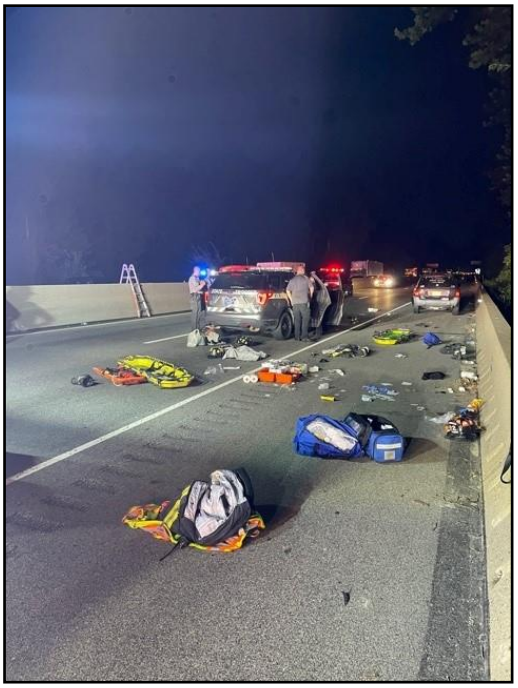
1000 FREDERICK LANE, MORGANTOWN, WV 26508 • 304.285.5916

Career Firefighter Dies and Three Others Injured in a Struck-By Incident while On-Scene at a Roadway Crash – Pennsylvania

Executive Summary

On July 24, 2021, a career firefighter died in a vehicular struck-by crash while preparing to leave the scene of an earlier two-vehicle crash on a four-lane limited-access state roadway. In addition, two volunteer firefighters and a state police trooper were also struck and injured. The volunteer firefighters sustained critical injuries necessitating air medevac from the scene. The state police trooper sustained moderate injuries and was transported by ground ambulance. At 03:04, two fire companies (FC1 and FC2), emergency medical services (EMS), and state police were dispatched to the westbound lanes of a state roadway for a vehicle crash with injuries. The roadway consists of two lanes for each direction divided by a barrier wall, and each direction is bordered by a 12-foot shoulder. Dispatch reported that the crash involved two passenger vehicles (VEH-1 and VEH-2). At 03:07, FC1 responded with a heavy rescue (rescue, R) with six crew members, which consisted of a volunteer captain (R-CPT), a volunteer lieutenant (R-LT), a career firefighter driver/operator (R-CFF), a volunteer firefighter (R-FF1), and two junior volunteer firefighters (R-FF2 and R-FF3). Upon arrival at approximately 03:12, members of FC1 observed VEH-1 and VEH-2 on the roadway shoulder separated by approximately 100-feet. R-CFF positioned the rescue in the right travel lane with its front bumper beside the rear bumper of VEH-1. The R-CPT advised the county dispatch center of two vehicles on the right shoulder of the roadway separated by approximately 100-feet, with occupants outside of the vehicles. The rescue crew deployed five traffic cones. The cones were placed from the driver's side rear of the rescue to the white line along the roadway shoulder (fog line), 10- to 15-feet behind the rescue. Crew members then went to assess the occupants for injuries. FC2 responded with a rescue engine (engine, E), also at 03:07, and arrived on-scene at approximately 03:16. The engine positioned as a blocking vehicle immediately behind the deployed traffic cones, diagonally blocking the right travel lane and the shoulder of the roadway. This positioning of the vehicle allowed oncoming traffic to pass the initial crash scene using the left travel lane.



Westbound view of roadway shown from alongside rescue displaying medical equipment and supplies on the roadway and shoulder with a police vehicle and involved civilian vehicles in the distance.
(Photo by Fire Marshal Office)

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The FC2 assistant chief (E-AC) disembarked and joined R-CPT. A state police vehicle then arrived on-scene with two troopers (TPR 1 and TPR 2). The police vehicle was positioned immediately in front of the rescue in the right travel lane. The fire department guidance provides that the law enforcement agency who has jurisdiction of the roadway maintain responsibility of traffic crashes once on scene. After troopers arrived, FC1 members assessing the occupants reported to R-CPT that there were no injuries involved with the crash. R-CPT cancelled responding EMS. R-CPT provided a face-to-face summary report to both troopers and received orders from a trooper that FC1 and FC2 were released. R-CPT advised county dispatch that the rescue and engine were released and back in service. After stowing the traffic cones, R-CFF, R-FF1, R-FF2, and R-FF3 were talking while standing on the shoulder area next to the rescue. R-CPT, R-LT and E-AC were at the front of the rescue. R-CPT notified the engine that they were released. The engine merged into traffic in the left travel lane, proceeded forward, came to a stop near VEH 2 to briefly talk with TPR 1, and then pulled away while notifying county dispatch of being back in service. During this same time, a vehicle traveling westbound was observed by R-CPT approaching the crash scene in the right travel lane and then swerving onto the right shoulder. R-CPT yelled "RUN." The vehicle was further observed passing by the rear of the rescue striking R-CFF, R-FF1, and R-FF2 standing within the right shoulder area and striking the rear of the first civilian vehicle and pushing it forward approximately 15-feet. R-FF3 had jumped on to the shoulder barrier wall, holding on to avoid falling to the ravine below. TPR 2 sustained a secondary strike during this event. R-CPT immediately requested multiple EMS units to respond, while available crew began triage and initiated treatment based on severity of those struck. After hearing the R-CPT's message to county dispatch, the engine immediately stopped and proceeded to back-up, approximately one-tenth mile to the scene, and the crew assisted with medical care. R-CFF was located in front of the police vehicle, approximately twenty feet away from the impact area, in cardiac arrest. R-FF1 was located between the rescue and police vehicle with altered levels of consciousness and extremity trauma. The trunk and rear window of the police vehicle sustained damage that indicates R-FF1 initially impacted the police vehicle before landing on the roadway. R-FF2 was found unresponsive with head trauma against the barrier wall shoulder wall. TPR 2 was found along the passenger side of the police vehicle with extremity trauma from a secondary strike. Five EMS units and multiple fire companies responded to the scene. Cardiopulmonary resuscitation was provided to the R-CFF while on-scene and during transport by ground ambulance to the local emergency room where he later was pronounced deceased. Two medical helicopters were dispatched to transport R-FF1 and R-FF2 to an emergency room. TPR 2 was transported by ground ambulance to the local emergency room.

Contributing Factors

- *Ineffective temporary traffic control in the following Temporary Traffic Control (TTC) zones:*
  - *Advance Warning Area*
  - *Transition Area*
  - *Activity Area*
  - *Termination Area*

- *Inadequate termination of a Traffic Incident Management Area (TIMA)*

- *Lack of continuous risk assessment*

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- *Ineffective situational awareness*
- *Failure to require and provide traffic incident management training and ensure competencies*
- *Inadequate and ineffective department and company traffic incident management policy and company traffic incident management standard operating procedure (SOP) for response to roadway incidents.*

Recommendations

- *Recommendation #1: All emergency responders involved with incident command operations should ensure an appropriate TIMA is identified and effective TTC zones are implemented for traffic incidents*
- *Recommendation #2: All emergency responders involved with incident command operations should ensure a proper and effective termination of a TIMA to maintain the safety of all responders through their departure from the scene*
- *Recommendation #3: All emergency responders involved with incident command and fire officers should ensure ongoing risk assessments through the duration of the incident until all responders have departed the scene*
- *Recommendation #4: All responders should develop comprehensive situational awareness through education, practice, and experience*
- *Recommendation #5: A multidisciplinary approach for traffic incident management training should be required and provided to all potential responders for roadway incidents*
- *Recommendation #6: Develop fire department-wide TIM policies, trainings, and SOPs that are further expanded by each fire company based on specific community needs*

For report slides that summarize this incident and recommendations: F2021-13RS

The National Institute for Occupational Safety and Health (NIOSH) initiated the Fire Fighter Fatality Investigation and Prevention Program to examine deaths of firefighters in the line of duty so that fire departments, firefighters, fire service organizations, safety experts and researchers could learn from these incidents. The primary goal of these investigations id for NIOSH to make recommendations to prevent similar occurrences. These NIOSH investigations are intended to reduce or prevent future firefighter deaths and are completely separate from rulemaking, enforcement, and inspection activities of any other federal or state agency. Under its program, NIOSH investigators interview persons with knowledge of the incident and review applicable records to develop a description of the conditions and circumstances leading to the deaths in order to provide a context for the agency's recommendations. The NIOSH summary of these conditions and circumstances in its reports is not intended as a legal statement of facts. This summary, as well as the conclusions and recommendations made by NIOSH, should not be used for the purpose of litigation or the adjudication od any claim.

