Oregon Work Zone Safety Audit

Summary Report

2013

Oregon Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

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Introduction

As part of ODOT'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 2013 Work Zone Safety Audits visited and reviewed 29 different highway construction work zones.

The 2013 construction season provided a wide variety of work zones to review. Project locations ranged from the Oregon Coast to the high desert of Eastern Oregon. 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, ODOT Region TCP Design and Region Safety personnel. Audit participants are asked to score the work zones 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 ODOT's Traffic Control Plans. This report provides important feedback for statewide TCP Designers, ODOT engineering consultants and Region Construction Project Management staff. ODOT 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 ODOT Temporary Traffic Control Design Standards and Practices are being implemented in the field consistently and uniformly.
- Confirm that the latest Standards and Practices 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.
- Strengthen communication and working relationships between ODOT design and construction staff, consultants, and contractor employees.
- Identify current standard practices that need to be updated based on observations and feedback.

Methods

Since 2002, ODOT has been conducting detailed work zone reviews in an effort to strengthen the quality, efficiency and safety of its highway construction work zones. The Work Zone Safety Audits serve as a key element within the Agency's quality control and quality assurance programs. The Audits allow designers, Safety staff, Project Coordinators and Construction personnel the opportunity to observe strengths and weaknesses within this unique and dynamic discipline.

Each Reviewer was asked to evaluate the condition and effectiveness of a variety of devices used within the work zone. Over 30 different "measures" are scored for each project visited. Scores are based on a scale of 1 (low) to 10 (high). A score of 4 or less warrants immediate contact with the ODOT Project Manager's office or an on-site agency representative to discuss the issue and possible mitigation strategies.

The Work Zone Safety Audit Evaluation Form (Figure 1) is used by Reviewers to record scores, notes and comments for each project visited.

This year's audits were conducted over three separate trips in July:

- Regions 1 and 2 (north)
- Regions 2 (south) and 3
- Regions 4 and 5

Evaluation Forms were collected from 29 different construction projects, visited by 14 Reviewers, resulting in over 170 pages of scores and comments.

The large amount of information and comments collected allows for a wide array of reports. Please contact the Traffic Control Plans Unit in Salem for additional information regarding reporting options and availability.

This year:

- 29 projects evaluated, spanning all five Regions.
- 14 different Reviewers participated, including representatives from:
  - ODOT Construction Project Management and Inspection
  - ODOT Traffic-Roadway Section
  - Designers from ODOT Region Tech Centers
  - ODOT Transportation Safety Division Safety Coordinators
  - Federal Highway Administration (FHWA)

Measures are scored as applicable for each project. If a device or condition was not present on a project at the time of the visit, a score was not given. For example, temporary concrete barrier may have been included in a particular contract, but if not in use on the project site at the time of the visit, "Temporary Concrete Barrier" (and likely, "Temporary Impact Attenuators") would not have been scored for that project.

Each of the following Measures are evaluated for each project visited:

Temporary Signing – Overall Quality (design, condition), Placement and Spacing (visibility and legibility).

Channelization Devices – Overall Quality, Condition, Placement and Effectiveness for Tubular Markers/ Cones, Drums, and Barricades.

Pavement Markings & Markers – Overall Quality (condition and visibility), Placement and removal of temporary and permanent markings, where applicable.

Temporary Concrete Barrier – Alignment, Crashworthy installations, and Quality of the barrier.

Reflective Barrier Panels – Condition (cleanliness and installation), Effectiveness, and Placement.

Temporary Impact Attenuators – Proper application and Quality (maintenance and placement).

Portable Changeable Message Signs (PCMS) – Effective placement, Condition, and Message quality.

Sequential Arrow Panels – Proper application, Placement, and Quality of the device.

Temporary Traffic Signals – Proper installation (design and layout), Operation, and Maintenance.

Bike/Ped/ADA Facilities – ADA Compliance, Adequate signing and devices; and, Continuity through the project site (detours, diversions).

Flaggers – Proper placement, Effective devices and equipment; and, Performance.

Pilot Cars – Appropriate application and Performance.

Mobility – Effect of construction activities on traffic. Not exceeding specified delay limits.

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

Site Housekeeping – Work site cleanliness and orderliness.

Figure 1—Work Zone Safety Audit Evaluation Form

PROJECT NAME:				DATE:
HIGHWAY:	MILEPOST:	REGION:		REVIEWED BY:
PROJECT MANAGER:	OTHER CONTACTS:			
GENERAL NOTES	CONTRACTOR:			TCS

Only score Devices you witnessed on the Project. If a certain device was not present, do not score it.

S C O R I N G

Notify PM or Field Project Representive!				BELOW AVG.	AVERAGE	ABOVE AVG.	GOOD	VERY GOOD	EXCELLENT
1	2	3	4	5	6	7	8	9	10

CATEGORIES		SCORE	NOTES
TEMPORARY SIGNING (Signs, Flags, Supports)	QUALITY		
	PLACEMENT		
	SPACING		
CHANNELIZATION DEVICES (Tubular Markers, Cones, Drums, Barricades)	Tubes/Cones		
	DRUMS		
	BARRICADES		
PAVEMENT MARKINGS (Paint, Tape, Reflective & Flexible Markers)	CONDITION		
	PLACEMENT		
CONCRETE BARRIER	CONDITION		
	PLACEMENT		
Reflective Barrier Panels? Y or N	CONDITION		
IMPACT ATTENUATORS (Drum Arrays, Narrow-Site & TMA)	CONDITION		
	PLACEMENT		
PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)	MESSAGE		Capture message, if possible
	PLACEMENT		
	CONDITION		
SEQUENTIAL ARROW PANEL (Arrow Board)	PLACEMENT		
	CONDITION		
TEMP. TRAFFIC SIGNALS	SET-UP		
	CONDITION		
BICYCLE, PEDESTRIAN & ADA FACILITIES (Score if existing facilities affected by construction)	SIGNING		
	Continuous Route?		
	ADA Compliance		
FLAGGERS	VISIBILITY		
	Performance		
PILOT CARS	Equipment		
	Performance		
MOBILITY	Overall Flow		
Time Stopped At Flagger or Signal (If applicable)		min	
Approx. Travel Speed thru the work zone?		mph	
WORKER GARMENTS & EQUIPMENT	GARMENTS		
	EQUIPMENT		
SITE HOUSEKEEPING	CLEAN, ORDERLY		
POLICE ENFORCEMENT	ON-SITE?	Y or N	
	PAYING OT?	Y or N	
DRIVER-FRIENDLY WORK ZONE	Ease of Navigation		This category for information only. Do not include in Page Total.
	Consistency		

	=		N *		FINAL SCORE
GRAND TOTAL =		÷		=	

* N = The Number of Scored Categories

Results

Results from approximately 3,000 scores from the 14 different Reviewers for the 29 projects are 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 are compared to scores collected since 2002 (Figures 3 through 7). Average scores for individual projects are ranked in order of highest to lowest (see Pages 10 through 17).

