ACKNOWLEDGEMENT

The Florida Department of Transportation’s Traffic Monitoring Handbook (TMH) is a guide for those interested in Florida’s traffic monitoring program. Our office wishes to acknowledge the collaborative efforts of the supporting offices and subject matter experts that contributed to its content.

The intent of this handbook is to provide guidance to those that collect, code, and use traffic data in an accurate and consistent manner statewide. In coordination with the district offices, the Office of Transportation Data and Analytics (TDA) administers the capture and analysis of traffic count data. This document is a continuation of FDOT’s effort to develop a comprehensive traffic monitoring procedure.

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Note:
Recent major changes to the document include the addition of a non-motorized traffic monitoring chapter, as well as, changes to the terminology of traffic monitoring sites (TMS). Previously, TTMS was a telemetered traffic monitoring site and PTMS was a portable traffic monitoring site. These are now referred to as continuous traffic monitoring sites and short-term traffic monitoring sites, respectively.
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TRAFFIC MONITORING HANDBOOK

INTRODUCTION

This handbook describes the end-to-end process of traffic monitoring at the Florida Department of Transportation (FDOT). Starting with devices traffic collecting (vehicular, pedestrian, and/or bicycle) in the field and culminating in yearly data and User reports. This process consists of three basic stages. **Stage 1** (Device Installation) includes the installation and setup of the field units. After installation, a device can be added to the array of field units and will be either a short-term count site or a permanent continuous count site. **Stage 2** (Processes) involves the accumulation and analyses of data from devices according to a schedule that is dependent on the count site type. **Stage 3** (Finalization) covers the end of year processing to generate traffic count data to be used in Department administration of highway programs along with published datasets and reports. Traffic data is fundamental to determining vehicle miles of travel, project design parameters, road classifications, and the level of service provided by a road facility.

The State Road Department started collecting data at ten traffic count sites in 1936. As the state grew, the need to expand traffic data collection was recognized. The value of good data became apparent during the evolution of the national Department of Transportation (DOT) and eventually the Federal Highway Administration (FHWA). This data translated into revenue allocations for state and federal highway programs and is therefore a critical necessity in each State.

The data collected at a traffic monitoring site may include: volume, speed, direction, vehicle classification and/or weight. A specific site may collect only volume or speed while others collect combinations of data categories. The type of equipment installed and the programs running the equipment determine how the site functions. The purpose is to provide the Department with a basis to meet the reporting requirements of the FHWA to sustain the funding of federal transportation programs and to provide critical data required for engineering analysis of existing facilities and to identify the need for expansion in the road network.

Florida has been collecting truck weight data using weigh-in-motion equipment in 1974. Beginning in 1988, permanent weight sensors and electronics were installed in selected locations and the systems monitored traffic continuously. The weigh-in-motion equipment collects the volume, speed, vehicle classification, vehicle lengths, gross vehicle weight, axle weights, and axle spacing of every vehicle that passes over the sensors. The vehicle class, speed, and length data are binned similarly to the continuous speed and classification sites. The vehicle weight and axle spacing data are only saved for vehicle classes 4 and higher, to conserve memory in the counters. These are the classes of vehicles that exert the most force on the pavement and structures and are used for pavement design and analysis.
1 DEVICE ARRAY ESTABLISHMENT

The FDOT traffic data collection program is a collaborative effort involving the District offices throughout the State and the Transportation Data and Analytics (TDA) office in the Department’s Central Office. In FDOT, traffic data covers vehicular traffic (e.g. trucks, automobiles, and motorcycles) on Florida’s road system AND bicycles and pedestrians on sidewalks, bikeways, and trails.

In broad terms, the TDA office is responsible for operating the continuous traffic monitoring and weigh-in-motion programs, developing policy, maintaining the traffic databases and developing the AADT estimates. The FDOT District offices are responsible for collecting the short-term coverage counts, defining the traffic segment breaks, keeping the station inventory file updated, and defining the factor categories. These sites provide road segment-specific traffic characteristics information on a cyclical basis.

1.1. Site Types (Continuous & Short-Term)

To collect traffic data, FDOT operates two traffic count site types:

1. **Continuous Traffic Monitoring Site (Continuous)** - A statewide system currently consisting of 230 permanent continuous vehicle count stations that collect volume, speed, vehicle classification data and 35 stations that collect weigh-in-motion data 24 hours per day, 365 days per year. The data collected is transmitted using a wireless cellular device to TDA at the FDOT Central Office. Information from these sites is used to determine traffic growth and tendencies as well as develop pavement design input, seasonal adjustment factors used in determining estimates of annual average daily traffic (AADT), axle correction factors for road tube counts, and directional design hour volumes (DDHV).

2. **Short-term Traffic Monitoring Site (Short-term)** – A short-term counting program that utilizes traffic count sites that may be permanently or temporarily established. As a part of the statewide count program administered by the FDOT District Offices, each road section is generally counted about every 3 years. This program consists of approximately 16,000 sites on the State Highway System and another 2,087 sites for purposes such as sampling of off system Federal Aid eligible and non-Federal Aid eligible local facilities, county roads, off-system bridge counts, at-grade railroad crossing counts, and other samples. Results are used to develop growth factors for estimating current year counts from known prior year counts and determine Vehicle Miles Traveled (VMT).

Florida’s traffic count program is based on the routine collection of data generated by traffic on Florida’s road network, sidewalks and pathway systems. By far the largest dataset comes from the continuous sites which generates the equivalent of over 120,000 days of traffic counts per year.
Continuous Traffic Monitoring Site Locations
The FDOT’s TDA office or a District office will determine when and where new continuous sites are required. Often when major road construction projects are undertaken, a count site will be included in the design plans at the request of the TDA or District office. Generally, 3-4 new sites are installed each year and several others receive equipment upgrades. The type of equipment installed is determined by the type of data desired. The customary procedure is to provide the site location and equipment information in the design plans as specified in the Roadway Design Plans Standard Index 17781 and 17900. Each set-up has a list of pay items and details of how the site must be constructed to function properly.

Short-Term Traffic Monitoring Site Locations
It is the responsibility of each District to determine the location of short-term non-continuous traffic monitoring sites. The exact location and count type should be determined by the physical geometry of the road. Each time a count is made, the technician will re-evaluate the site to determine if field conditions are still suitable for obtaining an accurate count. Some of the factors that should be considered when selecting site locations are the presence of curves, crests, valleys, driveways, intersections, schools, number of lanes, medians, shoulders, or turn lanes.

A traffic count station is usually located within each traffic break segment. It is important to note that adjacent roadway sections can utilize count data from a station located on either side of the traffic break if the same roadway and traffic characteristics exist. This helps to reduce the number of traffic counts that must be collected, processed and stored.

1.2. Site Selection
While selecting a traffic count site, there are several techniques that should be adhered to regarding placement of the traffic counter and sensors:

- Traffic counters should be placed at locations specified by the District, as listed from the Survey Processing Software (SPS) Inventory Database.
- Ascending and descending directions should be counted at the same milepoint. In congested areas with many intersections and driveways, this may not be possible (Please refer to Figure 1).
- All count interval times must be consecutive throughout the duration of the count
- Both ascending and descending directions must be counted for identical dates and times
- All count locations should have field equipment (traffic counter and sensors) verification checks done prior to leaving site to assure accuracy
- GPS coordinates for the site should be noted (dependent on District)
- Each counter must have the descriptive 10-digit identification code entered by the technician as the counter is set so that the Survey Processing Software (SPS) will know how to handle the resulting data file. See the SPS Manual [1] for examples of the 10-digit identification code
- Avoid placing counters on roadways that are under construction
Do not place counters and hoses too close to an intersection or driveways.
Ideal locations are where traffic can move freely over the hoses.

*Figure 1: Top Images - Close to intersection; Bottom Images – Free flow locations*

**Tracking of Installation**
Each District will develop a tracking method to assure sensors are installed according to plans and working properly after installation:

- Once it is determined that a site will be installed, it is important to get project status reports as soon as possible from the construction department.
- If possible, attend the pre-construction meeting to advise all parties of your interest in the site.
- It is also helpful to get a contact phone number as soon as possible. This will make the communication between the responsible parties more efficient.
- Begin close follow up once the installation has begun.
- All sites must be inspected to determine that they have been built according to the plans and are in proper working condition before payment is approved.

**Traffic (Road Section) Segment Breaks**
Each roadway section and sub-section is defined by a beginning milepoint and an ending milepoint in the Roadway Characteristics Inventory (RCI) database. Sections and sub-sections are divided into smaller contiguous segments that have similar traffic volumes and truck traffic. These smaller segments are called traffic breaks. For every traffic break on the State Highway System, AADT and K, D and T factors are calculated. Traffic breaks are defined in the Traffic Characteristics Inventory (TCI) database and are defined by beginning and ending milepoints. Traffic breaks include the beginning and ending of each...
Roadway section and subsection, the beginning and ending of exceptions, and where State and Federal roads intersect the road section. Additional traffic break points are located where there are significant changes in traffic characteristics. These changes usually occur at intersections and interchanges but the characteristics of the road can also govern break points.

Each year, through the application of engineering judgment, District traffic personnel re-evaluate all traffic breaks. Traffic breaks are added, deleted or moved to reflect changes in inventory and field conditions. Listed below are some considerations for determining the location of a traffic break point:

- Where changes in traffic volume exceed 20% (under 5,000 AADT) to 10% (over 25,000 AADT),
- Where changes in total truck volume exceed 250 vehicles per day,
- Traffic changes often occur where major County roads intersect State roads. Traffic breaks are usually placed at these intersections even if there is no significant change in traffic volume or vehicle mix, just to prove there is no significant change,
- The location of city limits and speed limits,
- Road geometry (e.g. a change in the number of lanes),
- Major commercial or residential development (such as shopping centers or subdivisions),
- Truck stops and industrial areas may indicate a change in truck traffic.

1.3. Types of Counts, Collection Periods and Duration

Volume Counts

There are two different types of volume counts that can be collected:

1. **Axle volume counts** – are obtained when a single road tube is set across a road. The counter connected to this road tube divides the number of hits on the tube by 2. This type of count data requires an axle adjustment factor (T-factor) to calculate a vehicle count.

2. **Vehicle volume counts** – are obtained from counters using sensors that detect an entire vehicle, not simply its axles. The most commonly used type of these sensors are inductive loops.

All of Florida’s continuous traffic monitoring sites can collect vehicle volume data. The data is collected for each lane, and usually in one-hour intervals, although the intervals can be varied as needed (any period that divides evenly into 60.
minutes). The most common type of sensors used to collect volume data at a continuous traffic monitoring site are inductive loops. In the case of a failed sensor, a continuous traffic monitoring site may be set to collect volume only using a single loop. Figure 2 illustrates an inductive loop used in the volume data collection process.

**Classification Counts**
Classification counts can be collected and grouped in two different ways:

1. Axle classification – Axle classification consists of collecting traffic data with counters that detect axles and measure the distances between axles on each vehicle. The vehicle is then classified per the criteria contained in FHWA Classification Scheme “F” (Figure 3). Classification data are usually collected using a combination of presence (loops) and piezoelectric axle sensors.

2. Length classification – Presently length-based classifications are not used by FDOT to report to FHWA. Due to limitations in collected data, this type of classification is still under research.

![Figure 3: FHWA Scheme "F"](image)

Vehicle classification counts obtained at approximately 64% of the count locations are used to develop axle adjustment factors. Most of the vehicle classification counts assign vehicles to one of the thirteen vehicle type categories established by the Federal Highway
Administration (FHWA). In some cases, length-based classification data may be collected, however the data is not used in the development of axle adjustment factors. Axle adjustment factors are computed for each highway functional classification category in each FDOT region. Limited speed data is also collected during vehicle classification counts.

Florida’s continuous traffic monitoring sites are built to collect vehicle classification, volume and speed data. Florida collects axle classification data according to the FHWA Scheme F standard. A typical sensor configuration used to collect vehicle class data consists of a loop-piezo-loop array. Figure 5 illustrates a typical layout for a classification site.

Traffic Speed Data Counts
All continuous traffic monitoring sites can collect vehicle speed data. Equipment required to collect speed data are two inductive loop sensors. Since 1995, all such sites have been routinely programmed to collect this data in binned files. Florida currently bins the speed data into 15 categories:

- <=20 mph
- 21-25 mph
- 26-30 mph
- 31-35 mph
- 36-40 mph
- 41-45 mph
- 46-50 mph
- 51-55 mph
- 56-60 mph
- 61-65 mph
- 66-70 mph
- 71-75 mph
- 76-80 mph
- 81-85 mph
- >=86 mph

The speed data is collected by lane for each recording interval. Only in rare cases are the speed data collected by class of vehicles, because these types of data files grow extremely large.

Acceptable Time Periods & Duration
Obtaining data that is most useful for historical trend reporting and forecasting requires that the collection period be taken during a time in which traffic would be representative
of the traffic patterns on the typical weekday. There are several guidelines that should be followed to help maximize collecting typical data:

- Counts should occur between Mondays 6:00 a.m. and Friday 2:00 p.m.
- Collecting data prior to, during, or right after, holidays or special events, should be avoided.

