A Guide for Work Zone Crash Data Collection, Reporting, and Analysis
FHWA Contract No. DTFH61-13-RA-00019

Submitted:
United States Department of Transportation
Federal Highway Administration
HSA Room #E71-324
1200 New Jersey Ave. SE
Washington, DC 20590

Contractor:
Wayne State University
Transportation Research Group
Civil & Environmental Engineering
5050 Anthony Wayne Drive
Engineering Development Center, Room #0504
Detroit, MI 48202

Subcontractor:
University of Missouri
Civil & Environmental Engineering
3502 Lafferre Hall
Columbia, MO 65211

Date:
October 30, 2015

The opinions, findings, and conclusions expressed in this publication are those of the contractor(s) and not necessarily those of the U.S. Department of Transportation or the Federal Highway Administration. This report was prepared in cooperation with the U.S. Department of Transportation and the Federal Highway Administration.
Table of Contents

1.0 BACKGROUND ..................................................................................................................... 1
2.0 WORK ZONE FATAL CRASH/FATALITY TREND IN THE USA ................................. 2
3.0 WORK ZONE CRASH DATA COLLECTION AND REPORTING ............................. 3
4.0 BEST PRACTICES - WORK ZONE CRASH DATA COLLECTION .............................11
5.0 CRASH DATA REPORTING ...............................................................................................14
6.0 CHALLENGES TO IMPLEMENTING UNIFORM WORK ZONE CRASH DATA ELEMENTS..........................................................16
7.0 WORK ZONE CRASH DATA ANALYSIS ....................................................................17
8.0 DATA ANALYSIS TOOLS ............................................................................................20
9.0 ADDITIONAL RESOURCES .........................................................................................21
10.0 REFERENCES ................................................................................................................22

APPENDIX I – SUMMARY OF WORK ZONE FATALITIES AND FATAL CRASHES (2004 THROUGH 2013) .................................................................23

APPENDIX II – STATES’ CRASH REPORT FORM - WORK ZONE RELATED FIELDS ...33

APPENDIX III – STATES’ CRASH REPORT FORM - WORK ZONE RELATED ATTRIBUTES .........................................................................................................35

List of Figures

Figure 1. Crash Data Collection and Reporting Process...................................................... 4
Figure 2. Component Parts of a Temporary Traffic Control Zone (6C-1) ........................... 7
Figure 3. States Using TraCS ..............................................................................................16

List of Tables

Table 1. Temporary Traffic Control Strategies .....................................................................12
1.0 BACKGROUND

The availability of accurate work zone crash data is important for the identification and analysis of work zone crash trends, to determine the potential causes of work zone crashes, to develop countermeasures and strategies, and to assist in the development of crash modification factors (CMFs). Unfortunately, work zone crash data suffers from inconsistencies and limitations, due to the variation in work zone related data elements that are generally captured by state DOTs and other agencies. Developing a unified system of work zone crash data collection and reporting, would result in more accurate crash data, efficiency in crash reporting, and greater uniformity across states.

The Model Minimum Uniform Crash Criteria (MMUCC) Guideline (1) recommends the voluntary implementation of a “minimum set” of standardized data elements that can be used to describe a motor vehicle crash on any state crash report form. The goal of this guideline was to address uniformity in all areas of crash data collection and reporting, to generate data that can be used to promote comparability and improve safety at the national, state, and local levels.

The MMUCC Guideline (1) recommends states include the details of five general work zone related attributes and they are:

1. Was the crash in a construction, maintenance, or utility work zone, or was it related to activity within a work zone?
2. Location of the crash,
3. Type of work zone,
4. Workers present, and
5. Law enforcement present.

Additional motor vehicle related attributes associated with the vehicle and “contributing circumstances” data elements further add information about how the work zone impacted the crash.
There is a wide variance among the 50 states regarding the types of work zone crash data that are collected. Eight states (Connecticut, Florida, Iowa, Maine, New Hampshire, Ohio, Pennsylvania, and Virginia) include all of the five work zone related attributes associated with the crash data elements as recommended by the MMUCC Guideline (I). Twenty-four states include only one attribute (work zone crash yes or no) or no attributes. The states of Pennsylvania and Iowa even include an additional work zone attribute that is not included in the MMUCC Guideline, “Work Zone Activity,” indicating whether the crash occurred during a construction, maintenance, or utility activity.

2.0 WORK ZONE FATAL CRASH/FATALITY TREND IN THE USA

The nature and accuracy of crash data collection may vary among the states; however, fatal crashes in all states are recorded by following the data elements required for the Fatality Analysis Reporting System (FARS). A historical analysis of data from the past decade indicates that fatal crashes in work zones were reduced from 931 in 2004 to 527 in 2013 (43% reduction), whereas work zone fatalities were reduced from 1,063 to 579 (45% reduction) over this same period. In contrast, worker fatalities in highway work zones have remained virtually stable with 110 in 2003 and 105 in 2013; however, it was noted that the years 2005 (169), 2006 (139), and 2012 (133) experienced much higher worker fatalities.

Such changes in fatal crashes/fatalities can be objectively evaluated within the context of the “Toward Zero Deaths (TZD)” goal, which many states have adopted. To quantify short-term progress TZD, it is important that appropriate exposure data is available. This has been a continuing concern in the safety community, as many states do not maintain detailed volume counts during the periods when work zones are in place. In the absence of individual work zone-based exposure data, total vehicle miles traveled (VMT) and annual average daily traffic (AADT) can be considered as a surrogate measure.

It also should be noted that approximately 59% of fatal work zone crashes result from single-vehicle collisions, while 20% result from rear-end crashes (Appendix I). Past studies have indicated that queuing at a work zone causes potential problems. It is important, however, to note that many work zone fatal crashes are associated with higher than safe speeds for the situation and condition. If work zone congestion is related to queue build up, and is not visible to approaching traffic, such a situation may not have sufficient or appropriate advance warning devices. A summary of the above noted fatal crash analysis is included in Appendix I.
3.0 WORK ZONE CRASH DATA COLLECTION AND REPORTING

Crash data are collected by local, county and state law enforcement agencies and/or statewide highway patrol, as appropriate in each state. All police officers are trained to collect highway crash data on their designated crash report forms. Changing or adding data elements on the crash report form requires consultation with law enforcement, road agencies, and others that utilize crash data directly or indirectly. Almost all states have some type of user group that initiate and monitor all activities related to any changes or additions to the existing crash report forms.

3.1 Crash Data Collection and Reporting Process

Traffic crash data collection and reporting involves many individuals and agencies that work to make the system successful. A macroscopic functional flow diagram is shown in Figure 1. The diagram exhibits various activities that are encountered by the first responder during field data collection, and as a part of the crash report review, and in preparing digital data. A traffic crash incident on the highway system is generally reported by:

- Passer-by/public
- Involved driver/passenger
- Transportation agencies by video surveillance
- Police officers on routine patrol.

Notification of the crash is then directed towards the first responder, who assesses the severity of the situation and calls the local/regional/state Police Department and EMS, as appropriate. Generally, police officer(s) arriving at a crash site may call for EMS and sometimes the local Fire Department, if the situation demands.

