2015-2016 Bus Collision Analysis

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Introduction

The policy and practice of TriMet is to provide its employees with a safe and healthy work environment. TriMet is committed to maintaining an injury- and illness-free workplace, and makes every effort to protect employees from injury.

TriMet has requested that BSI EHS Services and Solutions (BSI) review bus collision statistics for the time frame of 2015-2016 to create a frequency comparison for each of the analyzed categories, to include charts for ease of review, as well as a narrative discussion of the observed trends for each category. BSI has developed heat maps displaying the collision locations geographically for further trend analysis. In addition, BSI has been asked to offer recommendations for improvements or Best Practices, if available, to reduce the frequency and/or severity of collisions in each category.

Scope

BSI was asked to conduct an analysis of 2015-2016 bus collisions and develop heat maps for the top 20 bus routes which identify the following:

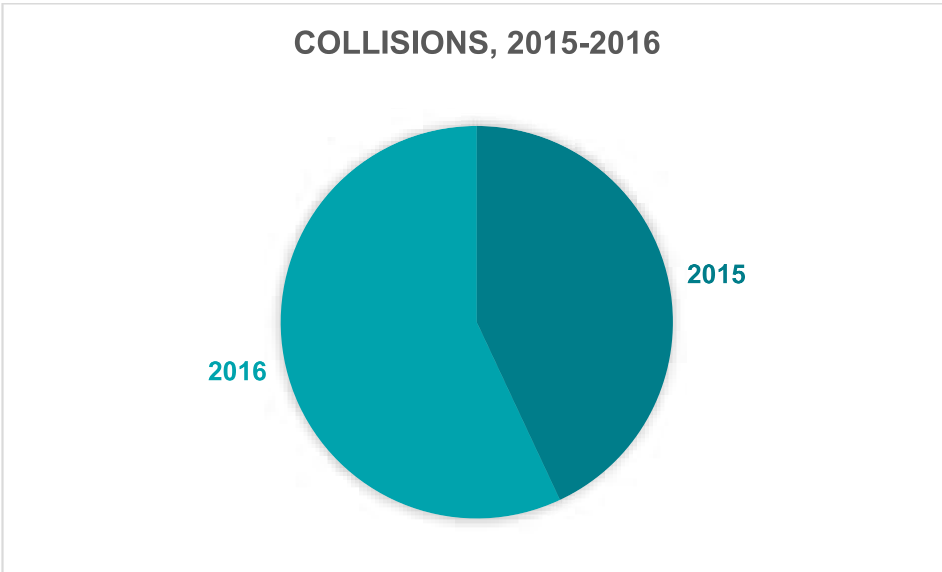
- Identification of routes from highest to lowest collision frequency
- Areas of higher risk due to multiple collisions
- Identify and trend type of collisions (collision with vehicle, mirror strike, collision with fixed object, collision with pedestrian or bicycle, other) and clearance (right, left, or unknown)
- Type of run (Regular run, vacation relief, extraboard)
- Model type of bus (e.g. 3300)

Afterwards, BSI was asked to create a frequency comparison for each of the analyzed bus types, routes, and run types. This includes charts for ease of review, as well as a narrative discussion of the observed trends for each category.

Finally, BSI offers recommendations for improvements or Best Practices, if available, to reduce the frequency and/or severity of bus collisions in each category.

Collision Data

In total, TriMet experienced 2,242 bus collisions over the past two years (2015-2016). There has been a slight uptick in number of collisions between these years.

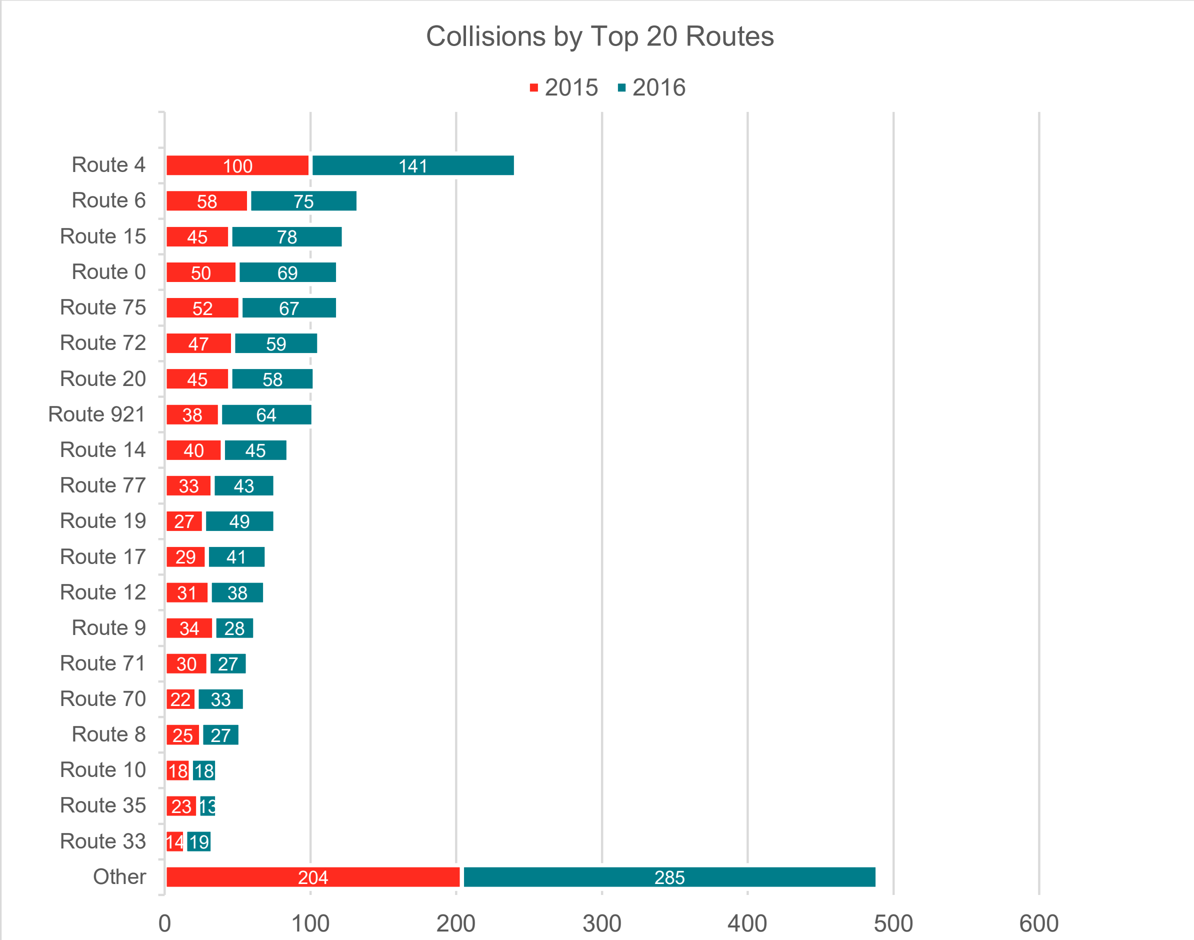


Seventy-seven collisions led to injury, and two involved fatalities, which were both caused by collisions with a moving vehicle.

Collision Trend Data

Top Affected Routes

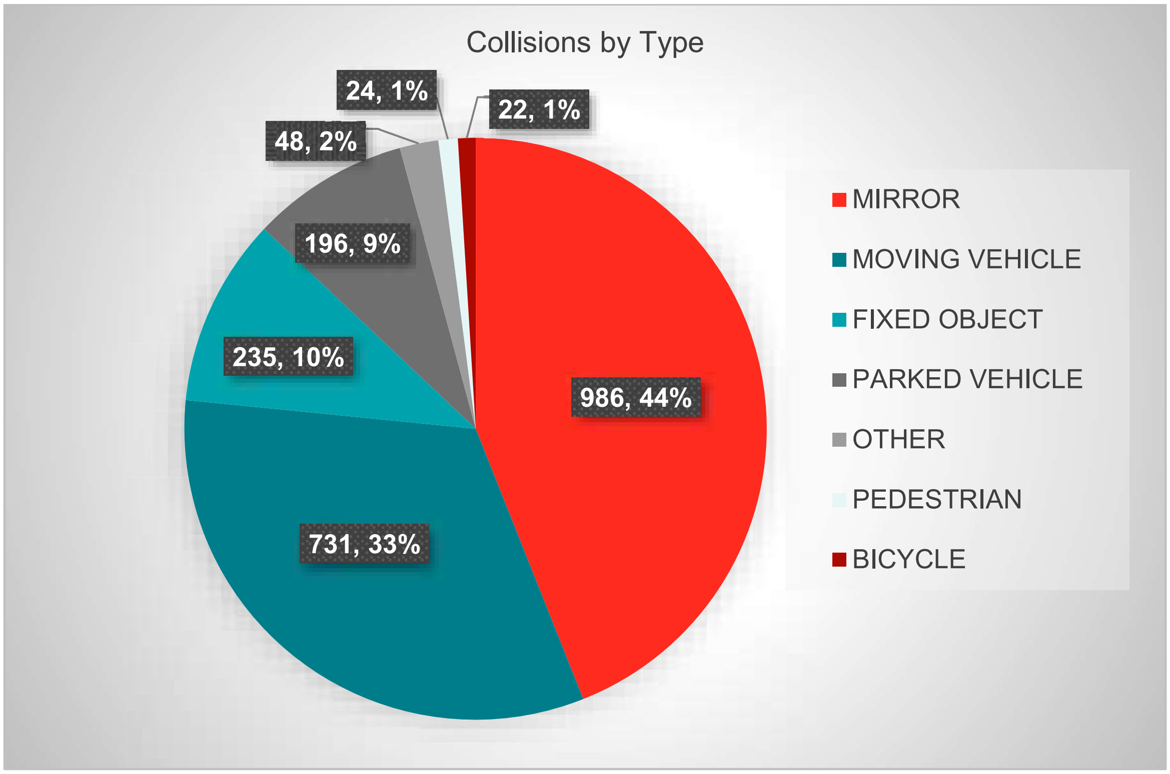
The routes on which collisions were most likely to occur in 2015-2016 are listed below. The route with the most frequent collisions was Route 4, with 10% of the collisions. Route 4 collisions increased by 29% between 2015 and 2016, and Route 6 collisions increased by 23%. Route 15 collisions increased by 42%.