For further information, visit the program website at www.cdc.gov/niosh/fire or call toll free 1-800-CDC-INFO (1-800-232-4636).

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Introduction

On July 24, 2021, a career firefighter died, and three other responders injured when struck by a vehicle that was able to enter the emergency work scene of a vehicle crash. On July 25, 2021, the U. S. Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. On August 25, 2021, two safety and occupational health specialists from the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) initiated a virtual investigation. The NIOSH team virtually met with the fire department chief, a deputy fire marshal, and the fire company chief. Documents, photos, and applicable records associated with the line of duty death (LODD) were transmitted to the NIOSH team through a secure access management system. Virtual interviews were conducted with firefighters that were present when the incident occurred. On June 10, 2022, a FFFIPP team of three safety & occupational health specialists traveled to conduct an onsite investigation and interview the remaining personnel that responded to the original incident.

Fire Department

The fire department provides fire protection and suppression, code enforcement, and fire education for residents of the township and an adjacent borough. The Chief Fire Officer (CFO) is responsible for providing incident command on fire emergencies and to have department-wide SOPs in place when more than one volunteer fire company is dispatched. The department provides appropriations for career firefighting personnel assigned as adjunct to seven volunteer fire companies within its jurisdiction. Each volunteer company is supplemented with full-time and part-time career firefighters to cover 24 hours per day, seven days per week.

Fire Companies

Fire Company 1: Volunteer fire company covering 2.1 square miles of a residential area and bordered on one side by an interstate roadway and a river. This company houses one of two heavy rescue apparatus within the township and provides rescue coverage of the bordering interstate roadway. In 2020, the fire company responded to 409 emergencies, of which 148 were rescue and emergency medical service calls. 316 emergency calls were within the first due district. The volunteer company is supplemented with a career firefighter for each 8-hour shift. Career firefighters are responsible for operating and maintaining the assigned fire apparatus to ensure first due response with volunteer members.

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Fire Company 2: Volunteer fire company covering 4.9 square miles of residential and commercial area bordered on one side with an interstate roadway and a river. In 2020 the fire company responded to 490 emergencies, of which 14 were rescue and emergency medical service calls. 212 emergency calls were within the first due district. Career firefighters are responsible for operating and maintaining the assigned fire apparatus to ensure first due response with volunteer members.

Training and Experience

FC1 firefighters did not have specific traffic incident management training as required by the Manual on Uniform Traffic Control Devices (MUTCD), the National Unified Goal (NUG) for Traffic Incident Management (TIM), and NFPA 1500, *Standard for a Fire Department Occupational Safety, Health, and Wellness Program*. All were certified in Firefighter I through the state fire academy. The academy's Firefighter I curriculum includes a section on "Riding Apparatus/Working at an Emergency Scene". This section includes the following skills for certification, which includes a portion of TIM training:

- Dons safety vest over PPE prior to boarding apparatus
- Checks seat area for obstructions, loose tools, etc.
- Mounts apparatus using handrails and demonstrates sound footing while mounting
- Sits in the seat provided, engages seatbelt/shoulder harness assembly provided
- Dons hearing protection, and eye protection for open or canopy cabs, if applicable
- Candidate looks and verbalizes they are checking traffic conditions prior to dismounting
- Dismounts apparatus using handrails and demonstrates sound footing while dismounting
- Deploys advance warning devices and verbalizes appropriate distance
- Setup a one-lane taper zone 75–100 feet from apparatus using appropriate equipment
- Setup the buffer and incident space downstream of traffic
- Setup flagging station and demonstrate signals to appropriately: slow, release, stop, and direct traffic
- At no time was the candidate not facing or visually watching for on-coming traffic
- Completes all tasks without compromising personal safety.

The CPT, as first arriving officer, was also certified in the following FEMA trainings: *Introduction to Incident Command* (ICS-100), I*CS for Single resources and Initial Action Incidents* (IS-00200.a), *National Incident Management Systems* (IS-00700.a), and the *National Response Framework* (IS-00800.B). The CPT also completed *Vehicle Rescue and Operations* training based on NFPA 1006, *Standard for Technical Rescue Personnel Professional Qualifications*.

Personal Protective Equipment

Federal law requires all roadway workers to wear an ANSI 107-2004 or ANSI 207-2006 compliant high-visibility vest [FHWA 2009a]. An exemption was created for firefighters and others wearing turn-out gear while engaged on roadways while actively fighting fire. NFPA has included requirements in the 2016 edition of NFPA 1901, *Standard for Automotive Fire Apparatus,* that each apparatus seating

position has available a high-visibility safety vest which complies with ANSI 207, *Standard for High-Visibility Public Safety Vests*, recommendations. NFPA 1500, *Standard for a Fire Department Occupational Safety, Health, and Wellness Program*, Paragraph 9.4.9, states, "When member assignments place them in potential conflict with motor vehicle traffic, they shall wear a high-visibility garment that meets ANSI 107, *American National Standard for High-Visibility Apparel and Access*, unless exposed to fire, heat, flame, or hazardous materials where NFPA-compliant turnout gear is more appropriate" [NFPA 2021a]. NFPA 1901, 5.9.4(18), states "one traffic vest for each seating position, each vest to comply with ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, and have a five-point breakaway feature that includes two at the shoulders, two at the sides, and one at the front" [NFPA 2016].

In this incident, all rescue crew members wore an ANSI/ISEA 207 compliant high visibility traffic vest in addition to civilian clothing, structural firefighting pants and boots.

Weather and Road Conditions

Weather Underground July 24 2021 historical data shows the following weather conditions in the area of the incident at 02:54:

- Temperature: 71 degrees Fahrenheit
- Wind: Zero
- Precipitation: Zero
- Dew Point: 60
- Humidity: 68
- Moon Phase: Waning Gibbous, 97-99% illumination

The roadway is maintained by the state's department of transportation. Law enforcement patrols are under the direction of state troopers. Emergency medical, rescue and fire services are provided by local agencies with pre-determined areas of response throughout the statewide road system. The area of roadway involved in this incident is located at the base of two hilltops in a vegetative area at a slight elevation along a riverbed. The hilltops reach up to 156-meters in elevation. The roadway consists of two lanes in each direction, east and west, divided by a barrier wall. Each direction contains an approximate 12-foot shoulder, with the west bound shoulder bordered with a barrier wall. The roadway contains no overhead lighting.

Traffic Incident Management

Understanding the history and phases of traffic incident management offers a better understanding on response to roadway incidents. Congress authorized focused research investigation of underlying causes of traffic collisions and congestion in 2005. Four focus areas identified were safety, reliability, renewal, and capacity. The National Traffic Incident Management (TIM) Responder Training Program was the first product available relating to the reliability focus. The National Unified Goal (NUG) for TIM was developed in 2006. The NUG encourages state and local agencies to adopt multidisciplinary

policies, procedures, and practices addressing the three objectives of responder safety, safe and quick clearance, and prompt, reliable, interoperable communications. Training was then developed and tested before being made available in 2012. The intent was to create a multidisciplinary training for all responders. Responders include communication, law enforcement, towing/recovery, emergency management, transportation/public works, fire/rescue, and other types of responders. TIM training aims to reduce risks by providing for safety of incident responders, safety of all road users, and congestion mitigation and commerce. The requirements for emergency operations at traffic incidents for the fire service were established in the 2013 edition of the NFPA 1500 (2013, 8.7.11) [NFPA 2013] and became more defined with subsequent editions (2018: 9.2.1 and 9.4.10) (2021a: 9.2.1 and 9.4.10). [NFPA 2018 and NFPA 2021] Since 2015, NFPA 1091, *Standard for Traffic Incident Management Personnel Professional Qualifications*, has provided professional qualifications requirements for traffic incident personnel through knowledge, skills, and abilities metrics.

Federal law requires a temporary traffic control (TTC) plan to facilitate road use through an incident area [FHWA 2009n]. The US Fire Administration identifies four TTC zones that should be identified for all roadway incidents: advance warning area, transition area, activity area, and termination area. TTC zones represent areas where road user conditions are changed due a traffic incident. The TTC zones combine to form the traffic incident management area (TIMA), which is the sum of all TTC zones with a distance determined based on the highway speed.

