2016 WORK ZONE SAFETY AUDITS ANNUAL SUMMARY REPORT

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Work Zone Traffic Control Section
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Cover Photo: 2015 Western Review

Introduction

As part of NCDOT's statewide work zone safety and temporary traffic control program, jointly with the FHWA, the Work Zone Traffic Control Section travels around the State conducting several, multi-day construction Work Zone Safety Audits. During 2016 Work Zone Safety Audits visited and reviewed 29 different highway construction work zones.

The 2016 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 Signing – 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.

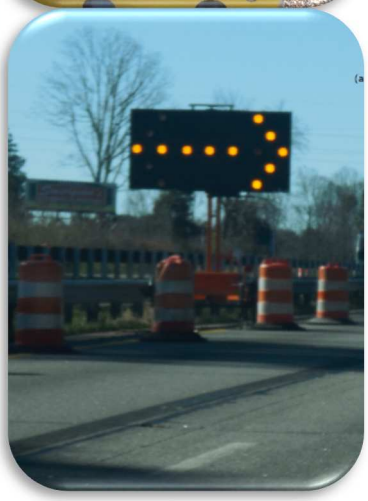
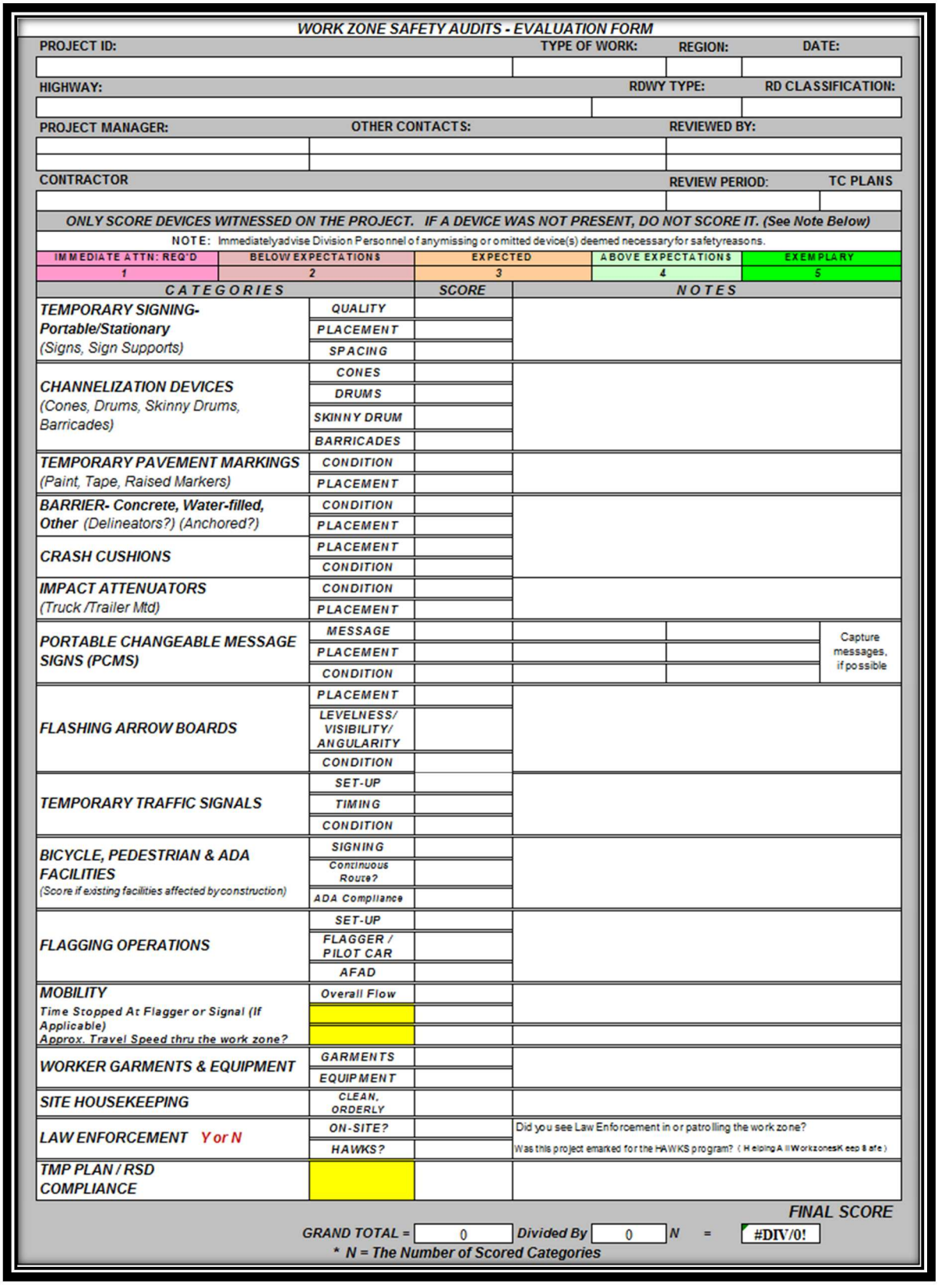