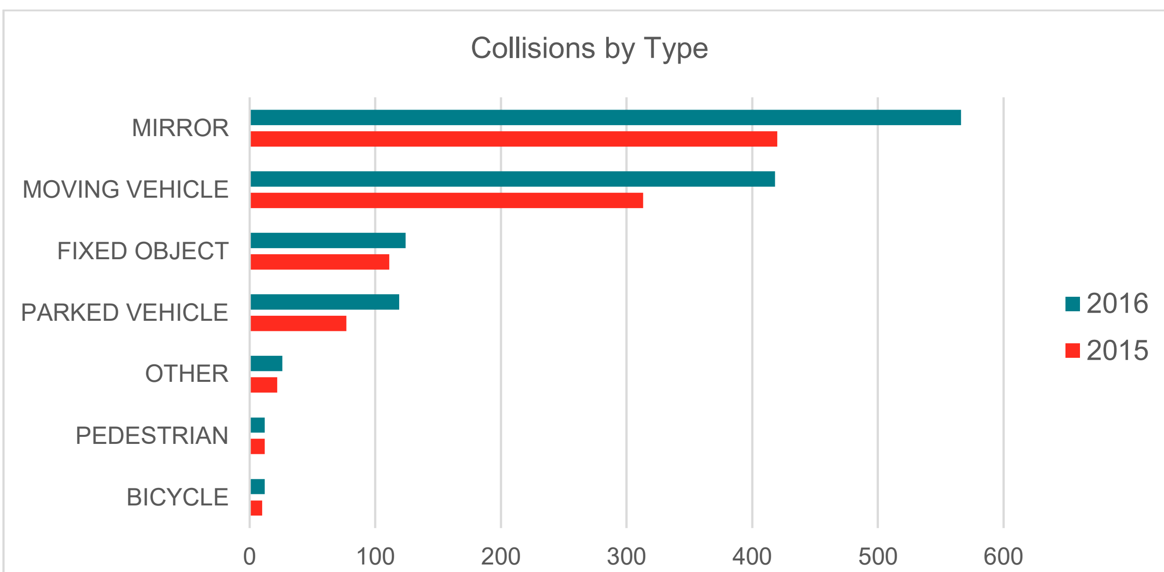
Heat Maps depicting data trends for each and collectively all of the 20 most affected routes can be viewed in **Appendix A**.

Collision Type

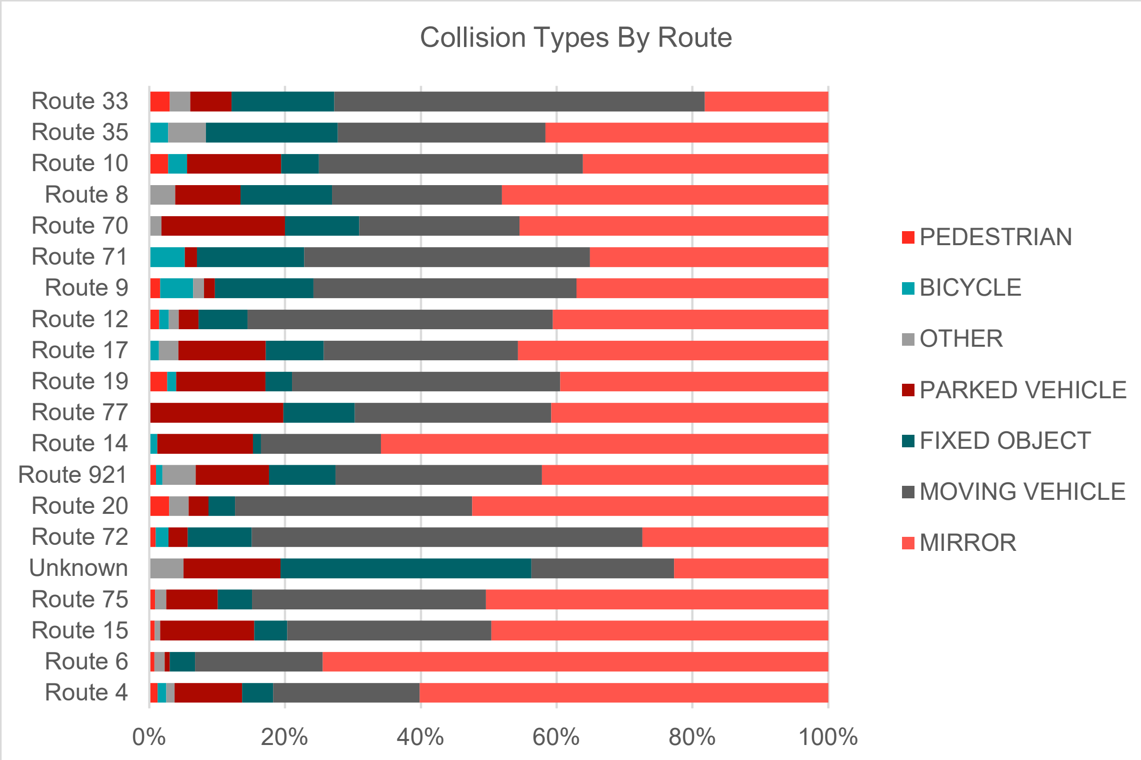
The primary type of collision was a *mirror strike* (44%), followed closely by *collision with a moving vehicle* (33%). Collisions with fixed objects and a parked vehicle follow with 10% and 9%, respectively.



Between the last two years, both *mirror strikes* and *moving vehicle* collisions increased by 25%. Parked vehicle collisions increased by 35%.

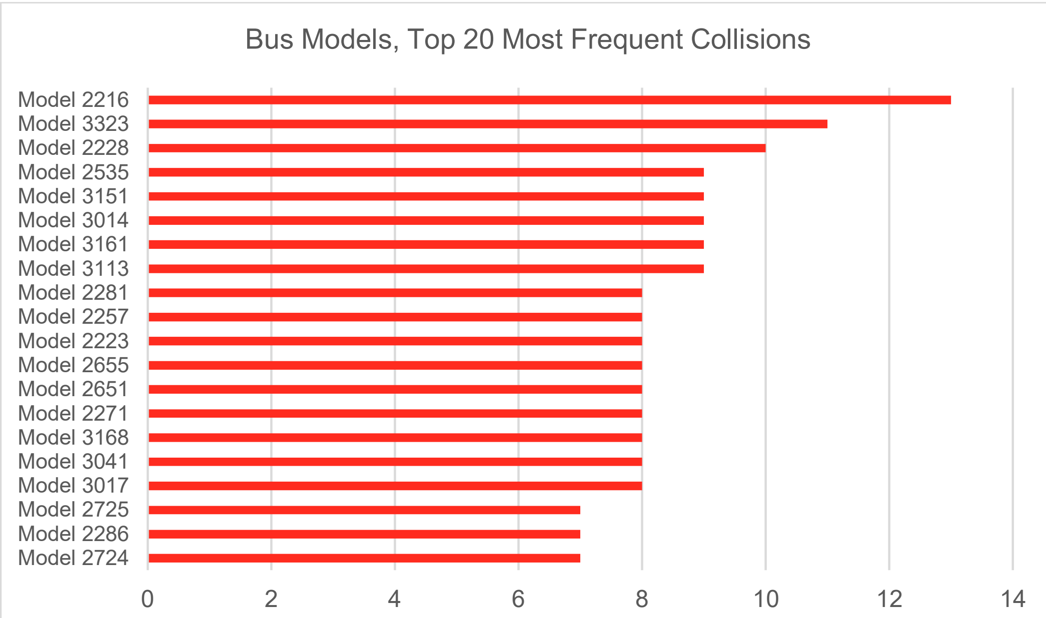


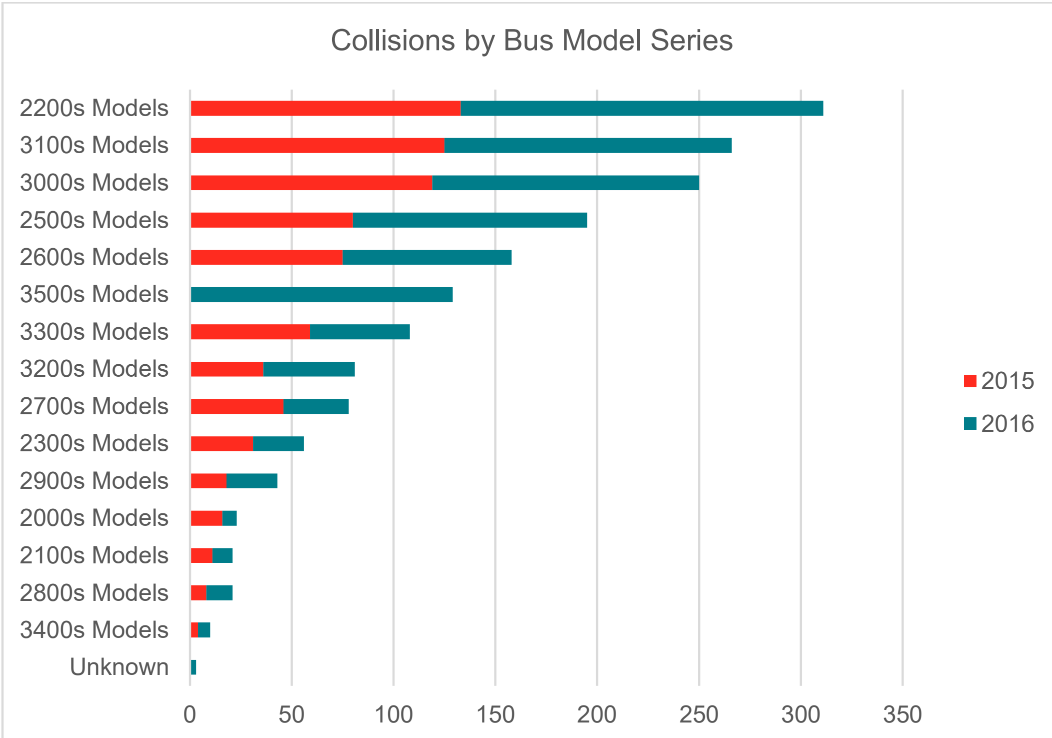
Analyzing collision types by route did not reveal any significant trends.



