

DRAFT

**I-90 Three Forks to Billings
Road Closure Management Study**

Existing Conditions Report

Montana Department of
Transportation

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**CDM
Smith**

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Section 1

Introduction

The Montana Department of Transportation (MDT) has identified a need to evaluate and mitigate operational impacts for Interstate 90 (I-90) closures and weather events between Livingston and Billings. The I-90 study area is defined from the intersection of I-90 and US 287 (RP 274) to Billings (RP 443), but recommendations for mitigation measures may extend beyond this study area if warranted, particularly east of Billings to the I-90/I-94 junction. However, the intent of this project is to provide assistance to rural drivers that may be trapped on the corridor for hours or days with little or no services.

This report summarizes the existing conditions for the corridor. It describes the travel and safety characteristics of the corridor that help define the needs and objectives and inform the potential mitigation measures recommended. Mitigation measures are expected to be a mix of operational, policy, and capital projects. A separate and subsequent report will evaluate any recommendations.

Weather events, especially during winter months, can create impassable conditions in this corridor, mainly between Livingston (RP 330) and Columbus (RP 408). These events can require closures or detours within the corridor. To better understand the issues, CDM Smith has met with MDT staff responsible for the closures and obtained data on the corridor, including number of closure events, traffic volumes, crash data, and an inventory of MDT assets related to the closures. Included in these assets are the physical right-of-way in and around interchanges.

MDT data, not including wind events in Livingston, identifies 212 closure events that occurred from 2007 to March 2018, or approximately 13 events per year. Based on the data provided, these closures were generally caused by severe driving conditions. From discussions with MDT Maintenance staff in Livingston, wind events that primarily occur from late October to March can impact I-90 travel two to three times per week. The Livingston wind events are separate from and not included in the 212 previously identified interstate closure events.

In **Section 2**, the general characteristics of the corridor are presented. This includes identifying the overall corridor and subareas of interest, as well as an inventory of the existing Intelligent Transportation System (ITS) and operational assets available to MDT.

Section 3 addresses operational data related to the corridor. This includes closure event-related information, and traffic data such as Annual Average Daily Traffic (AADT) and crash history. While exploring operational concerns, interviews with involved staff and field visits were critical to the operational understanding. Anecdotal information from these sources is included in this section.

Section 4 provides a summary of the existing conditions.

Section 2

Corridor Description

2.1 Overall Corridor

The corridor consists of approximately 170 miles of I-90 between Billings (RP 443) and the US 287 interchange west of Three Forks (RP 274). The focus of the project corridor is on the rural areas and addressing needs related to generally weather-related closures. While some solutions may involve the greater Billings area or address statewide issues, the physical corridor will remain between these two reference posts.

The roadway consists primarily of a four-lane divided interstate (two lanes in each direction). A third lane is provided in select spots, usually for acceleration lanes with entrance ramps. The inside median is primarily relatively level grass that provides errant vehicles with a traversable slope outside of the clear zone. Areas where the clear zone cannot be provided are protected with guardrail. The roadway typical section throughout the corridor generally consists of a 10-foot outside shoulder, two 12-foot travel lanes, and a 4-foot inside shoulder. MDT owns all ROW within each interchange.

The terrain consists of rolling hills and valleys with a mountainous section within the Bozeman Pass (approximately RP 313 to RP 324). As this is primarily a rural area, there are no close alternate roads. For long-distance traffic, major decision points for feasible alternate routes are typically in the Billings and Belgrade/Bozeman area, as well as areas outside the study area in Missoula and Butte.

This route primarily serves regional traffic within Montana as well as Interstate travelers. Annual Average Daily Traffic (AADT) are shown in figures 3-1 and 3-2. **Figure 2-1** is a map showing the location of permanent counters along the corridor. The area is subject to harsh winters with frequent significant snow storms; closures from these storms and other weather-related events are common and are the primary concern addressed by this analysis.

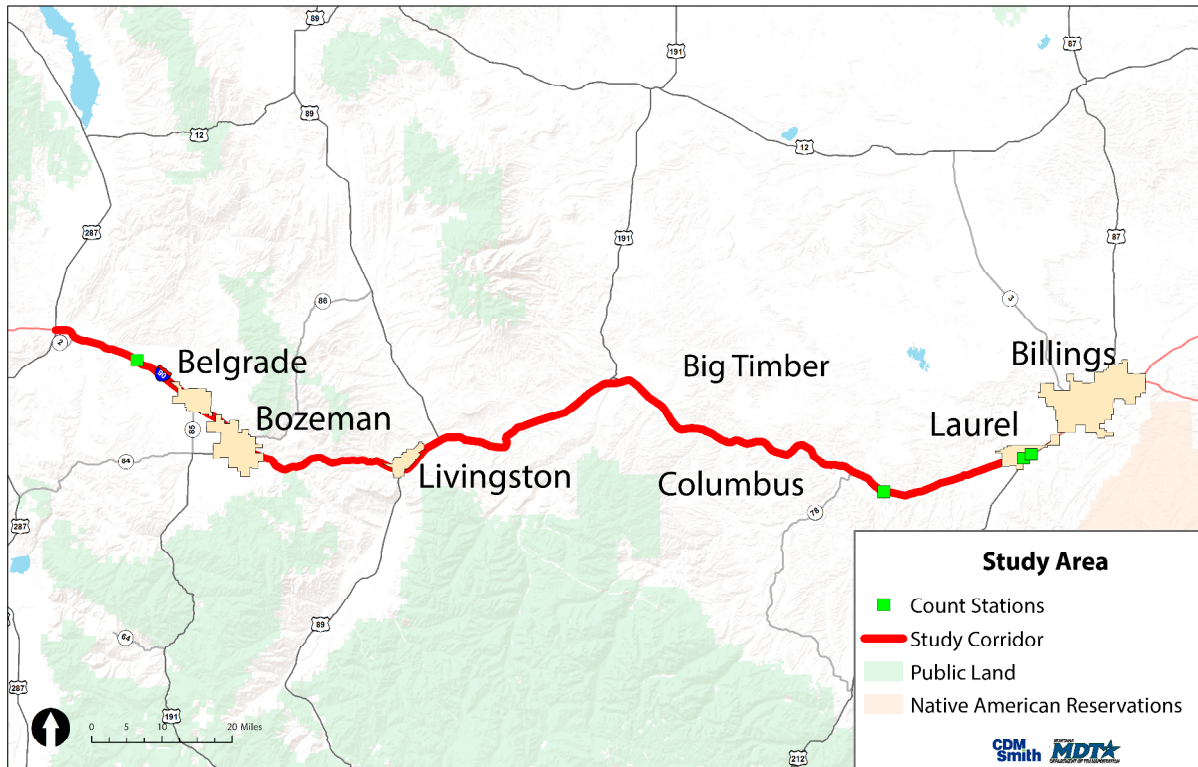


Figure 2-1: Permanent Count Station Locations

Rural corridors present unique operational challenges to agencies. While traffic is relatively light as compared to most urban corridors, the available assets on a per-mile basis are also relatively thin in comparison. Communications and preparation are therefore important to providing the required incident management and maintenance services to minimize impacts to the operations of the facility.

2.2 Communities

Five communities of note were identified by MDT along the corridor, including the cities of: Bozeman, Livingston, Big Timber, Columbus, and Billings. Columbus and Livingston were identified by MDT as field visit locations. CDM Smith staff met with the local MDT operations staff at these locations to complete a field review and gather information relevant to operations in the corridor. The following sections are a summary of these field visits.

