

2014 WORK ZONE SAFETY AUDITS ANNUAL SUMMARY REPORT



North Carolina Department of Transportation
Work Zone Traffic Control Section
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www.connect.ncdot.gov/projects/wztc/Pages/default.aspx

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Cover Photo: I-85 / I-73 Interchange construction – Greensboro, NC March 14, 2005



Introduction

As part of NCDOT's statewide work zone safety and temporary traffic control program, jointly with the FHWA, the Traffic Control Plans (TCP) Unit travels around the State conducting several, multi-day construction Work Zone Safety Audits. The 2014 Work Zone Safety Audits visited and reviewed 33 different highway construction work zones.

The 2014 construction season provided a wide variety of work zones to review. Project locations ranged from the North Carolina Coast in the east to the Blue Ridge Mountains of the west. Several projects completely closed the road to public travel, while others worked alongside high-speed, live traffic.

In conducting the Safety Audits, a number of Reviewers are invited to participate. Reviewers represent a broad cross-section within the temporary traffic control discipline – FHWA, NCDOT Region TCP Design and Region Safety personnel. Audit participants are asked to score the work zone on a wide array of performance measures. Scores and comments are used to focus and heighten awareness of the many standards, practices, procedures and devices used in the design and implementation of NCDOT's Traffic Control Plans. This report provides important feedback for statewide TCP Designers, NCDOT engineering consultants and Region Construction Project Management staff. NCDOT benefits from the Safety Audits by realizing measurable improvements in the quality and safety of the temporary traffic control plans used on its highway construction projects.



Objective

The purpose of the Work Zone Safety Audits is to:

- Confirm NCDOT Work Zone Traffic Control Design Standards and Practices are being implemented in the field consistently, uniformly and are effective at providing a satisfactory level of safety for the traveling public and construction workers.
- Reveal additional techniques or technologies needed to improve overall safety, traffic flow and construction efficiency.
- Identify current standard practices that need to be updated based on observations and feedback.
- Strengthen communication and working relationships between NCDOT design and construction staff, consultants and contractor employees.

Conducting the Safety Audit

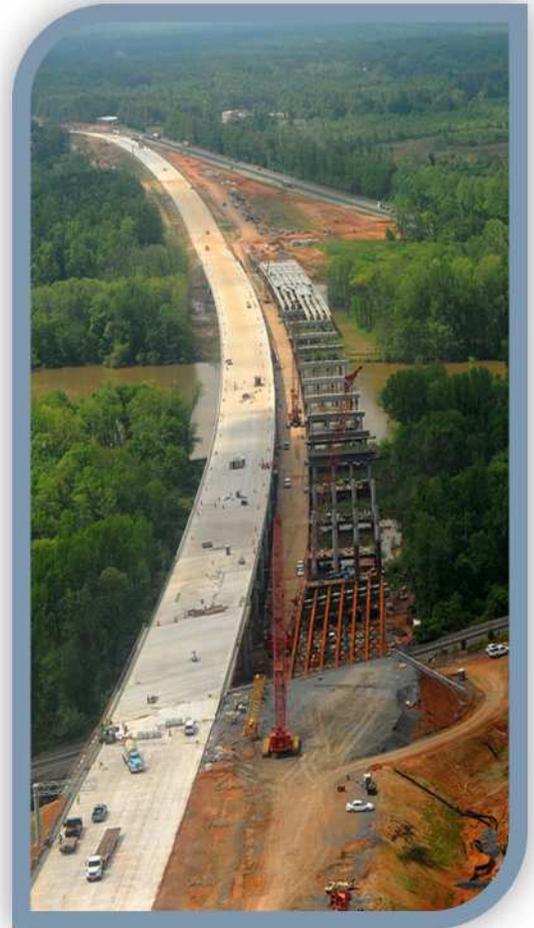
The Work Zone Safety Audits allow designers, Safety staff, Project Coordinators, Division and Construction personnel the opportunity to observe strengths and weaknesses within this unique and dynamic discipline.

Each Reviewer is asked to evaluate the condition and effectiveness of a variety of devices used within the work zone. 36 different “measures” are scored within 15 separate categories for each project visited.

Scores are based on a scale of 1 (low) to 5 (high). A score of 1 warrants immediate contact with NCDOT Division lead personnel assigned to the project to discuss the issue and possible mitigation strategies. Likewise any items or devices deemed necessary for safety reasons that’s found to be missing or omitted is immediately brought to the attention of Division project personnel as well.

The Work Zone Safety Audit Evaluation Form (see page 5) is used by Reviewers to record scores, notes and comments for each project visited.

