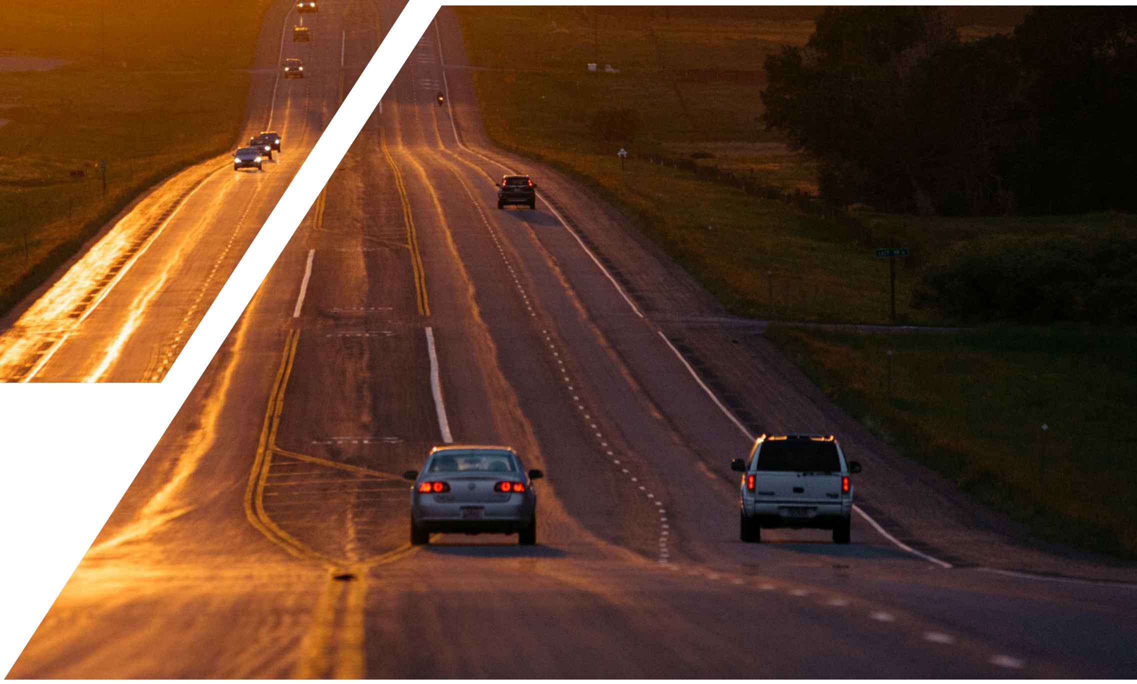
2025

Traffic Monitoring Handbook



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Abbreviations and Acronyms

AADT	Annual Average Daily Traffic
AADTT	Annual Average Daily Truck Traffic
ADT	Average Daily Traffic
AI	Artificial Intelligence
ATR	Automatic Traffic Recorder
AVMT	Annual Vehicle Miles Traveled (of Traffic)
CCS	Continuous Count Station
CFR	Congressional Federal Register
DHV	Design Hour Volume = K * ADT (usually 30th highest hour)
DVMT	Daily Vehicle Miles Traveled
ESAL	Equivalent Single-Axle Load
MADT	Monthly Average Daily Traffic
MPO	Metropolitan Planning Organization
NHS	National Highway System
NI-CCS	Non-Intrusive Continuous Count Station
NI-NHS	Non-Interstate National Highway System
RWIS	Road Weather Information Station
RP	Reference Post (Mile Post)
TDCA	Traffic Data Collection and Analysis Section
TMG	Traffic Monitoring Guide
TYC	Traffic Yearly Counts
VMT	Vehicle Miles Traveled
WIM	Weigh in Motion

Chapter 1. Traffic Monitoring Program Introduction

1.1. Purpose and Scope

Every State Department of Transportation (DOT) is required to develop, establish, and implement, on a continuing basis, a Traffic Monitoring System (TMS) to be used for obtaining highway traffic data in accordance with 23 CFR §490. This system is designed to collect highway traffic data, including traffic volume, vehicle classification and weigh in motion (WIM) that support a wide range of federal and state purposes such as funding allocation, program oversight, national performance reporting, and transportation planning. The data must be collected, analyzed, and reported in accordance with FHWA guidance and federal standards outlined in documents such as the Traffic Monitoring Guide (TMG) and the Highway Performance Monitoring System (HPMS) Field Manual. While the underlying federal requirements are consistent across all states, the implementation of each TMS may vary based on factors such as state size, roadway usage, geographic conditions, and available resources. To meet FHWA reporting requirements, TMS programs are typically organized around three core data collection activities: continuous traffic counts, short-term counts, and weigh-in-motion (WIM) programs, each supporting the systematic collection, processing, and reporting of highway traffic data (FHWA, Traffic Monitoring Guide, 2022).

To support the consistent implementation of Traffic Monitoring Systems (TMS) as required under 23 CFR §490, DOTs may choose to develop handbooks to formally document policies, procedures, and technical standards used to collect, process, and report highway and transit traffic data. While not required by regulation, such handbooks can serve as a centralized means of fulfilling federal documentation requirements, particularly when alternative procedures are used, as permitted, and must be submitted to the FHWA Division Administrator. These documents also help ensure alignment with federal expectations for systematic, precise, and continuous data collection in support of key purposes such as federal funding allocation, system performance analysis, and the design and oversight of FHWA-funded projects. When based on standards outlined in the TMG and HPMS Field Manual (FHWA, Highway Performance Monitoring System Field Manual, 2016), handbooks can promote consistency, data quality, and transparency. In this way, they function not only as internal reference tools but also as important instruments for maintaining compliance and enabling informed, data-driven decision-making.

This handbook documents procedures, practices, and operational framework of the Montana Department of Transportation's (MDT) traffic monitoring program. It provides a reference for how traffic data is collected, processed, validated, calibrated, stored, and distributed. The intent is to support consistent, high-quality data management, and ensure clarity and transparency for both internal staff and external stakeholders. In addition to serving as a guide for day-to-day operations, the handbook supports staff training, facilitates knowledge transfer, and promotes long-term program continuity. It reflects MDT's commitment to aligning with recognized traffic data collection practices and maintaining reliable data to inform transportation planning, asset management, and other decision-making efforts statewide.

1.2. Traffic Data Needs and Usage

A traffic monitoring program generates data that supports a wide range of transportation functions, from estimating travel demand to prioritizing infrastructure investments. At the Montana Department of Transportation (MDT), traffic data is collected and analyzed to address current mobility challenges, guide long-term planning efforts, and inform decisions that impact transportation system performance. In addition, the data is used in various ways, as illustrated in Table 1.

Table 1 provides an overview of how key traffic data types, such as volume, classification, weight, and speed are used across multiple highway-related activities. These applications include system design, maintenance, planning, safety evaluations, performance measurement, and environmental analysis. The table illustrates how different data elements contribute uniquely to disciplines such as engineering economics, freight operations, legislative policy, and administrative resource allocation.

By aligning its data collection efforts with these broad usage needs, MDT ensures that its traffic monitoring program remains relevant, data-driven, and supportive of both state and federal transportation goals.

Table 1 Examples of Highway Traffic Data Uses

Highway Activity	Traffic Volume	Vehicle Classification	Vehicle Weight	Vehicle Speed
Design	Highway geometry	Pavement design, bridge design	Pavement design, bridge design, and monitoring	Highway geometry
Engineering Economics	Benefit of highway improvements	Cost of vehicle operation	Benefit of truck climbing lane	Costs associated with congestion
Finance	Estimates of highway revenue and toll revenue	Highway cost allocation	Highway cost allocation	User travel time costs
Legislation	Selection of highway routes	Speed limits and oversize vehicle policy	Changing weight limits on highways	Speed limits
Maintenance	• Selecting the timing of maintenance, by lane volume for lane closure policies • Prioritizing activities. Determine bridge responsibility (State vs. local) • Determine highway striping responsibility (State vs. local)	Selection of maintenance activities	Pavement management, bridge management	Work zone safety measures

Highway Activity	Traffic Volume	Vehicle Classification	Vehicle Weight	Vehicle Speed
Operations	• Signal timing, by lane volumes • Traveler information emergency evaluation	• Development of control strategies and speed by class • Freight	• Weight enforcement activities • Freight	• Setting speed limits and speed by class • Traveler information
Planning	• Location and design of highway systems • Assignment/change of Federal Functional Classification • Prioritizing projects	Forecasts of travel by vehicle type	• Truck lanes • Truck ramps • Freight	Congestion measurement systems
Environmental Analysis	Air quality analysis, noise impact analysis	Forecasts of emissions by type of vehicle	Emissions by type of vehicle	Project-level analyses
Safety	Design of traffic control systems and accident rates	Safety conflicts due to vehicle mix and accident rates	Weight limits and regulations	Design of safety systems
Statistics	• Annual Average daily traffic • Vehicle Miles Traveled	Travel by vehicle type	Average weight by vehicle class	85th percentile
Private Sector	Location of service areas Development planning Business loans	Marketing keyed to particular vehicle types	• Trends in freight movement • Truck lanes	Accessibility to service areas
Administration, Other	Performance measurement, resource allocation, emergency operations, asset management	Lane use Tax administration	Enforcement	N/A

1.3. Traffic Data Collection and Analysis (TDCA) Section

As outlined in section 1.2, traffic data supports a wide variety of uses across transportation planning, design, maintenance, safety, and policy development. To meet these broad and growing demands, MDT relies on a structured and methodical approach to data collection and management. This responsibility is carried out by the Traffic Data Collection and Analysis (TDCA) Section, which plays a central role in ensuring that accurate, timely, and comprehensive traffic data is available to support internal operations, external reporting requirements, and stakeholder needs.

As shown in Figure 1 and Figure 2, TDCA is part of the Data and Analysis Bureau within the Asset Strategy, Operations, & Maintenance Program Area of the MDT and Electronics Equipment is within the Transportation System Management & Operations Bureau. TDCA is responsible for collecting, monitoring, processing, managing, maintaining, and reporting traffic and travel-related data across Montana's state highway systems, including Interstate, NI-NHS, Primary, Secondary, Urban and Off-system roadways. In addition, data is collected from representative data collection sites on selected local roads to support statistical sampling and reporting needs.

TDCA ensures that traffic data is accurate, consistent, accessible, and timely. This data supports internal planning, roadway design, and safety analysis, and is submitted monthly through the Travel Monitoring Analysis System and annually with final through HPMS to the Federal Highway Administration (FHWA) as part of the Highway Performance Monitoring System (HPMS) submittal. Furthermore, traffic monitoring data is made publicly available monthly as preliminary data and yearly as final data that is frequently used by federal/state/local agencies, private businesses, researchers, and other stakeholders who rely on high-quality transportation data.

TDCA fulfills its mission through three primary functions:

1. **Installation and maintenance of Continuous Count Stations (CCS):** These permanent stations use technologies such as inductive loops, piezoelectric sensors, and artificial intelligence (AI)-enabled video counters to collect continuous traffic volume, classification, weigh-in-motion, and speed data on key roadways across the state.

2. **Deployment and management of short-term portable traffic counters:** These counters are temporarily installed at various locations to gather supplemental traffic data, support statistical sampling, and fill in data gaps not covered by permanent stations.

3. **Acquisition, organization, integration, and dissemination of traffic data:** Collected data undergoes quality assurance and is then compiled for internal analysis, FHWA reporting, and public access through online platforms and published reports.

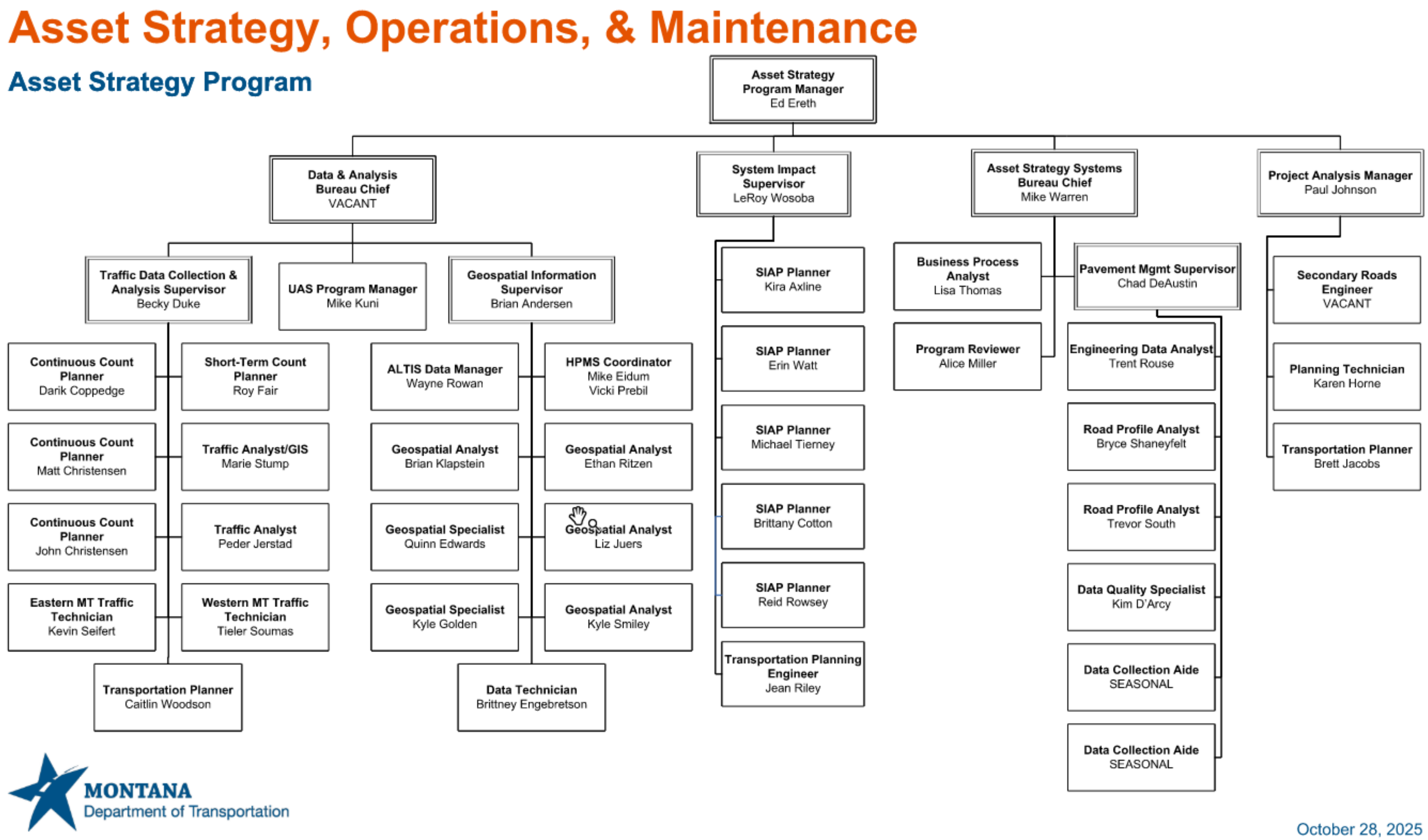

Figure 1 Organization Chart – Asset Strategy Program

Asset Strategy, Operations, & Maintenance

Transportation Systems Management & Operations Bureau

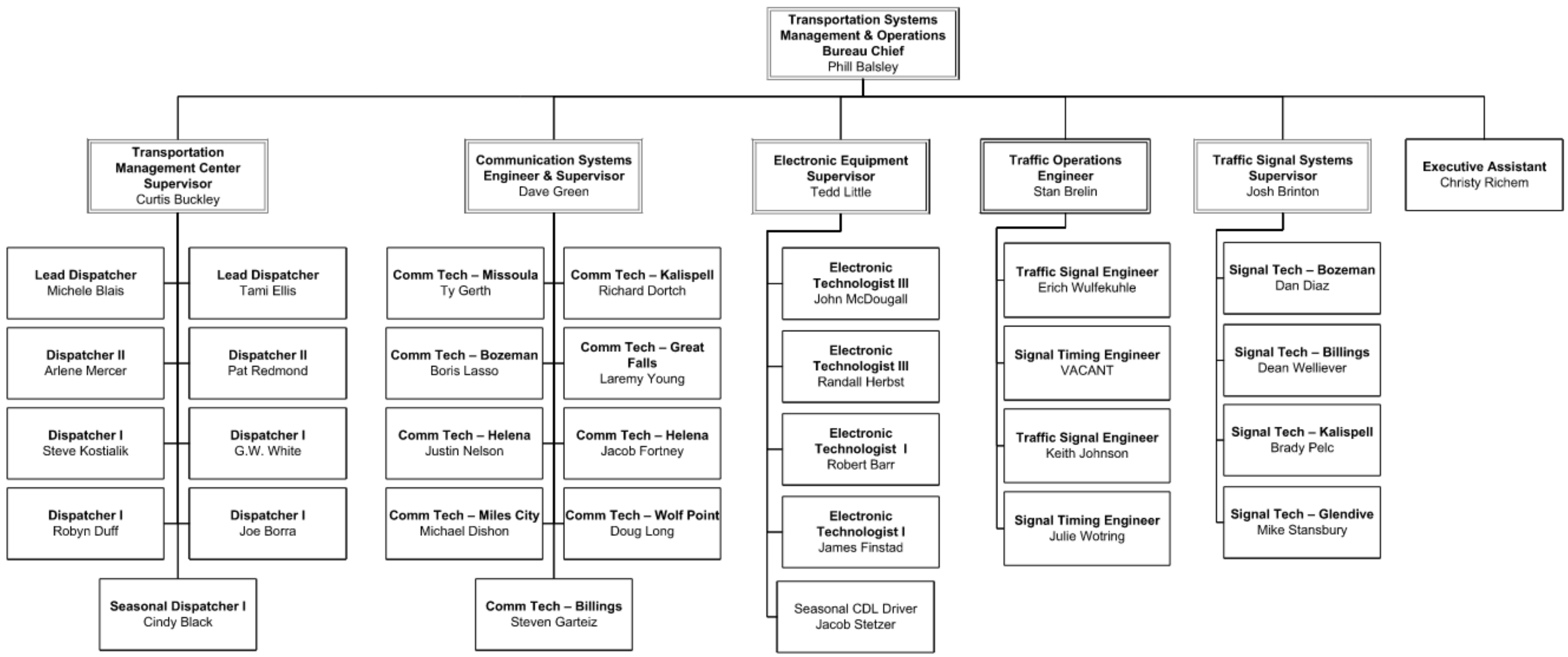

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Figure 2 Organization Chart – Transportation Systems Management & Operations Bureau

Chapter 2. Continuous Count Program

2.1. Overview of Continuous Count Stations (CSS)

Continuous Count Station (CCS) sites are the backbone of MDT's traffic monitoring program. These sites operate 24 hours a day, 7 days a week year-round and provide vital data used to develop seasonal factors for short-term counts and to observe seasonal traffic variations. As of August 30, 2025, MDT maintains over 110 CCS sites across the state, including 57 Continuous Volume Sites (CVS), formerly known as Automatic Traffic Recorders (ATR), 44 WIM sites, and 12 Non-Intrusive sites. These stations are strategically distributed across diverse geographic and economic regions to ensure representative data collection. In addition to providing volume information, a significant number of CCS sites provide information such as vehicle length, classification, truck weight data and unbiased speed data. Vehicle classification follows the 13 Vehicle Category Classification, as presented in Figure 3.