Figure 1 - Work Zone Safety Audit Evaluation Form



WORK ZONE SAFETY AUDITS - EVALUATION FORM

PROJECT ID:	TYPE OF WORK:	REGION:	DATE:

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)

NOTE: Immediately advise Division Personnel of any missing or omitted device(s) deemed necessary for safety reasons.

IMMEDIATE ATTN: REQ'D	BELOW EXPECTATIONS	EXPECTED	ABOVE EXPECTATIONS	EXEMPLARY
1	2	3	4	5

CATEGORIES		SCORE	NOTES
TEMPORARY SIGNING- Portable/Stationary (Signs, Sign Supports)	QUALITY		
	PLACEMENT		
	SPACING		
CHANNELIZATION DEVICES (Cones, Drums, Skinny Drums, Barricades)	CONES		
	DRUMS		
	SKINNY DRUM		
	BARRICADES		
TEMPORARY PAVEMENT MARKINGS (Paint, Tape, Raised Markers)	CONDITION		
	PLACEMENT		
BARRIER- Concrete, Water-filled, Other (Delineators?) (Anchored?)	CONDITION		
	PLACEMENT		
CRASH CUSHIONS	PLACEMENT		
	CONDITION		
IMPACT ATTENUATORS (Truck /Trailer Mtd)	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 (Score if existing facilities affected by construction)	SIGNING		
	Continuous Route?		
	ADA Compliance		
FLAGGING OPERATIONS	SET-UP		
	FLAGGER / PILOT CAR		
	AFAD		
MOBILITY Time Stopped At Flagger or Signal (If Applicable) Approx. Travel Speed thru the work zone?	Overall Flow		
WORKER GARMENTS & EQUIPMENT	GARMENTS		
	EQUIPMENT		
SITE HOUSEKEEPING	CLEAN, ORDERLY		
LAW ENFORCEMENT Y or N	ON-SITE?		Did you see Law Enforcement in or patrolling the work zone?
	HAWKS?		Was this project emarked for the HAWKS program? (HelpingA llWorkzonesK eep S afe)
TMP PLAN / RSD COMPLIANCE			

FINAL SCORE

GRAND TOTAL = 0 Divided By 0 N = #DIV/0!

* N = The Number of Scored Categories


ROAD WORK AHEAD
FINES HIGHER
ONE WAY
SIDEWALK CLOSED
ROAD CLOSED
DETOUR
EXIT
ROAD CLOSED
ALL TRAFFIC

RESULTS

Results from approximately 40 reviewers and 29 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 displayed later on in the report. (see pages 11 through 19).

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 2016 are:

- Flashing Arrow Boards - 3.72
- Temporary Traffic Signals - 3.47

Measures that consistently received the lowest scores (below 3.00) for 2016 are:

- Channelization Devices - 2.96
- Flagging - 2.93

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)