Measures are scored as applicable for each project. If a device or condition is not present on a project at the time of the visit, a score is not given. For example, temporary portable concrete barrier may have been included in a particular contract, but if not in use on the project at the time of the visit, “Barrier” (and likely “Crash Cushions”) would not be scored.



Scoring



Each of the following “measures” is evaluated within the categories listed for each project visited:

Temporary Signage – The overall Quality (design condition), Placement and Spacing (visibility and legibility).

Channelization Devices – The overall Quality, Condition, Placement and Effectiveness for Cones, Drums, Skinny Drums, and Barricades.

Temporary Pavement Markings – The overall Quality (condition and visibility), Placement and removal of temporary and permanent markings, where applicable.

Barrier – Alignment (placement), Crashworthy installations, and Quality (condition) of each type barrier in use. (Concrete, Water-Filled, or Other together with applicable Crash Cushions). Comments are also, made on barrier anchors (connections) and delineation (condition).

Impact Attenuators (Truck Mounted) - The overall Quality (condition), and Placement. Observations on the proper application for these devices should be noted as well.

Portable Changeable Message Signs (PCMS) – Effective placement, Condition, and Message quality. Notations of messages are recorded when possible.

Flashing Arrow Boards – Placement, Condition, Levelness, Visibility, and Angularity.

Temporary Traffic Signals – Proper installation (Placement / Setup), Operation (Timing), and Condition.

Bicycle, Pedestrian & ADA Facilities – ADA Compliance, Adequate signing and devices; and Continuity through the project site (detours, diversions)

Flagging Operations – Proper placement / setup, Effective devices and equipment, and Performance. (Flaggers and or Pilot car operations)

Mobility – Overall flow of traffic, Effect of construction activities on traffic. Reviewers are also, asked to record observations on how long they are stopped at a flagger or signal (if applicable) and the approximate travel speed realized through the work zone.

Worker Garments & Equipment – Standard application of safety measures for workers and equipment on the jobsite.

Site Housekeeping – Condition (Clean / Orderly)

Law Enforcement – Rather than a score we wish the reviewer(s) to indicate whether they observed Law Enforcement in or patrolling the work zone (on-site) or if the particular project was earmarked for the HAWKS program (Helping All Workzones Keep Safe) with a simple Y/N answer.

TMP Plan / RSD Compliance – Compliance with the plans and or standard drawings

Figure 1 - Work Zone Safety Audit Evaluation Form

WORK ZONE SAFETY AUDITS - EVALUATION FORM				
PROJECT ID:		TYPE OF WORK:		REGION:
HIGHWAY:		RDWY TYPE:		RD CLASSIFICATION:
PROJECT MANAGER:		OTHER CONTACTS:		REVIEWED BY:
CONTRACTOR		REVIEW PERIOD:		TC PLANS
ONLY SCORE DEVICES WITNESSED ON THE PROJECT. IF A DEVICE WAS NOT PRESENT, DO NOT SCORE IT. (See Note Below)				
<small>NOTE: Immediately advise Division Personnel of any missing or omitted device(s) deemed necessary for safety reasons.</small>				
IMMEDIATE ATTN: REQ'D	BELOW EXPECTATIONS	EXPECTED	ABOVE EXPECTATIONS	EXEMPLARY
1	2	3	4	5
CATEGORIES		SCORE	NOTES	
TEMPORARY SIGNING- Portable/Stationary <i>(Signs, Sign Supports)</i>	QUALITY			
	PLACEMENT			
	SPACING			
CHANNELIZATION DEVICES <i>(Cones, Drums, Skinny Drums, Barricades)</i>	CONES			
	DRUMS			
	SKINNY DRUM			
	BARRICADES			
TEMPORARY PAVEMENT MARKINGS <i>(Paint, Tape, Raised Markers)</i>	CONDITION			
	PLACEMENT			
BARRIER- Concrete, Water-filled, Other (Delineators?) (Anchored?)	CONDITION			
	PLACEMENT			
CRASH CUSHIONS	CONDITION			
	PLACEMENT			
IMPACT ATTENUATORS <i>(Truck /Trailer Mtd)</i>	CONDITION			
	PLACEMENT			
PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)	MESSAGE			Capture messages, if possible
	PLACEMENT			
	CONDITION			
FLASHING ARROW BOARDS	PLACEMENT			
	LEVELNESS/ VISIBILITY/ ANGULARITY			
	CONDITION			
TEMPORARY TRAFFIC SIGNALS	SET-UP			
	TIMING			
	CONDITION			
BICYCLE, PEDESTRIAN & ADA FACILITIES <i>(Score if existing facilities affected by construction)</i>	SIGNING			
	Continuous Route?			
	ADA Compliance			
FLAGGING OPERATIONS	SET-UP			
	FLAGGER / PILOT CAR			
	AFAD			
MOBILITY <i>Time Stopped At Flagger or Signal (if Applicable)</i> <i>Approx. Travel Speed thru the work zone?</i>	Overall Flow			
WORKER GARMENTS & EQUIPMENT	GARMENTS			
	EQUIPMENT			
SITE HOUSEKEEPING	CLEAN, ORDERLY			
LAW ENFORCEMENT <i>Y or N</i>	ON-SITE?		Did you see Law Enforcement in or patrolling the work zone? <small>(Was this project earmarked for the HAWKS program? (Helping A ll Work zones Keep it safe)</small>	
	HAWKS?			
TMP PLAN / RSD COMPLIANCE				
FINAL SCORE				
GRAND TOTAL = <input type="text" value="0"/> Divided By <input type="text" value="0"/> N = <input type="text" value="#DIV/0!"/>				
<small>* N = The Number of Scored Categories</small>				