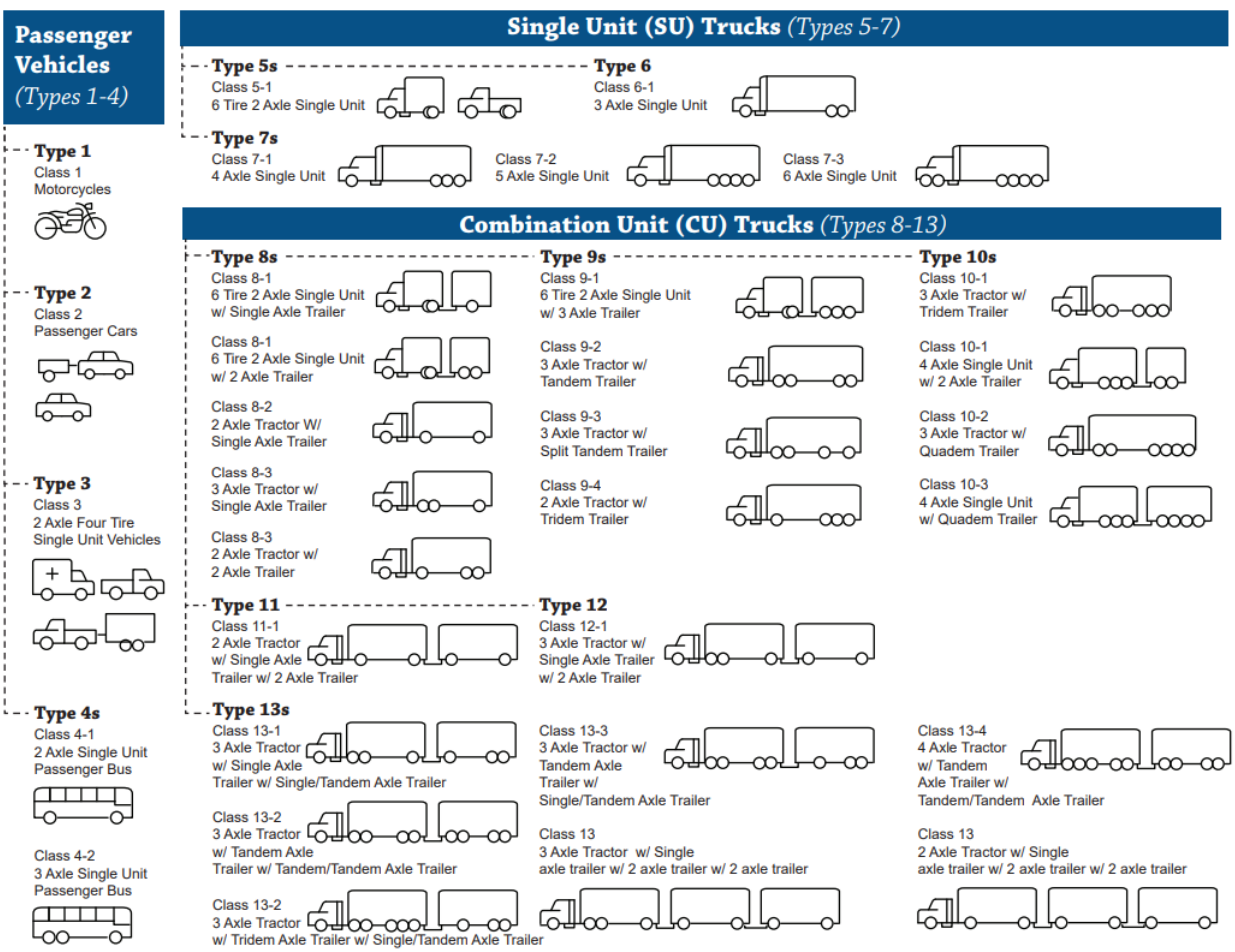


Figure 3 13-Vehicle Classification Schematic

The primary purpose of CCS sites is to obtain information for:

1. Seasonally adjusting short-term counts to estimate Annual Average Daily Traffic (AADT)
2. Providing site specific volumes (CCS AADTs), generalized peak (K) and design hour (DHV) factors for highway geometric design
3. Monitoring monthly and annual traffic trends
4. Providing long-term growth factors

2.2. Site Selection and Traffic Factor Groups

Montana is a big state with considerable geographic variety. Mountains in the west gradually give way to flatter prairie landscape that takes over in the central part of the state and continues to the eastern border. As the terrain changes, so do economic activities and travel behavior. To reflect the influence of geography and economic activity, TDCA selects site locations for CCS sites by traffic factor groups. Each group is assigned to a region (Financial District 1, for example) and road type (Rural Principal Arterial). Presented in Table 2, Montana currently has 14 traffic factor groups that represent the diverse travel patterns across the state.

Table 2 Traffic Factor Groups

Traffic Factor Group	Region and Road Type
REC_MA	Recreational on Minor Arterial roads
REC_PA	Recreational on Principal Arterial roads
RMA_RMC_12	Rural Minor Arterial and Rural Major Collector in Financial District 1 and 2
RMA_RMC_345	Rural Minor Arterial and Rural Major Collector in Financial District 3, 4 and 5
RPA_1	Rural Principal Arterial in Financial District 1
RPA_2	Rural Principal Arterial in Financial District 2
RPA_3	Rural Principal Arterial in Financial District 3
RPA_45	Rural Principal Arterial in Financial District 4 and 5
RURAL INNER INTERSTATE	Interstate roadway that falls within the travel triangle of Great Falls, Missoula, and Billings
RURAL OUTER INTERSTATE	Interstate roadway that falls outside of the travel triangle of Great Falls, Missoula, and Billings
UI	Urban Interstate
UMA_UC	Urban Minor Arterial and Urban Collector
UPA	Urban Principal Arterial
NI_URB*	Non-Interstate Urban. * This is an axle factor that gets applied to UMA_UC and UPA seasonal factor groups.

All roadways are categorized into Traffic Factor Groups based on their operational characteristics and the region they serve. These groupings are essential for developing seasonal adjustment factors, which are applied to short-term traffic counts to estimate AADT. The purpose of these groups is to ensure that roadway classifications with similar traffic behavior are adjusted using factors that reflect their specific seasonal patterns.

In 2020, TDCA created these traffic factor groups based on the MDT financial districts, shown in Figure 4. This regional structure allows for more localized adjustment factors, improving the accuracy of AADT estimates by accounting for geographic and economic variations across the state. Ideally, each traffic factor group would have its own adjustment factor derived from data collected at permanent CCS sites. However, in urban areas, there are currently not enough CCS sites to support the development of reliable region-specific factors. The TDCA is addressing this issue directly and is in the process of installing 2 non-intrusive CCS sites in each of Montana's five MPO areas. As a result, short-term traffic counts in urban areas are adjusted currently using a statewide factor, which is calculated using CCS data from across all regions. When the new sites are available the factors will be updated.

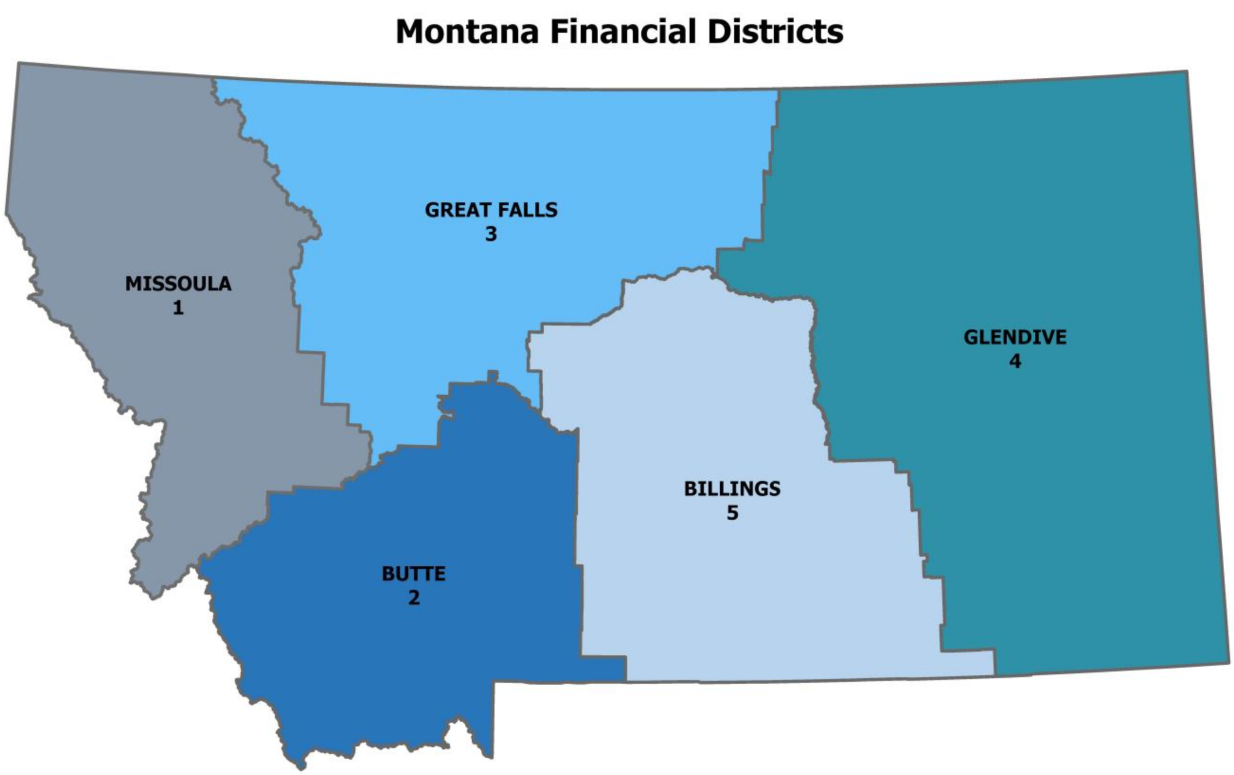


Figure 4 MDT Financial Districts

For reference, MDT roadways are organized according to a structured functional classification system, which categorizes roads based on the type of service they provide within the overall highway network (Figure 5).

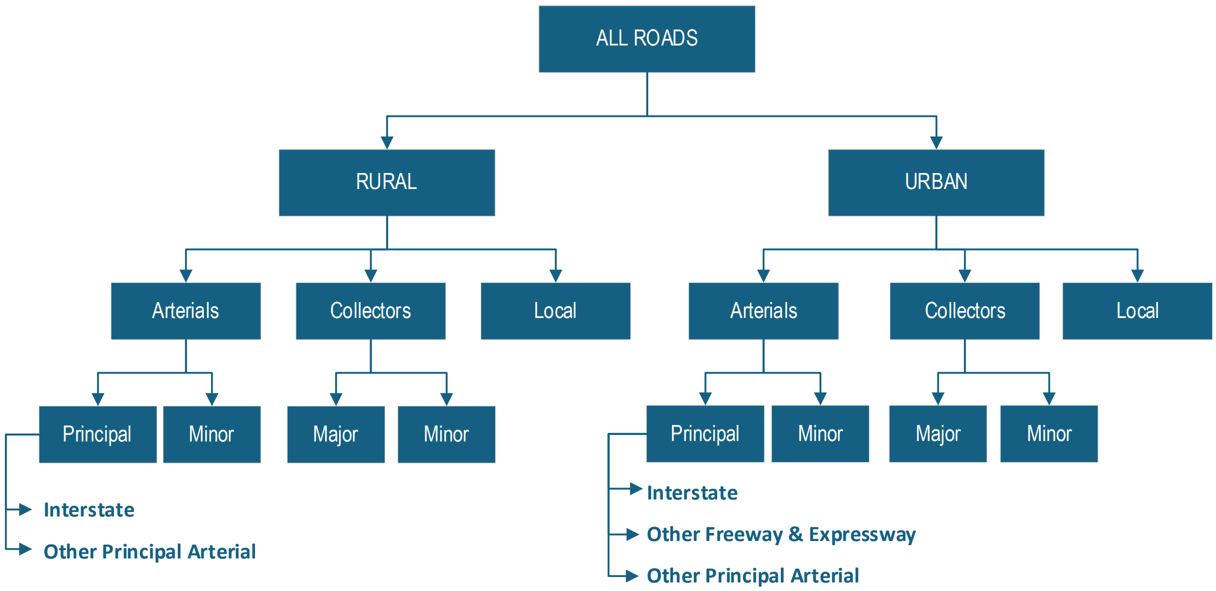


Figure 5 Highway Functional Classification

Thus, with Traffic Factor Groups in mind, new CCS locations are selected based on a combination of geographic diversity, roadway classification, and the need to capture representative traffic patterns. The decision to add or remove the CCS site is based on several key considerations:

- **Justification for additions or removals:** Sites are evaluated to determine whether they fulfill current data needs. New sites may be added where coverage is lacking, while existing sites may be removed if they no longer serve a representative purpose. Sites may be retired if they are no longer reflective of the surrounding area's travel behavior or if better, more representative locations are identified.
- **Regional and factor group relevance:** New CCS locations are prioritized in areas where traffic patterns are underrepresented within a specific Traffic Factor Group or regional context.

2.3. CCS Site Types and Technologies

CCS sites in Montana are designed to support long-term traffic data collection through a range of site types and technologies. The primary CCS site type is the Continuous Volume Site (CVS), formerly Automatic Traffic Recorder (ATR). Other sites such a CVC and WIM sites also provide volume data that is used by MDT for factoring and for other uses. These stations are installed on various roadway types, including interstates, U.S. highways, state routes, and secondary roads. CCS technologies typically include in-road sensors such as inductive loops and piezoelectric sensors, paired with roadside data loggers and communication equipment. Power for these sites is supplied either through grid connections (AC) or solar panels, depending on site location and infrastructure availability.

As part of a strategic initiative to modernize its data collection capabilities, MDT has a 3-year plan in place to transition all non-WIM CCS sites to non-intrusive (with a focus wherever possible to utilize RWIS locations which saves MDT a considerable amount of funds), AI-based traffic data collection technologies. This shift aims to reduce maintenance costs, improve safety during installation and servicing, and enhance the accuracy and timeliness of traffic data. Non-intrusive systems typically use roadside-mounted sensors and cameras integrated with artificial intelligence to classify and count vehicles without the need for lane closures, pavement cuts or embedded hardware.

This section provides an overview of the configurations and technologies used to support Montana's CCS network. Figure 6 shows MDT's CCS sites.

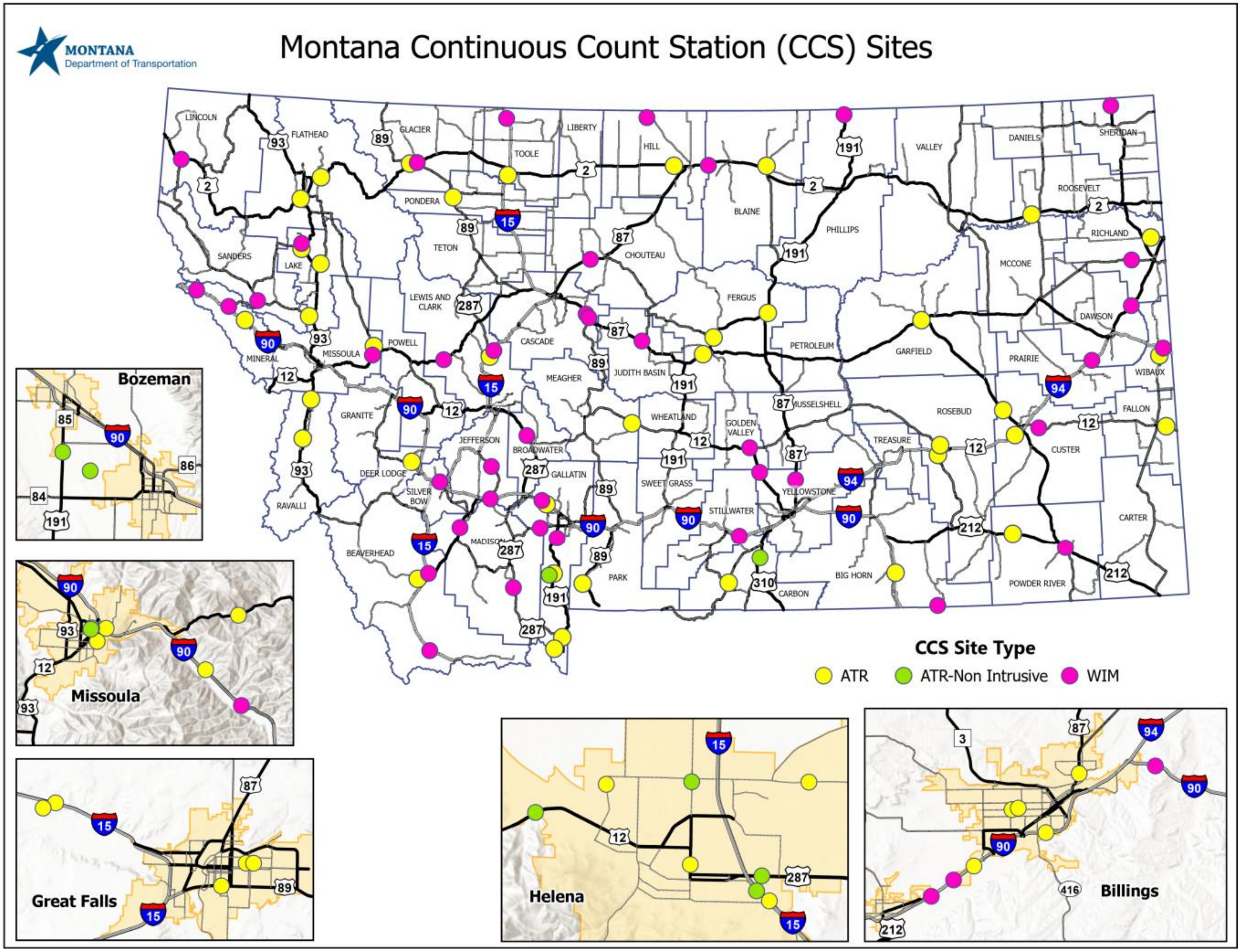


Figure 6 MDT's Continuous Count Stations
Source: *Montana Department of Transportation (2024)*

2.3.1 Loop and Piezoelectric Sensor Sites

MDT currently uses Diamond counters (https://diamondtraffic.com/) for in-road, non-WIM traffic data collection. Depending on the age of the site and the amount of congestion, these sites can have different configurations:

- **One inductive loop per lane:** These sites are in congested urban areas with stop and go traffic. One loop provides volume detection but is unable to classify vehicles. Inductive loop volumes are collected and stored in 15-minute intervals, commonly referred to as bins.

- **Two inductive loops per lane:** These older sites were installed as early classifier sites. They originally were often installed in a loop-piezo-loop to collect FHWA 1-13 vehicle data. Most of the piezoelectric sensors have failed at these sites, and the two existing loops provide volume, class by length (not FHWA 1-13), and speed data. Like the single inductive loop counters, vehicle counts, classifications, and speeds are collected and stored in 15-minute bins.

- **Two and four-piezo per lane:** These sites use multiple piezoelectric sensors to distinguish vehicles by axle spacing. They collect FHWA 1-13 classification data along with speed and volume data. This configuration of CCS site is set up to collect Individual Vehicle Records where timestamped data is recorded for each vehicle crossing the sensors.

