Transportation Systems Management and Operations Performance Report

2018 Q2 Edition

TSMO





pennsylvania
DEPARTMENT OF TRANSPORTATION

Introduction

This TSMO Performance Report is focused on providing information pertaining to PennDOT Operations to better understand where and how the Department can improve the efficiency of our Core Roadway Network[1].

The first section of this report is a continuation of the 2018 Q1 baseline analysis, to further examine TMC Operations and situational awareness around crashes that caused significant congestion. Subsequent sections describe how various operations tools/data sources perform at detecting incidents, and discuss and under-reported Traffic Operations dataset.

All analysis in this report was conducted using the Traffic Operations Analytics tool (https://analytics.penndot.gov). 2017 data was primarily used for this report due to most of the correlations, including a relationship to crash database, not being finalized for 2018. There are plans to provide current year information in future reports.

PennDOT TMC Operations

The information in this section concentrates on reportable crashes that impacted the core network for extended periods of time. A vital part of TSMO performance begins with TMC situational awareness of unplanned incidents on our core roads. To improve this incident awareness, we need to effectively use available incident and congestion tools to investigate and understand where these high congestion causing crashes are more prevalent. A dedication to improving incident detection will allow us to strengthen our core network traffic incident management (TIM) outreach, and provide better messaging to travelers so they can avoid known incidents.

Reportable Crashes and High Congestion[2] Crashes Captured in RCRS[3]

Table 1, on the following page, outlines the percentage of all reportable crashes on the core network and the subset of those crashes that caused "high congestion." Each of those crash categories is then associated to relevant RCRS entries and their percentage captured in the system.

As would be expected, RTMCs are capturing significantly more reportable crashes that cause severe or critical congestion (72% statewide average) than all general crashes (44% statewide average). The capture rate is consistently higher within each RTMC home District, and in several cases during staffed TMC hours of operation in the member districts.

[1] Pennsylvania's "Core Roadway Network" was established in 2011 for 511PA, and includes state owned interstates, limited access roads, and other major routes throughout the Commonwealth (http://www.511pa.com/pdfs/PA511IncidentandFlowNetwork.pdf).

[2] "Critical" and "severe" congestion severities are based on INRIX data and used to denote high congestion. A high congestion event has the scores: (1-Critical >= 10000, 2-Severe 3000 – 9999). Severity score methodology = (Duration of Incident) * (Historical Avg. Speed – Avg. Speed during Incident)

[3] Reportable crashes are determined to be linked to an RCRS event if there is an RCRS "crash," "police activity," "vehicle fire," "disabled vehicle," and "other" entry within 1500 meters (~1 mile) of the location of any crash report, and with a start time that is within the duration of congestion caused by the crash. If there is no congestion associated with the crash, the RCRS entry must occur within 45 minutes of the crash report.

TABLE 1. ALL REPORTABLE CRASHES[4] AND HIGH CONGESTION CRASHES CAPTURED IN RCRS

Traffic Management Centers (TMC)	2017 Reportable Crashes	Linked to RCRS	% Linked to an RCRS Event	High Congestion Crashes	Linked to RCRS	% Linked to an RCRS Event
Southeastern RTMC (D6)	***5,522***	***2,797***	***51%***	***891***	***685***	***77%***
Eastern RTMC (D8)	***5,509***	***2,240***	***41%***	***1118***	***784***	***70%***
District 4	206	48	23%	43	23	53%
District 4 (D8)	516	70	14%	89	37	42%
District 5	1,236	475	38%	297	204	69%
District 5 (D8)	785	146	19%	108	57	53%
District 8	2,766	1,501	54%	581	463	80%
Central RTMC (D2)	***1074***	***340***	***32%***	***147***	***112***	***76%***
District 2	460	234	51%	79	71	90%
District 3	411	83	20%	50	37	74%
District 9	203	23	11%	18	4	22%
Western RTMC (D11)	***2,573***	***1133***	***44%***	***561***	***379***	***68%***
District 1	120	19	16%	16	7	44%
District 1 (D11)	169	25	15%	32	15	47%
District 10	216	44	20%	50	21	42%
District 11	1,563	905	58%	345	272	79%
District 12	506	141	28%	118	64	54%
Statewide	***14,678***	***6,510***	***44%***	***2717***	***1960***	***72%***

Sources: Roadway Condition Reporting System (RCRS), INRIX, Crash Reporting System (CRS)