2.2.1 Columbus

Columbus is home to roughly 1,900 residents and is located 75 miles east of Livingston and 41 miles west of Billings. It serves as a gateway to the Absaroka-Beartooth Mountains and Yellowstone National Park.

The field visit was conducted on March 20, 2018. Details of the field visit are contained in the summary report included in **Appendix A**. There are no effective alternate routes between Columbus and Livingston where many of the road closures occur. The Columbus interchange (RP 408) is the logical turnaround location for westbound traffic, as its proximity to Billings provides

long-distance traffic with an opportunity to return to the Billings area in the event of an interstate closure. From the Billings area, road users have the option to either take an alternate route for major long-term closures or to take advantage of a greater availability of parking and services. Columbus is close enough to Billings that long-distance traffic has an opportunity to return to the Billings area and either take an alternate route for major long-term closures or take advantage of a greater availability of parking and services. In the event of a closure, westbound traffic that has traveled beyond Columbus (RP 408) is unlikely to re-route back to Billings, exasperating traffic problems further down the Interstate in Big Timber or Livingston.

Interviews with MDT staff indicate the following operational issues that have been observed:

- Historically, trucks frequently attempt to take US 191 to bypass snow events. Highway 191 is a two-lane road that runs in a northerly direction from Big Timber. Secondary 306 heads towards Rapelje. This route is not paved north of Rapelje. US 191 experiences blowing snow and exposes vehicles to near-continual broadside winds and is inadvisable as an alternate route, while the road towards Rapelje, which is not paved, can get drivers lost on the road with limited traffic.
- Vehicles traveling on US 212 are predominantly heading in an easterly direction and are unlikely to be impacted by Interstate closures west of Laurel.
- The area near the twin bridges over the railroad and Yellowstone River (approximate RP 398) does not have a workable detour between Reed Point and the Springtime interchange (Exit 400) if that section of the Interstate is closed.

The field visit also identified locations that serve as existing truck storage during closures, as well as attempting to identify additional potential locations. The following sites were identified:

- The City of Big Timber
- The Greycliff rest area (RP 381)
- The City of Columbus
- The Columbus rest area (RP 419)

The Greycliff rest area (RP 381) was recently rebuilt to handle additional truck storage due to road closures and is used when the road is closed between Springtime and Columbus. However, it is not a good option for wind events as it is beyond the point where wind events typically occur. During snow events trucks often park on the shoulder of the Interstate. This practice is unsafe and generally ineffectual. Trucks on shoulders often get blown in and immobilized by snow and are a hazard to plows and other motorists. The consensus of MDT staff is that historically, none of these individual areas, nor all of them collectively, can provide for the amount of traffic that can back up in the hours it takes to implement a closure and clear the roadway. Billings was identified as the only location able to handle the potential/typical amount of trucks that back up during closures.

2.2.2 Livingston

Livingston is located in Park County, with roughly 7,000 residents. Like Columbus, it is a gateway to Yellowstone National Park. It is located 26 miles east of Bozeman and 75 miles west of Columbus.

The field visit was conducted on March 21, 2018. Details of the field visit are contained in the summary report included in the **Appendix A**. The Livingston area is susceptible to wind closures. The field visit and interview identified numerous issues relative to the existing conditions in the corridor.

During the interview, it was noted that the westbound off-ramp at Exit 337 has less than desirable geometry, minimal visibility, and a notable lack of vehicle storage, which can back up quickly onto the Interstate in detour events. Per **Figure 2-2**, the westbound exit ramp geometry is limited because the interstate width is constrained by the US 89 overpass that crosses I-90 just east of the exit ramp. This bridge also blocks the exit ramp from view of westbound drivers until they arrive at the short 220' taper.

The deceleration length for this exit ramp is short, especially if traffic is backed up through the horizontal curve (note: stopping sight distance from 70-mph is 730-feet). The vehicles that have exited the Interstate must then enter onto US 89 westbound by making a left turn from a stop sign. This left turn can be difficult to make if there is a steady stream of detoured I-90 eastbound vehicles reentering I-90 at Exit 337.

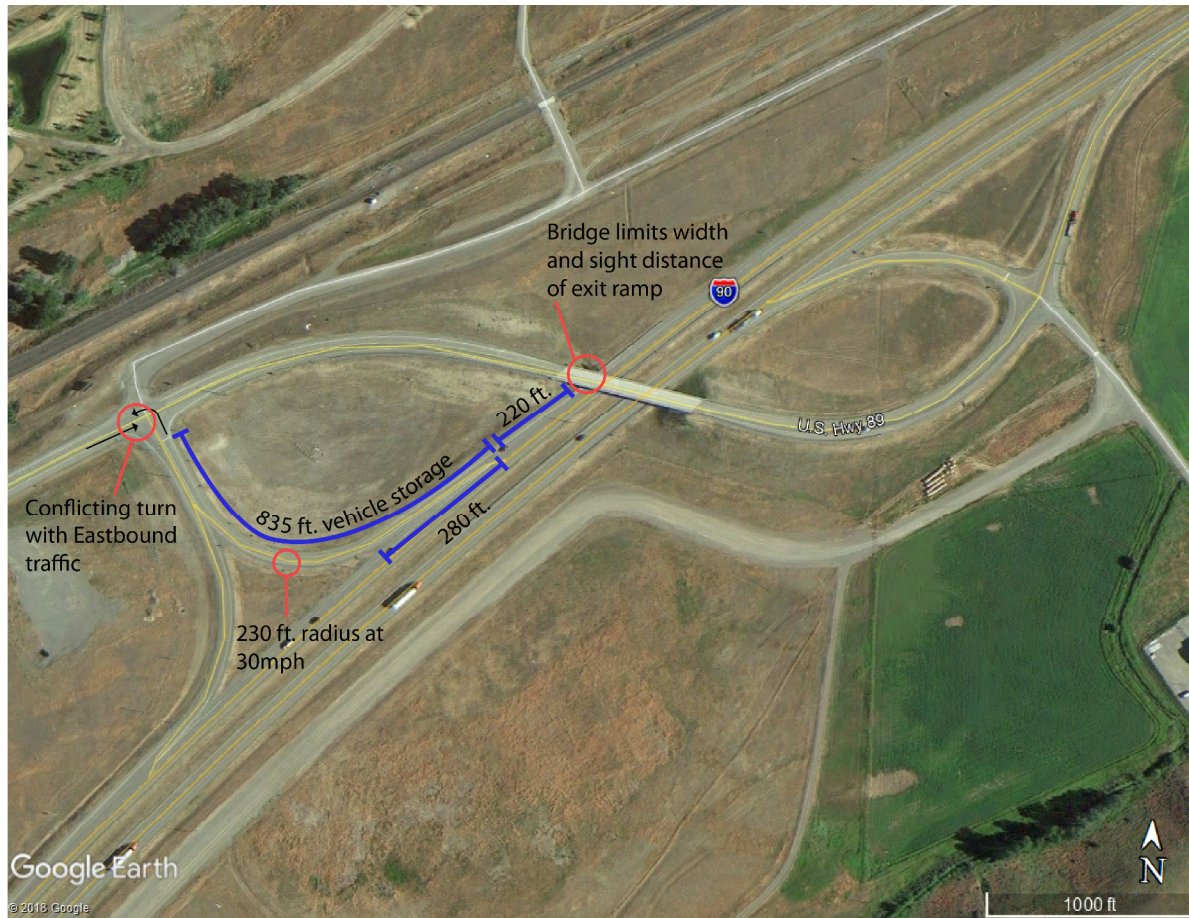


Figure 2-2: Livingston Exit 337 Interchange

Frequent wind events require traffic to detour through the community of Livingston. Several impacts of the detour route were discussed during the interviews and include the following:

- During full closure events, traffic quickly fills up the entirety of Hwy 10 W, and Park Street/US 89.
- Passing trains during detour events cause the railroad-crossing gates at the Y-intersection between HWY 10 W and Park Street to be closed (see **Figure 2-3**).
- The traffic signals in town currently do not have the flexibility to run in a detour phase.
- During detour events, signal phasing results in delays with left-turning traffic from eastbound Park Street at the Y-intersection at HWY 10 W.
- A general lack of truck parking in Livingston was noted—especially during hard road closure events. Local city/county staff have identified an empty parcel near Exit 337 for potential improvements that would provide increased vehicle storage capacity during closure events.
- There is a visibility issue for traffic approaching the westbound off-ramp at Exit 337. Traffic currently does not have direct visibility of MDT crews implementing a closure. Increased visibility will be a significant safety improvement for MDT staff initiating detours/closures,

and for the traveling public, who would have a better view of stopped traffic on the Interstate in advance of the existing condition.



Figure 2-3: Livingston - Highway 10 W and Park St.

As previously noted, there are two very specific points with recurring wind issues. The first problem spot is near mile marker 332 just east of Livingston Exit 330. The second problem spot is near mile marker 334 just east of the bridge over the Yellowstone River. Both locations are unique for not having a natural barrier/wall on the south side of the road. The strong winds elsewhere in this corridor are generally redirected away from the road by various natural treatments.

2.3 Inventory

There are many existing operational assets within the corridor, primarily consisting of staff, vehicles, and traffic control devices. As a rural corridor, this area has few Intelligent Transportation System (ITS) devices and no continuous power and communications to support technology throughout. The current assets are illustrated in **Figure 2-4**.

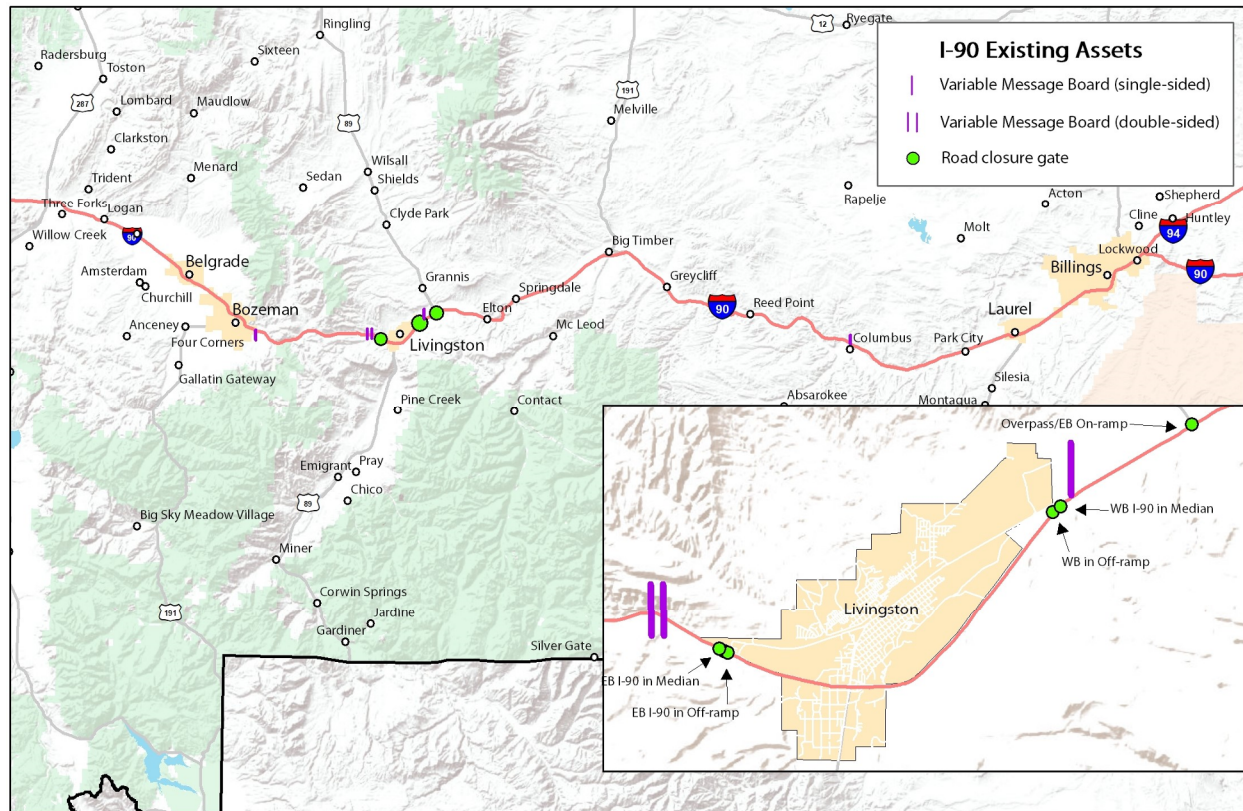


Figure 2-4: Maps of Corridor ITS and Operational Assets

2.3.1 Intelligent Transportation System (ITS)

Primary ITS assets within the corridor consist of the following:

- Variable message signs (VMS)
- Highway advisory radio (HAR)
- Count stations
- Weather stations
- Cameras (CCTV)

MDT has four permanent VMS in the study corridor. The MDT Billings Maintenance Area has one permanent VMS sign for westbound traffic, located approximately one mile east of Columbus, and they have a total of seven portable VMS signs between Hardin and Big Timber, an area covering approximately 130 miles of I-90 between the cities.

A total of four existing permanent VMS on three structures exist along I-90 within MDT's Bozeman Maintenance Area. One permanent VMS is located on the west side of the Bozeman pass near mile marker 311, with the additional two permanent VMS's located on either side of Livingston. A double-sided VMS is located just west of the Exit 330 eastbound off-ramp, and a single-sided VMS is located just east of Exit 337, near mile marker 338.

There are 42 existing flip-signs between RP 328 and RP 340 that must be manually operated by the MDT Bozeman Area Maintenance staff in order to implement a detour or closure at Livingston.

MDT operates a HAR station (AM radio station 530) in the Livingston area. The HAR sign for westbound travel was noted to be within the closed detour segment of I-90, rendering it useless in a closure event. The existing radio station has had performance issues, including a poor signal that grows noticeably weaker near Big Timber.

There are existing wind speed gauges near mile markers 332 and 334. The existing wind speed gauge at mile marker 332 can be accessed by MDT maintenance staff remotely, while the gauge at mile marker 334 currently requires that Maintenance staff manually download data.

2.3.2 Operational

Operational assets include traffic control devices used to close ramps and the Interstate. This starts with field staff and their vehicles, which include snowplows and smaller 2WD pickups used for implementing traffic control. While all vehicles are equipped with standard hazard/emergency lighting (e.g., amber light bars on top, additional flashers in back, etc.), it was noted that during blizzard and white-out conditions, this emergency lighting may not be adequate.