RESULTS

Results from approximately 1368 scores from 38 different Reviewers for a total of 33 projects were used to develop the project and measure scores. Project scores are combined and averaged based on the number of participants submitting an Evaluation Form. Overall average project scores are calculated for each Region and will be compared to scores collected each subsequent year. Average scores for individual projects are ranked in order of highest to lowest (see pages 11 through 16).

Measure Scoring Summary (Statewide)

Figure 2 (page 8) shows the statewide average score for each work zone measure. Figure 2 can be used to identify measures (devices, practices) needing additional attention at the design and/or implementation phase of the project. It also identifies measures that are meeting or exceeding road users' expectations.

Of the 36 measures, the majority received an average score within the range of 3.00 to 3.99 (Expected).

Measures that consistently received the highest scores (3.50 and above) for 2014 are:

- Impact Attenuators - 3.63
- Flashing Arrow Boards - 3.50
- Flagging Operations - 3.50

Measures that consistently received the lowest scores (below 3.00) for 2014 are:

- Channelization Devices - 2.98
- Pavement Markings - 2.92
- Bicycle/PED/ADA - 2.33

On the pages that follow, measured scores will be depicted as follows:

Measures Highlighted in **Green** are the Highest Average Scores **(3.50 and above)**

Measures highlighted in **Yellow** are the Middle Average Scores **(3.00 to 3.49)**

