Oregon Work Zone Reviews

Summary Report

2015

Oregon Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

Contents

Introduction 3

Results.....7

Region 1 10

Region 2 12

Region 3 14

Region 4 16

Region 5 17

Recommendations.....18

Work Zone Strengths 20

Work Zone Weaknesses 21

TCS, Plans..... 22

Work Zone Innovations 23

Conclusion 24

Figures

Figure 1: Evaluation Form..... 6

Figure 2: Average Measure Scores 7

Figure 3: Annual Scores 8

Figure 4: Annual Scoring Graph 8

Figure 5: Region Scoring Stats 9

Figure 6: # of Projects 9

Figure 7: Project Average Scores 9

Figure 8: Year Comparison 18

Figure 9: TCS 22

Figure 10: Plans..... 22

Introduction

As part of ODOT's statewide work zone safety and temporary traffic control program, jointly with the FHWA, the Work Zone Unit travels around the State conducting several, multi-day construction Work Zone Reviews. The 2015 Work Zone Reviews visited and reviewed 39 different highway construction work zones.

The 2015 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 Reviews, 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. Review 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 Reviews 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 Reviews 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 Reviews serve as a key element within the Agency's quality control and quality assurance programs. The Reviews 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 Review Evaluation Form (Figure 1) is used by Reviewers to record scores, notes and comments for each project visited.

This year's reviews were conducted over four separate trips :

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

Evaluation Forms were collected from 39 different construction projects, visited by 12 Reviewers, resulting in over 200 pages of scores and comments.

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

This year:

- 39 projects evaluated, spanning all five Regions.
- 12 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).

Channelizing 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), pedestrian channelizing device.

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 Reviews Evaluation Form

PROJECT NAME: | DATE:

HIGHWAY: | MILEPOST: | REGION: | TIME:

PROJECT MANAGER: | OTHER CONTACTS: | REVIEWED BY:

CONTRACTOR: | TCS for Project? YES, NO, UNSURE

SCORING PROCESS: Only provide a Score for Devices/Categories witnessed on the project.

NOTIFY PM (phone/email) or FIELD INSPECTOR !!				BELOW AVG.	AVERAGE	ABOVE AVG.	GOOD	VERY GOOD	PERFECT
1	2	3	4	5	6	7	8	9	10

CATEGORIES		*SCORE*	*COMMENTS*
TEMPORARY SIGNING ***LOOK FOR:*** Crashworthy design, supports, placement. Clean and visible. Legible, logical, efficient messages. Proper font size, sign color, design format.	***QUALITY***		
	PLACEMENT		
	SPACING		
CHANNELIZING DEVICES ***LOOK FOR:*** Placement and alignment. Quality and cleanliness. Proper application. Reflectivity. Crashworthiness.	***Tubular Markers or Cones***		
	DRUMS		
	BARRICADES		
PAVEMENT MARKINGS ***LOOK FOR:*** Paint, Tape, Markers. Proper type, Placement, Alignment, Condition, Removal quality.	***CONDITION***		
	PLACEMENT		
CONCRETE BARRIER ***LOOK FOR:*** Quality, Alignment, Pinned together. Secured to pavement, where necessary.	***CONDITION***		
	PLACEMENT		
REFLECTIVE BARRIER PANELS: Y or N	***CONDITION***		
IMPACT ATTENUATORS ***LOOK FOR:*** Sand barrels, Narrow-site, TMA. Proper place & Installation. Maintained. Correct Design Speed.	***CONDITION***		
	PLACEMENT		

		PANEL 1	*PANEL 2*	
PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS) ***LOOK FOR:*** Clear, Legible, meaninful Messages. Visible @ Location. Good working order.	***MESSAGE***			**Use reverse if multiple PCMS.**
	LOCATION			
	CONDITION			

SEQUENTIAL ARROW PANEL ("Arrow Board")	***PLACEMENT***		
	CONDITION		
TEMP. TRAFFIC SIGNAL (Span wire). ***PORTABLE TRAFFIC SIGNAL*** (Circle applicable)	***SET-UP***		
	CONDITION		
BICYCLE, PEDESTRIAN, ADA COMPLIANCE ***LOOK FOR:*** Consistent, complete signing. Smooth surfaces. Adequate widths. Effective curb ramps. Bicycle accommodation where facility impacted.	***SIGNING***		
	Ped. Channelizing Devices (PCD)		
	ADA Accomodation		
FLAGGERS ***LOOK FOR:*** Clean, reflective ANSI Class II garments. Proper hats, radio, Stop/Slow paddle. Hand signals, eye contact.	***VISIBILITY***		
	PERFORMANCE		
PILOT CARS ***LOOK FOR:*** Driving 35 mph or less. Warning lights. Clean, visible "PILOT CAR FOLLOW ME" sign.	***EQUIPMENT***		
	PERFORMANCE		
MOBILITY	***OVERALL FLOW***		
Time Stopped At Flagger or Signal:	***Minutes***		
Approx. Travel Speed through work zone:	***MPH***		
WORKER GARMENTS & SAFETY EQUIPMENT ***LOOK FOR:*** Clean, Class II vests (If in ROW). Hardhats. Fall protection, Trench shoring (over 5-ft)	***GARMENTS***		
	EQUIPMENT		
GENERAL SITE HOUSEKEEPING	***CLEAN, ORDERLY***		
POLICE ENFORCEMENT *(Circle appropriate answer)*	***ON-SITE?***	***Y or N***	***Was Law Enforcement present in or patrolling WZ?***
	PAYING OT?	***Y or N***	***Project include OT Enforcement Hours? (Contact Anne Holder, TSD)***
DRIVER-FRIENDLY WORK ZONE Clear path through WZ? Any "Surprises," or Conditions straining Driver Expectancy?	***Meet Driver Expectancy?***		
	Ease of Navigation		

FINAL SCORE = ÷ =

(# of Scores made)

Results

Results from approximately 4,000 scores from the 12 different Reviewers for the 39 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 two received an average score above 6.0. Five of the measures received average scores above 7.3.