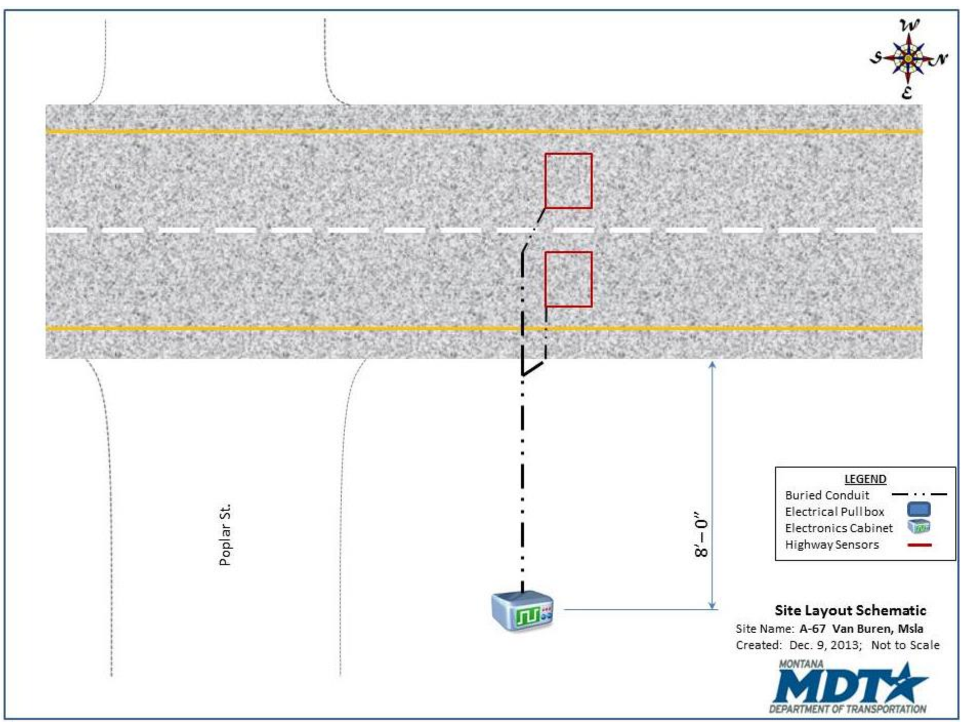


Figure 7 One Inductive Loop per Lane at Van Buren Street, Missoula
Source: *Montana Department of Transportation*

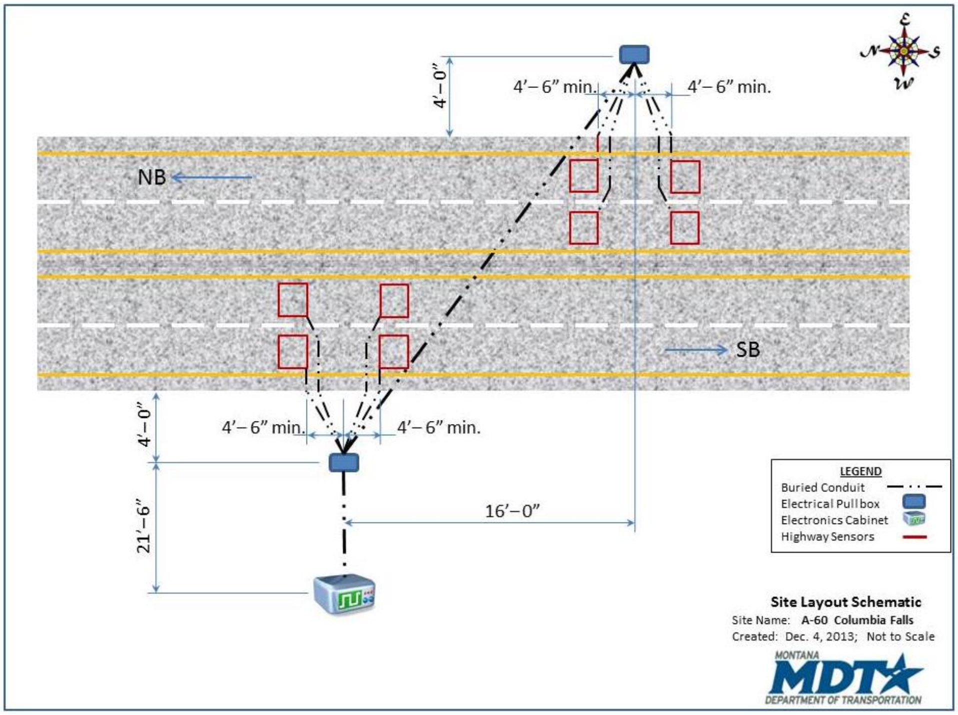


Figure 8 Two Inductive Loops per Lane at Columbia Falls
Source: *Montana Department of Transportation*

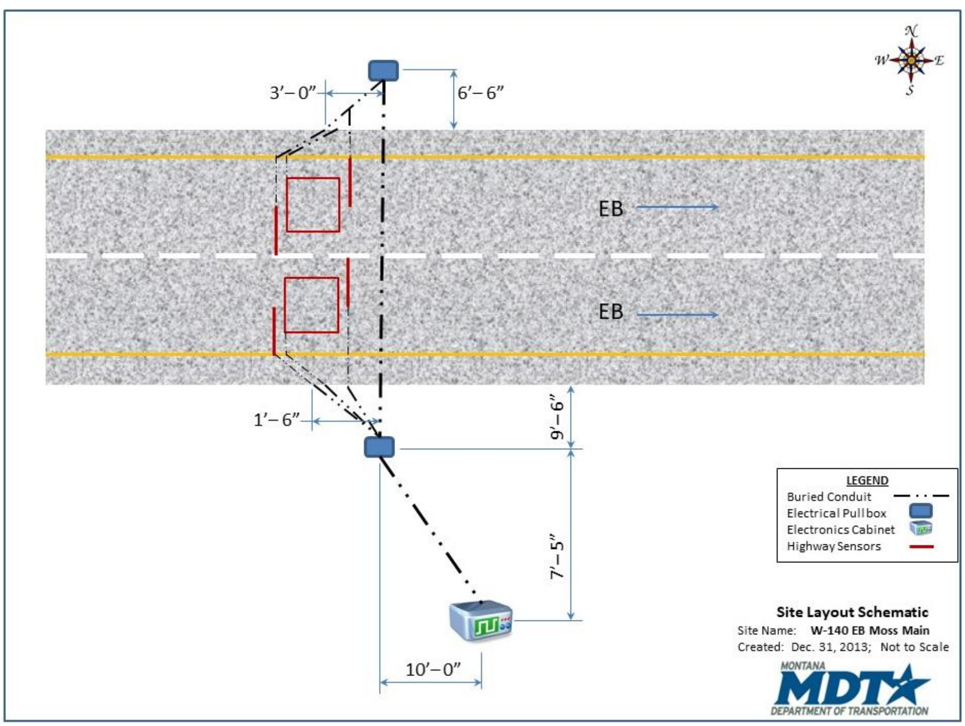


Figure 9 One Inductive Loop and Two Piezos per Lane at Moss Main
Source: *Montana Department of Transportation*

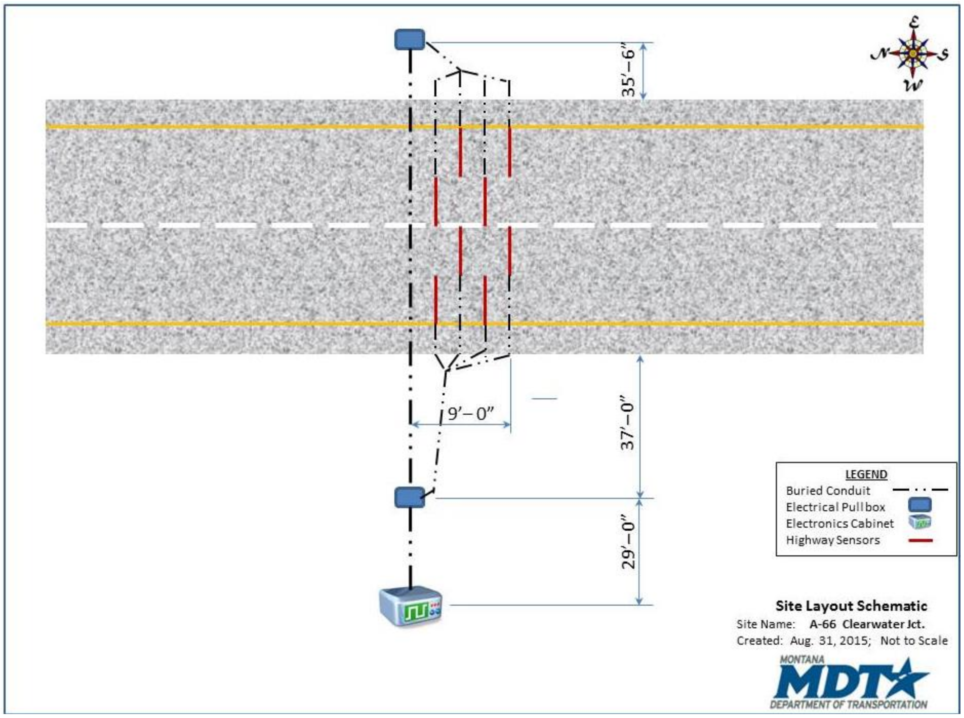


Figure 10 Four Piezos per Lane at Clearwater Jct.
***Source:** Montana Department of Transportation*

2.3.2 Weigh-in-Motion Sites

WIM sites use ceramic-quartz (Kistler Lineas) sensors and create Individual Vehicle Records (IVR) for classes 1-13 along with vehicle length, axle spacing by lane and direction . They collect and record vehicle weights along with volume, speed, and classification data. MDT began collecting weight data in the 1990's and has used Electronique Controle Mesure (ECM) Hestia controllers until switching to Kistler datalogger controllers in 2023. Most of MDTs WIM systems currently deployed are the older ECM controllers. The Hestia systems are no longer made or supported by ECM, so MDT has extra incentive to phase these systems out as soon as is feasible. Most WIM systems consist of two piezoelectric sensors with an inductive loop in between the sensors. MDT is transitioning to Kistler Data Loggers for WIM sites which will now be a loop, piezo, loop and piezo array. This is detailed in the FHWA WIM Pocket Guide as a single threshold WIM array (weighing each side of each axle once) (FHWA, Weigh-In-Motion Pocket Guide Part 1: WIM Technology, Data Acquisition, and Procurement Guide, 2018) (FHWA, Weigh-In-Motion Pocket Guide Part 2: WIM Site Selection, Design, and Installation Guide, 2018) (FHWA, Weigh-In-Motion Pocket Guide Part 3: WIM Calibration and Maintenance Guide, 2018). Some WIM systems located near Weigh Stations have more piezo sensors to more accurately determine weights and whether a commercial vehicle is operating within its permitted limits.

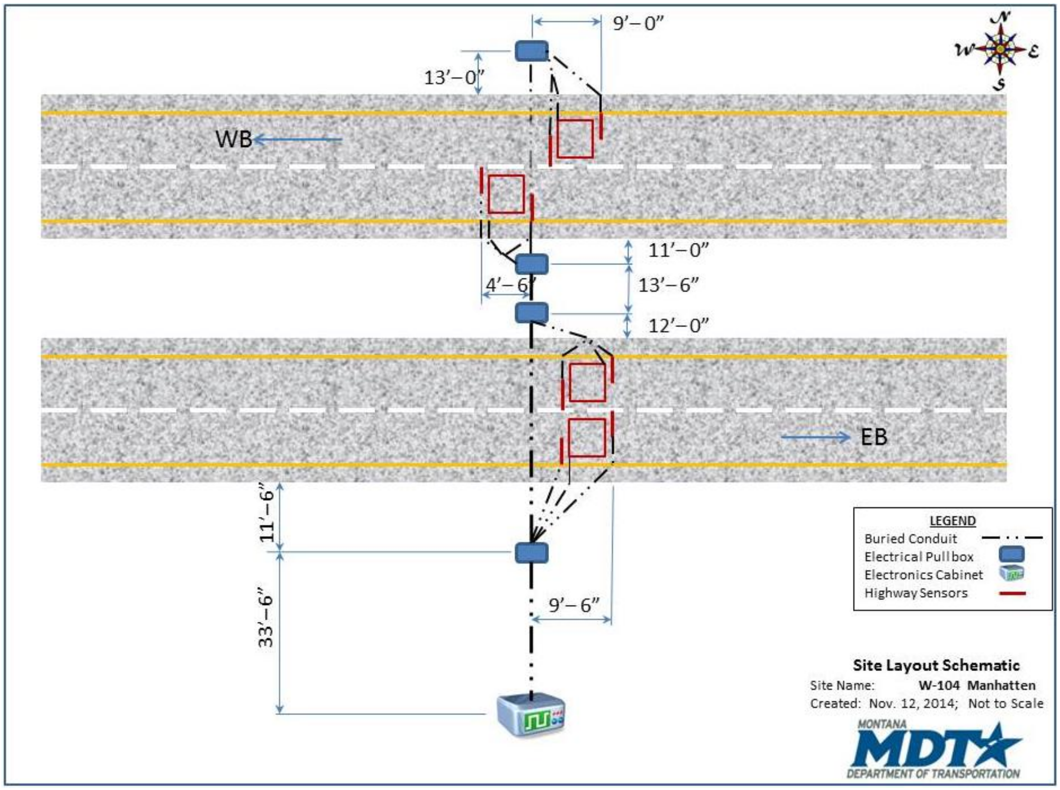


Figure 11 Weigh-in-Motion Schematic
Source: *Montana Department of Transportation*

2.3.3 Non-Intrusive AI Sites

Non-intrusive video sites use cameras linked to computers with AI processing abilities to classify vehicles. MDT currently uses Leetron Vision AI traffic counters (https://www.leetronvision.com/). A relatively new technology, AI traffic cameras/counters offer many benefits. Leetron offers IVR, class and speed data. Because the data is time stamped, metrics such as gaps and headways can also be computed. They collect the same data (except for number of axles and vehicle length are not yet provided) as the MDT's piezoelectric sensor Diamond counters, but no infrastructure needs to be embedded in/on the road surface. Equipment can be installed and maintained without the need for lane closures or workers having to be on the roadway. Also, pavement deterioration and construction projects do not impact the counters. AI counters do not require free-flowing traffic, so vehicles can be correctly counted and classified in most conditions. MDT intends to replace all non-WIM CCS sites with non-intrusive AI traffic counters as budgets allow, and as in-road sites reach the end of their service life. This transition to the AI-video counting systems will focus on RWIS installations because of the need for installing poles, power and communications.

Figure 12 Leetron Video Counter (Non-Intrusive) at Prospect Ave (US 12), W of Gibbon St
Source: *Montana Department of Transportation, 2014*

2.4. Installation and Maintenance

2.4.1 Electronics Equipment Section

The Electronics Equipment Section (EES) is part of the Transportation Systems Management and Operations (TSMO) Bureau and is responsible for installing, maintaining, and repairing all traffic counting equipment. This includes both CCS sites and portable pneumatic traffic counters used for short-term data collection. The EES ensures that all equipment remains operational and provides accurate and reliable traffic data to support planning, operations, and reporting efforts. The unit also conducts equipment calibration once per year (either in the spring or fall with more often calibrations performed if data indicates a calibration is necessary).

In addition to scheduled maintenance and deployment support, the EES also performs equipment repairs, especially for devices that are no longer covered under manufacturer warranty. This helps extend the life of existing systems and reduces the need for frequent replacements.

2.4.2 Field Inspections of Traffic Monitoring Sites

The following steps outline the recommended process that is used by all technicians when inspecting and inventorying a continuous site. The significant difference between continuous and short-term sites is the duration of the count, the wireless modem connection required for transmitting the data daily and the solar panel that supplies power to the battery.

When an issue is identified in the field, the technician documents the problem thoroughly. This typically includes capturing photos of the equipment or surroundings, performing a manual vehicle count using a Leetron system if needed, and recording any relevant observations. If further action is required, a work order is generated based on the findings for further actions. A sample work order form is appended for reference.

At The Site

Upon arrival at the field site, the technicians follow the MDT standard steps 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 put on their safety vest 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 strives to always face oncoming traffic and be alert whenever making field measurements and checking in-road devices or those adjacent to the travel lanes. MDT staff follow this safety protocol: Personal Protective Equipment (PPE) POL/PRO: 2-05-001 (MDT, 2023).

Sensor Configuration Inspection

- **Check Condition**: TDCA personnel visually inspect loops and piezos for rutting, cracking, and breaks that are reported for EES staff to then address. With sensor inspections 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. Instead, use a blunt, non-metallic tool such as a plastic probe or wooden dowel to gently check the depth without harming the sensors.
- **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 two piezos. Other sites may have different array configurations that may vary from site to site. If the data is found to be incorrect, staff checks to see if the site is programmed to match the site layout (array) and possible adjustments will be made to correct issues.
- **Measure Spacing:** With a wheel or tape measure, check loops to ensure that spacing is confirmed to be correctly done (often 16 feet from leading edge to leading edge). Each loop should measure 6 x 6 feet. The piezo should be installed per the manufacturer's specifications or often is centered between the two loops.

- **Check Sealant and Grout:** Visually check that the loop slot is filled with sealant and that the sealant is flush with the pavement. 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 sealants and grout compliance. If the loop slot is empty or has gaps, and/or if the piezo grout is concave, the EES technician should fill in with appropriate sealant.
- **Check Pull-Box:** Check the pull-box for correct installation. Pull-boxes should be located a minimum of 8 feet from the edge of the 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 home run cables if used will grounded in the cabinet. Piezo wires should not be spliced but simply passed through directly to the cabinet. Look for evidence of mice and other pests when inspecting the pull box. Mice can cause significant damage to the wiring. Other pests (wasp nests and snakes etc..) can be a safety hazard.

Cabinet Inspection

- **Take Photos:** Site photos are a visual record of the cabinet conditions, configuration, and cabinet inventory. The photos should include sensors, counters, pull-boxes, and inside and outside of the cabinet. All photos should be uploaded and attached to the cabinet inventory. The Figure 13 illustrates various control cabinets.

- **Check Fasteners:** Check that the cabinet is securely fastened and that it is good and tight. There should not be any excessive rust on bolts, nuts or brackets.

- **Check Height:** 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 seals on all entry holes, including internal conduit, not only for water and pests but also mice.

- **Check Wiring Harness:** Check and verify that the wiring harness is present and correctly installed, routed according to site specifications, and securely fastened with clips, ties, or mounts. Ensure all connectors are fully seated and properly matched, with no loose, pinched, frayed, or exposed wires. The harness should not interfere with moving parts or sharp edges, and all connections must be secure and free of visible damage.

- **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:** Record GPS coordinates for the site, if not already present, measure and record in ArcGIS Field Maps. The GPS coordinates help technicians locate the cabinet and ensure that the GIS maps are accurate. Output should be expressed in degrees with 5 decimal places to be consistent with the database.

Figure 13 Various Control Cabinets

Source: *Montana Department of Transportation*

Loop Inspections

Inductive loops are electromagnetic sensors installed on the road surface, typically in the form of wire loops embedded in the pavement 4" to 5" deep to avoid mill and fill re-paving operations. These loops detect vehicles as they pass over or stop on them. Inductive loop detectors operate by circulating a low alternating electrical current through a formed wire coil embedded in the pavement. The alternating current creates an electromagnetic field above the formed wire coil (1/2 the field height corresponding to the shortest leg of the loop), and a conductive object (e.g., car, truck, and bike) passing through the electromagnetic field will disrupt the field by a measurable amount. If this disruption meets predetermined criteria, then detection occurs, and an object is counted by a data logger or computer controller. Loop home run wiring should be twisted at 6-8 twists per foot rate to avoid cross talk between different loop wires.

- **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.