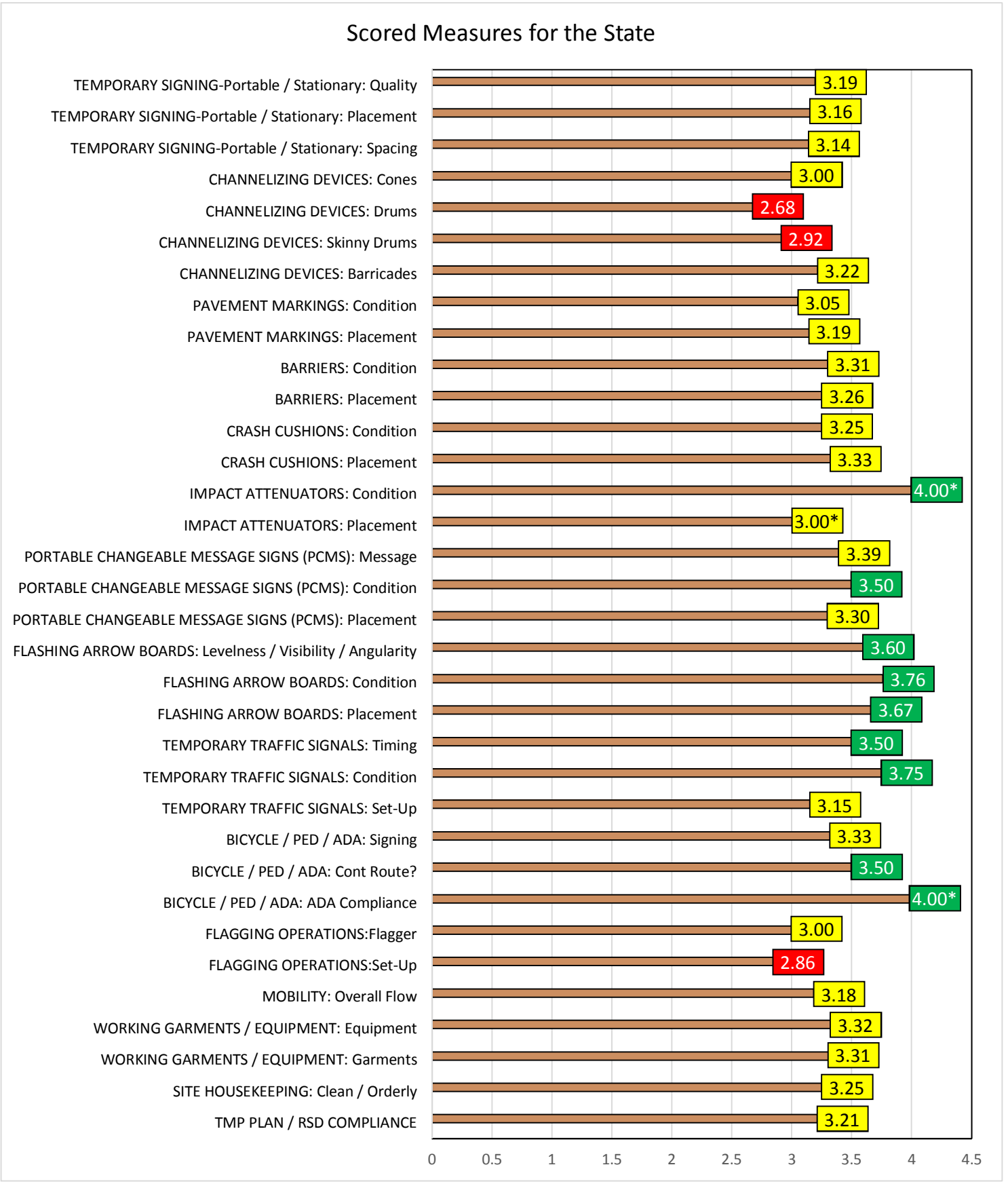


Figure 2 - Average Score for Individual Categories Reported

* Based off of a single score for this category

STATEWIDE SCORING SUMMARY

Total Projects Reviewed 2016 (29)

The statewide average project scores of 63.8* 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).