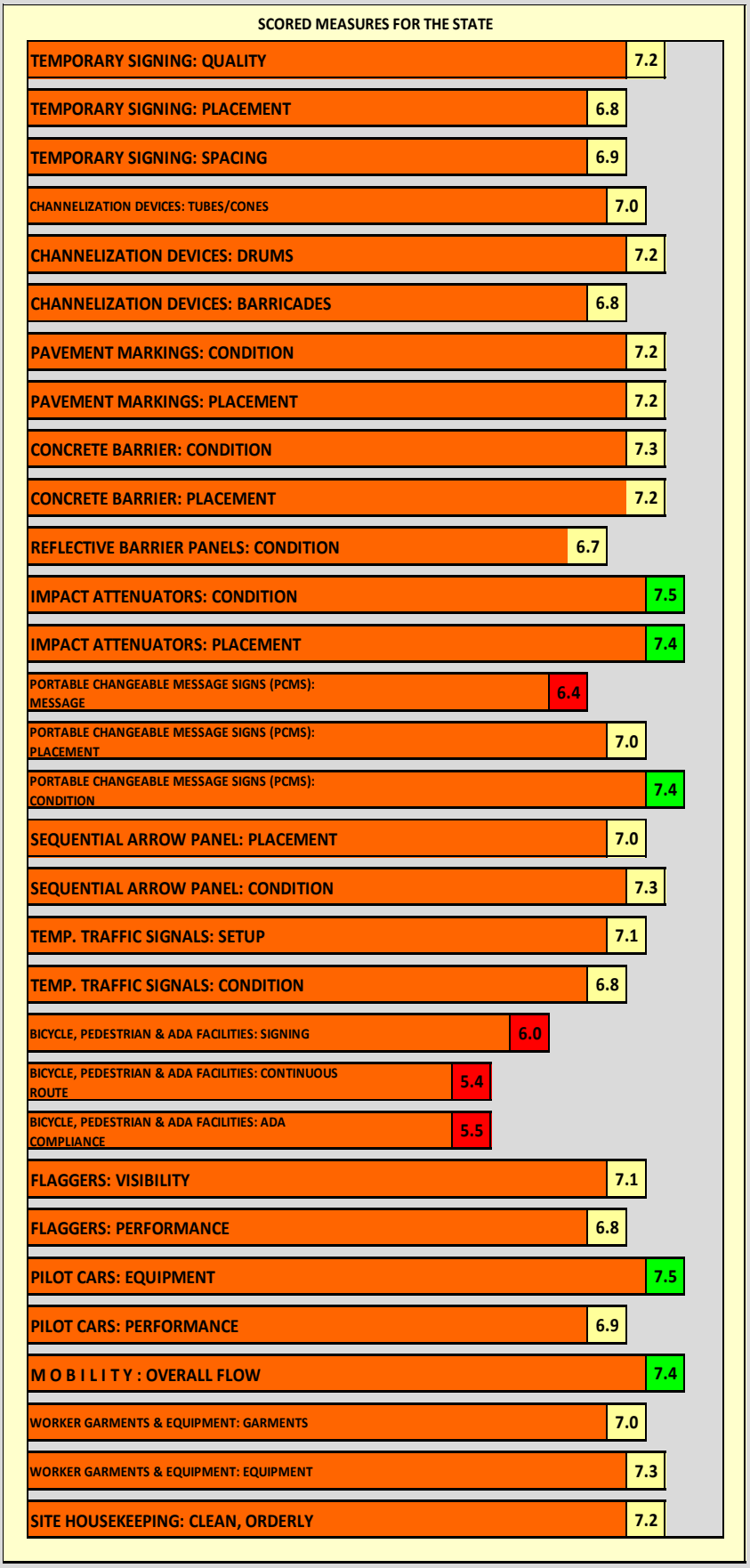
Measures that consistently received the highest average scores for 2015 are:

- Impact Attenuator – Condition, 7.5
- Pilot Car - Equipment, 7.5
- Impact Attenuator – Placement, 7.4
- PCMS – Condition, 7.4
- Mobility - Overview, 7.4

Measures that consistently received the lowest average scores for 2015 are:

- Bicycle, Pedestrian & ADA Facilities – ADA Compliance, 5.4
- Bicycle, Pedestrian & ADA Facilities – Continuous Route, 5.5
- Bicycle, Pedestrian & ADA Facilities – Signing, 6.0
- PCMS—Message, 6.4

Figure 2 — Average Scores



Statewide Scoring Summary

The 2015 Work Zone Reviews reviewed 39 projects. The statewide average project score increased from 2013 to 2015 and, is consistent with scores from past reviews.

The statewide average project score of 69* 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 Reviews, 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 Reviews are averaged and ranked – both statewide and for each of the five Regions. No Work Zone Reviews were conducted in 2014. (See Figures 3 through 6).