The Manual on Uniform Traffic Control Devices (MUTCD), Chapter 6I.01, defines a traffic incident as “an emergency road user occurrence, a natural disaster, or other unplanned event that impedes the normal flow of traffic,” The MUTCD further divides traffic incidents into three TIMA classes based on estimated time of duration. Minor Class is estimated to last less than 30-minutes, Intermediate Class is estimated to last 30-minutes to 2-hours, and Major Class is estimated to last more than 2-hours. An incident class can further be expanded as need, with more formal TTC zones established.

Once established, TTC controls must be maintained until the incident has been resolved and all personnel and equipment that were in the workspace have departed the incident scene. This demobilization should be completed from the termination area of the TIMA, working backwards to the advance warning area, while maintaining blocking vehicle protection for responders collecting traffic control devices from the roadway.

The National Unified Goal (NUG) for Traffic Incident Management (TIM) recommends a unified, multidisciplinary approach to TIM by National, State, Regional and local public safety and transportation agencies to improve how traffic incidents are managed. Multidisciplinary policies, procedures, and practices for quick clearance of traffic incidents can contribute to minimized risks for responders. NUG addresses responder safety through three strategies: practices for responder safety, Move Over/Slow Down laws which exist in every State, and driver training and awareness.

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Investigation

A timeline of pertinent events is in **Appendix 1**.

On July 24, 2021, at 03:04, two fire companies (FC1 and FC2), emergency medical services (EMS), and state police were dispatched to westbound lanes of a limited-access four-lane divided state roadway for a vehicle crash with injuries. The roadway consists of two lanes for each direction divided by a barrier wall, and each direction is bordered by a 12-foot shoulder. FC1 responded with a rescue truck (rescue, R) and a crew of six personnel, by accessing westbound lanes directly at 03:07. The crew consisted of a volunteer captain (R-CPT), a volunteer lieutenant (R-LT), a part-time career engineer (R-CFF), a volunteer firefighter (R-FF1), and two junior firefighters (R-FF2 and R-FF3). Upon arrival at approximately 03:12, the rescue was positioned in the right travel lane with all emergency lights activated. The R-CPT notified county dispatch that there were two vehicles (VEH 1 and VEH 2) on the shoulder of the roadway separated by approximately 100-feet, and that occupants were outside of the vehicles. The rescue crew deployed five traffic cones extending from the rescue's driver's side rear diagonally to the fog line. The cones extended approximately 10- to 15-feet behind the rescue. The crew also activated an apparatus-mounted electronic directional arrow with a left arrow to indicate to oncoming traffic to move to the left travel lane. After, the R-LT and three firefighters went to assess the occupants of the vehicles, and the R-CPT and R-CFF remained at the rescue.

Also, at 03:07, FC2 responded with a rescue engine (engine, E). Due to the limited access roadway, the engine approached on the eastbound lanes to a preidentified emergency crossover, before accessing the westbound lanes. Upon arrival at approximately 03:16, the engine was positioned diagonally behind the rescue and traffic cones blocking the right travel lane and the shoulder of the roadway. This positioning protected the emergency work area while allowing oncoming traffic to pass the crash scene using the left travel lane. The FC2 assistant chief (E-AC) disembarked the engine and joined R-CPT in front of the rescue.

Shortly after the arrival of the engine, a state police vehicle arrived on-scene with two troopers (TPR 1 and TPR 2). The police vehicle was positioned in front of the rescue in the right travel lane, and along the driver's side of VEH 1. Fire department guidance designates that law enforcement once on-scene, is responsible for traffic incidents on roadways within their jurisdiction. At the time of the trooper's arrival, the FC1 crew reported to R-CPT that there were no injuries among the occupants of VEH 1 and VEH 2. R-CPT requested county dispatch to cancel responding EMS. R-CPT provided a face-to-face summary of their findings to the troopers. One of the troopers then released the fire companies from the scene. County dispatch was notified by R-CPT that FC1 and FC2 were released from scene. R-CPT ordered the FC1 crew to collect the traffic cones and ready to depart the scene. After stowing the traffic cones, R-CFF, R-FF1, R-FF2, and R-FF3 were talking while standing on the shoulder area next to the rescue. R-CPT and R-LT were at the front of the rescue. R-CPT notified FC2 that they were released. The engine pulled into the flow of traffic in the left travel lane and proceeded forward. The FC2 crew stopped to talk briefly with TPR 1, who was near VEH 2, and then continued to travel downstream from the incident, notifying county dispatch that they were in service.

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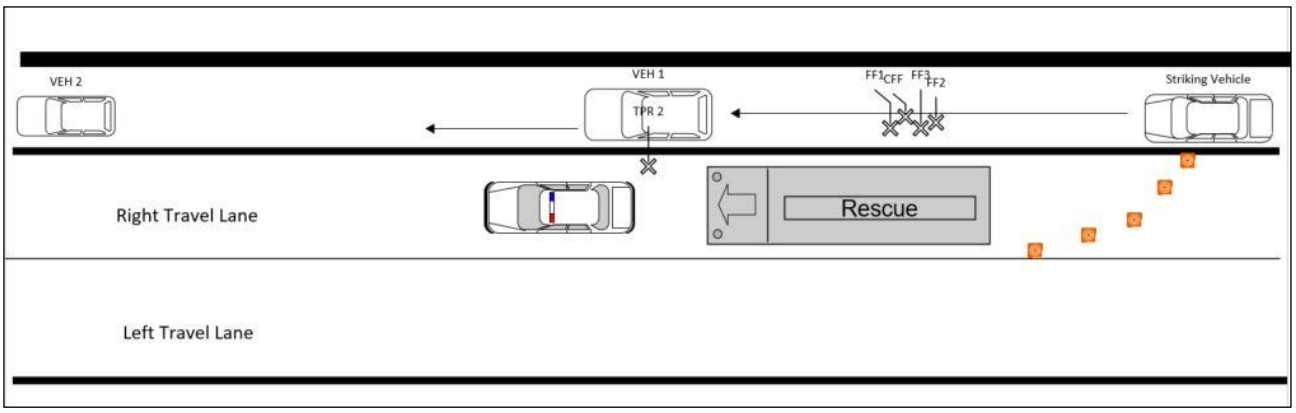

Photo 1: Diagram of vehicle and personnel location at the time of impact. Arrows show direction of vehicle movement during and after impact.
Diagram by NIOSH

During this same time, a passenger vehicle was observed by R-CPT, who immediately yelled "RUN", approaching the scene in the right travel lane and then swerving on to the shoulder past the rescue, striking R-CFF, R-FF1, and R-FF2 and VEH 1. R-FF3 had jumped on to the barrier wall, holding on to avoid falling approximately 40-feet to the land below. The impact with VEH 1 pushed VEH 1 forward approximately 15-feet. TPR 2 was injured in a secondary strike during this event. R-CPT immediately notified county dispatch of an "emergency priority" reporting multiple firefighters down and requesting "…at least five EMS units immediately." Available FC1 members and TPR 1 immediately initiated triage and medical care. The timing of R-CPT's emergency priority notification to county dispatch was immediately after the engine called back in service. Upon hearing the emergency priority, the FC2 crew notified county dispatch that they would return to the scene. The FC2 crew returned to the scene by going in reverse, approximately one-tenth mile, on the westbound lanes. Once back on-scene, the FC2 crew assisted in providing medical care.

R-CFF was located approximately 20-feet ahead of the police vehicle and was in cardiac arrest. R-FF1 was located between the rescue and police vehicle with altered levels of consciousness and extremity trauma. The trunk and rear window of the police vehicle sustained damage that indicated R-FF1 initially impacted the police vehicle before landing on the roadway. R-FF2 was unresponsive with head trauma and located against the barrier shoulder wall. TPR 2 was found along the passenger side of the police vehicle with extremity injuries from a secondary strike during this incident.

Multiple EMS, fire and state police arrived on-scene to provide medical care, to close the roadway to all traffic, and to assist with medical helicopter landing zones. Cardiopulmonary resuscitation was provided to R-CFF while on-scene and during transport by ground ambulance to the local emergency room where he later was pronounced deceased due to blunt force trauma injuries. Two medical helicopters were dispatched to transport R-FF1 and R-FF2 to a local trauma center, where they were

admitted and treated for their injuries. TPR 2 was transported by ground ambulance to the local emergency room, treated and released for continued care and treatment.

