Traffic Monitoring Program

2013

This document is an overview of Georgia’s extensive, quality driven traffic monitoring program including continuous monitoring, short-term monitoring, weigh-in-motion, and other sources of traffic data. Quality control and assurance will be outlined for both the weekly and annual data processes.

GDOT Georgia Department of Transportation

Office of Transportation Data

Facilitator: Jane Smith,
State Transportation Data Administrator
Prepared By: Kiisa Wiegand,
Business Analyst

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I. PURPOSE

Federal Regulations 23 CFR 500.202 states, *"Traffic monitoring system* means a systematic process for the collection, analysis, summary, and retention of highway and transit related person and vehicular traffic data." Federal Regulations 23 CFR 500.203 mandates, "Each state shall develop, establish, and implement, on a continuing basis, a TMS to be used for obtaining highway traffic data…" This document is intended to record the current procedures and practices of the Georgia Department of Transportation's traffic monitoring system.

This document provides a comprehensive analysis that fulfills the Federal regulation stated above. The study of traffic data procedures and monitoring is an extensive and very detailed subject with numerous publications and publicly available documentation. ***The focus of this document will be constrained to specifics on the Office of Transportation Data's management of the traffic data collection program, as currently performed, including collecting traffic data; quality control and assurance; weekly and annual data processing; and other considerations.***

II. BACKGROUND

The Federal Highway Administration (FHWA) requires every state to submit an annual Highway Performance Monitoring System (HPMS) report containing traffic count data, physical characteristics and other pertinent road data. This submittal is used in legislation, and to determine state funding of highway and road projects. According to the HPMS Field Manual, "State Maintenance of a comprehensive traffic monitoring data program to provide quality, timely, and complete traffic volume and vehicle classification data is important for meeting HPMS requirements." This report serves as a primary component for determining the Federal transportation funding apportionment allocated to states.

The data that the Office of Transportation Data (OTD) collects is used for many reasons by internal departments, including the Office of Planning, the Office of Bridge Design and the Office of Materials and Research. Traffic counts are used to determine traffic patterns and flows for modeling purposes. They are also used to alleviate congestion with the construction of new routes or alternate designs. The Office of Bridge Design uses Annual Average Daily Traffic (AADT) data to determine the Bridge Sufficiency Rating. Additionally, the Office of Materials Research uses a combination of truck percentages and AADT data to develop factors that assess the deterioration of pavement. The Traffic Operations Office uses the volume data for safety related purposes (e.g., calculating crash rates and addressing safety issues).

OTD provides data to a large variety of external customers. Customers of the data include transportation planning professionals, educational institutions, design engineers, contractors, real estate agencies, private companies, and other government agencies. Traffic data is important in determining which routes citizens are using for their daily commutes and leisure travel. During emergency evacuations in inclement weather, critical traffic data is provided to the Georgia Emergency Management Agency and surrounding states. The data is used on both a state and national level by the U.S. Department of Transportation and other customers for planning, modeling, allocation of funding, informational purposes, etc.

III. TRAFFIC DATA COLLECTION PROGRAM OVERVIEW

The Georgia Department of Transportation's Office of Transportation Data has an extensive, quality driven traffic count program in compliance with all Federal regulations and guidelines. OTD is comprised of two main groups: the Data Administration Group and the Geospatial Transportation Data Group. The Data Administration Group within OTD is responsible for the management of the traffic monitoring program. Traffic count data is collected using continuous counters, portable traffic monitoring system sites, short-term counts, or portable and continuous weigh-in-motion sites. All incoming data is processed with defined and established quality assurance and control measures.

FHWA requires that all states collect traffic data on the Federal-aid system and provide Vehicle Miles Traveled (VMT) estimates for the local functional classification (FC) systems as directed by Federal regulations. The traffic collection program is designed to provide statistically valid data for the HPMS report which is also required by FHWA on an annual basis. The design of the program closely follows the guidelines of the FHWA's *Traffic Monitoring Guide* (TMG). The following is a list of the road systems included in the traffic collection program:

- State Routes
    - Interstates
    - U.S. Routes
- County Roads
- City Streets
- Ramps

Georgia's State Traffic and Reporting Statistics (STARS) provides AADT counts collected from permanent and portable traffic collection devices throughout the state for every segment of Georgia's Public Road System. The traffic count data is updated on this website annually: http://www.dot.ga.gov/informationcenter/Statistics/stars/Pages/default.aspx.

Georgia's Transportation Polling and Analysis System (TPAS) provides traffic data collected 24 hours per day, seven days per week, 365 days per year from permanent traffic collection devices throughout the state for Georgia's Public Road System. Georgia's TPAS is intended for the general public to view current traffic information and historical traffic information dating back to January 1, 2008. The traffic data is updated on this website daily:
http://www.dot.ga.gov/informationcenter/statistics/TrafficData/pages/tpas.aspx.

Also, *Automatic Traffic Recorder (ATR) Traffic Data Reports* are published by OTD annually and contain information such as truck percentages by location, vehicle classification by functional classification and hour, and maps for locating ATR sites. The annual reports can be viewed on the following website:
http://www.dot.ga.gov/informationcenter/statistics/TrafficData/Pages/atr.aspx.

IV. TRAFFIC DATA COLLECTION

The foundation of the traffic monitoring program is the collection of traffic data. Data can be collected using continuous counters, portable traffic monitoring system sites, short-term counts, or portable and continuous weigh-in-motion sites. Specific sites and types of traffic data collection can be requested by internal GDOT offices only from the Office of Planning. Other potential future sources of traffic data include Intelligent Transportation System (ITS) data and data sharing partnerships. OTD is also participating in a research project with the Georgia Institute of Technology.

Continuous Counts

As of November 2013, OTD has 229 operational, permanent Automatic Traffic Recorder (ATR) sites located on road systems throughout the state. These sites are operational 24 hours per day, seven days per week, 365 days per year excluding any necessary maintenance periods. Permanent sites are polled on a daily basis. Vehicle classification data, traffic volume, and traffic speed is collected. Vehicle classification can also be referred to as classification or class data.

Portable Traffic Monitoring System (PTMS)

The Portable Traffic Monitoring System (PTMS) is a seasonally collected ATR site that does not have either a cellular or a land line connection. A field technician drives to the PTMS site and physically connects a portable traffic loop counter to the site. Traffic data is typically collected for a forty-eight hour period every three months.

Short-Term Counts

Portable collection devices consist of one or more pneumatic tubes stretched across a road and secured on both sides by a field technician. They are connected to a counter on one side of the road and the data is usually collected for a 48-hour period. The devices can be programmed to collect vehicle classification counts as well as volume counts. OTD collects short-term volume counts at approximately 9,000 locations statewide annually.

Portable and Continuous Weigh-In-Motion (WIM)

Portable and permanent Weigh-In-Motion (WIM) sensors and the related data collection equipment are utilized to collect truck weight data statewide. OTD collected data from 34 portable WIM sites located across the state in 2013. Additionally, OTD has 11 permanent WIM sites that collect data 24 hours per day, seven days per week, 365 days per year excluding any necessary maintenance periods. The permanent WIM sites also function as ATRs by providing volume and vehicle classification data.

Special Requests

Specifically requested traffic data or *special requests* are collected at site specific and project specific locations statewide by a traffic data collection consultant through the Office of Planning. Primarily, special requests are requested for project specific studies, which may include short-term vehicle classification, volume counts or turning movements at an intersection.

ITS and Data Sharing

The FHWA has encouraged all states to invest in innovative collection practices, such as data sharing or use of Intelligent Transportation System (ITS) data. Through the years, OTD has been actively seeking methods to augment traffic collection through partnerships. From 2006 to the 2012, OTD participated in a series of meetings with Information Technology Outreach Services (ITOS) a part of the University of Georgia's Carl Vincent Institute of Government, and local governments in attempts to collaborate on equipment and quality control standards in order to integrate traffic data. Despite quality control and formatting challenges, OTD plans to explore data sharing opportunities more in the future.

The ITS or Video Detection System (VDS) data, which is primarily focused on high volume Interstates in metropolitan areas, provides a limited coverage of the traffic monitoring program. In 2011, OTD did a comparison study of ATR data and GDOT's Traffic Management Center's VDS data at several locations around Atlanta and discovered that the AADT volumes varied from 10-50%. It was determined that this was not adequate for AADT and VMT calculations, and reporting purposes. In 2013, a research project compared VDS traffic count data and ATR traffic count data at several Interstate locations resulting in mixed results depending upon the location. OTD is planning to review and use traffic counts on ramps collected by the VDS in 2013. However, defined data quality standards and goals; an examination of the calibration methods; and additional field testing still needs to occur for OTD to widely use the VDS data.

Research

Many signalized intersections operate under some form of actuated control, in that the intersection approaches have some type of sensor. The most common is an inductive loop which can be configured to provide traffic counts. The Office of Traffic Operations is currently installing traffic signal detectors (inductive loops) in the pavement of various high volume corridors in the Atlanta vicinity. The traffic signal detectors are part of the Regional Traffic Operations Program (RTOP), a multi-jurisdictional, signal timing program with the goal of improving traffic flow and reducing vehicle emissions through improved signal timing.

In April 2013, OTD submitted a research needs statement, *Integrating Intersection Traffic Signal Data into a Traffic Monitoring Program*, to GDOT's Research Advisory Council. A one-year project was approved and is currently being researched by Dr. Angshuman Guin, a professor with the Georgia Institute of Technology. This research project will determine if and how the traffic volume data from the inductive loops can be appropriately utilized in OTD's traffic monitoring program.