Figure 3—Annual Scores

2015 WORK ZONE SAFETY AUDIT SUMMARY REPORT - SCORING STATISTICS by YEAR

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
TOTAL PROJECTS REVIEWED	22	29	46	54	43	38	43	60	42	43	29	29	-	39
HIGH SCORE	89	82	87	82	81	81	94	88	74	75	80	76	-	80
AVERAGE SCORE	72	73	73	71	71	75	77	76	67	69	71	67	-	69
LOW SCORE	54	63	53	51	59	63	68	62	53	57	57	50	-	30

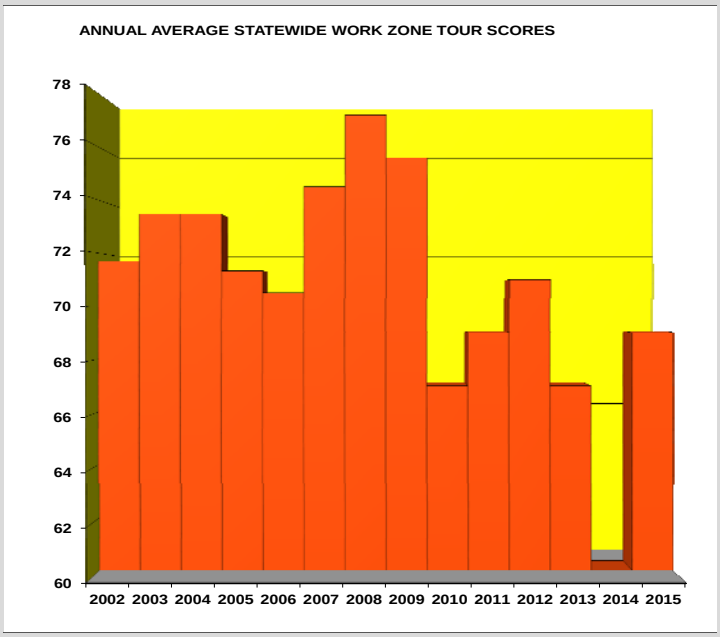


Figure 4—Annual Scores graph

Region Scoring Summary

Three of the ODOT Regions scores increased compared to 2013, while two of the Regions scores decreased. Region 4 had a significant increase in score, after having a significant decrease the year prior. Overall , Region average scores remained consistent with historical scores dating back to 2002.

Due to the completion of the 10-year OTIA III bridge replacement program in 2012 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

2015 WORK ZONE SAFETY AUDIT SUMMARY REPORT - SCORING STATISTICS by REGION

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	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	-	66.5	72.4
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	-	69.2	70.4
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	-	66.2	71.2
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	-	73.7	72.2
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	-	69.5	71.5

Figure 6 - # of Projects

Projects Scored per Region	
Region 1	7
Region 2	10
Region 3	7
Region 4	7
Region 5	8

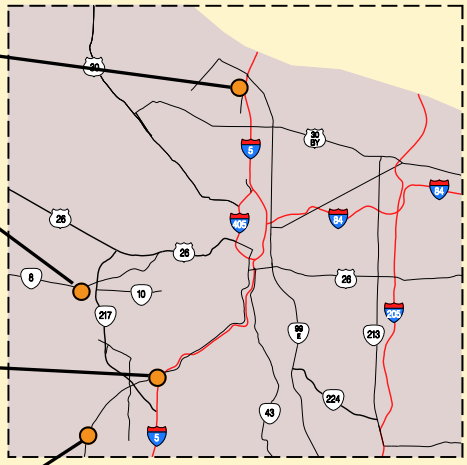
Figure 7– Project Average Scores

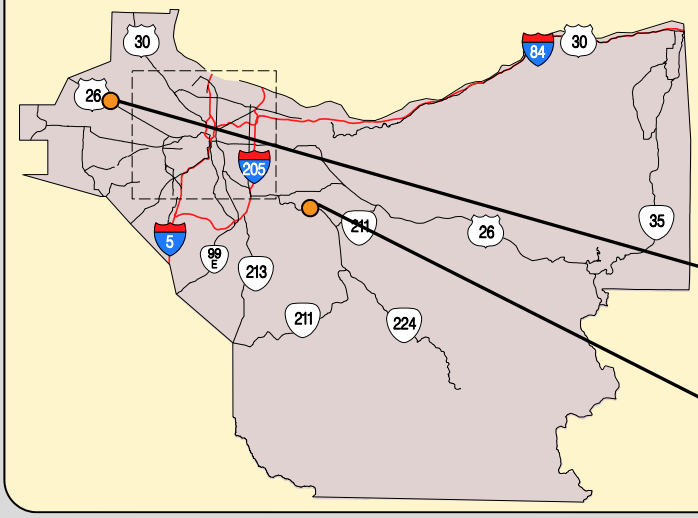
SCORE	# of Projects	% of Projects
> 8	2	5%
7 - 8	15	39%
6 - 7	19	49%
5 - 6	2	5%
< 5	1	2%

Region 1

Project Scores

OR99W: N. Victory Blvd.—N. Argyle St.	6.3
OR217: Hall-Scholls Intchgs & OR 10 @ Western Ave	6.2
I-5: Hood Ave—Tualatin Rvr Seismic Retrofit	6.5
OR99W: Gaarde/McDonald Intersection	7.3
US26: Brookwood/Helvetia Project	7.6
OR224: SE 197th Ave.	6.7





Region 1 Measure Strengths:

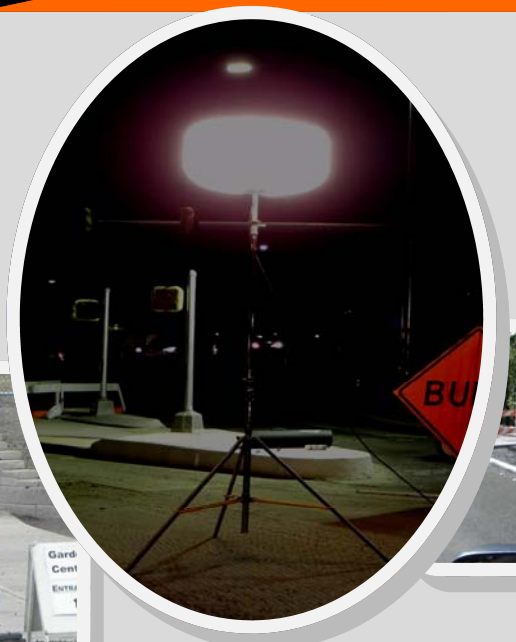
- Impact Attenuators
- Pavement Markings
- Mobility
- PCMS

