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Date: May 6, 2020

To: Steven B. Cooley P.E., Chief Engineer

From: Vidal T. Francis, P.E., Resident Engineer

Subject: Review of Enhanced Traffic Control Measures (TCM)

Project: I-5: Woodburn to Salem - Contract 15137 | Safety Pilot Project

INTRODUCTION & BACKGROUND

The intent of this report is to briefly summarize some of the enhanced traffic control measures (TCM's) included in the Contract and to provide suggestions and constructive feedback on how they performed. Various traffic control measures were used on this project. Some enhancements were very effective as planned and others needed field adjustments of various degrees to improve effectiveness.

The I-5: Woodburn – Salem (Sec) is a preservation paving project with limits from OR 214 in Woodburn, milepost 271.6, to the UPRR structure just south of the Chemawa Interchange at milepost 259.1. All six lanes of interstate highway, including selected ramps within the project limits, were paved. This amounted to nearly 81,000 tons of ACP placed. The project was Bid on March 28, 2019 and the contractor began working on May 7, 2019. Project completion was scheduled for October 31, 2019, but weather conditions and contractor missed opportunities resulted in delays which caused the permanent striping work not to be completed as planned. The permanent striping has been scheduled for May/June of 2020.

TRAFFIC CONTROL MEASURES

The list of enhanced TCP's are itemized below, followed by a brief explanation on each. Based on their performance from this project some of the benefits, challenges, and recommendations/suggestions will be provided. The enhancements listed are not exhaustive, but rather a list of enhancements that had the greatest impact for worker and public safety.

- Smart Work Zone System
- Use of Shoulders in Traffic Control Plan (TCP)
- Roller Mounted Portable Changeable Message Signs (PCMS)
- 60 Pound Base Weight for Plastic Drums
- Double Row of Plastic Drums
- Reduced Plastic Drum Spacing
- Temporary Transverse Rumble Strips
- Other TCM's & Support

SMART WORK ZONE SYSTEM

The addition of the Smart Work Zone System was an excellent feature and is highly recommended for use on future Freeway projects. Its purpose was to provide early warning real-time work zone conditions for traveling motorists. It also assisted the Resident Engineer Construction Office in the management of traffic conditions by providing real-time information. This aided decision making for congestion relief during peak critical hours.

Figure 1. Real-time (left) PCMS message board with radar unit. Video tower in right photo.

Benefits

The system does provide for real-time data and reporting/summarization of traffic conditions in terms of speed. The system comes with various static monitoring stations equipped with real-time video, radar surveillance, and GPS. The video surveillance has the capability to rotate 180 degrees to monitor opposing traffic, and the GPS system provides tracking of the equipment's location. The system can be accessed remotely so long as there is internet access. Real-time advance warning messages can be communicated to motorists of traffic conditions as they traverse the work zone.

Challenges

The system's configuration remains static unless monitoring stations are manually moved by the Contractor. Projects with long closures or queuing that extends for miles run the risk of dead zones or areas with minimal monitoring because of the system's layout. Paving projects where the work-zone is quickly moving may find itself working in low to no coverage areas, because construction activities may migrate in-between monitoring stations. The system was set up primarily to monitor the work zone and 1 to 2 miles before and after. On I-5, traffic delays extended well beyond those limits. Moreover, there did not appear to be sufficient monitoring units within the 12 mile project limits. The RE office resorted to outside assistance such as maintenance support, Trip Check, News Flash Alerts, and ODOT overhead VMS's to provide additional real-time messaging beyond the project limits. The online portion of the system did have some periodic glitches that made access and use somewhat difficult. In order to realize the full benefit of this type of system, the Contractor must fully buy into its use and the vendor must monitor the system's performance on a regular basis. This was the first experience of a Smart Work Zone system utilized by this contractor and there was much challenges with set up and take down early in the project.

Improvements

One suggestion to improve the system's effectiveness is additional specification language that requires the smart work zone technician to perform and report systems testing on a weekly basis and to report all data collected weekly. With that, there would need to be language that suspends work until the vendor and Contractor comply. It would also be better if more effort was made to determine optimal placement of the static monitoring stations. Locations were randomly selected and they remained as such for the duration of that side of work on the highway. The system is only good for one side of the highway due to its placement along the shoulder. Placement was such that they were only moved when the opposing side of the highway was ready to begin work. It would have been better if placed strategically in the median because of this being a divided highway. We further recommend and highly suggest that the Traffic designer have more input on where and how many monitoring stations are to be placed.

USE OF SHOULDERS

The use of shoulders as a travel lane was a great feature when fully utilized by the travelling public and the Contractor. Unfortunately, when used each night, it was mostly challenging to initially implement with motorist. This project was somewhat unique in that both the median and outside shoulders were wide enough to accommodate one lane of traffic. The use of the existing paved shoulder was to provide a wider work zone when possible. This allowed a material haul lane and increased worker/traffic separation when working on outside lanes or shoulders. In order to provide this wider work zone, public traffic was reduced to one travel lane. Typically, the use of the shoulders as an alternate travel lane is not permitted or encouraged due to the minimal roadbed support they provide.

Figure 2. Haul lane adjacent to open lanes with shoulder usage.

Benefits

It allowed for increased roadway width configuration. In limited instances we were able to have a haul lane.

Challenges

As shown in the depiction above, motorists unaccustomed to shoulder usage avoided the outside lane. We witnessed on multiple occasions where two lanes were intended to be used, one being the shoulder, yet drivers were not using the shoulder as a lane. Periodically a pilot car or an Incident Response (IR) Unit was used to help motorists recognize and use the outside lane. In figure 6, (right photo) an IR unit displays "USE SHOULDER" to help motorists make the lane shift. We began placing additional messages as part of the Smart work zone informing motorists that there were "2 lanes in use". The lack of use of the outside lane resulted in increased queues. Temporary pavement markings (stick & stomps) were used to help delineate the shoulder, but several vehicles with driver assisted lane guidance systems had issues detecting and maintaining their lane. Ultimately, we outlined edge of pavement with cones for delineation which helped.

For this project, the contractor means and methods was an opportunistic approach that resulted in the deviation from the intended use of the buffer space. They considered added space as an opportunity for production and convenience, rather than increased safety. Therefore, they constantly used the space for other construction support activities, such as vehicle stationing and encroaching work activities.

