake	Public	RP 2019-27	Address listed as "7600 Roberts Road" in 2019 EDDIE database. School moved locations; 7600 Roberts Rd was a temporary location while new campus was constructed.
63	Carroll Middle	920360	4520 Six Forks Rd, Raleigh, NC 27609	Wake	Public	RP 2019-27	
64	Wakefield Middle	920594	2300 Wakefield Pines Drive, Raleigh, NC 27614	Wake	Public	RP 2019-27	
65	East Millbrook Middle	920408	3801 Spring Forest Rd, Raleigh, NC 27616	Wake	Public	RP 2019-27	
66	Leesville Road Middle	920471	8406 Pride Way, Raleigh, NC 27613	Wake	Public	RP 2019-27	
67	Reedy Creek Middle	920400	930 Reedy Creek Road, Cary, NC 27513	Wake	Public	RP 2019-27	
68	Edwin A Anderson Elementary	650323	55 Halyburton Memorial Parkway, Wilmington, NC 2841	New Hanover	Public	RP 2019-27	
69	Walter L Parsley Elementary	650380	3518 Masonboro Loop Road, Wilmington, NC 28409	New Hanover	Public	RP 2019-27	
70	Fremont STARS Elementary	960334	101 Pine Street, Fremont, NC 27830	Wayne	Public	RP 2019-27	
71	Northeast Elementary School	960450	4665 NC Hwy 111 N, Pikeville, NC 27863	Wayne	Public	RP 2019-27	
72	Rosewood Elementary School	960370	126 Charlie Braswell Road, Goldsboro, NC 27530	Wayne	Public	RP 2019-27	
73	Eastern Wayne High School	960330	1135 New Hope Road, Goldsboro, NC 27534	Wayne	Public	RP 2019-27	
74	Holly Shelter Middle School	650343	3921 Roger Haynes Dr, Castle Hayne, NC 28429	New Hanover	Public	RP 2019-27	
75	Needham Broughton High	920348	723 Saint Mary's St, Raleigh, NC 27605	Wake	Public	RP 2019-27	
76	Alpha Academy	26B000	8030 Raeford Road, Fayetteville, NC 28304	Cumberland	UrbanCharter	RP 2019-27	
77	Bradford Preparatory School	60S000	2502 Salome Church Rd, Charlotte, NC 28262	Mecklenburg	UrbanCharter	RP 2019-27	Classified as "Virtual Status: SUPPVIRTUAL." Not eligible under initial sample selection criteria.
78	Envision Science Academy	92Y000	590 Traditions Grande Blvd, Wake Forest, NC 27587	Wake	UrbanCharter	RP 2019-27	
79	Ignite Innovation Academy - Pitt	74B000	901 Staton Rd, Greenville, NC 27834	Pitt	UrbanCharter	RP 2019-27	
80	Maureen Joy Charter School	32A000	107 South Driver Street, Durham, NC 27703	Durham	UrbanCharter	RP 2019-27	
81	Lake Lure Classical Academy	81B000	1058 Island Creek Rd, Lake Lure, NC 28746	Rutherford	Private_or_NonUrbanCharter	RP 2019-27	
82	Pinnacle Classical Academy (Lower Elem Campus)	23A000	900 S Post Rd, Shelby, NC 28152	Cleveland	Private_or_NonUrbanCharter	RP 2019-27	

School ID	School Name	EDDIE School ID	Address	County	SchoolType	MSTAProject	Notes
83	Pinnacle Classical Academy (Upper Campus)	23A000	2401 Joes Lake Rd, Shelby, NC 28152	Cleveland	UrbanCharter	RP 2019-27	
84	Youngsville Academy	35B000	2045 Hicks Rd, Youngsville, NC 27596	Franklin	Private_or_NonUrbanCharter	RP 2019-27	
85	Millbridge Elementary	800366	155 Ed Deal Rd, China Grove, NC 28023	Rowan	Public	RP 2019-27	

Appendix B2: Queue and Survey Data

metadata_ID	sch_ID	SchoolName	ObservationDate	SurveyCompletion	SchoolYear	Program	PK/K	1	2	3	4	5	6	7	8	9	10	11	12	Grades_Instructed	TotalStudents	PopCollectionMethod	Start_1	End_1	Start_2	End_2	TimeNotes	SchoolStaff	StudentsWhoTakeBus	AM_Buses	PM_Buses
1	1	Peak Charter Academy	3/3/2022	2/8/22 9:43	2021-2022	Regular Calendar	90	83	84	83	84	82	79	82	73							Survey	8:00:00 AM	3:15:00 PM	8:00:00 AM	3:30:00 PM	8:00 AM - 3:15 PM K-5, 8:00 AM - 3:30 PM 6-8	55	0	0	0
2	2	Greensboro Academy	3/15/2022	2/9/22 6:39	2021-2022	Regular Calendar	84	84	84	84	84	84	84	84	84							Survey	8:00:00 AM	3:00:00 PM				55	0	0	0
3	3	Summerfield Charter Academy	3/22/2022	2/16/22 12:51	2021-2022	Regular Calendar	89	84	85	86	86	90	83	85	85							Survey	8:00:00 AM	3:00:00 PM				60	0	0	0
4	4	Forsyth Academy	3/29/2022	2/9/22 8:57	2021-2022	Regular Calendar	93	80	74	77	73	73	80	79	75							Survey	8:15:00 AM	3:15:00 PM				65			
5	5	PreEminent Charter School	4/6/2022	2/17/22 7:00	2021-2022	Regular Calendar	91	86	72	77	71	62	73	67	78							Survey	7:45:00 AM	4:00:00 PM				75	0	0	0
6	6	Northeast Academy for Aerospace & Advanced Technologies	4/12/2022	2/18/22 8:21	2021-2022	Regular Calendar						100	100	100	100	100	100	80	42			Survey	8:15:00 AM	3:15:00 PM				71	320	8	8
7	7	The Academy of Moore County	4/19/2022	2/18/22 9:21	2021-2022	Year Round	104	110	87	70	60	45										Survey	7:55:00 AM	2:55:00 PM				50	220	3	3
8	8	Rolesville Charter Academy	4/21/2022	2/11/22 14:57	2021-2022	Regular Calendar	88	83	82	85	80	83	84	80	68							Survey	8:00:00 AM	3:00:00 PM				50	0	0	0
9	9	Gate City Charter Academy	4/27/2022	2/8/22 10:27	2021-2022	Regular Calendar	100	84	84	84	84	84	84	78	78							Survey	7:30:00 AM	3:00:00 PM				65	2	1	1
10	10	Bethany Community School	4/28/2022	2/23/22 15:15	2021-2022	Regular Calendar							99	102	99	88	69	80	40			Survey	7:35:00 AM	3:00:00 PM				45	160	5	6
11	11	Apprentice Academy High School of North Carolina	5/3/2022	2/18/22 17:22	2021-2022	Regular Calendar										75	75	60	40			Survey	8:00:00 AM	3:30:00 PM				27	90	3	3
12	12	Telra Institute	5/5/2022	2/22/22 6:39	2021-2022	Regular Calendar	78	78	55	35												Survey	8:15:00 AM	3:30:00 PM				30	65	3	3
13	13	Arapahoe Charter School	5/10/2022	2/21/22 6:10	2021-2022	Regular Calendar	46	27	43	42	38	53	48	49	43	37	15	26	24			Survey	7:45:00 AM	3:05:00 PM				83	395	12	0
14	14	Research Triangle High School	5/11/2022	3/7/22 14:44	2021-2022	Regular Calendar										138	160	180	135			Survey	8:45:00 AM	4:00:00 PM				54	18	1	1
15	15	Oxford Preparatory School	5/18/2022	2/21/22 14:41	2021-2022	Regular Calendar	58	61	66	61	56	67	71	75	69	80	56	53	28			Survey	8:00:00 AM	2:45:00 PM	8:20:00 AM	3:20:00 PM	8:00 AM - 2:45 PM K-6, 8:20 AM - 3:20 PM 7-12	80	0	0	0