There are permanent Interstate closure gates at Livingston Exit 330 and Exit 337. These gates are operated by manual cranks and require two to three people to close them during weather events.

2.3.3 Statewide Assets

One of the major goals of this analysis is to provide recommendations that may include projects that can be completed along the corridor. However, there are other statewide assets that have a role in managing events within the corridor. This includes the MDT traveler information system. This system incorporates Montana's 511 system, which was created and has been maintained by MDT staff. The traveler information system provides real time information on closure events throughout the state. The MDT's 511 website had over 10 million hits this past winter (2017-2018). Phone calls to 511 during the same period numbered at approximately YYYYYY. The traveler information system is also responsible for social media contracts (e.g., twitter). The MDT website includes a motor carriers' page. While other states have motor carrier pages that specifically address real time issues of importance to trucks, the MDT site currently primarily focuses on permitting and restrictions.

Construction information is entered manually every week, and project managers are responsible for updating this information if there are any changes. During winter, snowplow drivers report conditions through their radio dispatch center. The information is not automated but is typically updated within minutes by staff. It should be noted that there currently is no central traffic management center for MDT. During the winter (typically November to the first week of April), the traveler information system is staffed 24/7. Outside of winter, staff are on-call to remotely add events as needed.

MDT also cooperates with other state and local transportation departments. This includes some work with the Western Transportation Institute out of Montana State University and

representation with the Northwest Passage coalition. Both organizations provide opportunities for MDT to share information and provide ideas for new ways to manage events.

Montana has a statewide maintenance communications system, as well as private cellular networks. However, many passes and valleys have no cellular or radio coverage. Fiberoptic cable statewide is too expensive for the small amount of traffic. Crowdsourced information such as Google and Waze are also sporadic due to the lack of coverage and lack of “crowds” in a large rural state. Some of the other states in the Northwest Passage coalition have citizen reporting systems that allow everyday citizens to call in or use an app to report events and conditions.

Section 3

Observed Operational Problems

Part of the process of evaluating existing conditions involves noting operational issues. These issues are identified both through data analysis and anecdotal interviews with stakeholders. The issues need to be identified to assist with developing recommendations in the final study report.

3.1 Data Analysis

Data is available for a variety of operational concerns, including basic traffic and crash data, as well as road closure data.

3.1.1 Traffic

AADTs were determined from the three count stations at locations shown in **Figure 2-1**. AADTs in two areas in the corridor are illustrated in **Figure 3-1** and **Figure 3-2**. AADT is highest on the eastern end near Billings with a range between approximately 9,000 and 27,000. Large truck AADTs are fairly consistent throughout the corridor at approximately 2,000. AADTs vary significantly by month as shown in **Figure 3-3**, where July traffic can be nearly twice that of January.