Recommendations

From a design stand point the plans were largely sufficient and adequate. One suggestion to the traffic control detail would be to utilize W1-4b signs instead of the W1-4 to better illustrate that two lanes are to be used instead of one and add a custom "Drive in Shoulder" sign for large projects of this type. The challenges mentioned were more of an issue for construction staff needing to be aware of the potential lack of shoulder use and increased queuing and make adjustments. Adjustments were made, such as early use of a pilot car as assistance or adding additional or more explicit signs depicting "shoulder in use."

ROLLER MOUNTED PCMS

This was a great enhancement safety feature and should be used on all Freeway paving projects. We had little to no issues with the Roller Mounted PCMS. The only time a concern arose was about the message used on the display. Having standard message types makes the process simple and an easy quick success story with this safety enhancement.

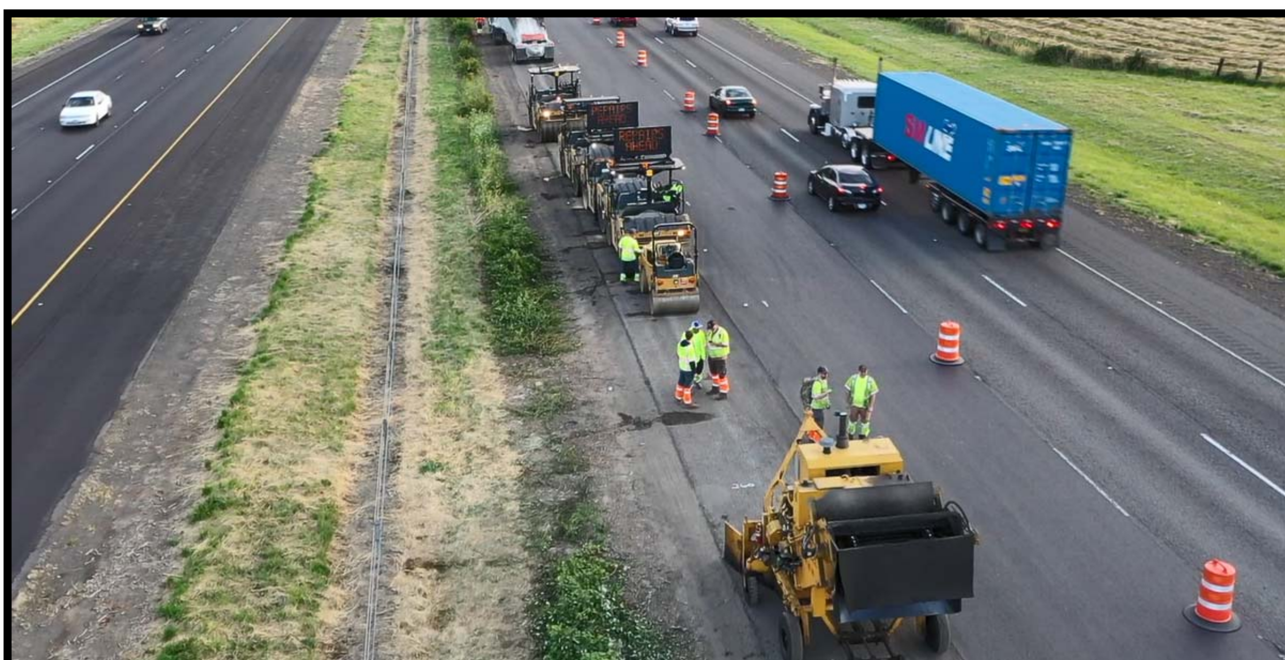


Figure 3. Rollers with PCMS just prior to shift start.

Benefits
Easy to set up. Increased recognition of equipment operating by all.

Challenges
Standardized messages to use. Best visibility at nighttime. Roller-mounted PCMS units can present a safety concern on smaller projects because they reduce visibility and field for the roller operator.

Recommendations
Should be used on all larger projects, with multiple lanes.

60 POUND BASE WEIGHT FOR PLASTIC DRUMS

The purpose of the weighted Base was to minimize the likelihood of drum movement during the course of the work shift due to minimal forces of wind and mild impacts of traveling motorists. The weight of the Base being almost doubled for this project would lend itself to less errant barrels and minimal displacements. Maintaining a prominent delineation between motorist and workers was critical to the objectives of this Safety Pilot project.

Benefits
Increased stability of plastic drums to maintain initial placement. They also have increased visibility and provides a pronounced demarcation of construction work zone.

Challenges
By increasing the weight of the drums, the drums pose another unique situation that increases the safety risk on the project. Despite bidding the project, the contractor was very vocal about the drums becoming a projectile with its added weight. The tradeoff for stability of the drum is more significant damage to an object being hit by the projectile drum. Even with the reduction in speed at 45mph the anxiety of a worker being hit by one of the drums was of significant concern by the contractor. Several drums were struck during the course of this project. The majority of impacts were not significant. Only one instance occurred where a drum was hit and struck another vehicle causing significant damage to their windshield. The contractor receive a claim from the motorist for their damaged windshield.

Another matter that arose was that the added weight increased the work to deploy the drums. Traffic control was set up daily and required that the drums be arranged in advance of the paving work. The increased work prolonged traffic control setup and breakdown. The Contract lane restriction times included traffic control setup and breakdown thus constricting the actual construction work window by about 30 to 45 minutes. The contractor did have a barrel mover as shown in figure 6, but due to safety concerns presented by OSP and the IR unit to maintain the shoulder clear and free of obstructions, we required the drums to be moved beyond the paved shoulders each night which resulted in some added hand work.

Suggestion
Although the Agency has moved to 100% plastic drums on Freeway projects, in this instance, the use of stackable cones outside the initial taper would not only simplify the deployment and removal but, it will maximize the construction window. It would also provide more lane width for public traffic and increased buffer space for haul vehicles and workers. The length of this project’s closure in terms of distance, duration, and required deployment & removal magnified the challenges of drum use. Closures where the increased weighted drums would be ideal are in situations where they would remain in place for 24 hours or more and where speeds are to be lower. A long duration urban project would better suit the use of weighted 100% plastic drums instead of a lengthy freeway project as this one.