The duration of the volume or classification count is dependent on the requirements of the District as well as the project. For the Annual Count Programs throughout the Districts, count locations are identified by the functional classification of the road on which they are located as either Rural or Urban. Because there is more day-to-day variation in the traffic flow in rural areas, a longer count duration is required to minimize this variation. The minimum requirements for Rural and Urban counts are as follows:

- **Rural** – minimum of 48-hours of continuous data in 15-minute intervals
- **Urban** – minimum of 24-hours of continuous data in 15-minute intervals

**Re-count Conditions - Traffic counts deemed inaccurate by the district may have to be re-taken.**

**Traffic Re-count Conditions**

When re-count conditions are noted in the field, the site will be re-counted before being submitted. Once a traffic counter has been set, the following guidelines should be followed to ensure that the collected data is accurate and will help determine if there is a reason to re-count. In general, a re-count condition will occur when:

- One or more machines at a count station mechanically fails to properly complete the count period
- One or more tubes were damaged or came loose
- An incomplete or inaccurate classification or volume count occurs during the count period
- The count was made in the wrong location
- The count was affected by an abnormal occurrence, such as a construction detour, long delay, special event, emergency incident, or adverse weather conditions.

A re-count condition may also be identified when the SPS check detects errors and subsequent tabulation and review of count results verify the need for a re-count. This condition can only be determined after District personnel have analyzed the submitted count information.

**1.4. Piezoelectric Sensors**

Piezoelectric axle sensors generate a uniform signal along their length when stuck by a vehicle. The configuration used in Florida is leading loop, piezo, trailing loop. Figure 6 illustrates a typical layout for a piezoelectric sensor.
Florida installs quartz piezoelectric axle sensors at the majority of its weigh-in-motion locations. These sensors provide weight data comparable to bending plate sensors. However, since the quartz sensors are about the same size as the regular piezoelectric sensors, they can be installed in flexible pavements with little danger to the motoring public. The typical quartz sensor configuration is a leading sensor in the right wheel path, a loop, and a trailing sensor in the left wheel path. Figure 6 is a typical depiction of quartz piezoelectric sensor.

1.5. Inductive Loop/Piezoelectric Axle Sensor Sites
There are several locations throughout the state where permanent loops and piezo sensors have been installed in the pavement. These sensors may be connected to portable counters and used to collect short-term vehicle counts, speed or class surveys, depending upon the sensor configuration.

General Specifications
- A single loop is required to collect traffic volume data.
- Two loops are required to collect speed data.
- Two loops and a piezoelectric sensor in each lane are required to collect classification data.

Site Selection for Inductive Loop/Piezoelectric
When determining locations for inductive loop/piezoelectric axle sensor sites, it is important to select a location that will give the most accurate data possible. Some of the factors that should be considered or reviewed when selecting a site location are as follows:
- Avoid driveways and curves.
- Avoid acceleration/deceleration areas.
- Avoid intersections and close to intersections.
- Avoid high pedestrian traffic areas.
- Prefer locations with free flow traffic, as slow-moving traffic may limit accurate data collection.
- Prefer locations that are easy to access from the road, with off-road parking available.
- Locate the cabinet in an area where the recorder display and the traffic can be viewed simultaneously.
- Locate the cabinet in an area safe from traffic, where both directions of traffic can be seen.
- Locate Traffic Monitoring Site (TMS) cabinet within the Right of Way.
- Install TMS cabinet in compliance with the Americans with Disabilities Act (ADA).
Considerations When Installing Inductive Loop/Piezoelectric Sites
There are certain criteria that should be looked at when determining and recommending the installation of a new inductive loop/piezoelectric site. The following guidelines should be used:

- Is the site really needed?
- Recommend site replacement be added to roadway project plans by the 30% design phase.
- Does the road geometry preclude use of road tubes?
- Are safety concerns addressed in the area to be counted?
- High speed locations are unsafe for road tube use.
- Is there an accident history at the location which could indicate an unsafe location?
- Areas of high traffic with queuing traffic are not recommended collection locations.

Sources for Review
Sources to be reviewed when selecting site locations are:

- Review design plans at 30% design stage, or earlier (Construction, Reconstruction, Resurfacing), so that, if desired, loops and piezo sensors can be installed in the pavement for future use as a short-term count location
- Review video logs for possible traffic monitoring sites
- Perform field inspection

Installation/Inspection Documents
The following list of documents will be used when working with the installation and inspection of inductive loop/piezoelectric axle sensor sites:

- Specification 695 of the Standard Specifications for Road and Bridge Construction
- Standard Index 17900 - Design Standard for Construction and Maintenance Operations on the State Highway System (Please refer to Appendix)
- Plan Notes

1.6. Road Tubes
Traffic counters frequently use rubber road tubes to sense and record the number of axles at a count location. When a vehicle’s axle crosses the road tube, pressure exerted from the tires causes the pulse of air that is created to be recorded and processed by the traffic counter. Road tubes are extended across desired lanes or directions that need to be counted, and depending on the type of count needed, one of several different road tube configurations may be placed in the road. The following figures illustrate typical road tube layouts:
Traffic data technicians are responsible for all road tube tests and inspections. At least once per month, replace each road tube - or blow clear and test for leaks by the application of air pressure. Visually inspect each road tube for adequate condition prior to each use.

**General Specifications**
- Hoses must be perpendicular to the road, with equal amounts of tension on each hose.
- Pavement should be clean and flat.

**Site Selection for Road Tubes**
When determining locations for road tube sites, it is important to select a location that will give the most accurate and useful data possible. When setting road tubes, you should consider the following factors:
- Avoid curves, if possible.
- Don’t locate at driveways, by schools, or when the pavement is wet.
- Avoid setting close to intersections, if possible—counters require vehicles of constant speed above 30 mph to work properly.
- Ensure the counter is secured in a dry location—possibly hang it above the ground.

**Road Tube Installation**
- For accurate vehicle classification data, both road tubes must be of the same type, condition, and within 1 inch in length.
- Road tube spacing is dependent upon average vehicle speed and equipment requirements.
  - 16 feet is recommended for interstates;
  - 10 feet is recommended for 55 mph roads; and
  - 6 feet is recommended for low speed urban roads, ramps, and curves.
- Adjust the de-bounce setting.
Hold the road tube a safe distance from your ear to feel an air pulse—if no pulse, get another hose.

Tape down hoses to minimize hose bounce, use a minimum of 5 pieces of tape per lane.

If nothing suitable is available for securing the counting device, drive a metal delineator post (with visible marking) into the ground, and secure the counter to the post.

For locations that are revisited, consider permanently installing nails (driven close to the road surface) and marking the location for future use.

Safety should always be a factor when driving nails and placing hoses.

1.7. Traffic Counters and Equipment

Acceptable Traffic Counters

Districtwide Count Programs utilize traffic counters that can count by lane, classify, measure speed, store data in files, allow user selected intervals, accept a 10-digit ID code and provide a data output file that is compatible with the FDOT Survey Processing Software (SPS). Traffic counting locations may have periods of congested traffic flow during which the axles of two or more vehicles are within 40 feet of each other. The counter shall have the ability to correctly classify vehicles during these “tailgating” conditions. Each traffic counter placed in the field should have a legible tag showing the name and telephone number of the owner. If the count is being collected by a contractor for FDOT, the name and telephone number of the FDOT contract administrator should also be written on the tag.

General Specifications

Acceptable traffic counters must have the following capabilities:

- Record traffic data (axle count, vehicle count, speed and/or classification) in specified time intervals
- Generate the 10-digit ID code required by the Survey Processing Software
- Provide a data output file that can be read into the SPS

Some acceptable devices include the following examples:
Figure 11: ADR 3019

Figure 12: Phoenix2 II

Figure 13: ADR 2000

Figure 14: EMU 3

Figure 15: iSinc
Certification of Traffic Monitoring Equipment
All traffic counters used by the Department or their consultants for general data collection activities must be certified for accuracy at least once per year. See Traffic Monitoring Equipment Certification Form (Appendix A). These certifications must be turned in to TDA no later than January 31st of each year.

Each counter shall be tested for accuracy with a specialized traffic counter tester. All sensor inputs (air switches, contact closure boards, loop boards and/or piezo boards) will be tested. A minimum test will consist of a 15-minute survey. The counter shall have a minimum of 95% accuracy of each criteria of data collected.

Traffic Site Vehicle Equipment
All District and consultant vehicles shall be equipped with the following equipment:

- Currently approved safety vests (worn by everyone during all field operations)
- Four-way flashing lights and a minimum of two yellow strobes mounted on a light bar
- Appropriate tools and supplies (e.g., traffic counter, spray paint, asphalt tape, nails, hammer, etc.)
- Appropriate manuals for counters
- Two-way radio or cellular phone
- Fire extinguisher
- First aid kit
- Orange cones
- Security chains and locks

Equipment for Inspection of a Permanent Site
The following equipment are recommended when inspecting a permanent site: Multi-meter, laptop computer, earth ground tester, loop wire insulation tester, tool kit with all applicable tools (pliers, screwdrivers, etc.), oscilloscope, gloves, shovel, broom, lubricant, insect repellant, wasp spray, insecticide, axe and pruners or shears.

![Figure 16: (Left to Right) Oscilloscope; Multi-Meter; Laptop Computer; LCR Meter](image)
1.8. Safety Procedures for Traffic Count Personnel

All traffic count personnel must be provided a minimum of two-weeks training by accompanying an experienced field technician who is collecting traffic data. All personnel must be trained in first aid techniques and must be familiar with the following safety procedures before they are allowed in the field. All vehicles used for traffic data collection will be equipped with the minimum equipment specified above.

All traffic count personnel shall adhere to the following procedures:

- Seat belts shall be worn during operation of vehicles.
- Safety vests and Underwriters Laboratories (UL) approved safety glasses or safety prescription glasses shall be worn during field operations.
- Vehicle lights shall be used in the following manner:
  - Turn signals and yellow roof mounted strobe lights shall be activated when approaching the work site, generally five hundred to one thousand feet (500’ – 1000’) before the site.
  - Four-way flashers shall be activated at the work site and the flashers and strobe lights shall remain activated until the proper turn signal is activated to leave the work site.
  - Strobe lights shall be turned off after the vehicle safely re-enters traffic flow.
- Traffic count personnel shall conform to OSHA RULES & REGULATIONS as well as the MOT
- Vehicles shall be parked where there is adequate space to park the vehicle safely without blocking sidewalks and driveways and parked a minimum of four (4) feet from the edge of pavement.
- Traffic count personnel shall exercise extreme caution when entering the road to set or retrieve traffic sensors.
- Under no circumstances shall sensors be placed in the road when it is raining or foggy.
- Traffic count personnel have the right to request their supervisor assign additional help to assist them if they deem there is a need for a two-person crew to set equipment safely.
- Only authorized vehicles are permitted to cross the Interstate/Turnpike/Limited Access Controlled Facility medians. All other vehicles are subject to moving violations.
- Reflective vests must always be worn when working at night.
- Night work should be done only when traffic flow dictates it to be necessary, and then only with two or more technicians. One person should spot while the other is working near the pavement. At least one set of eyes should always be on traffic when someone is working in the traveled way.
2 PROCESS

2.1. Data Acquisition

FDOT’s traffic monitoring program is a year-round activity for the TDA Central and District Offices that does not stop for holidays, hurricanes, or any other situation. The TDA Central Office operations involve daily acquisition of traffic count data from the continuous traffic monitoring sites (Continuous) and from the weigh-in-motion (WIM) sites. This data is examined and analyzed for accuracy and completeness so that problem sites can be quickly identified and corrected. This is accomplished through teams in the office and field that communicate daily. At the end of the physical year, year-end calculations are performed that result in data, factors and used throughout the traffic monitoring system.

In the District offices, the operation involves the accumulation of data (called short-term count data) from short-term traffic monitoring sites (Short-term), analyzing the data for accuracy and completeness, and passing that data to the TDA Central Office. Should the District discover problems with the data then the problem site is re-counted.

To maximize the efficiency and accuracy of traffic data, the Districts and Central Office must conduct a comprehensive analysis process that involves more than just obtaining and processing raw counts. After gathering the data, it is further processed to insure its integrity and validity and stored in a database. They must analyze the counts for acceptability, evaluate and monitor conditions that affect traffic data, and maintain a Traffic Monitoring Program that will obtain an accurate picture of evolving traffic characteristics.

2.2. Survey Processing Software (Sps)

All short-term traffic surveys performed for the annual program should be processed and uploaded to the FDOT mainframe using the Survey Processing Software. SPS was developed to provide a software package that could transfer raw data from a variety of traffic counters to a personal computer (PC), perform the required quality control minimum and maximum volume check on the raw data, and then upload summarized classification and volume data statistics from the accepted data from the District PC to the FDOT mainframe. SPS is a custom application written within Microsoft Access. See the Survey Processing Software User Manual [1] for operating instructions.

The four main functions of SPS are:

- **Convert Raw Data** - This function was designed to download the files contained in the traffic counters to the District or Consultant’s computer. It was written so that FDOT does not need to purchase multiple copies of each counter manufacturer’s proprietary software and spend the time learning how to use each. With SPS, the same steps are performed by the technician to download the counter data, regardless of brand—the software handles all the special vendor commands.
Load SPS Database - Once the traffic data files are extracted from the counters, they are loaded into the SPS Microsoft Access database before they can be further analyzed. This routine can read the files created by the previous step and can also read the proprietary file formats created by several of the vendor software packages. All files transferred to the Districts by the Consultants must be in *.txt or *.prn file format. These files can be transferred by physical media, Email attachments, or through the FTP site. SPS loads the data into its database by organizing it into 24-hour blocks starting with the first data interval. It also organizes the data by station and by date. If less than 24-hours of data is available, further processing cannot be undertaken.