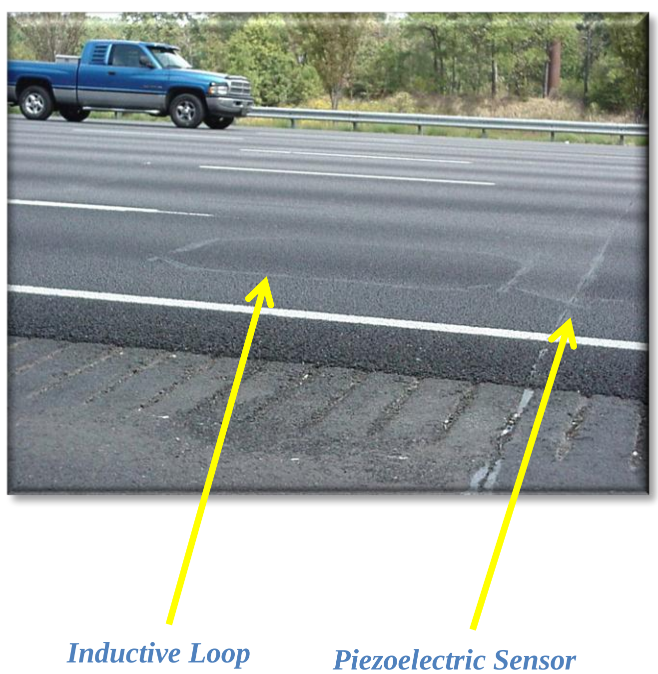
V. CONTINUOUS MONITORING PROGRAM

Continuous monitoring sites or otherwise known as Automatic Traffic Recorder (ATR) sites are installed on all types of roadways (State Routes, County Roads, and City Streets) in both asphalt and concrete. OTD's ATR sites provide volume, speed, and vehicle classification. These sites are continuously operational (24 hours per day, seven days per week, 365 days per year) except during any necessary maintenance periods. The data is stored on site in an ATR Controller Cabinet, prior to being automatically polled every night through the use of land line or cellular modems located at each ATR site.

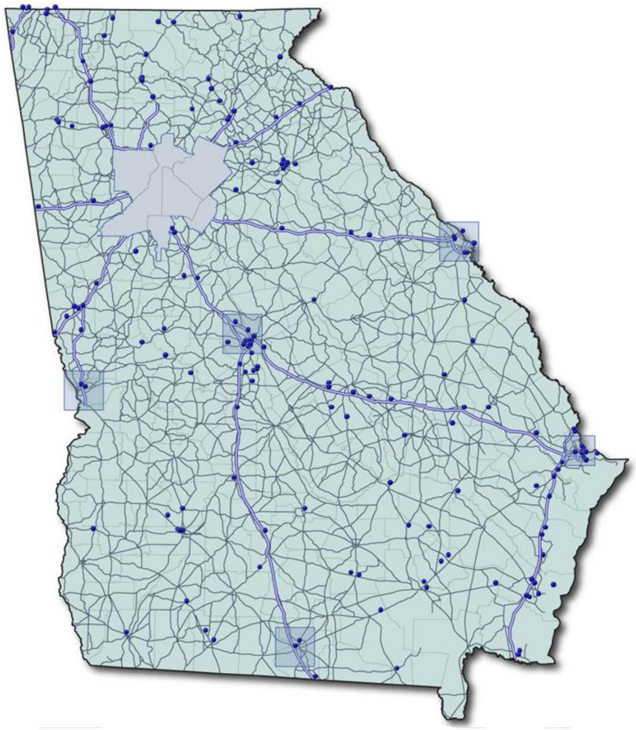
ATR Controller Cabinet

In Georgia, all ATR sites have equipment configurations that are capable of collecting vehicle classification in addition to volume counts. The ATR sites utilize two Inductive Loop Sensors and one Class II Piezoelectric Sensor embedded in each lane that operates according to the manufacturer's specifications. The system may require one of more of the following items as part of the system: Controller Cabinet, lightning suppressors, pull boxes, conduits, grounding electrodes, poles, concrete aprons, batteries and a solar panel. The piezoelectric sensors, equipment cabinet, inductive loops, cables, leads, and electronic hardware and software are furnished, installed, tested, calibrated and made ready for operation by OTD's contractor. Stringent adherence to calibration and set-up routines for equipment are required to ensure a high level of traffic data accuracy.

ATR Installed in Pavement



Georgia ATR Site Locations



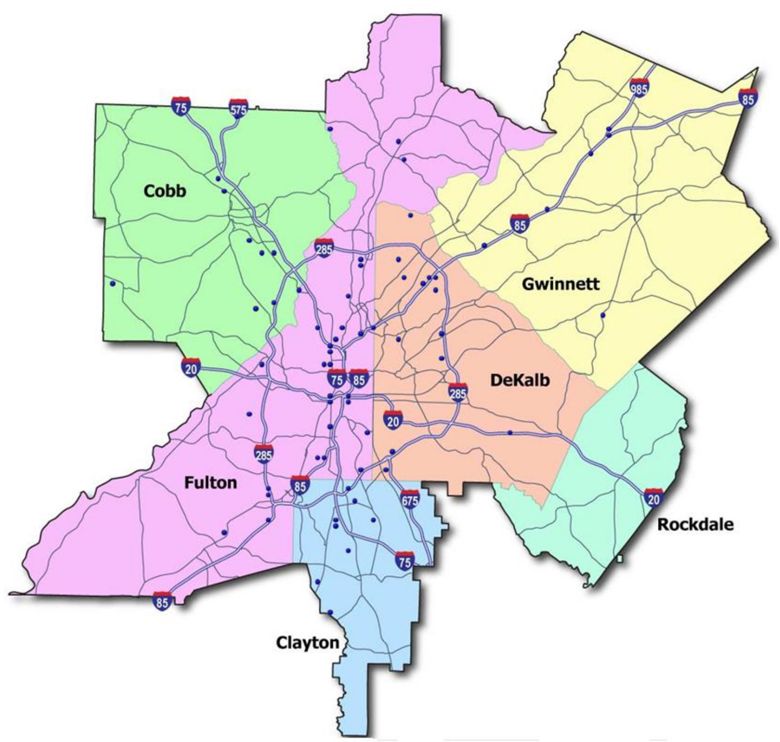
As of November 2013, OTD has 229 operational sites which are managed by the Data Administration Group. This number fluctuates due to road construction and equipment failures. For example, between April 2012 and November 2013, the number of operational ATR sites decreased from 234 to 229. Several of the sites had equipment failures with the piezoelectric loops in the pavement that are scheduled for repair. The other sites are not operational, because there has been road construction in the area which has damaged the sites.

Permanent sites are polled on a daily basis by the TPAS software. Incoming data (vehicle classification, volume, and speed) is processed through quality control checks and reviewed by office personnel. Refer to *Appendix A: 13-Bin FHWA Vehicle Classification Scheme* for detailed illustration on vehicle classification.

ATR sites provide valuable data statistics, such as:

- AADT, vehicle classification, and truck percentages
- Daily, monthly, and axle adjustment factors by traffic pattern group
- Design hour factors (peak hour and 30th highest hour) used for the design of highways
- Traffic growth and patterns
- Accurate traffic volume data used to calculate high volume Interstate and other freeway traffic (Step Down Method)

Atlanta ATR Site Locations



Selection Criteria for Installation of a New ATR Site

When funding allows for a new ATR site to be installed, a potential new ATR site is chosen based upon defined selection criteria. Then, the Data Administration Group makes a field inspection of any recommended new ATR site to ensure site feasibility and optimal placement for the physical installation of the ATR equipment within the traffic count segment. The Data Administration Group will review the results of the field inspection and approve the installation. The TMG states, "The main objectives of installing and operating ATRs are to provide highly accurate vehicle classification, track changes in volume over time, determine travel patterns, and create adjustment factors and factor groups."

The following is a list of the selection criteria that must be considered:

1. **Primary Selection Criteria**
   a. Minimum of five to eight ATR sites per Traffic Factor Group depending upon the traffic patterns and precision desired

2. **Secondary Selection Criteria**
   a. Critical nodes on high volume roads that are used in the Step Down Method
   b. Replacement of ATR sites that were eliminated due to construction
   c. Adequate coverage in each of the seven GDOT Districts to ensure geographic differences in travel trends are captured
   d. Minimum of one operational ATR site per Interstate route
   e. Minimum of one operational ATR site on other major arterials (e.g., SR-400 and SR-316)
   f. Area of particular interest to GDOT management for planning purposes or to meet specific Federal requirements (e.g., *Mechanistic-Empirical Design Pavement Guide of New and Rehabilitated Pavement Structures*)

In the last three years due to budget constraints, OTD has only installed one new ATR site located on I-85 in Gwinnett County near Jimmy Carter Boulevard. Seventeen installed ATR sites are inactive due to active construction projects, as of November 2013. OTD is considering installing a new ATR site on SR-400 near the new interchange with I-85. The above selection criteria will be used in this decision.

VI. SHORT-TERM MONITORING PROGRAM

The short-term program collects roadway segment-specific traffic count information on a scheduled cycle, collected at each segment for a 48-hour period. The short-term program can also be called the portable collection or the coverage program. The portable collection devices can be configured to collect vehicle classification counts as well as volume counts. OTD collects short-term volume counts at approximately 9,000 locations annually that are distributed statewide.

Portable collection devices have pneumatic tubes that are stretched across a road and secured on both sides by a field technician. They are connected to a counter on one side of the road where the data is stored. When a vehicle's axle crosses the road tube, the pulse of air that is created is recorded and processed by the traffic counter. Depending upon the type of count needed, one of several different road tube configurations may be set-up in the roadway.

There are two different types of portable collection devices used by OTD. In-house staff collects traffic data using the PEEK ADR1000 Portable Traffic Counter/Classifier. The majority of the portable traffic count collection is performed by a contractor that uses the MetroCount 5600 Series Roadside Unit. More information on the two systems can be found at the following websites: http://www.peektraffic.com/products_data.php and http://www.metrocount.com/products/mc5600/.