DOUBLE ROW OF PLASTIC DRUMS

The placement of two rows of plastic drums was initially based on the original design concept of a crossover that the contracting industry and ODOT had hoped to use. Due to the lack of stakeholder commitment the crossover alternative was not selected and it was decided to apply a hybrid traffic control design concept for this project. The double drum design in the Contract traffic control plan (TCP) was planned for placement between the Brooks and Woodburn Interchanges. Between the southerly project limits and the Brooks Interchange, the TCP only required one row of drums. The use of double drums was intended to still be used in this project as a way to better delineate the buffer space and not as a traffic separator between opposing traffic.

Benefits

Construction workers had an increased feeling of safety due to the placement of the paired drums along the work site. The work zone visibility was more pronounced.

Challenges

The Contractor initially followed the designed TCP of dual drums, but quickly requested that the second row of drums closest to the work be removed after some motorists entered the buffer lane thinking that it was an open travel lane for use. Once one vehicle entered others quickly followed. It appeared that some motorists were generally confused. An attempt was made to reduce the transverse spacing between the pair of drums but this limited access to haul vehicles entering and exiting the work site. Workers quickly realized their false sense of security because of unanticipated traffic in the buffer lane. We discussed the safety concerns of workers and restricted width for hauling vehicles entering and exiting the work zone and the Traffic Unit in concurrence with the Resident Engineer agreed that the second row of drums could be removed. A Contract Change Order (CCO) was written to document the TCP modification.

Recommendations

Though the transitions were correctly placed and temporary striping made clear delineated lanes for the traveling public, motorists were confused by the configuration or likely frustrated with the long queuing of vehicles. It may have been perceived that the barrels were delineating travel lanes. This project had significant delays during peak hour traffic and that's when a majority of these instances occurred. It is supposed that the delays coupled with work vehicles entering and exiting the work site contributed to this behavior. The use of dual drums in this scenario while having the constant traffic of haul vehicles entering and exiting the work site is not recommended. Also, the work zone extended for miles and drums could have been hit, displaced, and not immediately adjusted by the traffic control supervisor which could have given the impression of an open lane for motorists.

REDUCED PLASTIC DRUM SPACING

The reduced spacing of plastic drums was not as favorable as expected. Similar to the two rows of barrels, this enhanced safety concept was a carryover from the crossover design concept mentioned above. The intent was to better delineate the work zone.

Haul vehicles had challenges entering the work zone. Consequently their slowed entry resulted in impacts to the flow of public traffic. The Contractor requested a change to revert to the typical spacing of 40 feet to allow their haul vehicles easier accessibility into the work zone without reducing traffic speeds too significantly. This request was agreed to by the Agency and included in the CCO mentioned above in the "Double Row of Plastic Drums" section of this report.

Figure 4. Tight drum spacing made challenges for haul vehicles entering and exiting the work area.

Benefits
This made the work zone very apparent to motorists. Construction workers had an increased feeling of safety due to the added drums along the work site.

Challenges
The delivery method of ACP to the project site was the use of long Belly Dump trucks. The primary construction activities were milling and paving where the delivery and removal of material by haul vehicles is critical. This is magnified by the frequency of their entering and exiting the project site. Issues with accessibility for the haul vehicles were immediately apparent. The Contractor requested to change the drum spacing to the typical 40' because drivers were having challenges decelerating and accelerating to enter or exit the work site due to the reduced spacing. The issue was greatest when entering the work site. Trucks were slowing down in the travel lanes in order to negotiate and navigate between the drums increasing queuing and public delays.

Recommendations
In this instance the traditional spacing of 40 feet proved to be more favorable. If the project had moved forward with the original crossover alternative, the reduced spacing would have been more suitable because there would have been no need to accommodate any vehicles traversing the wall of drums to enter or exit the work zone.

TEMPORARY TRANSVERSE RUMBLE STRIPS

Temporary transverse rumble strips can be effective in warning motorists of upcoming construction or lane shifts. After using the temporary rumble strips on several attempts it was considered to be more of a safety concern than anticipated. Temporary rumble strips were used on this project as a calming measure to maintain reduced speeds of motorists entering the work zone. After the three lane section of highway was reduced to one lane, transverse rumble strips were positioned to engage the attention of motorists that this is an active work zone.

As shown in the figure(s) below, the cluster of portable temporary rumble strips that were placed moved in a unique motion pending how traffic engaged them. Originally these were all placed in a uniformed position forming a single line across three lanes of highway. Within 30 minutes of placement they would rotate in a skewing fashion, move laterally, and/or perpendicular to travel. Some movements were in excess of the recommended 3 feet skew, 2 feet lateral or 5 feet perpendicular. For comparison, the photo below at the time had only one lane (the travel lane) under traffic. The adjacent lane (center lane) not yet open to traffic. The left photo shows lateral and skew movements while making a continued encroachment into the adjacent lane. The center photo shows skew of over 3 feet, while the last photo shows a perpendicular movement that had reached about nearly 4 feet. All occurred within 20 to 30 minutes.

Figure 5. Movement of portable temporary transvers rumble strips.

Benefits

These rumble strips are relatively quick to deploy, and altered the motoring public of oncoming construction or traffic changes when functioning properly. They can alert crews of upcoming traffic if placed near the work site.

Challenges

The Contractor installed the transverse rumble strips on the first paving shift. To install the rumble strips a rolling slowdown was utilized and within minutes three strips were placed across the active lane at the required spacing. After +/-25 minutes of traffic flow it became apparent that this enhanced TCM was more maintenance and could create longer queues if having to straighten and adjust on 30 minutes intervals. As motorist traveled across the rumble strips they immediately began to rotate and shift. Their movement was mostly induced by the heavy trucks travelling at higher speeds, 45 mph and above. In some cases the rumble strip gradually moved off the lane. These rumble strips had to be adjusted once or twice an hour utilizing a rolling slowdown each time adding to traffic delays. Additionally, the blunt ends of the strip was a concern for motorcycles.

Recommendations

The benefit of hearing the rumble strips as a warning measure for workers was not realized because of their placement relative to the physical work within the work zone. The rumble strips would have been better if used in a slower traffic environment and where traffic volumes and speeds are significantly less. In hindsight, these strips could have been more effective in warning construction workers of oncoming trucks if placed in the haul/buffer lane within the work zone. Notwithstanding, the rumble strips inability to maintain proper positioning made them an unsuitable enhancement measure for this Freeway project.