Measures highlighted in **Red** are the Lowest Average Scores **(2.00 to 2.99)**

SCORED MEASURES FOR THE STATE

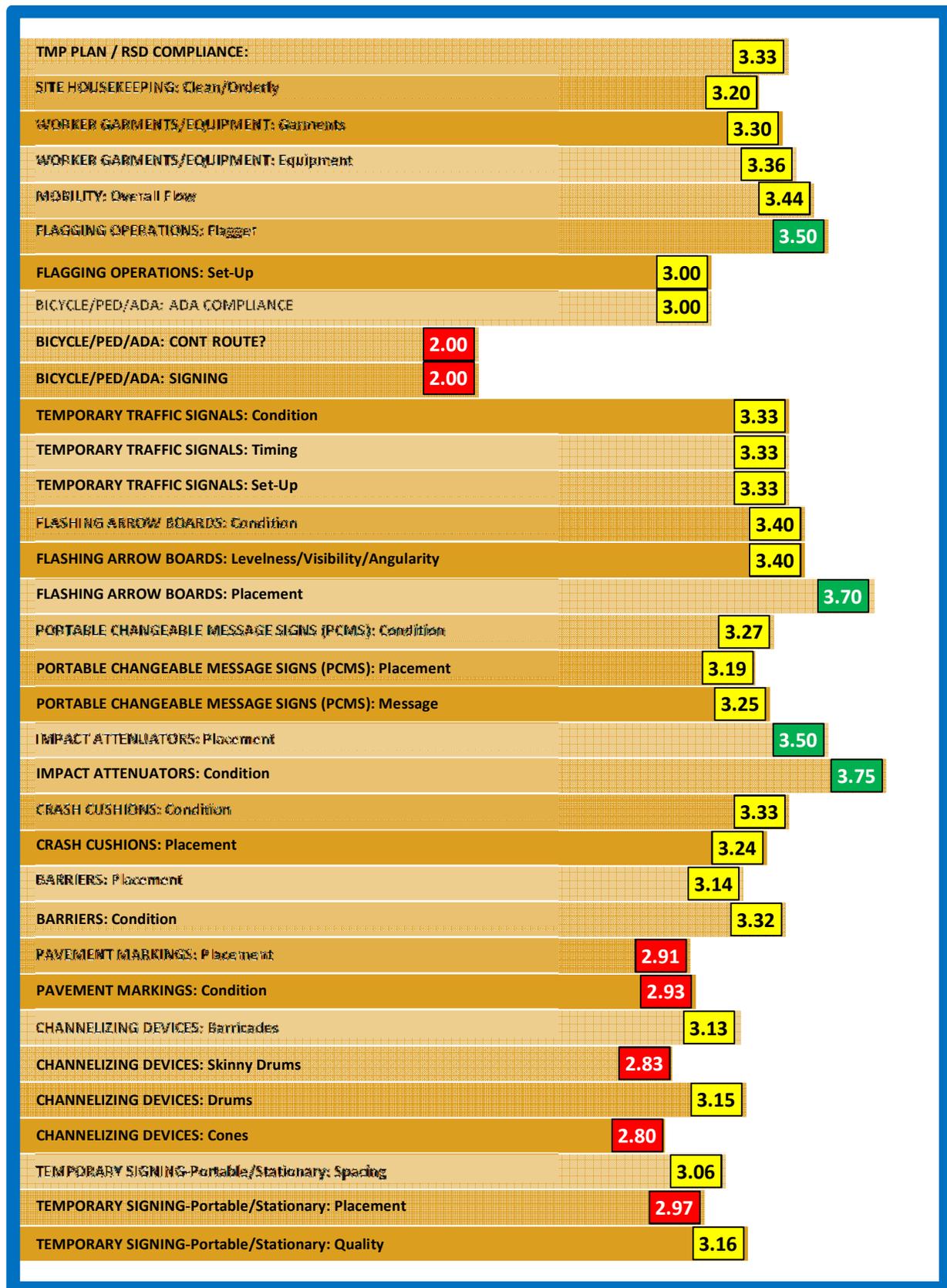


Figure 2 - Average Score for Individual Categories Reported

STATEWIDE SCORING SUMMARY

Total Projects Reviewed 2014 (33)

The statewide average project scores of 61.8* equates to a rating of “Expected” based on the current scoring system. The “Expected” rating confirms that the TCP Standards and Practices are mostly effective and being implemented a majority of the time.

* Raw scores (“out of 5”) are converted to scores based on 100 for annual comparison purposes with subsequent years.

The Measures scored during the Audits are averaged and ranked – both statewide and for each Region (See Figures 10 through 16).

Figure – 3 Annual Scores

2013 WORK ZONE SAFETY AUDIT SUMMARY REPORT – SCORING STATISTICS by YEAR				
	2013	2014	2015	2016
TOTAL PROJECTS REVIEWED	28	33	-	-
HIGH SCORE (Above Expectations)	0	0	-	-
AVERAGE SCORE (Expected)	63	61.8	-	-
LOW SCORE (Below Expectations)	0	0	-	-

Annual Average Statewide Work Zone Tour Scores

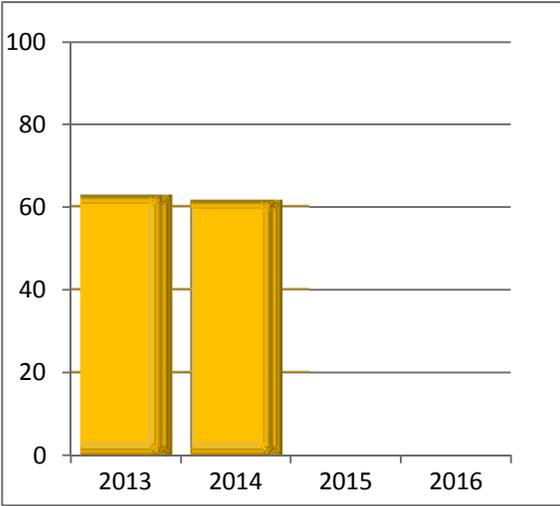


Figure – 4 Annual Scores graph

North Carolina County / Region Outline Map



REGIONAL SCORING SUMMARY

On the pages that follow, are graphical Region maps showing individual Project scores and overall average Measure scores for that region. Projects and measures follow the same highlighted color scheme depicted on page 7.