16	16	Voyager Academy	5/19/2022	2/21/22 9:13	2021-2022	Regular Calendar	100	105	99	105												Survey	7:45:00 AM	2:45:00 PM							
17	17	Excelsior Classical Academy CFA	6/2/2022	2/24/22 10:17	2021-2022	Modified Year Round	92	93	95	94	93	92	93	87	76	44	40					Survey	8:00:00 AM	4:00:00 PM				100	420	7	7
18	18	East Wake High School	9/20/2022	9/2/22 20:42	2022-2023	Regular Calendar										490	438	399	349			Survey	7:25:00 AM	2:18:00 PM				145	1000	16	16
19	19	Fuquay-Varina Middle	9/22/2022	9/6/22 11:00	2022-2023	Regular Calendar							369	401	396							Survey	8:15:00 AM	3:00:00 PM				100	700	12	13
20	20	Southern Nash Middle	9/27/2022	9/5/22 15:35	2022-2023	Regular Calendar							270	253	276							Survey	8:30:00 AM	3:30:00 PM				65	450	13	13
21	21	Selma Middle School	9/29/2022	9/8/22 9:15	2022-2023	Regular Calendar							107	123	148							Survey	7:25:00 AM	3:05:00 PM				63	348	9	9
22	22	Chatham School of Science & Engineering	10/4/2022	9/1/22 14:19	2022-2023	Early College										29	24	16	16			ADM Estimate	8:00:00 AM	3:00:00 PM				25		8	3
23	23	North Johnston High	10/18/2022	9/23/22 13:27	2022-2023	Regular Calendar										231	200	186	174			Survey	6:45:00 AM	2:15:00 PM				94	450	14	14
24	24	Cleveland High School	10/19/2022	9/26/22 4:22	2022-2023	Regular Calendar										528	472	452	452			Survey	7:15:00 AM	2:15:00 PM				145	600	31	31
25	25	West Johnston High	10/20/2022	10/5/22 13:44	2022-2023	Regular Calendar										405	415	368	287			Survey	7:15:00 AM	2:15:00 PM				125			
26	26	Southern Nash High	10/25/2022	9/25/22 17:40	2022-2023	Regular Calendar										283	294	278	205			Survey	7:30:00 AM	2:30:00 PM				100	500	18	18
27	27	Lucama Elementary	10/26/2022	9/26/22 20:32	2022-2023	Regular Calendar	67	64	56	47	57	62										Survey	8:00:00 AM	3:00:00 PM				55	120	3	3
28	28	Gray Stone Day School	11/1/2022	3/14/22 13:43	2022-2023	Regular Calendar							109	114	112	105	100	99	90			Survey	8:05:00 AM	2:10:00 PM	9:00:00 AM	2:30:00 PM	8:05 AM - 2:10 PM 6-8; 9:00 AM - 2:30 PM 9-12	60	0	0	0
29	29	Mountain Island Charter School Inc	11/2/2022	2/22/22 15:06	2022-2023	Regular Calendar	126	126	126	132	96	97	138	136	136	138	135	135	132			Survey	8:20:00 AM	3:20:00 PM	7:30:00 AM	2:30:00 PM	8:20 AM - 3:20 PM K-5; 7:30 AM - 2:30 PM 6-12	185	640	8	8
30	30	Stantonsburg Elementary	11/9/2022	10/17/22 12:38	2022-2023	Regular Calendar	50	30	30	30	30	40										Survey	8:00:00 AM	3:00:00 PM				30	75	2	2
31	31	New Hope Elementary	11/10/2022	10/17/22 12:53	2022-2023	Regular Calendar	60	88	78	61	75	69										Survey	8:00:00 AM	3:00:00 PM				50	90	3	3
32	32	Chatham Middle	11/16/2022	9/30/22 9:49	2022-2023	Regular Calendar							168	196	192							Survey	7:55:00 AM	2:55:00 PM				70	400	9	9
33	33	Seaforth High School	11/17/2022	9/29/22 16:34	2022-2023	Regular Calendar										212.8	195.6	172.1	151.5	Grades 9 - 12	732	Head Count	8:00:00 AM	3:10:00 PM				75	320	10	10
34	34	Archer Lodge Middle	11/29/2022	9/26/22 6:30	2022-2023	Regular Calendar							430	430	430							Survey	8:05:00 AM	3:05:00 PM				104	900	22	22
35	35	Winterville Charter Academy	12/8/2022	3/3/22 12:33	2022-2023	Regular Calendar	81	74	61	69	50	59	62	63	71							Survey	8:00:00 AM	3:00:00 PM				60	0	0	0
36	36	Thales Academy of Wake Forest	8/23/2022	2021-2022	2022-2023		142.5	150.7	119.2	95.88	82.18	61.64								Grades PK - 5	652	Enrollment	7:40:00 AM	2:45:00 PM							
37	37	West Rowan Elementary	10/28/2019	10/2/2019	2019-2020	Regular Calendar	89	106	88	94	77	120								Grades PK - 5	574	ADM Estimate						107		8	8
38	38	Winget Park Elementary		3/11/2020	2019-2020	Regular Calendar	99	108	105	102	94	116										ADM Estimate						93		0	12
39	39	Harold D Isenberg Elementary	10/30/2019		2019-2020															Grades K - 5	407	Reported by School									
40	40	Hawk Ridge Elementary		10/11/2019	2019-2020	Regular Calendar	122	143	124	147	176	152										ADM Estimate						84		11	11
41	41	Jesse C Carson High School		10/9/2019	2019-2020	Regular Calendar										311	246	313	255			ADM Estimate						115		10	10
42	42	Charles C Erwin Middle School	10/29/2019		2019-2020															Grades 6 - 8	869	ADM Estimate									
43	43	West Rowan Middle School	10/28/2019		2019-2020															Grades 6 - 8	672	ADM Estimate									
44	44	Lynn Road Elementary	1/22/2020		2019-2020															Grades PK - 5	476	Reported by School									
45	45	Yates Mill Elementary		11/14/2019	2019-2020	Regular Calendar	77	86	78	78	80	101										ADM Estimate						75		19	19
46	46	Wildwood Forest Elementary	12/4/2019		2019-2020															Grades K - 5	600	Reported by School									
47	47	Wakelon Elementary	12/5/2019	2/19/2020	2019-2020	Regular Calendar	81.75	86.92	86.92	93.13	91.06	96.23								Grades K - 5	536	Reported by School						65		7	7
48	48	York Elementary	12/2/2019	12/6/2019	2019-2020	Regular Calendar	75.35	67.52	68.5	70.46	71.44	57.74								Grades PK - 5	411	Reported by School						62		5	5
49	49	Apex Elementary		11/15/2019	2019-2020	Regular Calendar	116	107	108	105	116	96										ADM Estimate						85		8	8
50	50	Underwood Elementary		11/11/2019	2019-2020	Regular Calendar	82	67	79	70	78	81										ADM Estimate						75		7	7
51	51	Bryan Road Elementary	12/12/2019		2019-2020															Grades PK - 5	478	Reported by School									
52	52	Oakview Elementary School		11/8/2019	2019-2020	Regular Calendar	137	149	154	156	160	139										ADM Estimate						109		8	8
53	53	Abbotts Creek Elementary School		2/19/2020	2019-2020	Regular Calendar	142	141	152	158	147	125										ADM Estimate						101		9	9
54	54	Laurel Mill Elementary	3/4/2020		2019-2020															Grades K - 5	293	Reported by School									