Edit SPS Database - The edits performed by SPS alert the Districts to possible problems with the quality and accuracy of the counts by comparing each traffic survey to information stored in two tables---the Station Inventory and the Variance Factors tables. If there are discrepancies, SPS creates interactive error messages for analysis by District personnel. The operator can verify the accuracy of the count, make corrections to input data files, or update the Station Inventory, and then choose to accept or reject the data.

Toward the end of this step, SPS asks the user if it should create Record Summary and Synopsis reports. The Record Summary Report is primarily useful in examining classification data by hour of the day and by lane. The Synopsis Report displays a single day of volume information on one page, shows the calculated morning and afternoon peak hour data, and, for classification surveys, shows the Truck Percentage (T%). Even though the actual count may start at any time of day, SPS reorganizes the data into a uniform format running from midnight to midnight. This format makes it easy for the user to see how traffic flows through the day. A final set of mental quality control edits should be performed on the data before it is transferred to the mainframe. These edits are not performed by SPS, but by the user, such as, are the types of vehicles and the volumes reasonable for the location where the count was collected?

Upload Data to Mainframe - The final step in processing the traffic data through the Survey Processing Software is creating the summary records that are transferred to the mainframe. SPS creates for each station and date a single annual summary record, and a daily summary record for each direction of traffic data. Additionally, SPS adds the seasonal factor category from the Station Inventory to the volume summary record. If the volume data is from an axle counter (road tube), SPS also adds the axle factor category.

The summary records created by SPS to upload to the database are:

1. **ANS** -- The annual summary record, which contains the county, site, year, date, peak hour time, peak hour volume, peak hour truck volume, peak/daily ratio, and peak hour factor.
2. **CNT** -- The daily volume record, which contains the county, site, year, direction, date, survey type, survey program, total volume, seasonal factor category, and axle factor category.

3. **CLS** -- The daily vehicle classification record, which contains the site, year, direction, date, survey type, survey program, class 01 through class 15 volumes, total volume, and truck volume.

The summary records described above are written by SPS into a file named NCTRAFF.FDF that is transferred to the mainframe. A message will appear in the Status bar to tell a user when the transfer is complete. Upon successful transfer, SPS automatically launches a batch job that loads the summary data into the mainframe TCI database. The load program will then notify the user via email about the status of the upload. The email lists those records successfully loaded and creates an error file for unsuccessfully loaded records. If an error file was created during the TCI upload, the user can log into TCI, click on the District Tab, make corrections to the ANS, CNT or CLS records, and re-submit the load job. Or the user may elect to make corrections to the appropriate data files on the PC and rerun that station’s data through the entire SPS process or request a re-count.

**SPS Manual Data Entry**

Traffic counts can be manually entered into SPS by selecting the Count tab under the SPS Current Database. A new window will open. It will display detail “Records” in the top portion of the screen and “Summary” records below. First clear any summary records, then add new data by selecting the “Add a Count Summary Report” icon (third icon to the right of “Summary”—the icon looks like a sheet of paper). Type-in the 2-digit county number and the 4-digit site number, making sure to include leading zeroes. Type-in the date in a MM/DD/YYYY format. Enter the alpha direction code—N, S, E, W or B. If the manually added count record is an estimate (most manually entered counts are), enter a Survey Type code of “0”, and a Survey Program code of “1”. Enter the AADT value, taking care to round estimates to the nearest 50 (if AADT < 1000), nearest 100 (if AADT >=1000 and nearest AADT <10,000), or nearest 1000 (AADT >=10,000) vehicles, depending upon the volume range. Enter an Edit Flag code of “0”. When complete, upload the manual counts to the mainframe via the process described above.

**SPS Edits Performed**

SPS performs the following verifications, edits, and/or checks on the traffic data being processed:

- County-Station number is valid,
- Data type (axle, vehicle, classification) against the Survey Type code in the SPS short-term Inventory,
- Type of data being analyzed is compatible with the Sensor Type code in the SPS short-term Inventory,
- short-term inventory codes agree that the data being processed is from a portable counter,
i.e. the Survey Program code of the data must be 1 - 4

- Compares direction codes in the data to ascending/descending directions in the SPS inventory,
- Data from all lanes is present in the input files,
- Station Inventory to ensure the data is either directional or non-directional,
- Minimum of 24-hours of data for each count,
- Any directional volumes equal to “0” between 5:00am and midnight,
- No 4 consecutive hours have the same total,
- Volume in one direction is not greater than 80% of the total volume,
- Compares daily volumes of the count being edited to the minimum and maximum “variance factor” values for the station, month, and year, considering whether the data is an axle or vehicle count,
- Hourly volumes do not exceed 2000 vehicles for 2-lane roads, or 2500 vehicles per lane on all others,
- Classification Types 1, 4, and 15 are not above specified percentage as identified by the user.

Problems
If codes in the raw data file don’t match codes in the Inventory, SPS can’t load the count and can’t process it. The codes for the following items must match:

- County/Site Number
- Number of Lanes - Ascending/Descending
- Ascending/Descending Directions
- Count by Direction
- Count by Lane
- Sensor Type
- Survey Program
- Survey Type

Survey Type must agree with Sensor Type. Our Inventory currently utilizes the following codes for Sensor Type and corresponding Survey Type for short-term counts:

- Type 1 (Axle Counts) must be coded with Sensor Type 7 (Road Tubes)
- Type 2 (Vehicle Counts) must be coded with Sensor Types 1 - 6 (Loops and/or Piezos)
- Type 3 (Classification Counts) must be coded with Sensor Type 7 (2-Road Tubes) or Sensor Types 4 - 6 (Loops and Piezos)

Errors occur when the field technician doesn’t program the counters with the proper codes for Survey Program, Sensor Type, and Survey Type.

- Counts obtained by a consultant must be coded for Survey Program 2
- Sensor Type will be either 7 (road tubes) or Type 4 - 6 (Loops and Piezos)
- Survey Type will be either code 2 (Vehicle), code 3 (Classification) or code 1 (Axle)
**Problem Resolution**

Often, the problem can be fixed by correcting the codes in the Inventory or raw data file.

- To identify the problem, open the .PRN or .TXT file and compare it to the Inventory.
- If you can’t fix it, check your records before making a re-count---the problem might be an incomplete or corrupted data file (for instance, maybe all the lanes were counted but are not being processed).

If the site was classified last year, the Inventory will be coded Survey Type 3 and Count-by-Lane yes; the count won’t load if data is missing for any lanes. This happens when:

- This year’s data is volume, not counted by lane
- The number of lanes being processed doesn’t match the number of lanes listed in the Inventory.
- Data is missing for any lane.

If the direction codes don’t match, the count won’t load - This most often happens when the ascending/descending direction isn’t obvious to the technician in the field---for instance, a road might be Ascending N (1) and Descending S (5) according to the Inventory, but the segment of road where the count is taken might run NE and SW and the technician codes the count with E (3) and W (7).

**HINT:** You can often save yourself research time by the way you describe the site location in the Inventory: in this case, if you have described the site as NE or SW of the intersection---you know that E is N and W is S, and you can correctly edit the data file. Remember to update the TCI codes to match the data you send to the mainframe or the SPS upload to mainframe will fail---with the one exception: the software will allow you to utilize more than one Survey Program for each site.

### 2.3. Analyzing The Data

**Acceptability of Short-Term Data**

Even though acceptance of one or more days of data is accepted during preliminary edits, continue analyses to determine if all facets of the data appear reasonable. To analyze the count for acceptability, apply Seasonal Factors (SF) and Axle Correction Factors (ACF) from the previous year and compare it to historical data. Guidelines used to determine if counts are of acceptable quality will vary from site to site. There are no “hard, fast” rules because there are many variables that cause traffic characteristics to fluctuate.

Each District will determine what constitutes a significant difference for each facet of each short-term count. For example:

- Define a specific range that you consider reasonable; for instance, from 20% under 5,000 AADT to 5% over 50,000 AADT,
- Select a single percentage such as 10% for volume and 5% for classification categories,
Use a combination of methods. Start with a single percentage (such as 10%) for all preliminary screening. For counts that fall through the preliminary screen, continue analysis by using other guidelines that include regional growth trends and conditions.

For a quick volume screen without applying Seasonal Factors: if the County’s seasonal fluctuation varies at least 20% between peak and off-peak, and screening percentage is 10%, there is no need to apply SF unless the ADT varies from historical AADT by more than 20%.

If the data fails any acceptability tests; investigate why it failed and conduct further analyses until arriving at a logical decision to: accept, re-count, or estimate.

During the annual data processing activities described in Chapter 4 of the Annual Data Processing Report, re-evaluation of accepted counts using current year Seasonal and Axle Factors is possible.

Analyzing Raw Counts
It is important to remember when analyzing the counts, that the purpose of the annual traffic count program is to monitor traffic growth. Try to avoid significant traffic fluctuations that are due to temporary events such as road construction or severe weather. The data must be examined by direction, hour, and count interval (usually 15-minutes); from one day to the next and year-to-year.

Conduct a preliminary analysis by utilizing reports produced by SPS, the short-term Inventory Database, previous year AADT Report, Traffic Count Location Maps, Straight Line Diagrams, local street maps, and other counts obtained on adjacent road segments.

Using the reports produced by SPS, look at the count itself. Usually the directional split will be close to equal, and the count will be similar for both days. Also look for incorrect directional relationships—morning rush hour is usually toward town; evening rush is opposite.

Consider changes that have taken place in the field, such as lanes added, changes in one-way pairs, road transfers, new intersections, etc. Compare the count to last year’s AADT. Total volume and truck volume should be within reasonable increase or decrease of previous year’s counts, considering the season the count is taken and historic growth trends, providing there have been no significant changes in the field.

If AADT appears to be significantly higher or lower than expected, find out if there have been temporary changes in the field that might have influenced the traffic. If changes are temporary (such as construction), don’t use the count. If you can find no obvious reason for the change, apply the previous year’s Seasonal and Axle Factors and conduct a more detailed evaluation:

- Be aware that changes in one County can affect traffic patterns in another County,
- Consider the possibility that our winter visitors moved to Florida early this year because it snowed earlier than usual or they extended their stay in Florida to avoid a late snow up North,
Gas prices and the economy will influence travel.

Don’t automatically reject a count just because the total volume or truck volume shows significant change. If there have been numerous changes in your District, counts might not follow historical trends.

Locate the site on a map and visualize how traffic would flow. Imagine yourself in various driving situations---what route would you take? It might be obvious why the directional split is extreme, or why truck % or volume significantly differs from one segment to the next.

Analyze each category of your classification counts according to your District’s needs. In general, Federal Roads and Interstates require scrutiny to produce accurate classification and volume, State Roads require accurate truck percentage (T%) and volume. Federal Aid (off-system) roads need accurate volume.

- Except for classes 6 and 7 (due to dump trucks with lift axles), categories can be expected to be very similar by direction.
- On the Interstate, most trucks are usually Class 9 vehicles--as much as 80 to 90% of traffic loadings.
- There will be no numbers in category 14, this is reserved for special classifications that can be used.
- Class 11, 12 or 13 vehicles shouldn’t be on roads where their use is not permitted or expected.
  
  e.g.: expect a lot of class 13 trucks on the Interstate, but not on a 2-lane country road

- SPS creates error messages for counts with more than 3% in category 1, 5% in category 5, or 10% in category 15, by default. Districts can adjust these defaults as necessary.
- Vehicles that could not be clearly classified are put into Category 15 (Unknown). A high number in category 15 is a good indication that the traffic was not properly classified---it is also a good indication that the PIEZO might be going bad.
- Historical analysis will help you verify questionable volumes in the classification categories.

Review the *.SYN Report to verify the following information.

- AM/PM time: Occasionally a counter reverses AM and PM, resulting in a count that shows all the vehicles traveling during the night.
- Peak hours usually occur due to people traveling to work in the morning and home in the afternoon.
- The SPS, Peak Hour Report is set by Planning requirements and assumes Peak Hour is from 5:00 - 6:00 PM at all sites. This is not useful for analyzing accuracy of counts.
- 15-minute intervals: There should be no 0’s during peak hours.
There should be no exceptionally high or low counts during any intervals.

*.SYN files are the only reports that show T24 truck percentages, which can be verified with nearby classification counts, other counts obtained at this site during the current year, and previous T%.

Compare it to counts that were made in adjacent road segments, and on intersecting roads.

If a count’s validity is questioned; conduct additional in-depth analyses using Historical Traffic Data, Video log, and field review to consider long-term changes that are taking place in the field. Consult with people in other FDOT departments or local governments (MPO, County or City) who are knowledgeable about local conditions. Straight Line Diagram (SLD), field review, I-View and Video log, can be helpful in identifying conditions that have influenced a long-term change in traffic characteristics, such as:

- Lanes added (this can be done by restriping as well as widening).
- Changes in one-way pairs.
- Road transfers.
- New intersections/interchanges (especially on limited access roads).
- New roads.
- New housing developments.
- Changes in land use.
- Unusual configuration of one-way pairs may influence directional splits on other segments.
- Truck routes divert truck traffic.
- Traffic generators such as truck stops influence truck traffic.
- When City Limits are moved, speed limits will change.
- Orange groves can die causing sudden changes in traffic flow.
- Over a period of years, mining operations open new entrances or move to new areas when the old mines are played out.
- Truck patterns and type are heavily affected by local economic activity.
- A high percentage of through trucks tends to result in higher weekend and nighttime truck traffic than a road with a low volume of through trucks. This can cause significant differences in T% at continuous (which count all week) and T% at nearby short-term sites (which count only weekdays).
- Traffic flow exhibits more seasonal variation in recreational areas.
- Traffic flow exhibits higher daily fluctuations in rural areas.
- Re-counts or additional counts later in the year may help with difficult decisions.
- After you are reasonably confident that a count is of acceptable quality, upload it to the mainframe. (Please refer Chapter 4 for more details)

Some or all counts and re-counts along a road might show significant change for no apparent reason. After completing your analyses, what are your options for counts that remain questionable?
If you believe a change is temporary, and the count would significantly skew the history for the site; you can elect to reject the count and have Central Office provide an estimated AADT for the site.

