HIGHWAY FACTORS FACTUAL REPORT
MULTI-VEHICLE REAR-END COLLISION IN A WORK ZONE
GRAY SUMMIT, MISSOURI
AUGUST 5, 2010
HWY-10-MH-018
30 pages

NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF HIGHWAY SAFETY
WASHINGTON, D.C. 20594

HIGHWAY FACTORS FACTUAL REPORT

A. ACCIDENT

Type:	Truck Tractor, Pickup, School Bus Multivehicle Accident
Date and Time:	August 5, 2010, 10:11AM. CDT
Location:	Interstate 44 Eastbound West of Milepost 250.6 Gray Summit, Franklin County, Missouri
Vehicle #1	2007 Volvo Truck Tractor
Motor Carrier:	Climate Express
Vehicle #2:	2007 GMC Sierra
Vehicle #3:	2003 Bluebird, 71-Passenger School Bus
Motor Carrier:	Copeland Bus Services, LLC
Vehicle #4:	2001 Bluebird, 72-Passenger Bus
Motor Carrier:	Copeland Bus Services, LLC
Fatalities:	02
Injuries:	38

NTSB #: **HWY-10-MH-018**

B. HIGHWAY GROUP

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C. ACCIDENT SUMMARY

For a Summary of the accident see the Accident Summary Report which is available in the public docket for this investigation.

(See Figure 1 Below)

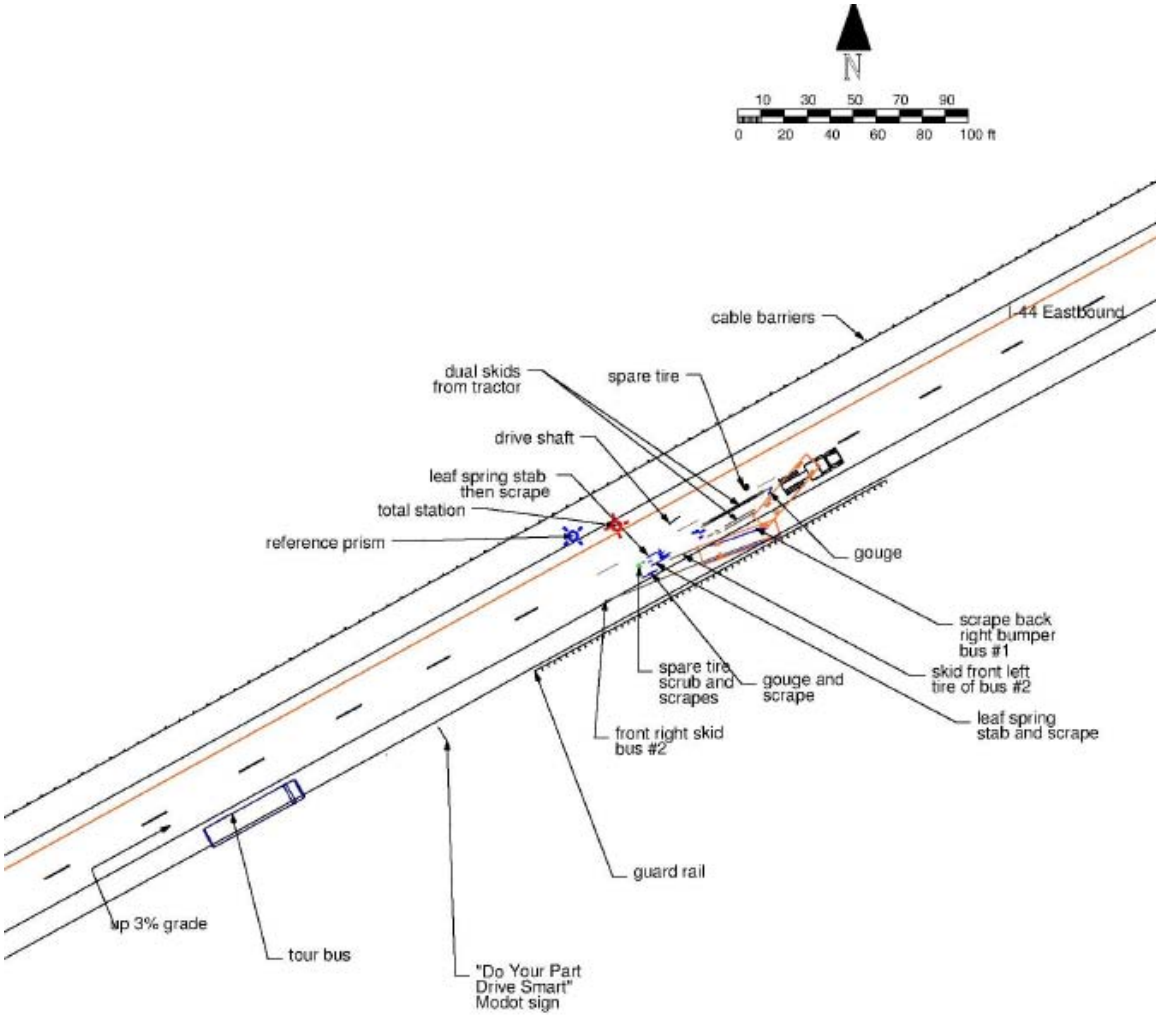

Figure 1
Courtesy Missouri State Highway Patrol
See Attachment 1 for Expanded Version

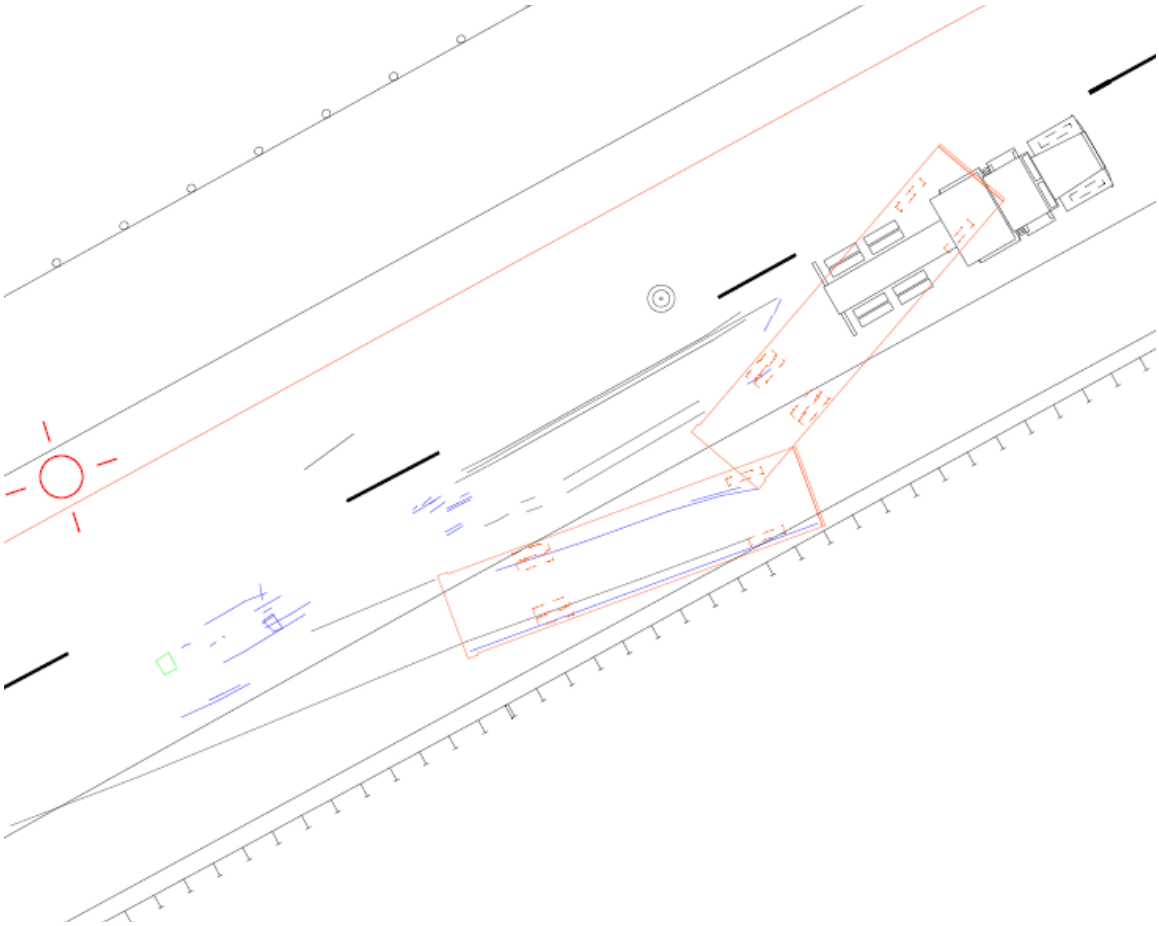

Figure 2 – Scene Marks
Courtesy Missouri State Highway Patrol

D. ON-SCENE ACTIVITIES

1. Documents Obtained and Reviewed:

- *Accident Histories on I44 from Milepost 245-255, statewide accident histories, and work zone accident histories*
- *Traffic Counts and speed surveys*
- *Plan and profile highway plans (as-builts)*
- *Design plans for Federal Project No. J6I2011 I-44 in Franklin County, Mo.*

- *Construction Contract and FHWA Approval Documents 490 pages*
- *Standards and Specifications- Division 100 and 600*
- *Manual for Uniform Traffic Control Devices (MUTCD)*
- *Pre-Construction Conference Meeting Minutes*
- *Project Inspectors Diary/Daily Work Record 155 pages*
- *Engineering Policy Guidelines (EPG)*
- *Changeable Message Sign(CMS) Locations and messages*
- *Dynamic Message Sign (DMS) Locations and Messages*
- *Summary of Traffic Management Center Functions*
- *MODOT Work Zone Safety and Mobility Policy Manual*
- *FHWA Construction Inspection Report*

2. Photos:

- *25 Scene photos*
- *2 Video Drive throughs of Work Zone Traffic Control*
- *Approximately 400 police photos*

3. Examine and Documented Accident Scene

4. Examined and evaluated videotape on boys school bus

E. INTRODUCTION

The report is organized in the following manner: First an outline is provided showing what details will be covered. Then prefatory data and highway data will be presented along with detailed information about the geometric alignment, scene documentation, and construction zone traffic control will be presented.