Operator Contributing Factors

The operator failures in this incident were not controllable by firefighters on-scene, but they should be anticipated and identified as potential hazards during continuous on-scene risk assessments and planned for in traffic incident management planning and training.

- *Failure of the striking vehicle operator to ensure safe vehicle operation*
  The state of residence of the operator placed the responsibility of ensuring safe vehicle operation on the vehicle owner. It was determined that the striking vehicle had only one of four brake lines operating at the time of the incident. Police reports revealed that the operator had been notified by law enforcement from the operator's state of residence of the poor condition of the brakes prior to the incident. The operator had the responsibility to make the needed repairs, however, failed to do so before traveling into the neighboring state. The only operable brake line failed as the vehicle entered the emergency workspace.

- *Failure of the striking vehicle operator to heed the Move Over Law*
  All US States have a Move Over law in place. In Pennsylvania, Act 105 of 2020 was signed into law and became effective on April 27, 2021. This law superseded the previous "Steer Clear" law by imposing harsher penalties on infractions and requiring drivers approaching an emergency response area who are unable to safely merge into a lane not adjacent to that of the emergency response to "pass the emergency response area at a speed of no more than 20 miles per hour less than the posted speed limit and reasonable for safely passing." (PA Title 75 § 3327) At this incident, the left travel lane was the only lane available for redirecting traffic past the incident. Witness statements recall that as the striking vehicle approached, for unknown reason, the operator moved from the right travel lane to the shoulder of the roadway. The vehicle penetrated the workspace along the shoulder, proceeded alongside of the rescue striking the responders standing on the shoulder area, impacting the rear of VEH 1 and pushing it forward approximately 15-feet.

Contributing Factors

- *Ineffective temporary traffic control in the following TTC zones:*
  - *Advance Warning Area*
  - *Transition Area*
  - *Activity Area*
  - *Termination Area*

- *Inadequate termination of a TIMA*

- *Lack of continuous risk assessment*

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- *Ineffective situational awareness*
- *Failure to require and provide traffic incident management training and ensure competencies*
- *Inadequate and ineffective policy and standard operational procedures (SOP) for response to roadway incidents*

Recommendations

Recommendation #1: All emergency responders involved with incident command operations should ensure an appropriate TIMA is identified and effective TTC zones are implemented for traffic incidents

Discussion: This incident occurred on a four-lane divided highway, at night, with a posted speed limit of 50-mph. The stretch of the roadway involved was straight for approximately 1.5 miles upstream of the incident. County dispatch notified responding units that there was a two-vehicle crash involving injuries. This portion of the roadway is common for roadway incidents as reported by FC1. USFA describes each TTC zone in the FA-330 report, *Traffic Incident Management Systems.* (See Photo 2):

- **Advance Warning area**: The point where road users are informed of an upcoming incident area. Placement of advance warning is based on the type of roadway and the speed of that roadway.

  The advance warning area is the first area of TTC zones. It provides warning to motorists of an upcoming traffic incident scene so the motorists can stay abreast for changes in traffic patterns. The advance warning area placement is dependent on factors which include the posted speed limit, anticipated speed of traffic, weather, road configuration and any other factors provided by the traffic incident. The requirements for advanced warning are tailored to the class of traffic incident – minor, intermediate, and major.
  Based on the road configuration and posted speed, MUTCD guidance is to locate the advance warning area approximately 1,000-feet upstream of the incident, or 8-12 times the posted speed in feet-distance for expressways. Advance Warning should include devices that can direct the motorist and adjust as conditions require. The SOP for FC1 traffic incident response on this stretch of roadway directs the rescue to respond to the traffic incident scene and a squad truck to respond to the upstream interchange to provide advance warning. Due to the limited access of the roadway, all motorists either pass, or enter the roadway at the interchange, which precedes the recommended advance warning area. Staging an advance warning area at the interchange would enable FC1 to provide the early warning from a secure area. This advance warning would be provided by an emergency vehicle with flashing emergency lights and directional lights to alert motorists of the traffic incident.

  In this incident, the squad truck remained on standby in station, reportedly waiting for rescue's request for response. The distance of the straight roadway at night could offer a warning to

motorists approaching a traffic incident scene. However, this may leave the direction of traffic channeling unknown until motorists reach the incident scene increasing risks of secondary traffic incidents.

- **Transition area**: The point where road users are redirected from their lane of travel. Redirection is completed with tapers using channeling devices and placement is based on the lane width, number of lanes involved, and speed limit of the roadway. Common channeling devices are traffic cones and flares.

  Channeling devices warn motorists of lane changing conditions needed to guide motorists safely around the traffic incident, while maintaining a safe workspace for responders. Tapering lanes aids motorists in complying with the Move Over laws. Traffic cones are commonly used by emergency responders as channeling devices. Traffic cones for nighttime use need to adhere to retroreflective and height requirements as determined by MUTCD. Traffic cones should be deployed in a safe and systematic way so that cones are placed approximately 20-feet apart and taper toward the direction of desired travel. Emergency apparatus typically have five traffic cones available, providing the ability to taper traffic beginning approximately 100-feet upstream of the activity area.

  In this incident, five traffic cones were deployed by the rescue. Traffic cones were reportedly placed from the driver's side rear of the rescue, diagonally, to the fog line. The distance of the lane taper was reported to be approximately 10-15 feet. Upon arrival of FC2, the engine was positioned upstream of the traffic cones, effectively making the cones unable to be seen by approaching motorists.

- **Activity area**: The point where the emergency incident activity is taking place. This area includes the workspace, traffic space and buffer space. The workspace involves the actual work activities. The traffic space involves the portion of the roadway used to allow traffic to pass the workspace. The buffer space involves the area separating the traffic flow from the workspace.

  Protection of emergency responders within the activity area relies on the motorist awareness of advance warning(s) and adherence to lane tapering with traffic control devices (TCD). The use of a blocking vehicle(s) to create a buffer between the transition area and the activity area provides a physical barrier to protect the activity area from erratic vehicle movement. Positioning of the blocking vehicle(s) should provide downstream protection of the lane(s) involved in the incident, plus an additional lane which becomes a traffic space, or "lane +1." The traffic space should continue along the entire activity area, which includes all apparatus, personnel, and equipment and end at the beginning of the termination area. The first arriving vehicle should provide lane blocking and ensure protection of the responders before attending to the traffic incident, until an intended blocking vehicle arrives on-scene. Once in place as a blocking vehicle, the blocking vehicle should remain in place until final termination of the incident.

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In this incident, the rescue was the first arriving vehicle on-scene. Vehicles involved in the traffic incident were observed to be on the roadway shoulder, separated by approximately 100-feet, with occupants outside of their vehicles. Fire company SOP directs the first arriving apparatus to block the incident lane and the lane next to it to provide highway safety. It continues to direct other arriving apparatus to block the same lanes behind the first arriving apparatus. The rescue was positioned in the right travel lane with the front of the rescue even with the rear of VEH 1. The FC1 crew dismounted the rescue, set up traffic cones as described above, and proceeded to assess the occupants of VEH 1 and VEH 2. Upon arrival of the engine, full blocking was provided for the activity area. The engine was positioned diagonally providing blocking to the right travel lane and the shoulder, effectively meeting the "lane(s) +1". Traffic was able to continue past the activity area using the left travel lane with reduced speed.

In this incident, the rescue provided ineffective blocking of the incident scene upon arrival by remaining in the right travel lane. Failure to provide blocking of the shoulder allowed a vulnerability to have an erratic vehicle penetrate the activity area on the exposed shoulder. Lane tapering was ineffective due to limited distance between cones and lack of an increasing taper with each cone from the upstream side, which should have included the shoulder lane. Upon arrival of the engine, full "lane +1" blocking was achieved. However, the engine blocked visualization of the traffic cone lane tapering placed by the FC1 and definitive visualization of the directional arrow on the rear of the rescue. There was no traffic control upstream of the blocking vehicle to guide motorists to the left travel lane. In PA, DOT has an agreement for a sponsored roving safety patrol vehicle during a specific timeframe during daylight through evening hours. This vehicle can be requested to respond and assist in traffic control for any roadway emergency. Response time and availability is determined based on the traffic incident class of the emergency, as well as the actual response time of the safety patrol vehicle to the incident location. The timing of this incident was outside of the sponsored hours of safety patrol coverage.