Number of Counts, Period of Monitoring, and the Cycle of Monitoring

The Federated Road Enhanced Database (FRED) database houses the Road Characteristics (RC) file, AADT and is used in the development of HPMS. Each road system is defined by a beginning and ending mile point in FRED. The road systems are divided into smaller sections designated with Traffic Count (TC) numbers that have similar traffic volumes. Each TC number has an AADT volume.

Georgia has approximately 27,000 TC numbers or segments. It is not possible to collect traffic counts on every road segment in Georgia every year due to practical limitations. Therefore, portable traffic is collected on a defined section of roadway (TC segment) on an annual or cyclical basis which varies with collection intervals ranging from two to four or six years. Traffic counts that are collected on a cyclical basis are adjusted with growth factors in years when they are not counted and marked as *Estimated*. AADT data is marked as either *Estimated* or *Actual* for each collection year for each TC number.

Federal Regulations 23 CFR 500.204 states, "Documentation of field operations shall include the number of counts, the period of monitoring, the cycle of monitoring, and the spatial and temporal distribution of count sites." The plan for the portable traffic collection program, including the number of counts and the cycle of monitoring, is re-evaluated each year. The period of monitoring is a 48-hour interval with data recorded for every hour of each day; a typical collection time for many state Department of Transportations. The 48-hour data from the portable traffic sites is usually collected Tuesday through Thursday. Refer to *Appendix B: 2011 to 2013 Portable Traffic Collections* for further details on the number of counts and cycle of monitoring.

OTD is striving to meet the demands of internal GDOT customers by increasing traffic collection near bridges and, in the future, near railroads. Collecting traffic counts near bridge and railroads will provide valuable information to our internal customers and improves their ability to make informed decisions related to their respective responsibilities. The collected data on these facilities (railroads and bridges) also improves the reliability and timeliness of other federally required reports such as Pontis and the Federal Railroad Administration reports. For reference, Pontis is a software application developed to assist in managing highway bridges and other structures.

Spatial and Temporal Distribution of Traffic Counts

Submitted portable traffic data includes details such as the time, date and location of collection. Garmin Global Positioning System (GPS) units are used during traffic data collection to record the physical location of the collected traffic count. The GPS data is used to create digital maps of the actual collected traffic count sites which are compared to the planned sites and reviewed for quality control.

VII. WEIGH-IN-MOTION PROGRAM

Each year, OTD collects Weigh-in Motion (WIM) data at 11 permanent sites and approximately 34 non-permanent sites located throughout Georgia. Refer to *Appendix C: Permanent Weigh-In-Motion Sites* and *D: Portable Weigh-In-Motion Sites* for a complete list of permanent and portable WIM sites, respectively. According to the FHWA guidelines, 10 of these sites should be on Interstate highways. OTD plans to install three more permanent sites. The permanent sites are not polled; data is retrieved at the physical location of the site on a regular basis (approximately once per month).

The permanent WIM sites collect vehicle weight, as well as vehicle classification, speed, and volume using a piezo-loop-piezo sensor configuration. The piezo-sensor utilized is a Kistler quartz piezoelectric sensor which provides 95% accuracy when collecting vehicle weight data. Temperature fluctuations do not affect the accuracy of this sensor.

Weigh-in Motion technology is used to measure vehicle counts, axle and gross weight, vehicle classification, and speed data. WIM data is used for pavement and capacity studies, enforcement and inspection purposes, and for analysis of truck transport practices. The data from these sites are provided to FHWA each year. FHWA runs the data through their software and produces summary W-table reports, which can be viewed at the following website: https://fhwaapps.fhwa.dot.gov/vtris-wp/.

GDOT has contracted with a consultant to study how to implement the latest *Mechanistic-Empirical Pavement Design Guide of New and Rehabilitated Pavement Structures* recommendations. The recommendations from this study may call for additional permanent WIM sites; however, funding will need to be identified, because these sites are very expensive to install and maintain. OTD has provided the consultant with collected WIM data and will review the consultant's implementation recommendations when presented.

VIII. QUALITY CONTROL AND ASSURANCE

One of the main goals of the traffic collection program is to provide an accurate portrayal of statewide traffic data and trends. With very few exceptions, OTD's collection program covers the complete State Highway System (about 18,000 miles). Every effort is made to collect the portable traffic data during typical travel conditions (excluding holidays or weekends). A one-time event, such as a county fair, is not an accurate representation of an 'average day' and is not a long-term traffic trend. On the other hand, there are conditions which do influence long-term changes in traffic characteristics. The following is a list of some of these conditions: addition of lanes, new intersections/interchanges, new roads, new business or residential developments, changes in the economy, changes in land use, etc.

Quality assurance refers to efforts made throughout the traffic collection cycle to ensure a high standard of data output. For example, OTD has documented procedures and staff training for the installation and calibration for all types of equipment. Additionally, all equipment installed by a contractor is closely reviewed by the Data Administration Group for adherence to guidelines. OTD employs the following approaches for data quality assurance:

- **Staff training and use of guidelines**
- **Data processing rules and checklists**
- **Proven software and data processing methods**
- **Tight control on vendors' compliance with guidelines**
- **Quality control checks with proven algorithms**
- **Stringent adherence to calibration and set-up routines for equipment**

According to the TMG, "Each highway agency should have formal, documented rules and procedures for their quality control efforts." OTD has established quality control (QC) rules and procedures that evolve in conjunction with new technologies and software enhancements which ensure accurate statewide traffic data. There are many quality control checks preformed on the traffic data by both OTD and the FHWA. For example, each month OTD submits ATR data to the FHWA online through the Travel Monitoring Analysis System (TMAS) which has built-in quality control checks. The Data Administration Group performs quality control reviews on a daily or weekly basis and also conducts a comprehensive review as part of the annual data processing.

IX. WEEKLY DATA PROCESSING

The weekly data processing of incoming ATR data and portable collection data is managed through two different processes mainly within one system (TPAS) which allows office personnel to quickly view the status of incoming data. Any data that does not meet standards of the established quality control rules is either rejected immediately or considered *flagged data*. The flagged data can be subjected to further review, as deemed necessary. Proven software and data processing methods enable OTD to efficiently process all data with a high level of quality.

Weekly Data Processing for Continuous Monitoring Sites

OTD can immediately identify the current status of every ATR site at a glance, such as: not polling, transfer errors, conversion errors, database errors, broken hardware, successful poll, multi-unit wait, unknown, atypical, and passed or failed QC rules. OTD can re-poll a particular site and also manually upload a data file to the system. Office personnel can view all details pertaining to a site regarding any issue with polling or quality control. A *High Level Overview of the ATR QC Process* is shown below in Figure 1:

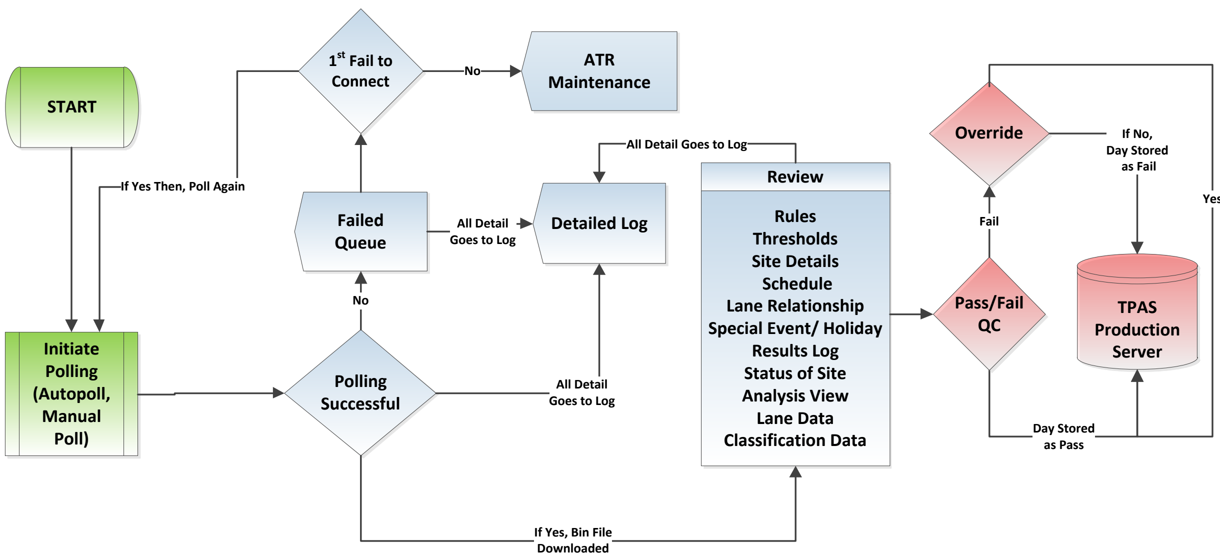


Figure 1: High Level Overview of ATR QC Process

The standard practice is to poll the data from ATR sites each night at 1:00 a.m. However, in inclement weather, OTD can configure the ATR sites to enable Real Time Polling in Emergency Mode which polls data from the ATR sites identified on hurricane evacuation routes every 15 minutes and has priority over the auto-poll. The data is stored in a directory on the TPAS server and is retrieved by the Emergency Operations Center (EOC) for critical planning and use.