OTHER TCM's

There were other TCM's that were used on this project. A **Speed limit Reduction** order was in place. The decision to reduce the speed limit was a very good policy and should be part of any Freeway paving project. In addition to the reduced speed order, the project was patrolled by OSP as part of ODOT's **Wok Zone Enforcement program**. Having OSP present made a huge difference in the attention that motorists paid while traveling the construction work zone. Of all the enhanced measures used this is among the top 5 most effective. In the absence of police enforcement, the contractor was permitted to use blue lights affixed on their paver as part of an agreement between ODOT and construction industry partners. It is difficult to measure how successful the **Blue Lights flashing on pavers were**. The contractor feels the lights improve safety, but ultimately we were not able objectively analyzed its use at this time.

Figure 6. Beginning from left moving Clockwise: (Left) Portable Radar Speed Trailer, (Top) Overhead Variable Sign Message board, (Right) IR unit with PCMS assist with shoulder lane shift, and (bottom) IR unit with PCMS. In the middle is the contractor's Traffic Control work truck with a front mounted barrel mover.

A major aspect to this paving project was the allowance of **Extended Work Hours** that permitted the contractor to work until 9am in some portions of the project. The extended work hours was intended to give the contractor the opportunity to maximize paving production thereby reducing the overall worker exposure in terms of days. The work window was as follows:

- OR214/Woodburn to just north of Brooklake Rd. – 7pm till 9am Sunday night to Friday morning
- Brooklake Rd. to the UPRR structure - 8pm to 5am Sunday night to Friday Morning
- Via CCO, we did permit closures for Saturday nights as well till 9am.

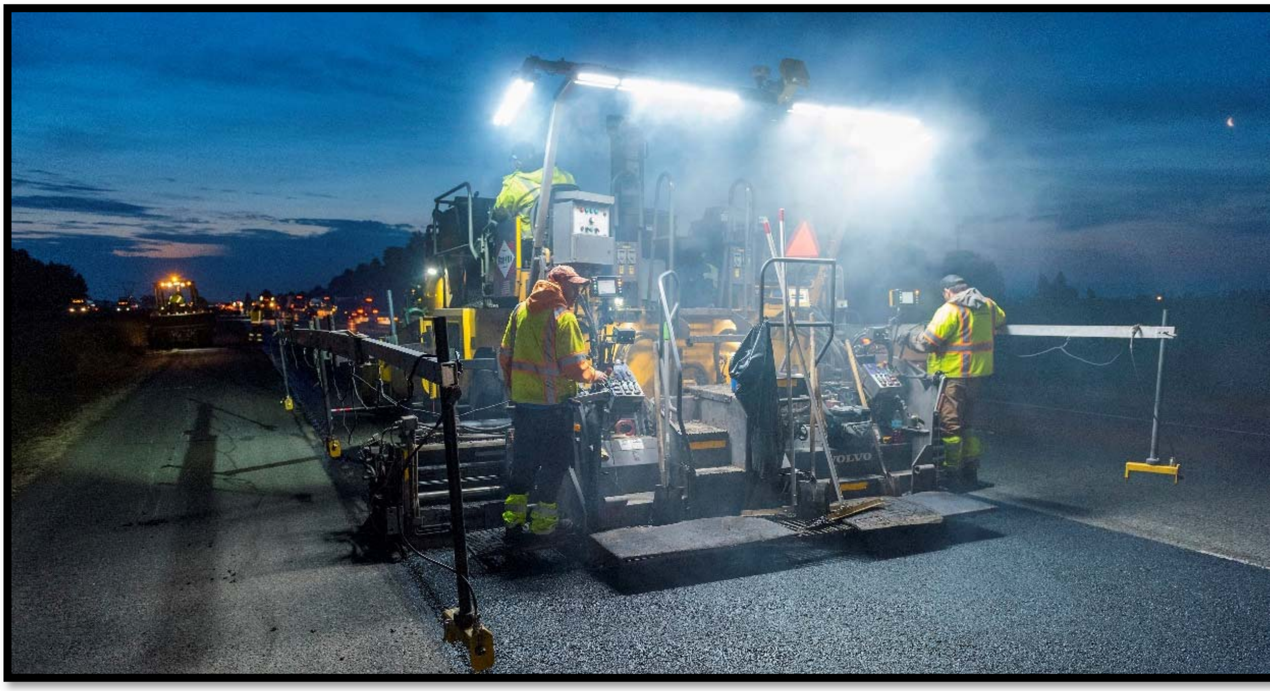


Figure 7. Paver outfitted with flashing Blue strobes above work lights (hard to see).

The extended closure time was expected to maintain a maximum 30 minute delay threshold for motorists traveling through the work zone. The peak evening traffic delays were generally within the threshold, though there were some days with motorists experiencing more significant delay. The morning commute was very challenging. Delays ranged from 10 to 50 minutes on average. Queues were very significant. In some instances 4 to 7 miles long. The delays were compounded when incidents or accidents occurred within the queue. The biggest help to this project was the use of a **Dedicated Incident Response Unit**. Although worker safety was important, we know that public safety is equally important. This project by large was an "incident management project". Our ability to get the work done was in part due to how well we could keep incidents from occurring so as not to create further delays.

Figure 8. Lengthy queues during peak travel periods.

How did we make it work:
Our objective was to "keep traffic moving." Once traffic is slowed down due to normal forces of volume, lane merges, construction activities, police presence, etc., it is near impossible to avoid the queueing. If traffic flow is able to maintain at least 20 mph, a vehicle in a 7 mile queue would be free in 22 minutes. On this project, a queue would begin to develop by 6:45 am. It would continue till lanes were open by 9am. By 9am queues were 3 to 7 miles. If an incident occurred along the queue, traffic would slow and the queue naturally grew further and the queue length appeared to grow exponentially.