55	55	Bunn Elementary	2/25/2020		2019-2020															Grades K - 5	543	ADM Estimate									
56	56	Northwoods Elementary	1/23/2020	11/18/2019	2019-2020	Regular Calendar	117.9	120.1	120.1	104.8	99.33	93.87								Grades PK - 5	656	Reported by School						86		7	7
57	57	Richland Creek Elementary School	12/9/2019	12/6/2019	2019-2020	Regular Calendar	82	68	78	69	91	93								Grades PK - 5	481	ADM Estimate						65		6	6
58	58	Kingswood Elementary		11/18/2019	2019-2020	Regular Calendar	70	84	55	61	64	53										ADM Estimate						73		5	5
59	59	Apex Friendship High	1/30/2020		2019-2020															Grades 9 - 12	2572	ADM Estimate									
60	60	Middle Creek High		11/12/2019	2019-2020	Regular Calendar										481	500	481	449			ADM Estimate						180		26	26
61	61	Wakefield High	2/3/2020	12/4/2019	2019-2020	Regular Calendar										496	487	454	433	Grades 9 - 12	1870	ADM Estimate						171		24	24
62	62	Apex High	11/19/2019		2019-2020															Grades 9 - 12	2097	ADM Estimate									
63	63	Carroll Middle		11/26/2019	2019-2020	Regular Calendar							340	338	304							ADM Estimate						100		12	13
64	64	Wakefield Middle	2/3/2020	2/14/2020	2019-2020	Regular Calendar							282.5	290	313.5					Grades 6 - 8	886	Reported by School						82		11	11
65	65	East Millbrook Middle	12/10/2019	12/8/2019	2019-2020	Regular Calendar							244	268	263					Grades 6 - 8	775	ADM Estimate						126		0	0
66	66	Leesville Road Middle	12/3/2019		2019-2020															Grades 6 - 8	906	ADM Estimate									
67	67	Reedy Creek Middle	11/20/2019	11/19/2019	2019-2020	Regular Calendar							225	288	300					Grades 6 - 8	813	ADM Estimate						102		9	10
68	68	Edwin A Anderson Elementary	3/10/2020		2019-2020															Grades K - 5	680	ADM Estimate									
69	69	Walter L Parsley Elementary	3/9/2020		2019-2020															Grades K - 5	649	ADM Estimate									
70	70	Fremont STARS Elementary		2/12/2020	2019-2020	Regular Calendar	26	47	32	36	48	45										ADM Estimate						40		2	2
71	71	Northeast Elementary School		2/10/2020	2019-2020	Regular Calendar	117	101	122	103	128	109										ADM Estimate						98		6	6
72	72	Rosewood Elementary School		1/27/2020	2019-2020	Regular Calendar	95	109	109	95	106	98										ADM Estimate						125		5	5
73	73	Eastern Wayne High School	2/11/2020		2019-2020															Grades 9 - 12	875	ADM Estimate									
74	74	Holly Shelter Middle School	3/2/2020		2019-2020															Grades 6 - 8	731	Reported by School									
75	75	Needham Broughton High		11/7/2019	2019-2020	Regular Calendar										569	523	458	436			ADM Estimate						190		19	19
76	76	Alpha Academy		5/11/2019	2018-2019	Regular Calendar	81	112	99	93	63	76	86	70	51	30						ADM Estimate						104		10	10
77	77	Bradford Preparatory School		5/7/2019	2018-2019	Regular Calendar	92	99	108	115	128	117	135	142	123	118	77	51	37			ADM Estimate						152		0	0
78	78	Envision Science Academy		5/1/2019	2018-2019	Regular Calendar	75	76	80	80	79	79	80	80	74							ADM Estimate						70		0	0
79	79	Ignite Innovation Academy - Pitt	5/23/2019		2018-2019															Grades K - 8	184	ADM Estimate									
80	80	Maureen Joy Charter School		5/3/2019	2018-2019	Regular Calendar	63	63	66	73	74	71	72	73	69							ADM Estimate						70		11	12
81	81	Lake Lure Classical Academy	9/17/2019	5/10/2019		Regular Calendar	29.9	27.84	39.19	42.28	45.37	44.34	51.56	41.25	34.03	46.4	44.34	21.65	27.84	Grades K - 12	496	ADM Estimate						57		0	0
82	82	Pinnacle Classical Academy (Lower Elem Campus)	5/22/2019	5/9/2019	2018-2019	Regular Calendar	115.2	109.9	91.93											Grades K - 2	317	Reported by School						36		0	0
83	83	Pinnacle Classical Academy (Upper Campus)		5/10/2019	2018-2019	Regular Calendar				84	90	85	56	53	55	43	36	28				ADM Estimate						72		0	0
84	84	Youngsville Academy		5/16/2019	2018-2019	Year Round	60	54	59	56	40	35										ADM Estimate						30		0	0
85	85	Millbridge Elementary		10/2/2019	2019-2020	Regular Calendar	67	91	100	88	94	90										ADM Estimate						70		6	6

metadata_ID	StudentDrivers_Grade10	StudentDrivers_Grade11	StudentDrivers_Grade12	StudentDrivers_Total	StudentsWhoWalk	StudentsWhoBike	GreenwayOrSidewalk	AM Queue (Feet)	PM Queue (Feet)	Loading Zone (Feet)	Notes
1	0	0	0		30	2	Yes	5871	5375	317	
2	0	0	0		0	0	Yes	2656	4050	192	
3	0	0	0		0	0	No	2054	3305	805	
4	0	0	0		50	0	No	444	4002	719	
5	0	0	0		10	0	Yes	993	2761	201	
6	5	10	15		75	0	Yes	179	1350	182	
7	0	0	0		0	0	No	794	2498	205	
8	0	0	0		25	0	Yes	1027	3780	310	
9	0	0	0		0	0	Yes	1496	3157	561	
10	21	36	11		0	0	No	192	1635	251	
11	0	5	15		0	0	Yes	837	360	56	
12	0	0	0		3	0	Yes	316	1392	128	
13	0	5	5		1	0	No	415	524	54	
14				75		4	Yes	639	1153	103	
15	10	30	22		5	0	No	412	1988	246	
16							Yes	285	3786	178	
17	4	0	0		3	0	Yes	3194	2360	171	
18	0	35	52		0	0	No	2017	1478	122	
19	0	0	0		95	2	Yes	1416	2944	210	
20				0	0	0	No	1950	2672	144	
21	0	0	0		0	0	No	40	592	60	
22	0	0	0		0	0	Yes	0	0	244	
23				158	0	0	No	632	1176	90	
24	100	200	300		10	1	No	2019	1838	783	
25					0	0	No	2051	878	255	
26	50	100	100		0	0	No		1581	171	
27	0	0	0		10	0	Yes	352	1047	149	
28	50	60	45	230	0	0	No		5386	454	
29	25	50	75		4	0	No	3802	1964	401	
30	0	0	0		5	0	Yes	0	220	122	
31				0	0	0	No	567	1478	354	
32	0	0	0		0	0	Yes		902	261	
33	0	85	0		2	1	No	712	1429	291	Grade-by-grade breakdown of known total population estimated from other public high schools
34	0	0	0		4	0	No	704	2847	339	
35	0	0	0		4	1	No	1336	3157	579	
36								2629	3012	317	AM queue observed 08/23/2022; PM queue observed 08/18/2022. Grade-by-grade split of total population estimated from The Academy of Moore County
37				0					2080		