- **Measure Loop Inductance:** Loop inductance refers to the ability of a wire loop to store energy in a magnetic field when electrical current flows through it. It is a critical parameter in vehicle detection systems, where the inductive loop senses the presence of a vehicle by detecting changes in inductance. Accurate inductance ensures reliable operation and minimizes false detections or missed vehicles. To measure inductance, use an LCR meter. A properly installed **four-turn** loop should read a minimum of 100 microhenries. The loop is typically installed on a square or rectangular channel cut into the pavement, about 0.25 inches wide, where the wire is laid. A "four-turn loop" means the wire is wound through the channel four times, forming a continuous loop that follows the shape of the cut, including any angled corners.

- **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 Megaohms 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.

Figure 14 ATR Sensors (Inductive Loop and Piezo) at Henderson
Source: *Montana Department of Transportation*

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, 5 volts peak for a truck.

- **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.

Check Communications

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

Check Power

- **Solar Panel:** Refer to Design Specification 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 underload 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.

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 volume, class, speed, and/or weight 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.

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 paperwork for the site is in the plastic bag or pocket attached to the panel door.
- Be sure that all fields are completed and the proper equipment type is circled in all forms.
- Take photos of the installation, location, cabinet mounting and signage.
- Return all tools and test equipment to your vehicle and secure them for safety.
- Ensure the office staff can dial into the site remotely.
- Be sure that vehicular flashers and turn signals are used to safely re-enter the traffic stream when traffic permits.

2.5. Data Collection Process

MDT's Continuous Count Program operates through a structured process designed to ensure the timely collection and validation of statewide traffic data. Each day, CCS sites across the state are polled remotely using wireless cellular modems. Most sites are integrated with MS2's autopoll extension, which automatically retrieves traffic data and populates it into the MS2 system the following day. However, approximately 30 older ECM WIM systems, which are not compatible with autopoll, are polled by MDT Planning Staff using ECM polling software, with data files stored on a local computer. Then the data is transferred to MS2 by MDT staff. While around 30 systems remain in manual polling, MDT aims to reduce this number significantly, ideally to zero, by the end of the year.

Once data from each site is retrieved, it enters a validation phase. The system or staff assesses whether the data is both complete and valid. If the data meets quality standards, it is accepted for reporting and analysis, contributing to AADT estimation and traffic trend monitoring. If the data is found to be incomplete or erroneous, the system either automatically re-polls the site or flags it for further inspection and possible equipment maintenance. Quality Assurance Measures section 2.6 provides further details.

Collected data is reported in two primary formats:

- **15-minute Intervals (bins):** These are standard for most loop and piezo sensor sites, capturing vehicle volume, speed, and classification in short, regular time slices. In this context, a "bin" refers to a fixed time segment used to group and summarize traffic data for analysis and reporting.

- **Individual Vehicle Records (IVRs):** Used primarily at WIM, AI video counters and advanced piezo sites. IVRs provide detailed, timestamped data for each vehicle, including weight, speed, axle spacing, and classification. This level of granularity allows for precise analysis of traffic patterns, vehicle types, and roadway impacts, making IVRs the gold standard for traffic data collection. Unlike aggregated data in time bins, IVRs enable high-resolution insights for pavement design, freight analysis, gap/headway, enforcement, and planning decisions.

Figure 15 presents the continuous count program data collection workflow. This process forms the foundation of MDT's long-term transportation planning and investment strategies.

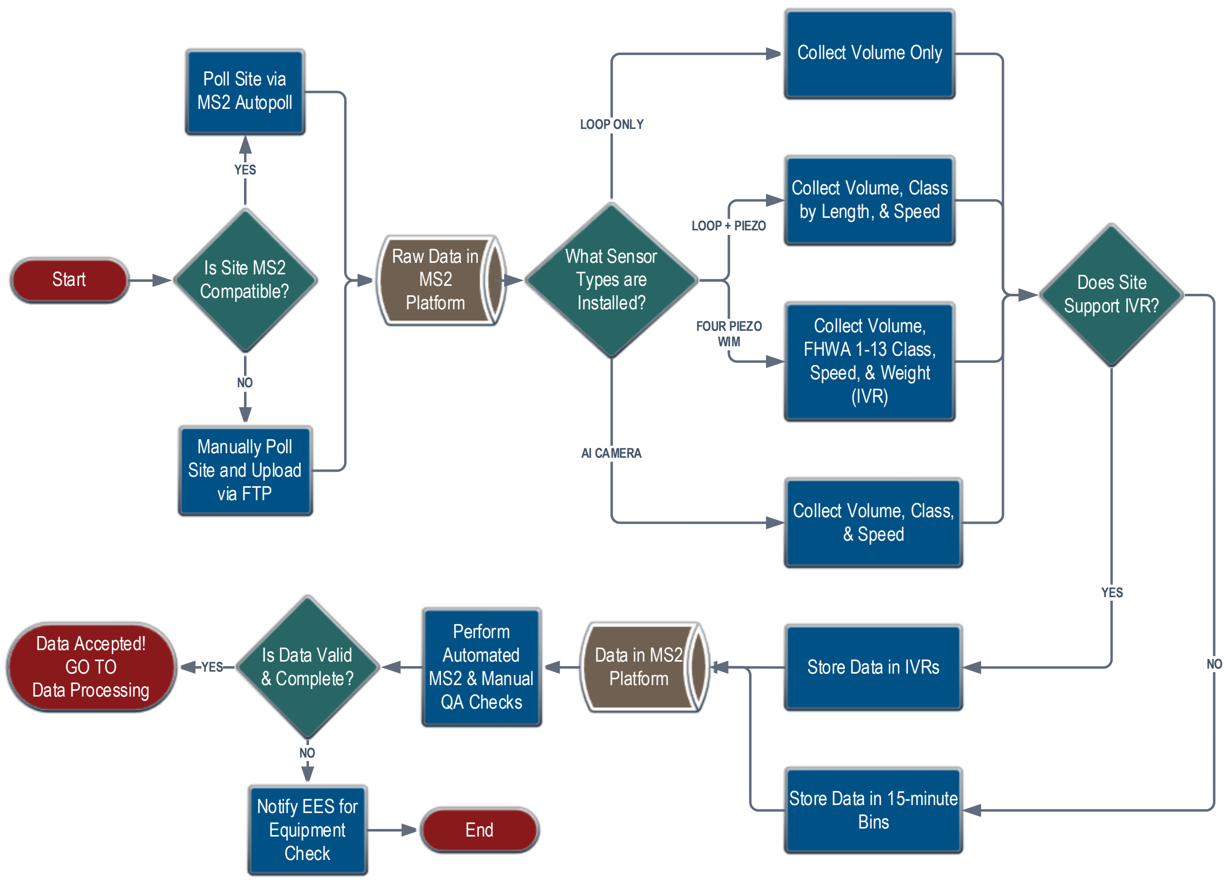


Figure 15 Continuous Count Program Data Collection Workflow

2.6. Quality Assurance

To make sure traffic data is accurate and reliable, TDCA uses both automated tools and manual reviews. These quality checks help detect errors or unusual patterns, known as *atypical data*, so only reliable information is used for statewide planning and analysis.

2.6.1 Automated Checks

Each day, when traffic data is uploaded to the MS2 software platform, it goes through automatic validation. These built-in tools look for issues like missing data or numbers that don't match expected traffic patterns. When atypical data is found, such as traffic counts that are too high or too low compared to the standard travel trend found at a given roadway segment, it gets flagged for further review. Typical automated checks include:

- Missing data
- Incomplete day or interval detection
- Abnormally high or low volume
- Speed out-of-range
- Weight out-of-range (for WIM data)
- Sudden spike/drop in counts between intervals
- Duplicate record detection
- Flatline or repeated identical values
- Sensor communication failure
- Unexpected classification patterns
- Inconsistent axle spacing or counts
- Volume-speed consistency
- Classification-weight mismatch
- Data format and structure validation
- Timestamp errors or overlaps
- Seasonal and day-of-week pattern comparison
- Corrupted or partial data file identification

2.6.2 Manual Review

TDCA staff also conduct weekly visual inspections of traffic data using graphs and reports on the MS2 system. During these reviews, staff look for flags such as zero-hour counts, atypical directional splits, unusual speed patterns, and anomalies in vehicle classification. These checks help identify irregular trends that may not trigger automated alerts, such as gradually decreasing counts due to sensor wear or damage. For example, if a sensor at a busy urban site shows steadily declining traffic over several weeks, staff may review past data or inspect the site to see if something is wrong with the equipment. Figure 16 illustrates a zero-hour count that should be flagged for inspection.

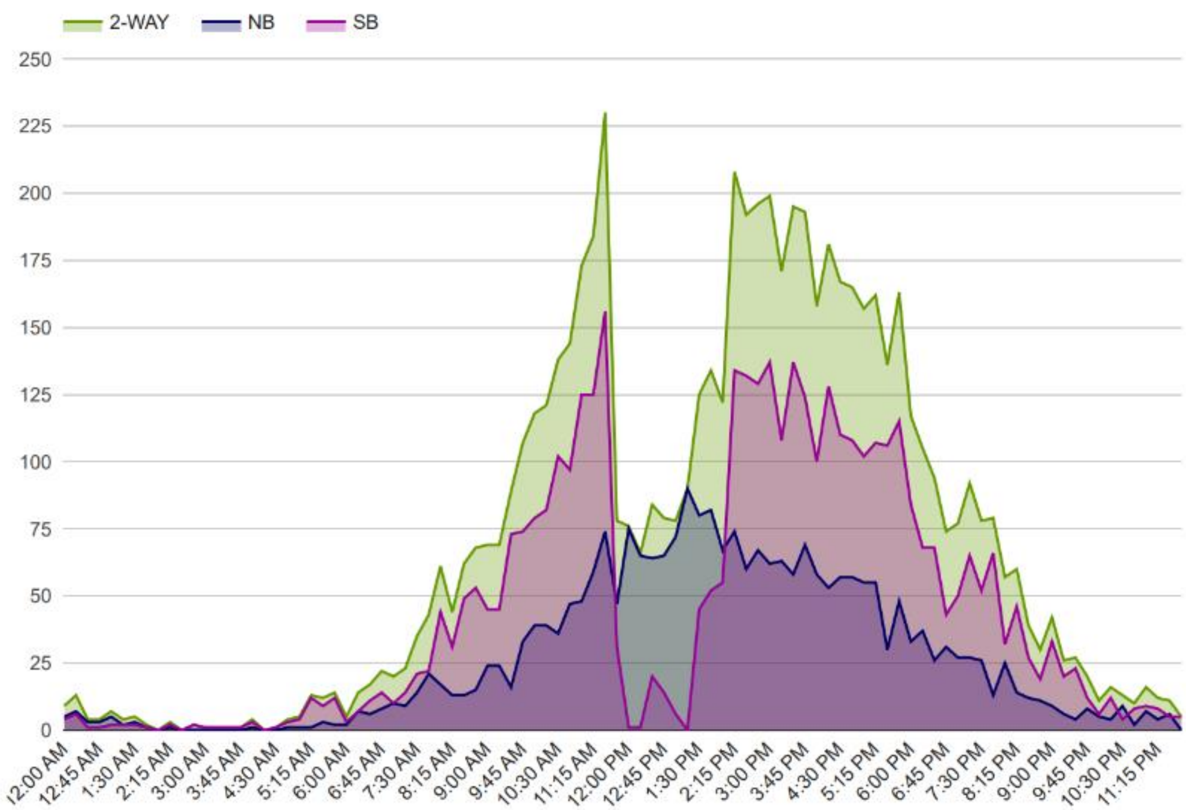


Figure 16 "Bad" Data Example

2.6.3 Handling Atypical Data

When data is flagged as atypical in the MS2 system, it is excluded from calculations used to develop factors, such as Monthly Day-of-Week (MDOW) or seasonal adjustment factors, to avoid skewing broader trends. However, if the data still provides reasonable insight for a specific location, it may still be used to generate the site's AADT estimate.

> ***Atypical data*** *refers to traffic data that significantly deviates from expected patterns (typically a 20% deviation) due to unusual events, equipment errors, or anomalies. This includes data that is abnormally high, low, inconsistent, or incomplete compared to historical trends or neighboring days.*
>
> ***Example:*** *A traffic site that normally records 12,000 vehicles per day suddenly logs 25,000 due to a nearby construction detour. This unexpected spike would be flagged as atypical because it doesn't represent normal conditions and could distort broader traffic factor calculations.*

Quality assurance doesn't stop once data is collected. TDCA continues to monitor data for consistency over time. If problems are found, they may re-poll the site, request maintenance, or investigate the issue further. By combining automated checks with expert review, TDCA ensures that only high-quality traffic data is used to support transportation decisions, project planning, and public safety across Montana.

2.6.4 Validation Counts

Most permanent sites are validated through remote analysis. With a strong historical dataset and reliable data patterns, it is often possible to confirm the accuracy of a location without deploying equipment in the field. This remote validation involves reviewing past trends, comparing data across similar sites, and identifying any anomalies that may indicate a change in conditions. It offers an efficient way to maintain data integrity while reducing the need for field visits. If remote validation is not sufficient due to missing data, irregular patterns, or known site changes a validation count can be performed. Table 3 summarizes the key attributes of the validation count procedure, including its purpose, frequency, and method of implementation.

Table 3 Attributes of Validation Counts

Validation Count Attribute	Description
Purpose	These counts help ensure that permanent installations continue to reflect typical traffic or environmental conditions.
Frequency	Validation counts are typically conducted 1–2 times per year at each site (not at AI video sites, they are checked another way see 2.6.4), or as needed based on data review or changes at the site.
Method	A portable Leetron is deployed at a location for 24 hours to verify the accuracy of the original location to confirm consistent data quality.

2.7. Data Storage and Management

All CCS and sort-term count data is stored in the MS2 Traffic Count Database System (TCDS). This centralized platform serves as the official repository for statewide traffic volume, speed, class, WIM and all related (K-Factor Hour, D – Directional Distribution, DHV – Design Hour Volume, etc.) traffic monitoring statistical data. This supports consistent data organization, long-term storage, and easy access for planning and reporting. The MS2 system is designed to handle data from a wide range of equipment types, including loop detectors, pneumatic tube traffic counters, non-intrusive (AI camera and radar equipment), piezoelectric sensors, and WIM systems. It standardizes inputs from various formats and technologies, so that users can efficiently analyze traffic volumes, classifications, and trends. A list of traffic monitoring statistics can be found in Table 4.

.

Table 4 Traffic Statistics in MS2 TCDS

Item	Definition
Year	Year of data collection
AADT	Annual Average Daily Traffic, the average (mean) traffic volume across all days for a year for a given location
DHV-30	Design Hour Volume – For Perm Stations this is the 30th Highest Hour for the year. For non-Perm Stations, this is the highest hour. The accuracy of either is dependent on when and how much raw data was collected. If the volume is axle-tube based, Axle Factors are applied if available.
K%	K-Factor –the proportion of AADT occurring in the peak hour (DHV-30) as a percentage of the AADT.
D%	Directional Factor – Percentage of peak hour volume (24-hour peak) in the peak direction during that hour.
PA	Passenger vehicles (FHWA Class 1-3) shown in number of vehicles and percentage of AADT
BC	Business/commercial vehicles (FHWA Classes 4 to 13) shown in number of vehicles and percentage of AADT
Src	Source of AADT calculation (e.g. Actual or Estimate)

Source: MS2 TCDS

In addition to traffic data, the system stores metadata such as site location (GPS, reference markers, descriptions, etc.), sensor type, collection method, polling frequency, factor group assigned, and validation results. This information helps ensure data traceability and quality control. MS2 also provides tools for:

- Calculating metrics such as AADT, seasonal factors, and hourly distributions
- Trend monitoring and performance analysis
- Generating reports for internal use and compliance with FHWA requirements
- Mapping and visualization, allowing to view traffic sites and patterns geographically

Chapter 3. Short-Term Count Program

3.1. Overview of Short-Term Count Stations

Short-term counts fill the gaps between CCS sites. MDT monitors over 7,000 traffic segments annually using portable equipment, which typically remains in place for 48 hours. This approach allows for broader geographic coverage and supports trend analysis. These counts, also known as coverage counts, make up the bulk of the Department's traffic count program.

3.2. Types of Counts, Collection Periods and Duration

3.2.1 Volume Counts

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

1. **Axle Volume Counts:** These are obtained when a single road tube is placed across a roadway, typically using Diamond counters. These counters register each axle as a separate hit and are configured to count every two axles as one "vehicle". So, the initial volume is calculated as axle count divided by 2. However, this conversion doesn't account for variations in axle configurations across different vehicle types. To address this, MS2 applies an additional axle adjustment factor, during year-end processing to more accurately convert axle counts into vehicle counts.

2. **Vehicle Volume Counts:** These are obtained from counters using sensors that detect an entire vehicle, not simply its axles with a dual tube class counter array. The most commonly used type of these sensors are non-intrusive AI video counters or dual tube class counts since MDT does not use portable volume counts from loops.

3.2.2 Classification Counts

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 by the criteria contained in 13 Vehicle Category Classification (Figure 3). Classification data are usually collected using a combination of vehicular presence (loops) and piezoelectric axle sensors.

3.2.3 Acceptable Time Periods and 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. Table 5 presents several guidelines that should be followed to help maximize collecting typical data.

Table 5 Guidelines for Acceptable Data Collection Time Periods

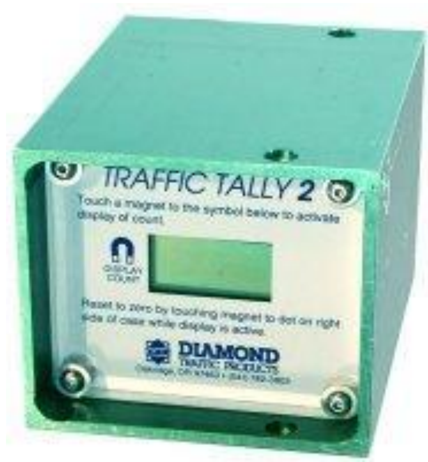
Acceptable Time Period	Data Collection Guidelines
Monday 6:00 a.m. through Friday 2:00 p.m.	Counts should take place between Mondays 6:00 a.m. and Friday 2:00 p.m. and should consist of 48 consecutive hours of hourly counts to ensure that every hour of the day is represented.
April through September	Counts should take place between April through September to capture travel patterns during months with more favorable weather and typical traffic conditions.
Avoid holidays or special events	Collecting data prior to, during, or right after, holidays or special events, should be avoided, as these periods can significantly alter typical travel behavior and skew the data.

3.3. Portable Traffic Count Equipment

3.3.1 Diamond Unicorn/Omega Pneumatic Tube Counters

Most of the counts collected each year by MDT's short term count program are taken with Diamond Unicorn pneumatic tube counters. These counters can be used to collect axle counts with a single road tube. In situations where traffic is free flowing, two road tubes can be used to collect classification data, as shown in Figure 17. This setup is accompanied by equipment like what is depicted in Figure 18.

Figure 17 MDT Field Technician Setting up Road Tube Counter
Source: *Montana Department of Transportation*



Counter

Classifier

Figure 18 Counter and Classifier
Source: Diamond Traffic

Like all equipment, road tube counters must be properly set up to work correctly. A poorly installed counter can produce inaccurate or unusable data, so attention to detail during installation is essential. Below are guidelines for road tube counters:

- Inspect the tube for damage before installation. Cracks, holes, or wear can compromise the accuracy of data.

- Choose an appropriate location that ensures the most reliable and useful data possible. When selecting a site, consider the following:

    - Avoid curves whenever possible, as they can distort vehicle paths and speeds.
    - All portable counters are always installed in the right-of-way and never on paved areas.
    - Avoid setting up close to intersections, counters work best when vehicles maintain a consistent speed above 30 mph.
    - Ensure the counter is secured in a dry location not subject to flooding.