Measure Scoring Summary

Figure 2 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 31 measures, all but three received an average score above 6.0. Six of the measures received average scores above 7.0.

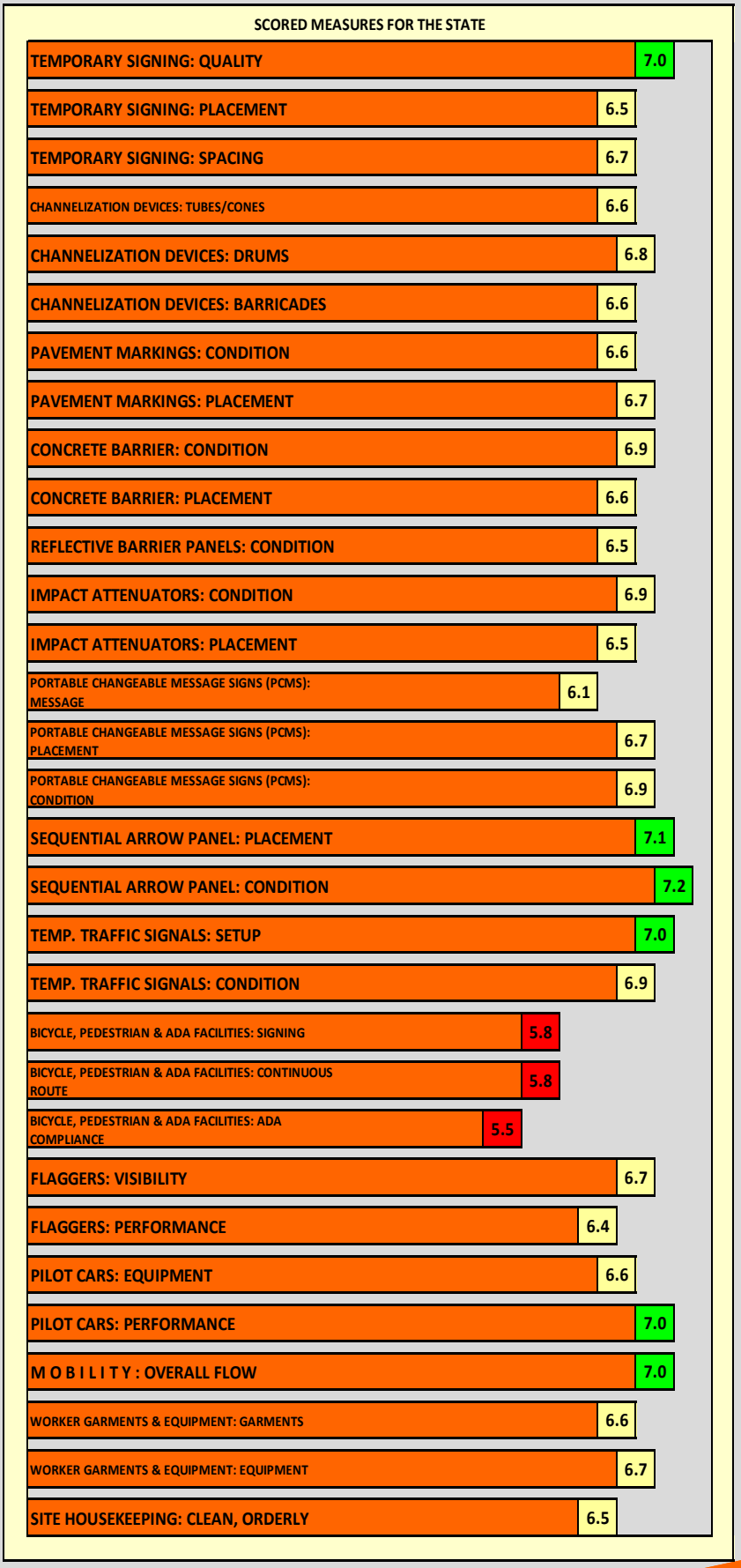
Measures that consistently received the highest average scores for 2013 are:

- Seq. Arrow Panel – Condition, 7.2
- Seq. Arrow Panel - Placement, 7.1
- Temp. Traffic Signals – Setup, 7.0
- Temporary Signs – Quality, 7.0
- Pilot Car—Performance, 7.0
- Mobility – Overall Flow, 7.0

Measures that consistently received the lowest average scores for 2013 are:

- Bicycle, Pedestrian & ADA Facilities – ADA Compliance, 5.5
- Bicycle, Pedestrian & ADA Facilities – Continuous Route, 5.8
- Bicycle, Pedestrian & ADA Facilities – Signing, 5.8

Figure 2 — Average Scores



Statewide Scoring Summary

The 2013 Work Zone Safety Audits reviewed 29 projects - the same number of projects reviewed as 2012. The statewide average project score decreased from 2012 to 2013; but, is consistent with scores from past audits.

The statewide average project score of 67* equates to a rating of, "Average" based on the current scoring system. The average rating confirms that the TCP Standards and Practices are mostly effective and being implemented a majority of the time.

** Raw scores ("out of 10") are converted to scores based on 100 for annual comparison purposes.*

During the Audits, a few isolated projects needed immediate attention to the traffic control plan. On-site Region Project Management staff was prompt and cooperative in responding to questions or suggested improvements.

The Measures scored during the Audits are averaged and ranked – both statewide and for each Region (See Figures 3 through 6).

Figure 3—Annual Scores

2013 WORK ZONE SAFETY AUDIT SUMMARY REPORT - SCORING STATISTICS by YEAR

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TOTAL PROJECTS REVIEWED	22	29	46	54	43	38	43	60	42	43	29	29
HIGH SCORE	89	82	87	82	81	81	94	88	74	75	80	76
AVERAGE SCORE	72	73	73	71	71	75	77	76	67	69	71	67
LOW SCORE	54	63	53	51	59	63	68	62	53	57	57	50

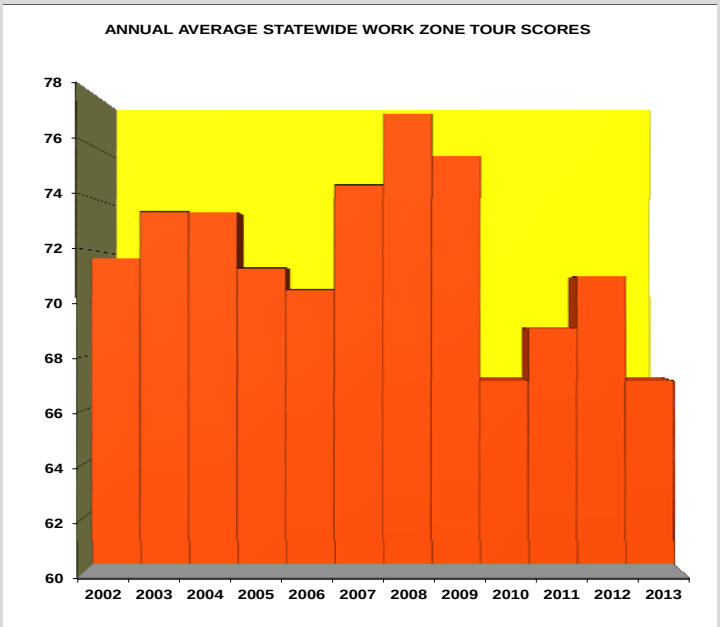


Figure 4—Annual Scores graph

Region Scoring Summary

All five of the ODOT Regions scores decreased compared to 2012. Overall , Region average scores remained consistent with historical scores dating back to 2002.