38				0							PM Buses data imputed from 10/11/2019 survey
39									952		
40				0							
41				250							
42									1344		
43									1358		
44									1410		
45				0							
46									1491		
47				0					1206		ADM estimate of population scaled to school-reported total volume; proportion by grade preserved
48				0					1850		ADM estimate of population scaled to school-reported total volume; proportion by grade preserved
49				0							
50				0							
51									1454		
52				0							
53				0							
54									517		
55									1733		
56				0					1139		ADM estimate of population scaled to school-reported total volume; proportion by grade preserved
57				0					1579		
58				0							
59									2064		PM queue: Many gaps due to students crossing the queue
60				500							
61				347					1701		
62									1210		PM Queue, data collector note: Hard to see if vehicles are parking or in the queue, should be helped with drone
63				0							
64				0					1238		ADM estimate of population scaled to school-reported total volume; proportion by grade preserved
65				0					840		
66									944		
67				0					2108		
68									1868		
69									1294		
70				0							
71				0							
72				0							
73									1121		PM Queue, data collector note: Middle of queue is very tough to see, also hard to tell whether cars are entering queue 1 and queue 2
74									1558		
75				560							
76				0							
77				45							
78				0							
79									322		
80				0							
81				25					852		
82				0					2562		ADM estimate of population scaled to school-reported total volume; proportion by grade preserved
83				50							
84				0							
85				0							

Appendix B3: Full Day Counts

Trip Counts (Total Arrivals + Departures), 5-Minute Bins																																																							
metadata_ID	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	11	11	13	13	14	14	15	15	17	17	21	21	23	23	24	24	25	25	26	26	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	35	35
Bin Start	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
School Name	Peak Charter Academy	Peak Charter Academy	Greensboro Academy	Greensboro Academy	Summerfield Charter Academy	Summerfield Charter Academy	Forsyth Academy	Forsyth Academy	PreEminent Charter School	PreEminent Charter School	Northeast Academy for Aerospace & Advanced Technologies	Northeast Academy for Aerospace & Advanced Technologies	The Academy of Moore County	The Academy of Moore County	Rolesville Charter Academy	Rolesville Charter Academy	Gate City Charter Academy	Gate City Charter Academy	Apprentice Academy High School of North Carolina	Apprentice Academy High School of North Carolina	Arapahoe Charter School	Arapahoe Charter School	Research Triangle High School	Research Triangle High School	Oxford Preparatory School	Oxford Preparatory School	Excelsior Classical Academy CFA	Excelsior Classical Academy CFA	Selma Middle School	Selma Middle School	North Johnston High	North Johnston High	Cleveland High School	Cleveland High School	West Johnston High	West Johnston High	Southern Nash High	Southern Nash High	Lucama Elementary	Lucama Elementary	Gray Stone Day School	Gray Stone Day School	Mountain Island Charter School Inc	Mountain Island Charter School Inc	Stantonsburg Elementary	Stantonsburg Elementary	New Hope Elementary	New Hope Elementary	Chatham Middle	Chatham Middle	Seaforth High School	Seaforth High School	Archer Lodge Middle	Archer Lodge Middle	Winterville Charter Academy	Winterville Charter Academy
Observation Date	3/3/2022	3/3/2022	3/15/2022	3/15/2022	3/22/2022	3/22/2022	3/29/2022	3/29/2022	4/6/2022	4/6/2022	4/12/2022	4/12/2022	4/19/2022	4/19/2022	4/21/2022	4/21/2022	4/27/2022	4/27/2022	5/3/2022	5/3/2022	5/10/2022	5/10/2022	5/11/2022	5/11/2022	5/18/2022	5/18/2022	6/2/2022	6/2/2022	9/29/2022	9/29/2022	10/18/2022	10/18/2022	10/19/2022	10/19/2022	10/20/2022	10/20/2022	10/25/2022	10/25/2022	10/26/2022	10/26/2022	11/1/2022	11/1/2022	11/2/2022	11/2/2022	11/9/2022	11/9/2022	11/10/2022	11/10/2022	11/16/2022	11/16/2022	11/17/2022	11/17/2022	11/29/2022	11/29/2022	12/8/2022	12/8/2022
5:00																																	3	0			3	0													0	1				
5:05																																	3	1			0	0													0	0				
5:10					1	0																											0	1	2	0	4	1													1	0				
5:15					0	0																									1	0	1	0	3	0	0	0													1	0				
5:20					0	1																									3	0	5	0	1	0	1	0													0	0	1	0		
5:25					0	0																									2	0	6	0	0	0	0	3									1	0			0	0	0	0		
5:30					0	0																					2	0			2	1	3	0	2	0	1	2									0	0			2	0	0	0		
5:35					0	0													1	0	1	0					1	0			0	1	2	1	0	0	0	2									0	0			0	0	0	0		
5:40					0	0							1	0					2	0	0	0					0	0			1	0	2	1	1	2	1	0									0	0	1	0	0	0	2	0		
5:45					0	0					1	0	0	0			1	0	1	1	1	0					2	0			4	1	3	0	0	5	0	0									0	0	0	0	5	0	0	0		
5:50					0	0					0	0	0	0			0	0	0	0	1	1					1	0			1	2	1	1	2	0	3	2									1	0	3	1	6	6	0	2		
5:55					0	0					0	0	0	0			0	0	0	0	1	0					2	0			2	2	0	4	0	1	0	0									1	0	1	0	0	3	0	1		
6:00					0	0					0	0	0	0			0	0	0	1	0	1					0	0			1	1	5	2	2	0	1	1	1	0							0	1	0	0	0	0	0	0		
6:05	1	0			0	0					2	3	1	0			0	0	0	1	0	0					0	0			0	0	6	0	4	1	2	1	0	0			2	1			0	0	2	0	0	0	1	0		
6:10	0	0			0	0					0	0	0	0			0	0	0	0	0	1					0	0			1	0	4	0	3	1	2	0	0	0			0	0			1	0	0	0	0	0	1	0		
6:15	0	0			0	0					1	0	2	0			1	0	0	0	1	0					0	0			4	0	9	0	7	0	1	0	0	0			2	2	1	0	1	0	1	1	0	0	1	0		
6:20	0	0			1	0					1	0	0	2			1	1	0	0	0	0					0	0			4	0	17	6	15	0	4	0	0	0	1	0	2	0	1	0	2	0	1	0	1	0	2	0		
6:25	1	0	1	0	1	0					2	0	0	1	1	0	1	0	0	0	1	0					1	0			8	0	28	3	16	2	6	0	0	0	0	0	4	2	0	0	2	0	1	0	2	1	0	0	1	0