- Install the tube perpendicular to the roadway, with equal amounts of tension on each tube.

- For classification counts, where the goal is to distinguish between vehicle types based on axle spacing:
    - Use two tubes of equal length and space them precisely 6 feet apart across the lane of travel.

    - This spacing is critical: the counter measures the time it takes for axles to cross the first and second tubes. Any deviation from the exact 6-foot spacing or difference in tube lengths can throw off these timing calculations, leading to misclassification of vehicles (e.g., misidentifying a light truck as a passenger car).

- Anchor the tubes securely:
    - On roads without curbs and gutters, use large spikes or stakes to hold the tubes in place.
    - In urban environments with curbs, survey nails are typically used. These can be embedded in the asphalt between concrete joints.
    - Be aware that asphalt can soften during hot weather. If using survey nails in softening pavement, slightly reduce the tension on the tubes to prevent the nails from being pulled out due to expansion or movement.

To reinforce the guidelines above, Figure 19 presents some practical installation tips that highlight common best practices for setting up road tube counters.

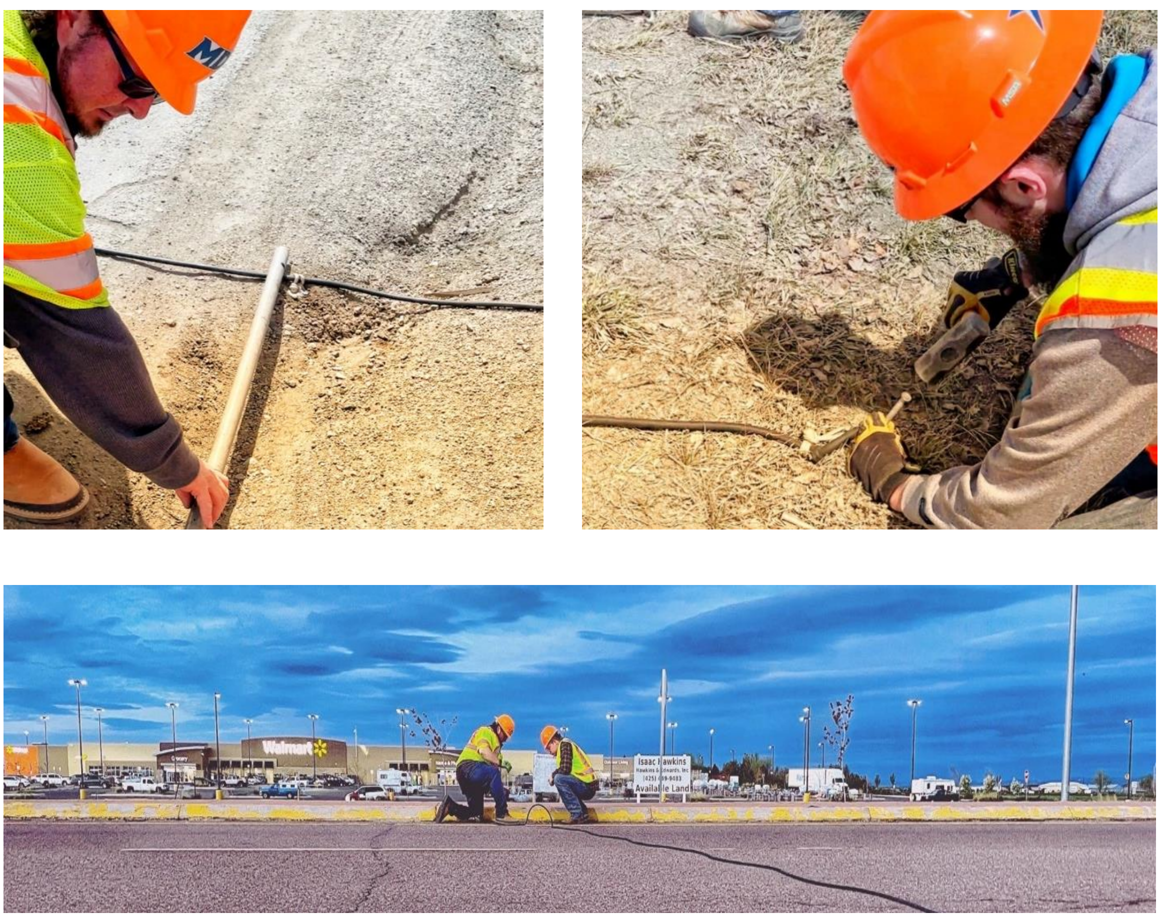


Figure 19 Pneumatic Tube Counters Installation
Source: *Montana Department of Transportation*

3.3.2 Leetron AI 100 Portable Video Counters

Leetron AI 100 counters use the same technology as the permanent Leetron counters but can be attached to existing infrastructure and are moveable. Utilizing these counters is beneficial to staff because it permits the field staff to never having to be in the roadway (really important on higher volume roadways) to obtain a quality class count. They can be used to collect FHWA 1-13 vehicle classification in congested areas where road tubes don't provide as accurate data due to tailgating and stop and go traffic patterns. They can also be used for much of the year; unlike road tubes, the equipment is not on the roadway and is typically not damaged by adverse weather or plowing.

The Leetron AI 100 can be installed in areas of stop and go traffic, but it must be in a location that has a clear view of the roadway. Staff benefit from how safe it is to collect 13 vehicle types from the side of the roadway without being in the road. The Leetron AI 100 when set up at a 18' height can be relied on for up to 4 lanes of travel, with 5+ lane segments a separate unit to monitor each direction will be needed.

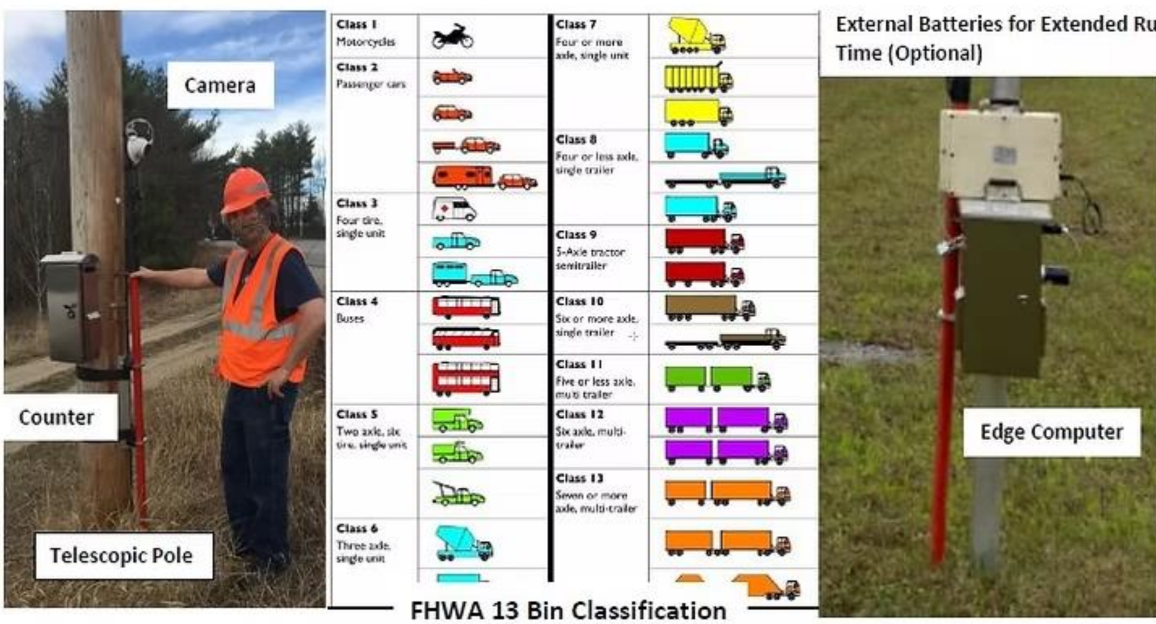


Figure 20 Leetron AI 100 Portable Video-Based Classification and Count System
Source: Leetron Vision

3.3.3 Houston Radar Armadillo Counter

MDT has a limited number of Houston Radar Armadillo counters. These counters collect volume, speed, and length classification data using non-intrusive radar. MDT has been using Houston Radar counters modified with small solar panels to continue collecting data at permanent CCS sites that have gone down during the year and for longer-term (2 weeks to six months) count collection.

Figure 21 Houston Radar Armadillo Counter
Source: Houston Radar

3.4. Planning and Deployment Strategies

Count assignments follow FHWA's TMG, with priority given to on-system and state-maintained routes. On-system routes refer to roadways that are part of the Federal-Aid Highway System, including Interstates, U.S. highways, and state routes. These roads typically receive federal or state funding and are critical for regional and national mobility. In contrast, off-system routes are local roads, county roads, or city streets that are not part of the designated federal-aid system. While off-system routes are important for local access and connectivity, they are generally lower priority in statewide traffic monitoring unless specified by local planning needs.

To implement this prioritization framework, the MDT coordinates data collection efforts through two parallel but integrated tracks: internal field operations by MDT technicians and external efforts conducted in partnership with Metropolitan Planning Organizations (MPOs) and other agencies. On the internal side, each technician receives (is assigned) a list of sites ranked by urgency (A to D), improving deployment efficiency in Montana's vast regions. Also loaded into Field Maps for ArcGIS – sites are color coded until collected, after which they turn grey, allowing for visual tracking of progress.

Concurrently, MPOs and local partners contribute to the program by requesting new count locations based on their planning needs. These requests are reviewed by MDT staff, who assign a site ID and incorporate the new locations into the centralized monitoring system. Each MPO or agency receives its own prioritized list, developed by the MDT, to guide their collection activities. Counts are uploaded through MS2 using the assigned site ID, and MDT staff validate the data to ensure consistency and reliability. MS2 also includes a jurisdiction field, which identifies which agency is responsible for each count, supporting coordination and accountability across the network.

3.5. Data Collection Process

MDT currently employs 2 full-time permanent Traffic Count Technicians. These technicians are primarily responsible for collecting the majority of short-term traffic counts across the state each year. Although their locations are flexible, one technician is typically stationed in the western half of Montana, and the other in the eastern half.

MDT supplements its full-time staff with two temporary seasonal workers and occasional assistance from the planning staff in Helena. The following sections provide details on the data collection process, including details such as equipment, resources, seasonal considerations, safety protocols, and the weekly workflow that guides the traffic counting process.

1. **Equipment and Resources**

Each full-time Traffic Count Technician is equipped with a van containing 40 pneumatic traffic counters and necessary accessories. Additionally, they are provided with 4–8 Leetron AI 100 counters. Due to the complexity of the Leetron AI 100 devices, seasonal workers are generally not trained on or assigned these units.

Figure 22 Field Technicians
Source: *Montana Department of Transportation*

Figure 23 Equipped Field Van
Source: *Montana Department of Transportation*

2. Count Coverage and Sampling Cycles

MDT collects short-term traffic data at 7,352 segments statewide (as of 2025). Following FHWA's TMG, MDT adheres to defined minimum sampling cycles:

- All on-system and state-maintained routes are counted at least once every three years.
  - All HPMS sample sites
  - All National Highway System (NHS) roadway sections
  - Principal Arterials
  - Vehicle Classification Sites (1/3 of VC sites collected each year)
- All other routes are counted at least once every six years.
  - Minor Arterials
  - Major Collectors
  - Minor Collectors (urban areas only)
  - Ramps

3. Traffic Counting Season and Factoring

The traffic counting season typically begins in spring, once snow and winter conditions have mostly subsided. While counts can begin in April, the primary season runs from May through October. MDT uses Monthly Day of Week (MDOW) factoring, which calculates seasonal factors by averaging each weekday's traffic volumes across the month (e.g., all Mondays averaged together, all Tuesdays together, etc.). This approach assumes traffic volumes are relatively consistent from week to week.

However, weather variability can affect this assumption. For instance, if one Monday experiences a blizzard while others are clear, the data from that weather-affected day can skew the factor. This, in turn, may skew the data to which the factor is applied. The purpose of averaging several Mondays, Tuesdays, Wednesdays, etc., is to smooth out anomalies caused by weather. Since a weather event is likely to occur each year, this method helps account for that seasonality. MDT's TDCA staff monitor the weather closely to avoid collecting data on atypical days.

> *The MS2 software does allow TDCA staff to mark CCS data as "atypical," which means the data is used in the creation of AADT for the site, but it is not used in the creation of factors. MDT is looking into the feasibility of using this feature to expand the traffic count season. For example, if the first half of the month of April one year is wintery, but the second half is warm and springlike, this happens in Montana all the time, TDCA staff would create factors using only the weeks that traffic counting in that region occurred.*

4. Count Prioritization and Efficiency

Because MDT relies on in-house staff rather than paying per count, technicians often exceed the minimum count requirements. In addition to being assigned all the counts required for the year, each technician receives a prioritized list of counts within their region, ranked as follows:

- A – Counts required during the current inventory season
- B – Counts due within the next year
- C – Counts due in approximately three years
- D – All other

The A-D ranking increases efficiency in a state as large as Montana. It allows technicians to place all their counters when they travel to a region that may not have many required counts. Table 6 shows MDT's 2025 priority list for traffic count locations, organized by rank to support efficient planning and field operations across the state.

Table 6 Count Location Priorities and Distribution (MDT's 2025 Priority List)

Priority	Description	Number of Count Locations
A	Needs to be counted in the current year to keep within FHWA recommended intervals	1,467
AA	Count ASAP	290
B	Will be required next year	1,526
C	Will be required within 2 years.	2,320
D	Will not have to be counted for 3+ years	1,718
Unspecified		31
Total		**7,352**

5. Field Procedures and Technology

Technicians use ArcGIS Field Maps on iPads to navigate to count locations assigned. These points are typically accurate, based on historical count data. Counters must be securely (chained/locked) attached to existing public infrastructure (e.g., signposts, light poles), as illustrated in Figure 24. If infrastructure has been removed or relocated, technicians should use provided segment boundaries to determine suitable placement locations. Attaching counters to private property (e.g., mailboxes, fences) is discouraged.

Figure 24 Field Technician Chaining the Counter
Source: *Montana Department of Transportation*

MDT uses ArcGIS Field Maps installed on iPads to help technicians find traffic count locations. The GIS application, coupled with GPS on the iPads, enables technicians to:

- Locate count point (location)
- Record the exact installation location
- Document the technology used
- Attach photos of site installation

At times, count locations may be affected by temporary conditions such as construction, utility work, or special events. Technicians should assess whether current on-site conditions are suitable for data collection. If the environment could compromise data quality, the count may be rescheduled for a later date.

6. Daily Work Schedule and Safety

Traffic technicians generally begin their workday early, often before peak morning traffic and sometimes in the dark. Vans are equipped with front and rear flashing lights, and technicians must wear reflective safety gear and hard helmets. Technicians typically work alone and do not set up a work zone, as the time required to install a portable counter is brief - often shorter than the time needed to set up and remove signage. In high-speed or congested areas, technicians are advised to use non-intrusive equipment and prioritize safety above all.

If no safe location exists for counter installation, technicians are instructed to skip the segment and consult the Short-Term Program Manager for guidance.

7. Weekly Workflow and Data Management

MDT's traffic counting process follows a structured weekly cycle designed to ensure data quality, consistency, and efficient use of technician time. This routine allows for standardized deployment and retrieval of counters across the state, while also accommodating weather variability and staff availability. The workflow is synchronized so that data collected during the week can be promptly reviewed, processed, and uploaded for analysis by the end of each week (Table 7).

Table 7 Weekly Traffic Counting Workflow

Day(s)	Activity
Monday to Wednesday morning (AM)	Technicians deploy traffic counters.
Wednesday to Friday morning (AM)	Counters remain in place for a minimum of 48 hours.
Friday before noon	Counters are retrieved.
Friday afternoon	• Full-time technicians upload data to MS2 for review. • Seasonal employees download the data and forward it to a full-time technician or the Short-Term Program Manager for upload.

The flowchart in Figure 25 provides a visual summary of MDT’s short-term traffic data collection process. It outlines the key steps involved - from planning and equipment deployment to data retrieval and upload - highlighting how the various components and personnel work together to ensure accurate and efficient data collection across the state.

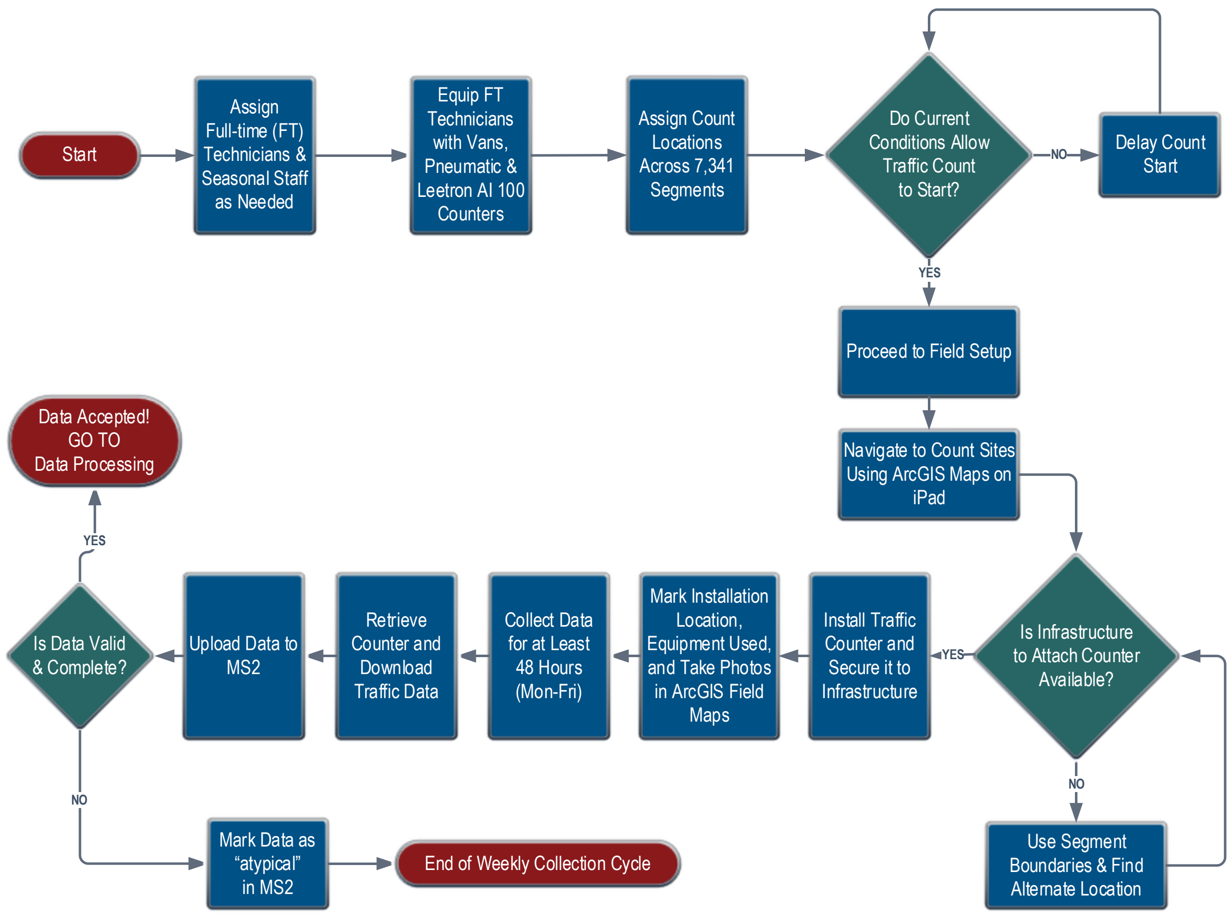


Figure 25 Short-term Count Program Data Collection Workflow

8. MS2 Data Upload

Short-term traffic count data is uploaded to MS2 using the Multi-File Upload tool. The user begins by selecting the appropriate file type - based on the brand of traffic counter - before choosing and uploading all relevant files of that type. MS2 then performs an initial validation to confirm that the uploaded files match the expected format. If the files are valid, the system accepts the data and transfers it to the Count Group Assign List. Invalid files are discarded and not processed further. After the upload is complete, the system automatically sends an email to the user detailing which files were successfully moved to the Count Group Assign List and which were rejected due to format issues.