Due to the completion of the OTIA III program and overall decreased statewide project funding, the number of projects available for review has been declining since 2009. Nonetheless, enough projects are still being constructed to aid the TCP Unit in improving the statewide work zone safety and traffic control plans program.

On the pages that follow, are graphical Region maps showing individual Project scores and overall average Measure scores for that Region. Projects and measures highlighted in green are the highest scores, highlighted in yellow the middle scores, and highlighted in red the lowest scores.

Figure 5 - Region Scores

2013 WORK ZONE SAFETY AUDIT SUMMARY REPORT - SCORING STATISTICS by REGION

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	AVERAGE
REGION 1	69.3	77.7	72.8	73.9	75.6	76.7	82.0	74.3	68.1	68.0	68.6	67.7	72.9
REGION 2	61.3	72.5	72.0	70.9	68.1	74.8	74.0	78.4	67.2	70.2	70.8	65.7	70.5
REGION 3	75.5	72.8	72.3	70.0	70.3	72.8	75.0	75.7	66.1	70.2	71.2	68.1	71.7
REGION 4	76.3	74.0	74.5	69.9	66.7	74.8	78.0	73.8	68.4	68.1	78.2	62.3	72.1
REGION 5	76.2	70.4	75.7	72.0	71.9	73.5	77.0	73.6	64.6	68.0	71.0	66.7	71.7

Figure 6 - # of Projects

Projects Scored per Region	
Region 1	6
Region 2	10
Region 3	7
Region 4	2
Region 5	4

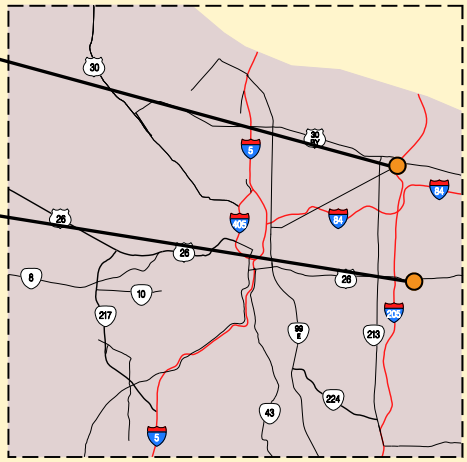
Figure 7– Project Average Scores

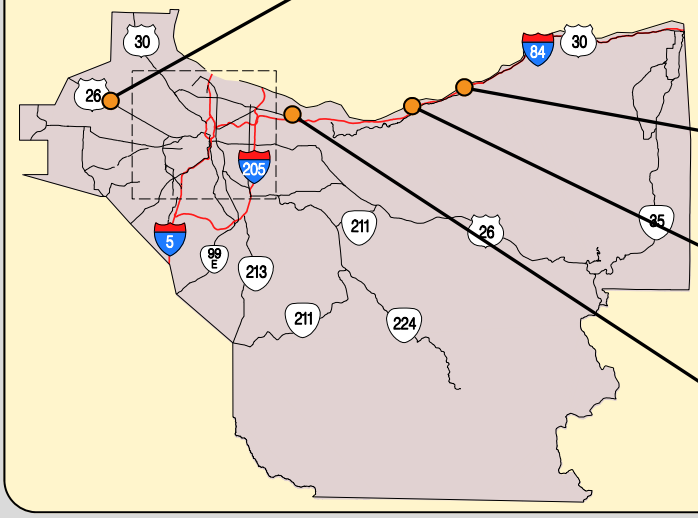
SCORE	# of Projects	% of Projects
> 8.0	0	0%
7.0 ≤ X ≤ 8.0	12	41%
6.0 ≤ X ≤ 7.0	12	41%
5.0 ≤ X ≤ 6.0	5	18%

Region 1

Project Scores

I-205 @ Airport Way Interchange	6.3
US26: Outer Powell Safety Improvements	6.2
US26 @ Glencoe Rd Interchange	6.5
I-84: Bridge Deck Overlays	7.3
US30: Historic Columbia River Hwy Guardrail Improvement	7.6
I84: Sandy River—Jordan Road	6.7





Region 1 Measure

Strengths:

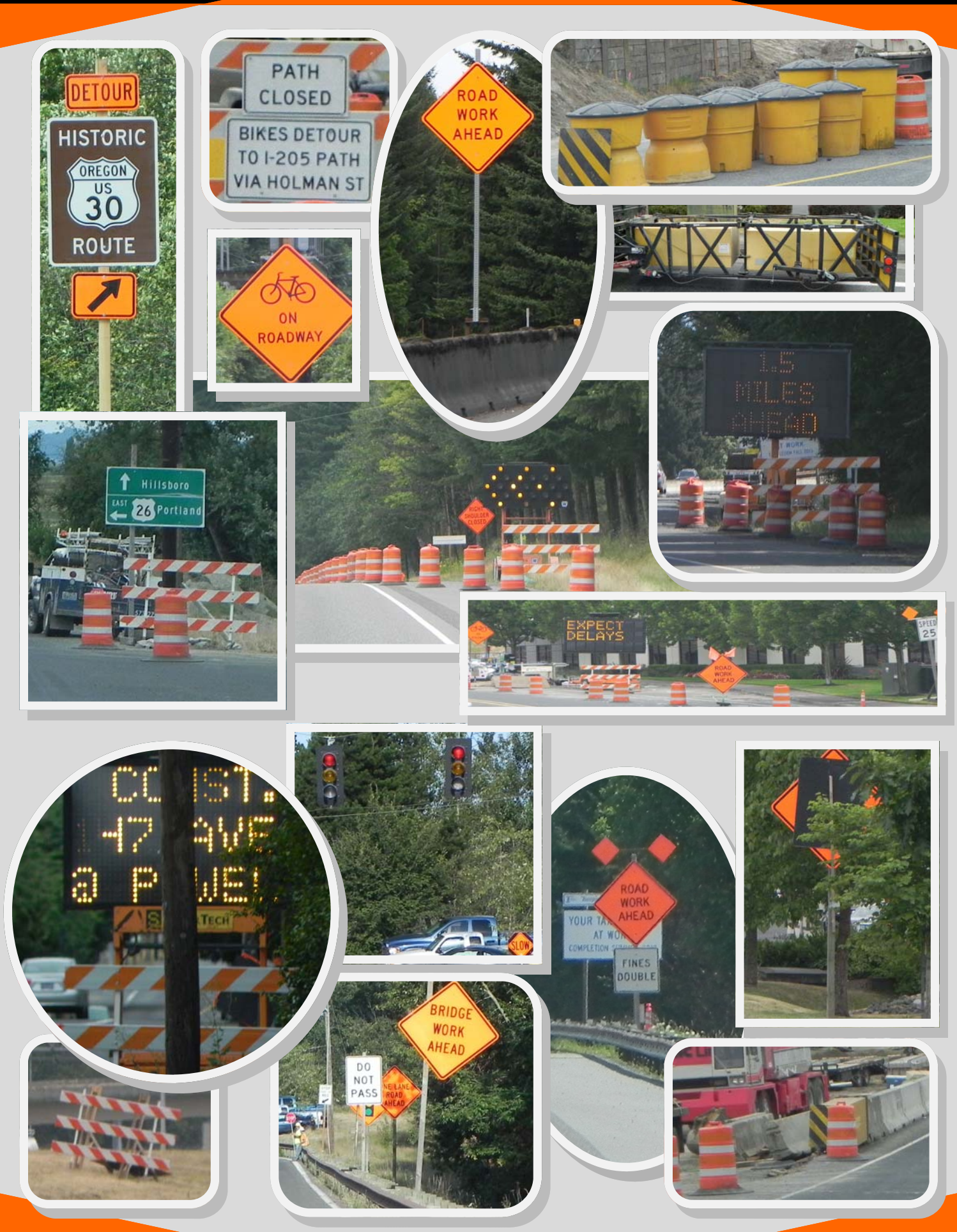
- Mobility
- Flaggers
- Seq. Arrow Panel
- Temp. Signing