F. DETAILS OF THE INVESTIGATION

Prefatory data was obtained that included construction history, average daily traffic, vehicle classification data, traffic accidents, fatal accidents, and accidents in the work zone approach area.

Highway data was obtained that included the functional classification,

highway design, posted speed limit, and 85th percentile speed[1]. Other highway data obtained included highway markings, design speed, horizontal and vertical geometry of the east and westbound lanes of Interstate 44. Detailed information will be provided about the design and placement of work zone traffic control devices. Additionally, information on the accident reconstruction will be provided.

G. PREFATORY DATA

Interstate Highway 44 (I-44), was originally constructed in 1966-1967. The facility was a 4-lane highway with the dual east and westbound lanes separated by a 40-foot-wide, depressed earthen median that had a 4H:V1-5H:V1 traversable slope[2i]. The median was protected by a three-strand low-tension generic cable barrier system with 16-foot post spacings, which was installed in the center of the median. The dual, 12-foot-wide lanes in each direction are delineated by dashed, white pavement stripes that are 10-foot-long at 30 foot-intervals. The 10.0 foot-wide, right-hand shoulders on both sides of the interstate have rumble strips cut into the pavement and the shoulder is delineated from the main travel lanes by a solid white pavement stripe. The left-hand or median shoulder on the eastbound lane is 5.5-feet-wide, and the median shoulder on the westbound side is approximately 5.5 feet-wide. Both are delineated from the travel lanes by solid yellow pavement stripes. The left-hand or median shoulders are also equipped with rumble strips. The collision occurred at Milepost 250.52 or Station number 1451.[3]

The general design of the highway matches the topography of the land with rolling terrain and numerous changes in vertical and horizontal alignment consisting of gentle curvature. The approach to the collision or impact area was on a straight section of roadway which was dry at the time of the accident. The approach was on an approximate 2,550-foot-long, 3 percent upgrade.

I-44 generally runs southwest to northeast from Wichita Falls, Texas through Oklahoma (where it is designated as the Oklahoma Turnpike) into Southwest Missouri near Joplin where it continues northeast to St. Louis.

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[1]The 85th percentile speed is the speed at which 85% of the vehicle traffic is traveling either at or below that speed or, 15% of the vehicle traffic is traveling above that speed.

[2] For every four feet of horizontal distance the elevation drops 1 foot

[3] Station numbers are official measurements found on highway design plans.

MODOT provided traffic count data indicating that the Average Daily Traffic (ADT) was approximately 20,223 vehicles. Commercial vehicles were approximately 23 percent of the traffic count. Design plans showed in areas further east of the accident area the ADT was 54,000 with a 27 percent commercial vehicle count. The 30-year predicted ADT was 60,000 vehicles per day in 2029. In 2009, the average speed on rural highways in Missouri was 69.42 mph. The 85th percentile speed on I-44 near the accident area was not available.

Prior to the construction zone the speed limit was posted at 70 mph. I-44 is a principal arterial interstate with a design speed of 70 mph in the accident area. The speed limit was reduced to 50 mph at milepost 250.4, approximately 1/10 of a mile west of where the accident occurred.

G. ACCIDENT HISTORY:

The following information includes data on general statistics on fatal and disabling injuries in Missouri on the statewide highway system for the period 2005-2009, specific to passenger vehicle, commercial vehicles, and accidents statewide in construction zones. Additional statistics are also provided on interstate system accidents, rear-end accidents, congestion ahead accidents, and statistics on truck and trailer, truck tractor, pick-up and school bus accidents. Finally accident statistics specific to the accident area will be provided, and accident related to the work zone will be provided.

The following charts show the number of fatalities in Missouri in 2005-2009.

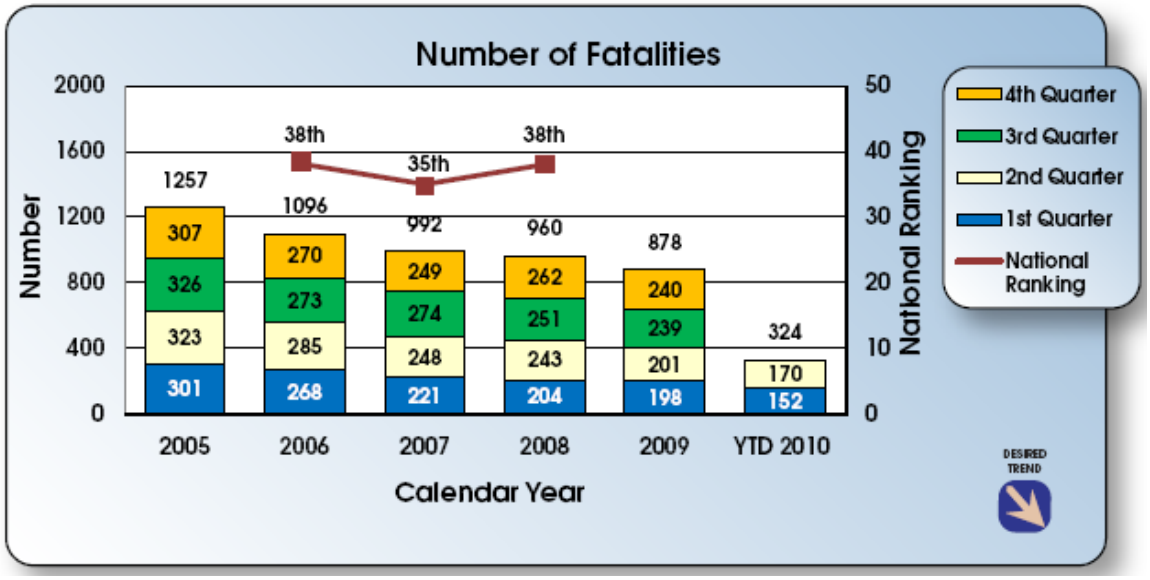


Figure 3

In figure 3 below the number of disabling injuries are provided on the statewide system in Missouri for the years 2005-2010.

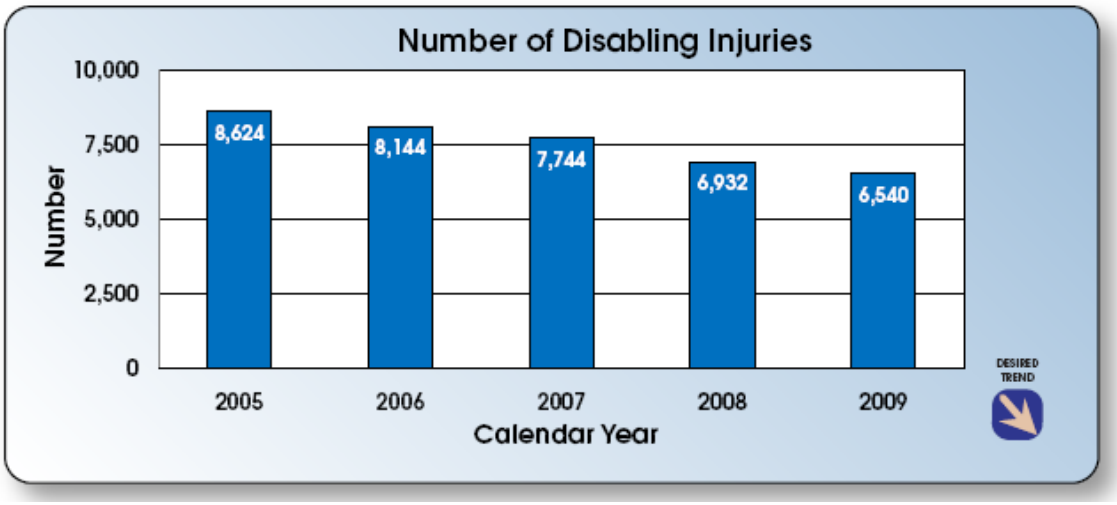


Figure 4

The last full year reported by NHTSA in the Fatal Accident Reporting System (FARS) was 2008. In 2008 the fatal crash rate per 100 million vehicle miles travelled for the United States was 1.25. The rate for Missouri was less at 1.22. In figures 5 and 6 below the number of fatal commercial

motor vehicle crashes and the number of fatalities in work zones are provided.