All state and local agencies are trained to appropriately deal with calls regarding crashes on the highway system. Public safety agencies are trained to secure the site, clear the crash site, remove the crash vehicle, as necessary, and restore traffic operations to normal. Crashes involving severe injury and fatality require very detailed crash data collection and reporting, that often includes, field measurements of the location of skid marks (if available), vehicle damage details, location of first harmful event, intermediate event (if any) and final event, crash scene photographs, and other data that are pertinent to the investigation.
Figure 1. Crash Data Collection and Reporting Process
Technology exists for collecting real-time online crash data, and several states use such digital forms; however, it is unclear if such unified forms are directly used by the first responder at a crash scene, or are entered during the crash report review process. A typical crash report form requires a multitude of data elements that need to be collected/acquired and entered. Work zone related data elements are few and should not be a major concern to include in the upgrading process of each state’s crash report forms. MMUCC Guideline (1) discusses all crash data, and therefore, the discussion of work zone related data collection is limited to what needs to be included. This guideline includes background information related to historical crash/fatality data that should be considered in developing work zone related crash data elements in future modifications of crash report forms. These elements complement the existing work zone related elements recommended by MMUCC and provide a means to collect data necessary for better addressing work zone safety.

3.2 Work Zone Related Crash Data Element

The MMUCC Guideline (1) includes one work zone related crash data element that should be included on the Police Accident Report (PAR) and collected at the scene of the crash. The MMUCC Guideline’s rationale for including PAR is as follows:

“Important to assess the impact on traffic safety of various types of on-highway work activity, to evaluate Traffic Control Plans used at work zones, and to make adjustments to Traffic Control Plans for the safety of workers and the traveling public. This data element needs to be collected at the scene because work zones are temporary or moving operations that are not recorded in the permanent road inventory files.”

The work zone related crash data element, “C19. Work Zone-Related (Construction/ Maintenance/Utility),” noted in the MMUCC Guideline (1) is detailed in the following five attributes to further clarify the work zone related crash:

- **Subfield 1:** Was the crash in a construction, maintenance, or utility work zone or was it related to activity within a work zone?
- **Subfield 2:** Location of the Crash
- **Subfield 3:** Type of Work Zone
- **Subfield 4:** Workers Present
- **Subfield 5:** Law Enforcement Present
**Subfield 1: Was the crash in a construction, maintenance, or utility work zone or was it related to activity within a work zone?**

To determine if the crash is considered a work zone related crash, the MMUCC Guideline (1) defines a work zone related crash as:

“A crash that occurs in or related to a construction, maintenance, or utility work zone, whether or not workers were actually present at the time of the crash. “Work zone-related” crashes may also include those involving motor vehicles slowed or stopped because of the work zone, even if the first harmful event occurred before the first warning sign.”

If the crash is considered to be a work zone related crash, the officer should indicate “Yes” on the crash report form and move on to the remaining subfields. If the crash is not considered to be a work zone related crash, the officer should indicate “No” and no further action is required for this section. If it is unknown whether or not the crash is work zone related, the officer should indicate “Unknown” on the crash report form and fill out the remaining subfields.

**Subfield 2: Location of Crash**

Once it is determined that the crash is work zone related, it is important to indicate the location of the crash. The MMUCC Guideline (1) defines the location of the crash into the following five different areas which are graphically presented in Figure 2 [Manual on Uniform Traffic Control Devices (MUTCD) (2)]:

- **Before the First Work Zone Warning Sign:** Any crash that occurs ahead of the first advance warning sign, but the location of the crash is in such close proximity that the crash occurrence may be directly or indirectly related to the work zone.

- **Advance Warning Area:** The area between the first advance warning sign and the start of the transition area.
Figure 2. Component Parts of a Temporary Traffic Control Zone (6C-1)
• **Transition Area:** The roadway space that accommodates the tapers. This area moves the traffic out of the normal path of travel.

• **Activity Area:** This includes the work space and the longitudinal buffer.

• **Termination Area:** This includes the longitudinal buffer, downstream taper and the space up to the end road construction and sign.

**Subfield 3: Type of Work Zone**

Once the crash location within the work zone is found, it is important to determine the type of work zone. The MMUCC Guideline (1) specifies the work zone type into the following four categories along with an “Other” category if the work zone type is unique:

- Lane Closure
- Lane Shift/Crossover
- Work on Shoulder or Median
- Intermittent or Moving Work
- Other

A **lane closure** is when the number of lanes are reduced and the flow of traffic needs to be merged into another lane of travel.

A **lane shift/crossover** is when a lane of travel is shifted to another lane or travel way without requiring any lanes of closure. Typical TTC devices indicating a lane shift/crossover would include a shifting taper and/or a “STAY IN LANE” sign. It is important to note that arrow boards are not to be used to indicate a lane shift/crossover and should only be used to indicate a lane closure. If the type of crash fits this parameter, the officer at the crash scene indicates “Lane/Shift/Crossover” on the crash report form.

**Work on a shoulder or median** occurs when there is encroachment from the activity area onto the shoulder or median of the roadway. Typical TTC devices indicating work on a shoulder or
median would include a shoulder taper, a “SHOULDER WORK” sign, and/or “ROAD WORK AHEAD” sign.

**Intermittent or moving work** is when the work area is continuously or intermittently moving. Such work may include roadway striping, street sweeping, mowing, joint sealing, pothole filling, pavement marking installation/ removal, or cleaning activities (e.g., debris removal, storm drain cleaning, etc.). Typical TTC devices indicating intermittent or moving work would include a convoy of multiple vehicles (e.g., work vehicles, shadow vehicles, etc.), truck mounted arrow boards, and portable changeable message signs.

**Other** option can be selected if the type of work zone does not fit any of the parameters for lane closure, lane shift/crossover, work on shoulder or median, or intermittent or moving work. In such cases, the officer should indicate “Other” on the crash report form.

**Subfield 4: Workers Present**

It is important to indicate whether or not workers were present in the TTC zone at the time of the crash. Anecdotal evidence suggests that drivers react differently to work zones depending upon whether work activities are ongoing. It is important to note that workers do not need to be present, in order for the crash to be considered a work zone related crash. If the crash occurred when no workers were present, the officer at the crash scene indicates “No” on the crash report form. If there is a scenario where the officer is unsure whether or not workers were present, the “Unknown” option can be selected.

**Subfield 5: Law Enforcement Present**

The presence of law enforcement in the work zone helps to prevent speeding or errant vehicles from entering the activity area. The presence of law enforcement may deter vehicles from driving recklessly through the work zone; however, it is not required for a work zone, so their presence may vary from work zone to work zone.
3.3 Work Zone Related Attributes Associated with Crash Data Element

The MMUCC Guideline (1) includes work zone related attributes for crash data elements to further clarify whether or not the work zone influenced the crash. The work zone attribute, “Work Zone/Maintenance Equipment,” should be indicated by the officer under the crash data element of “C7. First Harmful Event” if any work zone or maintenance equipment is the first injury or damage-producing event that characterizes the crash type. The work zone attribute, “Work Zone (construction/maintenance/utility),” is indicated in the MMUCC Guideline.