ATRs are categorized into groups, such as Interstates or low volume, which apply specific quality control rules. The system also has adjustable thresholds for quality control rules, when applicable. The QC rules check for various issues, such as incoming data format, volume minimums/maximums, vehicle classification comparisons, atypical days (holidays or special events), etc. Also, double-sided ATR stations are checked to ensure that both sides of the roadway are operational. A complete list of the *Quality Control Rules for Continuous Monitoring Sites* can be viewed in Table 1 on the following page:

Table 1: Quality Control Rules for Continuous Monitoring Sites

Quality Control Rule	Description	Maximum Threshold
All Counts/ One Bin	The system will reject the data if all the traffic for one vehicle class bin is in one lane for the day.	
Atypical Day or Holiday	The system will accept data that would have been marked as flagged based upon a predetermined list of atypical days or holidays. It will not accept incomplete data.	
Class 1 Greater than Class 2	The system will flag any day(s) where the volume in vehicle class 1 exceeds the volume in vehicle class 2.	
Class 14 Exceeds X	The system will flag the day(s) that have vehicles in class 14 greater than X percent of the total volume.	0.7%
Class 15 Exceeds X	The system will reject the day(s) that have vehicles in class 15 greater than X percent of the total volume.	0.7%
Class 3 Greater than Class 2	The system will flag any day(s) where the volume in vehicle class 3 exceeds the volume in vehicle class 2.	
Class 8 Greater than Class 9	The system will flag any day(s) where the volume in vehicle class 8 exceeds the volume in vehicle class 9.	
Daily Directional Volume Check	The system will flag the entire set of counts if volume in one direction is over X percent of the total volume. This check is not applied to non- directional data.	70%
Daily Ratio of Class 2 to Daily Total	The system will flag any day(s) where the daily total of vehicle class 2 data is greater than X percent of the total volume.	56%
Less than 24 Hours of Data	The system will reject any blank volume in one direction.	
Max Zeros	The system will reject the data if there are more than X consecutive hours of zeros.	7
Missing Lane Data	The system will reject the data if there are no vehicle counts during the day for a lane or not enough data records have been provided. There should be one data record for each hour for each lane defined in the incoming data.	
Multi-Unit Wait	The system will assign the ATR unit that has data (double-side sites only) with the temporary status of MULTI_UNIT_WAIT until data for the 2nd side is received.	
Sum of Combination Vehicles Exceeds Class 9	The system will flag any day(s), where the total of the volumes in vehicle classes, 11, 12, and 13 exceeds the volume in vehicle class 9.	
Zero Bound	The system will reject any day that has an hour with zero vehicles that has the immediate hour before and after the zero with a volume over X vehicles.	50

Weekly Data Processing for Short-Term Monitoring Sites

Portable traffic data collected by field technicians is processed on a daily or weekly basis by office personnel. Counties are *closed out* as the portable data collection is completed. Refer to *Appendix E: Georgia Counties and Federal Information Processing Standards (FIPS) Identification Numbers* for a list of counties.

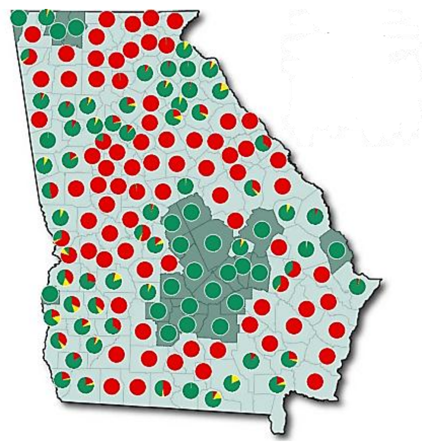


Figure 2: Status of 2012 Portable Traffic Collection as of 5/30/2012

Portable traffic collection is tracked and monitored. In Figure 2, 54% of the portable traffic collected has passed quality control (indicated in green); 2% has failed, has been marked uncountable or is parked (indicated in yellow); and 44% not been completed, yet (indicated in red). This is a typical status for May.

As discussed in section *V. Short-Term Monitoring Program*, GPS data and Field Notes collected at every portable data collection site assist with the quality control of the traffic count. Regarding GPS, office personnel compare the offset measured in meters between the current year and the last year of data collection. Recorded GPS data coordinates need to be within the assigned TC segment.

If incoming traffic data is flagged, office personnel perform further analysis, such as: evaluate GPS data coordinates, review the QC rule that the count has failed, view historical comparison for site, study trend analysis graphs, and compare traffic count data from adjacent sites. A complete list of the *Quality Control Rules for Portable Data Collection* can be viewed in Table 5.

Portable counts can be assigned into different categories: passed, failed, uncountable, reviewed, assigned, QC/load error, parked, or not reviewed. If a count has failed, the office personnel can assign it to a parked category where it will wait until the 2nd count data comes in for comparison. One, none or both counts can be accepted at that time. There is a comment box where reasons for the decision can be noted. A *High Level Overview of the Portable QC Process* is shown below in Figure 3:

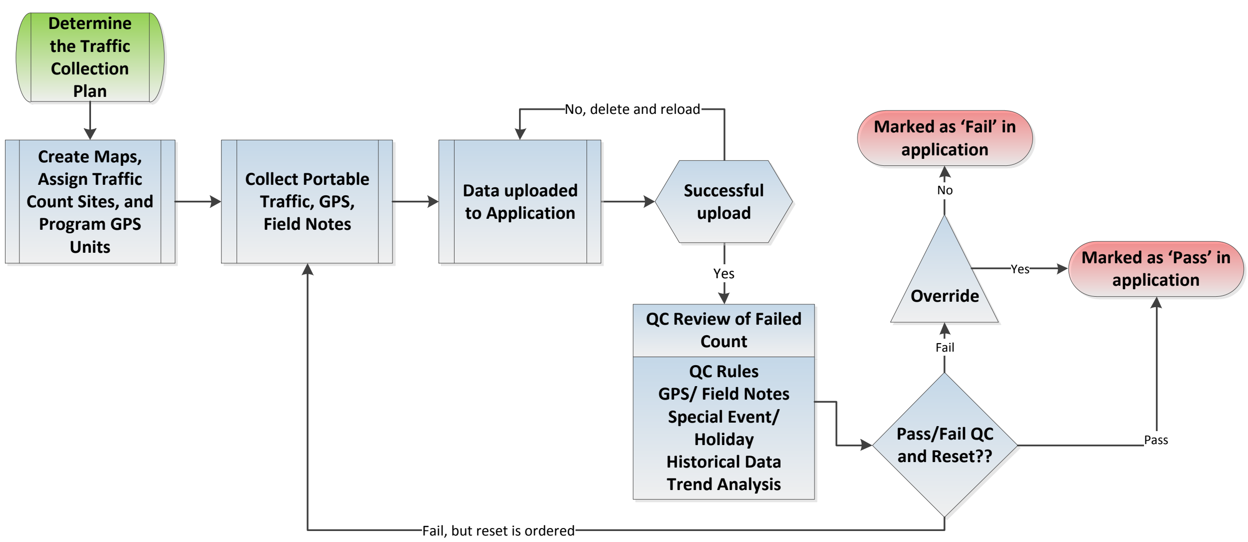


Figure 3: High Level Overview of the Portable QC Process

Table 2: Quality Control Rules for Short-Term Monitoring Sites

Quality Control Rule	Description	Minimum Threshold	Maximum Threshold
Blank (No Data) Check	The system will reject any blank volume in one direction.	--	--
Class 14	The system will flag the day(s) that have vehicles in vehicle class bin 14 greater than X percent of the total daily volume.	--	5%
Class 15	The system will flag the day(s) that have vehicles in vehicle class bin 15 greater than X percent of the total daily volume.	--	1%
Class 3 greater than Class 2	The system will flag any day where the volume in vehicle class bin 3 exceeds the volume in vehicle class bin 2.	--	--
Daily Directional Volume Check	The system will calculate the directional distribution (D Factor) of the traffic. If the D Factor is greater than X percent, the counts are flagged.	--	70%
Daily Ratio of Class 1 to 2	The system will compare the ratio of vehicle class 1 bin data to vehicle class 2 bin data. If class 1 is higher, the data for the day will be flagged.	--	--
Direction Check	The system will check that the direction for the site is correct. The system should PASS a 0 (non-directional) OR a pair (1:3 OR 2:4) at every TC Number. It would NOT accept a lone direction or an incorrectly matched directional pair (example: North-1 and East-2).	--	--
Factor AADT Outside Range	The system calculates the AADT based on the factor groups using daily, monthly, and axle factors. Then, the system compares the computed hourly AADT to the historical AADT and will flag sites that are outside the established volume group tolerances limits.	Variable	Variable

Quality Control Rule	Description	Minimum Threshold	Maximum Threshold
Historical Volume Check for Portable	The system averages the last 3 years of the AADT history. If 3 years of data is not available, the system will average the last 2 years of the AADT history. If 2 years is not available, the system will use one year of AADT history. The data is flagged, if it is outside the volume group tolerance limits.	Variable	Variable
Hourly Zero Volume Check	The system will reject any hour with zero volume in one direction when the current AADT for the site is greater than 10,000.	--	10,000
Less Than 48 Hours of Data	The system should reject the entire set of counts if there are not at least 48 hours of data. This means one or more row(s) in a PRN file is missing. If a row has a blank PRN file, the system still counts the row.	--	--
Max Hourly Volume	The system will reject the entire set of counts with an hourly volume count of greater than X	--	5,000
Midnight/ Noon Check	The system will reject the entire set of counts, if the midnight count is higher than the noon count.	--	--
Peak Hours (6-9 a.m.) (3-6p.m.)	The system will reject the entire set of counts with an hourly volume count of zero between the hours of 6 a.m. – 9 a.m. and 3 p.m. – 6 p.m. when the functional class is not equal to 9 or 19.	--	--
Portable Truck Percent	The system will calculate the truck percent by adding vehicle class bins 4 - 14 for the day and dividing by the total daily traffic count. Incoming data will be flagged, if the truck traffic is greater than X percent.	--	40%
Sum of Combination Vehicles Exceeds Class 9	The system will flag any day, where the total of the volumes in vehicle class bins 11, 12 and 13 exceeds the volume in vehicle class bin 9.	--	--
Volume Check	The system will flag any incoming data if there is an hourly volume count of greater than 9999. Allowable volumes are from 0 to 9999.	0	9,999