Figure – 5 Region Scores

2013 WORK ZONE SAFETY AUDIT SUMMARY REPORT – SCORING STATISTICS by REGION				
	2013	2014	2015	2016
EAST REGION	67	47.2	-	-
CENTRAL REGION	62	67.2	-	-
WEST REGION	62	57.8	-	-

Figure – 6 # of Projects

PROJECTS SCORED PER REGION	
EAST REGION	6
CENTRAL REGION	21
WEST REGION	6

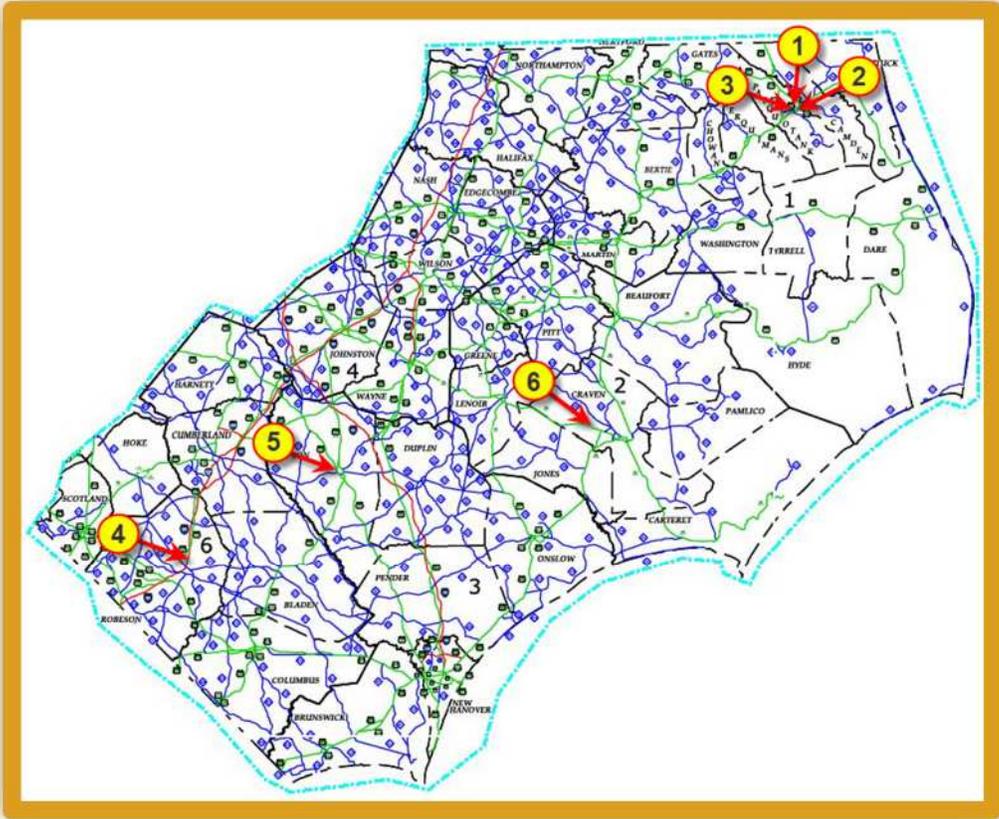
SCORE	# of Projects	% of Projects
>4.00	3	9%
3.00 - 4.00	19	58%
<3.00	11	33%

Figure – 7 Project Average Scores

EASTERN REGION

Divisions: 1, 2, 3, 4, & 6

Counties: Beaufort, Bertie, Bladen, Brunswick, Camden, Carteret, Chowan, Columbus, Craven, Cumberland, Currituck, Dare, Duplin, Edgecombe, Gates, Greene, Halifax, Harnett, Sampson, Hertford, Hyde, Johnston, Jones, Lenoir, Martin, Nash, New Hanover, Northampton, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Pitt, Robeson, Tyrrell, Washington, Wayne, Wilson



Scores of Individual Projects – East Region	
1. US 158-East Elizabeth Street	2.11
2. US 158	2.89
3. US 17 / US 158	2.78
4. Bridge on US 301 on I-95	2.68
5. NC 24 From Mitchell Loop Rd to US-421/701	2.67
6. US-70 East (near MM 403) Division 2	1.00

EASTERN SCORES

Average Measure Scores East			
Temporary Signing	2.44	Bicycle/PED/ADA	2.33
Channelization Devices	2.65	Flagging Operation	
Pavement Markings	2.30	Mobility	3.00
Barriers	2.80	Worker Garments/Equip	3.00
Impact Attenuators		Site Housekeeping	2.60
PCMS	3.00	Law Enforcement	
Flashing Arrow Broads		TC Plans/STD Drawings	2.67
Temporary Traffic Signals	3.00		