If you believe the change is part of a new trend, or if you are still not confident in a count, you can elect to upload the data to the mainframe and re-evaluate it during the AADT Development and Finalization Process.

Follow-up during next year’s count cycle to confirm decisions and resolve any unanswered questions.

**Examples and Tips From The Districts**

Sites 2000 and 2002 are coded as Classification counts, and databases were submitted in the classification format. Volumes look reasonable, but these look like bad counts since there are 0’s in all categories except Category 2. What caused this to happen? Was the counter programmed wrong, was data lost? If classification is required, request a re-count. Probably the counter was merely incorrectly coded for classification, but a volume count was collected—in which case, you can re-code the data file and accept it as a volume count.

SPS won’t load data for Site 1007. The error message reads "missing lane number 2 direction (E)." The classification data file submitted for this tube count has only 1 lane "E" and 1 lane "W" for this 4-lane location. Did the technician find a nearby 2-lane segment where the count was obtained? If so, you need to know where the count was made and why the site was moved. The site can be moved to the new milepoint for a more accurate classification, you can use the same site number, if there is nothing between the old location and the new one that will cause a significant change in traffic characteristics (such as a truck stop or major intersection); otherwise, assign a new site number. If an axle count was submitted instead of a classification count, change SPS’ short-term Inventory “SURVEYTYP” code to “1”, and change “CntByLane” code to “F”. If the site can no longer be classified with tubes, maybe this site is a candidate for permanent sensor installation.

Site 5130, with an ADT of 5,900 each direction is a little low, but not low enough to reject the count. In the classification categories, however, there are several discrepancies: in category 3, SB is more than twice as high as NB; Category 6 NB is 10 times higher than SB; Categories 5, 8, 9, and 10 have similar differences. This site is located on a 2-lane road several miles from the Interstate, so we don’t expect to see 410 vehicles in category 13. Nearby sites don’t have this many Class 13 trucks—where did they all come from, and where did they go? Looking only at Category 13, the 410 vehicles (378 of them are NB) with 7 or more axles is potentially 1,435 class 2 vehicles—no wonder the ADT is low! You don’t have to look any further to reject this data and request a re-count. Maybe this site can no longer be classified. Is your PIEZO going bad?

Sites 0108 and 0111 cause the error message "missing lane number 2- direction (E)." These volume counts are coded as classification. Change the SPS short-term Inventory
"CntByDir" code to "F" and the "SURVEYTYP" code to "1" and these records should pass the edits.

Site 0079 NB on 3/5, the ADT was significantly (approximately 45%) lower than NB---historically, D is similar; so you should reject that day. On 3/6, NB and SB are similar and look reasonable according to last year’s count. In the classification data, however; there are 1002 class 6 trucks NB and 40 class 6 trucks SB. The Synopsis Report shows 1020 vehicles in one 15-minute interval. Since there was only a total of 2,641 vehicles for the day, request a re-count.

2.4. Maintaining Efficiency and Accuracy

Over time, traffic data must effectively document evolving traffic patterns, and identify local variations in traffic characteristics. The Districts will develop recommendations and modify their Traffic Data Collection Program to maintain maximum efficiency and accuracy. It might be desirable to:

- Count more frequently, for longer periods, at locations where traffic characteristics are rapidly changing,
- Begin counting at additional sites as growth indicates,
- As adjacent segments become more homogenous, reduce counting sites,
- Consider locations for permanent sensor installation,
- Unusual seasonal fluctuations might require increasing counting frequency or modifying the schedule,
- Unique vehicle mix, or seasonal variations in truck percentage, might require more than one classification count per year.

During analysis, you might realize the need to conduct counts at “test” sites to obtain supplemental data for current or future analyses.

- Test counts will provide data for analysis of evolving field conditions,
- Test counts can be used to follow-up on questions that weren’t resolved to your satisfaction while analyzing current-year counts,
- If you wish, tests can be conducted every 2 or 3 years over a period of several years---the data can be stored in the mainframe database and a history can be built without assigning the test site to a section break.
3 FINALIZATION

3.1. Annual Data Processing

Between January 1 and March 15 each year, the Districts and the TDA office work together to evaluate and finalize traffic data that was captured during the previous calendar year. This year-end process includes factor development and assignments, and application of appropriate factors to traffic counts. AADT, K, D, and T are estimated for every traffic break of the State Highway System, all off-system roads that are functionally classified minor collector and above, and local roads that are NHS or SIS.

During this period, TDA produces several reports to help the Districts analyze short-term data and update databases. TDA coordinates this process within strict deadlines. Please refer to the Quality Control (QC) Plans in Appendices E and F, flow charts and QC plan deadlines.

Monthly ADT

Monthly ADTs are computed in the following manner:

- Each direction of travel at each site is processed separately,
- Only daily records with flags of N (normal), A (atypical), H (holiday) and S (special event) are used. Any records flagged B (bad) are not used in any calculation,
- For each month, all the Mondays, Tuesdays, etc. are averaged,
- The monthly ADT is computed by averaging the seven day-of-week averages. Note, if a Saturday or Sunday average is unavailable for a month, then that monthly ADT is not calculated. However, if both the Saturday and Sunday, and at least one weekday averages are available for a month, the monthly ADT will be computed based on the averages of available days.

AADT Computations

Annual average daily traffic counts are computed in the following manner:

- Monthly averages for each day-of-week are averaged to generate annual day-of-week averages,
- Seven-annual average day-of-week values are averaged for an annual average daily traffic,
- Directional annual average daily traffic volumes are summed to generate the annual average daily traffic for a station.

Seasonal Adjustment Factors

Seasonal (volume) adjustment factors are calculated in the following manner:

- Each direction of travel at each site is processed separately,
- Monthly ADTs are estimated for those months where data is lacking. Monthly ADTs will not be estimated for those stations missing more than 2 consecutive months of data,
- Monthly factors are computed by dividing the AADT by the MADT,
For each station, directional monthly factors are averaged together. For those stations that have only one good direction of data, the monthly factors are used for the station.

**Factor Categories**
Each year, changes in the number and type of counts result in the need to update the Assignment of Stations to Categories, and the Assignment of Categories to Counts. During the AADT DEVELOPMENT PROCESS, the Districts work closely with the Central Office to make certain the correct assignments are made, and the Inventory Database is updated. Seasonal and Axle Factors are applied to short-term counts to estimate AADT.

**Assigning Stations to Categories**
District staff assign up to eight stations to each factor category, so that reasonable factors can be calculated even if any stations are not counted that year, or if it is counted but has atypical or insufficient data. Assignments to categories can be made anytime throughout the count year cycle by using the Seasonal or Axle Factor Category Assignment screens available under the Factor Category (FCAT) tab on the TCI application.

**Seasonal Factor Categories**
It is recommended that more than one count station be assigned to each factor category so that a fair representation of the traffic’s seasonal flow and volume can be estimated. Seasonal categories have been designed to be county specific with at least one “Countywide” Seasonal Factor Category for each County and one Seasonal Factor Category for each Interstate Road within each County. Additional Seasonal Factor Categories can be developed to handle geographic differences within a single county (for example, beach traffic has different characteristics than urban traffic).

**Axle Factor Categories**
Axle Factor Categories are handled similarly to Seasonal Factor Categories, except both continuous and short-term classification stations can be assigned to Axle Factor Categories. Axle Factor Categories are more roadway-specific than Seasonal Factor Categories---an Axle Factor Category must be developed for each Roadway Section. This results in considerably more Axle Factor Categories than Seasonal Factor Categories.

Axle factors are derived from classification counts by dividing the total volume of vehicles by half the number of axles present on those same vehicles. This results in a factor that is always less than 1.00 (although it may round to 1.00 if there are few trucks in the traffic stream).

**Computing Seasonal And Axle Factors**
Data from all stations assigned to a factor category are averaged to generate Monthly Average Factors.

- The Monthly Average Factors are assigned to the week of the year that contains the midpoint of the month.
Weeks without factors are estimated by extrapolating from the mid-week of one month to the mid-week of the next month.

Assigning Categories to Counts
Seasonal and Axle Factors are assigned to each count by SPS when counts are processed—according to information contained in the Station Inventory Database. These assignments must be reviewed and updated during the AADT Development Process---with special care given to stations with more than one type of count.

Update Factor Categories
- Seasonal and Axle Factor Categories and assignments can be updated at any time throughout the year,
- At least one continuous count station (Continuous) must be assigned to each Seasonal Factor Category,
- At least one seasonal or continuous class station must be assigned to each Axle Factor Category,
- A Seasonal Factor Category must be assigned to each short-term monitoring site,
- An Axle Factor Category must be assigned to each short-term monitoring site,
- Assign classification stations to any Axle Factor Category for which no axle factors can be calculated because of lack of data.

Estimating AADT
Any active stations not counted during the year will have their AADT estimated by applying a Growth Factor (as obtained from the continuous count data) to the previous year's AADT. Estimated AADT values will be computed for a maximum of two years in a row. Each station is to be counted a minimum of once every three years. When a site can't be counted for a third year, the site will be deactivated in the Station Inventory and a station from a break with similar traffic characteristics will be assigned to the break. If they wish, the Districts can estimate an AADT for the third year manually.

Final Review
After updated factors are applied and reports are generated a final review is done. The following should be considered:
- Review the factored counts to make sure the correct Seasonal and Axle Factor Categories are applied to each count depending upon the type of count, the sensor type, and the survey program.
- If multiple counts are taken throughout the year at the same count station, it is possible that different Seasonal and Axle Factor Categories have been assigned to each count, depending on whether changes have been made to the Seasonal or Axle Factor Category assigned to a count station in TCI. If this occurs, manually change the incorrect factor category assigned to the count by using the TCI Count Data update screen. All counts at the same station should use the same Seasonal Factor Category for the count year. If there are multiple axle counts loaded for a
single station during the year, the same Axle Factor Category should be assigned to each.

- Make sure all factors are applied as desired adjust sites which the resulting AADT’s are not reasonable.
- Make sure all desired count sites are activated in TCI and deactivate sites that won’t be used.
- Make sure all counts are correctly included in the current year database. Districts can manually add, delete, or change count summaries from the Count Data screen in TCI.
- Compare the directional split to historic counts and to adjacent counts to make sure they are reasonable.
- Verify that any AADT that is 20% lower or higher than the previous year AADT is in fact a legitimate value, and not an error.
- All counts must either be directional or bi-directional at each site.
- Review truck volumes and T% to make sure they are reasonable. If truck volumes weren’t collected at a site, or aren’t reasonable, the Districts can assign T% from another site (called a “cross-reference”).
- K, D, and T Factor assignments not made at the District level will default to a Statewide Functional Classification Category.

### 3.2. Annual Statistics

An AADT, Standard K, D and T factors must be assigned to each count station. T factors can be calculated for all vehicle classification stations. K and D factors can only be calculated for continuous count stations with sufficient quantities of good data. For all other stations, the K, D and T values are estimated, based on the following methodology:

<table>
<thead>
<tr>
<th>Choice by</th>
<th>Continuous Monitoring Sites</th>
<th>Short-Term Monitoring Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority</td>
<td>K and D</td>
<td>T</td>
</tr>
<tr>
<td>1st</td>
<td>Seasonal Factor Category</td>
<td>Cross Reference</td>
</tr>
<tr>
<td></td>
<td>Axle Factor Category</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>Functional Classification Category</td>
<td>Axle Factor Category</td>
</tr>
<tr>
<td>3rd</td>
<td>Statewide Functional Classification Category</td>
<td>Districtwide Functional Classification Category</td>
</tr>
<tr>
<td>4th</td>
<td>Statewide Functional Classification</td>
<td>-</td>
</tr>
</tbody>
</table>

### Traffic Breaks

To assign an AADT, Standard K, D and T Factors to all roads in the RCI database, the Traffic Breaks file is used. This file is used to assign data collected at a point of the road to a length of road. Traffic Break statistics development is accomplished after the AADT,
K, D, and T values are finalized for each station. This involves review of the Traffic Breaks File on the Mainframe and the Traffic Breaks with no AADT Report for proper break points and station assignments. These Traffic Breaks can be entered or modified in the Traffic Breaks Characteristic (RCI database, Feature 330) at any time during the count year. One, and only one, count station must be assigned to each Traffic Break.

The TDA Office will compare the updated Traffic Breaks to the RCI database and provide a list to the Districts of any traffic break segments that must be modified to exactly match the current RCI database. Once the files agree, TDA will submit the job to delete all the traffic data in RCI Feature 331 and replace it with the new traffic data.

**Rollover**

The final step in the AADT development process is carried out by TDA. This consists of adding the finalized traffic data to the mainframe TCI databases, closing the old count year, opening the new count year, and copying the Axle and Seasonal Factor Categories (and station assignments) and the Traffic Breaks files into the new count year tables. After the Traffic Breaks traffic data is finalized, usually by April 1, TDA “closes” the databases so no more changes can be made. The Districts can then begin uploading SPS count summaries for the new count year.