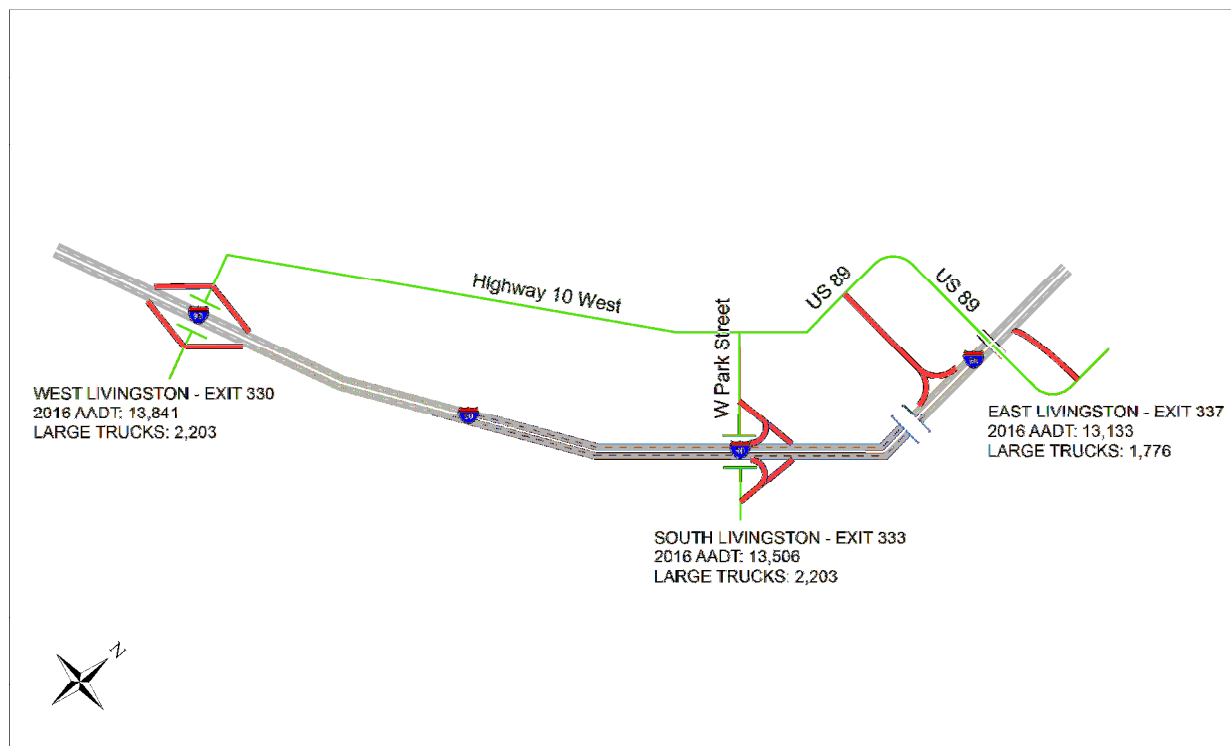


Figure 3-1: AADT Maps for Livingston

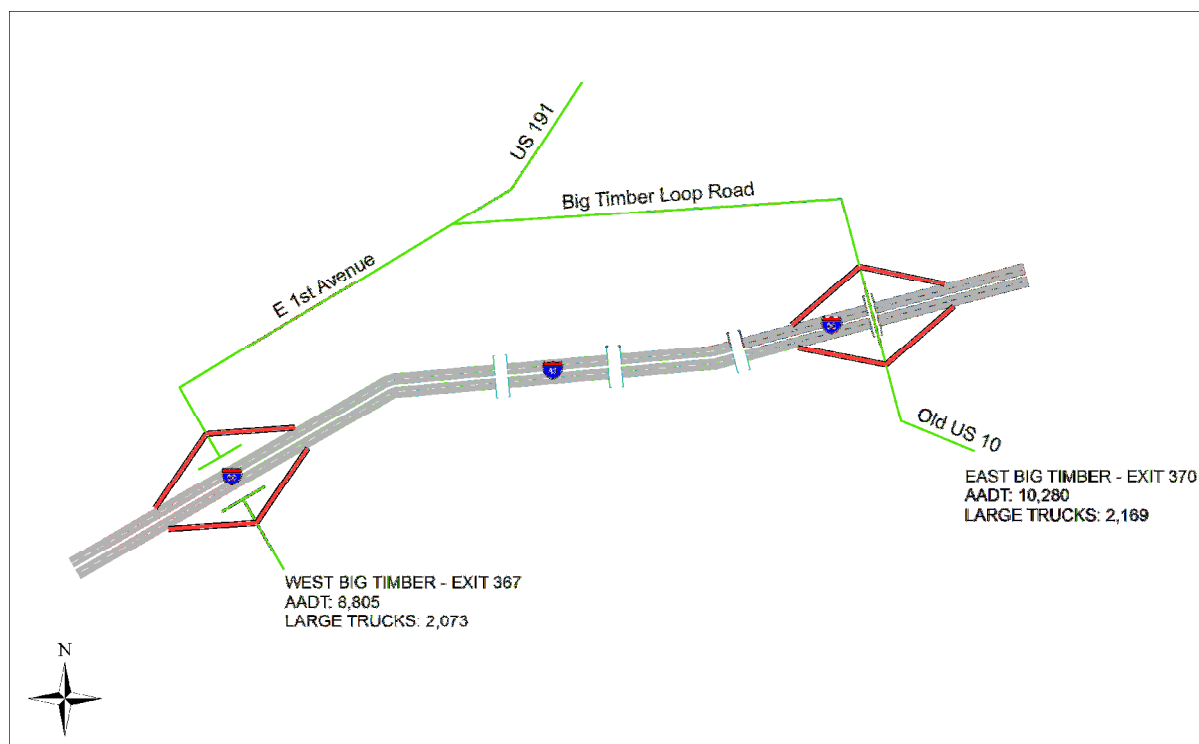


Figure 3-2: AADT Maps for Big Timber

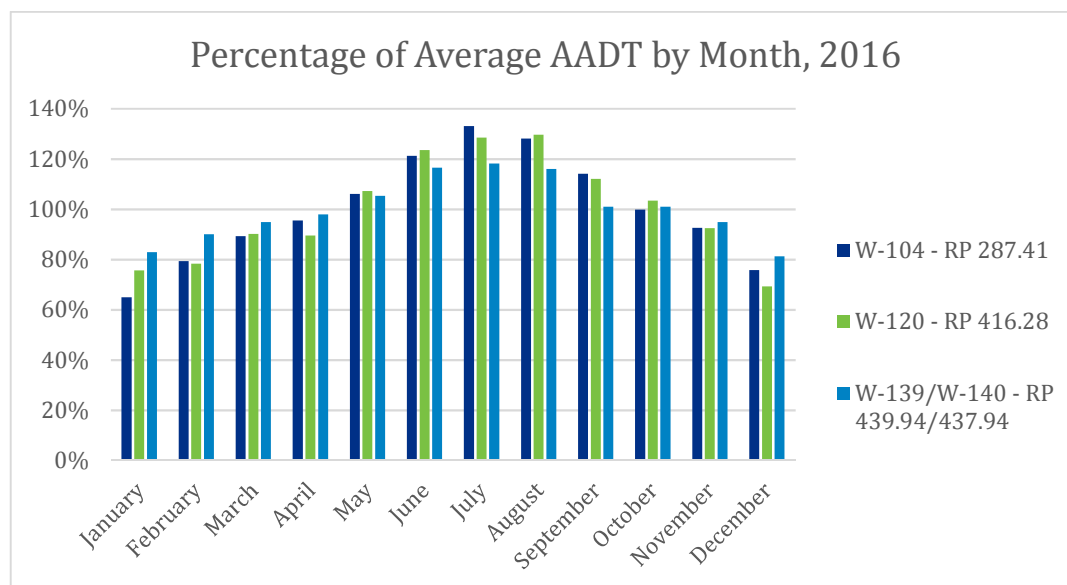


Figure 3-3: Monthly AADT Variation at Permanent Count Stations

3.1.2 Closures

The primary concern for the corridor is full closures of the roadway. These closure events happen relatively frequently in this corridor and are almost entirely winter storm-related. For most

traffic crashes, the MDT is typically able to maintain at least one open lane on the roadway. Winter weather closure information was provided by MDT for the period from 2007 to 2018. There are separate wind-related closures in the Livingston area that are addressed separate from the snow storms. **Figure 3-4** illustrates winter weather related closures, showing that the majority of road closing incidents occur between November and February, with more continuing through spring.

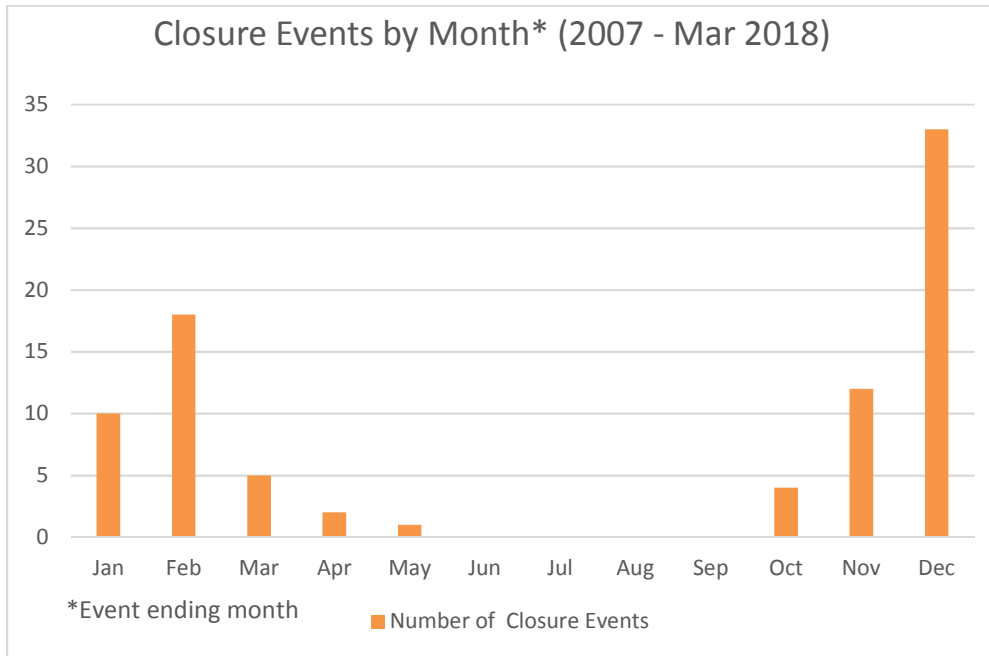


Figure 3-4: Total Closure Events by Month (2007-2018)

Closures can span a broad range of times and distances. Closing the road can take several hours, so these closures are only implemented when extreme conditions are warranted. **Table 3-1** summarizes the variation of impacts. Closures run from several hours to just over four days. The average is nearly seven hours, but the standard deviation of almost ten hours illustrates the highly variable nature of these events. Typical section lengths average 25 miles, with the minimum being 12 miles and the maximum 38 miles (see **Figure 3-5**).