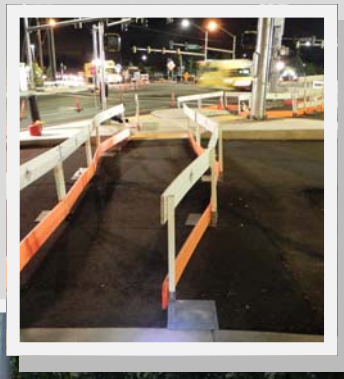
Weaknesses:

- Bicycle/Ped/ADA
- Flaggers

Measure Scores

Temporary Signing	6.6
Channelization Devices	6.8
Pavement Markings	7.0
Concrete Barrier	6.7
Impact Attenuators	7.2
PCMS	7.0
Sequential Arrow Panel	6.6
Temporary Traffic Signal	6.7
Bicycle/Ped/ADA	5.8
Flaggers	6.3
Pilot Cars	—
Mobility	7.0
Worker Garments	6.9
Site Housekeeping	6.8





BUSINESS
ACCESS

ABRUPT
EDGE
RIGHT

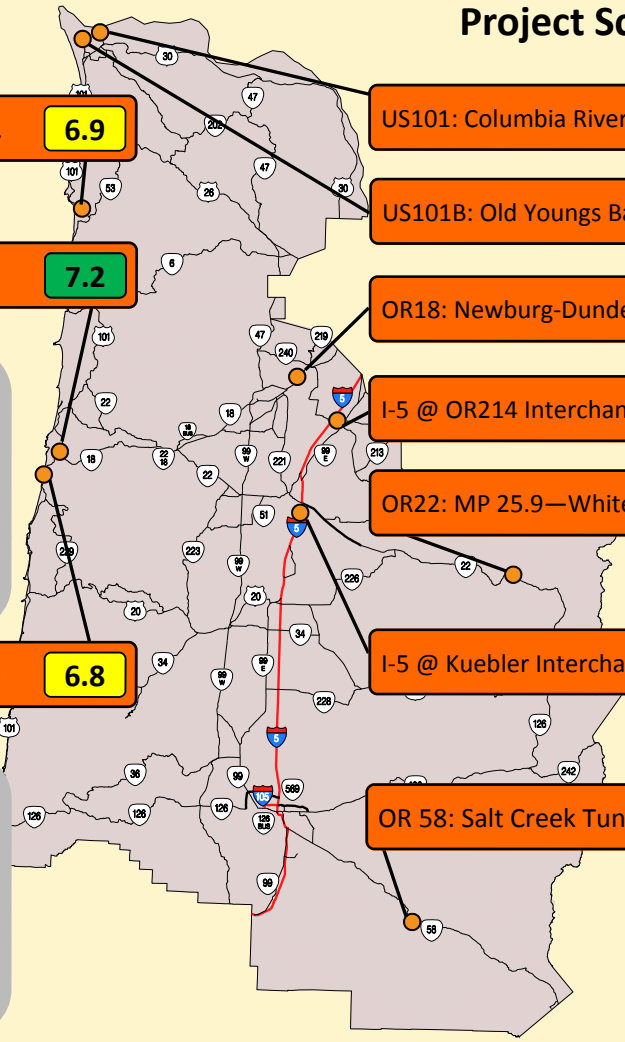
ON
ROADWAY
ABRUPT
EDGE
RIGHT

SHOULDER
WORK
AHEAD

ON
ROADWAY
CROSSWALK
CLOSED
SIDEWALK
CLOSED

Region 2

Project Scores



US101: Manzanita Ave—Neahkahnie Cr.	6.9
US101: Fraser Creek Culvert	7.2
US 101: SE 23rd—SW 35th (Lincoln City)	6.8
US101: Columbia River Bridge (Painting)	7.5
US101B: Old Youngs Bay and L&C Bridges	5.6
OR18: Newburg-Dundee Bypass, Phase 1D	6.9
I-5 @ OR214 Interchange (Woodburn)	6.7
OR22: MP 25.9—Whitewater Rd.	7.9
I-5 @ Kuebler Interchange	7.0
OR 58: Salt Creek Tunnel & Half Viaducts	6.7

Region 2 Measure

Strengths:

- Pavement Markings
- Site Housekeeping
- Mobility
- Channelization Devices
- Impact Attenuators

Weaknesses:

- Bicycle/Ped/ADA
- Seq. Arrow Panel

Measure Scores

Temporary Signing	7.1
Channelization Devices	7.2
Pavement Markings	7.4
Concrete Barrier	7.0
Impact Attenuators	7.2
PCMS	6.8
Sequential Arrow Panel	6.3
Temporary Traffic Signal	-
Bicycle/Ped/ADA	5.9
Flaggers	7.0
Pilot Cars	7.1
Mobility	7.2
Worker Garments	7.1
Site Housekeeping	7.3