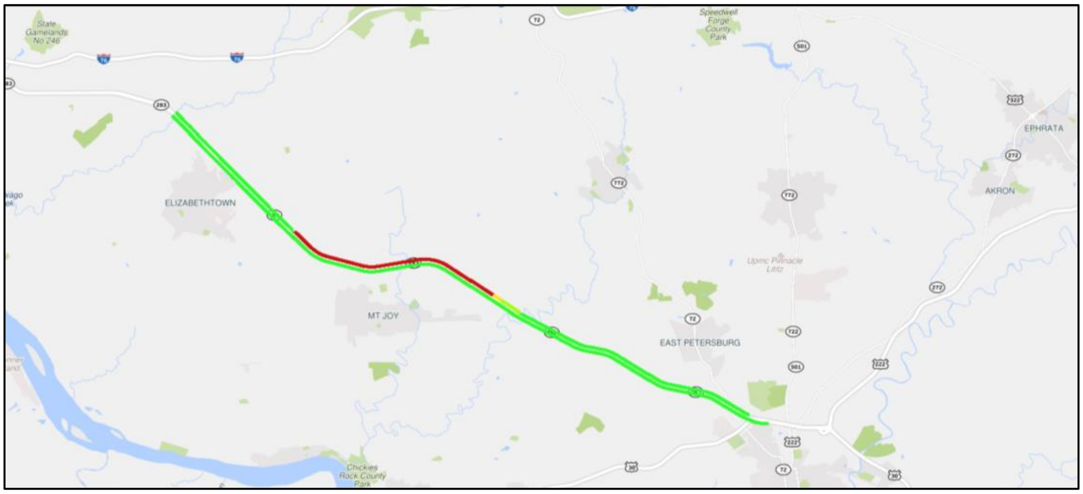
Data Notes: The "2017 Reportable Crashes" total is higher than identified in the Q1 report due to an enhancement to the TOA tool. This number is considered final for 2017.

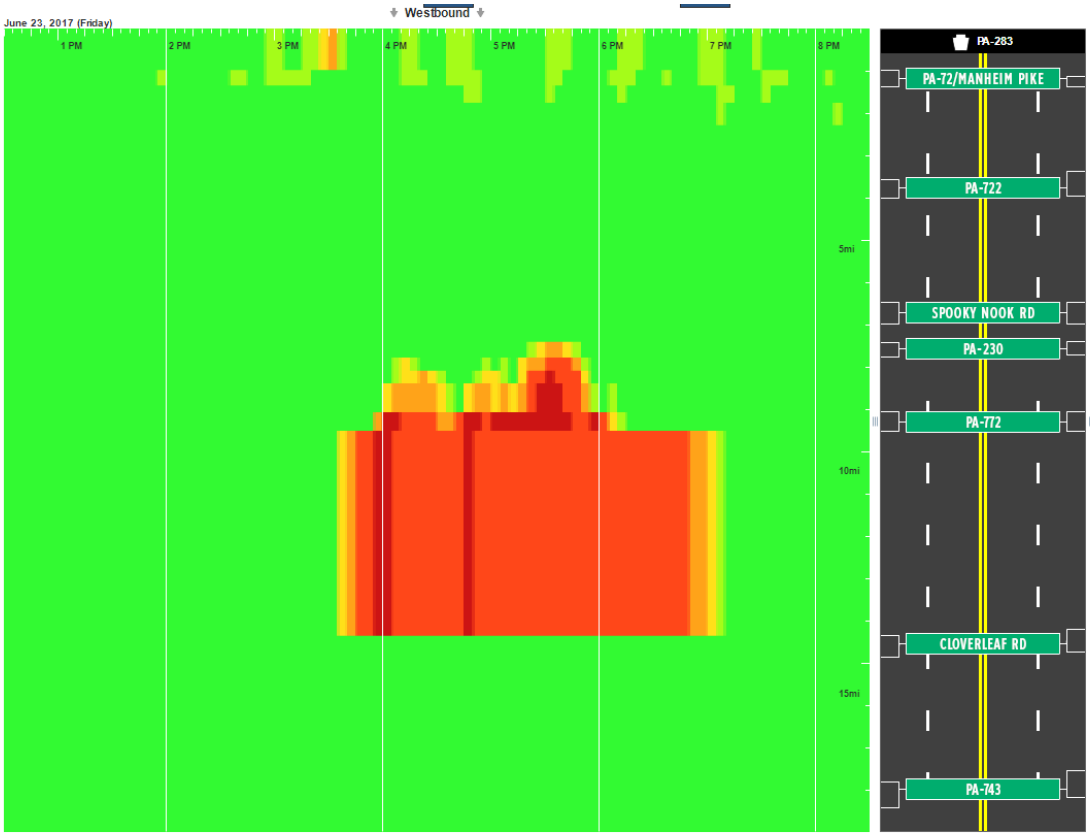
Conclusions

As TMCs look to improve awareness of incidents, the focus should begin with events that can be identified from our current operations resources (Google, INRIX, Waze, Police, PennDOT, SSP, CCTV, TIM Partners, etc.). For example, crashes on the core network resulting in high congestion is a type of incident within the capabilities of existing TMC resources.

[4] A reportable crash is one in which an injury or a fatality occurs, or if at least one of the vehicles involved required towing from the scene.