Average Scores for Audits Conducted in the Eastern Region

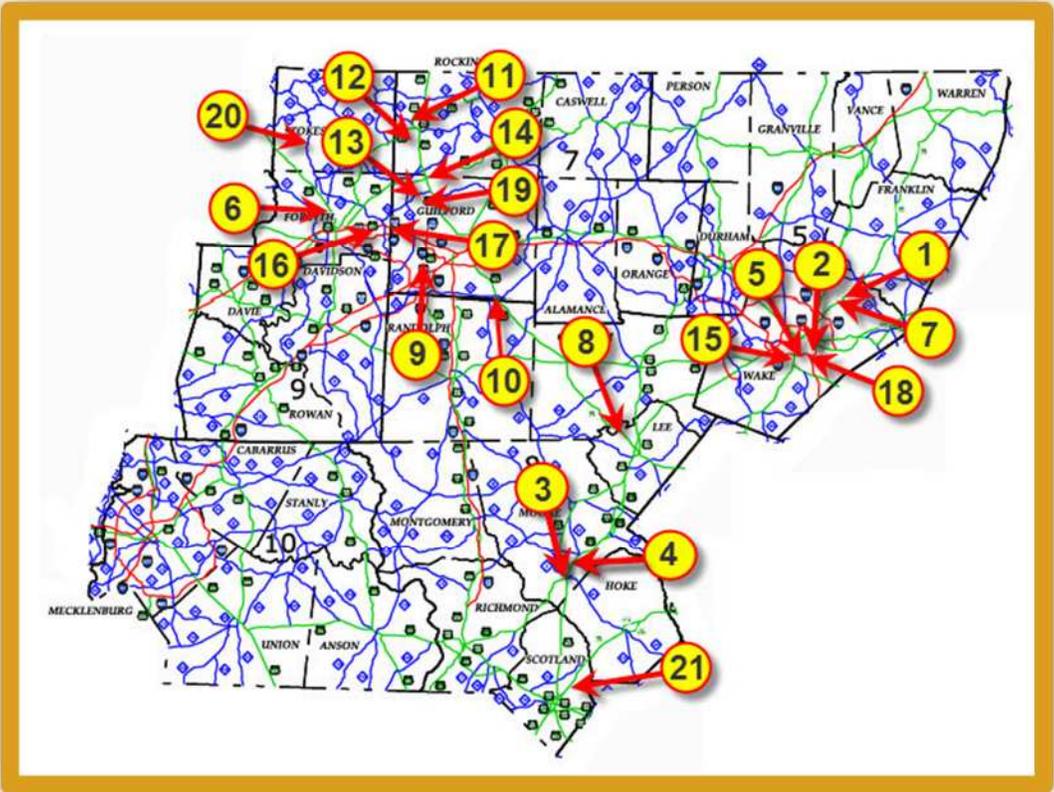
Weaknesses:

- Temporary Signing
- Channelization Devices
- Pavement Markings
- Barriers
- Bicycle/Ped/ADA
- Site Housekeeping
- TC Plans/STD Drawings

CENTRAL REGION

Divisions: 5, 7, 8, & 9

Counties: Alamance, Caswell, Chatham, Davidson, Davie, Durham, Forsyth, Franklin, Granville, Guilford, Hoke, Lee, Montgomery, Moore, Orange, Person, Randolph, Richmond, Rockingham, Rowan, Scotland, Stokes, Vance, Wake, Warren



Scores of Individual Projects – Central Region					
1. US 401 and -Y- Lines	3.00	8. US-421 / NC-87	4.24	15. I-40	3.53
2. I-440 – I-40 Crabtree	3.64	9. SR 4121 High Point Rd.	3.22	16. Union Cross Rd.	2.19
3. US 1 SB	3.77	10. US-421 S	3.00	17. Bus 40	2.95
4. SR 1319 – US1	3.13	11. US-220	4.17	18. I-440	3.50
5. I-40 WB	3.00	12. SR-1128	4.17	19. US 52	3.08
6. US 52	3.00	13. U.S. 220	3.95	20. US 52	3.00
7. US 401-Y-Lines	3.00	14. U.S. 220	3.86	21. US 401	3.07

CENTRAL SCORES

Average Measure Scores Central			
Temporary Signing	3.31	Bicycle/PED/ADA	2.00
Channelization Devices	3.09	Flagging Operation	3.33
Pavement Markings	3.19	Mobility	3.65
Barriers	3.46	Worker Garments/Equip	3.49
Impact Attenuators	3.83	Site Housekeeping	3.42
PCMS	3.40	Law Enforcement	
Flashing Arrow Boards	3.63	TC Plans/STD Drawings	3.57
Temporary Traffic Signals	3.67		

Average Scores for Audits Conducted in the Central Region

Strengths:

- Impact Attenuators
- Flashing Arrow Boards
- Temporary Traffic Signals
- Mobility
- TC Plans / STD Drawings

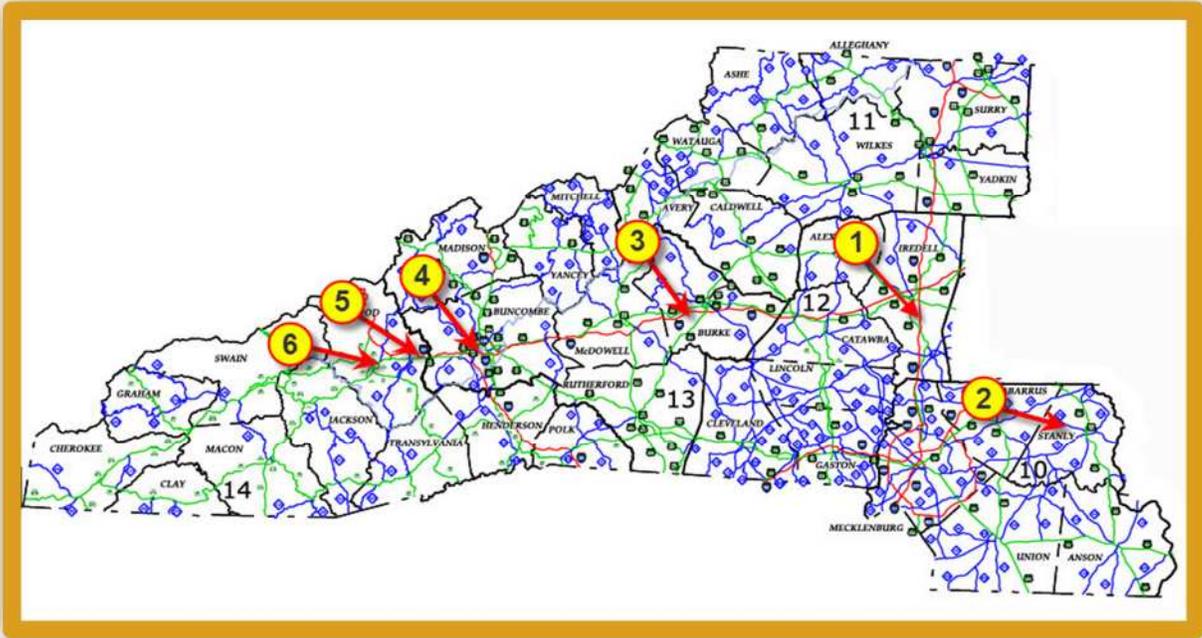
Weaknesses:

- Bicycle / PED / ADA

WESTERN REGION

Divisions: 10, 11, 12, 13, & 14

Counties: Alexander, Alleghany, Anson, Ashe, Avery, Buncombe, Burke, Cabarrus, Caldwell, Catawba, Cherokee, Clay, Cleveland, Gaston, Graham, Haywood, Henderson, Iredell, Jackson, Lincoln, Macon, Madison, McDowell, Mecklenburg, Mitchell, Polk, Rutherford, Stanly, Surry, Swain, Transylvania, Union, Watauga, Wilkes, Yadkin, Yancey



Scores of Individual Projects – West Region	
1. I-77 from exit 45 to 54	2.89
2. NC 49	3.00
3. SR 1922 Enola Rd	2.71
4. I-26	3.00
5. I-40	3.00
6. Great Smoky Mountains Expy	2.75

WESTERN SCORES

Average Measure Scores West			
Temporary Signing	2.83	Bicycle/PED/ADA	
Channelization Devices	2.92	Flagging Operation	3.00
Pavement Markings	2.81	Mobility	3.00
Barriers	3.00	Worker Garments/Equip	2.50
Impact Attenuators	3.00	Site Housekeeping	3.00
PCMS	2.92	Law Enforcement	
Flashing Arrow Boards	3.00	TC Plans/STD Drawings	2.93
Temporary Traffic Signals	3.00		

Average Scores for Audits Conducted in the Western Region

Weaknesses:

Temporary Signing

Channelization Devices

Pavement Markings

PCMS

Worker Garments/Equipment

TC Plans / STD Drawings

RECOMMENDATIONS

This being our second year for the audits in this format, all reviewers were internal Work Zone Traffic Control staff. The 2014 Work Zone Safety Audits revealed a number of consistencies, and positive comments.

The majority of all 33 projects visited in 2014 scored within the median “Expected” range (3.00 – 3.99). That being the case only those receiving the highest scores (3.50 and above), and those receiving the lowest scores (2.99 and below) will be mentioned in detail within the forthcoming pages.