Bus Model

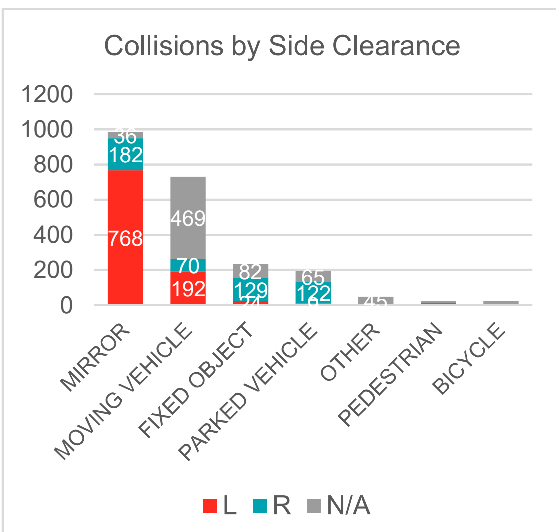
Bus models most involved in collisions are listed below. The *2216 model*, with the most frequent number of collisions, accounts only for 0.5% of all collisions between 2015-2016. In general, it does not appear that there is a trend in collisions with a particular bus model.

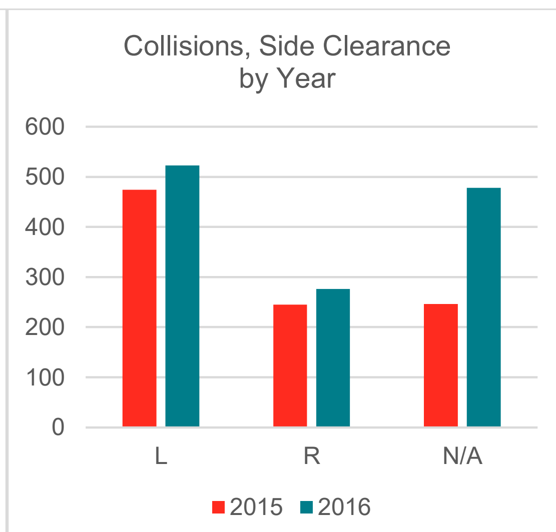




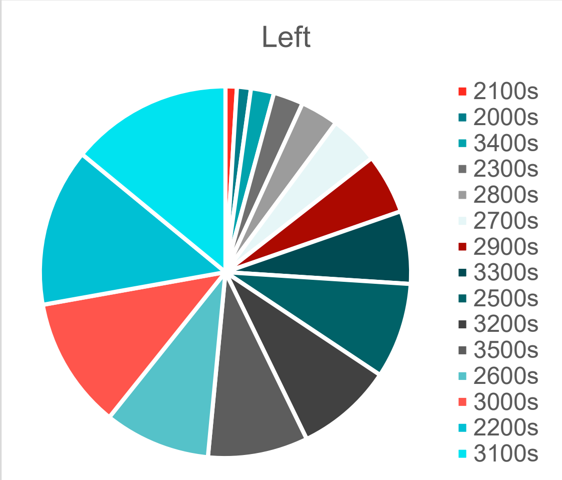
Side Clearance

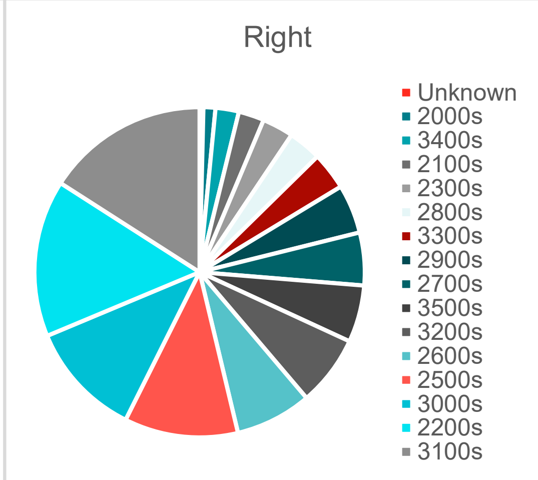
Most mirror strikes affected the *left* bus mirror (78%). Many moving vehicles were hit on the left (26%), though many collision reports (64%) did not include information on clearance. These trends have not changed significantly between 2015 and 2016.





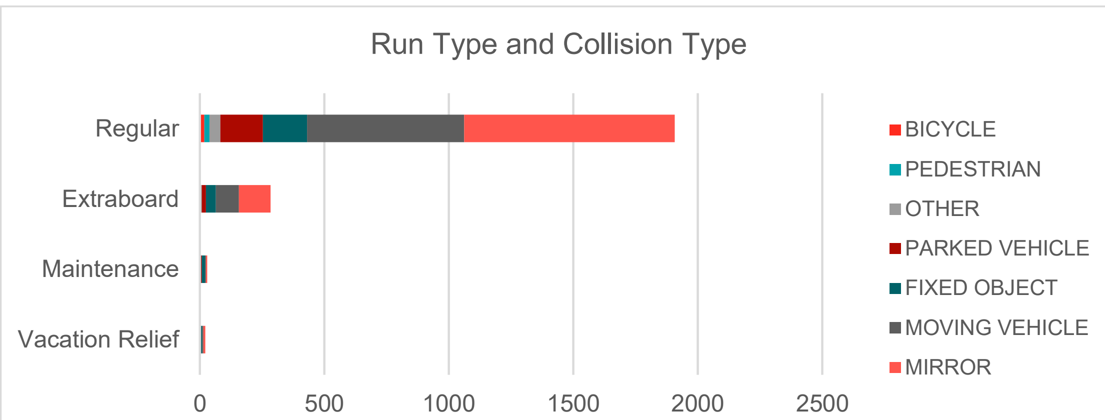
BSI compared side clearance to bus series to define any observable trends that may indicate certain blind spots on either side with particular a particular series of bus. Significant differences were not observed. The 3300s and 2200s were common bus models for both left and right collisions. Though BSI does not have this information, it is suspect that these are the most common bus models in TriMet's fleet, indicating no correlation between bus series and side clearance.

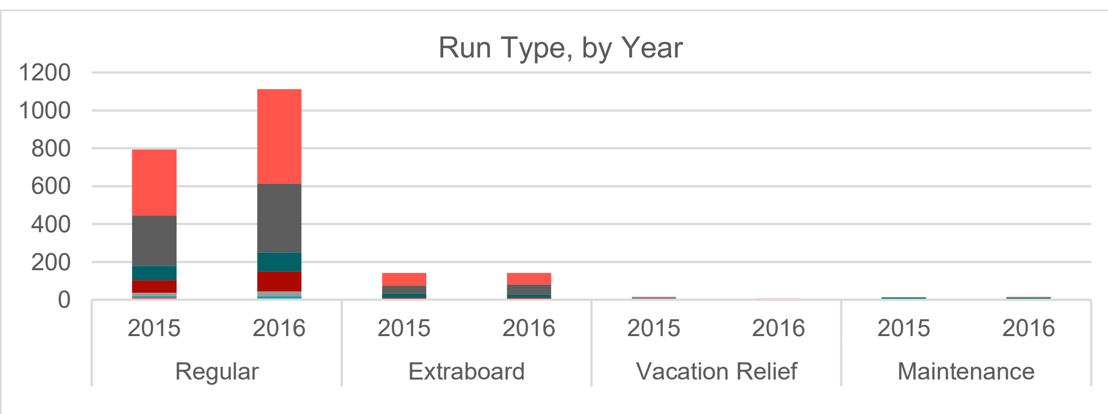




Type of Run

Overall, collisions are 50% more likely to occur on Regular runs than Extraboard. Maintenance workers and operators on Vacation Relief account for only 2% of all collisions between 2015 and 2016. These trends did not change from year to year.