Things we did:
Each morning was like a "go… no go situation" to permit the contractor to work beyond 7 am. To help us keep the project moving forward we did a couple of things:

1) Each night prior to the AM peak commute, remove all disabled vehicles from the shoulder. The IR unit was tasked with taking the necessary steps to complete nightly.
2) Monitored traffic in real-time via Trip check, google, and Smart Work Zone starting at 5:30 am. Estimated travel times and queue lengths were inferred or estimated to proactively address potential impacts, as the morning progressed.
3) At 20 min delay, based on real-time observation, notify Region communications team of pending delays on I-5. This included news alerts and programing VMS's to warn motorist congestion ahead to "BE PREPARED SLOW TRAFFIC AHEAD".
4) As incidents occurred, the prepositioned dedicated IR team member responded to quickly clear the incident.
5) Along the peripheral roads of I-5, Maintenance forces provided message boards to warn motorist taking alternate routes of possible congestion.

From the observations and data collected on various days during the project, we recognized and acknowledge that the Incident Response Unit made a substantial, positive difference to our work zone. This project by large was an "incident management project". Our ability to get the work done was in part due to how well we could keep incidents from occurring so as not to create further delays. The 30 minute threshold for delays was a challenge to meet at times. Sustained delay impacts (for months) with daily closures to 9 am is possible but not so desirable.

The following tables are a summarization of some of the data collected on the project. Each table provides to the extent available delay information and corresponding incident information. Adjacent to the tables is a graph with plotted speeds verses time. In some cases multiple speed recordings are shown to reflect various monitoring units placed along the project.

Analyzed Path: 640 Hawthorne Ave SE to 2996 Newberg Hwy

Delay Table

Date	Time (AM)	Delay (min)	Approx Delay length (mi) (continuous red)
6.5.19			
6.5.19	5:30	1	0.07
6.5.19	5:40	33	7.54 (4.83+2.71)
6.5.19	5:50	42	5.41 (2.74+2.67)
6.5.19	6:00	44	5.98 (3.36+2.62)
6.5.19	6:10	25	4.40 (2.98+1.42)
6.5.19	6:20	15	6.3
6.5.19	6:30	18	5.35
6.5.19	6:40	42	7.9
6.5.19	6:50	30	7.93
6.5.19	7:00	20	5.72
6.5.19	7:10	17	5.28 (0.15+5.13)
6.5.19	7:20	19	4.7
6.5.19	7:30	20	4.69
6.5.19	7:40	16	5.36
6.5.19	7:50	15	4.46
6.5.19	8:00	20	4.96 (3.96+1)
6.5.19	8:10	17	5.37 (.5+3.87+1)
6.5.19	8:20	14	5.75 (4.75+1)
6.5.19	8:30	17	4.2
6.5.19	8:40	14	5.03 (4.53+.5)
6.5.19	8:50	10	4.36
6.5.19	9:00	8	3.03 (.01+3.02)

Inview Incident Data http://inviewsalem.odot.state.or.us/Default.aspx
Event Summary Log https://app.powerbigov.us/view?r=eyJrIjoiOTc5MWFkN2MtNTY5YS00OTk5LWIzN

Incident Table

Date	Created	Cleared	ID	MP	Incident
6.5.19	5:19 AM	7:50 AM	1400	263	Crash - 2 vehicles; injuries unknown RAMP
6.5.19	6:45 AM	7:33 AM	1421	262	Hazardous Debris - Barrel in lane
6.5.19	7:09 AM	7:16 AM	1434	278	Hazardous Debris - Chemical spray

Table 1. Morning work zone travel data collected on 06-05-2019

Analyzed Path: https://goo.gl/maps/rG1xs2!

Inview Incident Data http://inviewsalem.odot.state.or.us/Default.aspx

Salandar Board https://projects.sindrtech.com/Salander/login

Delay Table				1194	1575	3100	Incident Table				
Date	Time (AM)	Delay (min)	Delay (mi)	Avg Speed	Avg Speed	Avg Speed	Created	Cleared	ID	MP	Incident
7.8.19	5:00 AM	3		64	61	63					
7.8.19	5:15 AM	2		67	61	62					
7.8.19	5:30 AM	2		67	64	64					
7.8.19	5:45 AM	2		68	64	65					
7.8.19	6:00 AM	1		66	64	63					
7.8.19	6:15 AM	2		67	66	65					
7.8.19	6:30 AM	2		66	63	64					
7.8.19	6:45 AM	2		63	63	66					
7.8.19	7:00 AM	7		64	64	63					
7.8.19	7:15 AM	18		64	56	64					
7.8.19	7:30 AM	21		64	8	64					
7.8.19	7:45 AM	23		64	10	62					
7.8.19	8:00 AM	25		65	8	63					
7.8.19	8:15 AM	24		63	11	61					
7.8.19	8:30 AM	26		63	8	61					
7.8.19	8:45 AM	25		65	8	59					
7.8.19	9:00 AM	22		65	17	60					
7.8.19	9:15 AM	20		64	47	51					
7.8.19	9:30 AM	16		64	63	60					

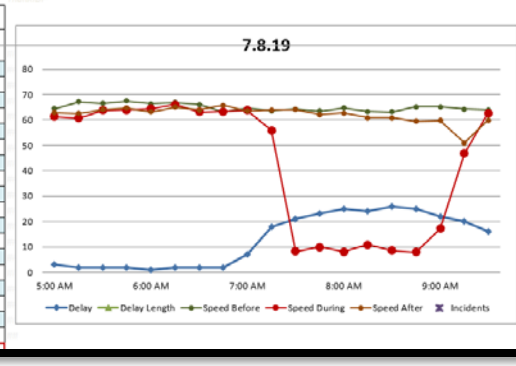


Table 2. Morning of 07-08-19.

Analyzed Path: https://goo.gl/maps/rG1xs2!