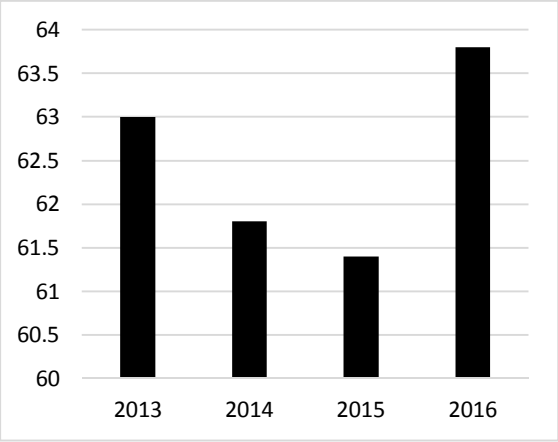
Figure – 3 Annual Scores

WORK ZONE SAFETY AUDIT SUMMARY REPORT – SCORING STATISTICS by YEAR

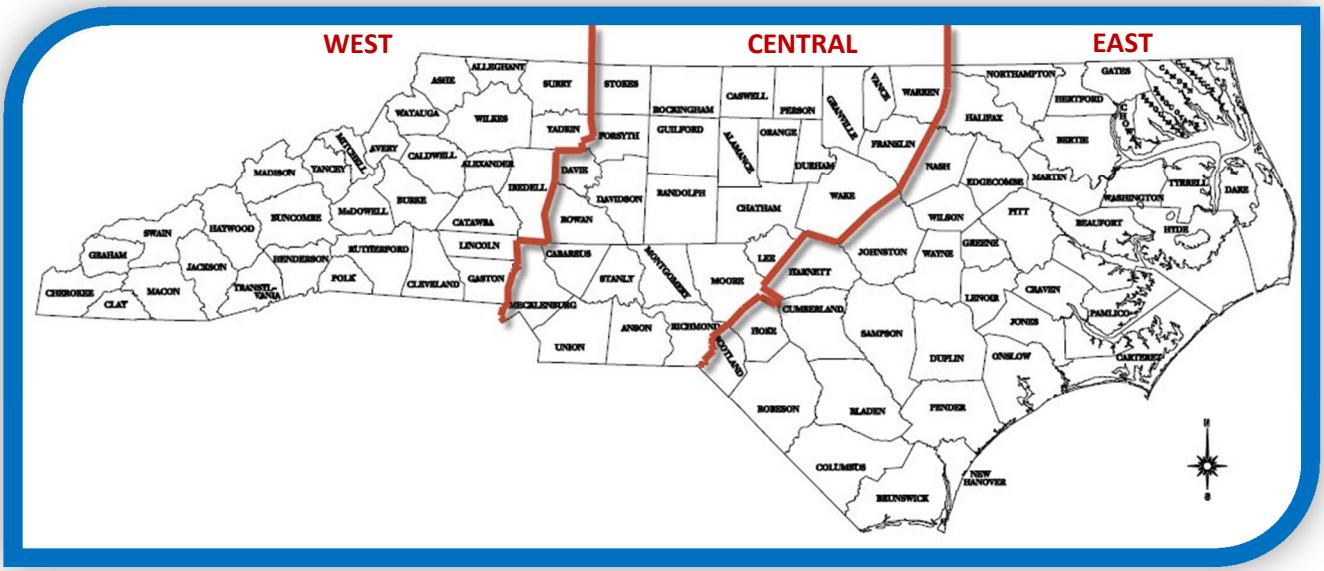
	2013	2014	2015	2016
TOTAL PROJECTS REVIEWED	28	33	45	29
HIGH SCORE (Above Expectations)	0	0	0	0
AVERAGE SCORE (Expected)	63	61.8	61.4	63.8
LOW SCORE (Below Expectations)	0	0	0	0