Weaknesses:

- Bicycle/Ped/ADA

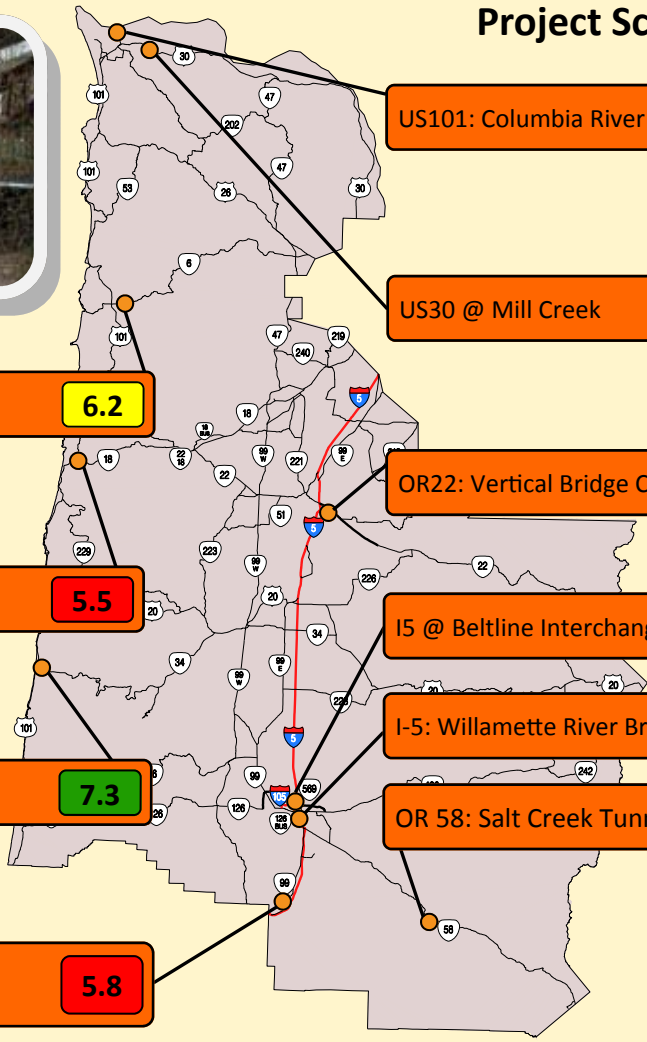
Measure Scores

Temporary Signing	6.9
Channelization Devices	6.7
Pavement Markings	6.6
Concrete Barrier	6.6
Impact Attenuators	6.4
PCMS	6.8
Sequential Arrow Panel	7.0
Temporary Traffic Signal	6.8
Bicycle/Ped/ADA	5.8
Flaggers	7.3
Pilot Cars	—
Mobility	7.3
Worker Garments	6.5
Site Housekeeping	6.5


DETOUR
HISTORIC
OREGON
US
30
ROUTE
PATH
CLOSED
BIKES DETOUR
TO I-205 PATH
VIA HOLMAN ST
ROAD
WORK
AHEAD
ON
ROADWAY
15
MILES
AHEAD
Hillsboro
EAST
26
Portland
EXPECT
DELAYS
SPEED
25
ROAD
WORK
AHEAD
SLOW
ROAD
WORK
AHEAD
FINES
DOUBLE
BRIDGE
WORK
AHEAD
DO
NOT
PASS

Region 2

Project Scores



US101: Columbia River Bridge	7.1
US30 @ Mill Creek	6.4
OR 6 @ Wilson River Loop Rd.	6.2
OR22: Vertical Bridge Clearance	6.4
US 101: MP 90.33 to 105.64	5.5
I5 @ Beltline Interchange	7.1
I-5: Willamette River Bridge	7.2
US 101: Alsea Bay Bridge	7.3
OR 58: Salt Creek Tunnel & Half Viaducts	6.7
OR 99 @ 4th and Main (Cottage Grove)	5.8

Region 2 Measure

Strengths:

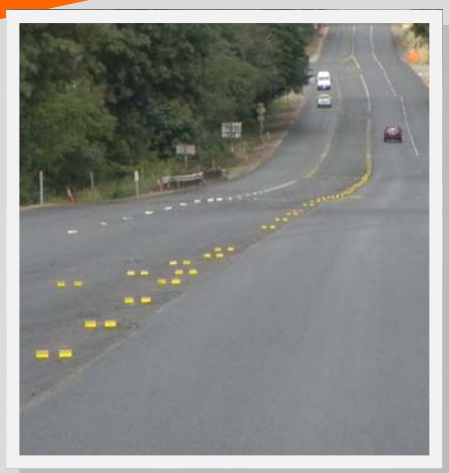
- Impact Attenuators
- Temp. Traffic Signals
- Concrete Barrier
- Seq. Arrow Panel

Weaknesses:

- Bicycle/Ped/ADA
- Flaggers
- Site Housekeeping

Measure Scores

Temporary Signing	6.6
Temporary Traffic Signal	7.1
Channelization Devices	6.6
Bicycle/Ped/ADA	6.0
Pavement Markings	6.5
Flaggers	6.2
Concrete Barrier	7.1
Pilot Cars	6.4
Impact Attenuators	7.3
Mobility	6.6
PCMS	6.5
Worker Garments	6.5
Sequential Arrow Panel	7.0
Site Housekeeping	6.3



OR 58 MP 56
CLOSED NIGHTS
MON-THUR 8P-6A

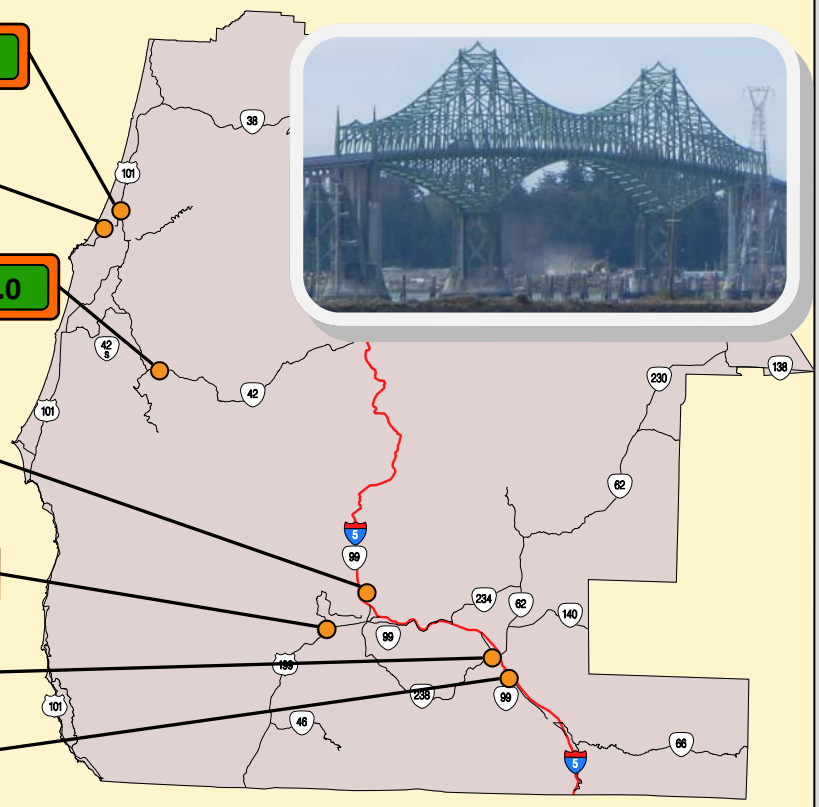
STOP

EXIT
194B

Region 3

Project Scores

US 101: McCollough Bridge Rehab	7.2
US 101: Coos Bay—North Bend	6.5
OR42: Hwy 542 Jct—Remote	7.0
I-5: Glendale –Hugo Paving, Sexton Climbing Lane	7.3
US199: Applegate River Bridge	5.9
I5: Exit 40 Kane Creek Fish Passage	6.7
I5: Rock Point to Seven Oaks	7.0



Region 3 Measure

Strengths:

- Mobility
- Temporary Signing
- Seq. Arrow Panel

Weaknesses:

- Bicycle/Ped/ADA
- Concrete Barrier

Measure Scores

Temporary Signing	7.0	Temporary Traffic Signal	–
Channelization Devices	6.6	Bicycle/Ped/ADA	5.8
Pavement Markings	6.9	Flaggers	6.5
Concrete Barrier	6.2	Pilot Cars	6.8
Impact Attenuators	6.8	Mobility	7.2
PCMS	6.7	Worker Garments	6.9
Sequential Arrow Panel	7.0	Site Housekeeping	6.7

REDUCED
SPEED
AHEAD

ROAD
WORK
AHEAD
ON
ROADWAY
FINES
DOUBLE
ROAD
WORK
AHEAD

CONSTRUCTION VEHICLE
DO NOT FOLLOW

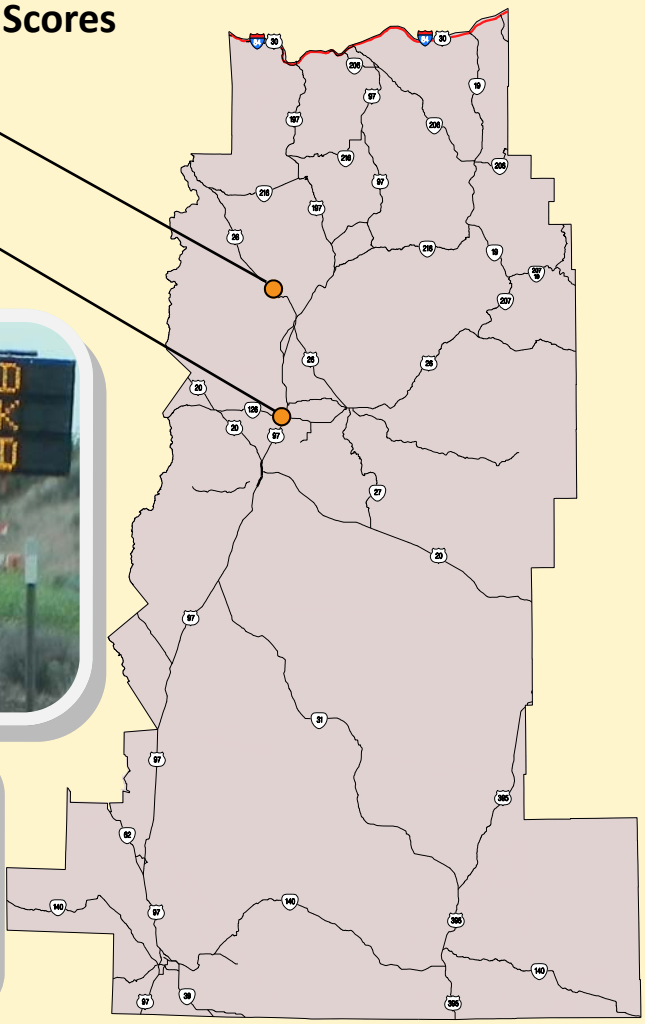
CAUTION
DETOUR
SIDEWALK
CLOSED
BUSTER'S
MAIN STREET CAFE
OPEN FOR
Breakfast & Lunch
EVERYDAY
8AM TO 2PM

ON
HIGHWAY
1/2 MILE

Region 4

Project Scores

US26: Mill Cr.—Warm Springs Grade	6.9
5th/6th St / Evergreen Jackpine	5.6



Measure Scores

Temporary Signing	5.6
Channelization Devices	6.4
Pavement Markings	6.7
Concrete Barrier	—
Impact Attenuators	—
PCMS	6.2
Sequential Arrow Panel	7.5
Temporary Traffic Signal	—
Bicycle/Ped/ADA	5.4
Flaggers	7.4
Pilot Cars	7.6
Mobility	6.5
Worker Garments	6.5
Site Housekeeping	6.4