6:30	1	0	1	0	2	0			1	0	4	2	1	0	0	0	1	0	0	0	1	1					1	1	1	0	12	1	35	4	27	2	4	0	0	0	0	0	5	0	0	0	3	5	0	0	0	1	1	0	0	0
6:35	0	0	1	0	0	0			0	0	1	0	0	0	0	0	7	0	0	0	2	1					4	0	0	0	13	0	44	9	39	1	7	1	2	1	0	0	3	1	0	0	2	2	0	1	1	0	2	0	1	0
6:40	2	0	0	0	2	0	1	0	0	0	1	1	0	0	2	0	6	5	0	0	0	0					5	2	3	0	17	3	65	18	76	1	13	2	0	1	2	0	8	0	0	0	1	1	0	0	3	0	2	0	4	0
6:45	1	0	2	0	2	0	0	0	1	0	1	1	2	0	1	0	6	1	0	0	0	0			1	0	3	5	1	0	27	5	91	48	82	51	7	2	1	0	1	0	8	0	0	0	1	0	0	1	1	1	3	2	3	0

Trip Counts (Total Arrivals + Departures), 5-Minute Bins

metadata_ID	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	11	11	13	13	14	14	15	15	17	17	21	21	23	23	24	24	25	25	26	26	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	35	35
Bin Start	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
6:50	2	0	5	0	2	0	1	0	3	4	2	0	2	0	6	0	11	2	2	0	4	0	1	0	0	1	3	1	0	0	43	20	96	49	102	52	15	4	1	0	1	0	22	2	0	0	3	1	3	0	2	0	4	0	7	0
6:55	5	1	2	0	6	0	1	0	7	4	2	1	4	0	6	1	8	1	2	0	3	0	0	0	2	0	3	0	2	0	58	30	121	53	113	58	29	12	4	0	1	0	43	2	1	0	3	1	1	0	1	1	8	3	5	0
7:00	3	0	4	0	14	0	1	1	6	4	1	0	7	0	8	3	17	1	0	0	5	0	1	0	7	0	3	0	4	0	76	35	135	63	96	37	48	22	3	1	1	0	56	15	0	0	6	0	2	1	2	0	19	5	11	0
7:05	12	0	5	1	12	1	2	0	4	1	4	0	10	0	8	1	19	6	3	1	6	0	3	0	6	0	5	0	3	0	70	52	131	64	79	65	60	33	6	0	3	0	65	31	1	0	7	1	6	1	3	0	23	13	16	0
7:10	12	0	14	0	19	0	2	0	8	4	10	0	10	0	6	0	17	0	5	4	7	0	0	0	3	1	3	0	6	0	28	50	78	74	31	85	82	40	6	1	1	0	90	39	0	0	13	1	8	1	6	1	31	19	21	0
7:15	25	1	21	3	22	0	8	1	8	2	7	1	15	0	26	2	16	4	3	0	4	0	3	1	12	0	6	1	8	0	2	2	5	30	1	12	64	24	13	0	4	0	69	55	1	0	12	1	7	1	15	5	32	18	12	0
7:20	32	0	20	28	29	40	10	0	11	3	9	1	21	22	22	3	23	2	5	2	15	1	4	3	21	0	3	1	10	2	5	2	4	2	6	4	54	20	11	1	16	0	76	40	5	1	14	0	17	0	21	7	28	20	27	0
7:25	64	35	34	17	43	28	11	0	16	4	13	2	25	27	25	2	30	2	2	5	12	1	6	6	27	6	5	1	16	14	2	2	1	3	2	5	41	49	14	0	19	0	27	34	11	2	19	0	31	6	15	5	23	11	21	41
7:30	77	49	44	27	47	32	21	2	28	3	25	22	45	25	40	35	26	34	1	1	5	0	6	6	43	38	10	1	14	10	0	1	0	1	3	0	7	5	14	21	24	25	44	30	11	12	27	33	16	5	40	21	43	21	32	67
7:35	81	50	66	34	76	44	22	5	23	8	34	23	39	36	63	46	40	42	8	1	11	0	6	4	52	53	15	0	14	11	3	1	1	0	5	3	3	6	23	29	33	30	26	28	10	10	35	42	29	52	44	23	43	38	53	31
7:40	76	48	70	46	81	45	31	11	41	17	32	34	56	39	64	51	45	48	15	11	13	0	4	2	52	38	20	0	14	15	1	0	3	0	1	3	2	2	31	27	40	22	17	36	7	6	39	33	44	34	54	32	66	36	51	35
7:45	65	48	57	57	78	49	32	33	39	39	25	24	26	38	58	54	58	58	17	10	26	23	12	6	48	55	25	0	15	12	1	0	3	1	7	4	1	1	35	31	50	33	18	13	13	8	38	43	42	37	70	36	51	63	64	50
7:50	6	49	63	41	59	50	40	60	46	46	41	25	15	35	59	54	54	57	11	8	20	19	14	14	55	46	41	0	7	9	0	0	4	3	3	1	4	3	16	28	55	30	17	17	14	14	35	26	29	39	86	45	43	47	42	49
7:55	7	49	47	42	15	45	40	28	45	61	46	37	2	12	37	59	49	50	14	10	14	16	12	9	47	57	30	26	9	9	2	4	3	4	3	2	1	0	14	14	42	31	38	23	17	13	21	37	21	20	49	57	52	56	16	62
8:00	9	50	13	40	7	55	59	48	44	46	38	34	2	4	19	61	11	53	16	10	0	6	15	11	61	46	41	48	2	2	1	2	2	1	1	2	1	0	6	4	33	35	28	29	4	7	8	8	5	3	11	27	38	60	7	6
8:05	0	45	3	45	6	36	61	44	36	45	40	35	1	3	11	14	6	22	14	9	0	0	14	8	27	41	55	44	3	2	1	0	4	2	5	0	2	0	0	6	41	35	51	40	2	2	2	1	1	1	3	3	14	19	5	7
8:10	1	5	4	42	4	4	51	54	33	35	24	32	0	1	5	11	4	6	12	8	0	1	16	12	24	20	38	36	2	3	2	1	3	0	5	2	4	2	2	0	30	17	57	39	1	0	1	1	1	1	6	4	5	10	2	6
8:15	1	3	2	4	2	1	22	62	21	29	22	22	3	0	3	2	1	7	6	1	1	1	23	11	17	20	29	45	1	0	2	2	12	0	1	2	0	1	1	1	38	16	34	47	2	0	0	2	1	1	6	2	3	7	2	4
8:20	1	0	3	3	4	4	12	12	10	16	11	14	0	0	1	1	2	5	4	4	0	1	32	21	16	16	41	39	1	0	4	0	15	2	0	2	2	2	0	1	15	18	16	33	0	1	0	1	0	1	13	5	2	0	1	2
8:25	1	1	0	2	1	2	10	14	6	10	4	9	0	0	2	3	1	4	2	3	0	1	45	35	6	5	38	42	0	0	7	0	29	4	1	1	2	2	0	1	5	9	1	8	0	0	1	0	0	0	12	10	3	1	2	2
8:30	0	0	2	1	0	3	3	7	7	4	3	4	1	1	2	2	4	3	1	1	3	0	52	28	2	5	4	42	0	0	11	5	16	9	2	1	1	1	1	1	4	5	6	4	0	0	0	0	0	0	5	7	2	2	1	1
8:35	0	0	1	1	1	2	3	3	1	4	2	3	1	0	2	4	1	1	0	0	0	0	40	33	0	0	0	5	1	0	17	2	6	47	4	1	4	2	0	0	2	1	4	4	1	1	1	2	3	1	13	3	1	2	1	1
8:40	1	0	0	1	2	1	2	2	1	1	1	4	2	2	0	0	3	2	3	1	1	1	64	35	1	0	0	1	2	0	14	3	4	4	2	6	0	3	0	0	3	1	7	1	0	1	1	1	1	2	7	5	2	1	0	1
8:45	1	1	3	3	3	0	1	2	1	1	3	3	2	1	0	1	2	1	1	0	0	0	19	50	1	1	1	0	0	2	7	6	7	4	5	8	2	2	1	0	0	1	1	3	0	2	1	0	0	0	5	2	2	2	3	0
8:50	0	1	3	1	1	1	0	0	3	1	3	4	2	0	0	0	2	1	0	1	2	0	13	9	1	0	0	0	0	0	1	4	5	3	5	5	5	1	0	0	0	1	1	0	0	0	2	1	1	0	4	3	2	2	2	0
8:55	1	0	0	0	0	2	1	1	3	3	5	6	0	2	0	1	1	1	3	1	0	1	9	5	2	0	1	1	0	0	3	0	9	9	5	4	6	3	0	0	0	1	5	2	0	0	2	1	0	0	2	1	5	1	0	1
9:00	1	1	2	1	0	0	1	1	4	3	1	4	0	1	0	0	2	3	1	1	0	1	5	3	1	2	1	0	0	0	0	2	2	6	6	2	0	3	0	0	3	1	2	1	0	0	0	1	0	0	0	2	2	3	1	2
9:05	2	1	0	1	0	0	0	0	1	2	10	11	0	0	1	0	2	0	1	1	0	0	2	2	2	1	2	0	0	0	1	4	3	1	10	0	0	2	0	0	7	1	2	2	0	0	0	0	0	1	2	1	2	3	3	0
9:10	2	1	2	0	0	0	3	2	1	1	5	5	3	3	0	0	0	1	0	0	1	0	1	1	3	0	0	2	0	0	2	0	1	4	12	3	2	1	0	0	10	2	3	1	1	1	0	0	0	0	0	1	4	2	0	0
9:15	0	0	2	1	1	0	2	1	1	3	2	0	1	0	0	0	0	2	1	0	3	0	0	0	2	2	3	3	1	0	1	1	4	3	23	6	1	1	0	0	4	1	3	3	2	0	1	0	0	0	2	0	2	1	0	1
9:20	1	0	1	0	2	0	2	1	1	0	2	2	0	3	1	0	0	0	0	2	1	1	1	2	1	1	4	2	3	1	1	0	2	2	5	4	1	1	2	0	7	1	8	0	1	1	3	0	0	0	4	0	0	3	0	0
9:25	1	2	2	0	0	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	0	1	0	1	1	2	3	0	0	0	3	0	6	3	5	0	2	0	0	0	2	1	2	4	0	3	1	3	0	0	1	3	1	1	0	0
9:30	1	1	0	2	1	2	1	0	0	0	2	3	0	0	0	0	1	0	0	0	1	0	2	1	2	0	3	2	0	1	3	5	3	5	4	4	3	1	0	0	0	1	5	0	1	1	1	0	1	0	2	1	1	2	1	0
9:35	0	1	0	0	3	1	0	2	1	1	5	3	0	1	1	0	1	1	2	0	0	0	1	2	1	1	3	2	0	0	1	3	6	3	1	3	2	0	2	2	0	1	10	0	0	0	1	0	1	0	3	2	1	1	0	1
9:40	0	0	0	0	1	2	2	0	2	0	1	1	1	0	1	0	2	1	2	1	1	0	4	1	2	4	1	0	1	0	0	2	13	5	1	5	0	0	0	3	2	1	5	6	1	1	0	0	0	1	0	1	2	1	1	1
9:45	0	0	1	0	0	1	0	1	0	2	2	3	0	1	2	1	0	0	0	0	0	0	1	0	2	1	2	3	0	2	2	4	13	4	2	3	1	3	2	1	1	1	7	3	1	2	1	1	0	0	1	0	1	0	0	0