The Count Group Assign List acts as a staging area where uploaded traffic count files can be reviewed. From here, users can approve files for inclusion in the live MS2 database or reject them as necessary. All accepted files in this list are displayed in numerical order for tracking and management.

Uploaded files in MS2 are flagged with a green, yellow, or red marker to indicate their quality and compatibility with the system, as presented in Table 8. Green markers signify that the count is valid and consistent with historical data collected at the same site. These files have no issues and are considered ready for further processing. Red markers indicate a fatal error - a critical issue that prevents the file from being accepted into the MS2 database. Common fatal errors include counts that do not cover a full 24-hour duration or lack a Site ID or include a Site ID that does not match any in the MS2 database. Yellow markers represent caution. These counts are flagged because they deviate from expectations based on the previous year's AADT or raw data. However, since Montana roads are highly seasonal and seasonal adjustment factors have not yet been applied during this stage of the upload, MDT policy is generally to accept caution-flagged records for contextual evaluation. For example, a yellow flag might appear if a July count is significantly lower (by more than 20%) than an October count from the previous year. This discrepancy is likely seasonal and will be corrected once seasonal adjustment factors are applied.

Table 8 MS2 File Flags and Implication

Flag Color	Indication	Common Issues	Action(s)
Green	Indicates that the data is complete, in the correct format, and consistent with historical records at the same site.	No issue(s)	These files are typically accepted without further intervention.
Yellow	Signals that the data deviates from historical trends or expected traffic volumes but do not contain critical errors.	Yellow flag often results from: • Significant seasonal variability (e.g., the count is more than 20% higher or lower) • Changes in local traffic patterns • Temporary disruptions such as construction or special events	• MDT policy generally allows yellow-flagged data to proceed, pending contextual review by the TDCA team. • If, upon review, a count is found to be significantly higher or lower than expected but is deemed accurate due to a new development or other changes near the location, the TDCA team may override and accept the data.

Flag Color	Indication	Common Issues	Action(s)
Red	Denotes critical issues (fatal errors) that prevent the data from being processed.	Common causes include: • Missing or incorrect Site ID • Incomplete counts (e.g., less than a full 24-hour duration) • Corrupted or improperly formatted files	• Red-flagged files must be corrected and re-uploaded, or the site must be recounted if the issue cannot be resolved. • If the site ID is entered incorrectly but the user knows the correct one, it can be updated either in MS2 or in the counter software. The choice depends on the type of count, but users typically prefer to edit in the counter software. This is because MS2 breaks incoming data into 24-hour records for each direction and data type, volume, class, speed, and per vehicle. For example, a 48-hour per vehicle count would require editing up to 16 separate records in MS2.

Once short-term traffic counts are loaded into MS2, they should be reviewed within the next week. This allows traffic technicians time to reset any problematic counts if necessary. During review, files are evaluated for completeness, consistency, and location accuracy (Figure 26).

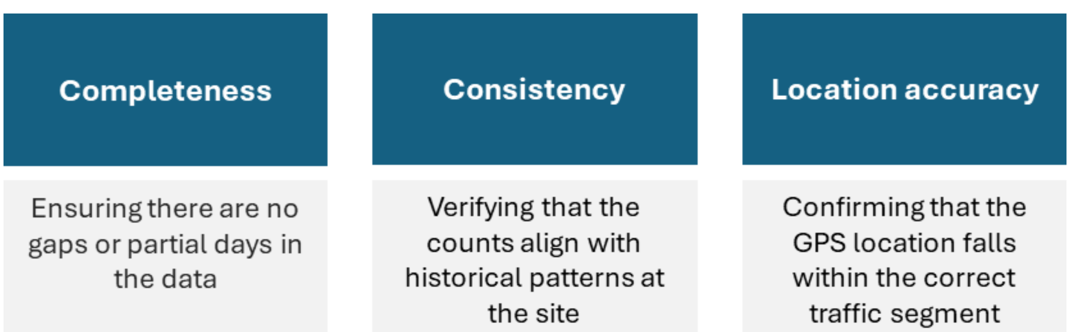


Figure 26 Short-term Traffic Count Quality Review Checklist

Standard traffic counts are expected to cover a 48-hour duration. However, in some cases - such as a broken or obstructed traffic tube - the count may stop prematurely. If the counter captures a complete 24-hour count and the data aligns with historical patterns at that site, MDT will accept the 24-hour count.

3.6. Short-term Count Data Validation Procedures

Once short-term traffic data has been collected and uploaded into MS2 using the Multi-File Upload tool, it undergoes a structured, multi-step validation process to ensure the accuracy, consistency, and usability of the data for statewide planning and reporting.

1. **Initial File Validation**

The first layer of validation occurs immediately upon upload. Technicians select the appropriate file type (e.g., Jamar, Leetron) corresponding to the brand of traffic counter used. MS2 then performs an automatic format check to ensure that the uploaded files meet the expected structural requirements, including proper headers, time stamps, and data intervals. Files that pass this initial check are moved into the Count Group Assign List, while files that fail are rejected and reported back to the uploader via email with specific error messages.

2. **Count Group Assign List Review**

The Count Group Assign List serves as a staging area for all valid uploads. Here, files are reviewed before being officially accepted into the MS2 database. Each file is flagged based on automated data screening results, as shown in Table 8.

3. **Contextual and Historical Analysis**

Before final acceptance, all files, especially yellow-flagged ones, are subjected to manual review. This step ensures that unusual values are not automatically discarded due to legitimate causes such as weather events, construction detours, or changing travel behavior. TDCA staff compare current counts against:

- Historical counts from the same segment
- Expected seasonal trends (based on MDOW factoring)
- Nearby segment volumes for consistency

If the review confirms that the deviation is explainable or aligns with broader traffic conditions, the data is accepted into the MS2 system.

4. GPS Location and Segment Verification

In addition to validating volume data, the geographic accuracy of the count is verified using GPS data captured via ArcGIS Field Maps during counter deployment. Uploaded data must fall within the correct route segment as defined by TDCA. Files flagged for location discrepancies are returned to the technician or the Short-Term Program Manager for correction.

5. Timing and Duration Checks

MDT policy specifies that standard short-term counts should cover a continuous 48-hour period. However, the validation process includes flexibility for the following scenarios:

- Acceptable 24-Hour Counts – If a counter collects a full and continuous 24-hour day of data and the volumes are consistent with historical patterns; the count may be accepted.
- Interrupted Counts – If traffic counters are dislodged, broken, or obstructed partway through the counting period, technicians may retrieve and re-deploy the counters. The original count is discarded unless it meets the minimum data duration (24-Hour) and quality standards.

6. Recounts and Follow-Up

If any count is found to be invalid or unusable due to critical issues (e.g., equipment malfunction, misplacement, or red-flagged errors that cannot be corrected), MDT's workflow allows for timely recounts. Since technicians upload and review data weekly, there is typically enough time in the season to revisit problematic sites.

All accepted counts are finalized in the MS2 system and incorporated into the statewide dataset. These data are subsequently used for generating AADT figures, planning analyses, and FHWA submittals. Figure 27 presents the data validation workflow.

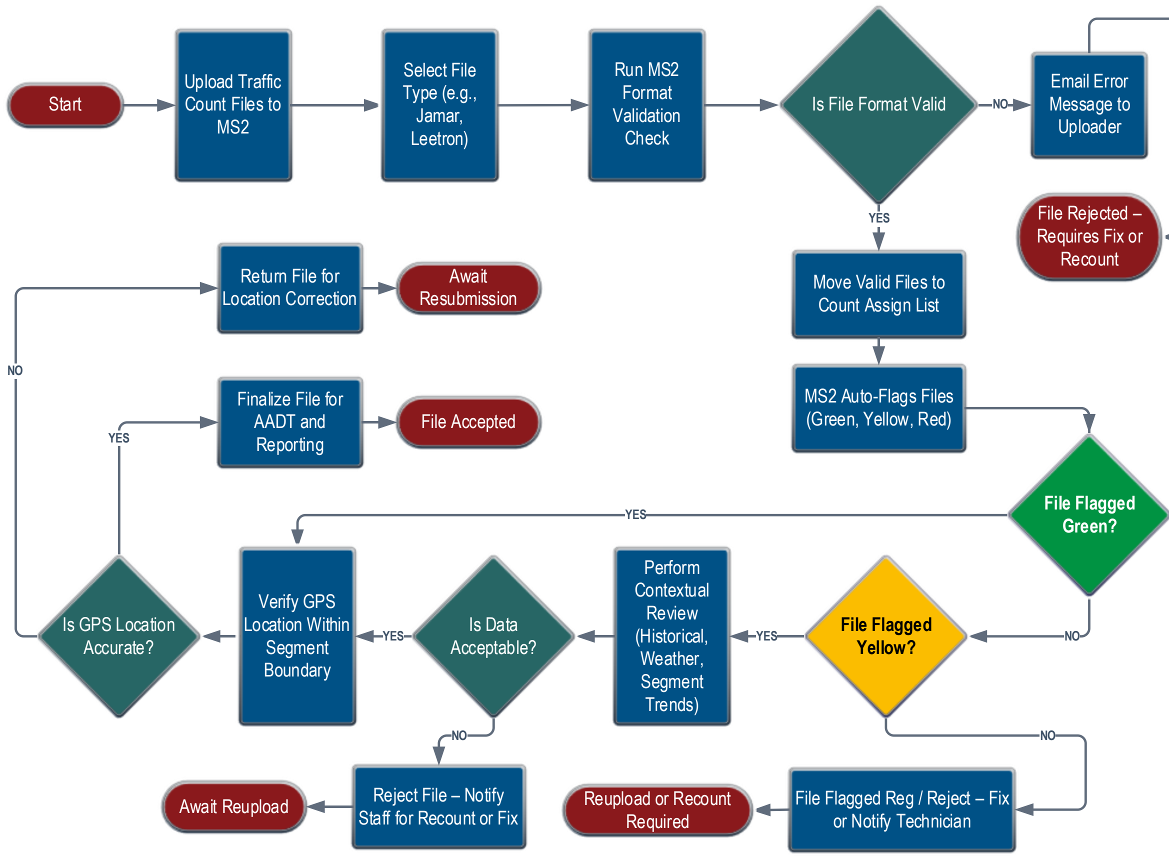


Figure 27 Data Validation Workflow

3.7. Integration with CCS Data

To derive AADT estimates from short-term counts, typically collected over 24 to 48 hours, TDCA applies seasonal adjustment factors developed from CCS data. These factors are correct for the time-specific variability in traffic patterns based on location and seasonal influences. Additionally, axle correction factors are applied to short-term counts where axle-based equipment is used, ensuring conversion from axle counts to vehicle counts.

MDT utilizes the MS2 Traffic Count Database System to manage, analyze, and integrate both short-term and continuous data. The MS2 platform automates the application of seasonal and axle factors, streamlining the process of expanding short-term counts into AADT estimates. The integration of short-term data with CCS-derived factors through MS2 not only streamlines AADT calculations but also ensures consistency across time and geographic regions. This process supports long-range planning, roadway design, system performance measurement, and trend analysis, forming the backbone of MDT's traffic monitoring and data-driven decision-making efforts.

Chapter 4. Data Processing and Reporting

4.1. Data Integration Techniques

As mentioned in the previous chapters, MS2 integrates traffic count data from both CCS and short-term data collection sites, using a multi-step process to ensure compatibility and consistency across datasets. The integration process begins with importing data from CCS and short-term counts into MS2. Before any processing, MS2 performs a series of automated quality control checks to flag and filter data anomalies, such as missing values, sensor malfunctions, or unrealistic spikes in volume.

A key part of the integration involves assigning each station, CCS or short-term, to a traffic factor group. The factor group assignments allow MS2 to apply appropriate seasonal and axle adjustment factors. Once factor groups are assigned, MS2 applies seasonal factors to convert short-term counts into AADT estimates. Axle factors are applied where vehicle classification is available.

MS2 also ensures that all point-based data (i.e., data collected at discrete count station locations) are linked with MDT's linear referencing system via TCDS Location IDs. This allows integrated data to be accurately referenced to the correct traffic segments in MDT's geospatial roadway network. Throughout the integration process, MS2 performs iterative reviews and cross-validations to ensure that the combined dataset supports downstream calculations, including VMT and other reporting requirements. In summary, data integration involves:

- Importing CCS and short-term count data into MS2
- Conducting quality control reviews and data flagging
- Assigning factor groups based on roadway and regional criteria
- Applying seasonal and axle correction factors
- Linking count locations to traffic segments using TCDS Location IDs
- Preparing a unified dataset ready for processing, analysis, and HPMS submission

4.2. Data Processing and Analysis

4.2.1 Year-End Processing

Each year, between January 1 and March 15, TDCA performs year-end processing to prepare finalized traffic data for the annual FHWA HPMS submittal and internal use. This process is supported by MS2 tools and involves verifying traffic factor group assignments, processing short-term and continuous count data, calculating AADTs, and generating various statistics required for HPMS. Table 9 outlines the full sequence of year-end processes, from verifying site assignments and importing data to calculating class AADTs, ESAL factors, and HPMS statistics. Additional steps include generating reports and preparing VMT summaries. While many processes are completed within MS2, some steps are performed outside of the system using internal MDT tools. For example, creating and managing the ALTIS-based road log files, loading final TYC data into Oracle tables, and conducting QA/QC of the Traffic Road Log are all handled outside of MS2. These external processes are essential for ensuring accurate data integration and meeting both internal and federal reporting standards.

It is worth noting that all assignments, calculations, and other processes completed during year-end processing are based on point-specific statistics tied to individual traffic stations in TCDS. However, HPMS data submissions are segment-based. To bridge this gap, the point-based TCDS statistics must be associated with road segments using TCDS Location IDs. MDT uses Esri's Roads and Highways extension to manage its Linear Referencing System (LRS). One of the many events managed within Roads and Highways is the Traffic Segment event. Each traffic segment is assigned to a TCDS Location ID and that is used to link point-based TCDS data to the individual traffic segments. TDCA usually provides the MS2 system with an updated road segment network containing mandatory and optional attributes. MDT's statewide Linear Referencing System (LRS) is managed and maintained in-house by the TDCA staff. The Traffic Segments event layer, which resides on this same LRS, is also maintained by TDCA staff. None of MDT's linear data is managed within MS2. Instead, once per year, TDCA provides MS2 with a complete, updated statewide LRS dataset, which includes all required attributes needed for MS2 to generate specific reports necessary for the HPMS submittal.

Table 9 Year-End Processes

STEP	PROCESS	DESCRIPTION	MS2 NEEDED
1	Verify Factor Group Assignments	Check that all sites have a seasonal, axle, growth, and WIM ESAL factor group assigned. All sites should have a factor from the previous year to carry forward to the following year.	Yes
2	Copy Factor Groups to the Following Year	Copy Factor Groups and their location assignments from the selected year to the following year. AADT's will appear next day on TCDS.	Yes
3	Import Short-Term Count Data	Acquire raw count files or have MDT, MPO, and Rail Safety technicians submit short-term counts to MS2. Aim to have all data in TCDS by mid-January. Keep in mind that AADT data for border states will also need review and discussion.	Yes
4	Line up Traffic Sites with ALTIS Road Network	Use Event Editor (EE) to add, delete, adjust, and review traffic segments and sites to ensure they are in line with the ALTIS road network throughout the year.	No
5	Assign Class Distribution Factor Groups	Review all Vehicle Class (VC) data collected in the current year and ensure each dataset is assigned to a VC factor group.	Yes
6	Calculate Permanent Count Station AADTs	Update all Station AADTs for permanent count stations.	Yes
7	Calculate HPMS Statistics	Calculate DHV-30, K% and D%, Single/Combination Truck AADT's, and percentage of single/combination trucks during the design hour statistics for counts by selected year and type. Creates Individual Class AADTs by using length counts to find a ComboTruck AADT, and then using class distribution, and the location's AADT, determines the individual classes AADTs for that location.	Yes
8	Review Top 100 High Hourly Volumes	Run and review the "Top 100 High Hourly Volume by Year" report to identify potential issues with hourly volume data.	Yes

STEP	PROCESS	DESCRIPTION	MS2 NEEDED
9	Recalculate AADTs (*if needed*)	Recalculate Permanent Count Station AADTs only if corrections are needed based on the High Hourly Volume review.	Yes
10	Calculate HPMS Statistics (*if needed*)	Recalculate HPMS statistics only if corrections are needed based on the High Hourly Volume review.	Yes
11	Directional Split	Using the 100 High Hour report, fill in the 30th High Hour Directional Split report by functional class. The final directional split values must then be added to the appropriate Oracle table.	Yes
12	Continuous Counter Site (CCS) Report	Generate the annual CCS report for internal and external stakeholders. The report includes the Yearly ATR Profile page and the Yearly Peak Hourly Volumes page. Include notes to explain any data gaps, site changes, or outages that may have impacted the report.	Yes
13	Seasonal Factors (SF) Clustering	Develop, review and calculate SF groups.	Yes
14	Axle Adjustment Factors (AF) Clustering	Develop, review and calculate AF groups.	Yes
15	Growth Factors (GF) Clustering	Develop, review and calculate GF groups.	Yes
16	Back Process AADT's	Recalculate all short count station AADTs for the selected year. This process updates 24-hour and partial volume count totals, then updates AADTs for non-permanent stations. It also creates lane-level AADTs, which are needed to calculate 2-way AADTs in the next step.	Yes
17	Calculate 2-Way AADTs from Directionals	This optional process provides two methods for creating missing 2-WAY AADTs where directional AADTs are available.	Yes
18	Calculate Missing AADTs from Growth Factors	Calculate missing AADTs for short count stations by applying the current year's growth factor to the previous year's AADT. This fills gaps where counts were not collected in the current year.	Yes
19	Calculate HPMS Stats (*for all sites at this point*)	This updates the DHV-30, K% and D%, Single/Combination Truck AADT's, and percentage of single/combination trucks during the design hour statistics for counts by selected year and type. Creates Individual Class AADTs by using length counts to find a ComboTruck AADT, and then using class distribution, and the location's AADT, determines the individual classes AADTs for that location.	Yes
20	Generate Default AADT's and Add Them to Respective Oracle Table	Use the growth factors to generate new default AADT's. And add them to the default AADT Oracle table.	No
21	Create HPMS Road Log GIS File	Use ALTIS tools to create the HPMS road log file, review it, load it into the ALTIS_MS2RL Oracle table, and send it to MS2.	No
22	Load MS2 Road Log Table	Use the traffic web app button to create the Traffic.MS2_RL Oracle table with default AADTs and required MS2 fields.	No
23	Border State AADTs and Commercial Trucks	Contact neighboring states to review AADT and commercial truck volumes (FHWA classes 5–13) for cross-border flow.	Yes
24	Create Class AADTs from Length Counts	Use length counts to calculate ComboTruck AADT, apply class distribution and site AADT to generate individual class AADTs.	Yes
25	Calculate Seasonal Classes	Calculate 13 Class AADTs for non-permanent stations using class factors from permanent stations in the same factor group.	Yes