Table 3-1: Closure Impact Summary

Measure	Closure Duration (hours)	Closure Duration (minutes)	Closure Distance (miles)
Minimum	0.7	42	12
Maximum	50.3	3,018	38
Mean	7.6	458	24
Median	4.2	250	18
Standard Deviation	10.1	606	10

Source: MDT event closure log

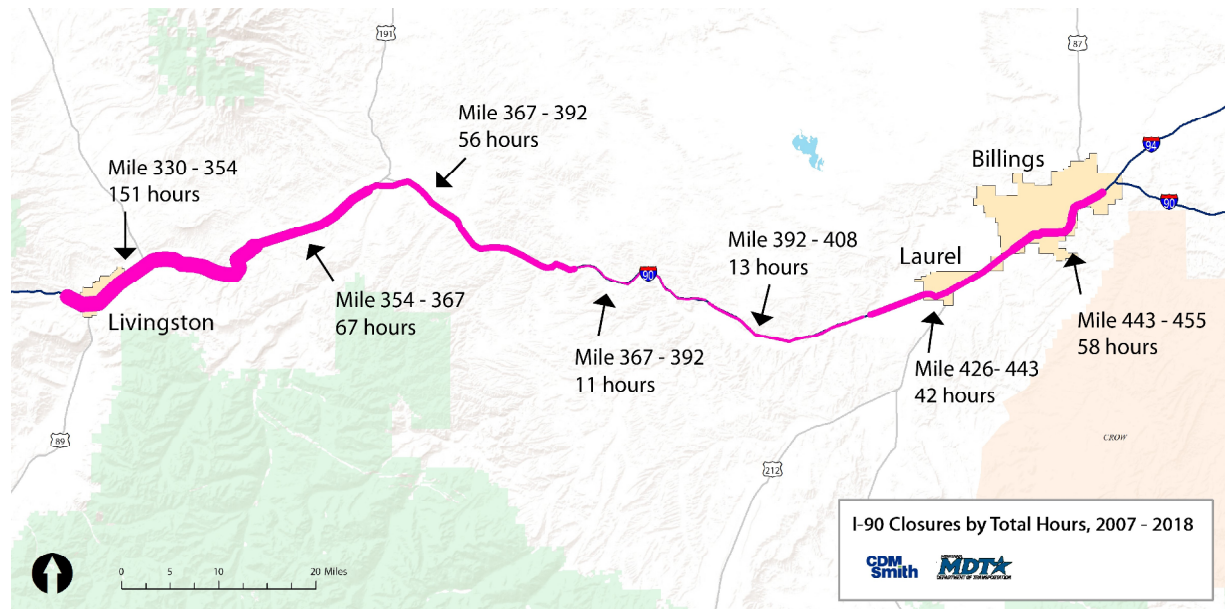


Figure 3-5: Closures Per Segment

These events exclude the wind advisory and detour events in the Livingston area. MDT staff in Livingston noted that I-90 is frequently closed during the winter months at two specific wind event locations (see **Figure 3-10** below). Wind-related closures can be for trucks only or all traffic. Hard data for the wind-related detours/closures was not available for analysis. This issue is discussed more below.

3.1.3 Crashes

While weather-related events are the primary cause of roadway closures, when addressing operational issues, it is important to look at all potential issues. Operational solutions are rarely isolated. A good solution to a winter weather road closure may benefit MDT in addressing a major crash, a hazmat situation, or a summer special event.

In addition, crash data often helps to illustrate potential operational issues, such as a curve, a weaving issue, or a sight distance issue. Finally, crash data also serves an important role in outreach on operational efforts. Having data that illustrates issues helps to both elevate the relative importance of the analysis and to educate travelers in potential solutions. For example, if the data indicates trucks are susceptible to run-off-the-road crashes in snow in a certain area, this information is important to convince truckers to use chains or abide by a variable speed limit for their own safety.

The number of crashes along the corridor is illustrated in **Figure 3-6**. Total crashes are indicated by the blue line, with truck-involved crashes shown by the orange line. The chart illustrates that truck-involved crashes are relatively uniform across the corridor, but car-related crashes are significantly higher between Belgrade and Livingston, and from Laurel to Billings – essentially near the larger communities where there is more commuter traffic.

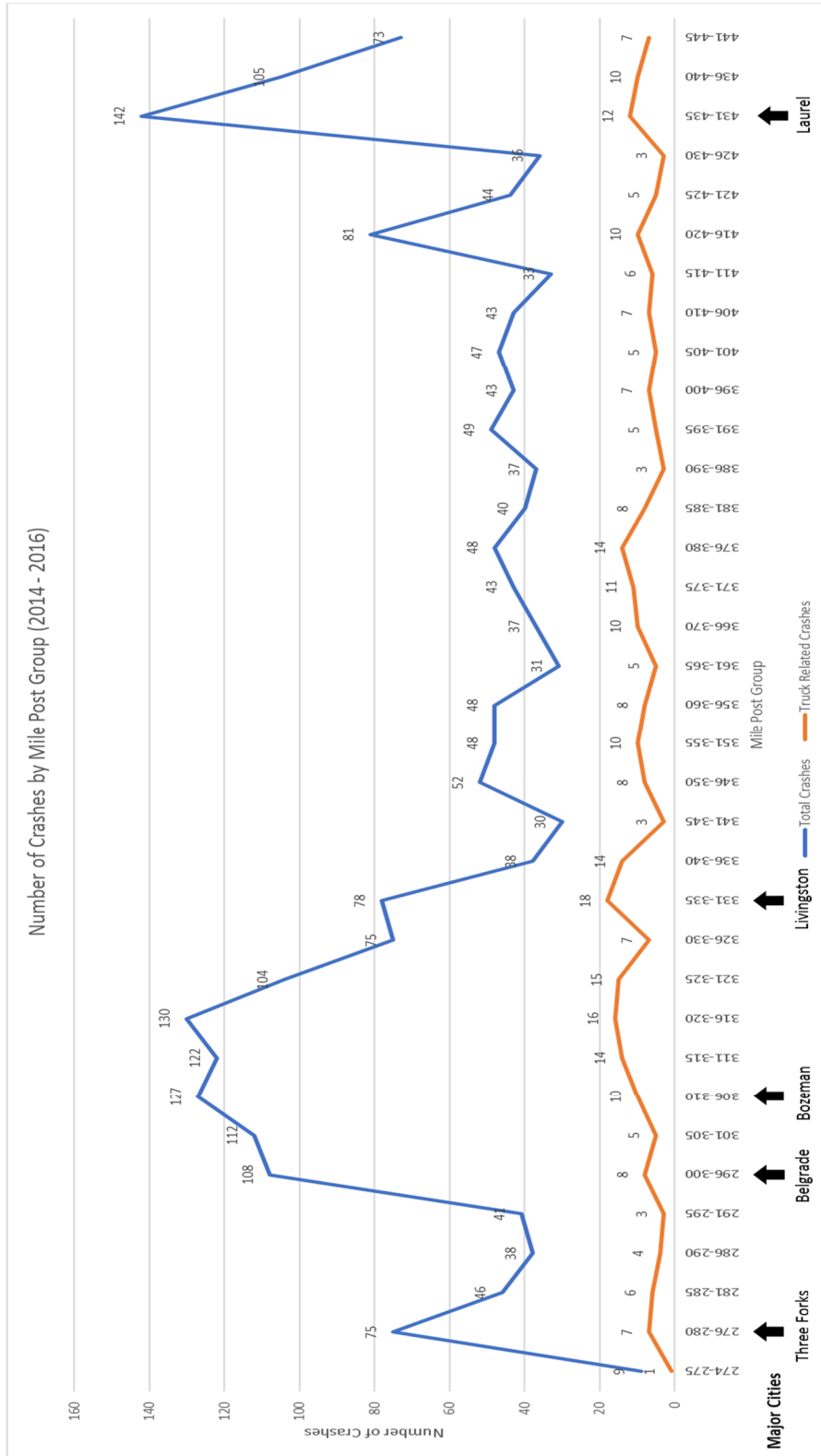


Figure 3-6: Crashes by Reference Post

Figure 3-7 shows a spike in crashes in the early winter months; otherwise, crashes are evenly distributed across the year. This may be typical problems with drivers no longer being used to driving in winter conditions. Similarly, **Figure 3-8** shows the crashes by hour of the day. While there is a drop in the early pre-dawn hours, and the morning and afternoon peak hours are higher, the overall distribution of crashes is relatively stable. This illustrates that the crashes are not a nighttime issue.