3.4 Justifications for Inclusion of the Work Zone Crash Data Elements

Identifying work zone crashes, injuries and fatalities is essential to develop programs and initiatives that are targeted to improve safety and mobility in construction and maintenance work zones. Highway and permanent traffic control designs generally follow AASHTO and MUTCD standards, whereas, in temporary traffic control, proper strategies may not be in place due to a variety of factors, including:

- Lack of site-specific considerations in work zone design process.
- Deficiency in field inspection.
- Lack of night time inspection and deterioration of retro-reflective performance of the traffic control device used in the temporary traffic control.

The national database, such as FARS, requires specific identification of work zone crashes.

Identifying the type of work zone such as construction, maintenance and utility work zone is helpful in developing future countermeasures that can alleviate similar work zones. The location of work zone crashes is most important in:

- Providing/increasing buffer spaces,
- Creating safety protection for workers in case an errant vehicle intrudes into the work area.
- Developing countermeasures related to increasing visibility, reducing approach speed, and other measures, not only for future work zone traffic control of similar situations, but also to implement additional traffic control treatments in the same work zones if they happen to be in intermediate term or long term projects. For example:
If a crash occurs in the taper area that is indicative of an excessive approach speed, various measures such as, increasing taper length, reducing drum/cone spacing to increase work zone visibility may be implemented. 

- Crashes associated with a high approach speed may be treated with removable rumble strips.

Crashes occurring in the work zone approach area may require a human factor-related analysis to identify various causal factors such as, information system deficiency, information overload, and others that may require additional positive guidance treatments through the work zone.

Availability of location data for work zone crashes allows safety analysts/engineers to identify potential issues/factors that may have contributed towards a specific crash. Identifying such potential factors may also assist in selecting countermeasures that will alleviate similar occurrences. For example, the following table (Table 1) shows some typical work zone crash types, probable issues, and possible countermeasures. The table shown is just an example, all state agencies should study work zone crashes and develop similar data to allow construction engineers/managers to identify and implement countermeasures in the field to alleviate the possibility of similar crashes occurring again, especially for intermediate term and long term construction projects.

### 4.0 BEST PRACTICES - WORK ZONE CRASH DATA COLLECTION

Each of the 50 states, as well as the District of Columbia, have their own crash report form along with supplemental reports, that an officer has to fill out when a crash occurs. Every state crash report form along with applicable supplemental reports can be found by accessing: [http://workzone.eng.wayne.edu/crash_report/report.html](http://workzone.eng.wayne.edu/crash_report/report.html) (3). The state crash report forms are organized in alphabetical order, indicating the report number and last revision date.

The MMUCC Guideline (1) provides guidance on what work zone attributes should be included on each state’s crash report form, but there is still a wide variance on what work zone crash report data that is being collected among the 50 states. Some states follow the MMUCC Guideline and include all of the work zone related attributes associated with the crash data element, while some do not include any. A summary table of all of the state crash report work zone related fields can be found in Appendix II.
<table>
<thead>
<tr>
<th>CRASH TYPE</th>
<th>POTENTIAL ISSUE</th>
<th>OBJECTIVE</th>
<th>WORK ZONE MODIFICATION</th>
</tr>
</thead>
</table>
| Single Motor Vehicle | Improper Use of Channelizing Devices | Mitigate Errant Vehicles | Decrease Channelizing Device Spacing  
Increase Buffer Zone  
Add Temporary Traffic Barriers and/or Crash Attenuators as Appropriate  
Add Barricades, Warning Lights, and/or Delineators  
Various Intelligent Transportation Systems (ITS) Deployment |
| Rear-End | Sudden Queuing | Increase Braking Distance | Increase Distance of Advance Warning Signs. Consider Adding Beyond the Minimum Traffic Control Device |
| | Speeding | Promote Alert Driving | Decrease Work Zone Speed Limit  
Add Law Enforcement  
Add Portable Rumble Strips  
Various ITS Deployment |
| Angle | Sight Distance Issue at Access Points (e.g., Driveways) | Increase Line of Sight | Provide Flagger  
Provide Alternate Access and Temporarily Close Driveway  
Restrict Left-Turning Movements Out of Driveway |
| Head-On Left-Turn | Improper Signal Timing | Create Greater Temporal Separation of Conflicting Traffic | Provide Protected Left-Turns (e.g., Split Phasing) |
| Head-On; Sideswipe-Opposite | Improper Lane Delineation (e.g., Lane Shift) | Improve Adherence to Lane Lines | Increase Lane Width  
Add Temporary Raised Pavement Markers and/or Islands  
Add Temporary Pavement Markings (i.e., Override Permanent Pavement Markings)  
Add Temporary Lane Separators |
| | Improper One-Way Traffic Control | | Provide Temporary Traffic Control Signal  
Provide Flagger |
| Sideswipe-Same | Improper Merging Maneuvers | Restrict Lane Change Behavior | Modify Taper to Accommodate Approach Speed  
Provide Arrow Board |
Each state crash report form was thoroughly reviewed to evaluate what work zone attributes are being collected. The following work zone attributes that are considered as best practices and should be uniformly implemented are:

- Related or In Work Zone (considered as separate coding element)
  - Yes
  - No
- Activity
  - Maintenance
  - Utility
  - Construction
- Location
  - Before First Warning Sign
  - Advanced Warning Area
  - Transition Area
  - Activity Area
  - Termination Area
- Type
  - Lane Closure
  - Lane Shift or Crossover
  - Shoulder or Median
  - Intermittent or Moving
- Workers Present
  - Yes
  - No
- Law Enforcement Present
  - Yes
  - No

Two states, including Iowa and Pennsylvania, reference all the noted work zone related attributes associated with the crash data element on their crash report form. Eight states, including Alaska, Connecticut, Florida, Maine, New Hampshire, Ohio, Virginia, and West Virginia reference five out of the six work zone related attributes. Eleven (11) states only reference between three to four work zone related attributes and 30, including the District of Columbia, reference two or
less. Minnesota’s crash report form only references three work zone related attributes, but also includes a diagram specifying the different locations (e.g., Transition Area, Activity Area, etc.) of a work zone to help assist the officer filling it out. Additional information regarding each state’s work zone attributes can be found in Appendix III.

5.0 CRASH DATA REPORTING

Crash data collection is a field activity that is performed by the police officer arriving at the scene of a traffic crash. This officer can belong to a local city/township, county sheriff or state police department. Typically, all police officers in the field are trained to collect all necessary data for the uniform crash report form. Providing appropriate tools and software will allow all officers to complete the crash reports electronically; however, many police agencies across the country complete the crash report forms in hard copies (i.e., paper forms). All states have a report review protocol that the supervising officer must follow, before reporting the data at the respective state’s data repository. In some instances, the field crash report forms (hard copy) are reviewed for accuracy and then entered to form digital databases. The digital database is then transferred to the state-wide repository and further reviewed for accuracy. Any modifications required are completed before finalizing the unified state-wide database. The final step in the reporting process is to provide the necessary data to a national database system, such as FARS for all fatal crashes.