### 3.3. Data Distribution

After TDA completes Rollover, no further changes can be made to the data for the year just closed, and this “official” data is made available for distribution and use until the next annual update. The Florida Department of Transportation Annual Average Daily Traffic Reports (a separate AADT Report for each County in the State of Florida) and other reports containing Annual Vehicle Classification, Peak Season Factor Category, Volume Factor Category Summary and Weekly Axle Factor Category reports are accessible online through the internet from TDA on the FDOT Florida Traffic Online web page at: [https://tdaappsprod.dot.state.fl.us/fto/](https://tdaappsprod.dot.state.fl.us/fto/)

These reports contain AADT, K, D, T and other information for every Section Break on the State Highway System. Traffic Count Station Location Maps for each county are also on the web page.

Data can also be accessed directly from RCI and TCI by users that have access to the FDOT host computer and possess a valid USERID and password.
4 COUNT SITE FIELD INSPECTION AND INVENTORY

4.1. Introduction

This chapter details the procedures and equipment used in the field when inspecting new and existing traffic monitoring sites. Throughout this handbook we have referenced the various types of traffic monitoring sites that make up the over 15,000 locations statewide where traffic data is collected on a 3-year cycle. Two categories of traffic monitoring sites have permanent equipment physically located in the road: Continuous Traffic Monitoring Sites (Continuous) and some Short-term Traffic Monitoring Sites (Short-term). They are the backbone of the traffic count program administered by the Florida Department of Transportation Central (TDA) and District offices.

Specifically, over 300 continuous sites are polled via wireless modem daily by the TDA computers. They record and transmit every day of the year and provide the data used for adjusting short-term traffic counts to Annual Average Daily Traffic (AADT). The second, short-term sites, are usually installed in high volume urban arterials where rubber hose counts or other equipment are difficult to install and maintain. The permanent parts of the installation are the in-pavement sensors (loops and/or piezos) and the traffic cabinet. Greater reliability and accuracy are the reason loops are preferred to hose counts. A traffic counter is normally placed in the cabinet and attached to the wire harness for a short period (2-7 days) either annually or quarterly then moved from one site to another, hence the term portable traffic monitoring. Some locations are in rural or urban fringe areas that are located for coverage counts on roads that have the potential for significant increases in traffic as development and new traffic patterns evolve. Others are located for safety reasons as the difficulty in setting road tubes is dangerous due either to high travel speeds and/or road volumes and visibility issues.

4.2. Installation and Maintenance Responsibility

Creation of a continuous site is determined by the District and/or the TDA at Central Office. The acceptance of the installation by the Department is determined after field inspection and inventory by a qualified technician completing the procedures outlined in this chapter. The next sections of this chapter detail the field inspection and inventory requirements of continuous and short-term sites.

Counts can be taken by other methods while a site is under repair, using non-intrusive technologies such as: Microwave radar.

4.3 Field Inspections of Traffic Monitoring Sites

This process begins with a request or work order from the Central or District Office for a field inspection and inventory of equipment at a new or existing site. Once the work order is initiated, a trained service technician makes a visit to the site to ensure the correct equipment is installed and working as specified by the design request of the District or
Central Office. The following steps outline the recommended process that should be used by all technicians when inspecting and inventorying a continuous or short-term site. The significant difference between continuous and short-term sites is the wireless modem connection required for transmitting the data daily and the solar panel that supplies power to the battery. Short-term sites may have the same cabinet, counter harness, loop diagrams and internal panels as a continuous site, but do not have the need for continuous power or communications.

Current data forms are required by FDOT to be completed by the field technician at each installation, to update the count site database. This handbook will step through the process of completing each of these reports, providing photo examples of the steps, and equipment used and installed at the sites.

**At The Site**

Upon arriving at the field site, the technician should follow the standard steps described earlier in this handbook for exiting the road safely by activating turn signals and flashers in advance of the site and pulling completely off the road and, whenever possible, providing the maximum amount of separation from the travel lanes and clear zones of the road, or a minimum of 4 feet. The technician should have a current safety vest on prior to or immediately after exiting the vehicle. It is important to always proceed slowly and cautiously when working at any location adjacent to the road. This is especially true when working alone, as is often the case with most field inspections at continuous or short-term sites. The technician should always face oncoming traffic whenever making field measurements and checking in-road devices or those adjacent to the travel lanes. **BE ALERT!!!**

The steps provided here require operating knowledge of oscilloscopes, multi-meters, and basic wiring. Voltages are low and therefore electrical shock is not a concern. However, damage to components from improper use or incorrect connection of testing equipment should be considered at all times. Examples of some of the equipment used in testing the equipment are provided in Section 4 of this handbook, as they are common to the technician and his tasks. Photos or videos of most of the equipment types and procedures used are provided to assist in identifying components and safe practices. All models or manufacturers may not be represented in the samples provided due to newer and more efficient replacements becoming available.

**Sensor Configuration**

**Check Condition** - Visually inspect loops and piezos for rutting, cracking, and breaks. If cracks allow water to surround the leads, it may interfere with the operation of the sensors. When checking the depth of cracks or missing sealant, don't use a sharp object like a screwdriver or pocketknife to probe as it may result in sensor damage.

**Check Layout** - Loops should be centered in the lane and perpendicular to lane stripes. The piezo sensor should be located between the loops and positioned to cover only a
single wheel path. In WIM sites, the layout will be Piezo-Loop- Piezo with the loop between 2 piezos.

The following Figures illustrate various loop layouts:
Measure Spacing - With a wheel or tape measure, check loops to ensure that spacing is 16 feet from leading edge to leading edge. Each loop should measure 6 x 6 feet. The piezo should be centered between the two loops.

Check Sealant & Grout - Check that the loop slot is filled with sealant. The piezo grout should be smooth. The piezo grout should be even with or slightly higher than the pavement surface. If the piezo grout is concave, the sensors will not perform correctly. Refer to the Approved Products List (APL) for sealant and grout compliance.

Check Pull-Box - Check the pull-box for correct installation. Pull-boxes should be located a minimum of 8 feet from the edge of pavement. Lids should be level with surrounding surface. Inspect the concrete box for cracks to ensure it is intact. Pull-boxes should be sitting on a 12 to 15-inch gravel base to allow proper drainage. The loop wires should be spliced only if total length of wire exceeds 150 feet. Stranded 14-gauge wires should be spliced by soldering or crimping to 14-gauge home run cable that is grounded in the cabinet. Piezo wires should not be spliced but simply passed through directly to cabinet.

4.4. Cabinet Inspection

Take Photos - Site photos are a visual record of the cabinet conditions, configuration, and cabinet inventory. The photos should include the sensors, counter, pull-boxes, and inside and outside of the cabinet.

The following figures illustrate varied cabinet inspection layouts.
Figure 23: Type 3 cabinet

Figure 24: Type 4 Cabinet

Figure 25: Breakaway Pole Mount

Figure 26: Type 5 Cabinet

Figure 27: High Base

Figure 28: Low Base

**Check Fasteners** - Check that the cabinet is securely fastened and that it is good and tight. There should not be any rust on bolts, nuts or brackets.
Check Height - The bottom center of a pole mounted or break-away pedestal cabinet should be 4-feet above the ground. A low base mounted cabinet sits on a 3.5-inch concrete platform.

Check Seals - Ensure that all entry holes are sealed against water and insect intrusion.

Check Wiring Harness - Check that the wiring harness is installed.

Locate Diagram - Locate and verify that the sensor wiring diagram was left by the contractor in the cabinet. Be sure the diagram is written directly on the cabinet door.

Record GPS - GPS coordinates should be recorded for this site, if not already present, measure and record them. The GPS coordinates will help technicians locate the cabinet and ensure that the GIS maps are accurate. Output should be expressed in degrees with five decimal places to be consistent with the database.

4.5. Loop Inspections

Label Leads - Ensure that all loops and piezo leads are clearly labeled as described in Design Standard 17900, Sheet 5.

Measure Loop Resistance - To test the series resistance of a loop, the loop must first be isolated from the terminal strip. Set the multimeter to the ohms setting and connect the multimeter leads to each end of the loop. Refer to State Specification 695-7 for all requirements pertaining to loop resistance.

Measure Loop Inductance - To measure inductance, an LCR meter is used. A four-turn loop should measure a minimum 100 microhenries.
Measure Loop Insulation - To measure loop insulation the loop must first be isolated from the terminal strip. Set the insulation tester (megger) to the 500volt setting, connect the negative lead to ground outside of the cabinet, and connect the positive lead to one end of the loop wire. While injecting voltage into the wire, the meter should read greater than 200 Megaoohms for new loops and greater than 20 Megaohms for existing loops. Remember to reattach and securely tighten the leads to the terminal strip after testing.

4.6. Check Piezos

Measure Voltage Output - Remove the piezo coax cable from the terminal strip. The ground side of the coax cable is wrapped around the center conductor. Connect the oscilloscope probe to the center conductor of the piezo, and the piezo ground to the oscilloscope probe ground. As vehicles pass over the piezo, measure voltage output with the oscilloscope. The pulse should be a minimum of 200 millivolts for a car.

Measure Capacitance, Resistance and Dissipation - To test resistance of a piezo, the piezo must first be isolated from the terminal strip. Set the multimeter to the ohms setting and connect the multimeter leads to the center conductor and the ground of the piezo. The piezo’s resistance should read more than 20 mega ohms. If the resistance is less than 20 mega ohms, the piezo should be replaced. Measure capacitance and dissipation of the piezo using an LCR meter. The capacitance of a newly installed piezo should be within plus or minus 20% of the factory certified measurement. If needed, the capacitance can be estimated based on the length of the piezo and cable. The dissipation of a newly installed piezo should be no more than .04 nano-farads, existing piezo readings can vary.

4.7. Check Communications (Continuous Only)

CHECK MODEM - The modem is connected to the counter by a cable. Record the equipment type and serial number. Check power and ground. Connect the modem to a laptop using a modem cable. Remember to plug the modem back in when finished.

4.8. Check Power

Solar Panel (Continuous Only)

- Refer to Design Specification 17900 for orientation of solar panels.
- Visually inspect overhead lines, cables and trees. They should not shade the surface area of the solar panel.
- Disconnect the solar panel from the regulator and verify that it produces 18-22 volts DC and a minimum of 4.5 amps.
- Connect the regulator and verify that the output voltage reads 13.5 - 14.1 volts DC on a sunny day.
Check Battery
Check the battery to be sure that it is providing power.

- A good battery under load shows a reading of greater than 12 volts DC.
- Measure and record the amperage rating, 100 amp/hr. is required.
- Verify that the voltage doesn’t drop below 12 volts DC when placed under a 3.5-amp load.

4.9. Backplane
A backplane provides a mounting facility for terminal strips where all sensor leads connect in the cabinet. A wiring harness connects the loops and piezos to the terminal strips. The harness ends in a 26-pin connector which is connected to the counter.
4.10. Check Counter

Record the equipment type, NH number, and serial number of the counter. Connect the laptop to the counter by disconnecting the cable connected to the modem and connecting it to the laptop. Run the compatible software program for the equipment type. After it begins to communicate with the counter you may be prompted to enter the password. Check that the information coming from the counter is correct. Set the time for the correct time zone and count interval. Check each lane’s vehicle data for accurate class, speed, weight, and volume data. Test sensors to see that the loops and piezos are sending proper signals. Monitor traffic data for 30 to 45 minutes to visually verify that the data being collected seems reasonable. The vendor software program displays the lane number, the exact time the vehicle is counted, the speed, number of axles, length axle bin, speed bin, weights and the distance between axles. The distance between the back axles of a semi-trailer is typically 3.9 to 4.1 feet. For continuous counter operation verification, call the TDA field unit at 850-921-7300 or 1-800-399-5523. The technician
will replicate a communication session and verify that the counter is transmitting appropriate data.

Figure 35: Peek 241 A

Figure 36: Diamond Phoenix 2

Figure 37: Peek ADR3000

Figure 38: MetroCount

Figure 39: Jamar
4.11. Final Re-Check

Prior to closing the cabinet:

- Check that all tools and test equipment have been removed.
- Check all cables and connections are secure. It may save the inconvenience of coming back to simply plug a modem back in.
- Ensure that all paper work for the site is in the plastic bag or pocket attached to panel door.
- Be sure that all fields are completed and proper equipment type is circled on all forms.
- Take photos of the installation, location, cabinet mounting and signage. Submit the photos with completed paper work to the appropriate FDOT facility for database updating.
- Return all tools and test equipment to your vehicle and secure them for safety.
- Tag any equipment that is faulty for return to the appropriate FDOT facility.
- Be sure that flashers and turn signals are used to safely re-enter the traffic stream when traffic permits.
5 NON-MOTORIZED TRAFFIC MONITORING

5.1. Introduction
This is the first edition of the FDOT Traffic Monitoring Handbook in which non-motorized travel (pedestrian/bicycle) is being introduced. The purpose of introducing these modes to the Handbook is to collect and maintain a statistically valid bicycle and pedestrian traffic volume data program so that statistics can be calculated and published annually to serve all FDOT data customers and partner agencies. Like motorized traffic volume data, non-motorized data can be used for similar types of analyses such as planning, designing, and programming facilities, pavement, and trail maintenance.