ROAD
WORK
AHEAD
FINES
DOUBLE

ROAD
WORK
AHEAD

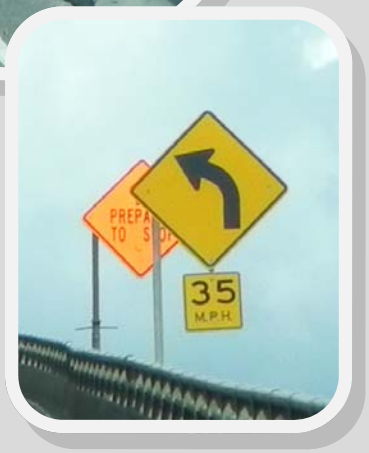
NORTH
PORTLAND

PREPARE
TO STOP
1.7MILES

MARKET
NO
PARKING

ROAD
WORK
AHEAD

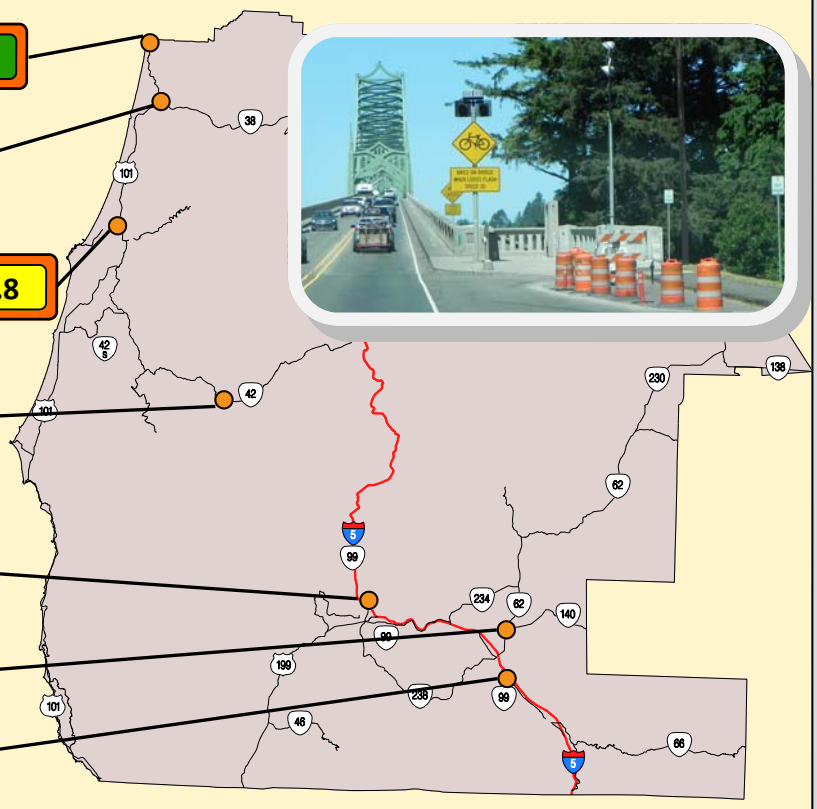
BUSINESS
101
DETOUR
FOLLOW
DETOUR
SIGNS


35
M.P.H.

Region 3

Project Scores

US101: Fogarty Creek Bridge (Project Administed by Region 3)	6.9
US 101: Umpqua River Bridge Rehab.	6.3
US 101: McCollough Bridge Rehab	6.8
OR42: County Line Curves	7.3
I-5: Exit 61 (Merlin)	6.4
OR62 @ OR140 Intersection	6.0
I5: Fern Valley Interchange	6.7



Region 3 Measure

Strengths:

- Impact Attenuator
- Mobility
- Worker Garments

Weaknesses:

- Bicycle/Ped/ADA
- Seq. Arrow Panel

Measure Scores

Temporary Signing	6.7	Temporary Traffic Signal	7.0
Channelization Devices	6.7	Bicycle/Ped/ADA	5.3
Pavement Markings	7.0	Flaggers	7.0
Concrete Barrier	7.0	Pilot Cars	-
Impact Attenuators	7.3	Mobility	7.3
PCMS	6.2	Worker Garments	7.2
Sequential Arrow Panel	5.9	Site Housekeeping	6.6