9:50	0	1	1	1	1	0	0	0	3	0	2	2	1	0	0	1	2	1	1	2	1	0	0	2	3	0	0	0	0	1	1	1	7	37	0	0	2	1	0	1	0	1	4	2	1	0	1	1	1	0	0	2	1	2	2	1
9:55	2	0	1	2	0	1	1	0	1	1	1	1	0	0	0	0	0	1	3	0	2	1	0	0	2	2	0	0	2	0	2	4	3	50	1	1	2	1	1	0	1	0	4	0	0	0	0	1	0	0	2	1	1	3	0	0
10:00	1	1	1	2	0	0	4	1	1	1	2	2	0	0	1	2	1	0	1	0	0	1	0	0	3	0	0	0	2	1	2	0	3	12	0	2	0	1	0	1	1	0	0	1	0	0	0	0	0	0	1	1	1	1	0	1
10:05	3	0	4	2	0	0	1	4	1	0	4	2	2	0	0	1	2	1	1	0	0	2	2	1	2	1	1	1	0	0	0	1	2	8	0	1	0	0	0	0	1	0	2	1	0	0	0	0	1	1	0	1	1	0	0	0
10:10	0	0	1	3	0	0	2	0	0	0	0	1	0	0	0	0	0	2	1	1	0	0	3	4	5	2	2	1	0	1	5	1	1	4	3	0	2	2	0	0	0	0	1	3	1	0	2	0	0	0	0	0	0	2	1	0
10:15	0	3	1	0	0	0	0	1	1	0	1	2	0	1	4	1	0	1	0	2	0	1	0	2	2	0	1	1	1	0	6	3	1	0	2	1	1	2	0	0	3	0	1	1	0	0	0	0	0	1	0	1	1	2	0	1
10:20	0	0	1	1	0	0	1	1	1	0	3	2	1	0	0	2	1	1	1	0	1	0	1	0	1	2	0	3	0	1	2	6	0	2	0	2	2	0	0	0	1	0	3	2	1	1	1	2	0	0	3	1	2	2	0	0
10:25	1	1	2	1	1	0	1	1	0	2	6	2	1	1	1	1	1	1	1	3	0	1	0	1	2	2	0	0	1	2	4	4	0	0	4	3	0	1	1	0	2	0	2	3	0	0	1	0	2	1	1	2	2	1	0	1
10:30	1	2	0	1	0	0	1	1	1	0	6	5	1	0	1	2	2	1	0	1	0	0	1	1	3	1	1	2	0	0	1	2	2	4	8	3	2	0	0	0	0	1	3	2	0	1	1	1	0	0	1	1	3	2	0	0
10:35	0	1	0	2	0	1	1	2	1	1	3	1	1	1	0	1	0	0	0	0	1	0	0	0	0	2	0	0	1	1	2	3	2	0	3	3	4	1	0	0	0	0	5	1	0	1	2	1	0	1	3	0	0	0	2	0

Trip Counts (Total Arrivals + Departures), 5-Minute Bins

metadata_ID	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	11	11	13	13	14	14	15	15	17	17	21	21	23	23	24	24	25	25	26	26	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	35	35
Bin Start	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
10:40	1	0	0	0	0	0	0	0	1	4	1	5	2	0	2	2	1	0	0	0	2	0	1	1	2	0	1	2	1	0	2	1	1	3	1	4	3	0	0	1	0	0	1	5	0	1	0	2	2	0	0	3	2	2	1	0
10:45	2	0	0	0	1	0	1	1	1	0	8	7	0	0	1	0	0	1	0	0	1	3	1	1	0	2	0	0	1	0	1	2	6	0	10	2	2	0	2	1	0	0	1	1	1	0	0	0	1	0	2	2	1	3	2	2
10:50	0	1	0	1	1	1	0	0	2	1	8	3	0	0	1	2	1	1	2	1	0	1	3	0	1	2	2	2	1	0	2	0	4	3	1	9	3	2	0	0	1	0	2	7	0	0	0	1	1	1	0	1	1	0	0	0
10:55	1	0	1	0	0	0	1	1	0	1	6	5	1	1	0	1	1	2	2	0	0	0	0	2	1	1	1	4	0	0	1	3	7	4	1	22	4	1	0	1	0	0	4	9	1	1	1	1	0	1	2	1	1	0	0	1
11:00	0	0	0	0	0	1	0	1	0	1	2	4	0	0	0	0	1	0	1	2	0	0	1	0	0	2	0	1	0	2	6	0	5	1	0	7	3	1	0	0	0	0	2	3	1	0	1	0	2	2	1	1	0	3	0	0
11:05	2	1	0	0	0	0	0	0	1	1	3	2	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1	3	12	7	4	0	2	9	1	0	0	0	4	1	0	2	2	1	1	1	3	4	5	2	1	0
11:10	2	1	1	0	3	0	3	1	1	2	2	3	2	0	0	0	1	1	1	1	0	0	1	0	2	0	0	0	1	0	1	3	11	44	0	0	2	3	0	1	0	0	4	2	0	0	1	2	2	0	0	2	0	1	1	0
11:15	0	1	2	2	2	1	2	1	0	1	3	4	2	2	1	1	2	2	3	0	1	1	3	2	0	0	0	0	1	0	4	4	3	62	2	2	3	4	0	0	0	0	1	4	1	1	1	1	2	2	1	1	0	3	0	2
11:20	1	1	2	3	2	0	0	2	0	0	5	11	0	2	1	0	0	0	1	3	0	0	2	0	1	2	0	0	1	0	2	2	1	16	1	3	2	5	1	0	0	0	2	5	0	0	0	1	1	3	0	1	0	1	2	1
11:25	1	0	0	1	0	0	1	4	0	0	4	2	1	0	0	0	2	0	1	3	0	2	2	0	3	1	0	0	0	1	1	1	2	2	0	0	0	1	0	0	1	1	1	2	1	0	2	0	0	0	1	2	1	1	1	2
11:30	0	1	0	3	1	1	2	1	1	0	5	6	1	1	0	2	1	3	1	1	3	1	7	1	1	0	1	0	0	0	2	2	7	4	1	2	3	2	0	0	2	0	5	3	0	0	1	0	0	1	1	1	1	1	0	3
11:35	2	0	1	0	0	0	2	3	0	0	3	3	0	3	0	0	2	0	0	0	0	1	3	7	5	6	5	5	1	0	2	1	5	2	2	0	3	1	0	1	2	3	2	3	1	2	2	3	1	1	0	1	1	1	1	0
11:40	0	2	5	2	2	2	1	1	0	1	5	3	0	0	2	2	0	1	0	0	2	0	3	3	5	8	2	2	1	0	1	4	5	3	2	1	2	3	0	0	0	0	2	2	1	0	2	1	0	0	1	1	1	0	1	1
11:45	1	0	0	2	2	0	2	1	0	0	4	3	1	0	1	0	1	1	1	1	0	0	2	4	1	3	2	1	1	3	2	0	3	13	1	0	1	4	3	0	4	0	1	3	0	0	1	1	1	1	6	0	4	2	2	0
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12:00	1	2	0	1	0	3	0	0	0	1	5	7	2	1	0	2	0	0	0	2	2	2	1	4	3	3	1	6	0	1	2	0	7	3	2	1	0	1	0	0	1	0	5	5	0	0	0	1	3	1	5	3	0	2	1	4
12:05	0	1	0	0	1	1	1	1	1	0	6	5	0	4	3	1	0	0	0	0	0	1	2	2	2	1	1	0	2	0	0	0	2	6	5	4	0	1	1	0	0	0	1	1	1	0	0	0	1	2	1	2	3	0	2	0
12:10	0	0	0	0	0	0	0	1	1	1	3	1	0	0	1	2	1	0	1	1	1	2	4	4	0	3	1	3	1	0	1	2	6	3	4	0	0	1	0	0	0	2	1	4	0	0	0	1	0	1	0	1	0	2	0	3
12:15	0	1	2	0	1	0	0	1	1	2	8	6	0	0	2	0	1	1	1	1	0	1	5	2	1	2	4	0	2	0	3	1	5	4	2	3	4	1	1	1	2	0	1	1	0	0	0	2	1	1	0	1	1	1	0	1
12:20	1	1	0	1	0	1	2	3	0	1	2	4	1	0	1	1	1	0	2	2	0	0	0	4	1	0	1	1	0	3	0	7	7	2	1	2	1	0	1	0	0	1	3	0	1	0	0	0	1	1	1	1	2	1	0	0
12:25	1	1	0	0	0	1	2	0	2	1	1	3	0	1	0	3	1	1	0	0	1	1	1	0	2	1	3	0	1	1	1	1	10	10	4	14	3	2	0	1	0	0	4	6	1	0	1	1	1	3	1	0	3	2	0	0
12:30	0	2	1	2	0	0	1	2	1	0	5	8	2	0	1	0	1	3	1	0	1	0	1	0	2	1	4	4	0	0	0	0	4	5	2	2	1	2	1	2	0	1	0	1	1	0	0	2	1	0	1	0	4	2	0	0
12:35	0	0	3	1	1	0	1	0	5	2	5	9	1	1	2	0	0	0	0	1	0	0	2	2	0	1	0	2	2	0	2	2	4	3	1	4	2	3	1	1	1	1	3	3	0	1	0	0	1	0	0	0	3	2	0	0
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12:45	2	2	2	1	0	1	1	1	0	0	12	5	1	2	2	1	0	0	1	0	2	1	1	1	0	2	1	0	2	1	4	8	9	3	1	2	4	1	1	1	0	9	1	1	0	0	2	2	0	1	0	0	2	2	0	0
12:50	1	1	1	0	2	1	1	0	0	1	9	10	1	0	1	1	4	0	1	1	1	2	1	0	1	1	1	1	2	1	3	11	16	6	2	23	7	2	0	0	3	1	1	2	0	1	1	2	2	0	1	0	0	2	2	0
12:55	1	1	1	1	2	1	3	1	0	0	2	1	0	0	1	0	1	1	2	0	0	1	1	1	0	1	2	0	0	2	1	5	12	4	4	6	1	4	0	0	3	0	0	0	1	1	1	2	2	1	0	1	0	1	3	0
13:00	0	3	1	0	0	2	1	1	1	0	8	2	0	1	3	0	1	0	1	2	1	0	0	1	0	0	4	3	4	0	1	1	7	17	4	3	3	5	0	0	1	0	1	2	0	1	0	0	3	0	0	0	0	0	1	2
13:05	0	0	0	1	0	2	2	2	0	0	4	3	1	0	1	1	0	3	0	0	0	3	1	1	2	0	1	0	1	2	0	1	3	6	6	1	3	2	0	0	3	0	2	10	1	0	1	0	0	2	2	0	1	0	1	0
13:10	0	1	2	0	3	2	4	0	0	1	1	5	0	0	1	1	1	0	0	1	1	0	0	0	3	1	2	2	0	0	4	0	8	3	6	4	4	1	0	1	3	3	1	6	0	0	0	0	0	0	0	0	2	3	2	2
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13:20	0	1	4	3	2	0	2	2	2	0	4	4	0	0	2	1	6	1	0	0	0	1	1	0	2	4	2	1	0	0	3	3	3	5	7	6	3	2	3	2	0	0	5	2	0	0	3	1	1	1	1	3	2	1	3	1
13:25	1	0	0	1	2	1	3	0	0	0	9	3	1	0	5	0	6	2	1	0	1	1	0	1	1	0	2	0	1	0	5	3	7	2	10	3	3	2	1	0	1	1	7	10	0	0	2	2	1	1	1	1	3	2	3	1
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13:35	0	2	1	1	2	0	5	2	5	3	2	1	1	0	2	1	4	3	0	0	1	2	0	0	4	1	0	0	1	0	2	6	9	2	10	7	1	2	0	3	2	1	10	2	1	0	2	1	1	0	3	1	3	4	4	0
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13:45	1	0	8	2	8	1	4	1	2	1	4	6	0	0	0	0	6	1	1	1	0	1	0	1	6	7	2	1	1	0	5	1	14	2	16	3	3	0	3	0	2	0	7	1	1	0	1	0	1	2	1	9	5	0	4	1