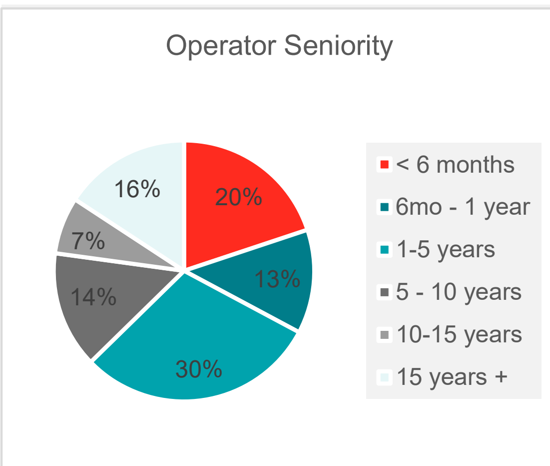
Operator Seniority

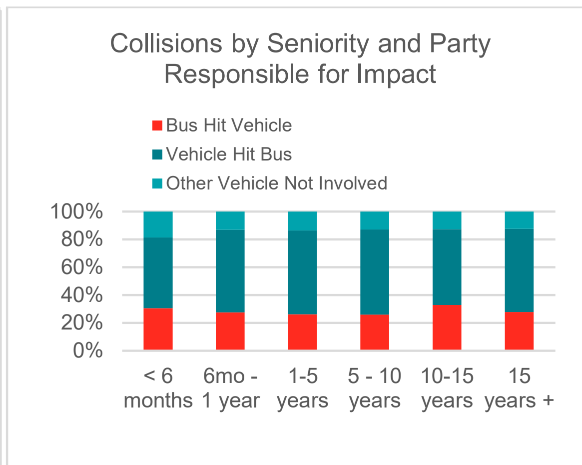
Seniority is a critical factor to consider as it is often a player in operator complacency in regards to safe driving. Of the collisions within the past two years, 30% were operated by drivers who have been operating for 1 to 5 years, and 20% were operated by brand new drivers with less than 6 months experience. 16% of drivers have had over 15 years of experience. Overall there are not significant differences in the amount of collisions in any category of seniority.

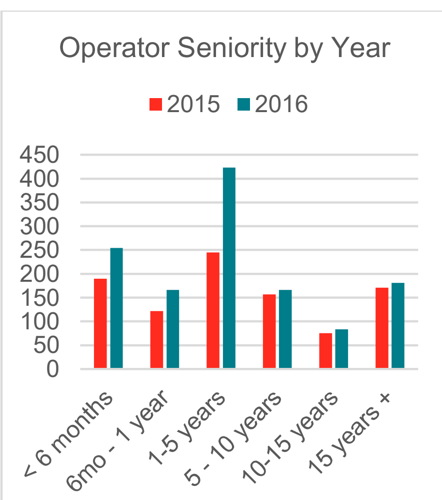
When assessing who was responsible for impact – the bus driver or another driver – the distribution is almost identical across seniority levels. No level of seniority was more likely to be responsible for a collision over other road drivers than any other level.

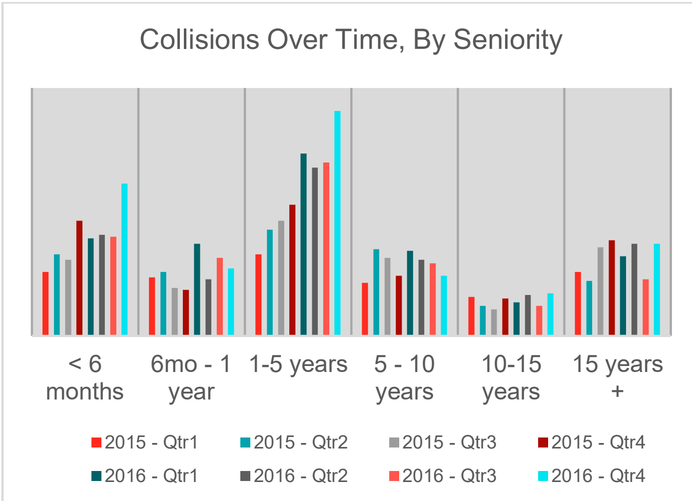
By year, most seniority levels experienced little changes, except there were *far more collisions in 2016 by operators with 1-5 years* of experience than in 2015.

Though the period of time in which data was analyzed is short (only two years), a further drill down into collisions over time shows a few trends in operator seniority levels. Most seniority levels have had similar numbers of collisions each quarter for the past two years, but *rookie operators* (those with less than 6 months experience) and *operators in the job for 1 to 5 years* have been involved in a number of collisions that has grown each quarter.





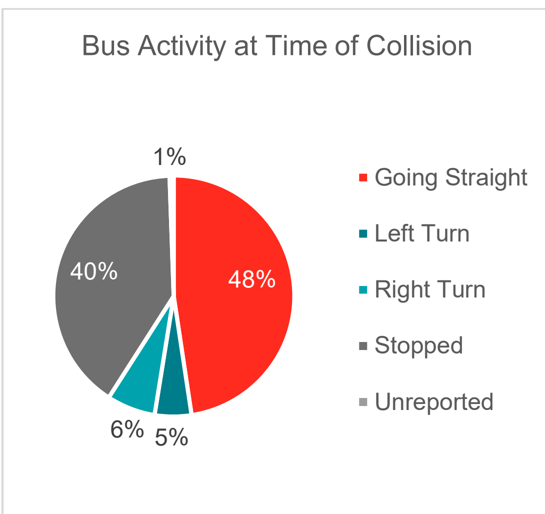


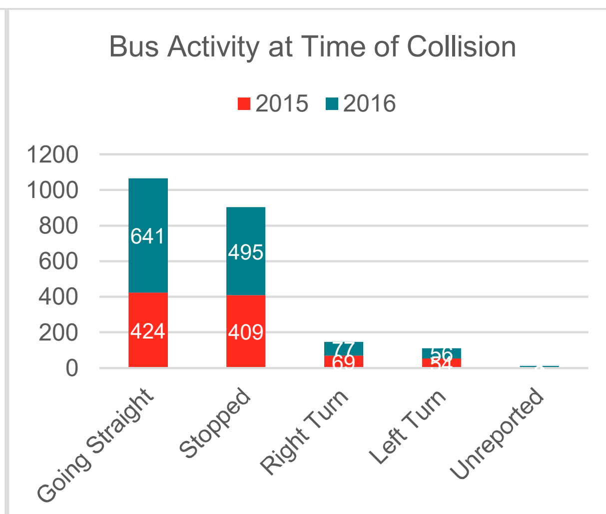


Additional Trend Data

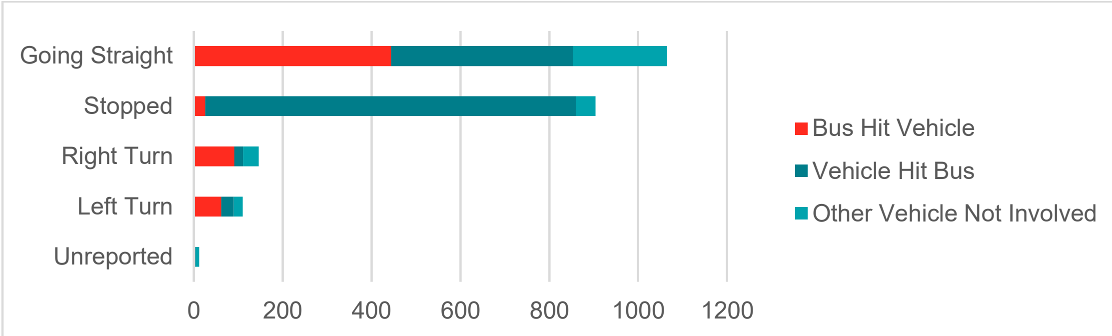
Bus Activity

Almost half of collisions within the past two years occurred while the driver was *driving straight*, and 40% of the remaining collisions occurred while the bus was *stopped*.

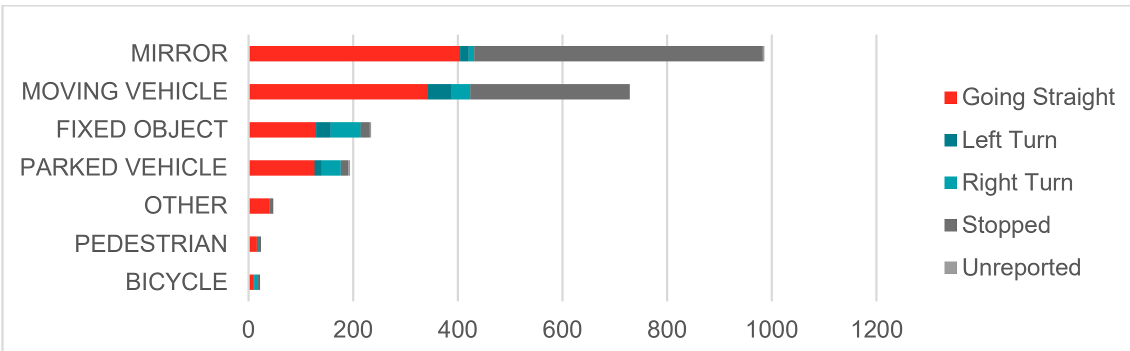




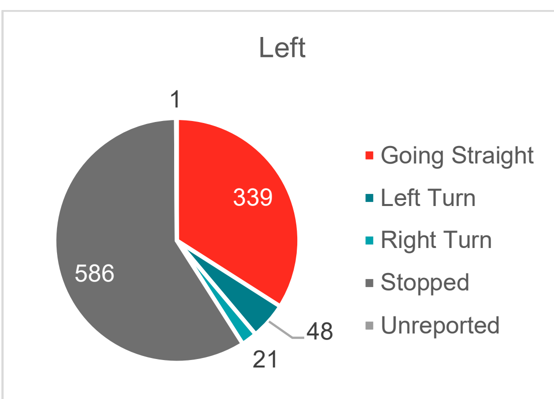
The collisions that occurred while the driver was driving straight are evenly split in terms of which driver made impact. There are, however, a larger percentage of collisions occuring during turns where the bus was responsible for impact.