STEP	PROCESS	DESCRIPTION	MS2 NEEDED
26	Send MS2 the HPMS Segment Network LRS	Run the SQL script to create the updated LRS file for the MS2 HPMS module. Send the file to MS2 and allow time for them to load it.	No
27	Class Distribution Factor Clustering	Review current vehicle class data and assign Class Distribution Groups (VC groups) to each TYC based on the evaluation.	Yes
28	Class AADT Adjustment	Proportionally adjust the 13 Class AADTs to sum up to the AADT	Yes
29	Compute Combined Truck Stats from Individual Classes	Combines individual class AADTs into Passenger Vehicles, Business Commercial, Single Unit Trucks, and Combo Unit Trucks.	Yes
30	Compute ESAL Factors	Calculate annual ESAL statistics (total and average rigid and flex ESALs) for each vehicle class and individual WIM stations and groups of WIM stations.	Yes
31	WIM ESAL Distribution Factor Clustering	Refine ESAL distribution groups. Use visual tools and algorithms to assign ESALs to factor groups.	Yes
32	Calculate Annual Flex/Rigid ESAL	Multiply Class AADTs by average Flex/Rigid ESAL values to calculate annual totals for each type at each station.	Yes
33	Pull HPMS Stats Forward from Previous Year	Fill in missing HPMS statistics by copying values from the previous year.	Yes
34	Request MS2 to Load Traffic Stats	Send MS2 an email asking them to load traffic stats into the LRS in the HPMS module.	Yes
35	Generate HPMS Metadata	Create the Road Event Collection Methods report showing count duration, type, and functional classification.	Yes
36	Create TYC Road Log	Use ALTIS tools to create the TYC road log and load it into the ALTIS_TYC Oracle table.	No
37	Export TYC from MS2 and Review	Export TYC data from the MS2 HPMS module, review traffic stats in Excel, and prepare it for loading into MDT's TYC Oracle table.	Yes
38	Load MS2 TYC Export	Load the MS2 TYC export file into the TYC_WORKING_MS2DATA Oracle table using PL/SQL Developer.	No
39	Load Final TYC Working Table	Use the traffic web app button to combine ALTIS_TYC linear data with MS2 traffic stats into the TYC_WORKING Oracle table.	No
40	Load Final TYC to TRAFFIC_YEARLY_COUNTS	Use the traffic web app button to push TYC_WORKING data to the TRAFFIC_YEARLY_COUNTS Oracle table. Fix any errors in TYC_WORKING and re-run if needed. Notify HPMS when complete.	No
41	VMT by Vehicle Type % and Non-Federal-Aid Summary	Run and review both reports for HPMS. Compare current year's values to the previous year.	Yes
42	Set AADT Back Date	In Admin > System Settings, update the AADT Back Date to the current year to lock previous year processing.	Yes
43	Notify HPMS	Let the HPMS Program Manager know the data is in Oracle. Resolve any validation errors before public release.	No
44	Create New Traffic Road Log (TRL)	Use ALTIS tools to create the TRL and load it into the ALTIS_TRL Oracle table.	No
45	Create Traffic Road Log	Use the traffic web app to create TRAFFIC.TRAFFIC_RL with the new year of data.	No
46	Review (QA/QC) Traffic Road Log	QA/QC the TRAFFIC.TRAFFIC_RL table.	No

STEP	PROCESS	DESCRIPTION	MS2 NEEDED
47	Run and Save Reports	In the traffic web app, run all reports (Traffic by Sections, Summary by System/Route, TB Counties, TB Urban, TB Cities). Review and save for website updates.	No
48	Update MDT Maps and Reports	Update MDT's webpage with new maps and reports	No
49	Review HPMS Validation Details Report	Review validation results from HPMS and write a response for any flagged issues.	No
50	Review HPMS Extent and Travel Reports	Compare HPMS VMT to VMT from the Traffic Road Log to ensure consistency.	No
51	Annual Process Summary	Summarize key statistics and trends for TDCA internal reference.	Yes
52	Annual Traffic Summary	Document annual traffic stats and major trends or changes.	Yes

4.2.2 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 (a statistic known as the day-of-the-week MADT for which there are 12 MADTs for every day of the week in the calendar year).
- Seven-annual average day-of-week values are averaged for an annual average daily traffic
- Directional annual average daily traffic volumes are summed up to generate the annual average daily traffic for a station.

4.2.3 Monthly ADT

Monthly ADTs are computed in the following manner:

- Each direction of travel at each site is processed separately
- For each month, daily traffic volumes are averaged by day of the week (e.g., all Mondays, all Tuesdays, etc.)
- 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.

4.2.4 Seasonal Factors

Seasonal 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.

4.2.5 Axle Factors

Axle factors are used to convert axle-based traffic counts, typically collected using single road tubes or other axle-counting devices, into estimated vehicle counts. These factors are necessary because different vehicle types (e.g., passenger cars, trucks, trailers) have varying numbers of axles, and simply dividing axle counts by two (as is sometimes done for two-axle vehicles) can lead to inaccurate results.

To improve accuracy, MDT calculates axle factors using Monthly Day-of-Week (MDOW) data. For each factor group, the average number of axles per vehicle is determined by dividing the total number of axles by the total number of vehicles recorded during the MDOW period. These factors are then applied to axle-based counts during year-end processing to produce vehicle counts, especially at short-duration count sites where only axle data is collected.

4.2.6 Growth Factors and Metrics

Understanding how traffic volumes evolve over time is important for transportation planning and infrastructure design. Several related but distinct metrics are used to quantify traffic growth and trends: change, growth rate, and traffic volume index.

Traffic Change (Year-over-Year)

Traffic change refers to the absolute or relative difference in traffic volume, typically AADT, between two consecutive years. It can be expressed either as:

$$Absolute\ Change = AADT_{current\ year} - AADT_{previous\ year}$$

$$Realative\ Change\ (\%) = \frac{AADT_{current\ year} - AADT_{previous\ year}}{AADT_{previous\ year}} \times 100$$

This basic comparison forms the foundation for more aggregated growth metrics.

Traffic Growth Rate

The Annual Growth Rate is the weighted average of the simple year-over-year AADT growth rates for all count stations. They are weighted by the AADT of each station. For example, a 50% growth for an AADT of 100 does not contribute as much to the calculation as a 50% growth for an AADT of 1,000 does.

Traffic Volume Index

The Annual Traffic Volume Index is calculated by compounding all of the growth rates up from the base year to the current year. The base year index = 1.0, while the current year index = previous year index * (1 + current year growth rate).

Growth Factor

Growth factor is an adjustment factor to reflect traffic change on a facility or in an area over a given time period. In general, growth is calculated as a ratio of AADT of the most recent year to the AADT of a preceding year. Growth factor is a key parameter in designing the capacity of a transportation facility to meet the growing demand in the region. Growth factors are applied for AADT values counted in prior years that need to be adjusted up to the current year (FHWA, Traffic Data Computational Method, 2018). They are also used to estimate AADTs at locations where traffic counts are missing for a particular year

4.3. Reporting Standards and Formats

4.3.1 Annual Continuous Traffic Counter Reports

Each year, MDT publishes a continuous traffic counter report that provides a summary traffic data collected from CCS sites. The report includes average weekday traffic and average day of week traffic by month, month, 10th, 20th and 30th (DHV), 50th and 100th highest hours and, where available, vehicle mix percentages (passenger vehicle and small and large truck). The report contains the historical traffic data available for each permanent count site. These metrics are calculated in MS2. A typical example of a yearly CCS site profile is presented in Figure 28.

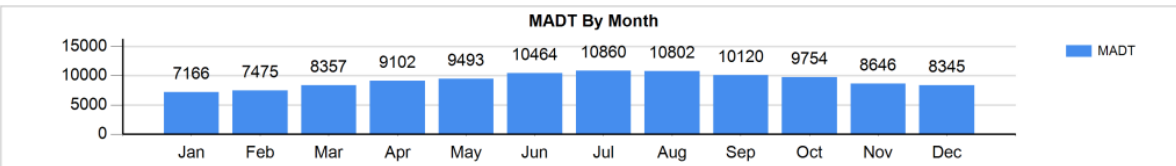
MONTANA Department of Transportation

Yearly CCS Profile

For Year: 2024
County: CASCADE
Station: A-009
At Road: 7 Mi. W of Great Falls
Ascending Direction: North

Location Id: 07-1-017
Functional Class: Principal Arterial - Interstate Rural
Traffic Factor Group: UI
Located On: I-15, RP 287.04, Vaughn, 7 Mi. W of Great Falls (C000015)
Traffic Mix: Pass: 87.87% SU: 1.20% CU: 10.93%
Directional Split: NB 50.47% / SB 49.42%

	Average Daily Number of Vehicles							Avg. Day	Avg. Day as % of	Avg. Weekday	Avg. Day as % of Avg. Weekday	Avg. Weekday	Avg. Day as % of Avg. Weekday
	Sun	Mon	Tue	Wed	Thu	Fri	Sat	(Mon-Sun)	Year Avg.	(Mon-Thu)	(Mon-Thu)	(Mon-Fri)	(Mon-Fri)
JAN	5,380	6,917	8,249	7,775	7,779	7,701	6,373	7,166	77.76%	7,680	93.31%	7,684	93.26%
FEB	5,347	7,607	7,680	7,501	8,538	8,641	7,015	7,475	81.11%	7,832	95.45%	7,993	93.51%
MAR	6,251	7,968	8,694	9,107	9,314	9,638	7,537	8,357	90.69%	8,771	95.28%	8,944	93.43%
APR	7,294	8,984	9,344	9,385	9,829	10,384	8,499	9,102	98.77%	9,386	96.98%	9,585	94.96%
MAY	7,793	9,281	9,497	9,529	10,060	11,252	9,046	9,493	103.01%	9,592	98.97%	9,924	95.66%
JUN	9,240	10,083	10,342	10,759	11,257	11,867	9,703	10,464	113.55%	10,610	98.62%	10,862	96.34%
JUL	10,068	11,296	11,104	11,584	10,322	11,559	10,095	10,860	117.85%	11,077	98.05%	11,173	97.20%
AUG	9,339	10,692	10,719	10,944	11,666	12,250	10,008	10,802	117.22%	11,005	98.15%	11,254	95.98%
SEP	8,362	9,817	10,236	10,226	10,881	11,466	9,858	10,120	109.82%	10,290	98.35%	10,525	96.15%
OCT	8,002	9,650	9,898	10,152	10,529	11,268	8,781	9,754	105.85%	10,057	96.98%	10,299	94.70%
NOV	6,873	8,895	9,075	9,491	8,842	9,637	7,717	8,646	93.82%	9,076	95.26%	9,188	94.10%
DEC	6,663	8,416	8,248	7,887	9,190	9,782	8,237	8,345	90.56%	8,435	98.93%	8,705	95.87%
Year	**7,551**	**9,134**	**9,424**	**9,528**	**9,851**	**10,454**	**8,572**	**9,215**		**9,484**	97.17%	**9,678**	95.22%



NOTE: VALUES ARE ROUNDED; TOTALS AND PERCENTS MAY NOT ADD UP.

Notes
N/A

Figure 28 Yearly CCS Profile of A-009
Source: *Montana Department of Transportation*

4.3.2 Monthly Volume Comparison Reports

The Monthly Comparison reports provide a change in traffic volumes, as compared to the same month last year (i.e. January 2023 as compared to January 2024), at each of CCS sites, as shown in Figure 29.

Monthly Commercial (Class 5-13) Comparison

(Class Sites Only)

January 2024

Loc. ID	Sys Desc	Located On	County	Avg. Day (Mon-Sun)		YOY % Change	Avg. Weekday (Mon-Thu)		YOY % Change	Avg. Weekend (Sat-Sun)		YOY % Change	Number of Days Monitored	
				2023	2024		2023	2024		2023	2024		2023	2024
A-003	INT	I-15, RP 191.64, 0.5 Mi. S of Helena (C000015)	Lewis And Clark	695	705	1.44%	803	788	-1.87%	493	561	13.79%	31	31
A-005	PRI	MT 7, RP 79.19, 1 Mi. S of Wibaux (C000027)	Wibaux	70	63	-10.00%	88	83	-5.68%	31	26	-16.13%	31	28
A-008	NHS	US 93, RP 26.3, 1 Mi. S of Ravalli (C000005)	Lake	385	379	-1.56%	485	482	-0.62%	171	154	-9.94%	31	31
A-009	INT	I-15, RP 287.04, Vaughn, 7 Mi. W of Great Falls (C000015)	Cascade	961	961	0.00%	1,127	1,080	-4.17%	628	740	17.83%	31	28
A-012	NHS	US 87/MT 200, RP 76.85, 5 Mi. W of Lewistown (C000057)	Fergus	171	145	-15.20%	223	189	-15.25%	71	50	-29.58%	31	23
A-014	SEC	S-278, RP 4.182, 7 Mi. SW of Dillon (C000278)	Beaverhead	28	20	-28.57%	37	25	-32.43%	7	7	0.00%	31	31
A-019	NHS	US 191/US 287, RP 7.82, Duck Creek, 7.5 Mi. N of W Yellowstone (C000050)	Gallatin	199	215	8.04%	234	249	6.41%	126	149	18.25%	31	25
A-027	NHS	US 191, RP 69.58, Roy, 3 Mi. N of Jct MT 19 (C000061)	Fergus	40	37	-7.50%	52	48	-7.69%	20	17	-15.00%	31	31
A-028	STH	Vaughn South Frontage Road, RP 3.33, 7 Mi. W of Great Falls (C007611)	Cascade	80	71	-11.25%	105	96	-8.57%	22	17	-22.73%	22	31
A-030	INT	I-90, RP 46.01, 1.5 Mi. W of Superior Interchange (C000090)	Mineral	1,950	1,835	-5.90%	2,156	1,945	-9.79%	1,530	1,622	6.01%	31	28
A-031	INT	I-94, RP 132.83, 4 Mi. W of Miles City (C000094)	Custer	1,116	952	-14.70%	1,159	964	-16.82%	1,044	935	-10.44%	31	30
A-034	PRI	US 12, RP 265.07, 5.5 Mi. NW of Forsyth (C000014)	Rosebud	25	16	-36.00%	28	19	-32.14%	17	11	-35.29%	31	26
A-036	NHS	US 2, RP 219.14, 2.3 Mi. SW of Browning (C000001)	Glacier		0			0						1
A-037	NHS	Orange St Bridge, Missoula, RP 1.48, South end of bridge (C008107)	Missoula		360			360						1
A-038	NHS	MT 200, RP 209.54, 2 Mi. SW of Jordan (C000057)	Garfield	79	55	-30.38%	97	67	-30.93%	47	35	-25.53%	31	31
A-046	NHS	US 2, RP 372.87, 9 Mi. W of Havre (C000001)	Hill	90	68	-24.44%	110	81	-26.36%	49	43	-12.24%	31	31
A-057	INT	I-90, RP 533.08, 2.4 Mi. S of Lodge Grass Interchange (C000090)	Big Horn	953	949	-0.42%	988	977	-1.11%	889	906	1.91%	29	31

Figure 29 Monthly Volume Comparison
Source: *Montana Department of Transportation*

4.3.3 Vehicle Miles Traveled (VMT)

Vehicle Miles Traveled (VMT) is a key metric used to measure the total distance traveled by all vehicles on a roadway network over a specific period. It serves as a fundamental indicator of travel demand, system usage, and regional mobility trends. VMT is widely used in transportation planning, policymaking, and performance monitoring at both the state and federal levels.

In Montana, estimates of monthly and annual VMT are produced using a combination of traffic volume data and roadway characteristics. These estimates reflect travel patterns across urban and rural areas and help monitor changes over time. Figure 30 presents Montana's Estimated Monthly Vehicle Miles Traveled (MVMT) from 2021 to 2025, illustrating seasonal fluctuations and overall trends in travel behavior. MVMT estimates are generated using data from HPMS in conjunction with monthly traffic volumes collected through CCS sites across the state. In addition to MVMT, MDT also publishes other VMT reports, including:

- Historical Annual VMT Report by highway system
- Daily VMT Summary by System Report
- Daily VMT Summary by Route Report
- VMT Traffic Statistics

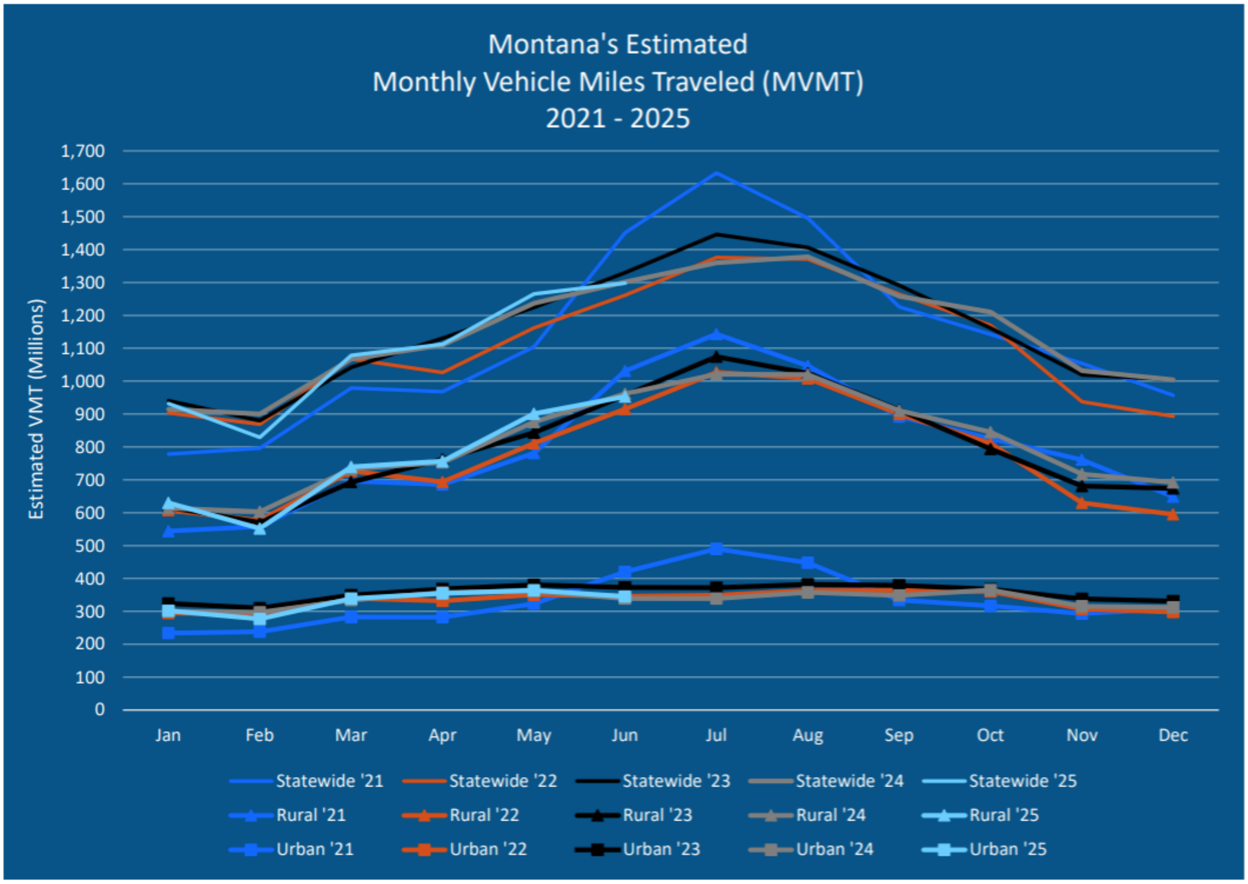


Figure 30 Montana's Estimated Monthly Vehicle Miles Traveled (MVMT) 2021-2025

4.4. FHWA Submittals

One of the main purposes of MDT's traffic monitoring program is to provide traffic data for the national and statewide specific FHWA Highway Statistic Summary. This summary is used by the US Congress to allocate transportation funding to MDT and other states for building and maintaining state highway infrastructure. The FHWA has specific traffic data reporting requirements for states, primarily through the HPMS. These systems ensure consistent data collection and reporting on highway extent, condition, performance, and safety across the nation.