The use of hard copy crash data collection is time consuming and labor intensive. Electronic data collection by police officers and on-line submission to their supervisors for review and quality assurance is reliable, provided that both the police officers in the field, as well as the supervisors in the office, have access to proper equipment and training to perform their tasks efficiently and accurately. The convenience of electronic in field data collection includes:

1. Options for all data elements that are in a drop down mode, and, therefore, do not require an officer to review the keys associated with various data elements.
2. Opportunities for less error.
3. Data entry is instantaneous.
4. Supervisor’s review is less time consuming.
Electronic Crash Reporting

Many states are transitioning to electronic traffic crash reporting to help simplify the data collection process and reduce the administrative responsibilities for officers. There are various online tools and software available for states to perform electronic traffic crash reporting, such as Traffic and Criminal Software (TraCS) (4), Report Beam (5), LexisNexis eCrash (6), and iyeTek (7). Some states use state-specific online tools and software, such as Alabama using their eCite (8), Georgia using their Georgia Electronic Accident Reporting System (GEARS) (9), Indiana using their Electronic Vehicle Crash Records System (eVCRS) (10), and Louisiana using their LACRASH (11).

Among the 50 states, the most popular electronic traffic crash reporting software is TraCS. The National Model (4), is a nationally recognized program for sharing online technologies to help improve crash data collection and reporting. There are currently 13 states using TraCS software (see Figure 3). The noted software was developed using public funds.

TraCS is a free software application available to any law enforcement agency. The Arizona Department of Transportation study (13) concluded that the TraCS system has all the necessary functionality, cost, and maintainability elements that are most desirable among the software that are being used or are available for electronic crash reporting.

TraCS uses mobile technology to allow officers to input the data wherever the crash has occurred. TraCS can be downloaded to any officer’s mobile data terminal to collect and send any crash report to their Supervisor for review and approval. TraCS offers many benefits such as (14):

- Lower data entry time by providing drop-down lists and auto-filling options
- Minimizes errors and prevents repeated data entry
- Electronic submission
- Crash reports are available to the public quicker
- High security by encrypting and compressing data
6.0 CHALLENGES TO IMPLEMENTING UNIFORM WORK ZONE CRASH DATA ELEMENTS

The number of data elements and options is minimal when compared to the entire crash data collection form. However, demonstrating the benefits of the inclusion of work zone related data elements, requires competing for data space with a variety of interests in engineering, driver related, enforcement related and financial interests of a state in recovering payment from the insurance industry and, most importantly, having the necessary space in a standard unified form. The following may assist in overcoming these concerns:
1. Develop data elements and options that are of interest to your agency, including how they relate to work zone crashes.

2. Prepare a concise document articulating short term, and long term benefits of work zone crash data. For example, location, characteristics, and type of crashes in intermediate term or long term work zones may allow applying treatments that could be site-specific, and would alleviate the occurrence of similar crashes at the same site. An analysis of crashes considering several similar sites and traffic scenarios may allow for the development of a targeted countermeasure that can be used as a part of the future TTCP development.

3. Present your proposal to the state’s crash report task force / user group. These groups often include local and state enforcement officials, engineers, trainers and administrators. Changing a crash report form requires the understanding and approval of all stakeholders, and the consideration of impacts on current software and grass-root training.

4. Changes related to the inclusion or modification of work zone crash data can accompany other changes, and, therefore, may not require extraordinary effort to accomplish.

7.0 WORK ZONE CRASH DATA ANALYSIS

Including appropriate work zone crash data elements in the crash report form will allow stakeholders to perform:

1. Area-wide effectiveness evaluation of work zone treatments
2. Evaluate effectiveness of typical countermeasures and emerging technology applications
3. Determine the safety consequences of work zone traffic control strategies
4. Analysis of site specific crashes in intermediate term and long term work zones.
Such an analysis may result in modifying traffic control treatments in future projects, developing standards that enhance safety and make work zones user friendly. While the crash analyses, noted above, are often completed to improve safety for future projects, the access to work zone crash data and analysis tools may assist work zone traffic control professionals in the implementation of countermeasures, during the same construction cycle to alleviate the recurrence of the same crashes at the same site, especially for intermediate and long term work zones.

Analysis of work zone crash data may consist of the following:

1. Site specific analysis of individual crashes that may lead to modifying work zone traffic control treatments at the site for intermediate term and long term work zones.
2. Analyzing groups of similar work zone sites to develop future TTCP for such situations.
3. Determining crash and severity trends at typical work zone locations.
4. Developing Safety Performance Functions and Crash Modification Factors for highway work zones for application in the prediction of safety consequences in work zones. Such data will improve the crash prediction and analysis of future projects.

Analyzing individual work zone sites, especially for an intermediate term or long term project, may allow work zone safety professionals to identify site-specific deficiencies and implement countermeasures that can alleviate the recurrence of crashes at the same site. All traffic control plans are developed as per MUTCD or State’s standards; however, sometimes devices may not be in full functional condition, thus creating additional challenges for the motorist. A drive through inspection by a work zone safety professional is recommended to ensure adherence to the intended standards, both during day and night periods.

Developing countermeasures for site specific work zone crash problems may require a systematic analysis that includes:

1. Determining location of crash, time of day and night, type of crash (e.g., single vehicle, rear end, head-on, etc.), and environmental conditions.
2. Based on the crash report and the investigating officer’s narrative and diagram, possible relevant factors can be determined, such as speeding under the conditions, distracted driving, sight distance problems due to roadway geometry, visual clutter, information overload, and other relevant factors.

3. Additional data needs such as a detailed crash report, construction and maintenance plans and standards, citation reports, drive through studies, reviews of TTC, traffic volume data, and approach speed data should be determined. Some of the noted data are generally available and some may need to be collected.

4. Countermeasures to alleviate similar crash occurrences may include:
   a) Use of dominant traffic control devices, such as arrow boards, changeable message signs,
   b) Speed reduction measures such as portable rumble strips,
   c) Use of increased buffer space,
   d) Enforcements,
   e) Use of advanced warning strategies, such as, end-of queue warning systems, dynamic lane merge systems (early and late),
   f) Increased inspection and maintenance of traffic control devices for nighttime visibility,
   g) Improving lighting, if necessary.

Developing countermeasures, based on a site-specific analysis, can not only be implemented in future work zones, it can also be used on existing ones, and especially for intermediate term or long term projects.

It is also important to note that road user characteristics may vary and, therefore, the effectiveness of a standard TTCP may require modifications to minimize the risk of work zone related traffic crashes and injuries.