Region 4 Measure

Strengths:

- Pilot Cars
- Seq. Arrow Panel
- Flaggers

Weaknesses:

- Bicycle/Ped/ADA
- Temporary Signing

Region 5

Project Scores

OR 334: Athena Main St. Improv.	5.0
US335: Southgate @ 37th St.	6.6
I-84: Region 5 Chain-Up Areas	7.6
I-84: Kamela I/C—2nd St. Uxing	7.4

Measure Scores

Temporary Signing	6.8
Channelization Devices	6.8
Pavement Markings	6.6
Concrete Barrier	6.8
Impact Attenuators	5.3
PCMS	7.1
Sequential Arrow Panel	7.6
Temporary Traffic Signal	—
Bicycle/Ped/ADA	5.2
Flaggers	6.3
Pilot Cars	—
Mobility	7.5
Worker Garments	6.8
Site Housekeeping	6.7

Region 5 Measure

Strengths:

- Seq. Arrow Panel
- Mobility
- PCMS

Weaknesses:

- Bicycle/Ped/ADA
- Impact Attenuators
- Flaggers

RECOMMENDATIONS

The annual Work Zone Safety Audits revealed a number of consistencies, improvements and positive comments. However, substandard quality control issues were observed – some new, some recurring. Work Zone Safety Audit comments, Measure scores and comparative 2012 rankings of the Measures were used to identify this year's TCP Strengths and Weaknesses.

TCP Strengths for 2013 included the usage and quality of Sequential Arrows, Temporary Traffic Signals, Pilot Cars and Temporary Signing, as well as Mobility and the accommodation of traffic through our work zones.

TCP Weaknesses for 2013 included design and accommodation measures used for managing bicycles, pedestrians and ADA users in the work zone. In addition, PCMS messages, Worker Apparel, Flagger performance and Site Housekeeping all showed declines in quality and effectiveness.

Several extraordinary examples of temporary traffic control measures were encountered during the safety audit, as shown below.

MEASURE	Statewide Ranking		+/-
	2012	2013	
SEQUENTIAL ARROW PANEL	9	1	+
MOBILITY	3	2	
TEMP. TRAFFIC SIGNALS	1	3	-
PILOT CARS	12	4	+
TEMPORARY SIGNING	5	5	
CONCRETE BARRIER	4	6	-
IMPACT ATTENUATORS	2	7	-
CHANNELIZATION DEVICES	13	8	+
PAVEMENT MARKINGS	8	9	
APPAREL	6	10	-
PCMS	11	11	
FLAGGERS	10	12	-
SITE HOUSEKEEPING	7	13	-
BICYCLE/PED/ADA	14	14	

Figure 8 - Year Comparison

Region 3: I-5: Glendale—Hugo Paving. PCMS mounted on asphalt roller. PCMS moves with work.

Region 2: US30 Mill Creek. Unique lighted device added enhanced visibility of flagger station.

Region 2, Astoria Megler Bridge. Custom sign mounts with flashing beacon for added conspicuity.

Work Zone Traffic Control Safety Audit "Strengths"

1. *Sequential Arrow Panel*

Sequential Arrow Panels are used exclusively to indicate a lane closure. Do not use Seq. Arrow Panels to indicate a traffic shift or to keep traffic to one side of a road, i.e "Keep Left".

The Sequential Arrow Panels encountered this year functioned well and were generally setup properly. Sequential Arrow Panels should be placed at the beginning of the lane closure taper, on the shoulder.

Sequential Arrows are most commonly misused when placed to indicate a lane or traffic shift, or when placed too far beyond the beginning of the lane closure taper (unless shoulder width is limited). Avoid placing Sequential Arrows in Flagger tapers or near Flagger Stations on two-lane, two-way roads. Sequential Arrows are reserved for closing one lane on a multi-lane roadway. In addition, lights and movement of the Sequential Arrow may distract drivers from directions being given by the Flagger.

2. *Mobility*

ODOT places strong emphasis on Mobility through its work zones. Mobility is actively managed by setting and modifying lane closure restrictions. The coordination of travel delay within the Region also plays an important piece of the mobility puzzle.

ODOT's emphasis on mobility was evident in the majority of projects visited during the Safety Audit. Most freeway projects had minimal delays, even when they included temporary speed reductions. The majority of work zones controlled by flaggers had minimal delays as well.

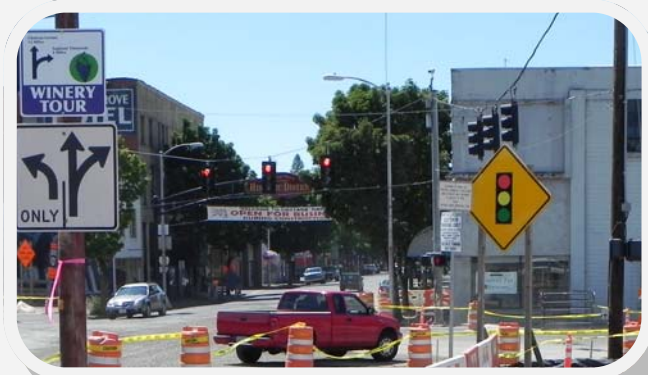
A few projects experienced delays that approached current delay limits (i.e. "20 minutes"). Lane Restriction language may have allowed lane closure times too close to peak traffic hours; or, contractor operations extended too far between Flagger Stations creating additional delay for stopped vehicles at one end waiting for piloted vehicles from the other end of the work area.

3. *Temporary Traffic Signals*

Temporary traffic signals can be used to temporarily replace a permanent signal, or to control alternating two-way traffic on a one-lane road.

The temporary traffic signals encountered this year properly setup and functioned well .

During the Safety Audits, several projects were observed using Flaggers to control traffic within, or in close proximity of, a signalized intersection or a temporary traffic signal. Traffic signals should be covered or turned off and the intersection flagged when flagging operations interfere with the operation of a signal controlled intersection.



4. *Pilot Cars*

Pilot Cars are typically used in conjunction with flaggers to guide platoons of vehicles through complex or lengthy two-way, one-lane work areas.

During this year's audit, projects using pilot cars managed traffic well. Operating speeds were reasonable and traffic delays were minimal. Projects using pilot cars that were most effective in controlling one-lane, two-way traffic involved projects with low traffic volumes (e.g. < 2000 ADT) and minimal side roads.

Pilot car operations were not as successful or effective in minimizing traffic delays for projects with higher traffic volumes (e.g. > 3500 ADT) or where there were numerous side roads and cross-traffic, combined with distances of more than 1-2 miles between Flagger Stations.