X. ANNUAL DATA PROCESSING

Annual data processing is a cycle that involves planning, traffic data collection, quality control, traffic calculations, reporting and publishing. Planning begins in November. Portable traffic collection begins in mid-January and ends around mid-November. The comprehensive review of the annual traffic begins in January. Refer to *Appendix F: Traffic Calculations* for further detail on traffic calculations. Reporting and publishing is usually in February or March. The following is a list of tasks that are performed during Annual Data Processing:

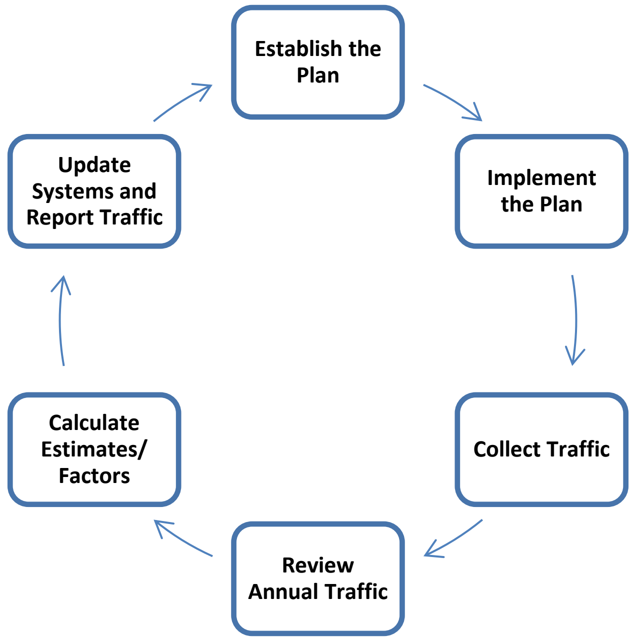


Figure 4: High Level Overview of Annual Data Processing

1. **Establish the Plan**
   a. Review TC segmentation
   b. Review collection cycle for portable data
   c. Compare TPAS site information and planned collection (Coverage List)

2. **Implement the Plan**
   a. Synchronize the Coverage List and TPAS
   b. Create lists of portable traffic count locations for field technicians and consultants

3. **Collect Traffic**
   a. Collect and review (QC) portable data, including GPS Data and Traffic Data Files
   b. Poll and review(QC) ATR data

4. **Review Annual Traffic**
   a. Ensure all portable and continuous traffic has been collected and has passed quality control standards

5. **Calculate Estimates/ Factors**
   a. Calculate traffic adjustment factors
   b. Estimate AADTs at uncounted TC sites based upon historical data and current year ATR data
   c. Calculate traffic on high volume roads (Step Down Method)
   d. Estimate traffic on local roads
   e. Calculate peak hour traffic data and K-factors

6. **Update Systems and Report Traffic**
   a. Populate the Federal Reporting Enhanced Database with traffic data
   b. Provide traffic data for external public viewing (GA STARS and ATR Reports)
   c. Report traffic data to the FHWA in the HPMS submittal

Management of Traffic Count Segments

According to the HPMS Field Manual, "Selection of count station locations should be based on previous count experience, recent land developments, and the existence of uncounted sections along the routes." Although TC segments were initially created to be homogenous (i.e., similar traffic for the entire segment); traffic has a fluid dynamic and, as such, updates must be made annually in order to maintain the integrity of the segments. Break points are added, deleted, or moved to reflect changes reported in the road inventory and actual field conditions.

OTD evaluation criteria for adding and spacing TC segments are as follows:

- TC segments must meet Federal-aid eligibility requirements. Federal-aid roadways are any public road with a functional classification higher than a local road or rural minor collector. Local roads are randomly sampled for traffic data reporting; meaning only select locations on local roads have TC numbers.
- Typically, and wherever possible, segments should span *from major intersection to a major intersection or a major traffic generator*. A major intersection is defined as an arterial roadway. An example of a major traffic generator is an entrance/exit to a major retail store, such as a Super Wal-Mart.
- The Data Administration Group's office personnel evaluate a road's segmentation if adjacent AADT volumes are varying by 20% or more. In connection with this effort, the last three or more years of traffic history is considered during the analysis.
- New business requirements may require additional TC segments. For example, OTD added traffic count segments containing bridges to the coverage program in 2009.

OTD evaluation criteria for retiring a TC segment are as follows:

- If there is a re-classification in functional classification which makes the road a local road without the presence of a bridge or railroad, the TC number would be retired.
- Also, OTD reviews and evaluate sample sites if adjacent segments have less than 5% difference in the AADT volumes. If the evaluation process supports a modification, OTD will delete a sample and expand the terminus of the adjacent TC segment.
- Additionally, there could be a change in Federal requirements or funding levels.
- There may also be cases where it is not safe or feasible for a field technician to collect the data.

Calculation of Traffic on High Volume Roads (Step Down Method)

GDOT uses the ramp counting procedure described in FHWA's TMG to estimate AADT volumes for Interstates and freeways. It is referred to as the Step Down Method, which is also known to some states as Ramp Balancing. The high volumes on these roads make them impossible to collect with a portable collection device due to the safety of the field crew. For example, the main Interstate through Atlanta, I-75, has an AADT (2012) of 336,490, and ramps at the I-285 and I-85 interchange in DeKalb County (also known as Spaghetti Junction) have AADTs (2012) from 6,000 to 45,000.

The Step Down Method involves counting all entrance and exit ramps between two established mainline anchor points (or nodes) and then reconciling the count data to calculate the mainline AADT. As shown in *Figure 5: Example of Step Down Method*, the calculated AADTs reduce in volume or 'step down' from TC0927 to TC0446. The ramps are counted using either portable collection devices or, in a few locations, PTMS sites. OTD makes every effort to use ATR sites as nodes.

An AADT for each uncounted mainline link is calculated by addition or subtraction of ramp AADT (multiplied by an adjustment factor) to or from mainline AADT, starting from one anchor point/node. The allocation of the volume difference to the ramps (and subsequently to the mainline volume estimates) is carried out by proportionally distributing the volume difference remaining at the ending control point to each of the ramps. The adjustment to each

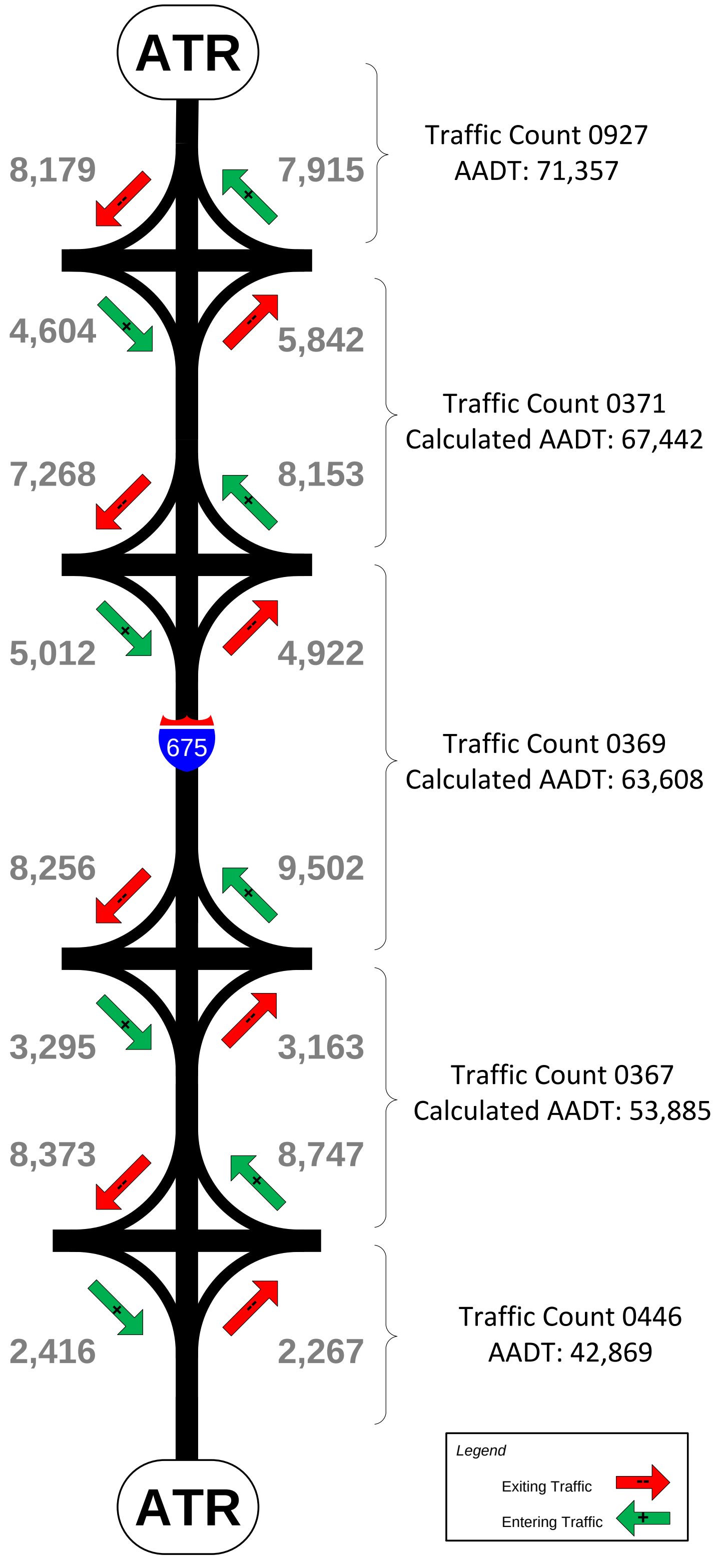


Figure 5: Example of Step Down Method

ramp is computed as the ratio of the difference in volume (remaining at the end of the reconcilement) to the sum of the ramp volumes.