Illumination of TIMA should be carefully structured to provide adequate scene lighting and minimize visual disruption, or blindness, of motorists. Different guidance is provided for daytime incidents versus dawn, dusk, and nighttime incidents. Ambient lighting during daytime can absorb the contrast of high-powered emergency lighting. However, at dawn, dusk and nighttime, the darker ambient lighting presents a stark contrast to emergency lights, which can disrupt vision or cause lighting blindness of motorists approaching and passing a TIMA. USFA provides guidance on effective conspicuity using emergency scene lighting and retroreflective markings on vehicles to provide increased responder safety. "Inappropriate use of scene lighting, headlights, warning lights and flood lights can confuse or blind motorists." [USFA]. NFPA 1901 identifies two separate signaling modes during emergency operations. 'One mode shall signal to drivers and pedestrians that the apparatus is responding to an emergency and is calling for the right of way. One mode shall signal that the apparatus is stopped and is blocking the right of way." [NFPA 2016]. The use of an optical warning system senses the parking brake or park

position to automatically switch between the two signaling modes. This enables programmatic reduced lighting while on-scene. For apparatus not equipped with an optical warning switch, or one that is not operational, a purposeful reduction in lighting should be made once on-scene. On-scene, reduced lighting will eliminate lighting blindness in passing motorists and enable traffic control devices and personnel to be easily seen.

This incident occurred during nighttime on a roadway with no overhead lighting and located between two hilltop elevations blocking the ambient light of a full moon. The rescue, engine and police vehicle are reported to have had all emergency lights engaged while on-scene. This could contribute to visual disruption or blindness of motorists approaching and passing through a TIMA, by creating blind spots beyond the lighted area.

- **Termination area:** The point where road users are returned to normal traffic flow, typically at the end of a downstream taper. [USFA 2008]

The termination area provides channeling of motorists after passing the activity area and restores normal traffic flow on all travel lanes. The termination area begins at the downstream end of the activity area. At the end of the activity area traffic control devices should be used to provide a controlled return to normal traffic flow. By tapering the flow of traffic using TCDs there is limited opportunity for a passing motorist to enter the activity area. Traffic cones, or flares, are commonly used to create a reverse taper. As in transition area fashion, the TCDs are spaced approximately 20-feet apart with an increasing taper with each cone.

In this incident, the traffic space was only provided by the rescue and state police vehicle near VEH 1. However, the activity area, by definition, extended downstream approximately 100-feet to the location of VEH 2. The downstream area after VEH 2 should have been the location of the termination area. TCDs were not deployed to guide motorists back into normal traffic flow.

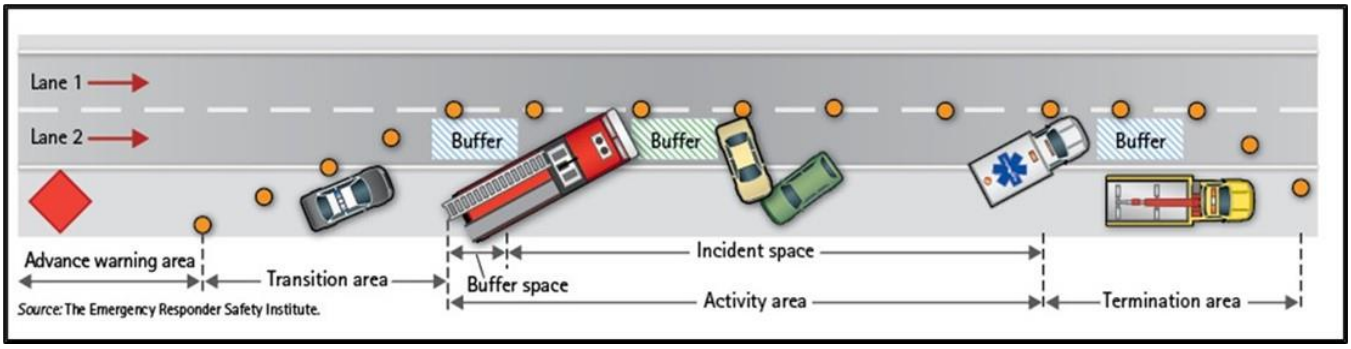

Photo 2: Diagram of a traffic incident management area with identified temporary traffic control zones.
Diagram by Emergency Responder Safety Institute

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Recommendation #2: All emergency responders involved with incident command operations should ensure a proper and effective termination of a TIMA to maintain the safety of all responders through their departure from the scene

Discussion: Termination begins after rescue and remediation of a traffic incident are completed. The activities on-scene turn to demobilizing and removing equipment, personnel, and response vehicles that will allow the closed portion of a roadway to reopen to normal traffic flow. Providing direction for exit strategies from a traffic incident is vital to maintain the safety of all responders, including law enforcement, EMS, mutual aid companies, tow operators, and utility companies [FHA 2020]. TIMA termination should be planned by all involved agencies on-scene, communicated to all involved responders, and termination tasks assigned. After all tasks are completed, the work area can be demobilized beginning with the termination area, or downstream of the incident, to the advance warning area, or upstream of the incident. The blocking vehicle may need to be systematically moved, or additional blocking vehicles used, to provide continuous protection while traffic control devices and other equipment are retrieved and stowed, and personnel are secured in their vehicles for release from scene. Quick clearance strategies and safe termination of an emergency work area is discussed in detail in the MUTCD and NUG for TIM. The termination plan should ensure that all responding personnel, equipment, and responders depart prior to the cessation of the blocking vehicle.

In this incident, the fire companies assessed VEH 1 and VEH 2 occupants. No injuries were reported and refusals for treatment and transport were provided, leaving the remaining activities of the traffic incident with state police for investigation. The fire department guidance provides that the law enforcement agency who has jurisdiction of the roadway maintain responsibility of traffic crashes once on scene. R-CPT notified dispatch that FC1 and FC2 were released from scene by the state troopers. The rescue crew retrieved and stowed the traffic cones on the rescue. The rescue crew remained outside of the apparatus on the shoulder of the roadway beside the rescue, except for R-CPT and R-LT who were in front of the rescue. The engine then initiated departure by pulling into the flow of traffic in the left travel lane. The rescue remained in the right travel lane behind the state police vehicle, which was alongside VEH 1, leaving the shoulder of the roadway unprotected. TPR 1 proceeded to walk to VEH 2, while TPR 2 stood on the driver side of VEH 1 gathering information from its occupants. After departing and proceeding into the flow of traffic, the engine stopped near VEH 2 to talk with TPR 1. This stoppage may have caused a pause in the flow of traffic. The engine then continued its departure and returned to service by providing radio notification to county dispatch. This notification occurred immediately before R-CPT notified dispatch of an emergency priority for a secondary strike. During the interview, R-CPT reported observing a vehicle approaching the TIMA in the right travel lane and then swerving on to the shoulder of the roadway. The vehicle entered the activity area by progressing past the rescue, striking three of the four rescue crew members standing on the shoulder before impacting the rear of VEH 1 and pushing it forward approximately 15-feet. Review of the audio tape and witness interviews indicated the secondary strike occurred after the departure of the engine and before the engine notified dispatch of their return in service.

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Recommendation #3: All emergency responders involved with incident command and fire officers should ensure ongoing risk assessments through the duration of the incident until all responders have departed the scene

Discussion: Risk management process relies on identifying hazards, assessing those hazards, implementing controls for each hazard identified, supervising the effectiveness of those controls, and monitoring for any continued or new hazards. NFPA 1500, D.1.4 defines risk controls for firefighter safety. [NFPA 2021a] When implemented, risk management aids in pre-planning by identifying hazards and developing controls that can mitigate these hazards. Known, or anticipated, hazards and hazard controls should be implemented in training and addressed in SOPs. This is described in TIM guidance through advance warning, TTC devices and blocking measures for protection of the activity area. Personal protection guidance includes training of the responders and their use of PPE equipment.

A roadway is a high-risk environment. Because it is impossible to control the actions of an approaching motorist, risk management is provided through driver education and the Move Over, Slow Down law, implementing traffic controls and blocking, and through personal protective equipment that aids in the visibility of responders on-scene. Once implemented, the risk of secondary crashes is lowered. The residual risks, after controls are implemented, should be identified through a continuous risk assessment by incident command and fire officers.