Considerations for developing safety performance functions and crash modification factors are included in a separate standalone document (15).
8.0 DATA ANALYSIS TOOLS

All data elements, such as crash type, crash severity, traffic control, weather, lighting condition, road condition, year, area of road, time of day, speed, driver citation data, and driver distraction data can be used to analyze work zone crashes. Many states have their own “Excel-based” or similar analysis tool available, that stores the data collected from every crash report and provides the opportunity for use by the stakeholders. Each state’s online storage tool typically contains a query of infinite filters that can be used to search for crashes that meet a set of specific criteria. For example, Michigan uses an online data query tool, Michigan Traffic Crash Facts (MTCF) [http://www.michigantrafficcrashfacts.org/ (16)], where a user can build their own query and filter any of the data elements identified on the Michigan crash report form (UD-10). For example, MTCF allows a user to search for “Construction/Maintenance” related rear-end crashes with wet road conditions during the AM peak hour. The MTCF can provide the results of the query in the form of a map, table, list, chart, and calendar, or provide a copy of the actual crash report (UD-10) forms.

The National Highway Traffic Safety Administration (NHTSA) also has an online tool called the Fatality Analysis Reporting System (FARS) [http://www.nhtsa.gov/FARS (17)] made available to the crash data user containing data on all vehicle crashes involving fatalities in the United States occurring on public roads. Similarly, a user can build their own query by selecting a specific crash, occupant, vehicle, driver, or pre-crash fields to filter crashes meeting the specific criteria. A user also has the option to filter by state. The FARS provides the results in the form of a table that can be extracted into Excel or a chart.
9.0 ADDITIONAL RESOURCES

- Refer to the Wayne State University – Transportation Research Group Work Zone Safety Website [http://workzone.eng.wayne.edu](http://workzone.eng.wayne.edu/) for copies of this document, other products developed under the Federal Highway Administration Work Zone Safety Grant, as well as the *Temporary Traffic Control Plan Selection Software* and *Work Zone Safety Compendium of Documents*.


- FHWA Work Zone Mobility and Safety program Website: [http://www.ops.fhwa.dot.gov/Wz/its/index.htm](http://www.ops.fhwa.dot.gov/Wz/its/index.htm)


10.0 REFERENCES


9. Georgia GEARS: https://gearsportal.com/Pages/Public/Home.aspx


11. Louisiana LACRASH: http://lacrash.lsu.edu/


APPENDIX I - SUMMARY OF WORK ZONE FATALITIES AND FATAL CRASHES (2004 THROUGH 2013)

(Source: FARS Database)
### Table 1A - Work Zone Fatal Crashes by Roadway Functional Type

<table>
<thead>
<tr>
<th>Type of Roads</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Principal Arterial - Interstate</td>
<td>129</td>
<td>112</td>
<td>123</td>
<td>83</td>
<td>73</td>
<td>94</td>
<td>70</td>
<td>77</td>
<td>89</td>
<td>85</td>
</tr>
<tr>
<td>Urban Principal Arterial - Interstate</td>
<td>165</td>
<td>157</td>
<td>150</td>
<td>139</td>
<td>143</td>
<td>117</td>
<td>115</td>
<td>115</td>
<td>117</td>
<td>106</td>
</tr>
<tr>
<td>Urban Principal Arterial - Other</td>
<td>72</td>
<td>65</td>
<td>65</td>
<td>58</td>
<td>51</td>
<td>50</td>
<td>42</td>
<td>39</td>
<td>45</td>
<td>35</td>
</tr>
<tr>
<td>Roadways other than interstate and freeways</td>
<td>565</td>
<td>603</td>
<td>557</td>
<td>452</td>
<td>395</td>
<td>328</td>
<td>294</td>
<td>302</td>
<td>304</td>
<td>301</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>931</td>
<td>937</td>
<td>895</td>
<td>732</td>
<td>662</td>
<td>589</td>
<td>521</td>
<td>533</td>
<td>555</td>
<td>527</td>
</tr>
</tbody>
</table>

Source: NHTSA Fatality Analysis Reporting System

### Table 1B - Work Zone Fatalities by Roadway Functional Type

<table>
<thead>
<tr>
<th>Type of Roads</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Principal Arterial - Interstate</td>
<td>163</td>
<td>134</td>
<td>141</td>
<td>97</td>
<td>82</td>
<td>116</td>
<td>89</td>
<td>86</td>
<td>99</td>
<td>102</td>
</tr>
<tr>
<td>Urban Principal Arterial - Interstate</td>
<td>186</td>
<td>169</td>
<td>161</td>
<td>172</td>
<td>153</td>
<td>129</td>
<td>129</td>
<td>125</td>
<td>128</td>
<td>120</td>
</tr>
<tr>
<td>Urban Principal Arterial - Other</td>
<td>85</td>
<td>69</td>
<td>69</td>
<td>59</td>
<td>53</td>
<td>54</td>
<td>45</td>
<td>43</td>
<td>49</td>
<td>35</td>
</tr>
<tr>
<td>Roadways other than interstate and freeways</td>
<td>629</td>
<td>686</td>
<td>633</td>
<td>503</td>
<td>428</td>
<td>381</td>
<td>323</td>
<td>336</td>
<td>341</td>
<td>322</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1063</td>
<td>1058</td>
<td>1004</td>
<td>831</td>
<td>716</td>
<td>680</td>
<td>586</td>
<td>590</td>
<td>617</td>
<td>579</td>
</tr>
</tbody>
</table>

Source: NHTSA Fatality Analysis Reporting System
### Table 2A - Work Zone Fatal Crashes by Regional Roadway Type

<table>
<thead>
<tr>
<th>Type of Roads</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Roadways</td>
<td>486</td>
<td>458</td>
<td>455</td>
<td>347</td>
<td>288</td>
<td>302</td>
<td>235</td>
<td>234</td>
<td>243</td>
<td>236</td>
</tr>
<tr>
<td>Urban Roadways</td>
<td>443</td>
<td>477</td>
<td>432</td>
<td>384</td>
<td>370</td>
<td>287</td>
<td>283</td>
<td>296</td>
<td>312</td>
<td>291</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>1</td>
<td>4</td>
<td>N/A</td>
<td>3</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>931</strong></td>
<td><strong>937</strong></td>
<td><strong>895</strong></td>
<td><strong>732</strong></td>
<td><strong>662</strong></td>
<td><strong>589</strong></td>
<td><strong>521</strong></td>
<td><strong>533</strong></td>
<td><strong>555</strong></td>
<td><strong>527</strong></td>
</tr>
</tbody>
</table>

Source: NHTSA Fatality Analysis Reporting System and https://www.workzonesafety.org/crash_data/workzone_fatalities

### Table 2B - Work Zone Fatalities by Regional Roadway Type

<table>
<thead>
<tr>
<th>Type of Roads</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Roadways</td>
<td>570</td>
<td>534</td>
<td>527</td>
<td>404</td>
<td>321</td>
<td>362</td>
<td>272</td>
<td>272</td>
<td>280</td>
<td>267</td>
</tr>
<tr>
<td>Urban Roadways</td>
<td>491</td>
<td>522</td>
<td>469</td>
<td>426</td>
<td>390</td>
<td>318</td>
<td>311</td>
<td>315</td>
<td>337</td>
<td>312</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>1</td>
<td>5</td>
<td>N/A</td>
<td>3</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1063</strong></td>
<td><strong>1058</strong></td>
<td><strong>1004</strong></td>
<td><strong>831</strong></td>
<td><strong>716</strong></td>
<td><strong>680</strong></td>
<td><strong>586</strong></td>
<td><strong>590</strong></td>
<td><strong>617</strong></td>
<td><strong>579</strong></td>
</tr>
</tbody>
</table>