GAS
LODGING
PHOENIX MOTEL
FOOD
Coleman Creek Estates

ROAD WORK AHEAD
FINES DOUBLE

DETOUR
NORTH
INTERSTATE
5
USE LEFT LANE

BRIDGE WORK AHEAD

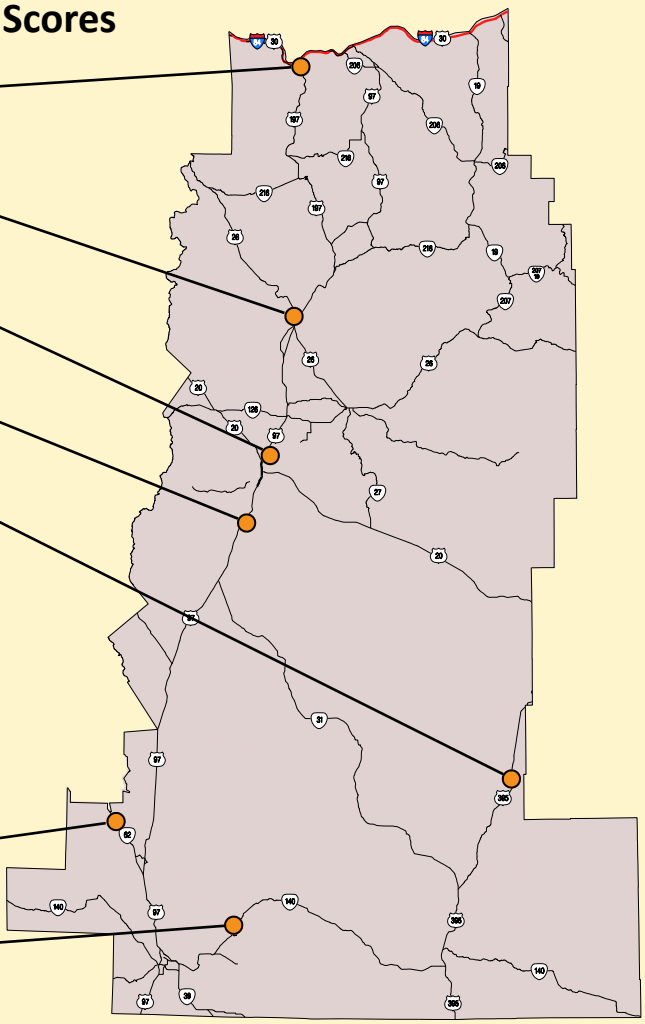
KLAMATH FALLS
DOLLAR TREE

EXIT 24
RIGHT LANE MUST EXIT
20

Region 4

Project Scores

I-84: The Dalles—Fifteen Mile Creek	7.8
US97 @ J St. (Madras)	7.5
US97 @ Murphy Rd (Phase 2)	6.8
US97 @ 1st Street (La Pine)	7.5
US395: Alkali Lake - Albert Lake	7.7
OR62: Ft. Klamath Sidewalks	6.9
OR140: Bly Mountain	7.5



Measure Scores

Temporary Signing	7.4
Channelization Devices	7.3
Pavement Markings	7.3
Concrete Barrier	7.8
Impact Attenuators	7.9
PCMS	7.4
Sequential Arrow Panel	8.0
Temporary Traffic Signal	8.4
Bicycle/Ped/ADA	6.0
Flaggers	8.0
Pilot Cars	7.2
Mobility	7.6
Worker Garments	7.9
Site Housekeeping	7.6

Region 4 Measure

Strengths:

- Temp. Traffic Signals
- Seq. Arrow Panel
- Flaggers

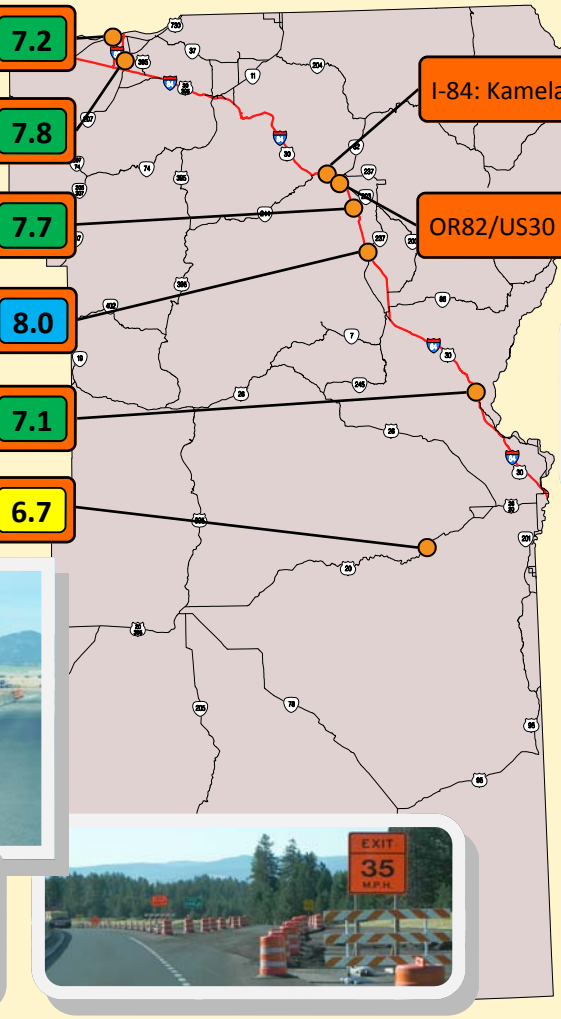
Weaknesses:

- Bicycle/Ped/ADA

Region 5

Project Scores

US730: Powerline Intersection	7.2
OR207: Umatilla River Bridge	7.8
I-84: Ladd Cr. Culvert	7.7
I-84: Bridge Rail Retrofits	8.0
I-84: Nelson Point - Lime	7.1
US20 Harper Jct—Crowley Rd	6.7
I-84: Kamela I/C—2nd St.	8.1
OR82/US30 Signal Upgrades	3.0



Measure Scores

Temporary Signing	6.1
Channelization Devices	6.9
Pavement Markings	7.1
Concrete Barrier	7.8
Impact Attenuators	7.8
PCMS	7.3
Sequential Arrow Panel	7.8
Temporary Traffic Signal	5.0
Bicycle/Ped/ADA	5.2
Flaggers	7.0
Pilot Cars	7.2
Mobility	7.8
Worker Garments	7.1
Site Housekeeping	7.1

Region 5 Measure

Strengths:

- Seq. Arrow Panel
- Mobility
- Concrete Barrier
- Impact Attenuators

Weaknesses:

- Temporary Traffic Signals
- Bicycle/Ped/ADA

RECOMMENDATIONS

The annual Work Zone Reviews revealed a number of consistencies, improvements and positive comments. However, substandard quality control issues were observed – some new, some recurring. Comments and Measure scores from this year, and comparative 2013 measure rankings, were used to identify TCP strengths and deficiencies for 2015.

TCP Strengths for 2015 included the usage and quality of impact attenuators, pavement markings, site housekeeping and apparel, as well as mobility and the accommodation of traffic through our work zones.

TCP Deficiencies for 2015 included design and accommodation measures used for managing bicycles, pedestrians and ADA users in the work zone. In addition, PCMS messages, sequential arrow panel, temporary signing, and temporary traffic signals all showed declines in quality and effectiveness.