Inview Incident Data http://inviewsalem.odot.state.or.us/Default.aspx

Salandar Board https://projects.sindrtech.com/Salander/login

Delay Table				1194	1575	3100	Incident Table				
Date	Time (AM)	Delay (min)	Delay (mi)	Avg Speed	Avg Speed	Avg Speed	Created	Cleared	ID	MP	Incident
7.9.19	5:00 AM	3	0.00	62	65	61					
7.9.19	5:15 AM	2	0.00	62	66	61					
7.9.19	5:30 AM	2	0.00	60	64	63	5:41 AM	5:42 AM	2231	266	Non-Hazard: Disabled Vehicle
7.9.19	5:45 AM	2	0.00	62	65	63					
7.9.19	6:00 AM	1	0.00	61	64	61					
7.9.19	6:15 AM	2	0.00	64	66	62					
7.9.19	6:30 AM	2	0.00	64	63	63					
7.9.19	6:45 AM	2	0.11	63	65	63					
7.9.19	7:00 AM	7	2.89	63	64	61					
7.9.19	7:15 AM	10	2.94	63	60	61	7:15 AM	8:14 AM	2267	253.87	Hazard: Animal Struck (blocking off-ramp)
7.9.19	7:30 AM	15	3.18	62	16	63					
7.9.19	7:45 AM	18	3.21	59	7	60	7:46 AM	7:59 AM	2278	251.53	Hazardous Debris: Trash can (off-ramp)
7.9.19	8:00 AM	21	3.40	57	11	61	8:13 AM	2:22 PM	2300	258	Herbicide Application - Median
7.9.19	8:15 AM	23	3.55	60	16	62	8:26 AM	8:34 AM	2309	257	Non-Hazard: Disabled Vehicle
7.9.19	8:30 AM	24	3.61	60	8	59					
7.9.19	8:45 AM	24	3.58	59	10	59	8L34	8:52 AM	2317	252	Non-Hazard: Disabled Vehicle
7.9.19	9:00 AM	22	3.57	59	10	59					
7.9.19	9:15 AM	17	3.11	58	30	51					
7.9.19	9:30 AM	6	2.64	61	62	48					

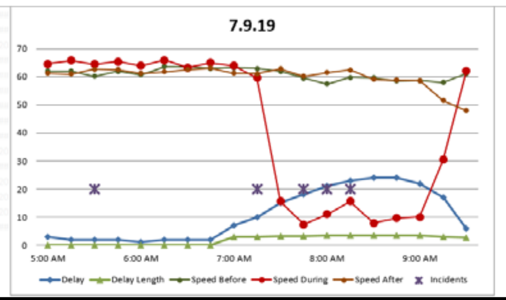


Table 3. Morning Work zone travel data collected on 07-09-2019

Analyzed Path: https://goo.gl/maps/rG1xs2!

Inview Incident Data http://inviewsalem.odot.state.or.us/Default.aspx

Salandar Board https://projects.sindrtech.com/Salander/login

Delay Table				1194	1575	3100	Incident Table				
Date	Time (AM)	Delay Time	Delay (mi)	Avg Speed	Avg Speed	Avg Speed	Created	Cleared	ID	MP	Incident
7.12.19	5:00 AM	8		34	56	62					
7.12.19	5:15 AM	9		34	61	63					
7.12.19	5:30 AM	10		30	56	63					
7.12.19	5:45 AM	12		35	59	64					
7.12.19	6:00 AM	12		35	59	62					
7.12.19	6:15 AM	15		34	62	65					
7.12.19	6:30 AM	16		37	26	62	6:35 AM	8:29 AM	3287	278	Crash: 4 vehicles - minor injuries
7.12.19	6:45 AM	19		28	10	63	6:55 AM	8:23 AM	3290	277	Crash: 2 vehicles - no injuries
7.12.19	7:00 AM	24		12	8	64					
7.12.19	7:15 AM	25		4	12	65					
7.12.19	7:30 AM	27		18	4	64	7:41 AM 7:44 AM	 8:14 AM	3290 3316	278 270	Crash: 2 vehicles Non-Hazard: Disabled Vehicle
7.12.19	7:45 AM	26		2	10	64	7:47 AM		3318	270	Complaint: Semi w/ blowout tires in RT lane
7.12.19	8:00 AM	28		6	4	63	7:44 AM	8:14 AM	3316	270	Non-Hazard: Disabled Vehicle
7.12.19	8:15 AM	27		8	9	62	8:25 AM	8:30 AM	3326	271	Non-Hazard: Disabled Vehicle
7.12.19	8:30 AM	25		16	6	62					
7.12.19	8:45 AM	24		28	10	61	8:37 AM		3333	278	Crash: Hit & Run
7.12.19	9:00 AM	24		17	9	60	8:48 AM	9:14 AM	3336	356	Hazardous Debris
7.12.19	9:15 AM	24		16	13	57					
7.12.19	9:30 AM	20		16	17	58					

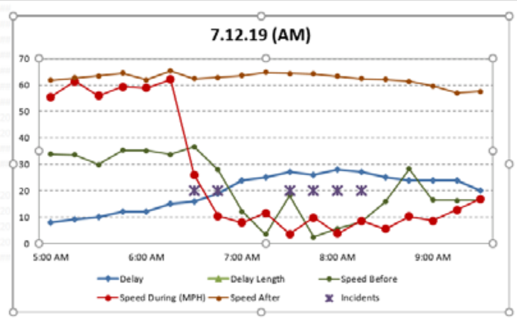


Table 4. Morning work zone travel data collected on 07-12-2019

Analyzed Path: https://goo.gl/maps/rG1xs2!

Inview Incident Data http://inviewsalem.odot.state.or.us/Default.aspx

Salandar Board https://projects.sindrtech.com/Salander/login

Delay Table				1194	1575	Incident Table				
Date	Time (AM)	Delay (min)	Delay (mi)	Avg Speed	Avg Speed	Created	Cleared	ID	MP	Incident
6.25.19	7:00 PM	1	0.00	67	66					
6.25.19	7:10 PM	1	0.48	67	67					
6.25.19	7:15 PM	1	0.00	67	67					
6.25.19	7:30 PM	2	1.09	66	65					
6.25.19	7:45 PM	1	0.00	68	66					
6.25.19	8:00 PM	1	0.00	68	65					
6.25.19	8:15 PM	1	0.00	68	64	8:15 PM	8:26 PM	8254	267	Non-Hazard: Disabled Vehicle
6.25.19	8:30 PM	1	0.00	68	67	8:35 PM	8:41 PM	8256	267	Non-Hazard: Disabled Vehicle
6.25.19	8:45 PM	1	0.00	67	67	8:47 PM	8:51 PM	8258	263	Non-Hazard: Disabled Vehicle
6.25.19	9:00 PM	1	0.00	66	65					
6.25.19	9:15 PM	8	1.79	66	64					
6.25.19	9:30 PM	17	4.21	66	22	9:38 PM	9:42 PM	12:00 AM	256	Non-Hazard: Disabled Vehicle
6.25.19	9:45 PM	25	3.33	65	3					
6.25.19	10:00 PM	27	2.99	65		10:01 AM	n/a	8270	248	Crash - 1 Vehicle (deer); no injuries
6.25.19	10:15 PM	28	3.01	66						
6.25.19	10:30 PM	27	3.24	66						
6.25.19	10:45 PM	22	3.30	64		10:50 AM	10:51 AM	8277	270	Non-Hazard: Disabled Vehicle
6.25.19	11:00 PM	21	3.36	66						
6.25.19	11:15 PM	22	3.14	66	13					
6.25.19	11:30 PM	21	3.42	65	36					
6.25.19	11:45 PM	17	3.11	64	60					
6.25.19	12:00 AM	16	3.18	66	64					