Source: NHTSA Fatality Analysis Reporting System and https://www.workzonesafety.org/crash_data/workzone_fatalities
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 AM - 9:00 AM*</td>
<td>52</td>
<td>46</td>
<td>41</td>
<td>37</td>
<td>39</td>
<td>30</td>
<td>25</td>
<td>35</td>
<td>34</td>
<td>28</td>
</tr>
<tr>
<td>4:00 PM - 6:00 PM*</td>
<td>61</td>
<td>51</td>
<td>62</td>
<td>49</td>
<td>40</td>
<td>32</td>
<td>26</td>
<td>28</td>
<td>37</td>
<td>31</td>
</tr>
<tr>
<td>Other**</td>
<td>818</td>
<td>840</td>
<td>792</td>
<td>646</td>
<td>583</td>
<td>527</td>
<td>470</td>
<td>470</td>
<td>484</td>
<td>468</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>931</strong></td>
<td><strong>937</strong></td>
<td><strong>895</strong></td>
<td><strong>732</strong></td>
<td><strong>662</strong></td>
<td><strong>589</strong></td>
<td><strong>521</strong></td>
<td><strong>533</strong></td>
<td><strong>555</strong></td>
<td><strong>527</strong></td>
</tr>
</tbody>
</table>

*Monday through Friday Only  
**Off-peak times Monday through Friday and all day Saturday and Sunday

Source: NHTSA Fatality Analysis Reporting System

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 AM - 9:00 AM*</td>
<td>54</td>
<td>52</td>
<td>45</td>
<td>38</td>
<td>40</td>
<td>36</td>
<td>27</td>
<td>42</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td>4:00 PM - 6:00 PM*</td>
<td>69</td>
<td>58</td>
<td>71</td>
<td>58</td>
<td>43</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>40</td>
<td>32</td>
</tr>
<tr>
<td>Other**</td>
<td>940</td>
<td>948</td>
<td>888</td>
<td>735</td>
<td>633</td>
<td>611</td>
<td>526</td>
<td>515</td>
<td>537</td>
<td>513</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1063</strong></td>
<td><strong>1058</strong></td>
<td><strong>1004</strong></td>
<td><strong>831</strong></td>
<td><strong>716</strong></td>
<td><strong>680</strong></td>
<td><strong>586</strong></td>
<td><strong>590</strong></td>
<td><strong>617</strong></td>
<td><strong>579</strong></td>
</tr>
</tbody>
</table>

*Monday through Friday Only  
**Off-peak times Monday through Friday and all day Saturday and Sunday

Source: NHTSA Fatality Analysis Reporting System and https://www.workzonesafety.org/crash_data/workzone_fatalities
Table 4A - Work Zone Fatal Crashes by Crash Type

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single motor vehicle</td>
<td>495</td>
<td>464</td>
<td>460</td>
<td>370</td>
<td>355</td>
<td>298</td>
<td>295</td>
<td>318</td>
<td>301</td>
<td>309</td>
</tr>
<tr>
<td>Rear-end</td>
<td>144</td>
<td>148</td>
<td>158</td>
<td>134</td>
<td>128</td>
<td>123</td>
<td>82</td>
<td>96</td>
<td>116</td>
<td>104</td>
</tr>
<tr>
<td>Head-on</td>
<td>95</td>
<td>105</td>
<td>86</td>
<td>78</td>
<td>48</td>
<td>51</td>
<td>39</td>
<td>37</td>
<td>50</td>
<td>26</td>
</tr>
<tr>
<td>Angle</td>
<td>80</td>
<td>103</td>
<td>93</td>
<td>86</td>
<td>52</td>
<td>47</td>
<td>80</td>
<td>61</td>
<td>64</td>
<td>73</td>
</tr>
<tr>
<td>Sideswipe-same direction</td>
<td>25</td>
<td>39</td>
<td>38</td>
<td>23</td>
<td>29</td>
<td>36</td>
<td>16</td>
<td>12</td>
<td>17</td>
<td>9</td>
</tr>
<tr>
<td>Sideswipe-opposite direction</td>
<td>81</td>
<td>60</td>
<td>47</td>
<td>32</td>
<td>37</td>
<td>25</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>11</td>
<td>18</td>
<td>13</td>
<td>9</td>
<td>13</td>
<td>9</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>931</td>
<td>937</td>
<td>895</td>
<td>732</td>
<td>662</td>
<td>589</td>
<td>521</td>
<td>533</td>
<td>555</td>
<td>527</td>
</tr>
</tbody>
</table>

Source: NHTSA Fatality Analysis Reporting System

Table 4B - Work Zone Fatalities by Crash Type

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single motor vehicle</td>
<td>536</td>
<td>493</td>
<td>489</td>
<td>405</td>
<td>374</td>
<td>327</td>
<td>309</td>
<td>339</td>
<td>328</td>
<td>330</td>
</tr>
<tr>
<td>Rear-end</td>
<td>179</td>
<td>174</td>
<td>184</td>
<td>154</td>
<td>143</td>
<td>145</td>
<td>95</td>
<td>116</td>
<td>133</td>
<td>114</td>
</tr>
<tr>
<td>Head-on</td>
<td>124</td>
<td>130</td>
<td>110</td>
<td>99</td>
<td>60</td>
<td>68</td>
<td>52</td>
<td>45</td>
<td>64</td>
<td>33</td>
</tr>
<tr>
<td>Angle</td>
<td>89</td>
<td>122</td>
<td>108</td>
<td>99</td>
<td>55</td>
<td>57</td>
<td>98</td>
<td>68</td>
<td>67</td>
<td>83</td>
</tr>
<tr>
<td>Sideswipe-same direction</td>
<td>27</td>
<td>44</td>
<td>42</td>
<td>24</td>
<td>32</td>
<td>39</td>
<td>18</td>
<td>12</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Sideswipe-opposite direction</td>
<td>94</td>
<td>74</td>
<td>57</td>
<td>37</td>
<td>39</td>
<td>32</td>
<td>6</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>14</td>
<td>21</td>
<td>14</td>
<td>13</td>
<td>13</td>
<td>12</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1063</td>
<td>1058</td>
<td>1004</td>
<td>831</td>
<td>716</td>
<td>680</td>
<td>586</td>
<td>590</td>
<td>617</td>
<td>579</td>
</tr>
</tbody>
</table>

Source: NHTSA Fatality Analysis Reporting System and https://www.workzonesafety.org/crash_data/workzone_fatalities
### Table 5A - Work Zone Fatal Rear End Crashes by Time of Day