Work Zone Traffic Control Safety Audit "Weaknesses"

1. Bike/Pedestrian/ADA

The MUTCD and ODOT TCP Design Manual include standards requiring construction projects to include pedestrian accommodation at the same (or better) level as the existing facilities, or provide appropriate alternative routes.

Historically, Bicycle/ Pedestrian/ADA accommodation measures have yielded the poorest scores. In general, comprehensive pedestrian accommodations are not seen in the projects being reviewed. Some effort is being made, but not consistently, and not in accordance with all MUTCD and ADA requirements and intentions.

Observations this year included, incorrect use of pedestrian channelizing devices, pedestrians walking through the work area, and unclear pedestrian detours/guidance. The Pedestrian Channelization Device was used on multiple projects and when used properly it provided effective pedestrian separation and guidance.

TCP Action

The TCP Unit has developed a number of new measures for safe and effective pedestrian work zone accommodation – including a specific Standard Drawing, new Standard/Boilerplate Specification language in Section 00220, and a new pay item device – the Pedestrian Channelizing Device (PCD). Designers are being encouraged to be more diligent in the design of their TCPs to include plans, specifications and pay items necessary to accommodate bicycles, pedestrians and ADA users in their projects. Construction staff are being encouraged to monitor these measures and temporary facilities for non-motorized users, and to remind contractors of these requirements within the contract.

2. Site Housekeeping

Site Housekeeping is a subjective measure of how well the contractor maintains a clean, orderly, work area and controls the location of stockpiled materials and equipment within the project limits. The Standard Specifications require contractors to keep the work area clean and provide a minimum clear area adjacent to traffic.

Several projects review were poorly maintained and unprotected stockpiled materials were well within the clear area.

TCP Action

Use the TCP Design Manual and TCP Design class to highlight the importance of site housekeeping and keeping stockpiled materials and vehicles parked outside of the work zone clear area. Review and revise current guidelines on developing and maintaining clear zones. Address the related issue of when to use positive protection in work zones.

3. Flaggers

Flaggers are used to control the flow of traffic in and around work zones, mainly for two-way, one-lane traffic.

A poor score for a Flagger is usually attributed to the performance of the Flagger or the setup of the flagging operation. Flagger performance suffers when they fail to provide appropriate directions (e.g. hand signals) to the driver, have their back turned to approaching traffic, or are distracted. Poor setup includes locating the Flagger Station with poor sight distance for approaching traffic, setting up the station in shadows or with the sun directly behind it, and not taking into account nearby traffic signals.

TCP Action

TCP Unit members will make sure the TCP Design Manual and TCP Design class cover the performance of flaggers and the setup of the flagger stations.

4. PCMS

Portable Changeable Message Signs (PCMS) are used to convey work zone related messages to the travelling public. Messages can be changed to match the work zone conditions.

PCMS deficiencies included confusing messages, messages with too much information, malfunctioning units, improper use, and poor PCMS placement. Improper, incomplete or ambiguous messages render the PCMS useless and can impact traffic and work zone safety.

TCP Action

The TCP Unit recently published a Oregon PCMS Handbook. The Handbook provides guidelines for the proper placement, usage and message design for the PCMS, as well as an extensive list of example messages for a variety of applications. Incorporate the new handbook guidelines into the TCP Design class and the TCP Design manual.

Traffic Control Supervisor (TCS)

For the fourth consecutive year, measure scores were examined to determine if the average score of a given performance measure was affected by the inclusion of a TCS in the contract. In Figure 7, 2013 results support the idea that inclusion of a TCS increases the performance measure scores. Over a five-year period, from 2009 to 2013, over two-thirds of measure scores were higher when a TCS was included in the project. Results do not take into account that TCS are generally reserved for complex projects or projects with frequent changes in traffic control. Based on 2013 scores, projects that included a TCS were more effective this year, with 12 of 14 measures scoring higher.

Figure 9 -TCS

MEASURE	TCS	NO TCS
TEMPORARY SIGNING	6.85	6.66
CHANNELIZATION DEVICES	6.66	6.64
PAVEMENT MARKINGS	6.80	6.53
CONCRETE BARRIER	6.79	6.67
IMPACT ATTENUATORS	6.74	6.64
PCMS	6.84	6.39
SEQUENTIAL ARROW PANEL	6.76	7.35
TEMP. TRAFFIC SIGNALS	7.04	6.60
BICYCLE/PED/ADA	5.83	5.64
FLAGGERS	6.99	6.34
PILOT CARS	7.15	6.46
MOBILITY	7.13	6.91
WORKER GARMENTS	6.61	6.66
SITE HOUSEKEEPING	6.47	6.46

Project-Specific Plan Sheets vs. Standard Drawings

It should be noted that some projects would not warrant the development of project-specific TCP sheets, nor would those projects that clearly demand TCP sheets benefit from relying solely on Standard Drawings. Some TCP measures are almost always shown on a plan sheet due to the nature and function of the device (e.g. concrete barrier, temp. traffic signals). Further, this comparison is being made to examine the relationship between the level of detail in the TCP and its effectiveness during implementation. Resulting data may determine if individual measure effectiveness could be improved with more detail or clarity provided by project-specific plan sheets.

As is evident in Figure 8, there are some measures where the relationship between the measure itself and the presence or lack of plan sheets, seems ambiguous – e.g. Worker Garments, Mobility, Site Housekeeping. However, for the remaining measures, 2013 data suggests no appreciable increase in measure scores can be attributed to the presence of project-specific plan sheets in the TCP. The most notable increases in scores were for PCMS, Pilot Cars, and Pavement Markings – the latter being higher for projects without TCP sheets. This result for Pavement Markings is surprising as experience tells us that showing the location and type of pavement markings on a plan sheets improves the ability to more accurately track marking pay items and place the markings.

The largest difference in score – for PCMS for projects with plan sheets – could be attributed to the practice of showing the physical location of the PCMS on the sheets and the messages to be programmed into the device.

Note: For concrete barrier and temp. traffic signals, plans are required to show the details as supported by the results in Figure 8.

Figure 10 - Plans

MEASURE	PLANS	NO PLANS
TEMPORARY SIGNING	6.69	6.91
CHANNELIZATION DEVICES	6.63	6.74
PAVEMENT MARKINGS	6.53	7.16
CONCRETE BARRIER	6.77	--
IMPACT ATTENUATORS	6.66	7.00
PCMS	6.69	5.89
SEQUENTIAL ARROW PANEL	7.02	7.42
TEMP. TRAFFIC SIGNALS	6.93	--
BICYCLE/PED/ADA	5.61	6.13
FLAGGERS	6.51	6.83
PILOT CARS	7.15	6.46
MOBILITY	7.06	6.68
WORKER GARMENTS	6.57	6.98
SITE HOUSEKEEPING	6.38	6.87

Work Zone Traffic Control Innovations

Currently Available

New Speed Reduction Measures

For freeways and high-speed divided highways, the TCP Unit has developed a number of new tools for moving operations on these facility types where workers will be exposed to live traffic. In cooperation with ODOT Director Matt Garrett and the AGC, we have developed a new Standard Drawing (TM880, in Jan. 2014), new Unique Special Provision language (Jan. 2014), a new Speed Zone Order recommendation letter for the STE to expedite the request process, and a new QPL category and pay item – the Speed Radar Trailer. We will be incorporating this new "tool" into the TCP Design Manual and the 2-day TCP Design Workshop. We will also be issuing a notification to ODOT Design and Construction staff, and to our Consultant Engineering contacts.