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

WORK ZONE SAFETY AUDIT SUMMARY REPORT – SCORING STATISTICS by REGION

	2013	2014	2015	2016
EAST REGION	67	47.2	60.4	60
CENTRAL REGION	62	67.2	59.2	72.5
WEST REGION	62	57.8	63.6	63.6

Figure – 6 # of Projects

PROJECTS SCORED PER REGION	
EAST REGION	6
CENTRAL REGION	3
WEST REGION	20

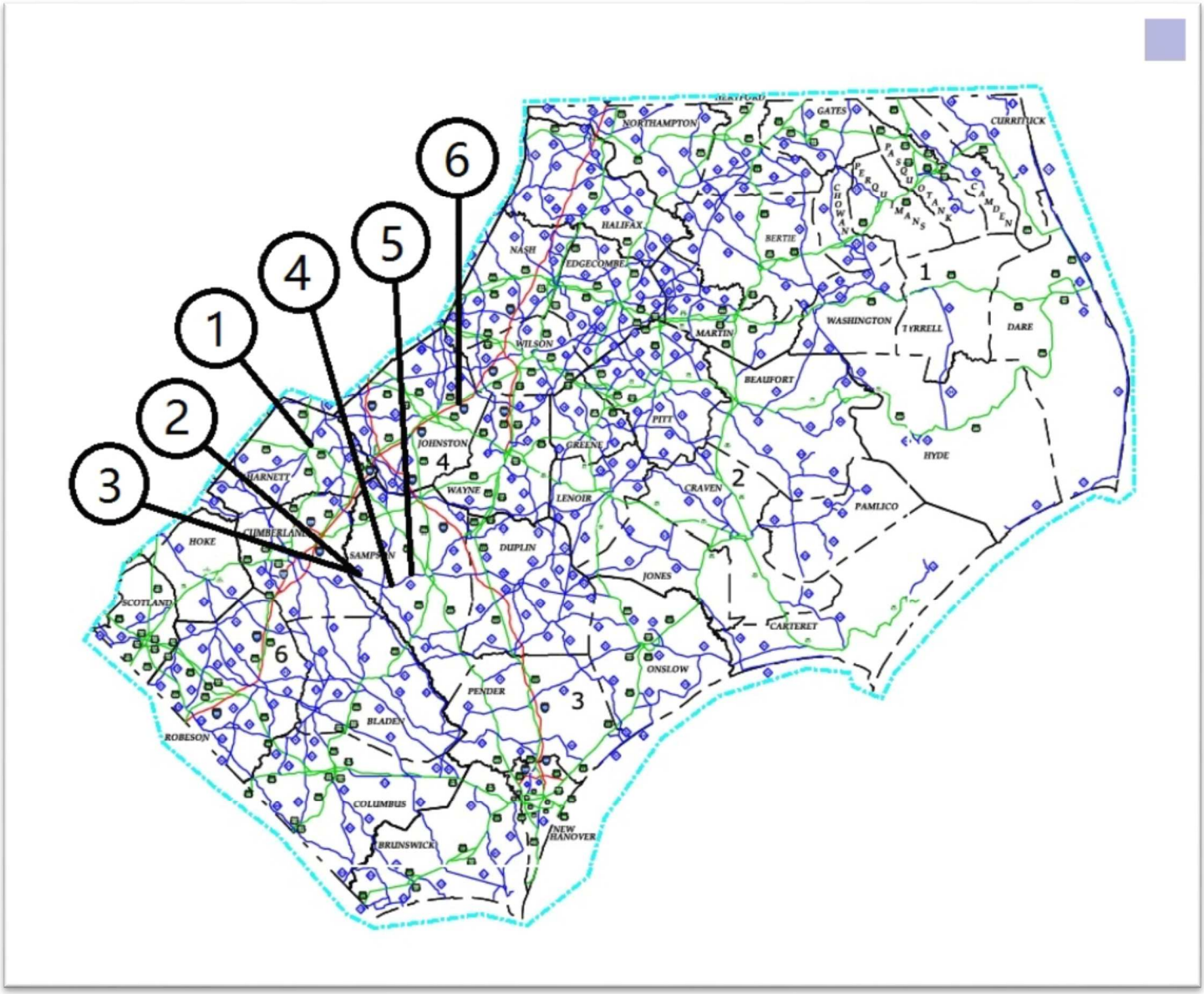
Figure – 7 Project Average Scores

SCORE	# of Projects	% of Projects
>4.00	0	0%
3.00 - 4.00	24	83%
<3.00	5	17%

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. Campbell University Pedestrian Tunnel Under US-421/NC-27 in Buies Creek	3.00
2. NC-24 From West of SR-1006 (Maxwell Rd/Clinton Rd) to SR-1404 (Dowdy Rd) in Sampson County	3.07
3. NC-24 From West of SR-1006 (Maxwell Rd/Clinton Rd) to SR-1404 (Dowdy Rd) in Sampson County	3.00
4. NC 24 From SR-1404 (Dowdy Rd) to SR-1303 (Mitchell Loop Rd)	3.00
5. NC 24 From Mitchel Loop Rd to US-421/701 and SR-1296 (Sunset Ave)	2.93
6. I-95 From Mile Marker 84 to 0.4 Miles North of US-70 Bypass	3.00

Average Measure Scores – Eastern Region			
Temporary Signing	3.00	Bicycle/PED/ADA	3.00
Channelization Devices	2.92	Flagging Operation	
Pavement Markings	3.00	Mobility	3.00
Barriers	3.00	Worker Garments/Equip	
Impact Attenuators		Site Housekeeping	3.00
PCMS	3.11	Law Enforcement	
Flashing Arrow Broads	3.00	TC Plans/STD Drawings	3.00
Temporary Traffic Signals		Crash Cushions	3.00