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

MEASURE	Statewide Ranking		+/-
	2013*	2015	
IMPACT ATTENUATORS	7	1	+
MOBILITY	2	2	
PAVEMENT MARKINGS	9	3	+
SITE HOUSEKEEPING	13	4	+
CONCRETE BARRIER	6	5	
PILOT CARS	4	6	
APPAREL	10	7	+
TEMP. TRAFFIC SIGNALS	3	8	-
CHANNELIZATION DEVICES	8	9	
FLAGGERS	12	10	
PCMS	11	11	
SEQUENTIAL ARROW PANEL	1	12	-
TEMPORARY SIGNING	5	13	-
BICYCLE/PED/ADA	14	14	

* No data for 2014

Figure 8 - Year Comparison

Region 4: I-84: Dalles—Fifteen Mile Creek. Custom sign to try and keep a single lane through the construction site operational.

Region 4: US 97 @ J St.(Madras). Pedestrian Channelizing Device to guide and separate pedestrians.

Region 3: I-5 @ Fern Valley Interchange. Temporary Rectangular Rapid Flashing Beacon (RRFB) to keep a separated path operational.

2013 Work Zone Reviews — Action Items

Bike/Ped/ADA TCP Action

A 2013 Work Zone review action item was to inform and encourage design and construction staff on the proper use of Bicycle/Pedestrian/ADA in work zones. The TCP unit has updated Bike/Ped/ADA guidance in the 2015 Standard Specifications and TCP Design Manual. The TCP Unit has also taken every opportunity to educate personnel on proper Bike/Ped/ADA use, including ODOT TLC All-Staff meetings, TCP Design Class, Project Managers meetings, Region Safety meetings, Work Zone Reviews, and the Statewide WorkZone Action Group. Although the TCP unit worked on informing ODOT staff on proper use, the Bicycle/Ped/ADA Measure continues to reveal the need for continued emphasis within ODOT's TCP Design program and our construction implementation efforts.

Site Housekeeping TCP Action

A 2013 Work Zone review action item was to update the TCP Design Manual and TCP Design class to highlight the importance of site housekeeping, including keeping stockpiled materials and vehicles parked outside of the work zone clear area, the work zone clear area itself, and positive protection. The TCP Design Manual was updated with additional guidance regarding the work zone clear area. The updated guidance was incorporated into the TCP Design Class. Updated positive protection guidelines are currently being pursued through the WorkZone Executive Strategy Sessions. The Strategy Sessions include a group of stakeholders interested in the use of positive protection to protect workers and the travelling public, including AGC and the Trucking Industry.

Flaggers TCP Action

A 2013 Work Zone review action item was to make sure the TCP Design Manual and TCP Design class cover the performance of flaggers and the setup of the flagger stations. Both the TCP Design Manual and the TCP Design class were reviewed and updated as necessary to cover the setup of flagger stations and the proper performance required for flaggers.

Portable Changeable Message Sign TCP Action

A 2013 Work Zone review action item was to inform design and construction staff about the recently published Oregon PCMS Handbook, and to make sure the information presented in the handbook was incorporated into the TCP Design Manual and the TCP Design class. The Oregon PCMS Handbook has been presented to the Statewide WorkZone Action Group, several TCP design classes, and the principles have been incorporated in the TCP Design Manual. The TCP unit will continue to inform design and construction staff about the PCMS Handbook.

Work Zone Traffic Control Safety Review "Strengths"

1. *Impact Attenuator*

Impact Attenuators are used to protect specific Traffic Control Devices and areas in the work zone. Impact Attenuators can be installed for the duration of the project, or used temporarily. Impact Attenuators can also be fixed to the ground, or mobile.

The Impact Attenuators encountered this year functioned well and were generally setup properly. Every year, the team encounters several projects where an impact attenuator is missing. This year only a few instances were encountered where the attenuator was omitted. Several outstanding uses of impact attenuators were encountered, including a temporary closure protected by barrier where the barrier had the proper impact attenuator mounted to the barrier end and a truck mounted impact attenuator was placed at the beginning of the barrier, to protect the entrance to the work area.

Impact Attenuators are most commonly omitted from the project altogether. Other common deficiencies include poor condition, improper locations, and an attenuator not suitable for the given design speed. When the impact attenuator is omitted or improperly applied, the work zone becomes less safe for both workers and traffic.

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 Review. 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.

In the past, where lane restrictions have been less conservative, or where little coordination between projects has occurred, significant traffic delays often resulted. Design, construction, and maintenance staff should keep lines of communication open and continue efforts to coordinate road work activities across office, District and Region borders. Traffic Analysts should perform a sensitivity analysis o the calculated lane restrictions. For example, if adding 10% more traffic volume to the facility, Analysts should be looking at how this might affect mobility through the project site.

Work Zone Traffic Control Safety Review "Deficiencies"

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. Temporary Signing

The quality, placement, and spacing of Temporary Signing is measured to determine whether or not the signs are effective at conveying information to the traveling public. Work Zone Reviews frequently encounter one or more temporary signs that fall short of current design practices, proper placement, and/or intent. Incidents of substandard temporary signing were more prevalent during this year's reviews.

To successfully convey the intended message to drivers, signs must be legible, and be located and spaced properly to optimize visibility and compliance. Signs also need to be applicable to the existing work zone, and covered or removed when the message no longer matches the roadway condition. Two issues related to temporary signing are commonly observed. One, normally-used temporary signs are absent; or, two, temporary signs are left visible to traffic when the message no longer applies.

TCP Action

Strengthen the guidance/requirements regarding the maintenance and use of temporary signing. Help educate design and construction staff on the proper maintenance and use of temporary signing.

Work Zone Traffic Control Review

Traffic Control Supervisor (TCS)

For the fifth 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 9, 2015 results slightly favor the omission of a TCS in a contract. This may be explained by the fact that many of the duties of the TCS are required in contracts whether or not a TCS bid item is included. The fact remains that over a six-year period, from 2009 to 2015, 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.