As incident command or first arriving officer, a scene size up should be completed as early as possible upon arriving on-scene. Scene size-up at a TIMA begins visually upon approach to the incident area and continues until a “lane +1” blocking is in place. “Lane +1” blocking is most commonly provided by the first arriving fire department apparatus. Once blocking is established, a more formal scene size up can safely be completed. As with any type of emergency response, the incident command and fire officers should stay alert for changing conditions and new or continued hazards. For example, prior to moving an apparatus at a TIMA, potential hazards should be assessed, and hazard controls should be identified and implemented.

In this incident, R-CPT as first arriving officer functioned as command upon arrival. Medical assessment of VEH 1 and VEH 2 occupants by FC1 members resulted in no reported injuries. R-CPT notified dispatch that there were no injuries and EMS was cancelled. Interviews support that there is common knowledge with the responding fire companies that state troopers assume incident command for traffic incidents on state roadways. There was no clear notification of the transfer of command from the R-CPT to the state trooper, however interviews report a face-to-face report and informal transition to the troopers. FC1 and FC2 were released from scene at this time. Upon being released from scene the engine departed, which caused the loss of blocking protection of the work area while responders remained on-scene.

Recommendation #4: All responders should develop comprehensive situational awareness through education, practice, and experience

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Discussion: All personnel operating at an emergency incident need to maintain situational awareness (SA) and conduct a continuous risk assessment throughout the incident. They should immediately report any unsafe or rapidly changing conditions to their immediate supervisor or the incident commander. Maintaining situational awareness must be an ongoing process as the hazards can rapidly increase and change as an incident develops. Given the large number of stressors that exist in any emergency incident response, the potential for human error is high. Human error can quickly and easily lead to flawed situational awareness, which can lead to ineffective decision making. The triad of human error, flawed situational awareness, and ineffective decision making, are common contributing factors in firefighter injuries and LODDs.

NFPA defines situation awareness as *"The perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future."* [NFPA 2021b]

Dr. Rich Gasaway explains situational awareness as *"The ability to perceive and understand what is happening in the environment around you, in relation to how time is passing, and then using your understanding of the situation to accurately predict future events in time to prevent bad outcomes."* [Gasaway 2019]

IFSTA *Essentials of Firefighting* defines situational awareness as "*a process working at three levels:*

- *Level 1: Perception – Perceive the situation around us.*
- *Level 2: Comprehension – Apply our knowledge and past experiences to our perception and develop an understanding of the meaning of the situation.*
- *Level 3: Application – Taking our understanding of the situation and applying it to the future, thereby predicting how and when the situation will change and what action is appropriate on our part."* [IFSTA 2019]

Level 1: Perception is also known as sensing. It is most often correlated in the fire service with size-up. While size-up is most often focused on visual observations, it is important to understand that effective perception should involve all five senses, hearing, taste, touch, sight, and smell. Care should be taken to utilize a sense only when it is safe to do so. Those senses should also be enhanced through the use of technology when possible. An example would be utilizing a thermal imaging camera to enhance the sense of sight. This first level in the situational awareness process must always be deliberate, accurate, and continually ongoing for success.

It is important to systematically seek out, and recognize, both positive and negative cues. Positive cues are ones that are present and can be perceived. An example of positive cues at a structure fire would include the fire and smoke conditions. Negative cues are things that could be there, however they are actually not present. While the presence of fire and smoke are a positive cue, the absence of fire and smoke could also be a negative cue. Due to human nature, in most situations the positive cues are

readily detected, however many negative cues are frequently missed. It is important to remember that both types of cues can play an equally important role in effective situational awareness.

Level 2: Comprehension is also known as understanding. It can be part of a forgone conclusion that perception will always lead to comprehension. Unfortunately, that does not always happen and there is a potential for misinterpretation to occur. In order to fully understand the critical things that we are perceiving we must have the proper knowledge, which comes from education, and an effective ability to apply that knowledge, which comes from experience. Given the broad range of incidents that we can respond to, it is critical to have a professional development program which provides a broad range of education and experience to develop effective comprehension capabilities.

If there are any doubts as to what is being comprehended, it is very important to reevaluate everything and when possible, seek the input of others. It is also important not to dismiss someone who has a different understanding of what is being perceived. Comprehending things differently can indicate that there is a misinterpretation, or that multiple understandings may exist. Having a shared understanding at the task, tactical, and strategic levels is critical for success at every emergency incident.

Level 3: Application is also known as predicting or forecasting. It is the final critical level that is only as successful as the outcomes from the first two levels. Given the fireground is a constantly changing and evolving place, plans must not only be based on what is currently taking place, but also based on what will happen in the immediate future. Failures frequently occur when the actions of personnel fail to keep pace with the speed at which the incident is developing.

The ability to forecast future events also relies heavily on having the appropriate knowledge and ability for a particular type of incident. It is critical to recognize when someone lacks the necessary knowledge or ability for a given situation as it can negatively impact their forecasting ability and accuracy. In those situations, it is important to use a contingency plan such as seeking input from someone who has more extensive education and experience for that particular type of incident. Effectively utilizing forecasting can allow decisions and actions to take place proactively, which increases the overall chances for success. Failing to do so and responding reactively instead increases the chances for failure [Gasaway 2013, 2017, 2019, 2022].

The following barriers most frequently have a negative impact on situational awareness because they interfere with a firefighter's ability to perceive, comprehend, and forecast:

- Need to Act – when firefighters arrive at an emergency incident, they are there to take immediate lifesaving actions and they must do so under time constraints. This can drive them to act very quickly before they have time to develop effective situational awareness.
- Stress – both the physical and mental stressors encountered in emergency response can negatively impact the cognitive abilities to sense, comprehend, and forecast.
- Sensory Conflict – there can be situations where the multiple cues that are being gathered from various senses are in conflict with each other, which can lead to issues with comprehension.

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- Ineffective Communications – developing shared situational awareness at an emergency incident requires effective communications among everyone. Even with significant advances in communication capabilities, there are still numerous failures that occur with both technology and human factors.
- Time Distortion – personnel operating at emergency incidents can experience time distortion with it seeming to slow down or speed up. This time distortion can make accurate forecasting very challenging.
- Distraction – given everything that can take place on at emergency incident it can be very challenging to stay properly focused long enough to conduct effective sensing and comprehension of critical cues. There is a fine line that must be balanced between considering too many different things to the point of becoming distracted or just considering a single thing and becoming too focused.
- Fixation – when attempting to accomplish a challenging task, or to address a life-threatening hazard, personnel can overfocus to the point of developing tunnel vision. When this occurs, other critical cues can be easily missed, and the process of forecasting can stop.
- Overload – without proper staffing levels, personnel can be forced to try and carry out multiple assignments simultaneously. This taxes cognitive capabilities to a point where a breakdown will occur in the three levels of situational awareness.
- Complacency – responding to similar incidents, with positive outcomes, can lead to a false sense of confidence. On similar incidents this can lead to assumptions or apathy. This results in failures to attempt to detect critical cues, ensure there is an understanding of what is actually taking place, and making assumptions rather than accurate fact-based predictions.
- Improper Procedure – comprehension and forecasting are routinely based on an understanding that certain procedures are being followed. When there is deviation from those procedures, without justification and communication, then comprehension and forecasting can fail when they are based on anticipated actions that are not occurring [Gasaway 2013, 2017, 2019, 2022].

Key factors to the development and utilization of effective situational awareness are:

- Providing comprehensive professional development that provides both education and experience that addresses all three situational awareness levels.
- Encouraging all personnel to work through the three situational awareness levels, as the situation timeline dictates, prior to taking any immediate high-risk actions.
- Ensuring that all personnel operating take periodic brief pauses to intentionally work through all three situational awareness levels.
- Employing all available human techniques such as controlled breathing, and all available operational techniques such as workload management, to control stress levels.
- Utilizing technology, procedures, and techniques to ensure effective communications with all personnel. Also utilize closed loop communications to ensure that all messages are being received and understood.

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- Ensuring multiple personnel within the incident management system at the task, tactical, and strategic level are monitoring for deviations from assignments or failures in executing assignments.
- Continually evaluating the development of the incident for any unexpected changes that do not fit the forecasted conditions or outcomes [Gasaway 2013, 2017, 2019, 2022] and [IFSTA 2019].

While there is a significant reliance at most incidents on the Incident Commander and the Incident Safety Officer to maintain and drive situational awareness, it is critical that everyone maintains situational awareness at their respective levels and within their areas of operation.