5.2. Methodology
The methodology used to develop a non-motorized traffic volume program involves following some of the established motorized data program procedures. For example, developing a non-motorized program includes establishing site selection and equipment installation/data collection criteria based on a geographic footprint with continuous and short-term volume counting that can statistically represent other non-motorized facilities. Once the selection criteria are established, a survey of stakeholders is conducted to gather input from across the geographic area being evaluated. Survey respondents first provide recommended sites in which to collect non-motorized count data. Next, the selection criteria are applied to the recommendations automatically creating a way of prioritizing where counting equipment and installation investments might be best implemented.

Statewide traffic monitoring programs generally include the following:

- A modest number of permanent, continuously operating, data collection sites
- A larger number of short-term data collection sites

The short-term counts provide the geographic coverage to understand traffic characteristics on individual roads, streets, shared use paths, and pedestrian facilities. They provide site-specific data regarding volume, time of day and day of week. Statistics such as annual average daily pedestrians (AADP) and/or average annual daily bicycles (AADB) cannot be accurately measured during a short-term count. Instead, data collected through short-term counts are factored to create annual average estimates. The development of those estimates requires the operation of continuous count stations. Continuous count stations provide data on seasonal and day of week trends. Continuous count stations also provide highly accurate data regarding changes in travel volumes among other characteristics.

Upon collecting data, the information is then put through a quality control and quality checking process. Once the data is verified, statistics are calculated and published on an annual basis. Finally, data customers are provided with access to this data for many different analyses.
5.3. Non-Motorized Data Collection Challenges

There are numerous challenges to consider when developing a count location or numerous locations. Above all, accuracy of the count should be top priority when developing a count location. During the FHWA Bicycle-Pedestrian Count Technology Pilot, some MPOs participating in the pilot observed over-counting and under-counting of bicyclists and pedestrians’ due to factors such as counter positioning and other technical requirements of the counters but corrected these issues once they identified the sources of the problems. The following section will highlight some of the more popular data collection techniques and devices used throughout the industry today. As explained in the FHWA Traffic Monitoring Guide, there are two over-arching challenges to consider when developing a Non-Motorized Traffic Monitoring Program:

- Pedestrians and bicyclists are less confined to fixed lanes or paths of travel, making it easier to undercount if they move out of the range of the counter
- Pedestrians and bicyclists sometimes travel in closely spaced groups, making it easier to undercount if a traveler is blocked by another traveler in front, also known as occlusion

5.4. Continuous Count Practices

As described in the FHWA Traffic Monitoring Guide, the process for developing a continuous non-motorized traffic program should follow these steps:

1. Review any/all existing count programs
2. Develop an inventory of available continuous count locations and equipment
3. Determine traffic patterns to be monitored
4. Establish pattern/factor groups
5. Determine the appropriate number of continuous monitoring locations
6. Select specific continuous and short-term count locations
7. Compute monthly, day of week, and hour-of-day factors to use for annualizing short-duration counts

The following sections will break down in the detail these 7 steps.

**Review Existing/All Count Programs**

When reviewing and assessing what existing count programs are already in place within or near your jurisdiction, it is important to coordinate with other government agencies/entities beyond the FDOT districts. Many MPOs, local governments, and advocacy groups have been monitoring non-motorized activity prior to state agencies such as FDOT. In addition to transportation related groups, other agencies, organizations, and community groups such as health agencies, parks departments, retail and/or business organizations, and bicycle/pedestrian advocacy groups should all be contacted and coordinated with as potential entities already engaged in non-motorized data collection practices.
Develop an Inventory of Available Continuous Count Locations and Equipment

Once coordination with state, regional and local partners is complete, the next step is to develop an inventory of all past and on-going count programs within your jurisdiction. In addition to mapping data collection locations, the FHWA Traffic Monitoring Guide recommends the following information also be recorded, if possible:

- Existing monitoring locations and why they were chosen
- Existing equipment and any noted performance/accuracy limitations
- Who is using existing data, and for what decisions?
- Is the existing data sufficient? If not, what are the additional needs and their priorities?
- If there is no existing data, who would utilize the data, and for what decisions?

If data does exist for a specific location, the following analysis should be conducted, if possible:

- How do counts vary throughout the day?
- How do counts vary by day of the week?
- How do counts vary by month or season?
- How do counts vary for inclement weather and other special events?
- How does traffic vary by street functional class and the presence of bike or pedestrian facilities?
- How do traffic patterns and profiles compare at different locations in areas with different land use and demographic characteristics?

After reviewing the existing non-motorized data, one should have an understanding on the format of the data, how it may be accessed and/or manipulated for further analysis. The following elements should be considered:

- What formats such as; data structure, time intervals, and metadata are available and/or being reported from the field equipment?
- What quality assurance and quality control processes are in place for the field data?
- Are erroneous or suspicious data flagged and/or removed?
- What summarization or adjustment factors (if any), are applied to the field data?
- How does the existing count program account for missing data?
- Are estimated values flagged or documented within the metadata?
- Are the non-motorized data integrated with motorized data? Or, is there a separate process in place?
- Are data summarization processes automated to the fullest extent possible? At what point is a manual review and/or intervention required?

The final step is to consider summary statistics. Continuous count stations should be providing 24 hours of hourly count data, 365 days a year, but this continuous data stream is often summarized into a few basic summary statistics such as Annual Average Daily Pedestrians and Annual Average Daily Bicyclists. Because non-motorized traffic is less
understood due to lack of data/information than motorized traffic, other summary statistics may also be important to consider, such as:

- Seasonal Average Daily Traffic
- Average daily traffic by month and day of week
- Peak hour volumes for peak seasons

**Determine Traffic Patterns to be Monitored**
After reviewing and documenting the existing non-motorized traffic inventory, the next step is to determine which traffic patterns are to be assessed. Part of the process will be determining which functional road classes and bicycle/pedestrian facilities are to be monitored, such as; local roads, county roads, state roads, shared use paths, trails, pedestrian malls, etc. Once the non-motorized network has been defined, one should determine traffic patterns on the network, using their best judgement. Most commonly, facilities will have a relative mix of commuter, recreational, and utilitarian trips. Depending on the proportions of these trip types, traffic patterns will begin to emerge. These patterns should be used in Step 4 to establish seasonal factor groups. The most popular method to determine traffic pattern groups is through visual analysis and charting existing data. Continuous count data is ideal for this step, but short-term count data may be used as an alternative with caution.

**Establish Seasonal Factor Groups**
After traffic patterns have been defined, the next step is to develop unique traffic pattern factor groups. Establishing factor groups serves as the foundation for the statewide non-motorized count program. At this early stage of the practice, non-motorized groups can be classified into one of three categories, as more data becomes available, factor groups can be further refined.

- Commuter and work/school-based trips – typically have the highest peaks in the morning
- Recreation/utilitarian trips – may peak only once daily, or be relatively balanced throughout the day
- Mixed trip purposes – has varying levels of the two different trip purposes above, or may include other miscellaneous trip purposes

Overall, it should be anticipated that climate conditions will have a significant impact on seasonal non-motorized patterns. Day to day weather conditions will have an impact on day-of-week or weekly patterns but should have minimal effects on seasonal impact. In addition, facility type and adjacent land use will also influence the purpose and timing of the trip.

**Determine the Appropriate Number of Continuous Count Locations**
This is still a relatively new realm of data collection for the state, therefore early stages of determining continuous count locations will be based on the amount of existing data available in the previous steps and using best judgement. As time progresses, more data will facilitate more informed decisions. At this point however, it is estimated that each
district should target three to five continuous count stations to be installed for each factor group.

**Select Specific Continuous Count Locations**
After the number of count locations within each factor group has been established, the next step is to identify specific count station locations. The FHWA Traffic Monitoring Guide advises several considerations to be addressed at this step:

- **Differentiating bicycle vs pedestrian traffic**
  Shared use paths and trails, which share non-motorized uses, should be equipped with data collection devices which can differentiate between the two modes. Exclusive bicycle lanes and separated bicycle lanes can be equipped with technology such as inductive loops or pneumatic road tubes, which only count bicyclists (Refer to Figure 55, page 74). Finally, pedestrian malls, sidewalks, and walking paths can be equipped with single-purpose counts such as infrared to count pedestrians exclusively.

- **Selecting representative continuous count locations**
  While it may be tempting to only install data collection devices at locations with the highest levels of non-motorized traffic, it would fail to produce a representative sample of activity to be further adjusted for annualized counts. It must be emphasized that the primary purpose of continuous count locations is to factor short-duration count locations. Continuous count locations in high volume areas may look impressive at first glance but will not yield accurate results when factoring short-duration counts.

- **Selecting optimal installation locations**
  Preferably on straight, level sections of road or trail, not on curves or on or near a steep grade
  On smooth pavement or another compact surface
  At a chokepoint here the traveled way is clearly defined and deviation is not common
  For infrared sensors, not near waterbodies or in direct sunlight
  For infrared sensors, not directly facing the roadway unless a vertical barrier exists
  For inductance loop detectors, not near high-power utility lines that could disrupt or distort the detection capability

**Compute Adjustment Factors**
The calculation of adjustment factors should be like motorized traffic volume procedures. These adjustment factors will be tailored for each factor group as defined in Step 4. Again,
due to the relative newness of the statewide non-motorized count program, very few agencies have created day-of-week adjustment factors. The current practice is to gather short-duration counts during dates and times that are believed to be average, therefore reducing the perceived need for adjustment. This practice will evolve and refine as more data and count stations are installed around the state.

5.5. Short-Term Count Practices
Like motorized traffic procedures, the majority of count stations across the state are short-term count sites. Coupled with continuous count stations, these locations can help produce sub-area or regional travel trends. Short-term counts are performed on specific facilities based on certain needs, but it is not known whether that specific facility is representative of a sub-area or region. More data and research will be required to establish those standards.

Selection of Count Locations
The following National Bicycle and Pedestrian Documentation (NBPD) Project Criteria are recommended for short-term counts:

- Pedestrian bicycle and corridor areas (downtowns, near schools, parks, etc.)
- Representative locations in urban, suburban, and rural locations
- Key corridors that can be used to gauge the impacts of future improvements
- Locations where counts have been conducted historically
- Locations where on-going counts are being conducted by other agencies through a variety of means, including videotaping
- Gaps, pinch points, and locations that are operationally difficult for bicyclists and pedestrians (potential improvement areas) to deviate from
- Locations where either bicyclists and/or pedestrian collision numbers are high
- Select locations that meet as many of the above criteria as possible

Once general monitoring locations have been identified, the most suitable counter positioning should be determined. The NBPD project recommends that following guidance for counter positioning:

- For multi-use paths and parks, locations near the major access point are best
- For on-street bikeways, locations where few if any alternative parallel routes are best
- For traditional downtown areas, a location near a transit stop is best. Count at one access point
- For shopping malls, a location near the main entrance and transit stop is best. Count at one access point
- For employment areas, either on the main access roadway or near off-street multi-use paths is best. Count at one access point
- For residential areas, locations near higher density developments or near parks and schools are best. Count at one access point
Mid-block versus Intersection Counts

- Mid-block counts are taken at a mid-segment location along a non-motorized facility
  - They are typically used to identify general use patterns along a facility, and are the equivalent of short-duration motorized counts
- Intersection crossing counts that should be taken where a non-motorized facility crosses another facility of interest
  - Typically used for safety and/or operational purposes and are most like motorized intersection turning movement counts.

Duration of Counts

Today, the ideal duration for a short-term count is between 7 to 14 days. In the past, non-motorized counts were focused on two consecutive hours on a single day, but this method is becoming increasingly rare as more technology evolves and more agencies understand the variability of non-motorized traffic. 7 days are the new minimum duration for an automated short-term count and 14 days is preferred so that every day of the week is captured and if one day of the week shows an anomaly, or has a weather event or equipment malfunction, then the other week can serve as a back-up to ensure every day of the week is captured.

Count Magnitude and Variability

If non-motorized levels are consistently high, shorter periods and or fewer days may be considered. However, a longer duration count will be required to determine how variable the non-motorized traffic is by time of day and day of week.

Weather

Weather can be credited with significant shifts in non-motorized activity. Seasonal weather patterns are expected between the Winter and Summer seasons, but heavy rains, unexpected heat waves, or cold fronts could also produce atypical variations to non-motorized activity. When inclement weather occurs during a manual count, the counts should be extended over multiple days, at the same time. Because weather can have a such an impact on non-motorized travel, it is important to record weather conditions whenever possible.

- High temperature – Record approximate high temperature for either day or duration of the count
- Low temperature – Record approximate low temperature for either day or duration of the count

Months/Seasons of Year Data Collection

The specific months/season of the year for short-term counts should be outlined to represent average or typical use levels, which can be readily determined for continuous counters. Short-term counts may be used to collect other months/seasons of the year that are not considered average or typical; but, a factoring process will be needed to adjust the counts to best represent an annualized estimate.
Factoring Short-term Counts

Depending on the count duration, type of data collection equipment, and presence of inclement weather, there may be up to five factors that could be applied to short-term counts:

- Time of day – if less than a full day is collected, this factor adjusts a sub-daily count to a total daily count
- Day of week – If data is collected on a single weekday or weekend day, this factor adjusts a single daily count to an average daily weekday count, weekend count, or day of week
- Month/season – If less than a full year of data is collected, this factor adjusts an average daily count to an annual average daily count
- Occlusion – If certain types of automatic counter equipment is used, this factor adjusts for occlusion
- Weather – If short-term counts are collected during periods of inclement weather, this factor adjusts an inclement weather count to an average, typical count.