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 AM - 9:00 AM*</td>
<td>10</td>
<td>8</td>
<td>4</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>13</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>4:00 PM - 6:00 PM*</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>6</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Other**</td>
<td>125</td>
<td>132</td>
<td>147</td>
<td>124</td>
<td>114</td>
<td>108</td>
<td>70</td>
<td>78</td>
<td>101</td>
<td>88</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>144</td>
<td>148</td>
<td>158</td>
<td>134</td>
<td>128</td>
<td>123</td>
<td>82</td>
<td>96</td>
<td>116</td>
<td>104</td>
</tr>
</tbody>
</table>

*Monday through Friday Only  
**Off-peak times Monday through Friday and all day Saturday and Sunday

Source: NHTSA Fatality Analysis Reporting System

### Table 5B - Work Zone Rear End Fatalities by Time of Day

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 AM - 9:00 AM*</td>
<td>10</td>
<td>9</td>
<td>5</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>19</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>4:00 PM - 6:00 PM*</td>
<td>15</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>5</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Other**</td>
<td>154</td>
<td>157</td>
<td>171</td>
<td>144</td>
<td>129</td>
<td>130</td>
<td>81</td>
<td>92</td>
<td>118</td>
<td>98</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>179</td>
<td>174</td>
<td>184</td>
<td>154</td>
<td>143</td>
<td>145</td>
<td>95</td>
<td>116</td>
<td>133</td>
<td>114</td>
</tr>
</tbody>
</table>

*Monday through Friday Only  
**Off-peak times Monday through Friday and all day Saturday and Sunday

Source: NHTSA Fatality Analysis Reporting System
<table>
<thead>
<tr>
<th>Time</th>
<th>Atmospheric Condition</th>
<th>Work Zone Fatal Crashes By Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Snow/Ice/Rain and Other Adverse Atmospheric Condition*</td>
<td>2004</td>
</tr>
<tr>
<td>7:00 AM - 9:00 AM</td>
<td>1 0 0 0 0 0 1 0 0 0 0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No Adverse Atmospheric Condition</td>
<td>9</td>
</tr>
<tr>
<td>4:00 PM - 6:00 PM</td>
<td>Snow/Ice/Rain and Other Adverse Atmospheric Condition*</td>
<td>1 1 0 1 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td></td>
<td>No Adverse Atmospheric Condition</td>
<td>8</td>
</tr>
<tr>
<td>Other</td>
<td>Snow/Ice/Rain and Other Adverse Atmospheric Condition*</td>
<td>2 8 9 1 5 8 1 6 2 3</td>
</tr>
<tr>
<td></td>
<td>No Adverse Atmospheric Condition</td>
<td>123</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>144</td>
</tr>
</tbody>
</table>

* Adverse conditions include snow, ice, rain, sleet, fog, smog, smoke, severe crosswinds, blowing sand, soil, and dirt

Source: NHTSA Fatality Analysis Reporting System
### Table 6A. Work Zone Fatal Rear End Crashes by Regional Roadway Type

<table>
<thead>
<tr>
<th>Type of Roads</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>67</td>
<td>71</td>
<td>68</td>
<td>57</td>
<td>54</td>
<td>62</td>
<td>34</td>
<td>49</td>
<td>67</td>
<td>51</td>
</tr>
<tr>
<td>Urban</td>
<td>77</td>
<td>76</td>
<td>90</td>
<td>77</td>
<td>74</td>
<td>61</td>
<td>48</td>
<td>47</td>
<td>49</td>
<td>53</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>144</td>
<td>148</td>
<td>158</td>
<td>134</td>
<td>128</td>
<td>123</td>
<td>82</td>
<td>96</td>
<td>116</td>
<td>104</td>
</tr>
</tbody>
</table>

Source: NHTSA Fatality Analysis Reporting System

### Table 6B. Work Zone Rear End Fatalities by Regional Roadway Type

<table>
<thead>
<tr>
<th>Type of Roads</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>90</td>
<td>84</td>
<td>83</td>
<td>66</td>
<td>62</td>
<td>79</td>
<td>39</td>
<td>63</td>
<td>80</td>
<td>54</td>
</tr>
<tr>
<td>Urban</td>
<td>89</td>
<td>89</td>
<td>101</td>
<td>88</td>
<td>81</td>
<td>66</td>
<td>56</td>
<td>53</td>
<td>53</td>
<td>60</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>179</td>
<td>174</td>
<td>184</td>
<td>154</td>
<td>143</td>
<td>145</td>
<td>95</td>
<td>116</td>
<td>133</td>
<td>114</td>
</tr>
</tbody>
</table>

Source: NHTSA Fatality Analysis Reporting System
### Table 7A - Work Zone Fatal Rear End Crashes by Roadway Functional Type

<table>
<thead>
<tr>
<th>Type of Roads</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeways*</td>
<td>94</td>
<td>95</td>
<td>104</td>
<td>80</td>
<td>77</td>
<td>77</td>
<td>61</td>
<td>64</td>
<td>77</td>
<td>64</td>
</tr>
<tr>
<td>Non-freeways</td>
<td>50</td>
<td>53</td>
<td>54</td>
<td>54</td>
<td>51</td>
<td>46</td>
<td>21</td>
<td>32</td>
<td>39</td>
<td>40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>144</strong></td>
<td><strong>148</strong></td>
<td><strong>158</strong></td>
<td><strong>134</strong></td>
<td><strong>128</strong></td>
<td><strong>123</strong></td>
<td><strong>82</strong></td>
<td><strong>96</strong></td>
<td><strong>116</strong></td>
<td><strong>104</strong></td>
</tr>
</tbody>
</table>

*Freeways include rural principal arterials-interstate, urban-principal arterial-interstate, and urban-principal arterial-other freeways or*

Source: Fatality Analysis Reporting System, NHTSA

### Table 7B - Work Zone Rear End Fatalities by Roadway Functional Type

<table>
<thead>
<tr>
<th>Type of Roads</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeways*</td>
<td>120</td>
<td>108</td>
<td>116</td>
<td>93</td>
<td>85</td>
<td>94</td>
<td>73</td>
<td>76</td>
<td>85</td>
<td>73</td>
</tr>
<tr>
<td>Non-freeways</td>
<td>59</td>
<td>65</td>
<td>68</td>
<td>61</td>
<td>58</td>
<td>51</td>
<td>22</td>
<td>40</td>
<td>48</td>
<td>41</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>179</strong></td>
<td><strong>174</strong></td>
<td><strong>184</strong></td>
<td><strong>154</strong></td>
<td><strong>143</strong></td>
<td><strong>145</strong></td>
<td><strong>95</strong></td>
<td><strong>116</strong></td>
<td><strong>133</strong></td>
<td><strong>114</strong></td>
</tr>
</tbody>
</table>

*Freeways include rural principal arterials-interstate, urban-principal arterial-interstate, and urban-principal arterial-other freeways or*