In the past, the process was time-consuming and labor intensive, because it was performed manually. Currently, the processing for the Step Down Method is calculated using a computer program after the AADTs have been calculated for the ATR sites. OTD does not calculate the AADT volumes derived by the Step Down Method by direction of travel.

Traffic Count Collection and Estimation on Local Roads

According to the FHWA, “States are required to report annually to the Federal Highway Administration (FHWA) aggregate estimates of VMT on the rural minor collector and local functional systems in rural, small urban and urbanized areas.” Collectively, these are referred to as *local roads* which have similar travel characteristics such as: providing direct access to adjacent land, providing service to travel over short distances as compared to higher classification categories, linking locally important traffic generators with their rural hinterlands, etc. Examples of local roads are a subdivision road or an unpaved country road. Generally, except for the local roads, OTD collects traffic data on all types of roads in Georgia.

On local roads, OTD collect a small number of samples to derive and compute VMT statistics for Federal reporting purposes. The total local road mileage is approximately 90,373 miles, as of the revision date of this document (December 2013). OTD has exceeded the HPMS sampling requirements with the total number of collected local traffic counts ranging from 800-1600 for the past several years.

According to the HPMS Field Manual, “Statistically speaking, a universe is a population from which a sample is taken. A population can be any set of sampling units, such as objects that can be observed or people who can be surveyed. A sampling frame is a list of all the sampling units in a universe.” In our case, the universe for local roads is the total local road mileage. The sampling unit is a randomly selected local road segment stratified by six local road types: **Urban Local – Not Atlanta, Urban Local – Atlanta, Small Urban Local, Rural – Paved, Rural – Unpaved, and Dead-end/ Cul-de-sac**.

Traffic Adjustment Factors

Federal Regulations 23 CFR 500.204 states, "The procedures used by a state to edit and adjust highway traffic data collected from short-term counts at field locations to estimates of average traffic volume shall be documented." The raw hourly counts from portable traffic collection devices for a 48-hour period are adjusted by monthly, daily and axle factors to determine the AADT. Factors are used to estimate 'average' conditions and to account for variability in the traffic stream. They are based on data provided by the ATRs and are currently calculated annually in TPAS.

Monthly factors are calculated by dividing the AADT by the monthly average daily traffic (MADT) for each location. In Georgia, January is usually the month with the lowest traffic volumes. Therefore, portable traffic collected in January would have the highest monthly factors.

Daily or day-of-the-week factors are calculated by dividing the AADT by the average daily traffic (ADT). Typically, the day of the week with the lowest traffic volumes is Sunday which consequently has the highest daily factors.

Axle correction factors are developed based on data that represents all seasons of the year. The axle correction factors are applied to raw counts taken with portable traffic counters which register two axle impacts as one vehicle. It is used to account for vehicles with more than two axles, typically trucks with three or more axles, in the traffic stream on a particular type of road. They should be applied to all counts that are based on axle sensors. Rural Interstates have the lowest axle factors, because they have the highest percentage of truck traffic in Georgia.

OTD plans to review our factoring approach every year based upon a variety of factors: additional ATR sites that are installed, traffic trends/patterns, high growth areas, truck traffic patterns, etc. The ATRs are currently grouped into 16 traffic factor groups (refer to *Table 6: Factor Groups*). As expected, Atlanta has significantly different traffic patterns compared to the rural areas of the state. The 2012 factors are shown in the following tables:

Table 3: 2012 Axle Factors

Factor Group*	Axle Factors
1	0.97
2	0.94
3	0.91
4	0.78
5	0.80
6	0.78
7	0.99
8	0.96
9	0.89
10	0.99
11	0.98
12	0.97
13	0.98
14	0.99
15	0.94
16	0.87

Factor Groups are described in Table 6: Factor Groups.

Table 4: 2012 Daily Factors

Factor Group*	*Sun*	*Mon*	*Tues*	*Wed*	*Thu*	*Fri*	*Sat*
1	1.27	1.00	0.98	0.97	0.94	0.88	1.05
2	1.30	0.99	0.97	0.96	0.93	0.87	1.07
3	1.21	1.02	1.01	1.00	0.95	0.85	1.03
4	0.99	1.09	1.12	1.08	0.98	0.85	0.95
5	0.99	1.07	1.10	1.07	0.99	0.84	0.99
6	0.95	1.08	1.14	1.10	0.99	0.82	0.99
7	1.27	0.98	0.97	0.93	0.93	0.89	1.12
8	1.37	0.99	0.97	0.96	0.93	0.85	1.06
9	1.24	1.00	0.99	0.98	0.93	0.86	1.08
10	1.38	0.95	0.93	0.92	0.91	0.89	1.18
11	1.47	0.96	0.94	0.93	0.91	0.86	1.12
12	1.46	0.98	0.94	0.94	0.92	0.86	1.10
13	1.42	0.97	0.94	0.93	0.92	0.88	1.10
14	1.36	1.00	0.96	0.94	0.92	0.88	1.06
15	1.23	0.99	0.98	0.96	0.93	0.90	1.06
16	1.35	0.97	0.95	0.94	0.91	0.87	1.12

Table 5: 2012 Monthly Factors

Factor Group*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.06	1.01	0.95	0.98	0.97	1.00	1.03	1.00	0.99	0.96	1.01	1.06
2	1.06	1.01	0.96	0.98	0.98	1.00	1.03	1.00	1.00	0.97	0.99	1.04
3	1.10	1.04	0.99	0.99	0.98	0.96	0.97	1.00	1.01	0.95	1.00	1.06
4	1.16	1.06	0.91	0.97	1.00	0.89	0.89	1.05	1.12	1.02	0.99	1.04
5	1.18	1.09	1.02	0.99	0.98	0.92	0.90	0.97	1.02	1.01	0.98	1.00
6	1.19	1.09	0.98	0.95	0.97	0.90	0.89	1.00	1.05	1.01	1.00	1.04
7	1.01	0.99	0.95	0.99	0.97	1.02	1.03	0.98	1.00	1.00	1.02	1.03
8	1.06	0.98	0.96	0.99	0.98	0.99	1.01	1.00	1.02	1.00	1.00	1.02
9	1.08	1.01	0.95	0.98	0.98	0.97	0.98	1.01	1.04	1.00	1.00	1.03
10	1.04	0.99	0.95	0.98	0.97	1.02	1.05	0.99	1.00	0.97	1.00	1.05
11	1.03	0.95	0.95	0.98	0.98	1.02	1.06	0.99	1.00	0.99	1.00	1.06
12	1.05	0.98	0.97	0.98	0.99	1.00	1.03	1.00	1.00	1.02	1.00	1.00
13	1.07	1.00	0.97	0.99	0.99	1.00	1.02	0.97	0.98	1.01	1.01	1.01
14	1.06	1.00	0.98	0.99	0.99	1.00	1.03	0.98	0.99	1.01	1.00	0.98
15	1.07	1.02	0.99	0.99	0.99	0.98	0.98	0.99	1.00	1.00	1.01	1.01
16	1.09	1.00	0.97	0.99	0.99	0.97	0.99	0.99	1.00	1.03	1.02	1.01

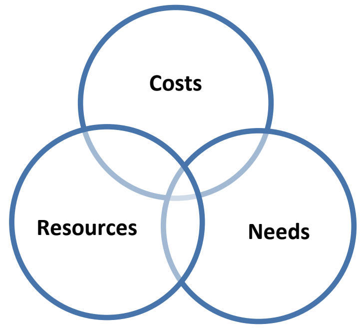
Factor Groups are described in Table 6: Factor Groups.

Table 6: Factor Groups

No.	Factor Group	Description
1	Rural - Local Collectors	Local roads or collectors in a rural area which provide low levels of travel mobility (e.g., a subdivision road or intra-county travel corridor)
2	Rural - Minor Arterial	Routes which provide service to corridors with trip lengths and travel densities greater than that of collectors or local roads (e.g., Appling County SR-15)
3	Rural - Major Arterial	Routes which have a trip length and travel density indicative of substantial state wide travel (e.g., Bartow County SR-20)
4	Rural - I-75	I-75 Outside of an Urban Area
5	Rural - I-85	I-85 Outside of an Urban Area
6	Rural - Interstates	Interstates that are accessed only using ramps and are outside of an Urban Area (e.g., I-16 in Bryan County)
7	Small Urban - Local Collector	Local roads or collectors in a small urban area which provide low levels of travel mobility (e.g., a subdivision road or intra-county travel corridor)
8	Small Urban - Arterial	Routes of moderate to high lengths and travel that are within a small urban area (e.g., Bulloch County SR-67 Bypass)
9	Small Urban/Urban - Freeways Interstate (Not Atlanta)	Freeways, Expressways and Interstates which are restricted access roadways and not in Atlanta (e.g., I-95)
10	Urban - Local Collector	Local roads or collectors in an urban area which provide low levels of travel mobility (e.g., a subdivision road or intra-county travel corridor)
11	Urban - Minor Arterial (Not Atlanta)	Routes that serve the major centers of activity with the highest traffic volumes and the longest trip lengths not in Atlanta (e.g., Catoosa SR-146)
12	Urban - Major Arterial (Not Atlanta)	Routes that serve the major centers of activity with the highest traffic volumes and the longest trip lengths not in Atlanta (e.g., Catoosa SR-146)
13	Urban - Minor Arterial (Atlanta)	Routes which provide trips of moderate length linking principal arterials in Atlanta (e.g., Fulton County SR-3)
14	Urban - Major Arterial (Atlanta)	Routes that serve the major centers of activity with the highest traffic volumes and the longest trip lengths in Atlanta (e.g., Cobb County SR-5)
15	Urban - Freeways Interstate (Atlanta)	Freeways, Expressways and Interstates which are restricted access roadways and are in Atlanta (e.g., I-75, I-85, SR-400, I-985)
16	Urban - I-285 (Atlanta)	I-285 Loop

XI. OTHER CONSIDERATIONS

A complete analysis of any program identifies and considers all relevant issues and challenges. The main program management challenge is balancing costs, resources, and statistical data needs. In a world not constrained by funding or other resources, every TC segment on every road would have actual traffic data count available every year. Perhaps, in a small geographical area with a large budget this is an actual possibility. However, as is the case with most state Department of Transportations, budget constraints must be continually balanced with resources (time and available staff) and the needs (quantity and quality of traffic counts collected). It is the classic paradox of project management.