13:50	3	1	7	0	6	1	4	2	6	1	3	1	0	0	2	0	5	0	1	0	1	0	1	1	3	5	1	2	0	0	9	3	19	3	14	7	5	0	0	0	4	2	9	2	0	0	3	3	2	2	3	0	4	7	4	0
13:55	4	0	7	2	10	1	3	1	7	1	5	2	2	0	10	1	6	3	1	1	3	0	1	1	5	2	4	2	0	1	9	0	19	5	17	1	9	3	0	0	4	1	11	1	1	1	4	1	3	1	1	2	3	1	7	0
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14:10	9	1	11	1	8	0	3	0	4	1	4	5	4	1	12	1	12	3	0	1	0	1	2	2	8	1	1	0	1	1	9	2	15	8	22	2	13	4	0	0	5	1	14	2	2	0	6	1	3	2	1	0	10	3	8	0
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14:20	11	1	11	0	16	1	9	0	6	2	8	5	6	0	15	1	17	3	0	1	0	1	0	1	9	2	7	2	1	0	9	88	32	136	17	99	2	4	4	0	5	12	21	2	5	1	4	0	4	0	3	0	17	3	7	0
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Trip Counts (Total Arrivals + Departures), 5-Minute Bins																																																								
metadata_ID	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	11	11	13	13	14	14	15	15	17	17	21	21	23	23	24	24	25	25	26	26	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	35	35
Bin Start	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
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14:35	11	3	11	1	11	7	14	2	7	1	8	4	9	2	10	1	25	1	0	1	3	2	0	1	14	2	7	1	3	0	3	8	12	17	6	13	23	103	2	1	7	2	16	63	0	1	12	3	4	4	2	0	22	3	13	0
14:40	17	0	25	0	11	0	11	2	12	1	4	2	16	0	14	0	10	0	0	3	3	1	1	0	12	3	5	0	3	1	3	4	8	12	3	23	31	51	3	1	15	3	20	69	3	0	9	6	5	1	7	1	11	3	15	0
14:45	17	4	23	1	18	1	8	0	9	0	11	3	17	1	16	0	14	0	2	0	6	0	3	0	15	22	9	2	3	1	3	10	10	3	1	7	11	36	6	0	17	2	19	33	6	0	3	1	6	0	12	3	1	1	11	0
14:50	20	2	16	0	19	3	7	0	8	1	6	4	19	1	14	0	16	2	4	4	6	1	1	0	23	28	8	0	6	0	0	4	5	5	4	7	7	18	12	0	7	2	22	10	7	0	3	0	1	2	12	3	3	2	9	0
14:55	22	0	19	0	7	5	9	1	7	0	7	5	17	11	13	1	16	6	1	1	4	1	1	1	18	27	7	0	3	1	1	3	6	6	3	4	5	11	14	4	0	0	16	3	4	0	2	7	12	13	8	1	3	2	13	0
15:00	33	0	5	7	14	19	8	0	1	2	16	1	15	42	17	6	13	14	3	1	7	3	4	0	27	21	7	1	6	1	2	3	4	3	3	12	3	7	8	2	0	0	29	6	1	12	23	44	15	30	18	1	5	7	17	0
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15:15	21	1	23	47	26	38	18	40	6	24	9	29	2	25	19	34	17	30	8	2	0	15	6	3	29	43	18	1	3	7	1	1	4	8	0	4	3	4	13	23	37	37	14	14	4	4	5	17	10	14	17	72	22	32	10	32
15:20	20	27	25	53	30	39	40	44	27	34	12	52	1	15	28	43	17	37	9	1	1	3	5	6	25	54	11	2	5	8	2	5	3	9	4	4	1	3	6	14	46	32	7	55	1	4	4	2	5	16	12	80	14	55	17	32
15:25	25	27	20	52	32	41	23	34	37	40	17	36	0	6	15	40	21	37	6	27	1	12	5	7	13	46	14	24	0	7	1	7	1	14	6	3	4	2	4	3	19	49	25	66	1	2	0	8	2	13	10	52	11	30	15	27
15:30	25	53	33	37	24	48	29	47	33	29	15	29	2	8	19	43	7	20	11	22	0	9	6	2	15	28	7	27	0	3	0	3	3	13	4	15	3	8	3	3	8	55	12	61	0	1	0	8	9	7	12	9	4	12	14	29
15:35	26	39	15	44	16	39	26	43	40	45	12	11	2	8	5	41	8	43	8	18	0	5	8	2	12	22	19	26	1	1	0	2	1	10	5	4	3	10	4	5	8	37	20	50	0	1	1	3	2	6	4	18	2	19	15	34
15:40	17	48	6	43	15	35	22	44	16	40	10	16	0	3	2	17	3	36	2	12	0	5	13	2	10	15	16	23	0	3	6	3	3	11	4	5	7	2	0	1	11	46	12	39	0	1	3	6	1	0	1	5	1	10	11	16
15:45	6	30	3	13	9	19	17	34	12	45	13	9	1	1	3	6	5	7	2	3	0	1	16	3	12	24	15	25	1	4	1	1	5	3	1	1	9	8	2	4	7	31	4	17	0	1	1	3	2	2	3	4	1	11	4	20
15:50	3	38	5	7	1	9	9	23	8	17	6	13	2	1	1	3	2	7	2	3	0	2	9	1	3	12	12	32	0	4	2	1	5	8	6	9	12	3	3	3	7	26	6	9	0	0	3	1	3	8	1	4	2	2	1	8
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16:00	3	39	0	3	0	2	4	7	7	18	9	11	7	2	3	1	3	3	1	7	0	4	16	32	0	3	10	34	2	4	3	11	18	9	5	2	4	19	5	1	6	8	5	10	0	2	1	4	2	4	6	4	2	5	1	7
16:05	1	27	2	5	2	4	3	4	2	16	6	11	6	2	8	2	4	2	1	0	0	1	15	27	2	3	4	34	0	5	3	5	9	33	7	14	7	18	2	6	4	9	10	10	2	0	1	4	0	5	1	4	3	8	1	3
16:10	2	11	2	2	4	3	6	1	1	12	7	3	6	1	9	7	2	5	0	1	1	2	17	50	2	7	4	22	1	0	0	8	11	16	2	14	7	7	1	6	3	5	7	12	0	2	2	2	4	8	3	5	3	3	1	3
16:15	3	6	0	1	5	4	4	23	1	5	7	10	7	7	6	20	1	2	0	3	0	1	14	30	0	4	1	18	1	2	1	6	7	14	8	8	2	7	3	6	0	4	7	10	0	0	3	4	5	5	6	7	6	1	3	1
16:20	3	6	3	4	0	6	3	5	5	4	10	8	3	19	7	17	7	2	0	0	1	0	17	33	0	2	3	11	0	1	4	4	5	4	5	6	5	4	1	6	3	3	12	9	0	3	4	2	1	1	4	2	11	3	0	2
16:25	1	6	2	4	3	9	2	4	3	5	9	4	1	4	2	3	8	3	1	2	1	0	13	29	4	7	0	7	0	0	4	4	6	5	2	14	3	8	4	4	1	2	9	13	0	2	3	4	4	2	4	9	7	0	1	2
16:30	5	1	3	2	2	3	3	4	4	3	8	17	1	3	0	6	7	13	0	2	1	2	12	11	1	7	2	3	0	2	4	4	4	3	6	1	4	7	2	0	3	1	5	15	0	1	1	5	1	7	2	2	7	12	1	1
16:35	3	3	2	7	1	5	2	2	7	5	1	1	3	1	1	7	5	12	0	0	0	1	4	14	0	0	3	5	3	4	3	8	3	6	2	2	4	15	2	4	3	7	10	8	0	0	1	0	1	6	1	4	3	26	1	2
16:40	1	8	3	4	0	0	1	2	2	4	6	5	2	4	1	4	3	9	0	0	0	0	3	7	6	3	0	3	0	2	7	3	9	7	11	17	1	10	1	6	0	3	10	12	0	0	1	3	0	4	1	8	1	4	5	4
16:45	4	9	5	8	4	2	4	4	5	0	2	2	1	3	3	5	5	1	1	0	1	1	7	8	0	8	0	4	2	0	5	2	11	17	4	18	7	10	2	8	4	4	8	5	0	2	3	2	2	1	5	3	2	3	4	2
16:50	0	3	3	4	2	1	2	8	4	4	5	7	0	4	2	2	4	3	1	2	0	2	3	8	1	6	1	1	1	0	3	2	7	7	8	7	6	7	5	4	1	17	15	7	0	4	0	5	3	2	1	5	4	4	2	4
16:55	1	2	9	3	5	4	1	4	3	2	4	3	4	0	0	0	2	3	0	1	0	1	7	8	3	2	0	0	3	1	6	5	7	15	9	16	7	5	4	4	1	8	11	13	0	0	0	0	3	1	6	2	5	7	9	1
17:00	0	2	7	8	4	6	0	0	6	5	1	0	3	3	2	4	4	3	1	0	1	1	4	9	2	4	1	1	6	5	3	3	9	9	4	5	11	15	4	4	3	3	11	21	0	0	0	1	2	0	8	1	3	5	2	1
17:05	0	0	3	16	1	11	0	0	5	3	3	3	2	2	1	3	2	14	2	2	0	1	7	11	0	5	1	1	4	6	10	5	12	11	9	9	12	22	3	1	1	3	2	21	0	0	2	0	2	9	1	2	1	4	8	1
17:10	3	0	2	11	1	6	0	1	7	22	2	2	3	3	4	0	1	7	0	1	0	1	4	11	3	0	1	1	3	5	18	41	14	10	10	6	8	24	4	3	1	0	5	5	0	0	3	1	0	3	1	10	0	3	3	2
17:15	2	1	4	5	5	4	0	0	1	9	3	3	3	3	0	1	2	2	2	0	1	0	3	3	5	2	2	2	2	1	2	5	14	13	7	6	1	6	2	6	0	4	3	4	0	0	1	5	1	0	6	11	0	0	5	7
17:20	1	4	3	4	3	4	0	1	2	3	5	1	2	3	7	3	4	3	2	2	0	1	3	6	0	5	2	6	5	6	3	2	18	11	7	10	0	4	3	4	2	3	5	6	0	0	4	4	2	2	2	5	0	1	3	2
17:25	2	2	3	2	4	2	0	2	2	2	1	2	1	3	3	3	3	4	0	5	0	0	3	10	2	2	1	1	4	3	7	2	28	24	11	9	1	1	1	5	1	0	6	3	1	0	2	5	1	2	6	4	0	0	1	1
17:30	3	3	3	5	3	2	0	0	2	2	2	2	1	4	2	5	5	8	1	4	0	0	2	4	1	3	1	1	4	5	5	6	27	23	16	3	0	1	0	4	2	1	3	5	0	1	0	0	1	0	2	2	0	0	2	0
17:35	2	3	3	1	4	2	0	0	3	1	3	4	4	1	1	3	2	3	1	1	0	0	2	2	4	1	2	1	6	7	2	4	27	12	10	2	1	3	3	4	1	0	4	6	0	0	1	2	0	1	10	4	0	1	1	3