Source: NHTSA Fatality Analysis Reporting System
<table>
<thead>
<tr>
<th>Roadway Type</th>
<th>Atmospheric Condition</th>
<th>Work Zone Fatal Crashes By Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeways</td>
<td>Snow/Ice/Rain and Other Adverse Atmospheric Condition*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>No Adverse Atmospheric Condition</td>
<td>91</td>
</tr>
<tr>
<td>Non-freeways</td>
<td>Snow/Ice/Rain and Other Adverse Atmospheric Condition*</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No Adverse Atmospheric Condition</td>
<td>49</td>
</tr>
<tr>
<td>Total</td>
<td>144</td>
<td>148</td>
</tr>
</tbody>
</table>

*Adverse conditions include snow, ice, rain, sleet, fog, smog, smoke, severe crosswinds, blowing sand, soil, and dirt

Source: NHTSA Fatality Analysis Reporting System
APPENDIX II - STATES' CRASH REPORT FORM - WORK ZONE RELATED FIELDS
<table>
<thead>
<tr>
<th>State</th>
<th>Location</th>
<th>Type/Where</th>
<th>Activity</th>
<th>Work Zone Related? Or in Work Zone</th>
<th>Contributing Circumstances</th>
<th>Workers Present?</th>
<th>Law Enforcement Present?</th>
<th>Other Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Alaska</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Arizona</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Arkansas</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>California</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Colorado</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Connecticut</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Delaware</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Delaware - Electronic</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Florida</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Georgia</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Hawaii</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Idaho</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Illinois</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Indiana</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Iowa</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Kansas</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Kentucky</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Louisiana</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Maine</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Maryland</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Michigan</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Minnesota</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Mississippi</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Missouri</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Montana</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Nebraska</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Nevada</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>New Jersey</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>New Mexico</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>New York</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>North Carolina</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>North Dakota</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Ohio</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Traffic Control - Construction Barricade</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Oregon</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>South Carolina</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Traffic Control Type - Work Zone</td>
</tr>
<tr>
<td>South Dakota</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Tennessee</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Traffic Control Devices - Construction Zone Controls</td>
</tr>
<tr>
<td>Tennessee - Electronic</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Texas</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Traffic Control Devices - Construction Zone Controls</td>
</tr>
<tr>
<td>Utah</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Vermont</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Virginia</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Traffic Control Type - Reduced Speed Work Zone</td>
</tr>
<tr>
<td>Washington</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Traffic Control Devices - Construction Zone Controls</td>
</tr>
<tr>
<td>West Virginia</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Work Zone Speed Limit</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Wyoming</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Traffic Control - Traffic Barrel/Cones, Temporary Jersey Barrier</td>
</tr>
</tbody>
</table>

**Before First Warning Sign**
- Advanced Warning Area
- Transition Area
- Activity Area
- Termination Area

**Lane Closure**
- Lane Closure
- Lane Shift/Crossover
- Intermittent or Moving Work
- Work on Shoulder or Median

**Maintenance Utility Construction**
- Traffic Control - Work Zone Sign
- Traffic Control - Construction Barricade
- Traffic Control Type - Work Zone
- Traffic Control - Traffic Barrel/Cones, Temporary Jersey Barrier

**Contributing Circumstances**
- Traffic Control - Traffic Barrel/Cones, Temporary Jersey Barrier

**Workers Present?**
- Yes
- No

**Law Enforcement Present?**
- Yes
- No

**Other Information**
- Activity - On or Off road
- Picture of Work Zone Location Components Included
- Factors: Inactive/Active Work Zone
- Work area marked with warning signs or cones; Work activity at time of crash
- Lane Closure Section - lane closed; lane closure direction; traffic detoured; estimated time closed; Work Zone Speed Limit
- Traffic Control - Construction Barrycades
- Traffic Control Devices - Construction Zone Controls
- Traffic Control Type - Reduced Speed Work Zone
- Traffic Control Devices - Construction Zone Controls
- Traffic Control Type - Work Zone
- Traffic Control Devices - Construction Zone Controls
- Traffic Control Type - Reduced Speed Work Zone
- Traffic Control Devices - Construction Zone Controls

**Updated:** 1/4/16
APPENDIX III - STATES' CRASH REPORT FORM - WORK ZONE RELATED ATTRIBUTES
### All States’ Crash Report Work Zone Typical Categories

<table>
<thead>
<tr>
<th>Location of work zone:</th>
<th>Type of work zone:</th>
<th>Work zone activity:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Before first warning sign</td>
<td>• Lane closure</td>
<td>• Maintenance</td>
</tr>
<tr>
<td>• Advance warning area</td>
<td>• Lane shift/crossover</td>
<td>• Utility</td>
</tr>
<tr>
<td>• Transition area</td>
<td>• Intermittent or moving work</td>
<td>• Construction</td>
</tr>
<tr>
<td>• Activity area</td>
<td>• Work on shoulder or median</td>
<td></td>
</tr>
<tr>
<td>• Termination area</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Pennsylvania and Iowa

- Location of work zone
- Type of work zone
- Work zone activity
- Was the crash work zone related or in a work zone?
- Contributing circumstance
  - Work zone (option)
- Were workers present?
- Was law enforcement present?

### Pennsylvania Lane Closure Section

- How much the lane was closed?
  - Partial
  - Fully
  - Unknown
  - Not Applicable
- Direction of lane closure
  - North
  - South
  - East
- West
- North and South
- East and West
- All (N, S, E, W)
  - Estimated time of closure
    - < 30 minutes
    - 30 – 60 minutes
    - 1 – 3 hours
    - 3 – 6 hours
    - 6 – 9 hours
    - > 9 hours
    - Unknown
  - Was traffic detoured?

**Connecticut, Maine, Virginia, Florida, and New Hampshire**

- Location of work zone
- Type of work zone
- Was the crash work zone related or in a work zone?
- Contributing circumstance
  - Work zone (option)
- Were workers present?
- Law Enforcement present?

**Virginia**

- Traffic Control Type
  - Reduced Speed Work Zone (option)

**Nebraska, South Carolina, South Dakota, Utah, Delaware and Wyoming**

- Location of work zone
- Type of work zone
- Was the crash work zone related or in a work zone?
- Contributing circumstance
  - Work zone (option)
Were workers present?

All of Delaware’s work zone information is on their electronic crash report. They include no information on their paper report form from 1987 about work zones.

Oklahoma

- Location of work zone
- Work zone type
- Was the crash work zone related or in a work zone
- Were workers present?

Minnesota and North Dakota

- Location of work zone
- Type of work zone
- Were workers present?

Minnesota’s report also includes diagram of components/location of a work zone.

Louisiana, Maryland, Montana, and Wisconsin

- Contributing circumstance
  - Work zone (option)
- Was the crash work zone related or in a work zone?

Nevada

- Highway / Environment Factors
  - Active work zone (option)
  - Inactive work zone (option)

Alabama, Arkansas, Colorado, Washington DC, Hawaii, and Massachusetts

- Work zone related or in a work zone on their reports?
California, Kentucky, New Mexico, Nevada and Vermont

- Contributing circumstance
  - Work zone (option)

Nevada

- Factors
  - Inactive Work Zone
  - Active Work Zone