Despite budget constraints, the demand for traffic data in all formats has not been reduced. For example, the most recent HPMS reassessment is requiring additional traffic data to be collected on ramps. Special requests for traffic counts are also a competing factor with the portable traffic count program. Often, these traffic counts revolve around a special event and are not valid for use in an AADT calculation. As previously mentioned, OTD has also added traffic counts specifically located near bridges to meet internal data needs.

Other challenges include relational database struggles, software integration, staffing issues, and making traffic data accessible to the public in an easy-to-use interface. Most of the traffic data customers want an easy-to-use, simple interface that provides traffic counts. Other customers want all types of traffic data in detail as soon as it is available to them. OTD has made significant strides towards making data more accessible to the public and is continually exploring how to better serve customers.

In regards to traffic data collection, safety of the traffic data collection crew is the primary concern in collecting data on high-volume routes. Due to equipment failures, collecting traffic data in stop-and-go traffic conditions is a challenge. Increased traffic congestion increases the difficulty in obtaining reliable vehicle classification counts. Construction and incidents also impact traffic data collection activities. Data processing, and quality control and assurance are challenges especially for high traffic-volume routes. Atlanta, in particular, as a metropolitan area with approximately five million people has significant traffic congestion, construction, and traffic incidents.

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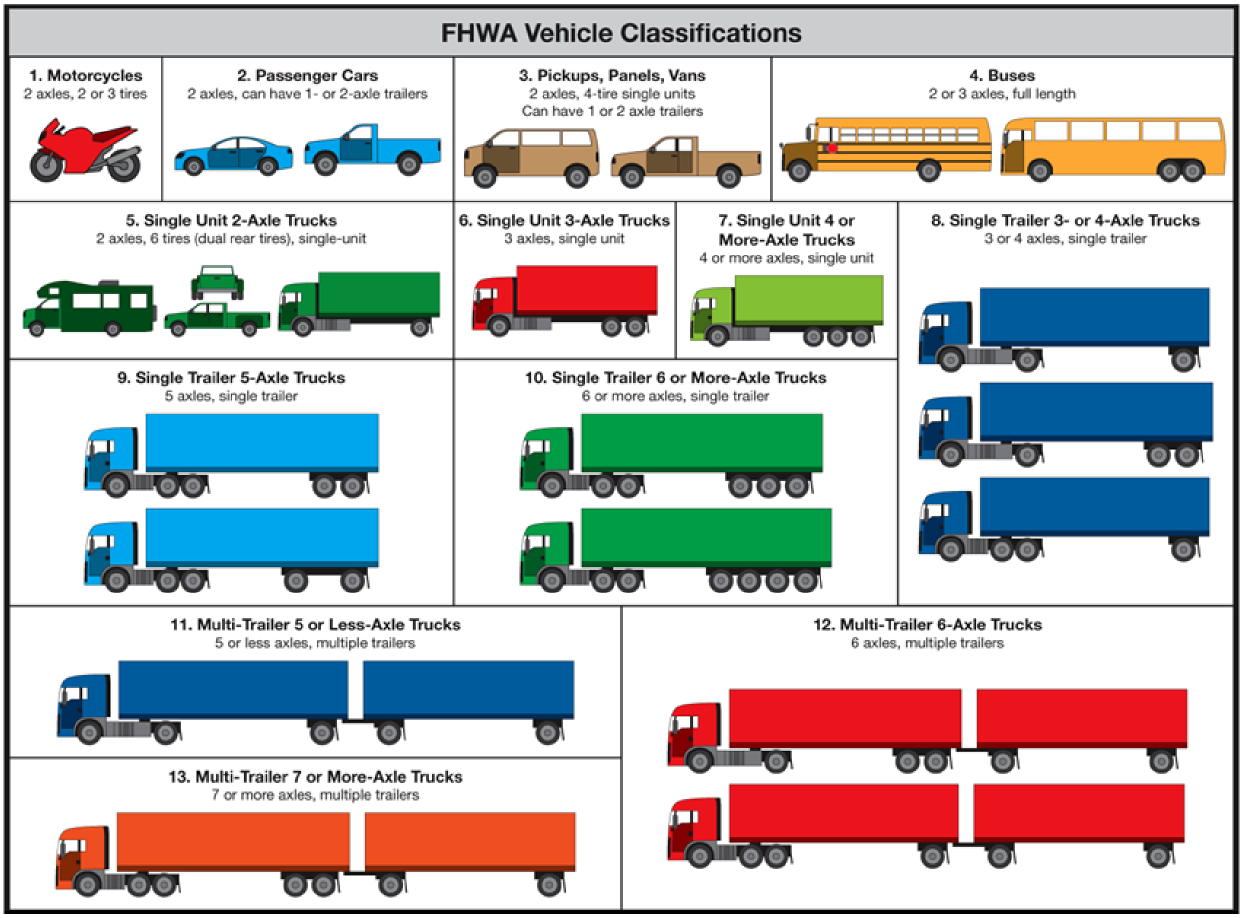
Appendix A: FHWA 13-Bin Vehicle Classification Scheme



Source: Texas Department of Transportation's illustration of the FHWA 13-Bin Vehicle Classification Scheme

Appendix B: 2011 to 2013 Portable Traffic Collections

Table B-1: 2011 Portable Traffic Collections (Planned)

Road System	Cycle	Volume Only Traffic Counts	Classification Traffic Counts	PTMS Counts	Total Traffic Counts
State Routes	2 Year	2,100	1,989	11	4,100
Off-System Federal - Aid	4 Year	1,700	298[1]	2	2,000
Non Federal-Aid Locals[2]	6 Year	1,300	200		1,500
Critical Ramps[3]	Annual	615	--	35	650
Major Ramps[4]	2 Year	350	--		350
Other Ramps[5]	4 Year	250	--		250
			Total		**8,850**

Table B-2: 2012 Portable Traffic Collections (Planned)

Road System	Cycle	Volume Only Traffic Counts	Classification Traffic Counts	PTMS Counts	Total Traffic Counts
State Routes	2 Year	2,367	1,629	11	4,007
Off-System Federal-Aid	4 Year	1,623	371[1]	2	1,996
Non Federal-Aid Locals[2]	6 Year	1,034	359	--	1,393
Critical Ramps[3]	Annual	615	--	35	650
Major Ramps[4]	2 Year	350	--	--	350
Other Ramps[5]	4 Year	244	6	--	250
				Total	**8,646**

Table B-3: 2013 Portable Traffic Collections (Planned)

Road System	Cycle	Volume Only Traffic Counts	Classification Traffic Counts	PTMS Counts	Total Traffic Counts
State Routes	2 Year	1,878	2,178	11	4,067
Off-System Federal-Aid	4 Year	1,487	332[1]	2	1,821
Non Federal-Aid Locals[2]	6 Year	1,184	529	--	1,713
Ramps	Mixed	1,315	--	35	1,350
				Total	**8,951**

Footnotes:

1. The Off-System Federal-aid vehicle classification counts are on off–system HPMS sample locations and National Highway System (NHS) Intermodal facilities.
2. Non Federal-aid local counts include counts taken near bridges and railroads.
3. The ramp program will be divided into its own program based on priority to step-down, urban areas, and HPMS needs. Critical ramp interchanges are defined as the following:
    a. Interstate-to-Interstate
    b. Interstate-to-Freeway
    c. Strategic Atlanta Exits/Interchanges (High Volume Corridors): I-285, Inside Perimeter, I-85 in Gwinnett, I-75 in Cobb, and GA-400 in Fulton
4. Major ramp interchanges are defined as the following:
    a. Other Atlanta Urbanized Area Boundary Interchanges
    b. I-95, I-516, I-520 Locations (Not Already in Critical Ramp Category)
    c. Other Step-down Interchanges
5. Other ramp interchanges are defined as the following:
    a. All other Step Down interchanges (rural locations)
    b. All other HPMS qualifying ramps not used in Step Down calculations