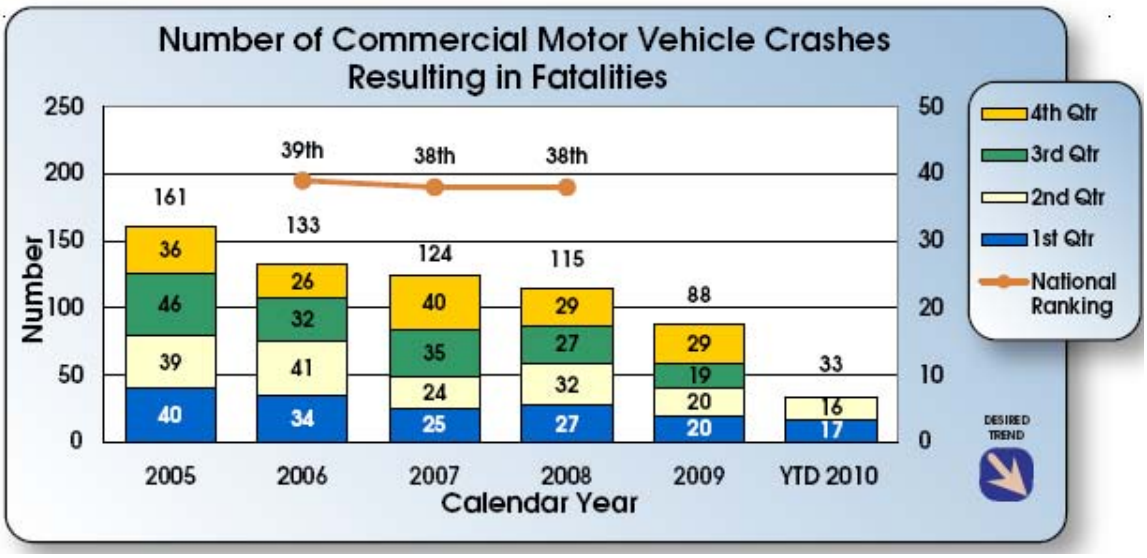


Figure 5

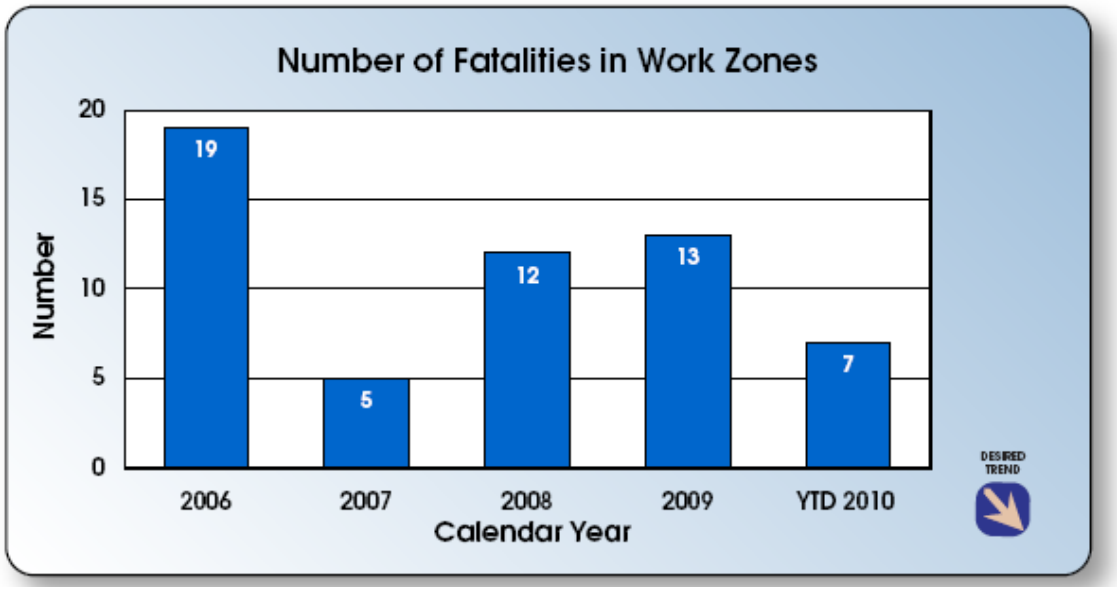


Figure 6

Accidents statistics for the work zone general area and approach from milepost 245-255 eastbound showed that three fatal accidents occurred between 3/3/10 and 8/5/10. Two of these fatal accidents involved commercial vehicles. All of the fatal crashes were between mileposts 248.4-251.6. There were an additional 11 injury accidents and 53 property damage accidents in this 10-mile long segment of road between March and August.

Examination of the Daily Work Reports (DWR's) showed that 15 accidents were noted in the project manager's diaries. In each DWR the traffic control was described for each accident that occurred. (See Attachment 2 for more details)

Statistics Specific to Milepost 245-255 for the periods March 3-August 5, 2005 through 2010 are provided below:

I-44 Franklin County, Missouri Milepost 245-255 (PDO= Property Damage Only)

	Fatal	**Injury**	**PDO**
2005			
Passenger	1	4	29
Commercial Vehicle	2	1	14
2006			
Passenger	0	9	32
Commercial Vehicle	0	6	16
2007			
Passenger	1	20	38
Commercial Vehicle	0	7	15
2008			
Passenger	0	17	41
Commercial Vehicle	0	2	18

	Fatal	**Injury**	**PDO**

2009			
Passenger	0	6	29
Commercial Vehicle	0	0	27
2010			
Passenger	1	9	30
Commercial Vehicle	2	2	23
Total			
Passenger	3	65	199
Commercial Vehicle	4	18	113

Figure 7

In all three 2010 fatal accidents a left lane closure was in effect at the time. The first one occurred on E/Bound I-44 at Milepost 248.4 about 4:20 pm on April 13, 2010. A passenger car struck the rear of a motorcycle. The second fatal crash occurred at Milepost 251.6 about 3:05 p.m. on May 14, 2010. A speeding passenger car struck the rear of a truck tractor semi-trailer.

As a result of the first accident, MODOT and the contractor held a meeting on 5/04/2010, and decided to limit the lane closures from 9am to 2pm and adjust the times as needed.

The following section provides the number of congestion ahead related accidents on the statewide highway system, the number of rear-end accidents on the statewide highway system, the number of single-unit truck and truck tractor accidents, the number of single unit pick-up truck accidents, and the number of school bus accidents on the statewide highway systems. Also statistics are provided on accidents occurring on the interstate system only. This data is provided for calendar years 2004-2007.

Congestion Ahead Accidents:	**2004**	**2005**	**2006**	**2007**	**2008**
Fatal	**15**	**23**	**15**	**16**	**8**
Injury	**2910**	**3000**	**2923**	**2664**	**2140**
Property Damage Only	**8303**	**8387**	**8573**	**8026**	**6251**

Rear-end Accidents	**2004**	**2005**	**2006**	**2007**	**2008**
Fatal	**Not Listed**		**41**	**41**	**42**
Injury	**Not Listed**		**7926**	**7507**	**6355**
Property Damage Only	**Not Listed**		**24362**	**23830**	**19310**

Single Unit Truck&Tractor	**2004**	**2005**	**2006**	**2007**	**2008**
Fatal	**44**	**42**	**43**	**37**	**30**
Injury	**837**	**855**	**729**	**674**	**625**
PDO	**2668**	**2550**	**2395**	**2359**	**3361**

Pick-up Trucks Not Tow a Trailer	**2004**	**2005**	**2006**	**2007**	**2008**
Fatal	**228**	**239**	**221**	**220**	**187**
Injury	**7370**	**7140**	**6653**	**6429**	**5446**
PDO	**18,899**		**17874**		**14730**

School Bus Accidents	**2004**	**2005**	**2006**	**2007**	**2008**
Fatal	**3**	**3**	**1**	**1**	**None**
Injury	**75**	**68**	**63**	**62**	**42**
PDO	**212**	**224**	**239**	**196**	**184**

Interstate System Accidents	**2004**	**2005**	**2006**	**2007**	**2008**
Fatal	**141**	**180**	**135**	**107**	**108**
Injury	**4901**	**4915**	**4781**	**4631**	**4292**

H. Construction Details

Federal project J6I2011 entailed widening the road by constructing an additional third lane in each direction over a 4.122-mile long area beginning east of State Route 100 to east of State Route OO near Pacific, Mo. The project limits were from station No. 1518-to-1727+77 or approximately 21, 764 feet long. Consequently, while the accident occurred outside the project limits, it did occur within the advance warning area which is covered by the traffic control plan. (See Attachment 3 for more details) Also, 23 CFR Subpart J Part 630.1004 defines a work zone crash as "One in which the first harmful event occurs within the boundaries of a work zone or on an approach to or exit from a work zone, resulting from an activity behavior or control related to the movement of the traffic units through the work zone. This includes crashes occurring on the approach to, exiting from or adjacent to work zones that are related to the work zone."