Temporary Rumble Strips

Temporary transverse rumble strips (TTRS) are a tool currently available to traffic control designers to use in work zones. The use of TTRS does require State Traffic Roadway Engineer approval. TTRS are used to alert drivers of unexpected changes in alignment, surfaces, traffic control and other conditions that may require them to slow or stop.

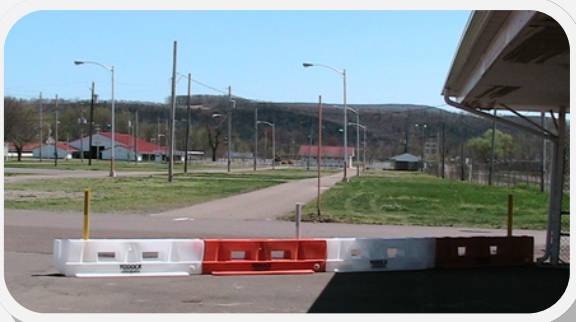
Currently, a TTRS standard detail, TTRS request form for STRE approval, and a Unique specification are available to designers. When used properly TTRS should increase safety for both the public and for workers.

Future Improvements

Bicycle Channelizing Device

During the safety audits, pedestrian and bicyclists are commonly observed travelling through the work area next to workers and equipment. Channelization devices are commonly designed for automobiles, leaving gaps for pedestrians and bicyclists to travel through. Unfortunately signs and other traffic control devices used to channelize non-motorized users are being ignored.

The TCP unit is working on finding devices that channelize pedestrians and bicyclists away from the work area. The Pedestrian Channelizing Device is already available for use, and hopefully soon a Bicycle Channelizing Device will be available to guide bicyclists away from the work area. Currently the product that is being looked into is a small plastic channelizing device, similar to the pedestrian channelizing device.



Barrier "Gawk" Screen

The TPC unit continues to look into barrier "gawk" screen to replace the plywood "gawk" screens. These products are intended to minimize drivers slowing down through work zones to "gawk" at the work.

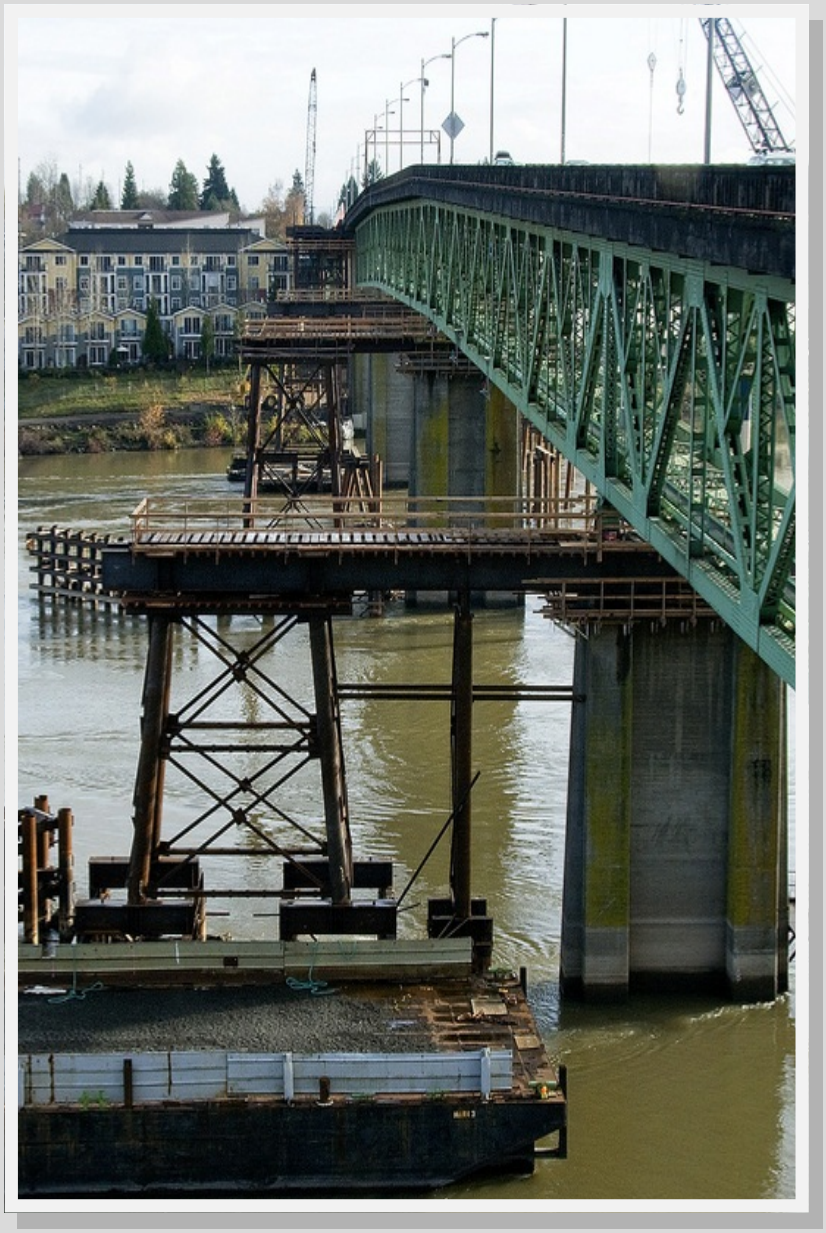
Barrier "Gawk" screens will most likely be lightweight plastic screens mounted on concrete barrier. Hopefully "gawk" screens will be available for the 2014 construction season.

CONCLUSION

The 2013 Work Zone Safety Audits were again a success in identifying strengths and weaknesses within ODOT'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 and collect over 3000 pieces of information. Overall, although we witnessed a slight decline in the safety audit scores, the goals of the audits were accomplished.

The Audits helped us meet some important goals:

- Confirmed ODOT 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.
- Revealed additional techniques and technologies needed to improve overall safety, traffic flow, and construction efficiency.
- Strengthened communication and working relationships between ODOT design and construction staff, consultants, and contractor employees.
- Identified current standard practices that need updating based on observations and feedback.



An important additional benefit from the Work Zone Safety Audits is seeing recurring "Weaknesses." We can prioritize 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 reduce repeat "Weaknesses".

The Traffic Control Plan Unit would like to thank each of the Reviewers who helped with the monumental task of improving safety in Oregon work zones. Thank You.

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