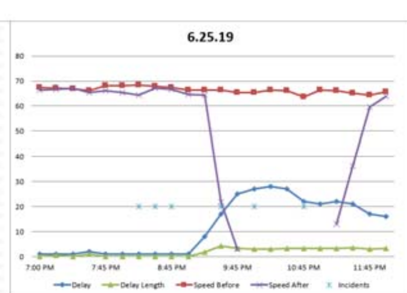
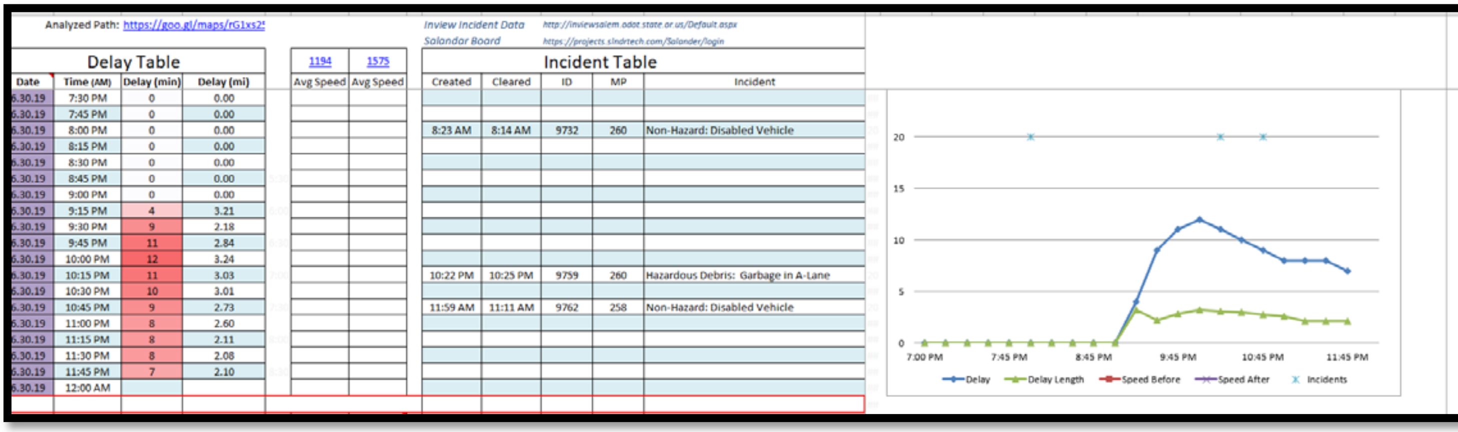


Table 5. Evening peak work zone travel data collected on 06-25-2019



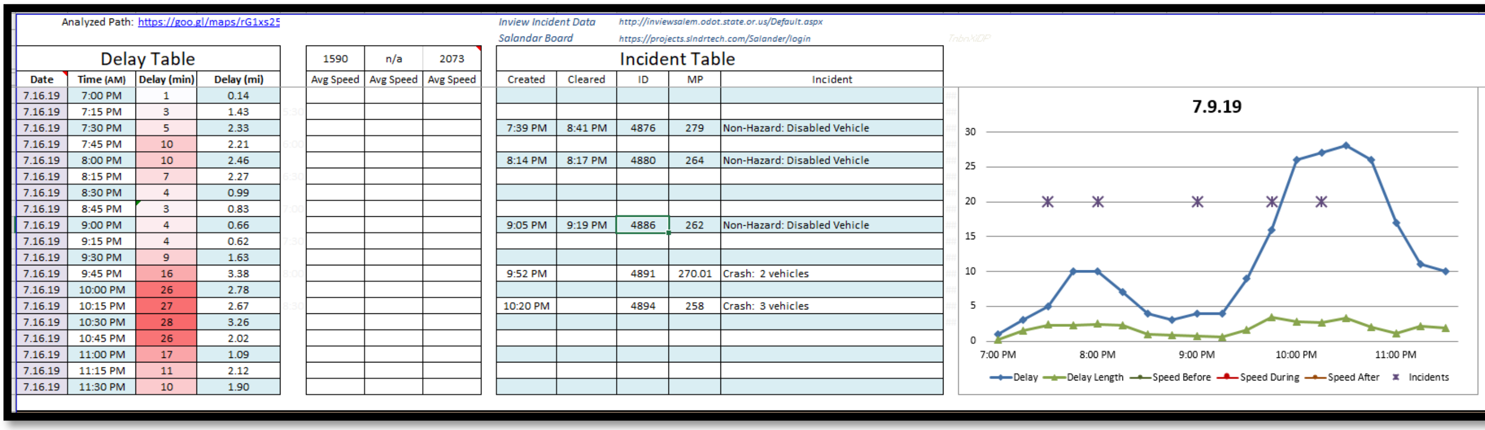
Analyzed Path: https://goo.gl/maps/rG1xs2!