An additional work zone was underway at Milepost 248 involving bridge construction repair by Pavement Solutions, Inc. under Federal Project J6I735D. The same MODOT inspectors provided oversight on both contracts and coordinated lane closures. There were no lane closures for the bridge project on the day of this accident.

The construction was designed to be completed in the following five stages of the sequence of construction:

1. Stage 1

   Install temporary signage, channelizers and erosion control devices.

   Install object markers along outside shoulder at all proposed and existing guardrail locations at 100-foot spacing.

Close outside lane per lane closure details during unrestricted hours. Leave existing guardrail in place during stage 1 construction.

Excavate existing shou8lder area as required and install edge drain and new shoulder optional pavement. Excavation and work area shall not extend beyond that which pavement and construction can be completed during unrestricted hours.

Restore two lane traffic in each direction prior to restricted hours as defined in the job special provisions.

2. Stage 2A

Prior to opening new pavement to traffic completed in stage 1, the contractor shall use excavated material to eliminate pavement edge differential. No direct payment shall for this work. Remove existing pavement marking and install temporary pavement marking by closing outside lane during unrestricted hours.

Shift traffic to the stage 2 location and install temporary concrete traffic barrier, attenuators, channelizers, and construction signing as required.

Remove existing overlay on 10-foot width of existing lane behind the barrier and perform survey per special job provision to establish profile grade.

Place a minimum of a 2-foot width of aggregate or millings behind barrier per the details on the Traffic Control Plan typical sections to meet the requirement for barrier deflection.

Complete earthwork, storm sewer, rock base, edge drain, pavement, shoulder, and permanent traffic barrier installations shown in the stage 2A Traffic Control Plan typical section. Complete pavement repairs as required.

3. Stage 2B

Relocate temporary concrete traffic barrier to new 2A shoulder in median or relocate to storage and place channelizers as shown.

Close inside lane during unrestricted hours and complete pavement overlay as shown on section 2B typical section sheets of the Traffic Control Plan. Restore two-lane traffic prior to restricted hours.

Construct shoulder reconstruction and temporary pavement in median from station 1498+37 to station 1512+00.

Any pavement edge drops shall be addressed in accordance with standard plan 619.10. No direct payment will be made for edge treatment if required in stage 2B

4. Stage 3

Relocate temporary concrete traffic barrier as shown on stage 3 typical section of the Traffic Control Plan .

Plug bridge drains over traffic lanes and remove plug when no longer needed. Install temporary pavement marking and traffic control as shown. Complete pavement repairs as required. Complete proposed pavement and shoulder overlay, outside rumble strips, installation of guardrail, placement of millings, ditchwork, sideslope gradings, and permanent signing installations.

Stage pavement overlay in ramp areas to provide continuous access. Install temporary surfacing as required to provide smooth surface for access to ramps.

Remove excess temporary pavement from the median from station 1501+07 to station 1512+00 as shown on the traffic control plan.

Remove temporary concrete barrier, remove temporary pavement marking, and complete inside rumble strip and final pavement marking.

5. Post Stage 3

> Mill existing asphalt lanes and place 1 ¾ inches SP1258SM from station no. 1727+77 to station 1770+35 eastbound and station no. 1727+77 to 1770+50 westbound.

One of the "Special Provisions" of the contract addressed the traffic management plan and adherence to Divisions 100 and 600 of Missouri's Standards and Specification for Highway Construction 2004 and Missouri Standard Plans for Highway Construction 2008. The special provision was a contractual requirement limiting lane closure delays to 15 minutes and providing penalties to contractors who fail to comply with the requirement. Eastbound lane closures were also prohibited between 5am-9am (See Attachment 4 for project contract, attachment 5 for Design plans, and Attachment 6 for Standard Specifications)

The 15- minute queueing or delay time was evaluated by Fred Weber and the Traffic Management Center of MODOT using the following three procedures.

1.Traffic Cameras in the TMC

2."Blue Toad" Traffic Delay Prediction Systems powered by "Blutooth" (See WWW.Trafficcast.com for more details)

3. Establishing known queueing lengths that would result in a 15 minute delay.

The closest traffic camera to the accident site was located at milepost 251.7 on I-44. The scene could not be viewed from this location because of a horizontal curve that limited the view to the scene. Additionally, the "Blue Toad" system did not record a 15 minute delay. The "Blue Toad; queue detectors were located at Mile Marker 247 and approximately Mile Marker 251. The resident engineer for MODOT indicated that they had measured delay times in the area and had established a location near milepost 247 for determining a 15-minute delay. In other words, the lane was closed at milepost 251 for the work area at milepost 252. Traffic would have to queue 4 miles to milepost 247 before the project inspectors would instruct Fred Weber

to re-open the lane closure. At the time of the accident the traffic had only become congested back to milepost 250.52, so the delay was not considered a problem that would warrant re-opening the lane.

I. Advance Warning Electronic Devices and Signs

On the afternoon of the accident, the MSHP major crash team videoed the eastbound approach to the accident area beginning at milepost 232 or about 18.5 miles before the accident location. The MODOT project engineers videotaped this area on the day after the accident. (See Attachment 7 for Videotape)

The NTSB inspected the Advanced Warning on Saturday 8/7/10. Additionally, the positions of both Changeable Message Signs (CMS) and Dynamic Message Signs (DMS) warning boards were also documented in the project managers DWR's.

The inspections noted that advance warning of the lane closure was first located at milepost 237 or 14 miles in advance of the lane closure. At this location a (DMS) was posted. This is a permanent installation. The messages are digitally recorded by the TMC. At this location the DMS displayed, "Road Work at mm 251 Left lane closed"

This same message was displayed on another DMS at mile 249.9, which was 1.1 miles in advance of the left lane closure. There were temporary horizontal rumble strips installed across the width of both eastbound lanes in advance of each DMS sign to attract the attention of motorists to the signage and messages. There were also (CMS) located at milepost 246.8 and 247.9. Both CMS signs displayed the message, "Paving Work Mon-Fri Expect Increased Delay."

The dimensions of the DMS signs are as follow: They are located on dual concrete columns that are located 33 feet and 44 feet from the shoulder edge. The top of the message sign is 17 feet 8 inches high above the ground and the sign is 20 feet 8 inches wide. The display letters were 16 inches tall and 12 inches wide. The CMS signs had the following dimensions: Right-hand shoulder edge to middle of the sign pole was 27 feet two inches. From the top to the ground was 154 inches. The digital display sign was 134 11/2 inches wide by 70 inches tall. It had 3 rows of panel boards each having 8 display panels. The

illuminated letters were 18 inches tall and 12 inches wide. There was an MB 91 CMS at milespost 246.8. It was manufactured by Wanco in Denver. See www.Wanco.com for more information. The CMS was provided by a subcontractor, Traffic Control Company, see www.TrafficControlcompany.com for more information.

The other CMS sign was an MB81 model provided by the same sub contractor and manufactured by National signal incorporated. The sign was located 11 feet off of the road edge. It was 159 inches above the ground. The display was 128 inches wide by 76 inches tall.

The following sign dimensions were noted: At milepost 249.7 there were "Road Work Ahead" signs on both shoulders. The height of the signs above the ground were 143 inches. The signs were 48 inches square, and there were 3 white traffic panels with orange diagonal stripes below the main sign. The panels were 5 inches wide by 8 feet 5 inches long. On top of the signs 18-inch square, orange flags were mounted. The signs were coated with retroreflective engineering grade orange sheeting.

At milepost 250.4 the speed limit was reduced to 50 mph. The 30-inch-long by 24-inch-wide black on white regulatory sign was posted on a 48-inch square orange warning construction sign (2-Wo3-5) MUTCD code. The bottom of the sign was 82 inches above the ground and the top of the sign was 147 inches high.

Contractors at Fred Weber, Inc. and the MODOT Resident engineer indicated that the standard taper that preceded the lane closure had orange Directional Indicator Boards (DIB's) and an arrow board. The complete details from the Traffic Control Plan Detail Sheets can be found in attachment 5 Design Plans. The section on the lane closure is provided in the figures below.