A combination of the Work Zone Safety Audit scores and comments were utilized.

MEASURE	STATEWIDE RANKINGS		+/-
	2013	2014	
IMPACT ATTENUATORS	13	1	+
MOBILITY	1	2	
FLASHING ARROW BOARDS	6	3	+
TEMPORARY TRAFFIC SIGNALS	2	4	-
WORKER GARMENTS/EQUIPMENT	7	4	+
TMP PLAN/RSD COMPLIANCE	3	4	
CRASH CUSHIONS	9	7	+
FLAGGING OPERATIONS	13	8	+
PCMS	10	9	
BARRIERS	7	9	-
SITE HOUSEKEEPING	4	11	-
TEMPORARY SIGNING	11	12	
CHANNELIZATION DEVICES	4	13	-
PAVEMENT MARKINGS	12	14	-
BICYCLE/PED/ADA	N/A	15	

Work Zone Traffic Control Safety Audit “Strengths”



Impact Attenuators (Truck/ Trailer Mounted)

- An impact attenuator is a device intended to protect structures, vehicles, equipment, and people during a vehicle collision.
- The impact attenuators used on site were properly installed by following TMP / RSD guidelines and they appeared to be in good condition.



Flashing Arrow Boards

- Flashing arrow boards are used to notify drivers that they need to merge lanes. They are often used on freeways and expressways because of high flowing traffic, high speeds, and low visibility.
- The flashing arrow boards used on the workzones followed TMP / RSD guidelines very closely even in unorthodox situations. All of the flashing arrow boards were in good condition.



Temporary Traffic Signals

- Temporary traffic signals are used mainly for temporary replacement of a permanent signal, or to regulate the flow of traffic in a one lane, two way TTC zone.
- The temporary traffic signals used within the work zones were functioning properly and the ones on site that were not being used were properly covered up. All of the traffic signals were in good condition.



Flagging Operations-Flagger

- A flagging operator must be properly equipped, in a visible yet safe location, and be trained to coordinate with other flaggers properly in order to perform his or her job effectively.
- The flaggers were very alert and aware of their surroundings when performing their job and were properly equipped and trained.

Work Zone Traffic Control Safety Audit “Weaknesses”

Channelization Devices



- Channelizing devices are used to warn and alert road users of hazards in work zones, protect workers, and guide and direct drivers and pedestrians past the hazards.
- In some work zones, there was not a sufficient amount of drums used to distinguish traffic direction and there was also a deficiency in barriers to protect worksites.

Pavement Markings



- Pavement markings are used to give motorists the most clear and defined travel path to get through the work zone safely.
- The main problem with most worksites is the lack of pavement markings. All pavement markings stated in the TMP need to be constructed properly in order to maintain safety.

Bicycle/PED/ADA



- When bicycle and pedestrian paths are closed or disrupted due to construction, then pedestrian traffic control is needed. This includes the use of signs, channelizing devices, flags and suitable fencing.
- Bicycle/PED/ADA paths often missed barricades, signs, and directional signage that would direct pedestrians to the correct location safely.

Temporary Signage-Portable/Stationary



- Temporary signs used on a work zone must follow NCHRP 350 requirements for the sign and stand to be used.
- The placement of some temporary signs were difficult to see. Also, there were multiple cases where signs were not level nor centered with other signs.

CONCLUSION

The 2014 Work Zone Safety Audits were a success in identifying strengths and weaknesses within NCDOT's TCP standards and practices and the implementation of those practices in our contracts. The Audits gave us the opportunity to review 33 different State highway construction work zones. Overall, although we witnessed a small decrease in the work zone safety audit scores, the goals of the audits were accomplished.

The Audits helped us meet some important goals:

- • Confirmed NCDOT Temporary Traffic Control Design Standards and Practices are largely being implemented in the field with consistency and uniformity.
- • Confirmed the latest Standards and Practices are effective at providing a satisfactory level of safety for the traveling public and construction workers.
- • Strengthened communication and working relationships between NCDOT design and construction staff, consultants, and contractor employees.
- • Identified current standard practices that need updating or better definition based on observations and feedback.

An important additional benefit from the Work Zone Safety Audits is seeing recurring "Weaknesses." We can focus on and more closely analyze these features for solutions to improve the overall design and implementation of our work zone traffic control plans. 'Lessons learned' can be shared between all TCP designers and construction personnel in efforts to avoid seeing repeat "Weaknesses".

The Workzone Traffic Control Section would like to thank each of the Reviewers who helped with the monumental task of improving safety in North Carolina work zones. Thank You.