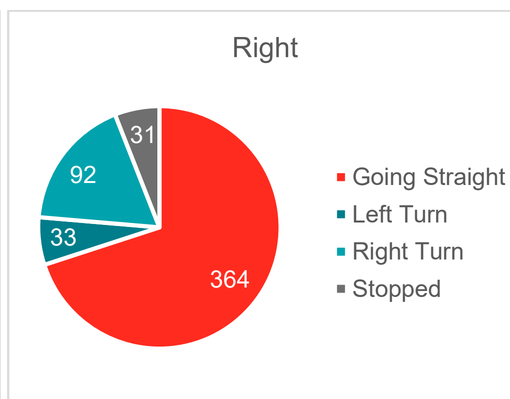


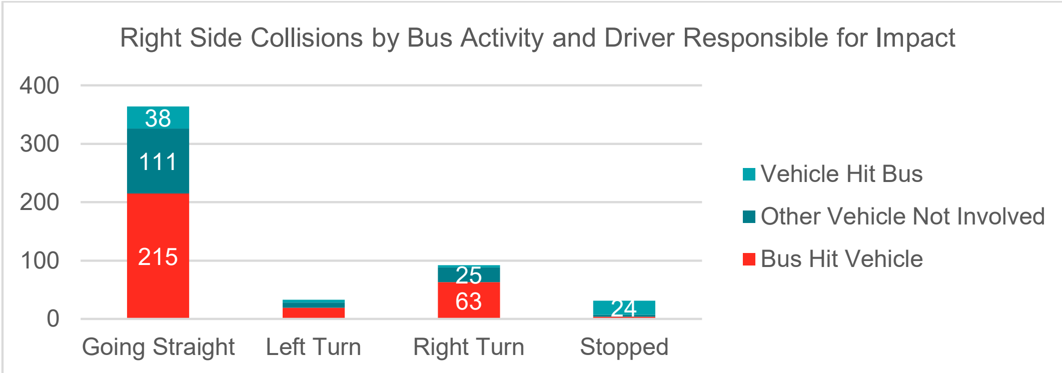
In terms of collision type, **mirror collisions** occurred mostly while the bus was either *stopped* (551 collisions) or *going straight* (404 collisions).



BSI analyzed side clearance to determine if there were trends as to what side of the bus was most affected during various bus activity. **Left-side clearance** collisions occurred primarily while the bus was *stopped*, indicative of mirror strikes from oncoming traffic at bus stops. **Right-side clearance** collisions occurred primarily while the bus was **going straight**, of which most were the operator's fault. This could potentially indicate right-sided blind spot issues when changing lanes.

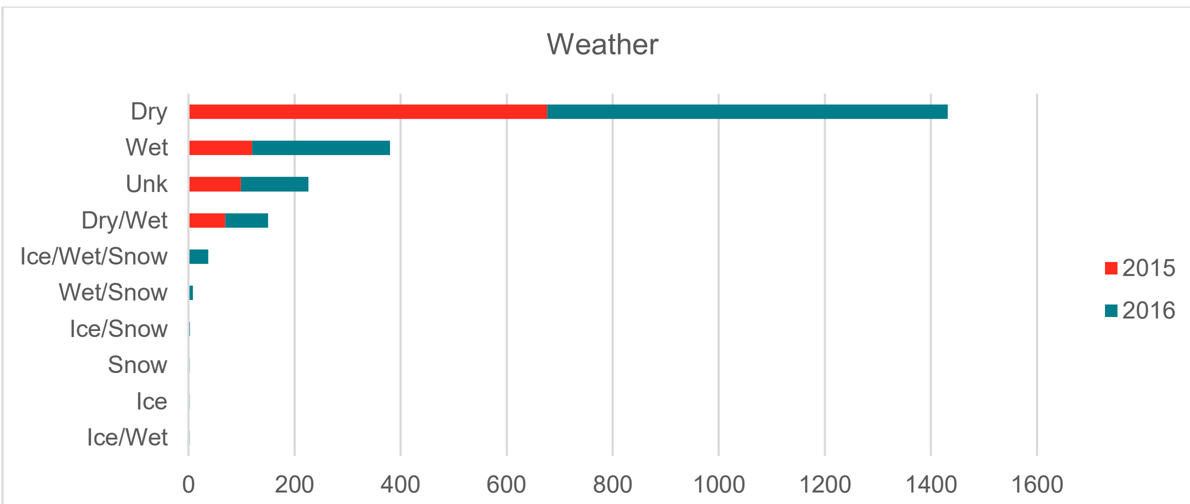






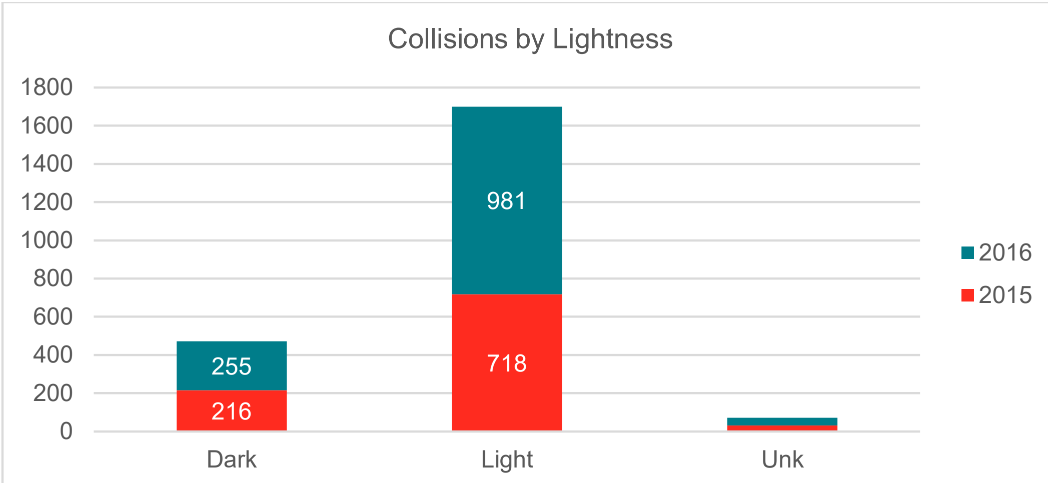
Weather Conditions

Most collisions (64%) from 2015-2016 occurred on reportedly *dry roads*. Wet roads accounted for only 17% of collisions.



Lighting

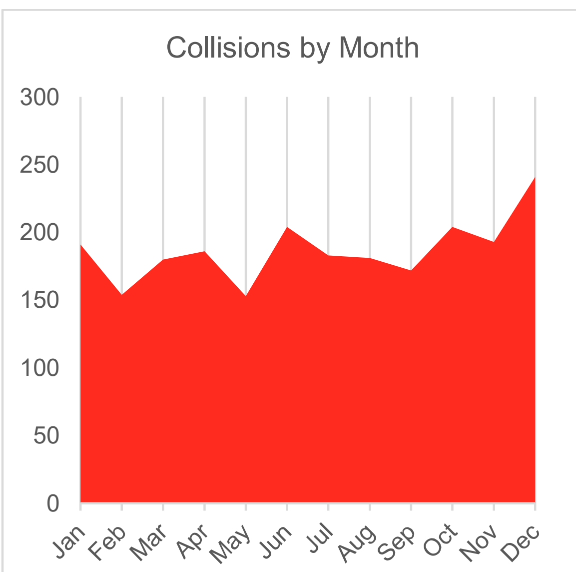
The majority of collisions occurred during *daylight*, though still nearly 500 collisions occurred in the dark.

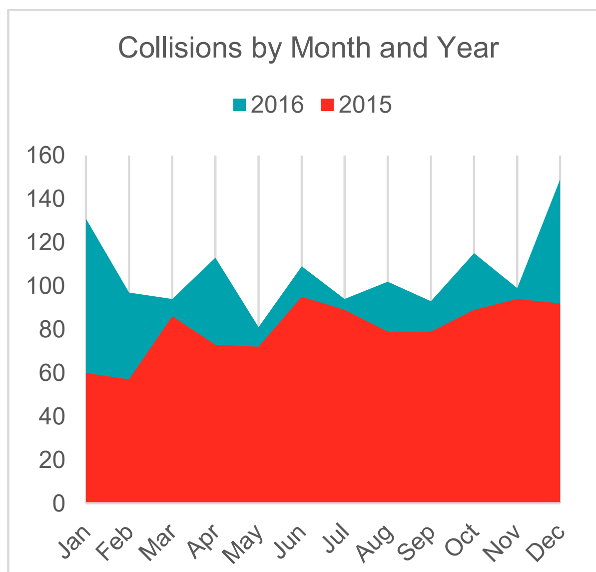


Collisions by Month

In total, collisions appear to occur most frequently in *December*, with *June* as the second most common month.

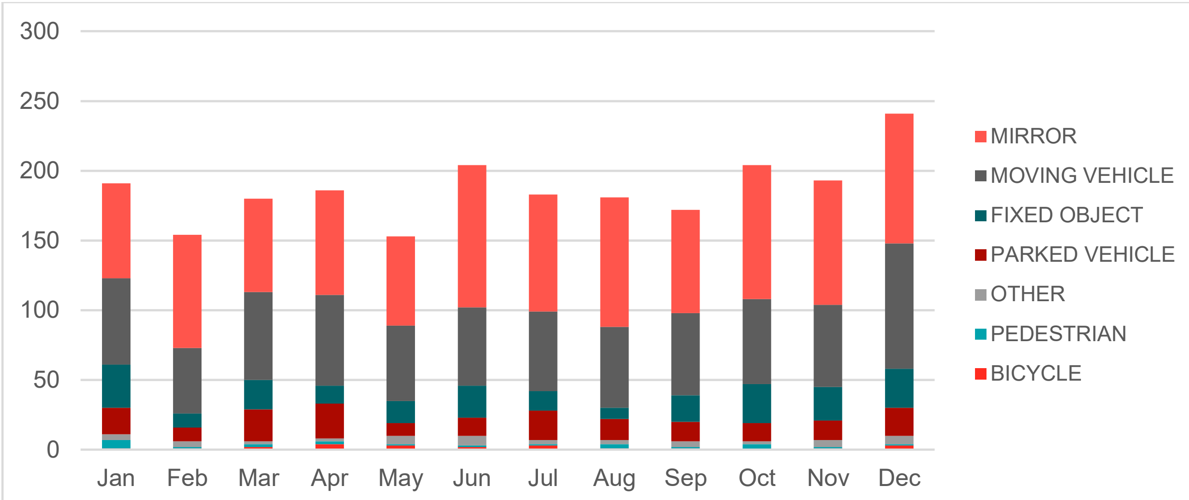
When each year is analyzed individually, there are different spikes. 2015 saw most of its collisions in June and late fall, while 2016's peak was in December and January. Of interest, both years show a dip in collisions in May.