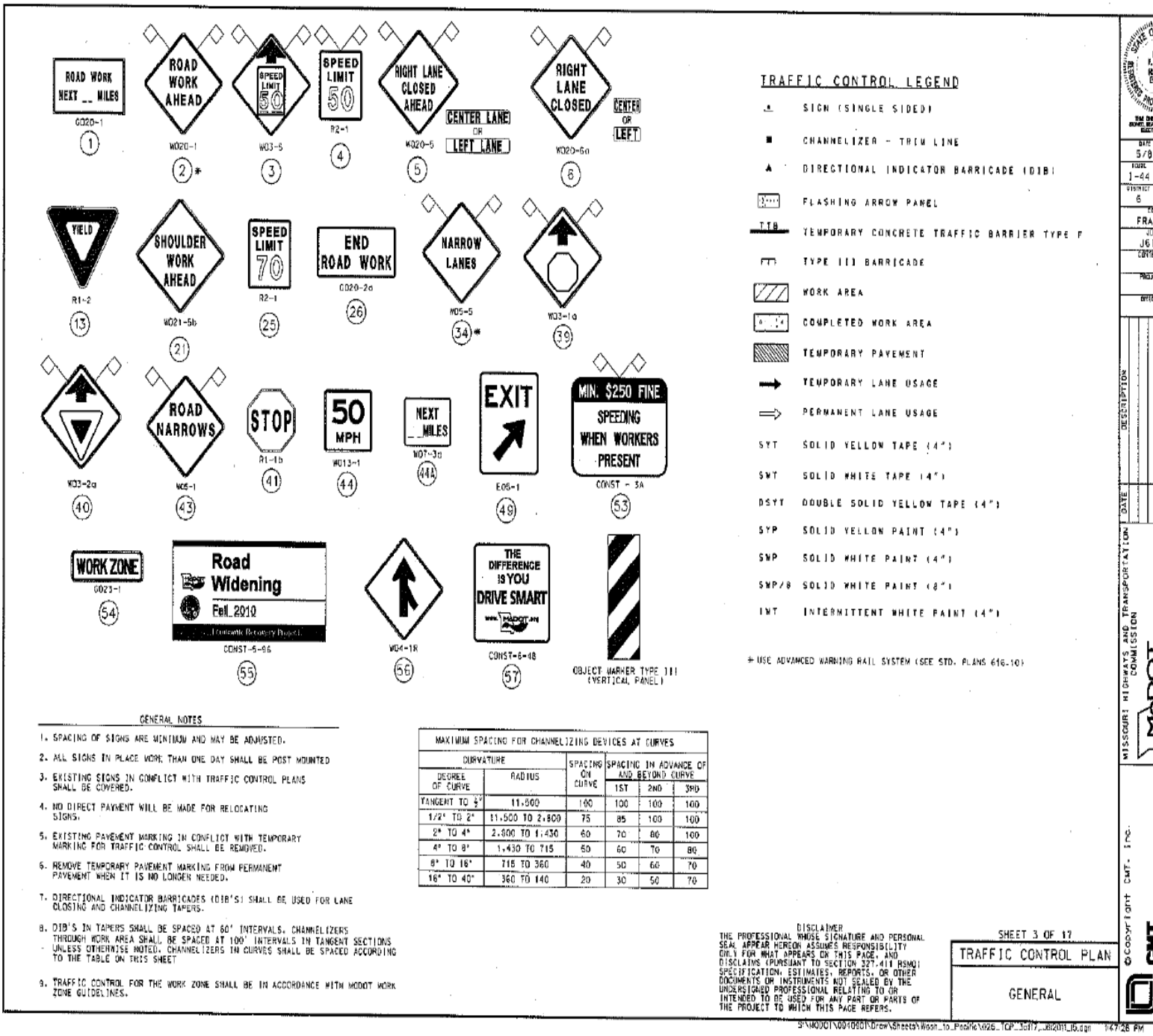


Figure 8

See Attachment 5 for larger print viewing.

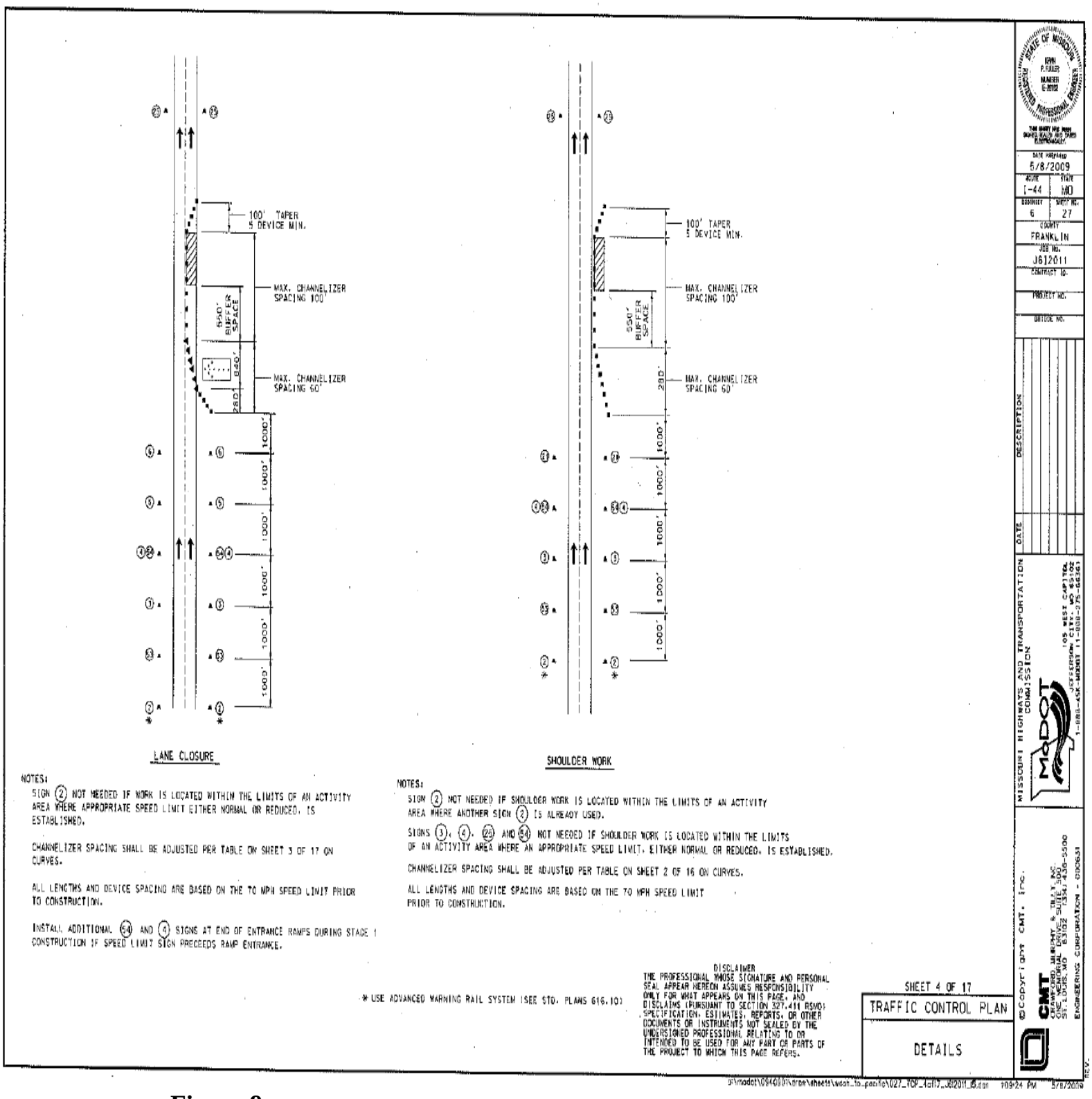


Figure 9

See Attachment 5 for larger print viewing

The Traffic Management Center (TMC) is directed by a professional engineer, and each shift has a supervisor and 4-6 screen operators. The screen operators monitor all of the DMS sign messages, traffic cameras, and the "Blue Toad system." More information on travel indices and the St. Louis TMC can be found at WWW.Gatewayguide.com.

J. Scene Information

The alignment, grade, pavement dimensions and scene evidence was located by the MSHP major crash investigation team using a total station. All measurements were verified by the NTSB. The alignment of the pavement was tangent for over 2,550 feet prior to the impact location which was 626 feet east of milepost 250.4. A sag vertical curve ended at 2,550 feet from the impact area. There were no alignment restrictions to visibility.

The roadway was aligned N-64 degrees 57 minutes 10 seconds East.

The area encompassing the pre-impact tire friction marks, impact gouges, post-crash tire marks and gouges, and the final positions of all the vehicles were within an area 196 feet long. In figure 10 the accident location is at approximately Station Number1451, which is displayed along the top line or just to the right of Milepost 250.4 which is displayed along the bottom of the drawing.