All personnel must maintain their situational awareness by constantly working through the three levels of sensing, comprehending, and predicting, until the incident is over. The greatest chances for success come when the greatest number of personnel utilize effective situational awareness, effectively communicate their findings with key personnel, and there is shared situational awareness at all levels of the incident. It is critical to remember that effective situational awareness is the foundation for successful decision making.

Recommendation #5: A multidisciplinary approach for traffic incident management training should be required and provided to all potential responders for roadway incidents

Discussion: NUG for TIM states that all personnel responding to traffic incidents shall be trained on traffic incident management. NFPA 1500 provides that traffic incident management training is required of all personnel responding to traffic incidents. Standard firefighter training provides theory and practice on response for traffic incidents based on expected duties at traffic incidents and experience in managing a TIMA. [NFPA2021a] Contents of locally developed traffic incident training is the responsibility of the authority having jurisdiction (AHJ) and should meet the minimum requirements of NUG for TIM. NFPA 1091 offers job performance requirements to meet levels of responsibility at traffic incidents. [NFPA 2019] These performance requirements can be used by the AHJ to ensure training programs are developed and meet the expectations for TIM and that training is specific for the coverage area. The state fire academy offers Traffic Incident Personnel certification after a firefighter completes a combination of training, which includes hazardous materials, incident command, and a highway incident/traffic management course. Pennsylvania Traffic Incident Management Enhancement supports state-wide TIM training for highway agencies and emergency responders, as well as developing unified incident command training. The Federal Highway Administration recommends training through the Responder Safety Network. This free online resource offers three progressive traffic incident training certifications: *National TIM Training*, *Innovative Responder Safety Strategies*, and *Roadway Incident Response Safety Leadership*. Training is also available for fire police, or others, responsible for directing traffic at any incident scene through Responder Safety Network and required in NFPA 1901. [NFPA 2016]

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NFPA 1091, *Standard for Traffic Incident Management Personnel Professional Qualifications*, provides professional qualification standards that are written as job performance requirements (JPRs). JPRs describe the performance required for a specific job and are grouped according to the duties of the job. [NFPA 2019a] NFPA 1001, *Standard for Fire Fighter Professional Qualifications*, 4.3.3 and A.4.3.3, addresses requisite knowledge and requisite skills related to working at emergency scenes [NFPA 2019b] All NFPA professional qualifications standards contain an appendix "B" that addresses how JPRs are to be developed and used for instructional purposes.

JPRs state behaviors required to perform specific skills on the job and the desired outcome of any training. These behaviors should be converted into instructional objectives with behaviors, conditions, and degrees to be measured within the educational environment. Instructional objectives are used to identify and measure what recruits must do at the end of the training session. By converting JPRs into instructional objectives, instructors can clarify performance expectations and avoid confusion caused by the use of statements designed for purposes other than teaching [NFPA 2019b, NFPA 2019c].

Training institutions, AHJ, and individual fire service instructors can use NFPA JPRs in their instruction and evaluation development. No matter the length of the session, every training task leading up to evaluation of a JPR should be designed by instructional objectives and clearly understood by instructors and recruits.

The volunteer fire companies involved in this incident did not require traffic incident management training as part of their organizational risk management plan. The fire department which oversees career personnel assigned to the volunteer fire companies did not require traffic incident management training of its career personnel.

Since this incident, the fire department has put into effect the following SOPs:

- SOP for minimum qualifications of all officers and firefighters will include training in department-provided traffic incident management;
- SOP for limited access and accessible highway response designates the purpose of the SOP and the roles and responsibilities of potential emergency responders. These include the following branches of response: emergency medical services, fire, police, DOT, towing and recovery, and local municipalities. This SOP can be further improved through the development of a TIM committee with representation of each branch involved. This will support multi-disciplined response and unified command training opportunities; and
- SOP diagrams for blocking procedures for various roadway incident scenarios.

Recommendation #6: Develop fire department-wide TIM policies, trainings, and SOPs that are further expanded by each fire company based on specific community needs

Discussion: Developing, communicating, and training on mutual aid policies and procedures with other agencies and emergency responders promotes a coordinated delivery of TIM. Policies should identify

responsibilities of each agency and SOPs should identify the manner of implementing the responsibilities. The SOPs should be modular so that a variety of common incident types may be addressed and cover increasing or decreasing scopes of traffic incident needs. Advanced planning for multi-agency response can be effectively done by a task force that includes representatives of the disciplines involved in TIM. Plans should be developed for each type of roadway or for roadways with known frequency of incidents. Historical information of traffic incident locations, severity, and resources used should be considered in the development of TIM policies and planning for the coordination of responding agencies. Policies should address incident types, management activities, roles and responsibilities, and opportunities for improvement. Policies should also identify training needs to meet the roles and responsibilities of each discipline [FHA 2009].

Once policies are written, the SOPs should be developed and trained on in collaboration with other response agencies. The SOPs should be written clearly and concisely with a logical and consistent format and should be a living document that is reviewed regularly and after each incident. The SOPs should describe situations in the scope of the SOP, set broad procedural guidelines for operations, and identify automatic/mutual aid agencies.

TIM agreements should take into consideration response times of automatic and mutual aid responders, the training and experience of the responders, types of roadways, roadway access and egress, typical use of the roadways and historical and potential severity of incidents that may occur so that additional resources can be anticipated and planned for in the development of the agreements. Agreements should also ensure that apparatus and equipment identified in aid agreements meet current standards and guidelines. Development of these agreements should be a group effort with representatives from each involved fire company and each discipline that is anticipated to be involved in a roadway incident. Regular review of the agreements will allow for continued improvement and more effective response to changes in roadway development and use, identification of detour routes and options to maintain traffic flow, and identification of equipment, apparatus, and staffing needs to address commercial and personal transportation types of traffic incidents.

Establishing an effective plan for response to roadway incidents is best addressed through a TIM committee involving all disciplines involved in roadway safety which facilitates collaboration and coordination. The Delaware Valley Regional Planning Commission (DVRPC) has an established interstate compact between Pennsylvania and New Jersey, which includes transportation systems management and operations office which oversees operational improvements and system-wide approach to addressing traffic-related concerns. DVRPC has a developed traffic incident management program involving the Greater Philadelphia area. The task force facilitates emergency responder coordination, development of policy and SOPs, roadway engineering design adjuncts, and training programs to assist emergency responders. Traffic Incident Management in the DVRPC Region | DVRPC.

The state defines a volunteer fire company as “a nonprofit chartered corporation, association or organization located in this Commonwealth which provides fire protection or rescue services, and

which may offer other voluntary emergency services…" [Title 35 2020]. Volunteer companies, either chartered or incorporated, are governed by a board of directors or trustees, and should have by-laws which define membership requirements and duties, officer requirements and duties, and describe equipment, apparatus, and training needs to conduct business. Volunteer fire companies should have SOPs to ensure response capabilities in accordance with NFPA 1720, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments*. SOPs should extend to automatic aid and mutual aid organizations and training should be conducted for all involved. [NFPA 2020]

NFPA 1720 defines automatic aid as "a plan developed between two or more fire departments for immediate joint response on first alarms" and mutual aid as "reciprocal assistance by emergency services under a written plan among AHJs that is part of a communication center's dispatch protocol." [NFPA 2020] Automatic aid and mutual aid should reflect the geographics and demographics of the community served. These agreements should be developed and regularly updated to continuously provide service to the community while addressing the geographic and demographic growth in the community served.

Pertaining to this incident, the roadway carries heavy commercial travel along with heavy passenger vehicle travel due to access to a major city. Interviews reported that this stretch of roadway has a frequent history of traffic crashes. The state DOT has a mutual aid agreement with emergency response agencies which provides that state troopers assume incident command upon their arrival, with exception of fire, medical or hazardous material emergencies, for which a unified command would be provided. To ensure safety of all responders involved, fully developed agreements for this roadway should reflect the need of service based on geographic and demographic conditions that exist and specify intercommunity organization for automatic/mutual aid within the township. It should also identify responding agencies for each traffic incident class and direction of roadway travel involved, roles of each responding agency, traffic controls and pre-identified detour routes, additional resources available, and training that addresses all disciplines for traffic incident response.