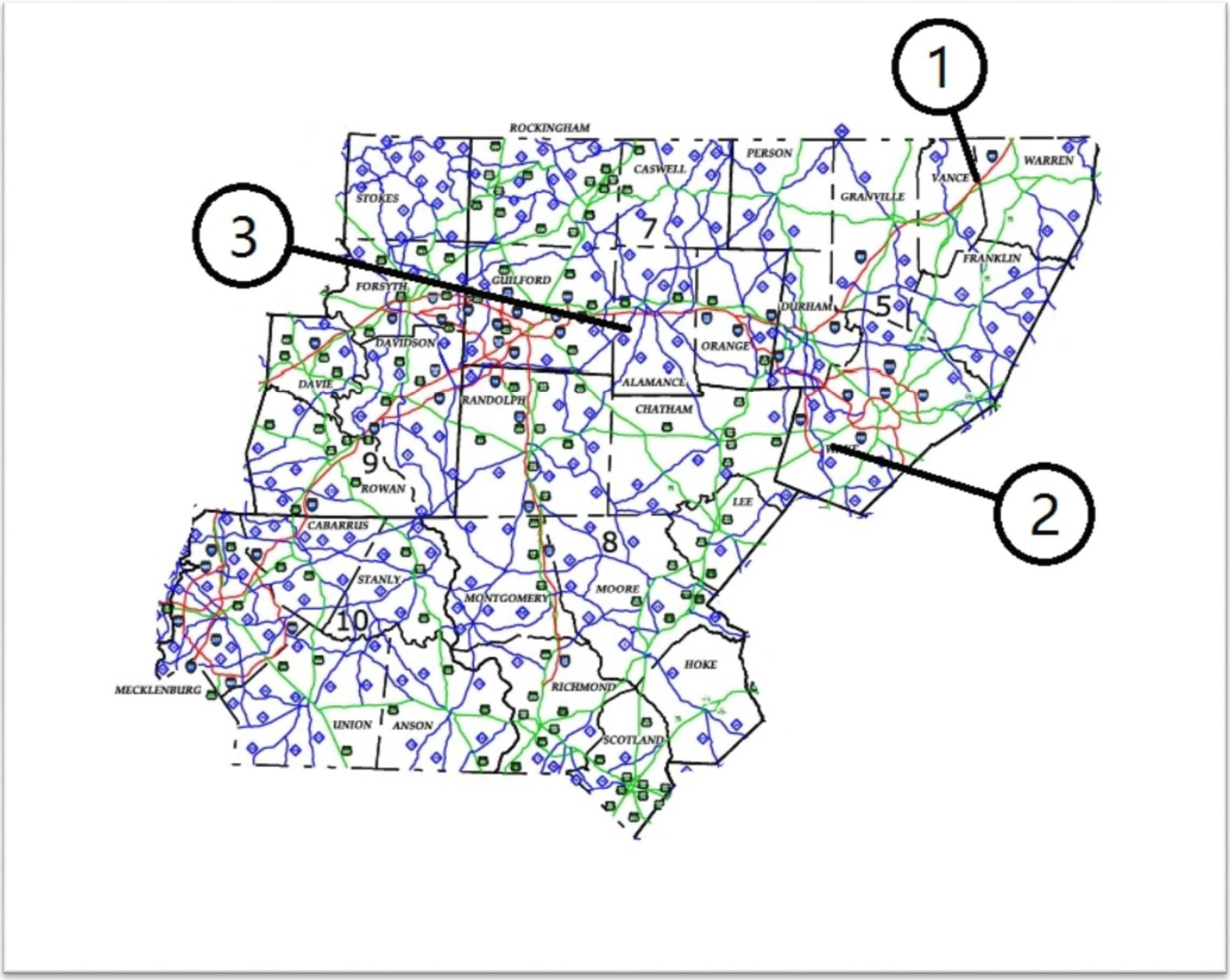
Weaknesses:

Channelization Devices

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. I-85 From North of SR-1162 (Dabney Dr) in Vance County to Virginia State Line	3.91
2. Smith Rd./Stephenson Rd. in Apex	3.00
3. Bridge #27 over US-29/64/70 and I-85 BUS Loop on US-52	3.63