Table 10 provides the recommended data submittal frequency to FHWA. This frequency applies regardless of whether files being submitted are fixed-width or pipe-delimited formats.

Table 10 Data Submission Frequency

Data Type	Submittal Frequency/Due
Station Description Data	Annually, or when a change occurs
HPMS Segment Network LRS	Annually, or when a change occurs
Traffic Volume Data	Monthly, by 25 days after close of the month for which the data were collected
Vehicle Classification Data	Monthly, by 25 days after close of the month for which the data were collected
Weight Data	Monthly, by 25 days after close of the month for which the data were collected
VMT	Annually, June 15th part of the HPMS submittal

4.5. Dissemination to Internal and External Stakeholders

MDT is committed to making traffic data accessible, accurate, and usable for a wide range of stakeholders. Once finalized, traffic data is made available through structured reports, interactive tools, and by request to support transportation planning, engineering, policy development, and public transparency. This section outlines the primary users of the data, reports and platforms used for dissemination, and the process for fulfilling special data requests.

4.5.1 Data Users

Finalized traffic data is made available to a broad audience of internal and external users. Within MDT, various planning and engineering units use data to inform decisions related to roadway design, capacity needs, pavement preservation, and statewide system planning. Traffic counts and trend analysis feed directly into corridor studies, project prioritization, safety analyses, and performance-based planning efforts. Additional beneficiaries include:

- Local governments and MPOs
- Consultants and contractors
- The public via MDT’s traffic data portal and MS2 traffic map

4.5.2 Reports and Online Access

Once TDCA completes the annual rollover process, the previous year’s traffic data is closed for editing and designated as “official”. This finalized data is disseminated in both published report formats and through online tools to accommodate different user needs and technical skill levels.

MDT's standard traffic reports are made available on the department's public website at:

https://www.mdt.mt.gov/publications/datastats/traffic.aspx

In addition to downloadable reports, users can explore and analyze traffic data using the MS2 Traffic Map and GIS-based interactive web maps. These platforms provide access to historical data and spatial visualizations, helping users make data-driven decisions more efficiently. Table 11 outlines various reports published by MDT.

https://www.mdt.mt.gov/publications/datastats/traffic-maps.aspx

Table 11 Annual Reports

Report	Purpose	Key Metrics Included
Annual Continuous Traffic Counter Reports	Provide summary traffic data collected from CCS sites (ATR and WIM sites). The report contains historical traffic data available for each permanent count site. A typical example of a yearly CCS site profile is presented in Figure 28.	• Average weekday traffic and average day of week traffic by month • 10th, 20th and 30th (DHV), 50th and 100th highest hours • Vehicle mix percentages (passenger vehicles and small and large truck), where available.
Annual Traffic By Sections (TBS) Reports	Provide three years of traffic data using MDT's Departmental Route naming protocol (I-90, N-1, P-9, etc.) for On System routes only.	• Referencing and description information • AADT and DVMT for all vehicles (Types 1-13) for each roadway segment • Commercial truck information, where available
Annual Traffic By Counties Reports	Provide county-level view of DVMT by roadway system across Montana's 56 counties	• DVMT by roadway system by county
Annual Traffic By Urban Area Reports	Provide DVMT by roadway system across urban areas	• Provide DVMT by roadway system by urban area
Annual Traffic By Cities Reports	Provide DVMT by roadway system across cities	• Provide DVMT by roadway system by city
Adjustment Factors	Presents annual adjustment factors by day and month by traffic factor group	• Adjustment Factors by Day and Month by Traffic Factor Group (see Figure 31)

Seasonal Factors								
Group	**Month**	**Sunday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
RURAL INNER INTERSTATE	Jan	1.643	1.477	1.38	1.381	1.379	1.336	1.496
	Feb	1.385	1.383	1.388	1.368	1.251	1.143	1.319
	Mar	1.145	1.243	1.208	1.146	1.059	0.984	1.105
	Apr	1.034	1.434	1.086	1.106	1	0.904	0.984
	May	0.965	0.992	1.032	1.032	0.927	0.799	0.889
	Jun	0.796	0.927	0.927	0.864	0.795	0.716	0.84
	Jul	0.716	1.025	0.832	0.843	0.781	0.712	0.767
	Aug	0.759	0.869	0.887	0.841	0.78	0.702	0.78
	Sep	0.861	0.896	0.938	0.912	0.852	0.736	0.807
	Oct	0.906	1.019	1.019	0.964	0.918	0.786	0.908
	Nov	1.135	1.224	1.17	0.995	1.23	0.986	1.052
	Dec	1.226	1.307	1.328	1.344	1.164	1.033	1.07

Figure 31 Excerpt of Adjustment Factors By Day and Month Report

MDT uses web-based tools to give users interactive access to traffic data. The MS2 Traffic Map allows users to search and filter traffic data by location, year, and counter type. In addition, MDT's GIS-enabled web maps provide spatial visualizations of traffic data. These tools help stakeholders visualize traffic conditions in a geographic context, improving understanding of system-wide trends and local issues. Together, MS2 and GIS tools significantly enhance access to MDT's traffic data and support more responsive, informed transportation planning and analysis across Montana.

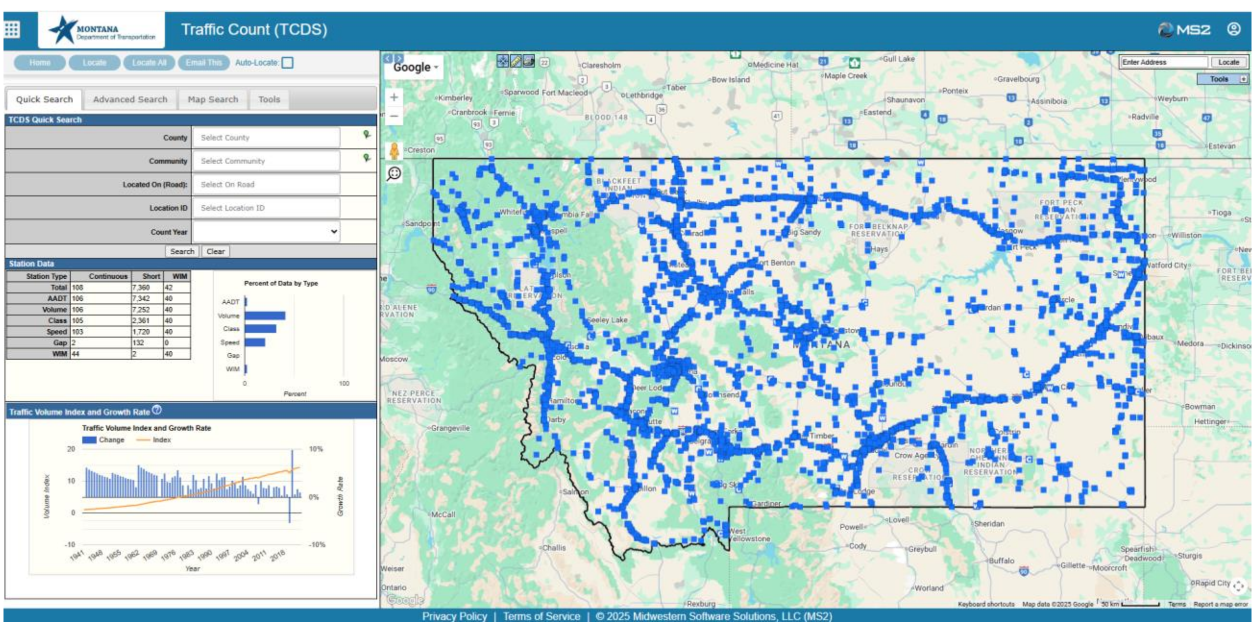


Figure 32 MS2 TCDS

4.5.3 Special Requests

Special data requests are submitted when customers need traffic information, whether it's already available online or requires more specific assistance. These requests come from both internal MDT staff and external stakeholders, such as consultants, realtors, agencies, and concerned citizens. Typical questions include: "What is the traffic on US-93?", "What are the volumes on Reserve Street in Missoula?", or "What's the traffic like at this specific address?".

Requests are typically submitted through MDT's Public Information Request (PIR) form, which helps route inquiries to the appropriate staff for timely response and support. Since MDT has made more traffic statistics accessible through online tools, the volume of direct requests has decreased. Most remaining requests come during the spring and summer months, when traffic volumes rise across Montana and public awareness of congestion increases. Most requests can be addressed within a day, and staff aim to respond promptly.

When possible, MDT staff respond by sending a direct link to the relevant data along with instructions on how to access and interpret the information. This approach not only answers the immediate question but also empowers users to explore data for surrounding areas on their own. As a result, individuals gain a broader understanding of regional traffic patterns, and the number of follow-up requests is reduced.

Glossary

Acronym	Term	Definition
AADT	Annual Average Daily Traffic	The total volume of vehicle traffic of a highway or road for a year divided by 365 days. It is meant to represent traffic on a typical day of the year.
AAWDT	Annual Average Weekday Traffic	The estimate of typical traffic during a weekday (Monday through Friday) calculated from data measured at continuous monitoring sites.
ACF	Axle Correction Factors	Factors developed to adjust axle counts into vehicle counts. Axle correction factors are developed from classification counts by dividing the total number of vehicles counted by the total number of axles on these vehicles. However, the prevalence of data collection equipment that is dependent on pneumatic tubes that count axles rather than vehicles require adjustments by applying an axle correction factor to represent vehicles. Equipment that detects vehicles directly (such as inductive loops or vehicle classification counters) does not require axle factor adjustments. In general, the higher the percentage of multi-axle vehicles on a road, the more error you will introduce into the data by not using proper axle correction factors.
ADT	Average Daily Traffic	The total volume during a given time interval (in whole or partial days), greater than one day and less than one year, divided by the number of days in that time interval. ADT is also known as raw data and unadjusted or non-factored data.
ATR Site	Automatic Traffic Recorder Site	The location of an automated traffic recorder (permanent station) used for collecting traffic volume data; now use the term CCS.
Axle Spacing	Axle Spacing	For each vehicle axle, the horizontal distance between the center of that axle and that of the preceding axle is the vehicle axle spacing (ASTM E17.52, E1572-93).
Axle Weight	Axle Weight	The weight (normal force) placed on the road by all wheels of one axle.
Classification Scheme	Classification Scheme	A classification scheme (method) provides detailed information about how travelers are organized within a structured naming convention. For example, the most common vehicle classification scheme is the FHWA 13-bin structure, where 13 different groups of travelers are organized.
Continuous Count	Continuous Count	A continuous count is a count derived from permanently installed counters for a period of 24 hours each day over 365 days (except for leap year) for the data-reporting year.

Acronym	Term	Definition
CCS	Continuous Count Station	Permanent counting site that provides 24 hours a day and 7 days a week of data for either all days of the year or at least for a monthly (seasonal) collection. Different types of counters (vehicle volume counter, speed, classifier, and WIM) could be installed at a CCS.
Count	Count	Refers to how the data are collected to measure and record traffic characteristics such as vehicle volume, classification (by axle or length), speed, weight, lane occupancy, or a combination of these characteristics.
DVMT	Daily Vehicle Miles Traveled	Indicates how many vehicles have traveled over the distance of a route, for a data-reporting year, when reported as an average day for a given year. (DVMT = AADT X section length).
D-Factor (D)	D-Factor (D)	The directional distribution factor. It is the proportion of traffic traveling in the peak direction during a selected hour, usually expressed as a percentage. For example, consider a typical weekday morning when commuters are traveling from suburban areas into the city for work. During that hour, more vehicles are generally moving toward the city than away from it. If traffic data shows that around 62.5% of vehicles are heading into the city and the remaining 37.5% are heading out, that would reflect a fairly common directional imbalance seen on commuter routes.
Federal-Aid Highways	Federal-Aid Highways	All NHS routes and other roads functionally classified as Interstate, Other Freeways and Expressways, Other Principal Arterials, Minor Arterials, Major Collectors, and Urban Minor Collectors.
Functional Systems	Functional Systems	Functional systems result from the grouping of highways by the character of service they provide.
Inductance Loop Detector	Inductance Loop Detector	Inductance loop detectors operate by circulating a low alternating electrical current through a formed wire coil embedded in the pavement. The alternating current creates an electromagnetic field above the formed wire coil (1/2 the field height corresponding to the shortest leg of the loop), and a conductive object (e.g., car, truck, and bike) passing through the electromagnetic field will disrupt the field by a measurable amount. If this disruption meets predetermined criteria, then detection occurs and an object is counted by a data logger or computer controller.
Intrusive Sensor	Intrusive Sensor	Traditionally, most vehicle detection sensors were placed on top of or in the pavement (e.g., road tubes versus inductive loops). These sensors are commonly referred to as “intrusive” sensors.

Acronym	Term	Definition
K-Factor (K)	K-Factor (K)	The proportion of AADT occurring in the peak hour is referred to as the peak hour proportionality K-factor. It is the ratio of peak hour to AADT. It is used in design engineering for determining the peak loading on a roadway design that might have similar traffic volumes. For example, by applying the K-factor to a volume, a design engineer can estimate design hour volume. The K30 is the 30th (K100 is the 100th) highest hour divided by the AADT.
MADT	Monthly Average Daily Traffic	This can be computed by adding the daily volumes during any given month, dividing by the number of days in the month, and weighting the number of specific days in the month with the associated weighting factor for the number of DOWs in the given month. For MADT, most of the calendar month of data should be included with a minimum of at least one time increment for each DOW. For a CCS site that operates 365 days per year without failure, the MADT can be computed by adding the daily volumes during any given month and dividing by the number of days in the month. The new FHWA AADT/MADT method is recommended for all MADT calculations.
Non-intrusive sensors	Non-intrusive sensors	Non-intrusive sensors can be overhead-mounted sensors, under-the roadway sensors, and side-fired sensors. Side-fired sensors have the advantage of being mounted beside the road. This makes them easy to install, access, and maintain.
PHF	Peak Hour Factor	The hourly volume during the maximum traffic volume hour of the day divided by 15-minute volume multiplied by four, a measure of traffic demand fluctuation within the peak hour. It represents one hour of data at the peak time.
PTR	Portable Traffic Recorder or Counter	A vehicle counter or classifier that is portable/mobile (can be moved to different locations) and not permanently installed in the infrastructure, including sensors placed across the road.
STC	Short Term Count	Counts that are collected for less than a continuous basis. This allows the temporal data to be expanded to other areas. Consequently, these could be considered as supplying spatial data. Count taken on a 24-hour to 7-day basis for roadway segment-specific locations. These counts may be used in special studies.
Traffic Counter	Traffic Counter	Any device that collects pedestrian, bicycle, micromobility devices, and vehicular characteristics data (such as volume, classification, speed, weight). A traffic counter is placed at specific locations to record the distribution and variation flow by hour of the day, day of the week, and/or month of the year. It may be used to collect data continuously at a permanent site or at any location for shorter periods.

Acronym	Term	Definition
TMAS	Travel Monitoring Analysis System	The FHWA-provided online software used by States, MPOs, and cities to submit traffic data for Federal purposes.
Vehicle Count	Vehicle Count	The activity of measuring and recording traffic characteristics such as vehicle volume, classification, speed, weight, or a combination of these characteristics.
Vehicle Length	Vehicle Length	This refers to the overall length of a vehicle measured from the front bumper to the rear bumper including permanent equipment that may extend beyond the rear bumper such as that used to improve aerodynamic performance.
VMT	Vehicle Miles Traveled	Vehicle Miles Traveled indicates how many vehicles have traveled over the distance of a route, for a data-reporting year, when reported as Annual VMT (VMT = DVMT x 365). It indicates how many vehicles have traveled over the distance of a route or functional classification or geographic area in one day. VMT is calculated by multiplying the AADT value for each section of road by the section length (in miles) and summing all sections to obtain VMT for a complete route. VMT is not the same as daily vehicle distance traveled (DVDT), which measures the distance traveled by vehicles in a day, not how many (VMT) vehicles traveled over a given distance in a day. Depending upon the formulas used, these numbers may be the same.
WIM	Weigh in Motion	A measure of the vertical forces (normal) applied by axles to sensors in the roadway. This is used to measure the weight carried by vehicles (trucks) to determine the appropriate pavement design.

Appendices

Work Order Form

Montana Department of Transportation

Montana Department of Transportation
PO Box 201001
Helena MT 59620-1001
www.mdt.mt.gov

PROBLEM DESCRIPTION	
Location Name	I-90, RP 117.99, 4 Mi. S of Turah (C000090) @ 1 Mi. NW of Clinton Intch
Location ID	W-121
Class	Site Repair
Service Type	Sensor Work
Received By	JMcDougall
Description	TCDS Location ID: W-121:
Caller Name	
Caller Phone	
Caller Email	

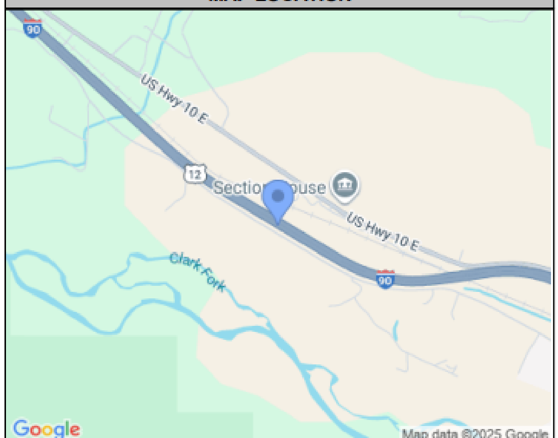
KEY INFORMATION	
Create Date	8/7/2025 8:21:27 AM
Origination Date	8/5/2025 8:21:00 AM
Service Started	8/5/2025 6:22:00 AM
Field Work Complete	8/5/2025 8:22:00 AM
Response Time	0 Days 0 Hours 1 Minutes
Dispostion	

CREW INFORMATION	
Crew Name	EEU
Crew Supervisor	John McDougall
Assigned By	John McDougall
Date Assigned	8/7/2025 8:21:42 AM
Crew Leader(s)	Tedd Little
Problem Verified?	No
Handled by Mdt?	Yes
Instructions	
Inspection Required?	No

PICTURE 1	PICTURE 2	PICTURE 3

WORK ORDER STATUS	
Work Order #	2025108M
Priority Level	Medium
Status	F.W. Completed
Closed By	

MAP LOCATION



LAT/LONG	46.797778	-113.763833

INSPECTION	
Date Inspected	
Inspected By	
Passed?	No
Notes	

COST
No Cost Data Available

History - Last 3 Actions
No History Available

Service Action
Worked on Lane 0, EB DR. Replaced sensor P2 that was damaged when the passing lane was milled. Also installed a leading loop before the existing sensor array to accommodate a future kistler data logger installation. Ran and connected a loop lead for the new sensor. P2 sn 5869073

Lane numbers increase towards the center of the road, where lane 1 is the curb.

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