The township code Article I Fire Administration identifies seven fire companies that are members of the township fire department. The fire department is made up of the Chief Fire Officer (CFO) and a Deputy CFO. The responsibilities of the CFO include, responding to and assuming command at all alarms and fires when two fire companies have responded, and conditions make it necessary for protection of life and property or for an emergency of a serious nature. Otherwise, incident command is assumed by the fire company fire chief of that jurisdiction. The fire chiefs are responsible for training their members under the direction of the CFO and adhering to uniform fire department procedures. The fire department has written SOPs to provide township-wide guidance for ensuring response in accordance with NFPA 1720. [NFPA 2020] The fire department SOPs should be included in the development of fire company SOPs to provide uniformity among all township fire companies. At the time of the incident, the fire department SOP and the fire company SOP did not address a multi-

agency approach to provide TIM in accordance with NFPA 1500, *Standard on Fire Department Occupational Safety, Health, and Wellness Program*, Chapter 9. [NFPA 2021a]

In this incident, FC1 had a fire company SOP for response to the involved stretch of roadway. The SOP identified the rescue as first due for all traffic incidents along this portion of the roadway and the advance warning location for the squad response was dependent on the location of the traffic incident on the roadway. The SOP provided that the first arriving unit was to implement "lane +1" blocking, additional arriving apparatus were to continue blocking measures upstream of the incident, and that all operating firefighters were to use high-visibility vests. It was common knowledge that FC2 is assigned as automatic aid for traffic incidents on this roadway, however, the fire company SOP did not address the role of automatic aid response.

The fire department's *Roadway Safety Operations* SOP (dated December 2008) provides direction that law enforcement are responsible for the traffic incidents within their jurisdiction. The first arriving apparatus shall provide physical protection of the work area implementing a "block to the left/right" and "lane +1" standard. Additional emergency vehicles arriving on scene shall be parked off of the roadway or released back to service whenever possible, and that all responders, unless involved in fire operations, are to wear high-visibility safety vests.

Specific actions should be included in policies, agreements, and SOPs that safely mitigate specific situations. For example, this incident began with fire, EMS, and police response. Once on-scene, this incident was determined to be a minor class incident with primary command by the first arriving fire officer and blocking provided by the second arriving fire apparatus. Interagency understanding for emergency response on this roadway identifies that a state trooper serves as incident command upon arrival to the scene. State troopers arrived on-scene after deployment of traffic control devices and implementation of blocking procedures by the fire companies. Ineffective policies and procedures provided the release of the fire companies prior to all emergency responders safely departing the scene after a TIMA had been established. Release of the fire companies allowed termination of the TIMA and increased risk of secondary incidents involving the remaining responders.

At the time of this incident, there were no discussions in fire department or fire company policies, agreements, or SOPs for procedures in downgrading of an incident once a TIMA is established that provides continued protection for state troopers. Policies, agreements, and SOPs should ensure that TCDs and blocking remain in place until all responders, including state troopers, have departed the incident. [FHA 2009]

Since this incident, the fire department and fire companies have implemented a memorandum of understanding (MOU). This MOU details terms and conditions in performing fire services within the township, and incorporation of a strategic plan. The MOU is one of eleven planning elements identified in the strategic plan, which will be implemented over a 5-year period. Included with the MOU is an organizational command chart based on the strategic plan.

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Career Firefighter Dies and Three Others Injured in a Struck-By Incident while On-Scene at a Roadway Crash – Pennsylvania

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NTIMC [2007]: National Unified Goal for traffic Incident Management - Detailed Explanation, Washington, DC, National Traffic Incident Management Coalition

PA Act 105 [2020], Title 75 - PA General Assembly, Section 3327 – Duty of Driver in Emergency Response Areas and in Relation to Disabled Vehicles, 2020 Amendment

PSFA [2021]: Pennsylvania State Fire Academy Firefighter I Skills Stations, Pennsylvania State Fire Academy

Title 35 [2020]: Health and Safety - Omnibus Amendments, PA Consolidated Statute 35, Act 91, Health and Safety, Pennsylvania General Assembly

USFA [2012]: FA-330, Traffic Incident Management Systems, U.S. Fire Administration – Federal Emergency Management Administration, fa_330.pdf (fema.gov)

Investigator Information

This incident was investigated by Tammy Schaeffer, Murrey Loflin, and Michael Richardson, Safety and Occupational Health Specialists with the Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH located in Morgantown, WV. An expert technical review was provided by Jack Sullivan, JCS Tech Services. A technical review was also provided by the National Fire Protection Association, Emergency Response and Responder Safety Division.

Disclaimer

The information in this report is based upon dispatch records, audio recordings, witness statements, and other information that was made available to the National Institute for Occupational Safety and Health (NIOSH). Information gathered from witnesses may be affected by recall bias. The facts, contributing factors, and recommendations contained in this report are based on the totality of the information gathered during the investigation process. This report was prepared after the event occurred, includes information from appropriate subject matter experts, and is not intended to place blame on those involved in the incident. Mention of any company or product does not constitute endorsement by NIOSH, Centers for Disease Control and Prevention (CDC). In addition, citations to websites external to NIOSH do not constitute NIOSH endorsement of the sponsoring organizations or their programs or products. Furthermore, NIOSH is not responsible for the content of these websites. All web addresses referenced in this document were accessible as of the publication date.

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Appendix 1
Incident Timeline

Sections within the timeline where "Time not available" is shown indicates the order of events provided through witness interviews. All times are estimated based on audio recordings, CAD, and witness interviews.

Dispatch and Communications	Time	On-scene Activities
County dispatch activates alarms for FC1, FC2 and two EMS units	03:04	Caller reports that the other vehicle attempts to leave the scene but then stops
FC1, FC2, and EMS acknowledges the call and are enroute	03:07	FC1 has direct access to the westbound lanes FC2 must access the roadway eastbound to a predetermined crossover to the westbound lanes
FC1 on-scene and positions in the right travel lane near VEH 1	03:12	FC1 notifies dispatch of two vehicles on the westbound shoulder separated by approximately 100-feet. All occupants are out of vehicle
FC2, heading eastbound, passes the westbound crash	Time not available	FC1 crew deploys five traffic cones to divert traffic towards the left travel lane. Crew members then proceed to evaluate occupants for injuries.
FC2 arrives on-scene	03:16	FC2 positions behind the deployed cones blocking the shoulder and right travel lane
State troopers arrive on-scene	03:17	FC1 crew provide a no injury report to R-CPT. R-CPT provides an update to troopers and notifies dispatch to recall EMS
FC1 And FC2 are verbally released from scene	Time not available	R-CPT directs crew to stow traffic cones FC2 readies to depart scene

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Dispatch and Communications	Time	On-scene Activities
R-CPT notifies FC2 of release face-to-face	Time not available	FC1 crew stows cones and are talking while standing on the shoulder lane. FC2 departs scene by merging into left travel lane and then stops near VEH 2 to briefly talk with TPR 1
R-CPT yells out to FC1 crew to "RUN"	Time not available	A vehicle was observed approaching the scene in the right travel lane and the moving onto the shoulder passing the rescue and striking three firefighter and VEH 1. TPR 2 sustained a secondary strike during this event.
E-AC notifies dispatch of return in service. R-CPT notifies dispatch of "emergency priority and requests "at least 5 EMS units" E-AC notifies dispatch of return to scene to assist FC1	03:23	Remaining FC1 crew and TPR 1 identify locations and initiate triage of R-CFF, R-FF1, R-FF2, and TPR 2 Engine returns by going in reverse on the westbound lanes approximately one-tenth of a mile
Dispatch alarms to multiple fire, EMS, medevac, and police for assistance in emergency care and transport, landing zone set up and transport, road closure/traffic control	03:25	Remaining crew members from FC1, TPR 1, and FC2 crew members continue emergency care and treatment: R-CFF – CPR R-FF1 – head and extremity trauma R-FF2 – head trauma TPR 2 – extremity trauma
EMS enroute	03:31	Unknown EMS arrival on-scene
EMS request medevac x2	03:35	Medevac enroute and on-scene at unknown time

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Dispatch and Communications	Time	On-scene Activities
Transport and disposition	03:50	R-FF1: Transported by medevac, evaluated and admitted for continued care
	03:51	R-CFF: CPR continued during ambulance transport to hospital. Later pronounced deceased
	03:52	R-FF2: Transported by medevac, evaluated and admitted for continued care
	03:52	TPR 2: Transported by ambulance, evaluated and discharged for continued care and treatment as outpatient