Below, is an example of what a "high congestion crash" would look like on a map with traffic data, and the associated incident timeline from the University of Maryland's Probe Data Analytics Suite:



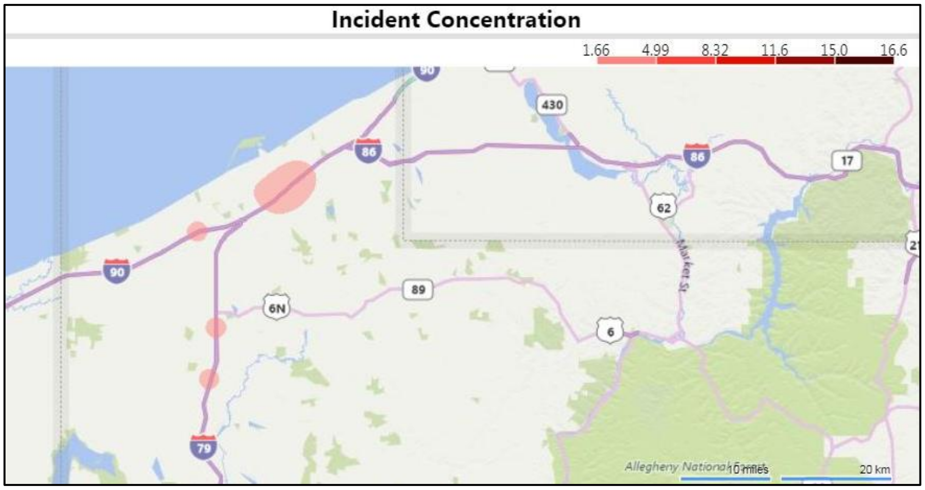


Data Notes: The above example is a "severe" congestion incident with a score of 7,350: 210 minutes of congestion with an average speed of 25 mph, where the normal historical speed was 60 mph (210 * (60 – 25) = 7,350). Severe: 3,000 – 9,999, Critical: >=10,000

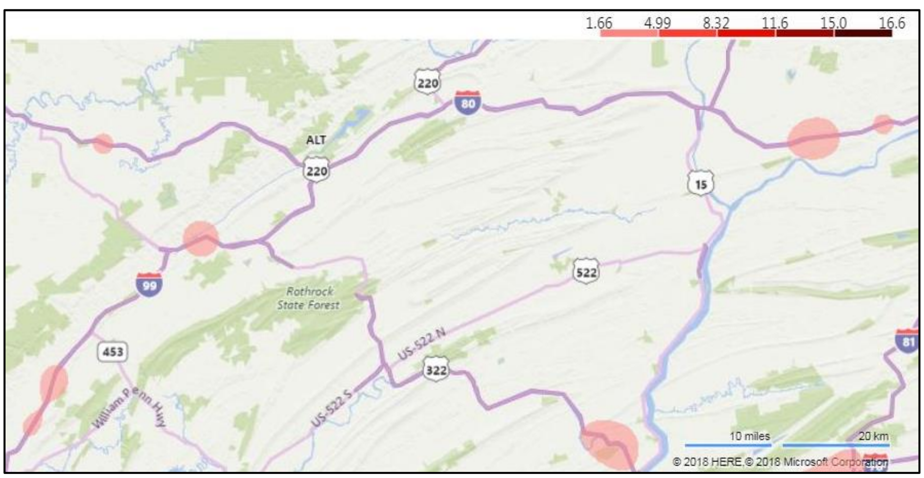
Locations of High Congestion Crashes Not Captured in RCRS

The heat maps below represent areas on the core network where high congestion crashes were not captured in RCRS. The darker the color, the higher the concentration of crashes without RCRS entries. The heat maps should help identify areas where TMCs can focus situational awareness efforts, and investigate potential improvements to day to day operations coverage.