Average Measure Scores – Central Region			
Temporary Signing	3.44	Bicycle/PED/ADA	4.00
Channelization Devices	3.14	Flagging Operation	
Pavement Markings	3.25	Mobility	3.67
Barriers	3.50	Worker Garments/Equip	4.00
Impact Attenuators	3.50	Site Housekeeping	3.67
PCMS	4.00	Law Enforcement	
Flashing Arrow Boards	4.00	TC Plans/STD Drawings	4.00
Temporary Traffic Signals	3.50	Crash Cushions	3.75

Average Scores for Audits Conducted in the Central Region

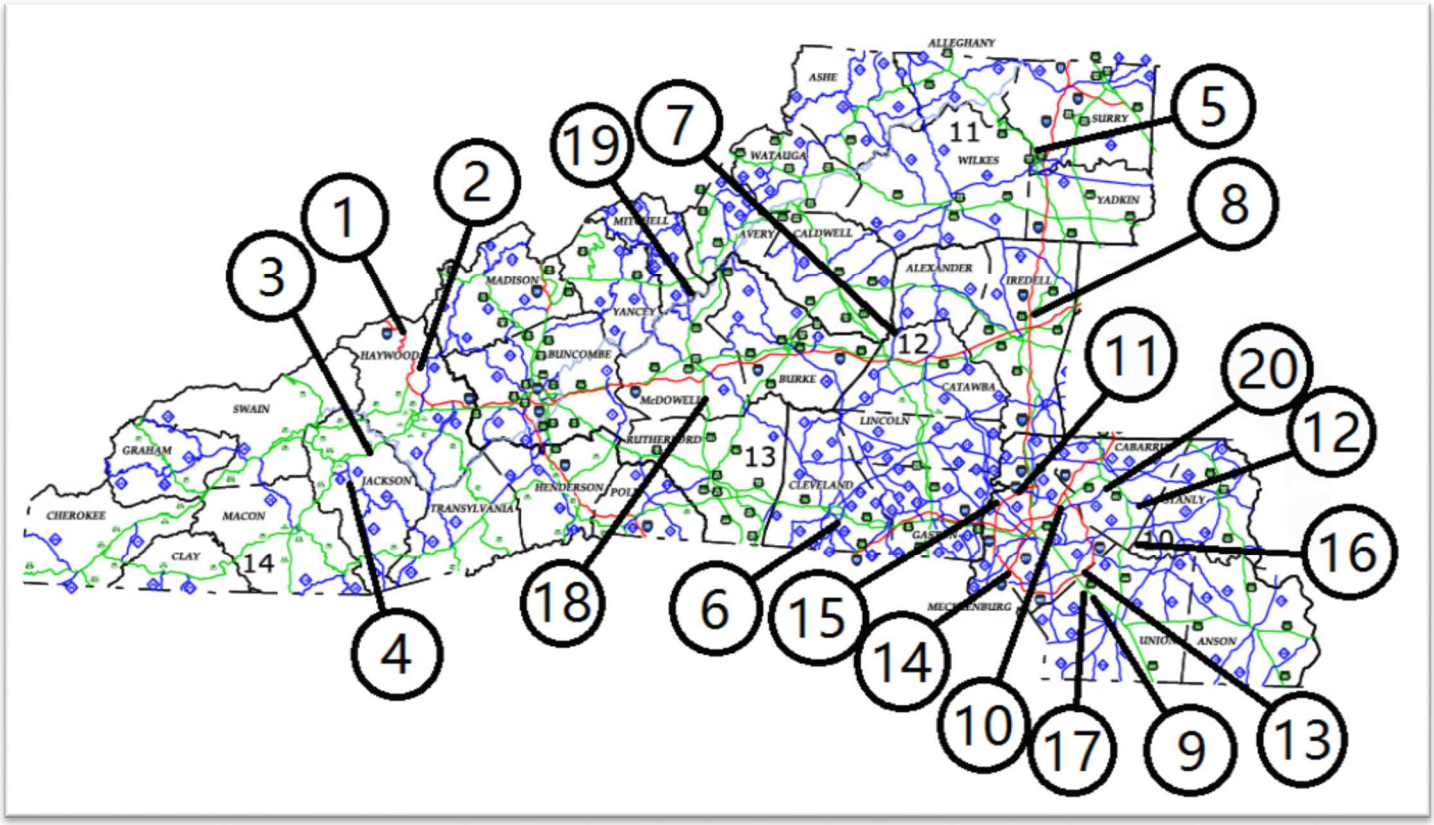
Strengths:

PCMS, Flashing Arrow Boards, Bicycle/PED/ADA, Mobility, Worker Garments/Equip, TC Plans/STD Drawings, Site Housekeeping, Crash Cushions

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-40 Near MP-7	3.14
2. I-40	3.00
3. US 23 Near Sr 1705 (Dark Ridge Rd)	3.09
4. SR-1449 Cope Creek Rd-Jackson County	3.16
5. US 21 in Alleghany County	3.15
6. US 74 (Shelby Bypass)	3.55
7. SR 1404 (29th Avenue NE)	3.70
8. I-77 (Rest Area)	3.56
9. US 74 (Mecklenburg County)	2.76
10. US 29 South of E Mallard Creek Church Rd	3.00
11. I-485, SR-2042	2.83
12. SR 1006 (Mt. Pleasant Road S)	3.67
13. US 74 Bypass/ SR 1501 (Secrest Shortcut Rd)	3.25
14. US 74 Bypass/ SR 1514 (North Rocky River Rd)	3.07
15. US 74 Bypass/ SR 1622 (Deese Rd)	3.33
16. US 74 Bypass/ US 601 (Concord Hwy)	2.97
17. US 74 Bypass/ SR 1367 (Unionville-Indian Trail Rd. W)	3.06
18. US-221 Near SR 1148	3.43
19. US-19	2.75
20. George Liles Parkway from SR 1304 (Roberta Rd) to SR-1431 (Weddington Rd)	3.15

Average Measure Scores – Western Region			
Temporary Signing	3.17	Bicycle/PED/ADA	3.00
Channelization Devices	2.88	Flagging Operation	2.93
Pavement Markings	3.16	Mobility	3.15
Barriers	3.31	Worker Garments/Equip	3.27
Impact Attenuators		Site Housekeeping	3.26
PCMS	3.33	Law Enforcement	
Flashing Arrow Boards	3.70	TC Plans/STD Drawings	3.17
Temporary Traffic Signals	3.48	Crash Cushions	3.25

Average Scores for Audits Conducted in the Western Region

Strengths:

Flashing Arrow Boards

Weaknesses:

Channelization Devices

Flagging Operations

RECCOMENDATIONS

This being our fourth year for the audits in this format, all reviewers were internal Work Zone Traffic Control staff. The 2016 Work Zone Safety Audits revealed a number of consistencies, and positive comments.

The majority of all 29 projects visited in 2016 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		+/-
	2015	2016	
IMPACT ATTENUATORS	15	3	+
MOBILITY	2	11	-
FLASHING ARROW BOARDS	1	1	
TEMPORARY TRAFFIC SIGNALS	4	4	
WORKER GARMENTS/EQUIPMENT	7	6	+
TMP PLAN/RSD COMPLIANCE	9	10	-
CRASH CUSHIONS	5	7	-
FLAGGING OPERATIONS	12	15	-
PCMS	8	5	+
BARRIERS	6	8	-
SITE HOUSEKEEPING	3	9	-
TEMPORARY SIGNING	10	12	-
CHANNELIZATION DEVICES	13	14	-
PAVEMENT MARKINGS	11	13	-
BICYCLE/PED/ADA	14	2	+

Work Zone Traffic Control Safety Audit "Strengths"

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.
- One minor deficiency that was noticed was the board was not leveled. Other potential deficiencies that have occured in the past include bulbs not working properly, specifically bulbs that are dimmed.

Temporary Traffic Signals

- Temporary traffic signals are non-permanent, usually portable, signaling devices positioned at road intersections, pedestrian crossings, and other locations to control the flow of traffic.
- The main things inspected during a review are the set-up to make sure it's placed and angled correctly, its overall condition, and the timing of the lights.
- Many clear, well-timed signals caused its positive review.

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. Other problems included dirty/poor reflectivity and dented drums, along with not having the proper spacing. Also, there were instances of skinny drums being mixed with normal drums and barricades not supported with sandbags.
- To fix these weaknesses, the guidelines/ requirements should be reinforced to ensure these problems are corrected.

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 not constantly flagging construction vehicles entering and existing. Signs were sitting upright instead of flat when flagging was completed. Some sites did not consist of flagging that should have due to grade and site distance.
- Guidance/requirements should be reinforced to ensure flagging operations are consistently taking place when needed.

Conclusion

The 2016 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 29 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 repeated "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.