Appendix C: Permanent Weigh-In-Motion Sites

No.	Site ID	WIM Lanes[1]	Location
1	**021-0334**	1N	I-75/SR 401 between I-475 and SR 247
	021-0334	1S	I-75/SR 401 between I-475 and SR 247
2	**039-0218**	1N	I-95/SR 405 between the Florida State Line and St. Marys Road (Camden County)
	039-0218	1S	I-95/SR 405 between the Florida State Line and St. Marys Road (Camden County)
3	**051-0368**	2E/2W	I-16/SR 404 0.6 miles east of SR 307 Dean Forest Road
4	**065-0118**	1E/1W	US 84/SR 38 north of Leland Smith Road, Homerville (Clinch County)
5	**067-2373**	4N	I-285/SR 407 at Orchard Road between mile post 16 and 17 (Cobb County)
6	**081-0347**	1N/1S	SR 300 west of Culpepper Road between mile post 10 and 11, Cordele (Crisp County)
7	**127-0312A**	2N	I-95/SR 405 between SR 27 and Golden Isles Parkway (SR 25 Spur)
	127-0312B	1S	I-95/SR 405 between SR 27 and Golden Isles Parkway (SR 25 Spur)
8	**143-0126**	1E/1W	I-20/SR 402 at the Alabama State Line between mile post 0 and 1 (Haralson County)
9	**185-0227**	1N	I-75/SR 401 between the Florida State Line and Lake Park Bellview Road (Lowndes County)
	185-0227	1S	I-75/SR 401 between the Florida State Line and Lake Park Bellview Road (Lowndes County)
10	**207-0222**	2N/2S	I-75/SR 401 between Pate Road and Bibb County Line, Macon (Monroe County)
11	**245-0218**	1E/1W	I-20/SR 402 between SR 104 and South Carolina State Line

Footnotes:

1. N=North, S=South, E=East, and W=West

Appendix D: Portable Weigh-In-Motion Sites

No.	Site ID	Location
1	**027-0138**	US 84/SR 38 east of Boston near Pidcock Road (CR 91) (Brooks County)
2	**031-0187**	US 301/SR 73 towards town just north of SR 46
3	**051-0350**	SR 307 just outside Garden City Terminal main gate (Chatham County)
4	**057-0239**	I-575 just south of Sixes Road interchange (Exit 11) (Cherokee County)
5	**059-0125**	US 129/SR-15 Alternate, just north of the Athens Perimeter between Homewood Drive and Trinity Place (Clarke County)
6	**071-0006**	SR 133 southeast of Moultrie near Culbertson Road (Colquitt County)
7	**089-3112**	SR 42 (Moreland Avenue) just north of I-285 (DeKalb County)
8	**089-3205**	SR 155 just southeast of I-285 near Columbia Drive (DeKalb County)
9	**097-0045**	SR 6 north of I-20 near Oak Ridge Road (Douglas County)
10	**097-0323**	SR 6 south of I-20 near Factory Shoals Road (Douglas County)
11	**099-0047**	US 84/SR 38 west of Donalsonville and east of Jakin near Harrell Moye Road (Early County)
12	**107-0022**	US 1/SR 4 north of Swainsboro near Hawhammock Church Road (Emanuel County)
13	**115-0087**	US 411/SR 53 west of Cave Springs near Buttermilk Road (Floyd County)
14	**121-5716**	SR 6 just west of I-285 near Welcome All Road
15	**151-0103**	SR 155 just north of Bill Gardner Parkway/Hampton Locust Grove Road (Henry County)
16	**157-0245**	US 129/SR 11 just east of I-85 Interchange (Jackson County)
17	**171-0127**	US 41/SR 7, 2.3 miles north of town
18	**179-0041**	US 84/SR 38 in Walthourville just east of SR 119 (Liberty County)
19	**189-0003**	US 78/SR 10 just north of SR 43/Lincolnton Road (McDuffie County)
20	**199-0212**	SR 109 west of Greenville between Highpoint Road and Fire Tower Road (Meriwether County)
21	**219-0258**	SR 316 just west of US 78/SR 10 interchange near Caterpillar Plant (Oconee County)
22	**223-0103**	SR 6 west of Dallas near Gold Mine Road (Paulding County)

No.	Site ID	Location
23	**227-0237**	SR 5/515, 0.3 miles north of SR 108 at mile post 12.85
24	**229-0123**	US 84/SR 38 southwest of Patterson near Aaron's Way (Pierce County)
25	**241-0052**	US 441/SR 15 south of SR 246 near the State Line (Rabun County)
26	**245-0132**	SR 56 (Mike Padgett Highway) north of Hephzibah-McBean Road (Richmond County)
27	**255-0373**	SR 16 between South McDonough Rd and High Falls Rd
28	**269-0138**	SR 96 west of Butler between McCall Road (CR 239) and Back Road (CR 63) (Taylor County)
29	**285-0047**	US 27/SR 1 just south of SR 54 north of LaGrange (Troup County)
30	**297-0018**	SR 10 between Youth Monroe Rd and SR 10BU Alcovy River
31	**303-0001**	SR 15 south of Sandersville between Montgomery Road and Harrison-Riddleville Road (Washington County)
32	**305-0041**	US 341/SR 27 near River Road southeast of Jesup (Wayne County)
33	**319-0125**	US 441/SR 29 just east of SR 112 near Thompson-Denson Road (Wilkinson County)
34	**321-0145**	US 82/SR 520 near Summer between West Road and College Street (Worth County)

Appendix E: Georgia Counties and FIPS Identification Numbers

County	Code	County	Code	County	Code	County	Code
APPLING	001	DADE	083	JEFFERSON	163	RICHMOND	245
ATKINSON	003	DAWSON	085	JENKINS	165	ROCKDALE	247
BACON	005	DECATUR	087	JOHNSON	167	SCHLEY	249
BAKER	007	DEKALB	089	JONES	169	SCREVEN	251
BALDWIN	009	DODGE	091	LAMAR	171	SEMINOLE	253
BANKS	011	DOOLY	093	LANIER	173	SPALDING	255
BARROW	013	DOUGHERTY	095	LAURENS	175	STEPHENS	257
BARTOW	015	DOUGLAS	097	LEE	177	STEWART	259
BEN-HILL	017	EARLY	099	LIBERTY	179	SUMTER	261
BERRIEN	019	ECHOLS	101	LINCOLN	181	TALBOT	263
BIBB	021	EFFINGHAM	103	LONG	183	TALIAFERRO	265
BLECKLEY	023	ELBERT	105	LOWNDES	185	TATTNALL	267
BRANTLEY	025	EMANUEL	107	LUMPKIN	187	TAYLOR	269
BROOKS	027	EVANS	109	MCDUFFIE	189	TELFAIR	271
BRYAN	029	FANNIN	111	MCINTOSH	191	TERRELL	273
BULLOCH	031	FAYETTE	113	MACON	193	THOMAS	275
BURKE	033	FLOYD	115	MADISON	195	TIFT	277
BUTTS	035	FORSYTH	117	MARION	197	TOOMBS	279
CALHOUN	037	FRANKLIN	119	MERIWETHER	199	TOWNS	281
CAMDEN	039	FULTON	121	MILLER	201	TREUTLEN	283
CANDLER[1]	043	GILMER	123	MITCHELL[1]	205	TROUP	285
CARROLL	045	GLASCOCK	125	MONROE	207	TURNER	287
CATOOSA	047	GLYNN	127	MONTGOMERY	209	TWIGGS	289
CHARLTON	049	GORDON	129	MORGAN	211	UNION	291
CHATHAM	051	GRADY	131	MURRAY	213	UPSON	293
CHATTAHOOCHEE	053	GREENE	133	MUSCOGEE	215	WALKER	295
CHATTOOGA	055	GWINNETT	135	NEWTON	217	WALTON	297
CHEROKEE	057	HABERSHAM	137	OCONEE	219	WARE	299
CLARKE	059	HALL	139	OGLETHORPE	221	WARREN	301
CLAY	061	HANCOCK	141	PAULDING	223	WASHINGTON	303
CLAYTON	063	HARALSON	143	PEACH	225	WAYNE	305
CLINCH	065	HARRIS	145	PICKENS	227	WEBSTER	307
COBB	067	HART	147	PIERCE	229	WHEELER	309
COFFEE	069	HEARD	149	PIKE	231	WHITE	311
COLQUITT	071	HENRY	151	POLK	233	WHITFIELD	313
COLUMBIA	073	HOUSTON	153	PULASKI	235	WILCOX	315
COOK	075	IRWIN	155	PUTNAM	237	WILKES	317
COWETA	077	JACKSON	157	QUITMAN	239	WILKINSON	319
CRAWFORD	079	JASPER	159	RABUN	241	WORTH	321
CRISP	081	JEFF-DAVIS	161	RANDOLPH	243		

Footnote:

1. Numbers 041 and 203 have been deliberately omitted.

Appendix F: Traffic Calculations

Description	Equation*
Annual Vehicle Miles Traveled (AVMT)	Daily Vehicle Miles Traveled * 365
ATR AADT	Sum of Total Yearly Traffic Volume/ Total Number of Operational Days
Axle Factors	Total Vehicle Volume / (Total Axle Strikes/ 2)
D or Directional Distribution Factor	Predominate Direction of Peak Hour Volume/ Total Peak Hour Volume
Daily Factors	AADT/ Average Daily Traffic
Daily Vehicle Miles Traveled (DVMT or VMT)	Length of Roadway Segment * AADT
K or Design Hour Factor	30^{th} Highest Hour/ AADT
Monthly Factors	AADT/ Monthly Average Daily Traffic
Portable AADT (Classification)	24-hour Short-Term Volume * Daily Factor * Monthly Factor
Portable AADT (Volume Only)	24-hour Short-Term Volume * Daily Factor * Monthly Factor * Axle Factor
Simple Sample Size Calculation	$n = \frac{t^2 \times p(1-p)}{m^2}$ *Description:* n = Required Sample Size t = Confidence Level at 99% (Standard Value of 2.576) p = Population m = Margin of Error at 5% (Standard Value of 0.05)
Truck Percentages	(Sum of Vehicles in Classes 4-13/ Total Sum of Vehicles) * 100

Footnotes:

1. The list above is intended to be a basic list of equations. It should be noted that additional steps, such as summation or averaging, may be necessary before an equation listed above can be applied to the data.
2. Data that has not been accepted based upon the established QC rules is omitted from any calculation.