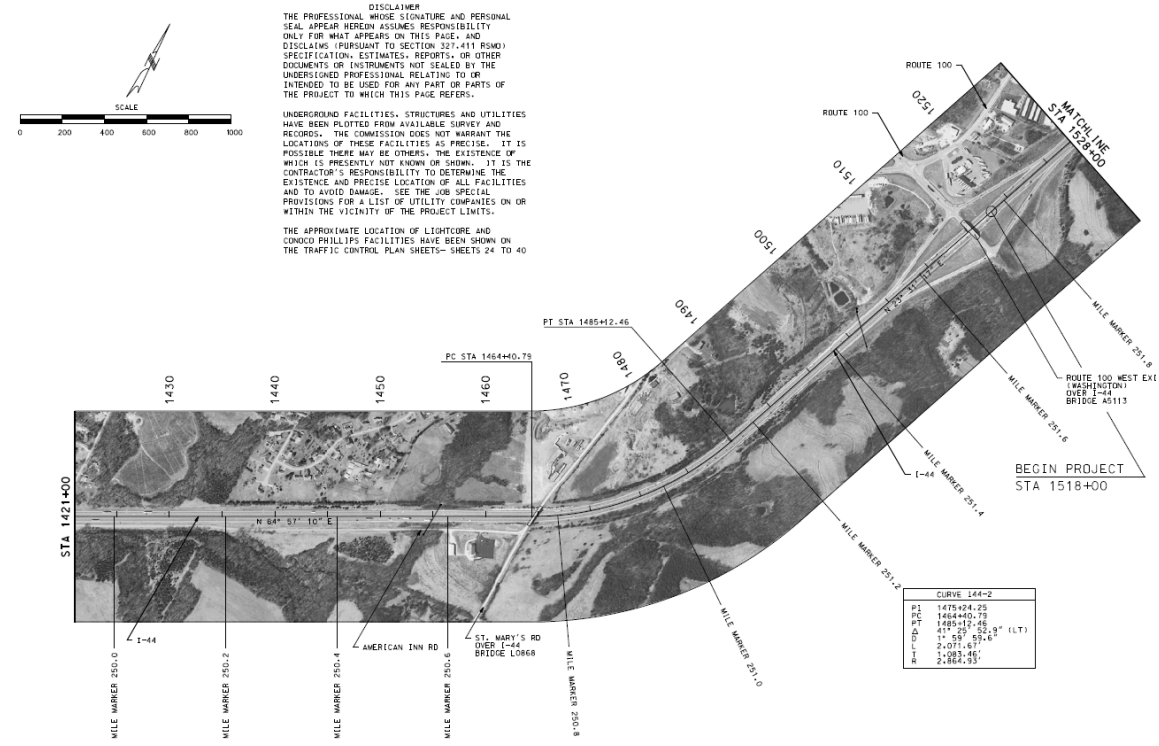


Figure 10

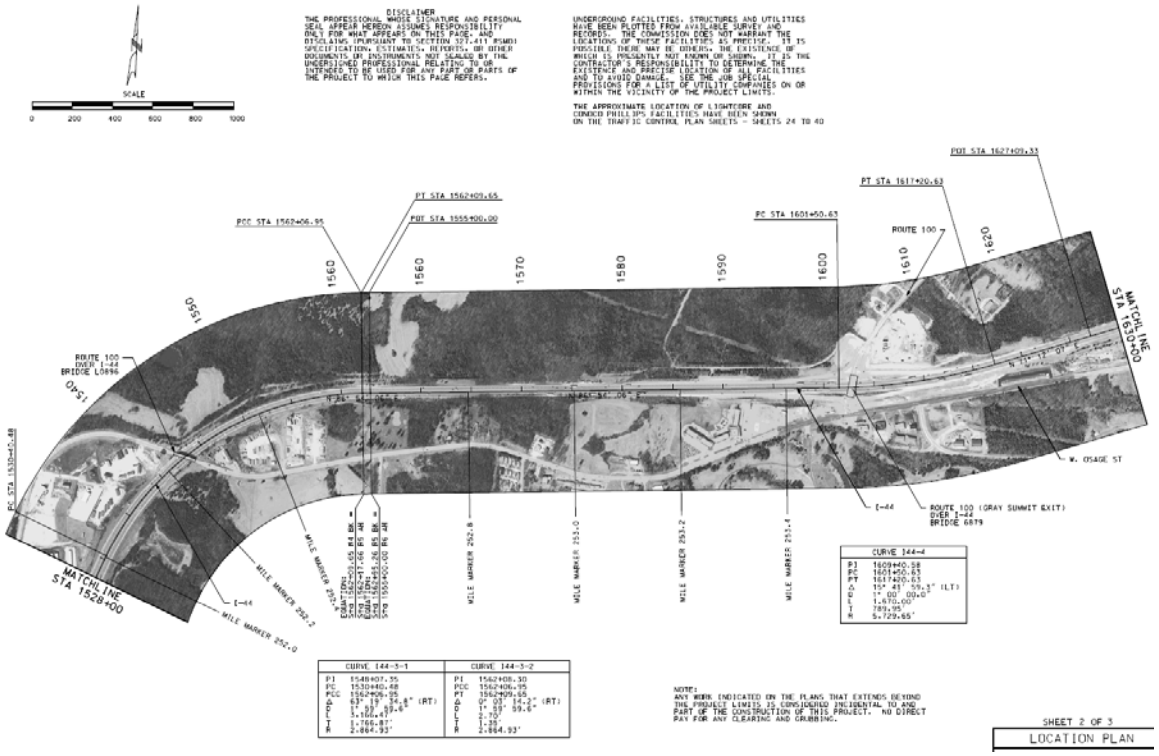


Figure 11

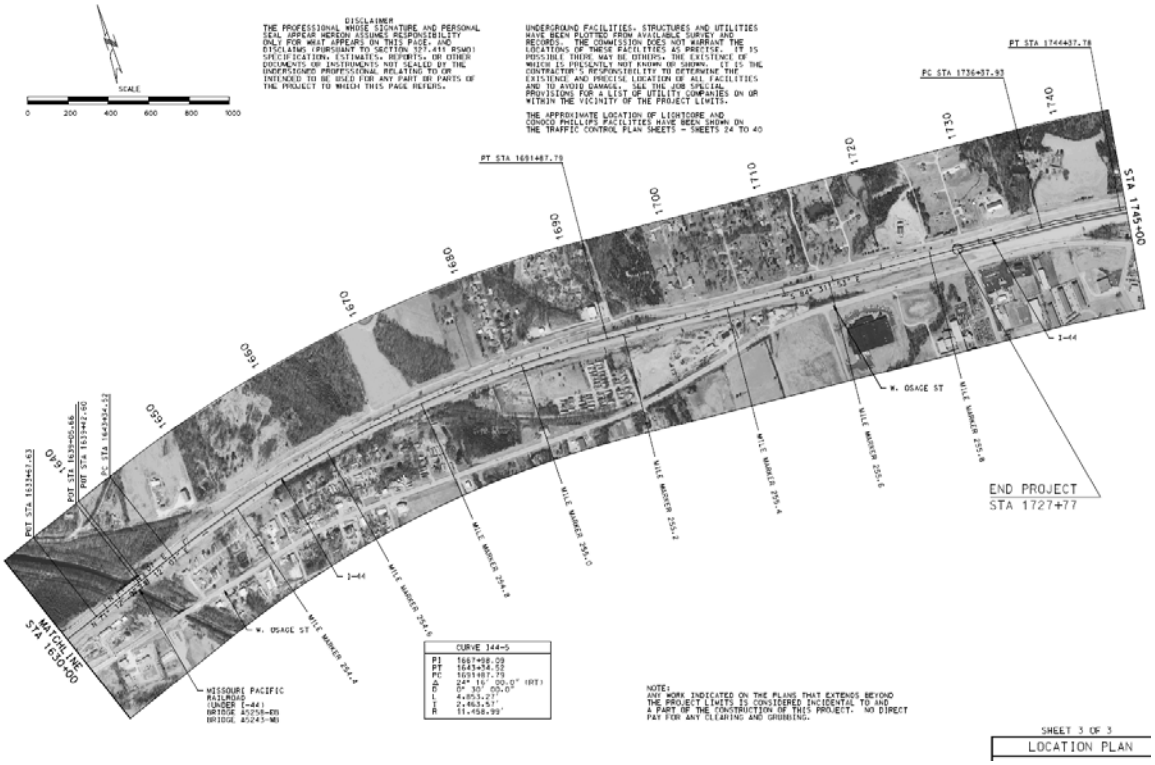


Figure 12

See Attachment 5 for larger print viewing of figures 10-12

K. Work Zone Oversight

The Federal Highway Administration (FHWA) exercises oversight of Federal-aid project work zones through guidance found in 23CFR630 Subpart J., "Traffic Safety in Highway and Street Work Zones." Subpart J was re-titled "Work Zone Safety and Mobility in October 2007 in response to federal rulemaking in 2004. (See 69 FR54562 , Published September 9, 2004, for more information.)

The key components of the update rule included the following:

1. Development and implementation of an overall, agency-level work zone safety and mobility policy to institutionalize work zone processes and procedures.
2. Development of agency-level processes and procedures to support policy implementation, including procedures for work zone impact assessments, analyzing work zone data, training, and process reviews.
3. Development of procedures to assess and manage work zone impacts of individual projects.