17:40	2	4	3	4	6	4	0	1	2	4	3	3	1	2	2	1	5	3	2	2	0	0	1	2	5	4	3	3	3	5	5	4	33	16	15	8	0	0	2	2	1	2	6	3	0	0	0	0	0	1	4	7	2	2	1	2
17:45	3	3	5	3	11	0	0	0	1	2	1	3	5	2	6	2	6	4	3	1	0	0	0	3	2	4	4	3	2	10	4	0	17	42	18	33	0	0	1	6	1	5	3	1	0	0	1	0	0	0	6	1	0	0	0	7
17:50	1	4	3	3	5	26	0	0	5	1	3	2	0	5	2	1	2	5	0	0	0	0	0	0	1	2	6	0	1	4	5	0	22	19	11	21	0	0	2	0	1	4	5	3	0	0	1	2	0	0	9	2	0	0	2	2
17:55	0	4	8	2	3	44	0	0	3	6	0	0	0	1	2	1	1	3	2	0	0	0	1	2	2	5	1	0	0	0	7	0	12	7	19	12	3	0	5	1	0	6	8	6	0	0	0	4	0	0	8	2	0	0	2	4
18:00	0	4	4	8	4	9	0	0	0	4	0	1	0	2	3	1	2	1	13	3	0	3	0	2	0	1	0	0	2	3	5	2	15	7	17	9	2	0	1	1	0	5	11	8	0	0	0	0	0	0	10	1	0	0	0	1
18:05	0	2	0	0	1	2	0	0	1	2	2	4	0	0	2	1	0	2	4	5	0	0	0	4	0	2	0	0	0	2	10	6	9	6	24	5	1	2	0	0	0	3	6	13	0	0	0	0	0	0	11	3	2	0	2	1
18:10	0	0	0	1	1	5	0	0	0	1	4	1	0	0	2	3	1	2	6	4	0	0	0	1	1	0	0	0	0	0	8	1	5	2	20	5	1	1	0	1	0	0	9	15	0	0	0	0	0	0	4	9	4	0	1	1
18:15	0	0	0	0	0	0	0	0	0	0	2	1	0	0	1	1	1	2	3	4	0	0	0	0	0	0	1	0	0	0	4	5	4	3	16	4	1	1	1	1	0	2	7	5	0	0	0	0	0	0	11	5	4	1	1	4

Trip Counts (Total Arrivals + Departures), 5-Minute Bins

metadata_ID	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	11	11	13	13	14	14	15	15	17	17	21	21	23	23	24	24	25	25	26	26	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	35	35
Bin Start	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
18:20	0	3	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	2	2	0	3	0	0	0	1	1	0	0	0	0	7	4	4	2	24	1	3	0	1	0	0	1	5	6	0	0	0	0	0	0	14	14	0	1	0	3
18:25	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	1	1	0	0	0	0	0	3	1	1	1	0	0	0	8	2	5	4	16	3	4	0	2	1	0	0	5	15	0	0	0	0	0	0	20	13	1	4	0	2
18:30	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	4	0	0	0	0	1	0	2	1	0	1	0	1	3	2	5	2	13	4	5	1	0	2	0	0	4	13	1	1	1	1	0	0	22	10	2	0	0	0
18:35	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	1	0	0	0	1	2	0	3	0	1	0	1	1	1	3	2	5	4	7	0	0	0	0	0	1	13					0	0	37	6	1	5	3	3
18:40	0	1	0	0	0	0	0	0	0	0	2	3	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	3	4	2	1	14	4	3	5	2	0	0	0	3	3					0	0	48	2	1	0	0	2
18:45			0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	1	1	1	0	0	0	0	0	4	3	1	3	2	3	0	14	0	0	1	0	4	1					0	1	44	5	0	2	0	1
18:50			0	1	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	3	1	0	0	0	0	3	5	2	2	9	3	0	9	0	0	1	1	5	1					0	0	43	10	0	2	0	0
18:55			0	0	0	0	0	1	0	0	1	1	0	0	0	3	0	0	0	0	1	1	0	0	2	4	0	0	0	0	0	2	4	0	8	1	1	1	0	0	0	0	6	4					0	0	17	8	0	0	0	0
19:00			1	1	0	0	0	1	0	0	3	3	0	0	0	2	0	0	0	0			0	0	0	2	0	0	0	0	2	2	11	0	2	2	1	1	0	0	0	0	3	3					0	0	12	4	0	0	0	1
19:05			1	0	0	0	0	0	0	0	1	1	0	0	0	3	0	0	0	0			0	0	0	0	0	0	0	0	0	2	1	6	6	0	0	2	0	0	1	1	1	3					1	0	7	10	1	1	0	0
19:10			0	14	0	0	0	0	0	0	2	2	0	1	0	1	0	0	0	0			0	2	0	0	0	1	0	0	0	6	6	32	6	2	1	4	0	1	0	0	1	1					0	1	4	1	0	0	0	0
19:15			0	2	0	0	0	0	0	1	0	0			0	4	0	0	0	1			0	0	0	0	1	1	0	0	1	6	2	38	4	1	0	3	0	0	0	0	1	0					2	0	2	2	0	0	0	0
19:20			0	0	0	0	0	0	0	0	0	0			1	4	0	1	1	0			0	0	0	0	1	7	0	0	3	21	2	29	3	1	1	2	0	0	0	0	2	2					1	0	2	3	0	0	0	0
19:25			0	1	0	0	0	0	0	0	2	2			0	2	0	1	2	0			0	0	0	0	0	7	0	0	3	16	2	16	2	2	0	2	1	1	0	0	1	0					4	0	4	0	0	0	0	0
19:30			2	0	0	0	0	0	0	0	0	0			0	0	0	0	0	1			0	0	0	0	0	1	0	1	1	6	2	13	5	2			0	1	0	0	6	6					2	2	9	2	0	0	0	0
19:35			0	2	0	0	1	0	0	0	1	1			0	0	0	0	0	0			0	0	0	0					1	4	1	13	1	23					0	0	0	7					2	9	2	15	0	0	0	0
19:40			0	0	0	1	0	0	0	0	0	4			0	0	0	0	0	1			0	0	0	1					1	1	5	5	1	7					0	0	2	3					3	2	3	4	0	0	0	0
19:45			0	0	0	0	0	0	0	0	1	3			0	0	0	0	0	0			0	0	0	0					2	14	3	1	1	1					0	1	1	0					0	2	3	44	0	0	0	0
19:50			0	0	0	0	0	1	0	0	2	2			0	0	0	1	0	0			0	0	0	1					3	0	4	2	1	8							2	0							1	24	1	1	0	0
19:55			0	0	0	0	0	0	0	0	0	0			0	0	0	0	1	0			0	0	0	0					1	3	4	1	2	8							3	1							2	4			0	0
20:00			0	0	1	0	0	0	0	0	0	0			0	0	0	0	3	0			0	0	1	0					0	8	1	0	4	5																			0	0
20:05			0	0	0	0	0	0	0	0	0	1			1	0	0	0	3	1			0	0	0	0					0	2	0	4	0	3																			0	0
20:10			0	0	0	0	0	0	0	0	3	2			0	0	0	0	1	0			0	0	0	0					0	2	1	1	1	4																			0	0
20:15			0	0	0	0	0	0	1	0	2	0			0	0	0	0	4	1			0	0	0	0							0	0	1	1																			0	0
20:20			0	0	0	0	0	0	0	0	2	3			0	0	0	0	0	3			0	0	0	0							2	0	2	5																			0	0
20:25			0	0	0	0	0	0	0	0	1	0			0	0	0	0	2	0			0	0	0	0							0	0	4	4																			0	0
20:30			0	0	0	0	0	0	0	0	2	0			0	0	0	0	3	0			0	0	0	0							0	0	1	3																			0	0
20:35			0	0	0	0	0	0	0	0	0	0			0	0	0	0	2	1			1	1	0	0							0	0	3	2																			0	0
20:40			0	0	0	0	0	1	0	0	0	1			0	0	0	0	2	4			0	0	0	0							2	0	6	20																			0	0
20:45			0	0	1	0	0	0	0	0	2	2			0	0	0	0	0	15			0	0	0	3							1	2	4	33																			0	0
20:50			0	0	0	0	0	0	0	0	2	2			0	0	0	1	0	4			0	2	0	1							1	1	1	48																			0	0
20:55			0	1	0	0	0	0	0	0	0	0			0	0	0	0	0	2			0	0									1	3	3	30																			0	1
21:00			2	2	0	1	0	2	0	0	1	1			0	1	0	0	0	1			1	1									0	6	1	24																				
21:05							0	0	0	0	1	0			0	1	0	0	0	0			0	0									0	1	1	9																				
21:10							1	1	1	1	0	0					0	0	0	5			0	0									0	4	1	20																				
21:15									0	0	1	4					0	0	0	3			0	0									0	3	1	5																				
21:20									0	1	0	0					0	0					0	0									4	3	1	3																				
21:25											0	0					0	0					0	0									0	2	0	2																				
21:30											0	0					0	0					0	0									0	2	0	0																				
21:35											0	0					0	0					1	0									0	0	1	0																				
21:40											2	2					1	1					0	0									0	0	0	1																				
21:45																							0	1									2	0	0	0																				
21:50																																	0	4	0	1																				
21:55																																	0	1																						