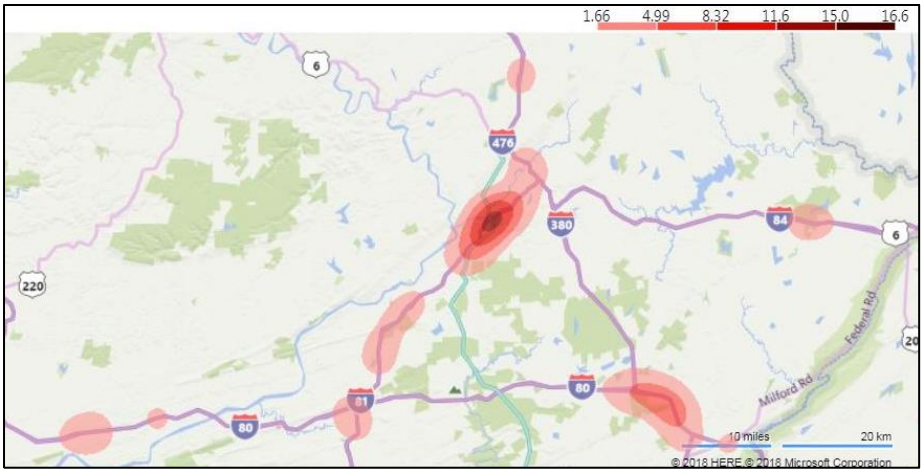
District 1



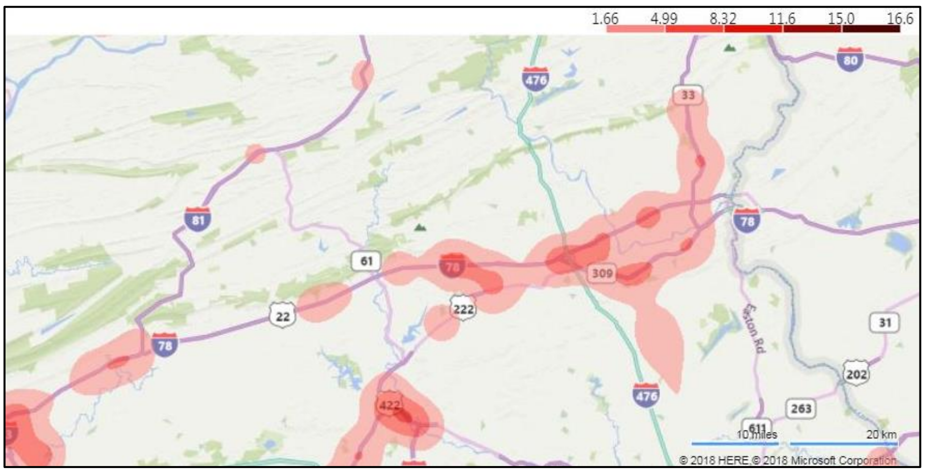
District 2, 3, and 9



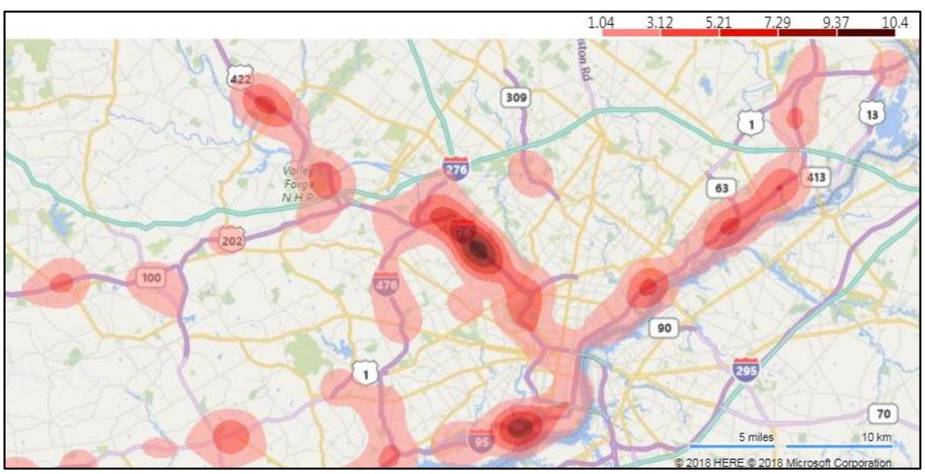
District 4



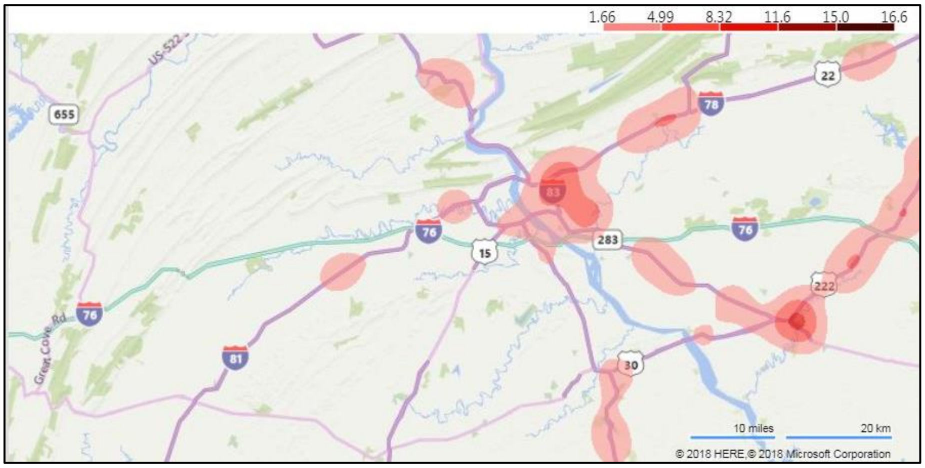
District 5



District 6

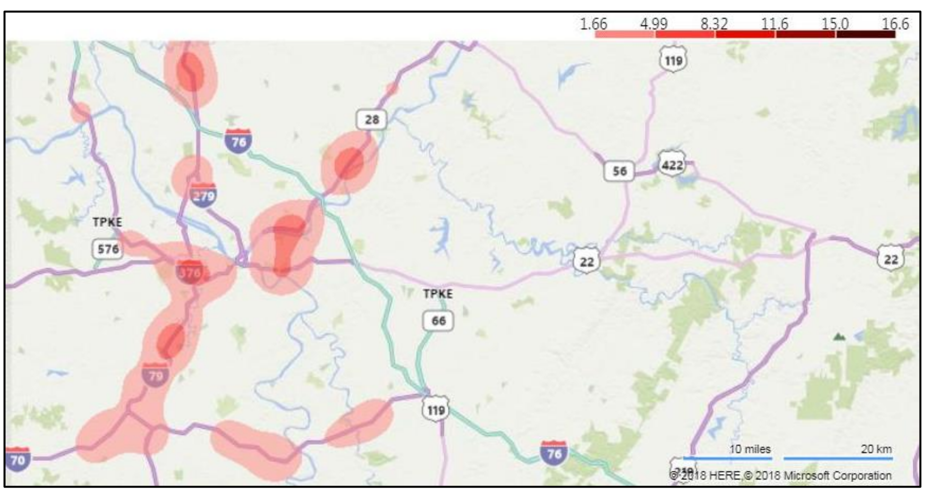


District 8



District 10

District 11 and 12

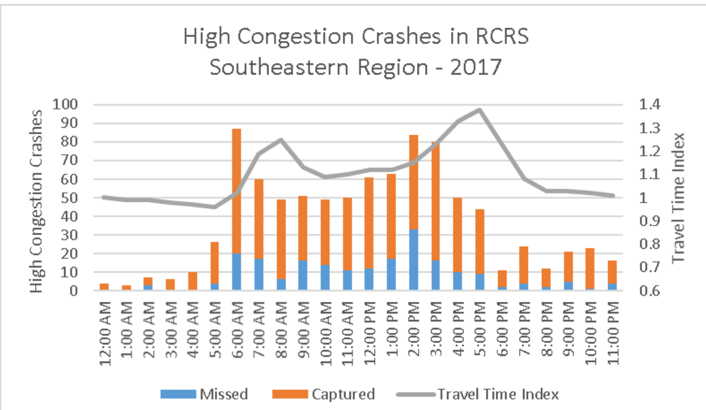


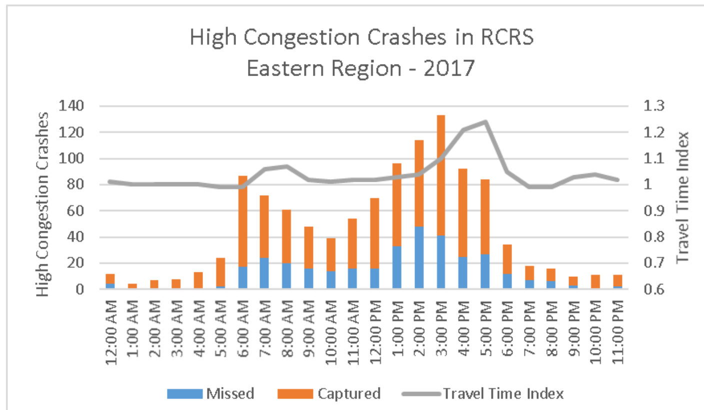
Data Notes: The Heat Maps in Traffic Operations Analytics tool (https://analytics.penndot.gov) can be used for further analysis, including several other crash-centric variables.

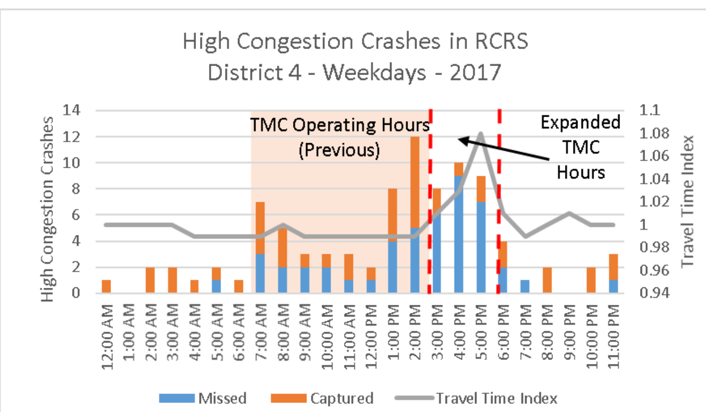
High Congestion Crashes Not Captured in RCRS, by Time of Day

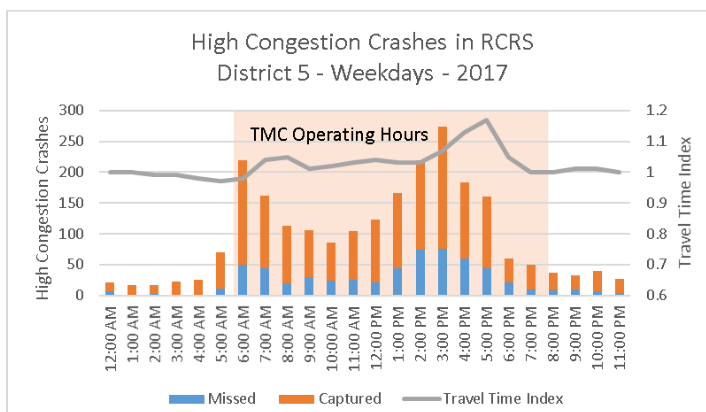
The charts below show the corresponding number of high congestion crashes that were not entered in RCRS, by time of day. The associated average travel time index[5] has been included so the reader can visualize the inherent magnitude of recurring congestion during that time. The "missed" numbers directly correlate to the heat map locations listed in the previous section.

As seen on the charts, the largest amount of high congestion crashes not entered in RCRS occurs in the early afternoon. Statewide, there appears to be a critical window between 1 PM and 4 PM (M-F) which correlates to 1 in 3 high congestion crashes not captured in RCRS. Improved situational awareness and a rapid incident response during this timeframe could directly contribute to a reduction of congestion and improved reliability during the PM peak travel period. In areas with freeway service patrols, districts are encouraged to evaluate the benefits of starting shifts ahead of this critical time window.