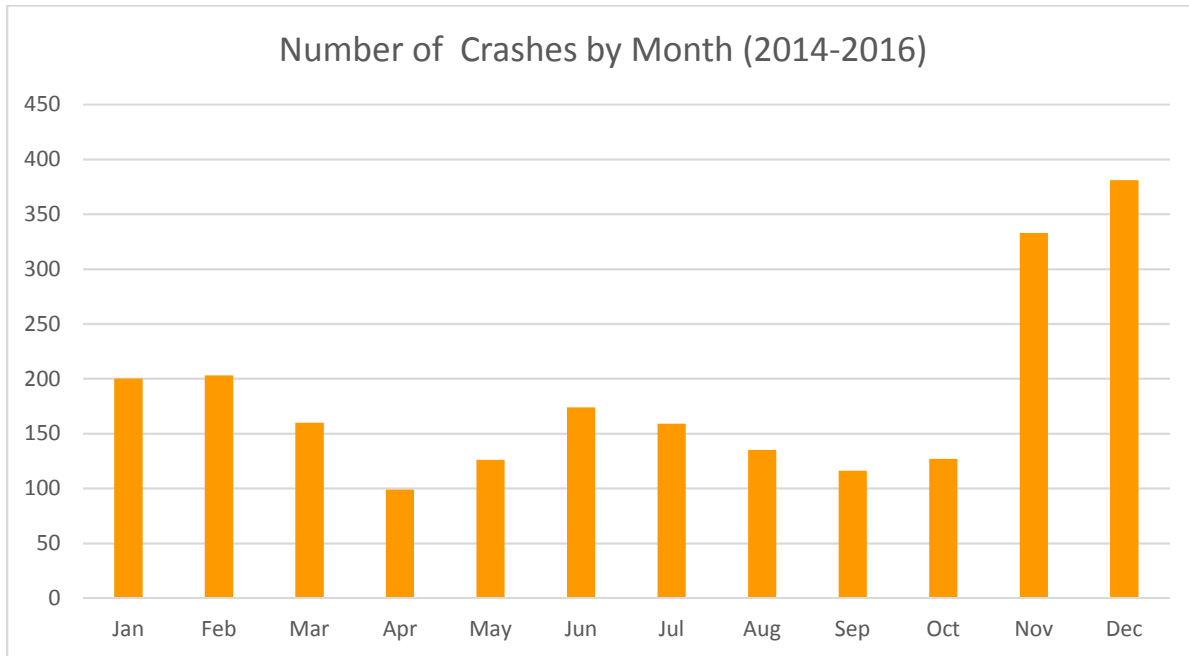


Figure 3-7: Crashes by Month

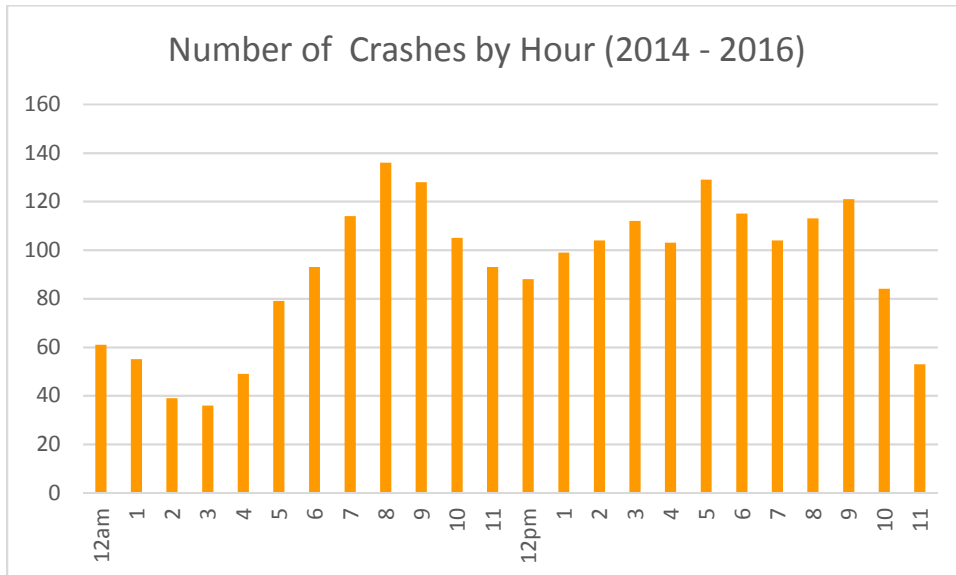


Figure 3-8: Crashes by Time of Day

Figure 3-9 is a summary of the top five collision types. These top five represent 87 percent of the total crashes within the corridor. Fixed object crashes on a rural Interstate are typical of run-off-the-road crashes. Second are animal crashes, which are common to rural areas with dense populations of large ungulate species, including but not limited to deer and elk. Animal crashes are more typically during nighttime and often more numerous during the early fall. Roll-over crashes are also indicative of run-off-the-road crashes, but in this corridor may be more representative of trucks and wind-related events. Rear-end and side-swipe crashes are more typical of urban areas and congestion.

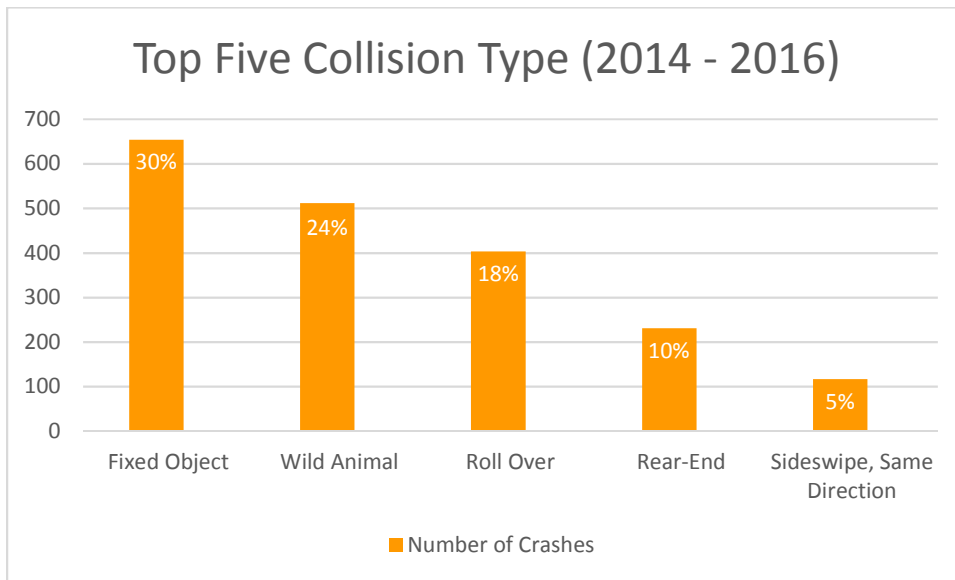


Figure 3-9: Crashes by Type

3.2 Field Visits

3.2.1 Columbus

Interviews with MDT Billings Maintenance staff noted that closure incidents within the Billings District are infrequent and primarily caused by blowing/drifted snow with low- to no-visibility conditions. The flats on either side of Big Timber are known snow drifting locations; these are the most likely areas to force Interstate closures within the MDT Billings Area Maintenance territory.