5.6. Non-Motorized Data Collection Technology

As non-motorized data collection has gained importance, the market has responded with an array of data collection devices to aid in developing valid and reliable data collection programs. Today, there are various data collection devices used for recording non-motorized activity. Depending on the characteristics of the facility, surrounding environment, duration of the count, budget and staffing resources, these factors will play a role in determining the most appropriate data collection device to use at a count location.

Non-Motorized Counting Equipment

- Manual Counts - the oldest and most popular technique for counting non-motorized activity has been manual counts. With this technique, a live person situates themselves in a location with a clear vantage point of the location they are observing for non-motorized activity. Supplied with a clip board, paper, and a writing device or an electronic counting board, the person individually records each non-motorized traveler, documenting direction, gender, age demographic, helmet usage, among other features. While having a live person comes with its advantages, there are numerous challenges associated with this technique, especially when a program is moving in the direction of continuous duration counts at numerous locations.

The first major challenge is the cost associated with manual counts. A person must be compensated for each count performed. In addition to paying for time at the location, transportation fees associated with getting to and from the counting location must also be covered. Next, there normally is post-processing of the data which must be compensated as well. The next challenge associated with manual counts is data capture accuracy. A live person must be sure to be at a location and ready to start recording at a precise time. If a person starts counting too early or too late, it affects the validity of the count being performed. In addition, depending
on the level of non-motorized activity at a location, it may be too active for a single live-person to capture all the activity accurately. For instance, a live counter staged at an urban city street may experience hundreds or even thousands of non-motorized travelers within a two-hour period, all moving in different directions and at different speeds. Include a high level of automobile/truck traffic obscuring a person’s view, the level of complexity occurring makes it very difficult to collect an accurate count. For these reasons, manual counting will remain an effective method for short term duration counts, however are not advised for continuous/long term count programs.

![Figure 42: Manual Counter (Courtesy of: NJBikePed.org)](image)

- **Pneumatic Tubes** - Pneumatic tubes are a popular technique used not only for capturing motorized activity but non-motorized activity as well. Whenever an automobile drives over the rubber tube, a pulse of air is squeezed through the tube. The pulse of air is converted into an electrical signal, then recorded by the receiver box. For non-motorized activity, the tire moving over the rubber tube would be a bicycle wheel. Each time a bicycle rides over the tube, the pulse of air is recorded by a receiver box.

Data collection vendors have created pneumatic tubes that are now specific for bicycle data collection. Pneumatic tubes used for automobiles should not be used when collecting bicycle traffic. When purchasing tubes from a vendor, make sure you state that you need tubes calibrated for bicycle travel. Not only are the bicycle tubes calibrated to detect the appropriate weight, but the tubes are also a bit softer making it easier for a bicycle, skateboard, skates to cross over the tubes with less chances of an unwanted trip or fall. To reduce any chances or tripping, all pneumatic tubes should be securely fastened to the road with nails on each end, and further reinforced with special road tape along the center of the tubes.

Depending on the duration of the count, once tubes are laid down, they should be checked by technicians to makes sure they are secure to the road and collecting data properly. Pneumatic tubes are considered a reliable device option for
recording bicycle traffic only, but not for collecting pedestrian traffic. Passive infrared can be used in conjunction with tubes, loops, or piezos for enhanced bicycle detection. Please review Figure 52 Non-motorized Data Collection Equipment Matrix for more information about combining technologies. See Section 1.6 for more information about motorized tubes.

![Figure 43: Pneumatic Tubes (Courtesy of: bicyclecoalation.org)](image)

- **Passive Infrared** - Passive infrared is a data collection technique that uses an infrared device records activity whenever an object that produces heat passes through a specific zone. This device does not require physical touch to record activity, therefore making it possible to record both bicyclists and pedestrians; however, the technology will not be able to differentiate between the two. Infrared devices can be combined with pneumatic tubes, inductive loops, and / or loop detectors to differentiate bicyclists and pedestrians. Please review Figure 52 Non-motorized Data Collection Equipment Matrix for more information about combining technologies.

Passive infrared does have challenges with occlusion. Occlusion represents lost data, not recorded due to interference from an object in front of the device’s field of vision. Groups of walkers, runners and or bicyclists passing in front of a passive infrared sensor simultaneously are in danger of not being recorded, thus skewing the data’s accuracy.

One method used to avoid occlusion is to install the passive infrared device overhead rather than to the side of a facility. Having the device pointed downward means that a group of non-motorized travelers can all pass through the field simultaneously and the device will detect all travelers. This method makes installation of the device a sensitive procedure and could incur more costs. The benefit, however, is a more accurate data collection procedure thus capturing more valid and reliable data. Whichever data collection device is selected, it is recommended that technicians calibrate and conduct their own ground-truth count tests for the automated technologies before they deploy at a given site or set of sites.
Active Infrared - While passive infrared uses one device that has a designated zone, active infrared device possesses two units (signal transmitter and receiver) which together create a beam. Whenever an object interrupts the beam, the activity is recorded. The beam for active infrared possess a narrower spread than passive
infrared and may be used for recording both bicyclists and pedestrians, but using this method of detection, active infrared may be used for recording both bicyclists and pedestrians but will not differentiate between the two. Like passive infrared, if multiple objects are moving close together, it is possible for occlusion to take place, thus skewing the data being recorded. Infrared devices can be combined with pneumatic tubes, inductive loops, and or loop detectors to differentiate bicyclists and pedestrians. Please review Figure 52 Non-motorized Data Collection Equipment Matrix for more information about combining technologies.

![Active Infrared](image)

**Figure 46: Active Infrared (Courtesy of: Trailmaster.com)**

- **Automated Video Cameras** - Automated video cameras are a newer form of data collection technology. Automated cameras have numerous benefits associated with them but are also considered to be the most expensive data collection device available. Automated video cameras provide the ability to capture bicycle and pedestrian activity and direction of travel over a designated zone. Software has been imbedded in the camera to allow for automatic distinction between bicyclists and pedestrians. These capabilities are dependent on the level of algorithm development within the product. Weather and lighting may also reduce the accuracy of the captured activity. As a benefit, if any of the processed data looks suspicious because the data has been recorded, the technology provides the ability to validate counts through a manual review process.

Using cameras for recording non-motorized activity provides an added benefit of capturing behavior. From a data collection perspective, recording behavior may not be so important, but it may prove useful to an agency partner. For example, through video analysis, a safety expert and/or design engineer may be able to distinguish design or traffic control flaws that would improve the safety of a location by observing the behavior of the non-motorized and motorized travelers through the camera’s recording.
Inductive Loops - Inductive Loops are a popular form of data collection device for motorized travel. Recently, this technique has proven effective for recording bicycle data as well. Inductive Loops create a magnetic field which can be disrupted when a metallic object crosses over the field. If the disruption meets a predetermined criterion, then a detection occurs and the object is counted by a data logger or computer controller. The metal frames of a bicycle serve as the metallic object that causes the disruption.

The preferred counting location for inductive loops is at a mid-block or other location where bicycles are free flowing or not likely to stop. Ideally, loop detectors for bicycle counting will be placed on exclusive bicycle lanes. If loop detectors are placed in lanes shared by motorized traffic, special algorithms will be needed to distinguish the different modes. Inductive loops may be combined with an infrared device to differentiate between bicyclist and pedestrians. Please review Figure 52 Non-motorized Data Collection Equipment Matrix for more information about combining technologies. According to the FHWA Traffic Monitoring Guide, the most important variables in accurate bicycle detection via loop detector are:

- Loop configuration – several different wire patterns have been used for counting bicycles such as: quadruple, diagonal quadruple, chevron, and elongated diamond patterns
- Detector circuit sensitivity – the sensitivity should be high enough to detect bicycle frames but not high enough to detect motorized vehicles in parallel lanes
Bicycle position over the loop – pavement stencils may be used to indicate optimal bicycle position over the loop detector, which is typically directly over the saw cut for the wire coil.

Bicycle size and composition – A large steel bicycle frame will more likely disrupt the loop’s detector field than a smaller non-steel frame. Some inductance loop detectors can detect bicycles with non-steel frames due to the presence of ferrous metal in the wheels or other bicycle components.

Figure 48: Inductive Loop in Bike Path

Figure 49: Inductive Loops in Shared Lane

Piezoelectric Strips - Piezoelectric strips emit an electrical signal when they are physically deformed. Counters using this technology embed two or more strips into the pavement across the traveled way. When a bicycle passes over piezoelectric strip, the pressure depresses the strip, deforming it and creating an electric signal. The counters require pavement cuts to install the material and, depending on the location, considerable lead time may be necessary to obtain needed permits before the installation. The data logger is usually stored in a utility box/cabinet next to the facility, which may require additional excavation and costs.

Overall, piezos function like pneumatic tubes, replacing air pressure with an electric signal and can be used to detect direction and speed using multiple strips. However, unlike pneumatic tubes, piezoelectric strips are a permanent fixture that costs more for its installation, like loop detectors. Also, they are not used in mixed traffic, or to detect pedestrians unless combined with an infrared sensor. Please review Figure 52 Non-motorized Data Collection Equipment Matrix for more
information about combining technologies. Please review Section 1.4 for more information regarding piezos used for recording motorized traffic.

![Piezoelectric Strips in a Bike Lane](image)

**Figure 50: Piezoelectric Strips in a Bike Lane**

- **Radar Scanners** - Radar sensors are similar to active infrared sensors; however, they use a different frequency of waves for their beam. They can typically use two different frequencies to differentiate bicycles from pedestrians with a single sensor. They are considered expensive to purchase, but inexpensive to mount and operate. Accuracy of this technology requires more real-world tests to determine the level of accuracy.
Thermal Sensors - Thermal sensors operate like passive infrared but should be mounted above the detection area. This method allows for more data gathering, such as directionality and speed. Thermal sensors are deemed expensive to install and, therefore, would be used mostly in continuous monitoring locations. In addition, they do not have the ability to differentiate between bicyclists and pedestrians.

Laser Scanners - Laser scanners send pulses of light in various directions and then record and analyze the reflections. They cannot differentiate between bicyclists and pedestrians. Experience of laser scanners within the United States is still very limited. Two versions of the laser scanners exist: horizontal and vertical. Laser scanners deployed at continuous count locations will require an available electrical power connection. Horizontal scanners will require locations with no obstructions. Vertical scanners are mounted above the detection area, which may induce additional installation costs. To this point, laser scanners have primarily been used indoors, but could potentially be used in an outdoor setting for a temporary study.
Pressure and Acoustic Sensors - These sensors are buried beneath the surface of a facility. The devices sense the pressure waves emitted by pedestrians or bicyclists as they step on or pass over the surface. They are used primarily on unpaved paths. Since they can only sense movements directly above them, they are only reliable if pedestrians or bicyclists pass single file or if multiple sensors are used side by side. They do have the capability to differentiate between bicyclist and pedestrians. They are considered expensive to install because they need to be buried in the ground. They are considered best to use at continuous count sites.

Figure 53: Pressure Sensitive Counter (Courtesy of BeCounted.co.nz)

Magnetometers - Magnetometers are like loop detectors. They pick-up metallic objects passing over a magnetic field. While popular in use for detecting motorized traffic, they are still new regarding detecting bicycle activity. Magnetometers are best suited for rural locations due to their highly sensitive detection rates of ferrous metal objects. In addition, due to their limited detection range, they are preferably installed at locations in which bicyclists will be traveling in a single file. They are not used for detecting pedestrians. They are considered expensive to install due to their need to be imbedded in pavement. They are considered best to use for continuous count sites.
### Figure 54: Magnetometer (Courtesy of FHWA.DOT.gov)

### Figure 55: Non-Motorized Data Collection Equipment Matrix

<table>
<thead>
<tr>
<th>1. What are you Counting?</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. What is the count duration?</td>
<td>Bicyclists Only</td>
<td>Pedestrians Only</td>
<td>Pedestrians &amp; Bicyclists Combined</td>
<td>Pedestrians &amp; Bicyclists Separately</td>
<td>Cost</td>
</tr>
<tr>
<td>Continuous Count</td>
<td>Plezo/Inductance Loops</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td></td>
<td>Magnetometer</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressure Sensor</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Radar Sensor</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seismic Sensor</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Automated Camera</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Infrared Sensor</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pneumatic Tubes</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manual Counts</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>

- ✔ Indicates that counting with this technology is possible
- ✔✔ Indicates a common or preferred practice
- ✔✔✔ Indicates a common practice, but technology must be combined with other technology to differentiate between the two modes

**Page 68 of 88**
ABBREVIATIONS

AADB – Average Annual Daily Bicycles

AADP – Annual Average Daily Pedestrians

FCAT – Factory Category

FDOT – Florida Department of Transportation

FHWA – Federal Highway Administration

MPO’s – Metropolitan Planning Organizations

NBPD – National Bicycle and Pedestrian Documentation

TCI – Traffic Characteristics Inventory
REFERENCES


TRAFFIC CHARACTERISTICS INVENTORY (TCI) DATABASE

The official traffic database resides on the Department’s computer network, where it can be viewed by anyone in the Department. However, only authorized traffic count personnel may insert, delete, or change any data, or view the open-year traffic data. It is a relational database containing station information, historical and current year traffic volumes, and vehicle classification data. Some traffic count stations have historical data as far back as 1970. The stations’ database records are used in data quality checking of short-term counts.