The MODOT developed these policies and procedures in their Engineering Policy Guide 616.14, "Work Zone Safety and Mobility Policy." (See Attachment 8 for a copy of the Guide) This document is also available on the internet, at the following website address: http://epg.modot.mo.gov/index.php?title=616.14_Work_Zone_Safety_and_Mobility_Policy

Noteworthy items found during a review of the Plans, Specifications, and Estimates (PS&E) and MODOT EPG were detailed traffic control plan specifications, establishment of requirements for responsible parties trained in traffic control at MODOT and contractor level, detailed strategies, special provisions for restricting lane closures during peak hours, establishing delay times and procedures to determine delay periods, and establishing separate pay items for advanced traffic control devices, such as, Changeable Message Signs (CMS). Also, weekly work zone meetings were held each Wednesday in the TMC to discuss all work zones in the St. Louis District. Additionally, quarterly "Tracker Performance" progress meetings are held, which involve MODOT, FHWA, and Contractors. Tracker is a performance oriented goal evaluation system where progress toward 18 tangible results is reviewed statewide each quarter.
http://www.modot.org/about/general_info/Tracker.htm

L. Excerpts From Daily Work Records

Almost every day from January 14, 2010, the first day the left lane was closed until August 5, 2010, the day of this accident there were comments from the work zone inspectors about the traffic control being in compliance with the traffic control detail sheets. On most days the traffic was moving well and when it was not it was noted. On many occasions there were notes about the contractors terminating the lane closure for brief periods of time to move out congested traffic. On 3/19/10, the work zone

inspector noted the traffic was heavy and terminated the lane closure. He also noted they would discuss traffic control alternatives some more in the coming week. On 4/13/10, the date of the first fatal accident the lane closure was not terminated until 4:30 pm 10 minutes after a fatal accident occurred. The inspector noted the accident occurred outside the project limits near MP 248.4. He also noted that they had kept the closure in place longer than normal so that a patch could be installed over some cross road pipe.

On 4/17/10 there was an E/B lane closure from 5am-11am that was pulled when traffic got heavy. It should be noted that this closure violated the restrictions of the special provisions, because the lane was closed during restricted hours. On 4/29 the E/B lane drop was terminated at 11 am due to heavy traffic. On 4/30/10 the same congestion occurred and they had to terminate the lane drop at 10:30 am.

On 5/04/10 they traffic became heavy around 4 pm resulting in a 20 minute delay, also a violation of the special provisions. MODOT had a meeting with the Contractor on this day where it was decided to limit the left hand lane closure from 9am until 2pm and see how that worked with the caveat that it would be adjusted accordingly.

On 5/14 the lane drop was not initiated until noon because of rain. The contractors began working about 1 pm and then halted about 3 pm when it began raining again. Before they could complete taking down the lane closure the second fatal accident occurred about milepost 251.6.

On 5/19/10 another meeting occurred between the contractor and MODOT. One of the inspectors, Donnie Payne, stressed to the contractor that they had to be proactive to a solution if traffic starts to back up. "We have got to fix whatever problems we are having right now, they cannot just push the issue until we are backed up several miles."

On 5/24/10 another accident occurred on E/B 44 while the left lane closure was in effect at about 4:30 p.m.

On 6/03/10 there was a left lane closure set up early at 5 pm for the night shift. Traffic was noted as being heavy with a 25 minute peak delay.

On 6/11/10 the traffic became congested early and the left-hand lane closure had to be pulled at 12 noon. The inspector noted that there were

significant back-ups both east and west bound and that he discussed the issue with Trey and told him that it was unacceptable.

On 6/29/10 MODOT and the contractor had a meeting to discuss Stage II traffic control, schedule, and safety issues.

This accident occurred during Stage II operations at a time in the morning when it was not normally congested. The diary indicated the left lane was closed from Milemarker 251-254.

M. Independent Inspection Reviews

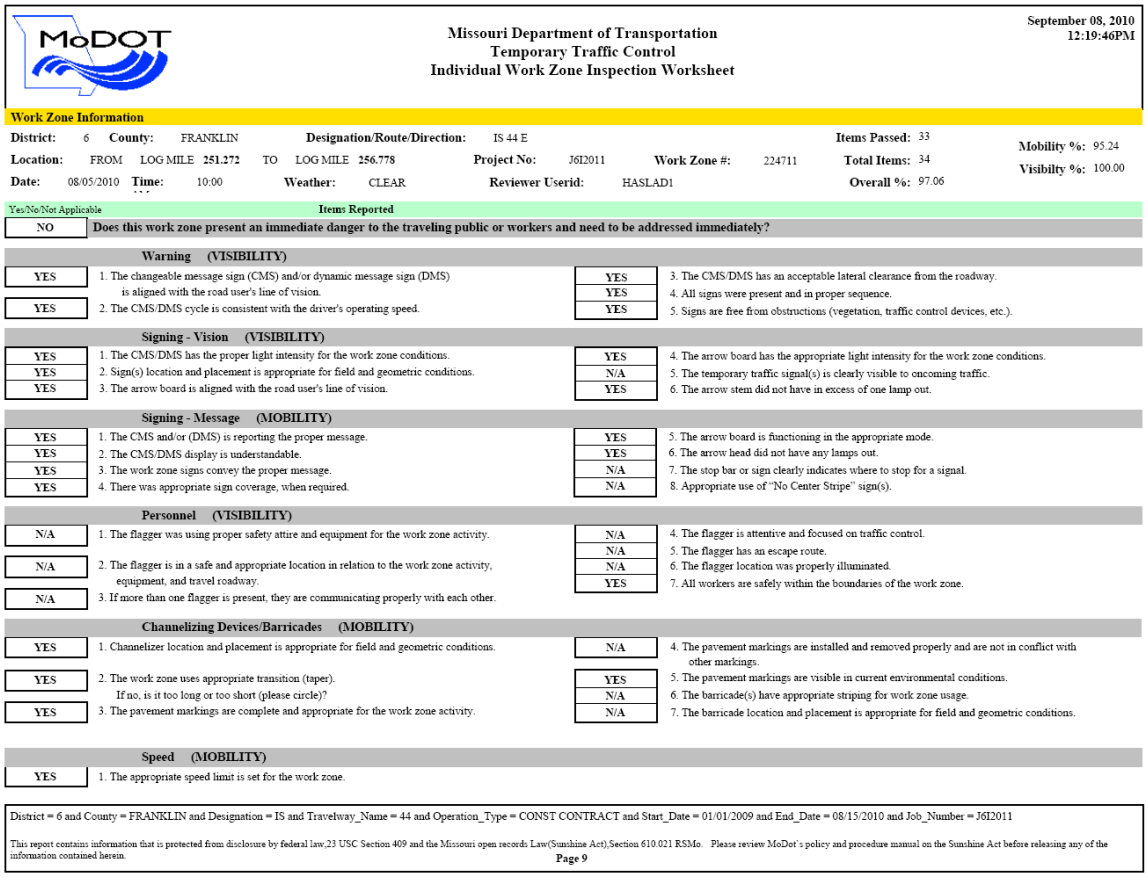
Between January and August 15, 2010, MODOT employees sent in 21 independent inspections of the I-44 work zone. All MODOT technical employees are authorized to inspect a work zone out of there area when they are driving through a different area of the State. These independent reviews are placed into a database and maintained by the State Work Zone Coordinator. There were a few discrepancies noted but overall, the work zone was rated at 97.96 percent. A Work Zone Inspection Form was completed on the day of this accident. (See Attachment 9 for more details and figure 13 below)

N. FHWA Construction Inspection

On June 16, 2010, the Federal Highway Administration inspected this project to determine compliance with contract requirements. As part of that inspection the work zone traffic control was evaluated. The FHWA engineer noted that no problems or deficiencies were found. The inspector noted that the speed limit was reduced to 50 mph due to narrowed lanes to accommodate the on-going paving operations. He indicated the speed reduction appeared to be adequate for the conditions.

The only overall deficiency noted was that as of the date of the inspection only 34% of the work had been accomplished and 71% of the

contract time had elapsed. (See attachment 10 for FHWA Inspection Report)



Missouri Department of Transportation
Temporary Traffic Control
Individual Work Zone Inspection Worksheet

September 08, 2010
12:19:46PM

Work Zone Information

District: 6 **County:** FRANKLIN **Designation/Route/Direction:** IS 44 E **Items Passed:** 33
Location: FROM LOG MILE **251.272** TO LOG MILE **256.778** **Project No:** J6I2011 **Work Zone #:** 224711 **Total Items:** 34
Date: 08/05/2010 **Time:** 10:00 **Weather:** CLEAR **Reviewer Userid:** HASLAD1 **Overall %:** 97.06

Mobility %: 95.24
Visibilty %: 100.00

Yes/No/Not Applicable	Items Reported
NO	**Does this work zone present an immediate danger to the traveling public or workers and need to be addressed immediately?**

Warning (VISIBILITY)

YES	1. The changeable message sign (CMS) and/or dynamic message sign (DMS) is aligned with the road user's line of vision.	YES	3. The CMS/DMS has an acceptable lateral clearance from the roadway.
YES	2. The CMS/DMS cycle is consistent with the driver's operating speed.	YES	4. All signs were present and in proper sequence.
		YES	5. Signs are free from obstructions (vegetation, traffic control devices, etc.).

Signing - Vision (VISIBILITY)

YES	1. The CMS/DMS has the proper light intensity for the work zone conditions.	YES	4. The arrow board has the appropriate light intensity for the work zone conditions.
YES	2. Sign(s) location and placement is appropriate for field and geometric conditions.	N/A	5. The temporary traffic signal(s) is clearly visible to oncoming traffic.
YES	3. The arrow board is aligned with the road user's line of vision.	YES	6. The arrow stem did not have in excess of one lamp out.