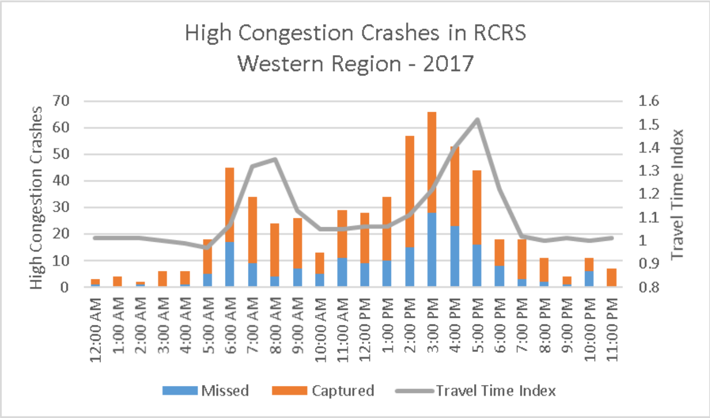


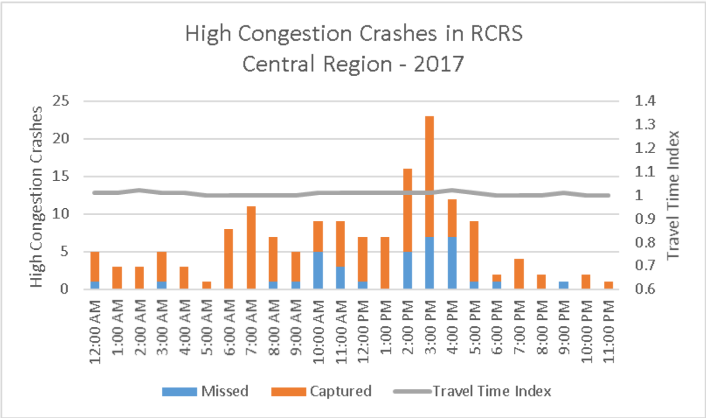






[5] Travel Time Index is defined as the ratio of the current travel time to the travel time under free-flowing condition. For these charts, travel time index is calculated only on Core Roadway Network route sections that are in more populated areas, and as a result, are subject to recurring congestion.





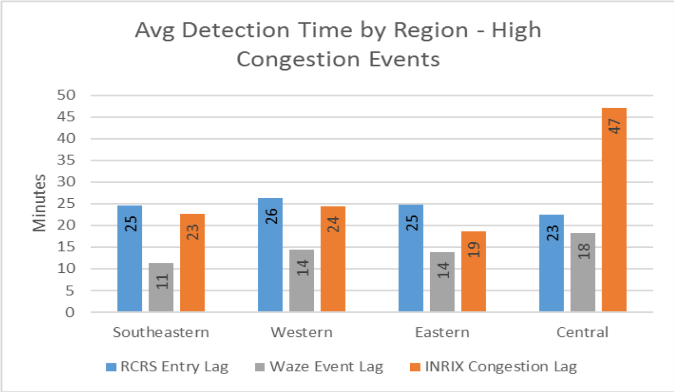
Crowd-Sourced Incident and Congestion Data

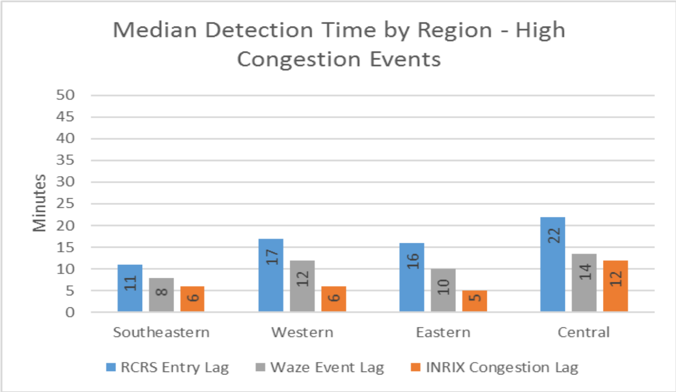
A year-long pilot has been underway with TMCs to use crowd-sourced information to assist with incident identification, validation, and the response process. The information in this section quantifies the validity of Waze and INRIX as incident detection sources. RCRS detection times are for baseline comparison and are not to serve as a one to one evaluation between Waze and INRIX detection times. TMC Operations guidelines allow for an ~15-minute incident response grace period prior to RCRS generation. Improving TMC awareness of high congestion crashes through available tools is the desired outcome of these available data sources.