Collisions by Day of Week

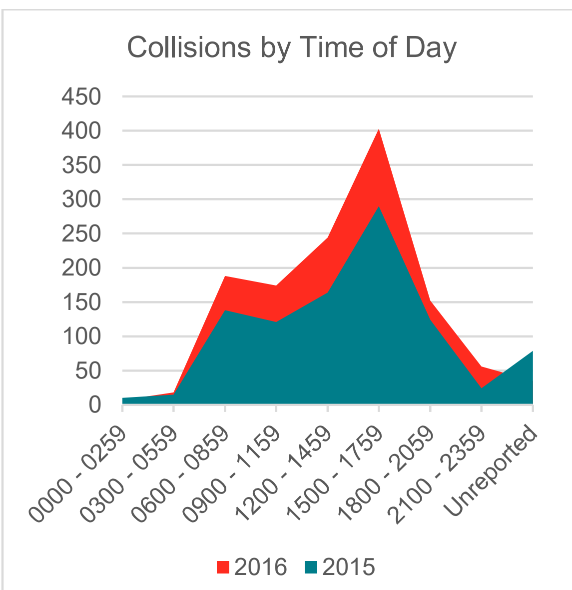
Collisions occur most often during *weekdays*. There is no variation in frequency across each weekday.

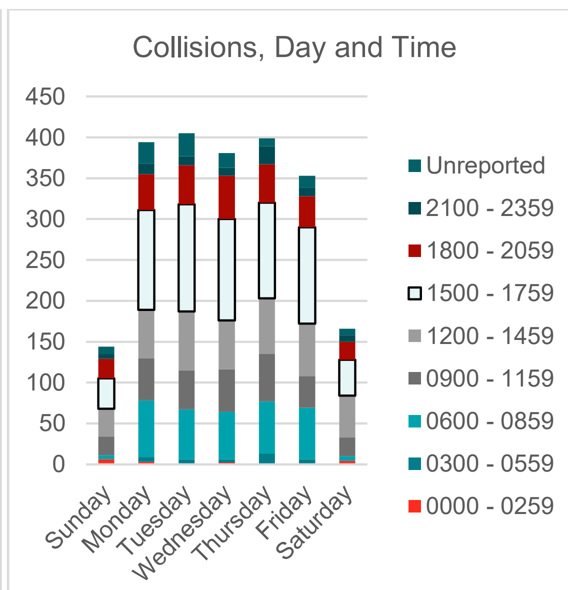


Collisions by Time of Day

Cumulatively, the most common time of day for collisions is between *3:00pm and 6:00pm*.

BSI also analyzed day of the week and found that most of the collisions occur during *weekdays*, indicating that collisions are most common during rush hour.

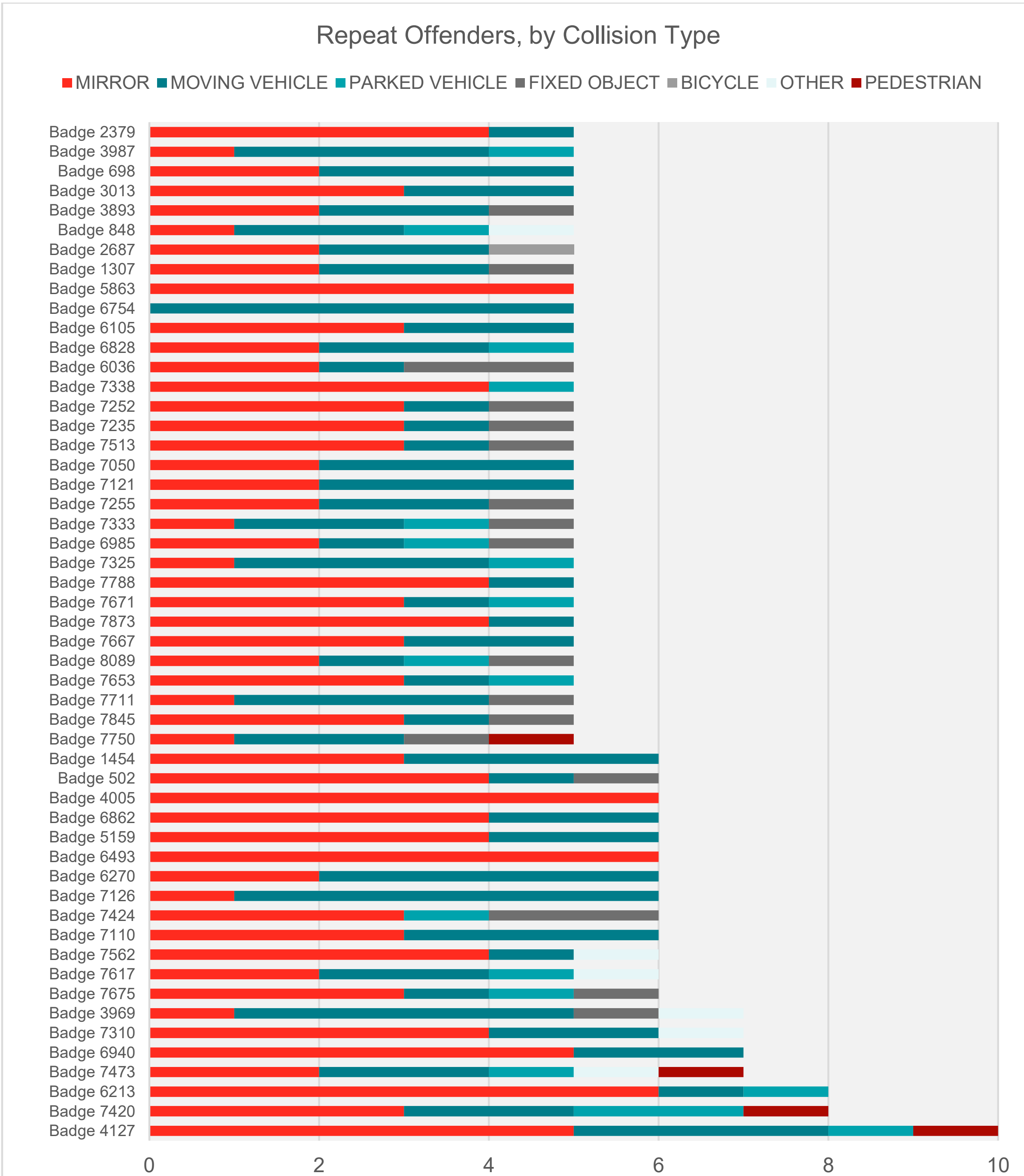




Repeat Offenders

BSI notes that several bus operators were involved in more than one accident in the last two years. Operator 4127 had the most collisions at 10, followed closely by operators 7420 and 6213 with eight collisions each.

Data suggests that the majority of collisions by repeat offenders were mirror strikes, though this is also the most common collision type among all operators.



Recommendations

Summary

Based on a review of data, the following trends were observed in collisions occurring between 2015 and 2016:

- The number of collisions has **increased** substantially from one year to the next.
- Most collisions were **mirror strikes**, half of which occurred due to another vehicle's collision with the bus while the bus was stopped.
- The majority of remaining collisions were while the **operator was driving straight**. Of those, it is almost an even split between the bus hitting another vehicle and another vehicle hitting the bus.
- The most common environmental conditions for accidents is December and January, during **rush hour, Monday through Friday, on dry roads, during daylight**.
- **Route 4** has been affected by collisions notably more than any other route, and in particular at the easterly bus stop on **SE Division St and 12th Ave**.
- There are a number of **operators who have been involved in more than five collisions** in the past 24 months.

Collision Prevention Strategies

As with injury prevention, a hierarchy of controls is used as a means of determining how to implement feasible and effective control solutions. Control methods at the top of graphic are potentially more effective and protective than those at the bottom. Following this hierarchy normally leads to the implementation of inherently safer systems that mitigate risk more effectively.

[1]

[1] Centers for Disease Control and Prevention. National Institute for Occupational Safety and Health. Division of Applied Research and Technology (DART). *Hierarchy of Controls*. Accessed October 6, 2017 at https://www.cdc.gov/niosh/topics/hierarchy/default.html.

BSI strongly suggests considering any engineering controls provided in this section over administrative as they have been shown to be more effective, though both will be provided for TriMet's discretion.

Industry Best Practices: Literature Review

There are published strategies for addressing transit accidents that have been developed based on statistics from regional accident authorities. The Transit Cooperative Research Program (TCRP), a program of the Transportation Research Board of the National Research Council funded by the Federal Transit Authority (FTA), published perhaps the most widely accepted guidance document in 2001 entitled *TCRP Report 66: Effective Practices to Reduce Bus Accidents*. The publication contains a literature review of best practices in collision reduction, results from a survey conducted with various small, medium, and large transit agencies, and details of several case examples from a select group of high safety performers.