Signing - Message (MOBILITY)

YES	1. The CMS and/or (DMS) is reporting the proper message.	YES	5. The arrow board is functioning in the appropriate mode.
YES	2. The CMS/DMS display is understandable.	YES	6. The arrow head did not have any lamps out.
YES	3. The work zone signs convey the proper message.	N/A	7. The stop bar or sign clearly indicates where to stop for a signal.
YES	4. There was appropriate sign coverage, when required.	N/A	8. Appropriate use of "No Center Stripe" sign(s).

Personnel (VISIBILITY)

N/A	1. The flagger was using proper safety attire and equipment for the work zone activity.	N/A	4. The flagger is attentive and focused on traffic control.
N/A	2. The flagger is in a safe and appropriate location in relation to the work zone activity, equipment, and travel roadway.	N/A	5. The flagger has an escape route.
N/A	3. If more than one flagger is present, they are communicating properly with each other.	N/A	6. The flagger location was properly illuminated.
		YES	7. All workers are safely within the boundaries of the work zone.

Channelizing Devices/Barricades (MOBILITY)

YES	1. Channelizer location and placement is appropriate for field and geometric conditions.	N/A	4. The pavement markings are installed and removed properly and are not in conflict with other markings.
YES	2. The work zone uses appropriate transition (taper). If no, is it too long or too short (please circle)?	YES	5. The pavement markings are visible in current environmental conditions.
YES	3. The pavement markings are complete and appropriate for the work zone activity.	N/A	6. The barricade(s) have appropriate striping for work zone usage.
		N/A	7. The barricade location and placement is appropriate for field and geometric conditions.

Speed (MOBILITY)

YES	1. The appropriate speed limit is set for the work zone.

District = 6 and County = FRANKLIN and Designation = IS and Travelway_Name = 44 and Operation_Type = CONST CONTRACT and Start_Date = 01/01/2009 and End_Date = 08/15/2010 and Job_Number = J6I2011

This report contains information that is protected from disclosure by federal law,23 USC Section 409 and the Missouri open records Law(Sunshine Act),Section 610.021 RSMo. Please review MoDot's policy and procedure manual on the Sunshine Act before releasing any of the information contained herein.

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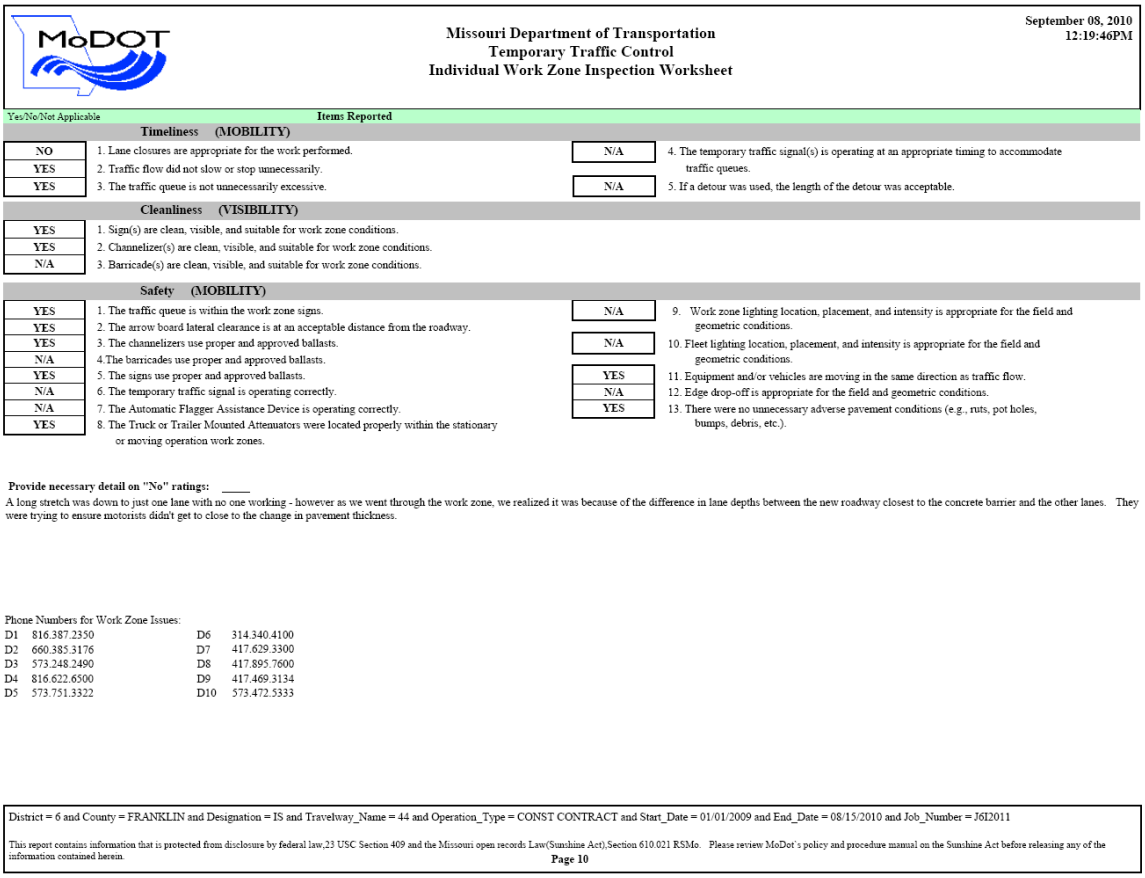
Figure 13



Missouri Department of Transportation
Temporary Traffic Control
Individual Work Zone Inspection Worksheet

September 08, 2010
12:19:46PM

Yes/No/Not Applicable	Items Reported
	Timeliness (MOBILITY)
NO	1. Lane closures are appropriate for the work performed.
YES	2. Traffic flow did not slow or stop unnecessarily.
YES	3. The traffic queue is not unnecessarily excessive.
N/A	4. The temporary traffic signal(s) is operating at an appropriate timing to accommodate traffic queues.
N/A	5. If a detour was used, the length of the detour was acceptable.
	Cleanliness (VISIBILITY)
YES	1. Sign(s) are clean, visible, and suitable for work zone conditions.
YES	2. Channelizer(s) are clean, visible, and suitable for work zone conditions.
N/A	3. Barricade(s) are clean, visible, and suitable for work zone conditions.
	Safety (MOBILITY)
YES	1. The traffic queue is within the work zone signs.
YES	2. The arrow board lateral clearance is at an acceptable distance from the roadway.
YES	3. The channelizers use proper and approved ballasts.
N/A	4.The barricades use proper and approved ballasts.
YES	5. The signs use proper and approved ballasts.
N/A	6. The temporary traffic signal is operating correctly.
N/A	7. The Automatic Flagger Assistance Device is operating correctly.
YES	8. The Truck or Trailer Mounted Attenuators were located properly within the stationary or moving operation work zones.
N/A	9. Work zone lighting location, placement, and intensity is appropriate for the field and geometric conditions.
N/A	10. Fleet lighting location, placement, and intensity is appropriate for the field and geometric conditions.
YES	11. Equipment and/or vehicles are moving in the same direction as traffic flow.
N/A	12. Edge drop-off is appropriate for the field and geometric conditions.
YES	13. There were no unnecessary adverse pavement conditions (e.g., ruts, pot holes, bumps, debris, etc.).

Provide necessary detail on "No" ratings: ____

A long stretch was down to just one lane with no one working - however as we went through the work zone, we realized it was because of the difference in lane depths between the new roadway closest to the concrete barrier and the other lanes. They were trying to ensure motorists didn't get to close to the change in pavement thickness.

Phone Numbers for Work Zone Issues:

D1	816.387.2350	D6	314.340.4100
D2	660.385.3176	D7	417.629.3300
D3	573.248.2490	D8	417.895.7600
D4	816.622.6500	D9	417.469.3134
D5	573.751.3322	D10	573.472.5333

District = 6 and County = FRANKLIN and Designation = IS and Travelway_Name = 44 and Operation_Type = CONST CONTRACT and Start_Date = 01/01/2009 and End_Date = 08/15/2010 and Job_Number = J6I2011

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Figure 14

See Attachment 9 for larger print viewing

O. Accident Reconstruction Information

Pick-up Truck weight = 4965 pounds
Volvo tractor weight = 18,100 pounds
2003 bluebird school bus weight = 21,160 pounds
2001 bluebird school bus weight = 21, 389 pounds

Drag factor for post crash skidding last impact = .2594 g's
Drag factor for post crash skidding 2nd impact - .63 g's
Pre-crash skidding last impact = .63 g's

Skid distances:

Post crash skid distance for 2nd impact = 23.31 feet
Post crash skid distance for last impact = 16.91 feet
Pre-crash tire friction mark prior to last impact = 46.17 feet

First Impact Data:

CDR recorded speed for GMC pick-up = 55 mph
Change in velocity for GMC pick-up= 33 mph