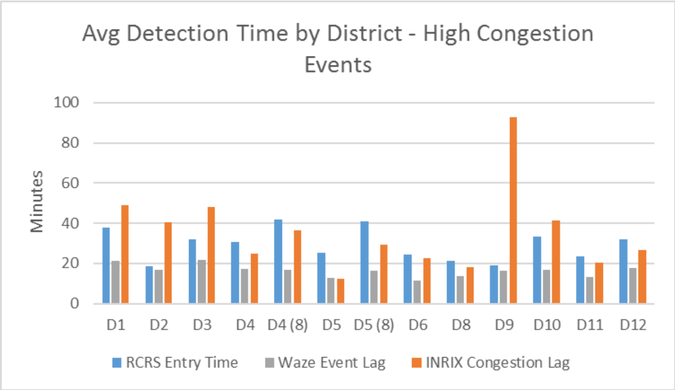
Waze, INRIX, and RCRS Average and Median Detection Time of High Congestion Crashes

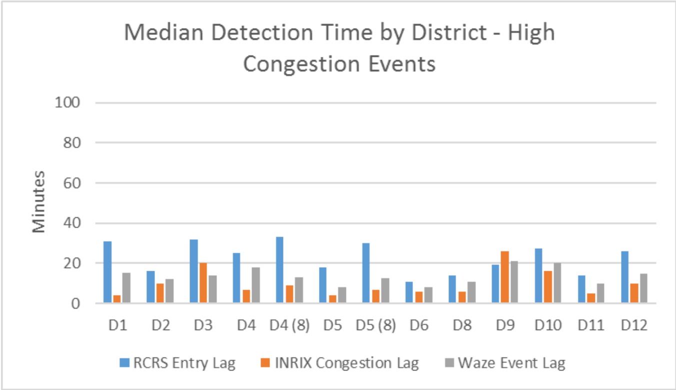
The charts on the following page compare the average and median detection times of high congestion crashes for RCRS, INRIX, and Waze. The charts have been displayed by RTMC Region and by District to understand any inconsistencies in the data by location.

During our analysis, we uncovered a noticeable lag in INRIX's average detection time in rural areas. Some factors that play a part in this delay are a low number of incidents and corresponding low traffic volume. For example, District 9 had 18 crashes that caused high congestion and several occurred without consistent traffic volume. Due to these conditions, it took extended periods of time for the congestion to build and INRIX to detect it. Consequently, we chose to include the median numbers charts also to demonstrate that at least 50% of the time INRIX is the fastest source to detect a crash.



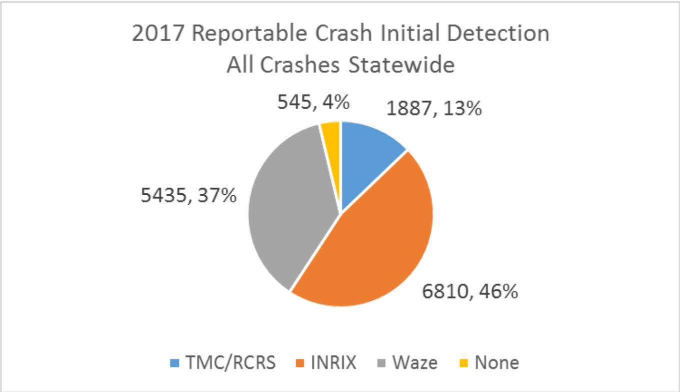


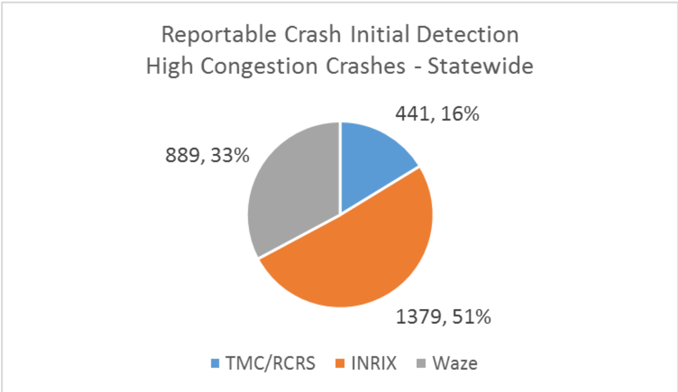




Waze, INRIX, and RCRS First Detection Percentage of All Reportable Crashes and High Congestion Crashes

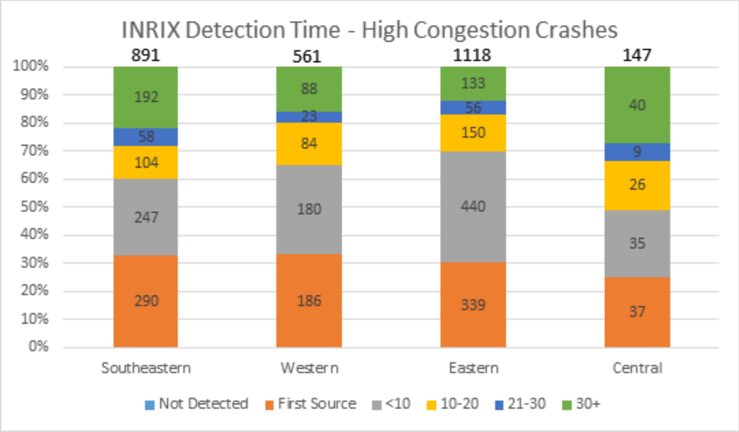
The following pie charts depict which source was first to detect the incident, based on all crashes and crashes that caused significant congestion. Together, TMCs, Waze, and INRIX had situational awareness on 96% of all reportable crashes. INRIX and Waze combined detect incidents first on approximately 84% of all crashes and high congestion crashes.