Figure 9 -TCS

MEASURE	TCS	NO TCS
TEMPORARY SIGNING	6.88	6.96
CHANNELIZATION DEVICES	7.01	6.99
PAVEMENT MARKINGS	7.26	7.13
CONCRETE BARRIER	6.92	7.58
IMPACT ATTENUATORS	7.25	7.68
PCMS	7.02	6.89
SEQUENTIAL ARROW PANEL	6.88	7.43
TEMP. TRAFFIC SIGNALS	7.08	5.00
BICYCLE/PED/ADA	5.85	5.32
FLAGGERS	6.61	7.28
PILOT CARS	7.10	7.19
MOBILITY	7.24	7.48
WORKER GARMENTS	6.95	7.35
SITE HOUSEKEEPING	7.00	7.40

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 10, 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, 2015 data suggests an appreciable increase in measure scores can be attributed to the presence of project-specific plan sheets in the TCP. The most notable scores were for Bicycle/Ped/ADA, Channelization Devices, Temporary Signing, Sequential Arrows, and Pavement Markings . For most of the devices the scores increased dramatically with the inclusion of plan sheets.

Figure 10 - Plans

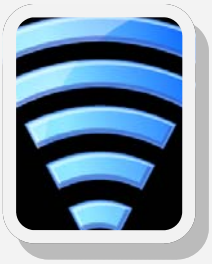
MEASURE	PLANS	NO PLANS
TEMPORARY SIGNING	7.05	6.38
CHANNELIZATION DEVICES	7.13	6.41
PAVEMENT MARKINGS	7.16	7.34
CONCRETE BARRIER	7.34	5.75
IMPACT ATTENUATORS	7.48	7.17
PCMS	6.93	6.94
SEQUENTIAL ARROW PANEL	7.27	5.83
TEMP. TRAFFIC SIGNALS	6.91	-
BICYCLE/PED/ADA	5.80	4.59
FLAGGERS	6.66	7.81
PILOT CARS	7.17	7.17
MOBILITY	7.44	7.11
WORKER GARMENTS	7.16	7.24
SITE HOUSEKEEPING	7.25	7.24

Work Zone Traffic Control Innovations

Currently Available

Smart Work Zone Trailers

Four Smart Work Zone Trailers are available for construction projects on a trial basis. Each trailer is equipped with a camera, travel time sensor, and a traffic sensor. The trailers are designed to be able to communicate with internal ODOT systems and provide relevant data to both ODOT personnel and the travelling public. Currently all four trailers are deployed on I-5 in Region 3 for a pilot project. Contact the TCP Unit for capabilities and availability.



Temporary Glare Screens

Temporary Glare Screens are now available to replace the plywood "gawk" screens. These products are intended to minimize drivers slowing down through work zones to "gawk" at the work.

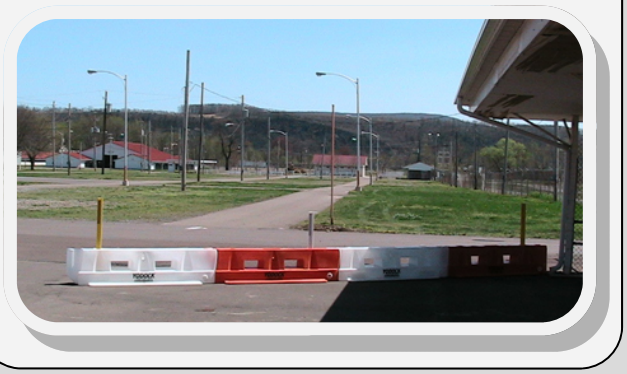
Temporary Glare Screen are lightweight plastic screens mounted on concrete barrier.

Future Improvements

Bicycle Channelizing Device

During the Reviews, 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 bicyclists away from the work area. The TCP Unit is currently working toward the development of the Bicycle Channelizing Device (BCD) pay item, specifications, drawing details, and additional guidance within the TCP Design Manual. A variety of products are being explored that could be used effectively to keep bicyclists out of work areas.



Potential Signing Improvements

Several potential signing improvements are in the works, including rotating signs in the median and increased conspicuity signing. Increased sign conspicuity options are being explored - including different sign border colors and patterns. New delineation ideas are being investigated for ODOT's Temporary Sign Supports (TSS) - to replace large Type III barricades in front of the TSS with reflective sheeting mounted directly to TSS posts.

CONCLUSION

The 2015 Work Zone Reviews 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 Reviews gave us the opportunity to review 39 different State highway construction work zones and collect over 4000 pieces of information. The goals of the reviews were accomplished, and continue to help ODOT improve the practice of temporary traffic control across the State of Oregon.

The Reviews 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 Reviews is seeing recurring "Deficiencies." 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.

Oregon Department of Transportation
Traffic Control Plans Unit

Traffic Standards & Asset Management Unit, MS #5
4040 Fairview Industrial Drive SE
Salem, Oregon 97302-1142

Scott McCanna, PE
State Work Zone Engineer
503.986.3788
scott.m.mccanna@odot.state.or.us

Matt Wilson, EIT
Work Zone Traffic Analyst
503.986.3971
matthew.j.wilson@odot.state.or.us

Justin King, PE
Work Zone Standards Engineer
503.986.3584
justin.s.king@odot.state.or.us

Michael Kimlinger, PE
Traffic Standards Engineer
503.986.3583
michael.j.kimlinger@odot.state.or.us

U.S. Department of Transportation

Federal Highway Administration

FHWA Oregon Division
530 Center Street NE, Suite 420
Salem, Oregon 97301
http://www.fhwa.dot.gov/ordiv/index.htm

Chris Woods
FHWA(Oregon) Programs Manager
503.316.2558
Chris.woods@odot.gov