In the publication, the Transportation Research Board states that all bus accident prevention strategies are based on the following seven categories:

- **Driver selection and hiring** refers to practices used to identify and attract potential candidates who have the proper skills and aptitude to become a safe and competent bus operator.
- **Driver training** refers to the initial training of new operators, regularly scheduled refresher training, and retraining triggered by one or more preventable accidents or observation of driving problems by supervisory personnel.
- **Safe driver incentive practices** refer to practices intended to reward bus operators for safe driving (i.e., for having no preventable accidents within a specific time period).
- **Customer safety practices** refers to practices that help a passenger avoid personal injury accidents while boarding, riding, or exiting a bus. Many of these practices target school children (particularly as the children exit the bus and leave the bus stop area) as well as passengers with disabilities.
- **Management practices** refers to activities that ensure that management is fully aware of bus accident trends and that identify specific problems with individual operators or types of buses. Examples include safety audits, ride checks, computerized accident or incident databases, safety committees for accident review, and practices for "accident repeater" drivers.
- **Bus technology safety improvements** refers to practices that enhance passenger safety and reduce collision accidents by increasing the visibility of the bus for pedestrians and for the drivers of other vehicles. Examples include low-floor buses, improved doors and door controls, improved driver vision through mirrors and lighting, high-visibility brake lights and warning signs, and daytime running lights.
- **Operating environment practices** refers to practices that help create a safer operating environment for buses, such as making safety an integral part of new bus route planning, designing safer bus stop zones and placements, and providing pullouts or bus bays to remove the bus from a high-speed or congested travel lane.

The Transportation Research Board collected both written survey and telephone interview responses from transit safety managers regarding questions about accident prevention practices. Several best practice accident prevention methods found within these responses are discussed and were analyzed for effectiveness by a variety of small, medium, and large transit authorities. The top ten most effective prevention methods are listed in the graphic below and several are defined in the paragraphs following.

TABLE B5 Top ten highly effective bus accident prevention practices

No.	Practice	Percent Using	Percent Ranking Highly Effective
1	Defensive Driving	97%	68%
2	Driver Vision or Mirrors	79%	65%
3	Vehicle Safety Inspections	93%	60%
4	Safety Considerations in Route Selection or Scheduling	76%	59%
5	Personal Interviews	98%	53%
6	Doors and Door Controls	60%	52%
7	Ramp Entry-Low Floor Bus	26%	52%
8	Brake Lights or Warning Signs	69%	50%
9	Daytime Running Lights	58%	50%
10	Programs for "Accident Repeaters" Drivers	69%	49%

[2]

Defensive Driving training was acknowledged to be the most highly effective bus accident prevention practice performed by almost all transit systems surveyed. The National Safety Council offers the gold standard training module, but there are several other training modules and systems utilized by other transit authorities including the Smith System® and another developed by the Professional Development Associates. The publication also calls out TriMet's defensive driving 2-day workshop as a successful strategy, as evidenced by effectiveness studies conducted by TriMet in the 1990s.

Driver Vision or Mirrors were also rated highly effective. This strategy involved improving the driver's vision and view of door and wheel well areas. Suggested strategies include remote-controlled heated mirrors and full-size convex mirrors on both sides of the bus.

[2] Transportation Research Board. Transit Cooperative Research Program. *Effective Practices to Reduce Bus Accidents.* National Research Council. 2001. National Academy Press: Washington, D.C. 2001.

Vehicle Safety Inspections are typically a standard tool for reducing accidents and may or may not include both pre- and post-trip inspections between 3000 and 6000 miles.

Safety Considerations in Route Selection or Scheduling involves reviewing route pathways for signs of road features or traffic conditions that may increase risk of collisions, including road width, turn radius, and traffic generators such as malls or large parking lots. This would include reviewing data during different times of day.

In 2017, the Transportation Research Board released a newer publication entitled *TCRP 126: Successful Practices and Training Initiatives to Reduce Accidents and Incidents at Transit Agencies*. It contains another literature review, results from another survey, and details of several case examples from US transit agencies.

It is suggested that **retraining** occur frequently, at least annually, and that it should involve both classroom and hands-on interactive skills training and coaching, and **video footage analysis sessions** from actual collisions. Topics should include hazard recognition, de-escalation, incident reporting, and fatigue prevention. It is also suggested that though expensive and varied in functionality and source, **simulator training** has been shown to reduce training costs, driver reaction times, and frequency of accidents.

Technology solutions are numerous and the effectiveness of specific systems is not yet entirely clear, but there are increasing options for solutions that should be considered. **Pedestrian warning devices** are encouraged, including vehicle-to-infrastructure devices that communicate on the street when a bus is approaching and oppositely to the operator when a pedestrian approaches. Some devices also use **parametric speaker technology** to warn pedestrians verbally of the approaching bus. Camera systems are nearly ubiquitous in the transit industry at this point in time, but the publication encourages agencies to utilize videos in operator training to demonstrate risky driving or de-escalation events. Some cameras have been installed to display blind spots to operators while driving. **Telemetry-based driver monitoring systems** are also discussed and have been shown to be effective in identifying risky drivers and helping to mitigate unsafe practices *before* a collision occurs. **Rear lighting** was also discussed as there have been an assortment of configurations attempted including larger LED lights, amber strobes, flashing “STOP” signs, and retroreflective strips, though no one method has proven to be solely effective.

The publication concludes that in eleven case studies there was no single solution that has effectively led to increased safety. Rather, it is likely a combination of practices in improved operator training, utilization of technology solutions, implementation of infrastructure improvements, and establishment of safety campaigns that impacts safety most effectively.[3]

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[3] Transportation Research Board. *Successful Practices and Training Initiatives to Reduce Accidents and Incidents at Transit Agencies.* National Academy of Sciences: Washington, D.C. 2017. Sponsored by the Federal Transit Administration in Cooperation with the Transit Development Corporation.

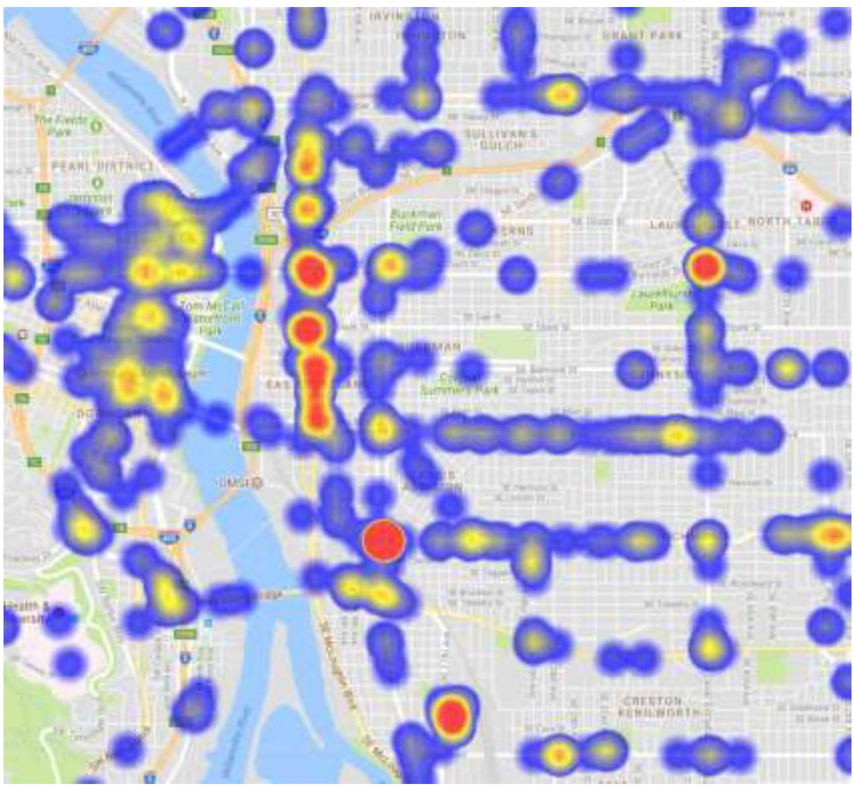
Suggested Interventions Based on TriMet Data

A review of the statistics and graphical representations of TriMet's collision data from 2015-2016 point to specific areas where frequent collisions of similar types are identified that could potentially be addressed with several recommended solutions.

Locations of Collisions

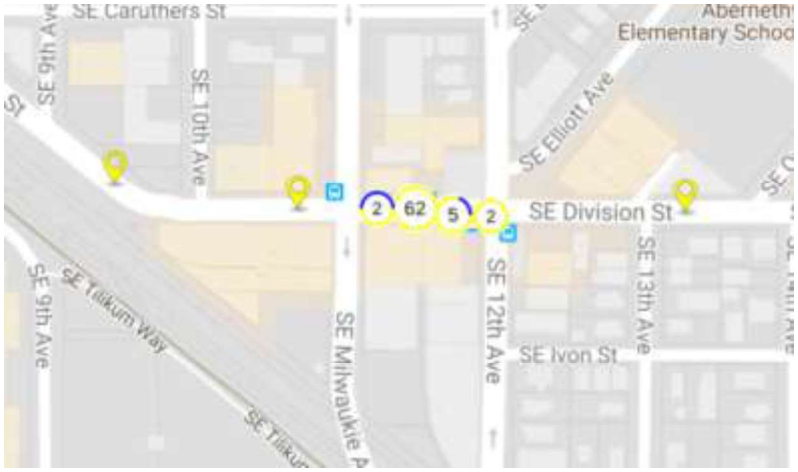
Frequency heat maps, of which an excerpt is displayed below, indicate several street locations where there have been a number of collisions:

- Intersection of E Burnside St. and NE Grand Avenue
- SE MLK Blvd along the block between SE Stark St and SE Washington St.
- SE Grand Ave along the blocks between SE Morrison St. and SE Madison St.
- SE Division Street along the block between Milwaukee Ave and 12th Ave.
- Intersection of SE Cesar Estrada Chavez Blvd and E Burnside St.