Home Tab

The Traffic Characteristics Inventory (TCI) application system provides the Department with the ability to archive and record traffic volumes, vehicle classifications, and related traffic information. This data is collected and stored at specific locations, called traffic stations (or traffic monitoring sites within each county). The station specific data is extrapolated to encompass the entire State Highway System through the use of traffic segment break files. The Traffic Characteristics Inventory maintains comprehensive information about each traffic station and about each traffic break segment. It contains a history of traffic information from 1970 to the present.

Figure 56: Traffic Characteristics Inventory (TCI) Webpage
Station Tab

Station Identification
The official Station Inventory is maintained in the FDOT database. It contains information such as: Station ID, County, Location, Latitude, Longitude, Seasonal FCAT, Sensory Type, Survey Type, Count By, Count By Lane, Ascending Direction, Descending Direction, Active, Managing District, Axle FCAT, Purpose Code, Survey Program, Count Median Lane?, Ascending number of Lanes, Descending number of Lanes, Roadway ID and Beginning Milepoint.

Each evening, the data in the Station Inventory is copied to a dataset residing on the host. It is this copy that is downloaded by SPS and placed into an ACCESS table on the District PC. SPS can download this dataset whenever the operator desires.

If the District operator does not want to wait until the following day to download the updated Station Inventory to the District PC, it is possible to change the piece of data in the SPS station inventory and continue to process the traffic data. However, the next time SPS downloads the Station Inventory, any changes made to the SPS station inventory will be over-written or lost. To avoid problems with the Weekly Load, be sure to update the Station Inventory database so it matches the information in the summary records. (See SPS EDITS PERFORMED and PROBLEM RESOLUTION).

Stations Per Roadway
All traffic count stations located along a specific section of road (Roadway ID) for every year (active or / and in-active) can be viewed using this transaction. The stations are listed in ascending order of station milepoint. The user can elect to display all, active, or inactive stations. The count year is optional, if entered, the transaction will display the AADT of the selected count year, Station status, beginning / ending milepoint, type and status. This transaction can make a nice ad-hoc report of the traffic volumes on a specific road.

Count Tab

Station Counts
The detailed traffic count data are stored in this traffic database. It contains the date and direction of the count, and its raw and adjusted values. Anyone can look at this historical data, but only traffic count personnel can view the data for the current open year. A quick look at this database can confirm that a load job has run successfully.

Volume Statistics
The processed traffic data is stored in the annual count database. It consists of such items as the AADT, K, D, and T Factors for all sites, and the peak hour information for short-term counts only. This data is updated annually.

AADT History
Historical Annual Average Daily Traffic volumes are saved in the TCI database. The database contains traffic from as far back as 1970 for some stations. This data can be viewed by specifying the six-digit count station number, and the earliest year for which
data is desired. The transaction will return traffic volumes from the entered year (or next closest stored year) forward to the latest year.

**Monthly ADT**
This table stores the monthly ADT values for the continuous counters only. The monthly ADTs are stored for each direction of travel at the station.

**Class Data Tab**
**Classification Detail**
The 24-hour summaries of each type of vehicle, and the daily total volume are stored for each direction, lane, and date for each short-term classification station.

**Vehicle Statistics**
Annual vehicle summary classification data is stored in this database table. It contains the annual percentages of traffic by each vehicle classification, the annual T Factor (daily truck percentage), and the design hour heavy, medium and total truck percentages. This data is updated annually.

**Vehicle History**
The annual classification summary data are displayed on this Inquiry Only screen. The 15 Modified Scheme "F" vehicle classes are collapsed into just 4 groups (passenger vehicles, single-unit trucks, semi-trailer combination trucks, multi-trailer combination trucks) to fit on the screen. The percentages are multiplied with the AADT to calculate the number of vehicles in each group. The data is stored by county-station and year.

The database contains classification traffic data from as far back as 1970 for some stations. This data can be viewed by specifying the six-digit count station number, and the earliest year for which data is desired. The transaction will return information from the entered year (or next closest stored year) forward to the latest year.

**Speed Data Tab**
**Under Development**
In the future, Speed Detail, Speed Statistics, and Speed History data will be available – continuous stations only.

**Factor Category (FCAT) Tab**
**Seasonal Factor Category**
Seasonal Factor Categories are those groupings of continuous count stations whose data will be used to develop the factors that will adjust short-duration counts for the time of year. The category is a 4-digit number—the first 2 digits are the county codes, and the second 2 digits are a user supplied sequence number. It contains a verbal description that informs the user of its intended use, and a maximum of eight continuous count station numbers.
The End-of-Year Processing programs calculate the appropriate factors from the data collected at the stations assigned to the factor categories. It is best if multiple stations (upper limit of 8), are assigned to a factor category, so that reasonable factors can be calculated even if a single station is not counted that year, or if it is counted but has atypical traffic.

**Axle Factor Category**
Axle Factor Categories are those groupings of vehicle classification stations whose data will be used to develop the factors that will adjust axle counts into vehicle counts. The category is a 4-digit number—the first 2 digits are the county codes, and the second 2 digits are a user supplied sequence number. It contains a verbal description that informs the user of its intended use, and a maximum of eight vehicle class stations. Both short-duration and continuous classification stations can be assigned to Axle Factor Categories. The End-of-Year processing programs calculate the appropriate factors from the data collected at the stations assigned to the factor categories. It is best if multiple stations (upper limit of 8), are assigned to a factor category, so that reasonable factors can be calculated even if a single station is not counted that year, or if it is counted but has atypical traffic.

**Weekly Seasonal Adjustment Factors**
The Weekly Seasonal Adjustment Factors are stored in the database and displayed with this application. There can be from 52 to 54 weekly factors, depending upon which day-of-week January 1 falls. The seasonal adjustment factors are multiplied with the raw count (and axle correction factor for road tube volume counts) to derive an AADT estimate. If the Seasonal Factor is greater than 1, that means the count was collected during a time of the year when the traffic volumes are low, and must be raised to reach the annual average. If the seasonal factor is less than 1, the raw count was collected during a time of year when the traffic volumes are high, and the raw count must be lowered to the annual average.

**Weekly Axle Adjustment Factors**
The Weekly Axle Adjustment Factors are stored in the database and displayed with this application. There can be from 52 to 54 weekly factors, depending upon which day-of-week January 1 falls. All axle adjustment factors are less than or equal to 1. The axle adjustment factors are multiplied with the raw count to lower axle counts into vehicle count estimates.

**Traffic Breaks Tab**
**Per Roadway**
The Section Breaks Database contains the beginning and ending milepoint limits of the traffic break segments as defined by District personnel and the station at which the traffic for that break is counted, and a flag indicating whether that station is located within, adjacent to, or from a different roadway than the traffic break segment. Traffic section
breaks are defined for each traffic count cycle. They are used to distribute the traffic volumes taken at a specific point (i.e., station) to a length of road (i.e., section).

**Reports Tab**

**Station Inventory** (Figure 57) This Tab produces a report of the traffic monitoring stations for the District and station status selected by the user:

![Station Inventory Report](image)

**Figure 57: Station Inventory Report**

**AADT History** (Figure 58) This Tab produces a report of the AADTs for the selected years and stations after logging in using the Login Tab:
Figure 58: Traffic Station AADT History Report

**Raw Counts** (Figure 59) This tab produces a report of all the raw counts that have been saved in the database for the selected year and stations after logging in using the Login Tab:

![Raw Counts Report]

Figure 59: Raw Counts Report

**Monthly Continuous ADT** (Figure 60) This tab produces a report of the monthly ADTs for the selected years and stations:
Figure 60: Monthly Continuous ADT Report

Login Tab
This Tab allows authorized users of TCI to log in to enable the user to select either the Resubmit Load or Station Data Load tabs.

Traffic Flow Breaks
The traffic flow breaks are stored and maintained in the Roadway Characteristics Inventory (RCI) database, under Feature 330. The user must enter the roadway ID (county, section, subsection) of the desired road. RCI will return a list of all traffic break segments that have been identified along this road. Each traffic break consists of the beginning and ending milepoints of the break, and two characteristics: FLWBRKID (count station assigned to the break) and TRFBRKCD (traffic break code). See RCI Features and Characteristics Handbook.

If the beginning and ending milepoints of traffic break segments are tied to an intersecting road (RCI Feature 251), when the road is shortened or lengthened (due to a re-inventory), then the milepoints of the traffic break are automatically adjusted correspondingly. This keeps the traffic breaks synchronized with RCI so that the AADT, K, D and T can be easily placed into RCI Feature 331 after the annual traffic data processing cycle.
APPENDIX A.
Traffic Monitoring Equipment Certification

MEMORANDUM
DATE: Tuesday, July 17, 2018
TO: District Planning Managers
FROM: Steven Bentz, Office of Transportation Data and Analytics
SUBJECT: Traffic Monitoring Equipment Certification

As you know the new objective evaluation process will include points based on when (or if) certification is provided that traffic monitoring equipment is proper and functioning correctly. We now have a certification process and form that can be used for this purpose. The attached sheet has the Traffic Monitoring Certification Guidelines on one side and the Traffic Monitoring Equipment Certification Form on the other side.

Please review the Guideline and the Form, and let me know if you have suggestion for improving either of them. If you have questions about the details of them please contact Joey Gordon.

Copies of the Guideline and Form may be available at the District Directors of Planning and Programs meeting; if you have a chance, you may want to discuss these materials with your Director before then.

Steven Bentz
<table>
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<th>Test Date:</th>
<th>Test Begin Time: AM / PM</th>
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<td>Test Site Direction:</td>
<td>Model No.: Serial No.</td>
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**COMPARATIVE ANALYSIS**

Results of Equipment Tested: Continuous or Visual Test Results

<table>
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<th>Total Vehicles Counted:</th>
<th>Total Vehicles Counted:</th>
</tr>
</thead>
</table>

Vehicle Counts (By Class) If Applicable: Vehicle Counts (By Class) If Applicable:

<table>
<thead>
<tr>
<th>Class 1:</th>
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</tbody>
</table>

This is to certify that the portable traffic monitoring equipment listed above was tested in accordance with the guideline on the reverse of this form (to be incorporated in a procedure currently being developed), and meets the accuracy requirements needed for traffic data programs. Otherwise, the equipment is "REJECTED" as reflected in the comments section below.

Test Performed By:
Name: Title:
Organization: Signature:

Test Monitored / Analyzed By:
Name: Title:
Organization: Signature:

Comments: REJECTED WHEN THIS BOX IS CHECKED

*Figure 61: Traffic Monitoring Equipment Certification Form*
Traffic Monitoring Equipment Certification Guideline

Once a year, all portable traffic volume counters and portable automatic vehicle classification counters used by the Department or used by consultants for general data collection activities or other Department projects must be certified for accuracy in data collection.

The testing of portable traffic volume counters will consist of setting the portable counters sequentially at a selected location and then comparing their counts with reference counts taken at the same time from an adjacent telemetered traffic monitoring site or a manual count. 10-15 machines can be set at one time for a minimum of one-hour data collection. If the count for a portable machine is within ten percent of the reference volume count, then the equipment is functioning properly.

For portable automatic vehicle classification counter operation, two tests are used for certification:

1. The total volume is compared to the total reference volume. If the portable automatic vehicle classification counter total counts are within ten percent of the reference volume, then the accuracy test is met.
2. The counts for each of the 14 classes will be grouped for comparison to make sure that an anomaly in one class with a very low volume for instance, doesn’t disqualify a machine. The groupings will be: a) Classes 1 through 3, b) Classes 4 through 8, c) Classes 9 through 13, d) Class 15 (unknown vehicle types)

If the difference in any of the first 3 group totals for the classification counts compared to the reference data do not exceed ten percent and then the class 15 counts are less than 10% of the total counts, then the test is met. Any portable machine that passes the accuracy test for traffic volume and / vehicle classification can be certified for only the type of count on which it was tested (i.e. volume, classification or volume and classification).

The test results will be documented for each counter to be used on a Department project. The documentation will be submitted to the district and the Central Office for their working files and must include:

1. Count location and direction of travel
2. Automatic count manufacturer make, model number, and serial number
3. Volume count data and / or classification count data from the automatic counter in tabular form and in fifteen-minute intervals
4. Date and times of testing
5. A certification stating that the counter has successfully completed testing for data collection accuracy.
APPENDIX B.  
Standard Index 17900 Cabinet Installation Details
NOTE:
1. Cabinet installed per Index 17P41 except cabinet center will be 4 feet above grade.
3. Use #10 AWG stranded copper wire per Solar Panel array installation. Use the T-2009 for parem level. B3 wire setting. Black insulation is T130 or T220A for regular 12 volt wiring. Green insulation is T140 or T213A for ground bonding of the solar array frame to the pole and panel.
4. Solar panel should be installed facing due south with angle of tilt equal to the sum of the following equations: The latitude of the parents location multiplied by 0.7, plus 8.1 degrees. Equation expressed as G55/30°X(0.7)+8.1°
5. Provide all wiring from the weather head to the solar panel in conduit
6. Concrete Base Requirements:
   a. 2 posts: 2'-0" x 2'-0" wide, a depth of 7'-0"
   b. 2'-0" or 2'-0" wide, a depth of 7'-0"
   c. 4'-0" or 3'-0" wide, a depth of 4'-0"

SOLAR POWER POLE
WITH POLE MOUNTED CABINET
(Telemeter Sites)

PEDESTAL MOUNTED CABINET
(Portable Traffic Monitoring Sites)