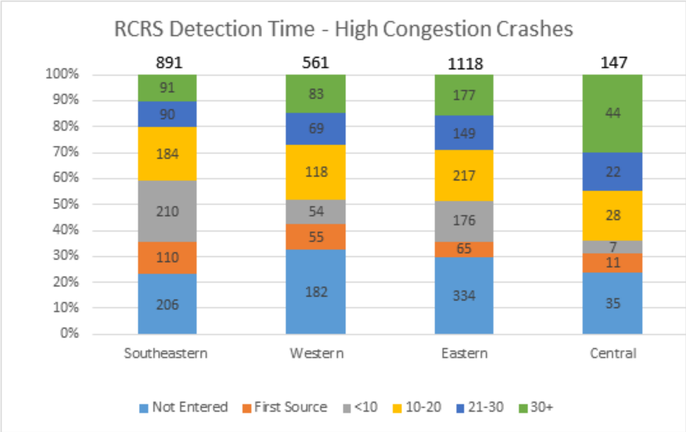


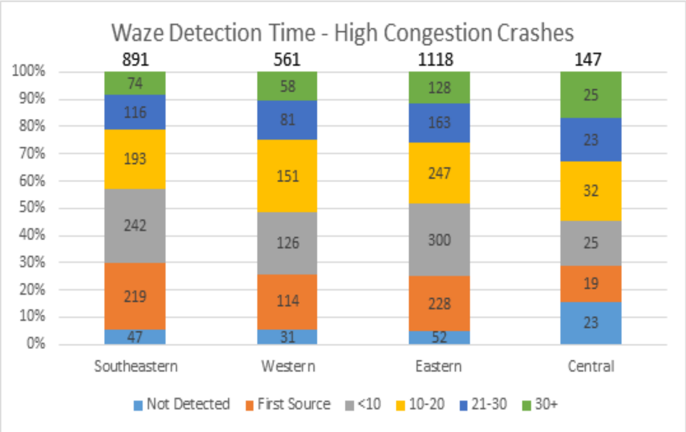


Waze, INRIX, and RCRS High Congestion Crash Detection Times

The following charts are broken down by each source to better visualize the respective detection times, and overall awareness of high congestion crashes by region. On average, Waze and INRIX detect 83% of all high congestion crashes statewide under 30 minutes, with INRIX detecting approximately 65% under 10 minutes. INRIX information is used as the baseline for high congestion, so there are no events "not detected." The clock on the incident timeline starts with the earliest time any of the three sources detects a crash, or if the time on the crash report is earlier than any of the three data sources. The following charts depict the first source detection and minute time windows in which the high congestion crashes were detected.







Although Waze and INRIX data are not the only sources for incident identification and verification, they can provide valuable information to help TMCs identify incidents and improve situational awareness.

To assist with this effort, a TMC "Traffic Alerts" dashboard is being developed to better display Waze and INRIX information for events on the core network. The dashboard will allow operations staff to monitor incidents "real time" as they progress (real time google traffic, Waze report updates with incident photos, and INRIX incident and congestion lengths). The specific incident timeline information can be tracked in a separate webpage with real time updates that show beginning/end queue points. This application is slated to be delivered in August 2018.

Data Quality – PennDOT and First Responder on Scene

Traffic Incident Management (TIM) plays a large role in helping the Department effectively operate and manage the Department's core network. Nationwide best practices place DOTs as a focal point for improving incident management processes, and TMCs can serve as a hub for dispatching Department resources.

To better understand the importance of the various roles in incident management, accurate information is needed to qualify the benefits associated with PennDOT or other responders being on scene. TMCs can assist with this effort by keeping RCRS up to date with accurate information when PennDOT or first responders arrive on the scene of an incident.

RCRS PennDOT and First Responder on Scene

Preliminary analysis appears to show that PennDOT on scene may have a direct effect on shortening incident clearance and influence times. However, these conclusions are based on a very limited data set as outlined below. Table 2 is a statewide snapshot of all crashes where a PennDOT or a first responder was recorded as on scene in RCRS. Assuming, for example, that first responders are on scene for nearly 100% of full closures, we can draw the conclusion that this information is being underreported. Current reporting shows that PennDOT is on scene for only 2% of full closures and lane restrictions which again is likely being underreported.

Table 2. RCRS Crashes with PennDOT or First Responder Reported on Scene

Lane Status	Total RCRS Crashes	PennDOT On Scene	% of Events	First Responder	% of Events
Full Closure	1,043	24	2%	236	23%
Lane Restriction	7,248	144	2%	1,238	17%
No Lane Restriction	1,628	66	4%	306	0%
All	**9,919**	**234**	**2%**	1,780	18%
District					
District 1	78	1	1%	3	4%
District 2	295	1	0%	1	0%
District 3	***120***	***3***	***3%***	***5***	***4%***
District 4	157	1	1%	31	20%
District 5	924	10	1%	55	6%
District 6	4,277	4	0%	264	6%
District 8	***2,213***	***74***	***3%***	***894***	***40%***
District 9	42	1	3%	1	2%
District 10	53	0	0%	4	8%
District 11	1,575	139	9%	496	31%
District 12	185	0	0%	26	14%
Statewide	**9,919**	**234**	**2%**	**1,780**	**12%**