❖ **Recommendation 1: *Investigation of hot spots***. BSI recommends examining and investigating these particular locations for signs of safety impediments such as left turns, narrow streets, insufficient signage, street lighting, and other infrastructure-related risks. These specific locations may benefit from improved signage and lighting, markings identifying bus bays, or even the need to reposition bus stops.

❖ **Recommendation 2**: ***Investigate, in particular, Route 4***. Route 4 has been affected by collisions notably more than any other route. The location on the route with the most frequent collisions is on SE Division Street between Milwaukee Ave and 12th Ave with a total of 73 accidents in that one spot in the last 24 months. An examination of that location indicates that there is no bus bay to protect the bus in traffic, the stop appears to potentially have inadequate lighting, and it is frequently heavily trafficked. TriMet may want to consider options for better visibility at that stop, street indicators such as signage or lights that a bus may be ahead, or even relocation of the stop altogether.



Mirror Strikes

Most bus collisions were identified as mirror strikes (44%), half of which occurred due to another vehicle's collision with the bus while the bus was stopped.

- **Recommendation 3**: ***Consider increased installation of bus bays.*** Collisions with mirrors while the TriMet vehicle is stopped are likely the result of other vehicles not being allotted proper clearance in road lanes to avoid contact with the bus while in traffic. Bays may be indicated by painted lines or by road barriers or even reflective raised pavement markers. The presence of bus bays allows for the bus to pull away from oncoming traffic and also, if designed in this way, can allow for additional space for bus to pull back into traffic. TriMet may need to work with the local public works department to install approved markings on roadways in a compliant manner.

BSI notes that bus bays may not be feasible at some existing bus stops where roads are narrow. In these situations, where collisions are more frequent, TriMet may consider relocating the stop if possible to an area with less traffic or increased road width.

- **Recommendation 4**: ***Evaluate reflective and visual cues on bus rear and side.*** There are various styles of configuration and methods of technology use to assist in risk mitigation on roadways. Utilization of retroreflective tape on rear and side or the mirror itself or larger LED or strobe lights on bus rear may help notify drivers to increase distance when clearing a stopped bus in traffic.
- **Recommendation 5**: ***Minimize operator blind spots.*** The occurrence of mirror strikes may be a result of various causes, but for those in which the party responsible for impact was the bus driver, minimizing blind spots will help prevent collisions by drivers attempting to merge with traffic or change lanes. Strategies to reduce blind spots include larger or convex mirrors, side or rear blind spot cameras giving operators access to live footage of traffic in difficult visualization areas, and even mirror repositioning training in-services. Care should be taken when implementing these solutions so as not to implement equipment or monitoring screens that could lead to awkward neck or posture strain and potentially impact operator injury.

Bus Model

During analysis, it was noted that bus model 2216 was more likely than any other model to be involved in a bus collision.

- **Recommendation 6: *Investigate bus model 2216***. BSI recommends performing various investigatory tasks on bus model 2216 to look for inefficiencies or positioning, functionality, rear lighting, and distracting advertising that could increase risk of collision. The investigation should include a visual inspection, maintenance inspection and records review, ride-alongs, interviews with drivers, and a deeper dive into historical incident data.

Collisions by Other Drivers

The majority of remaining collisions were while the operator was driving straight. Of those, it is almost an even split between the bus hitting another vehicle and vice versa. Mitigating blind spots will assist with reducing collisions as a result of a bus operator making impact with other vehicles. Additional or modified visual cues such as retroreflective or reflective markings on bus sides and rear will also reduce the potential of other drivers colliding with buses.

- **Recommendation 7: S*pecify and increase emphasis* on *defensive driving and awareness campaigns.*** Defensive driving is cited in industry literature as the most widespread and most effective strategy for reducing collisions. The most common conditions for TriMet accidents is December and January, during rush hour Monday through Friday, on dry roads, during daylight. Though is it a persistent struggle to positively impact other driver situational awareness and caution on roadways, employers such as TriMet can be responsible for comprehensively and frequently retraining drivers on strategies to drive defensively. Additionally, communicating with operators and ensuring awareness of the conditions in which collisions are most likely to occur will help inspire a heightened awareness and caution when operating buses in those conditions which could help drivers prevent accidents proactively. Defensive driving training in-services and educational materials should be specific to TriMet’s most frequent contributing factors. Collision data should be provided to operators.

Repeat Offenders

There are a number of operators who have been involved in more than five collisions in the past 24 months. It is critical that TriMet become involved in coaching and counseling operators who have a history of accidents to play a role in shifting unsafe behaviors that may have developed.

- **Recommendation 8: *Develop or bolster accident investigation protocols for repeat operators.*** The TCRP Report 66: Effective Practices to Reduce Bus Accidents provides varied examples of management system protocols used by safety performers in the industry to address operators involved in accidents. A local agency, King County Metro, conducts an accident ride check in which the collision itself and contributing factors are discussed with the operator interactively, an analysis by the ride coach of preventability, a series of review panels including the safety officer, an accident committee, and accident review board, decision of severity, and subsequent disciplinary action based on severity. In addition, counseling is conducted for all preventable incidents. If an operator requires retraining twice following a preventable accident, that operator must also be suspended from operating. King County’s action protocol is based on a points system. If an operator completes 12 months of driving with zero preventable accidents, points can be deducted from the driver’s record to reduce the disciplinary and counseling requirements. This is one of many methods that can be implemented, but crucial components include prompt follow-up and counseling with driver, accident-catered ride checks with a trainer, skills analysis and coaching, and repeat driver monitoring or simulator testing to evaluate effectiveness of coaching interventions.
- **Recommendation 9: *Encourage operator feedback and create an environment that supports non-punitive hazard reporting.*** The front-line worker is always the best source for recognizing potential hazards when performing the task, but they are often also the best source for developing solutions. Efforts should be made to have frequent, casual, non-punitive discussions with operators in which they are asked what could make their job safer. Particularly following collisions, operators may be able to pinpoint risky scenarios and have a particular advantage in that they may be able to see solutions given their experience in the driver seat. Questions such as “if you could do anything, what would an ideal solution to this risk?” may lead to expensive or non-feasible suggestions, but it could also reveal a strategy that could be accomplished using other more feasible means. It is also important to ensure that the environment of the workplace is one that encourages feedback without blowback so that operators feel comfortable sharing their valuable ideas. Utilizing

an anonymous system or hotline can help reduce reporting concerns among operators.

❖ **Recommendation 10: *Consider evaluating the use of a driver monitoring system.*** Recent literature collected by the Transportation Research Board has shown effectiveness with facilities that have procured and utilized a telemetry-based driver monitoring system. Driver monitoring systems are integrated into the bus and have the ability to identify behaviors that have the highest probability of causing a collision by collecting data on close calls and near misses, aggressive maneuvering and braking, and seatbelt use (coupled with the ability to record audio and video feed). These systems can capture, identify, prioritize, and analyze the causes of poor or risky driving before an incident occurs, which enables the transit agency to take corrective action (Lytx 2016). San Francisco's Municipal Transportation Agency reported a 50% decline in bus accidents in one year, attributed to a DMS, with the greatest improvements among the bus operators with the worst driving records (Lytx 2016). The Jacksonville Transit Authority (JTA) reported a 90% improvement among its riskiest operators in just 9 months of using a DMS, owing to the ability to intervene with remedial training before an incident occurred. The Greater Cleveland Regional Transit Authority (RTA) was awarded METRO Magazine's 2015 Innovative Solutions Award in Safety for its partnership with a DMS provider (Roman 2015). RTA installed DMSs on its entire fleet in 2014; within a year it experienced a 60% reduction in speed violations, a 55% reduction in red light violations, and a 53% improvement in seatbelt compliance (Lytx 2015). In a survey sent to transit agency managers, the ability to monitor and track an operator's behavior while driving and then to target a coaching or counseling session with that operator on observed unsafe behaviors was viewed as very important.[4] Alerts can be sent to the safety department real-time if unsafe behaviors are detected and video footage can be utilized in coaching sessions with that operator to correct risky tendencies. One downfall of the system is that it can be costly to obtain TriMet may want to consider installing this system on buses operated by repeat offenders as a trial to evaluate effectiveness and return on investment.

Data Collection Suggestions

Various regional transit authorities have compared data over the years to investigate solutions to reducing likelihood of collisions with public transportation vehicles. The most common data points evaluated are:

- Seasonality
- Darkness/Time of Day
- Collision type (rear-end, side-swipe, pedestrian or bicyclist, etc.)
- Activity just before collision

[4] Transportation Research Board. *Successful Practices and Training Initiatives to Reduce Accidents and Incidents at Transit Agencies.* National Academy of Sciences: Washington, D.C. 2017. Sponsored by the Federal Transit Administration in Cooperation with the Transit Development Corporation.

- Problem corridors

Those above as well as other factors were provided to BSI for analysis. Additional data points either not immediately available in the collision reporting system or not reviewed as part of this project but have been evaluated in other studies include:

- Operator Seniority
- Operator training history and frequency
- Speed limits of area where crash occurred
- Availability of bus bays for collisions that occurred at bus stops
- Presence and specific design and configuration of safety lights or signs
- Presence of and notability of external bus advertisements

BSI recommends that in the future TriMet consider adding the above-mentioned data fields to the collision reporting system to identify additional trends that could highlight areas for improvement.