Inview Incident Data http://inviewsalem.odot.state.or.us/Default.aspx

Salandar Board https://projects.slndrtech.com/Salander/login

Delay Table				1194	1575	Incident Table				
Date	Time (AM)	Delay (min)	Delay (mi)	Avg Speed	Avg Speed	Created	Cleared	ID	MP	Incident
6.30.19	7:30 PM	0	0.00							
6.30.19	7:45 PM	0	0.00							
6.30.19	8:00 PM	0	0.00			8:23 AM	8:14 AM	9732	260	Non-Hazard: Disabled Vehicle
6.30.19	8:15 PM	0	0.00							
6.30.19	8:30 PM	0	0.00							
6.30.19	8:45 PM	0	0.00							
6.30.19	9:00 PM	0	0.00							
6.30.19	9:15 PM	4	3.21							
6.30.19	9:30 PM	9	2.18							
6.30.19	9:45 PM	11	2.84							
6.30.19	10:00 PM	12	3.24							
6.30.19	10:15 PM	11	3.03			10:22 PM	10:25 PM	9759	260	Hazardous Debris: Garbage in A-Lane
6.30.19	10:30 PM	10	3.01							
6.30.19	10:45 PM	9	2.73			11:59 AM	11:11 AM	9762	258	Non-Hazard: Disabled Vehicle
6.30.19	11:00 PM	8	2.60							
6.30.19	11:15 PM	8	2.11							
6.30.19	11:30 PM	8	2.08							
6.30.19	11:45 PM	7	2.10							
6.30.19	12:00 AM									

Table 6. Evening peak work zone travel data collected on 06-30-2019



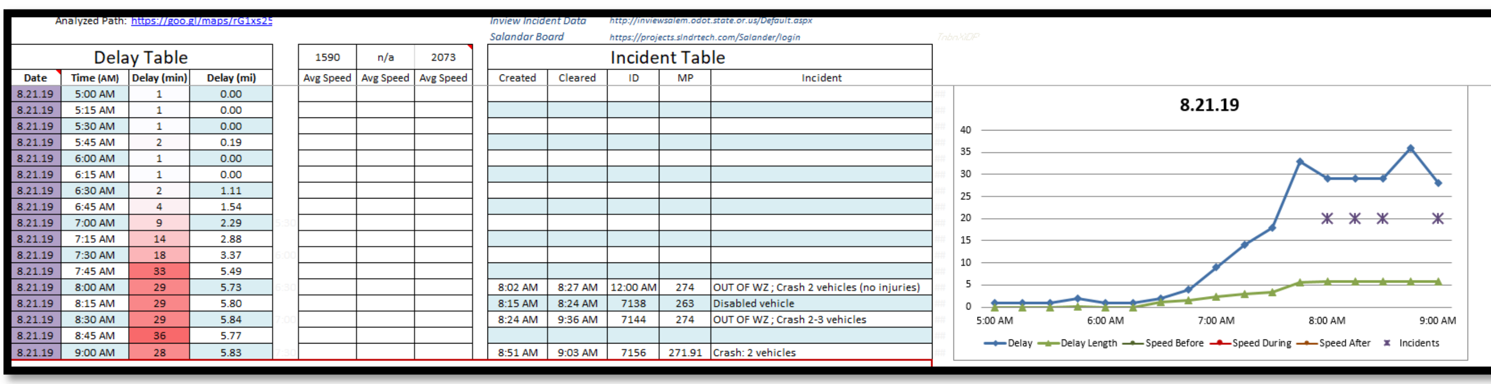
Analyzed Path: https://goo.gl/maps/rG1xs25

Inview Incident Data http://inviewsalem.odot.state.or.us/Default.aspx

Salandar Board https://projects.slndrtech.com/Salander/login

Delay Table				1590	n/a	2073	Incident Table				
Date	Time (AM)	Delay (min)	Delay (mi)	Avg Speed	Avg Speed	Avg Speed	Created	Cleared	ID	MP	Incident
7.16.19	7:00 PM	1	0.14								
7.16.19	7:15 PM	3	1.43								
7.16.19	7:30 PM	5	2.33				7:39 PM	8:41 PM	4876	279	Non-Hazard: Disabled Vehicle
7.16.19	7:45 PM	10	2.21								
7.16.19	8:00 PM	10	2.46				8:14 PM	8:17 PM	4880	264	Non-Hazard: Disabled Vehicle
7.16.19	8:15 PM	7	2.27								
7.16.19	8:30 PM	4	0.99								
7.16.19	8:45 PM	3	0.83								
7.16.19	9:00 PM	4	0.66				9:05 PM	9:19 PM	4886	262	Non-Hazard: Disabled Vehicle
7.16.19	9:15 PM	4	0.62								
7.16.19	9:30 PM	9	1.63								
7.16.19	9:45 PM	16	3.38				9:52 PM		4891	270.01	Crash: 2 vehicles
7.16.19	10:00 PM	26	2.78								
7.16.19	10:15 PM	27	2.67				10:20 PM		4894	258	Crash: 3 vehicles
7.16.19	10:30 PM	28	3.26								
7.16.19	10:45 PM	26	2.02								
7.16.19	11:00 PM	17	1.09								
7.16.19	11:15 PM	11	2.12								
7.16.19	11:30 PM	10	1.90								

Table 7. Evening peak work zone travel data collected on 07-16-2019



Analyzed Path: https://goo.gl/maps/rG1xs25

Inview Incident Data http://inviewsalem.odot.state.or.us/Default.aspx

Salandar Board https://projects.slndrtech.com/Salander/login

Delay Table				1590	n/a	2073	Incident Table				
Date	Time (AM)	Delay (min)	Delay (mi)	Avg Speed	Avg Speed	Avg Speed	Created	Cleared	ID	MP	Incident
8.21.19	5:00 AM	1	0.00								
8.21.19	5:15 AM	1	0.00								
8.21.19	5:30 AM	1	0.00								
8.21.19	5:45 AM	2	0.19								
8.21.19	6:00 AM	1	0.00								
8.21.19	6:15 AM	1	0.00								
8.21.19	6:30 AM	2	1.11								
8.21.19	6:45 AM	4	1.54								
8.21.19	7:00 AM	9	2.29								
8.21.19	7:15 AM	14	2.88								
8.21.19	7:30 AM	18	3.37								
8.21.19	7:45 AM	33	5.49								
8.21.19	8:00 AM	29	5.73				8:02 AM	8:27 AM	12:00 AM	274	OUT OF WZ ; Crash 2 vehicles (no injuries)
8.21.19	8:15 AM	29	5.80				8:15 AM	8:24 AM	7138	263	Disabled vehicle
8.21.19	8:30 AM	29	5.84				8:24 AM	9:36 AM	7144	274	OUT OF WZ ; Crash 2-3 vehicles
8.21.19	8:45 AM	36	5.77								
8.21.19	9:00 AM	28	5.83				8:51 AM	9:03 AM	7156	271.91	Crash: 2 vehicles

Table 8. Morning peak work zone travel data collected on 08-21-2019