Additional weather-related threats include wildfires. MDT staff had indicated that historically they were able to maintain at least one lane of traffic on I-90 in both the eastbound and westbound directions while closing the lane closest to the fire for firefighting operations. Interstate flooding within the area is not an issue, although Maintenance staff did identify one location between Big Timber and Bridger Creek (RP 384) where the possibility of flooding exists.

3.2.2 Livingston

The primary trigger for I-90 warnings, detours, and closures in this corridor is wind. Wind events primarily occur from late October through March. On average, staff had indicated about two wind events occur every week during the windy season (partial or full detours between Exit 330 and Exit 337). Wind event durations last up to 2 days.

There are two critical wind event locations that primarily impact westbound truck traffic. The first problem area is near mile marker 332 just east of Livingston Exit 330. The second problem area is near mile marker 334 just east of the Interstate bridge over the Yellowstone River. Existing wind gauges are installed near each location. A third known wind location that does not have a history of truck rollovers occurs along the flats just east of mile marker 336.

The four primary types of incidents in the Livingston area are as follows:

1. **Severe cross-winds warning:** triggered when wind speed reaches 40 mph
2. **Partial I-90 closure between Exit 330 and Exit 337:** trucks/towing vehicles must take detour route through Livingston; triggered when wind speeds reach 50 mph
3. **Full I-90 closure between Exit 330 and Exit 337:** all vehicles must take detour route through Livingston; triggered when wind speeds reach 60 mph or as deemed necessary by the MDT Bozeman Area Maintenance Superintendent, based on weather conditions
4. **Full I-90 closure East (or West) of Livingston:** The Interstate is closed completely to the east or west of Livingston; this type of incident is rare, and primarily occurs when blowing snow between Livingston and Big Timber creates low-visibility conditions

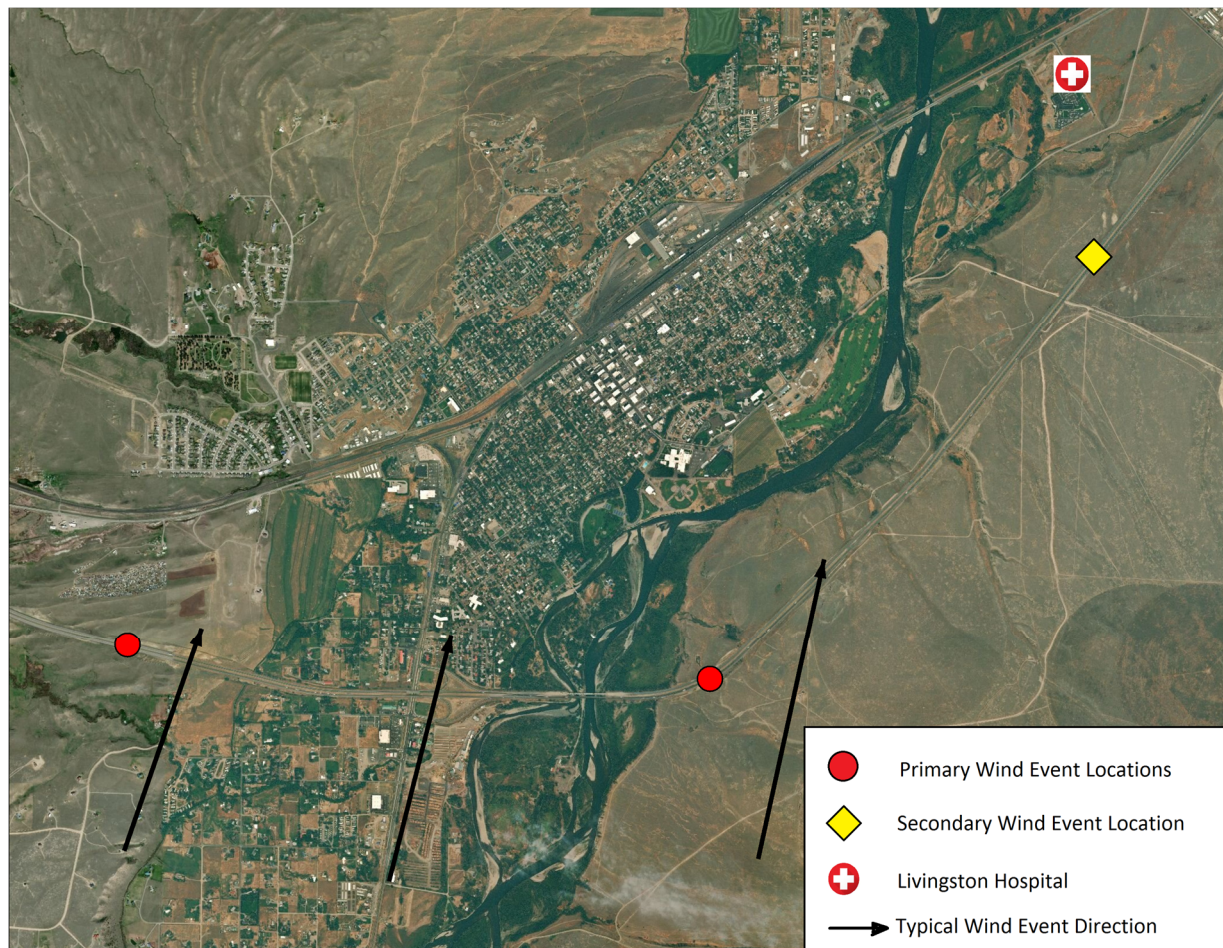


Figure 3-10: Wind Event Locations

During full closure events, MDT staff indicated traffic quickly fills up the entirety of HWY 10 W and Park Street/US 89. Problems created by the traffic jam impacts traffic throughout town, and, critically, the ability of ambulances and other emergency service vehicles to safely and efficiently navigate through Livingston and to/from the Hospital.

3.3 Traveler Information Systems Interview

The 511 Traveler Information System is Oracle-based and was identified as “near the end of its life.” The Maintenance Division just purchased a major system to upgrade their asset management system.

MDT is pursuing federal funding for upgrading the traveler information system. The money may be used to purchase and modify an off-the-shelf traveler information system, or it may be used to pay MDT staff to create a tailored system.

Section 4

Summary

The purpose of this report was to review the existing conditions with the intent of being better able to assess impacts and inform the development of recommendations to minimize or address the recommendations in subsequent reports. A quick summary of the key points from this are as follows:

The corridor is rural and carries approximately 2,000 trucks a day. Winter weather conditions are a major factor in maintaining an open facility.

Primary areas of consideration are as follows:

- Improved traveler information – to prevent vehicles from entering a road that is closed ahead
- Improved ability to close the road – when necessary, to do so quickly and safely
- Additional storage and local treatments to help address truck parking and movements during closure events.

