Workzone Traffic Analysis Guide

Providing the Capacity to Keep Traffic Moving

I. Introduction

The **purpose** of this paper is to outline the methodology used by ODOT's Traffic Control Plans (TCP) Unit for highway Workzone (WZ) Traffic Analysis and recommendations related to workzone lane closure restrictions. ODOT often limits the hours that workzone lanes and roads may be closed in an effort to reduce motorist delay and crash potential. This analysis is critical because lane closure restrictions can result in expensive staging or lengthy delays for the successful completion of the project. The number one criterion is the safety of the traveling public and the construction workers.

The **methodology** presented is based on decades of on-the-job experience, technical observation and engineering evaluation. It does not follow the Highway Capacity Manual (HCM) methodology for highway capacity analysis, but has been shown to be effective and efficient in anticipating the needed capacity to keep traffic moving safely through construction project areas.

The highway **analysis objective** is straightforward:

- Establish the volume of vehicles expected on the highway.
- Determine the available capacity of the highway with one or more lanes closed.
- If the volume is larger than the capacity, recommend appropriate lane restrictions.

Highway WZ Traffic Analysis really is that straightforward. The rest of the procedure explains how to gather and adjust the data so that it is pertinent to the time and location of the project.

Note: This methodology is designed for **highway segment analysis**. If you need to **analyze an intersection** for possible workzone lane closures, a completely different methodology must be used. Contact the TCP Unit for details on intersection analysis.

ODOT's lane closure restrictions are found in section 220.40 of the project special provisions located at: http://www.odot.state.or.us/tsspecs/02specials/200/SP220.DOC and are also found at the end of this paper.

II. Analysis Requests

Devise an **analysis request procedure** so that the analysis can be done **early** in the project development, especially when the workzone restrictions could have significant impacts to the project's schedule. Within ODOT, the Regional TCP Designer or Project Leader submits a WZ Traffic Analysis Request Form to the Regional Traffic Analysts to get the analysis process started. Copies of the form are attached at the end of this paper.

III. Deliverables

Stand-alone reports (see attached samples) need to be submitted with the following information from the Analysis:

- Recommendations for lane restrictions, ramp closures and potential detours.
- Physical characteristics on the main highway and the cross streets, such as lane width and configuration, grade, pedestrian and bike facilities, heavy vehicles impacts, sight distance limitations, etc.
- Include closure information for holidays, weekend restrictions and/or special events.

Additional data to submit separately are:

- Volume data
  - Source and location of the volume data
  - Date that data was collected
  - Automatic Traffic Recorders (ATR) and/or Traffic Volume Table (TVT) data used
  - Adjustment factors used for:
    - Truck data
    - Growth factors
    - Seasonal adjustments
    - Weekend vs. weekday factors from appropriate ATRs

- Document how the capacity was chosen
- Queuing and delay analysis including charts, tables and calculations as outlined later in this document

The Traffic Control Plans Engineer takes ultimate responsibility for the specifications relating to lane closure restrictions. Analysts making recommendations to the TCP Engineer need to provide quality recommendations for every project. Until an Analyst feels confident with the process, it would be advisable to go over it with someone from the Central TCP Unit the first few times. The concept of the analysis is straight-forward, but determining the appropriate capacity and adjusted volumes can be somewhat complex.

Anyone who has done traffic analysis will tell you that analysis **data are not set in stone**. Keep in mind that highway capacities and traffic volumes **can** be highly variable and will contain a degree of uncertainty. For instance, you wouldn't project traffic volumes of 732.2 Passenger Car Equivalents (PCE). Depending on the level of confidence that an analyst has in the data, they may be revisited to see how sensitive they are to change. A small adjustment to the numbers may change the available construction hours.

IV. Traffic Volumes

A. Where to Find Traffic Volumes

Traffic volume data is available from ODOT, city and county sources. In most cases, volume data from several sources are required to make a reasonable assessment of workzone traffic analysis. These sources follow with the best choices listed first:

- ODOT Manual Counts – ODOT has an extensive library of manual traffic counts all over the state. A good place to start looking is on the ODOT Traffic Data web site at http://www.oregon.gov/ODOT/TD/TDATA/ . At this time, ODOT's individual manual counts cannot be retrieved by folks outside of ODOT; however, please contact the ODOT Regional Tech Centers or the TCP Unit if you need manual traffic count data.

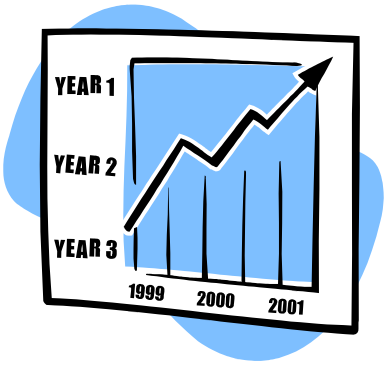
- City and County manual and machine counts are also available. Contact the local agencies directly for this count data.

- If count data is not available from other sources, have new counts done. Check with your project leader on how to have new counts performed.

- One of the best ways to get traffic volume data is to go to the project site and record the count information yourself. This will provide limited duration count information, but it will also provide an opportunity to observe the dynamics of the traffic in the area. Also, talk to the Area Maintenance Manager or other Region folks to see if there any unique characteristic s in the area.

- ODOT's Transportation Volume Tables (TVTs) are available at http://www.oregon.gov/ODOT/TD/TDATA/tsm/tvt.shtml#Traffic_Volume_Tables. These tables give valuable highway average daily traffic (ADT) volumes and traffic volume trends that are recorded from ODOT Automatic Traffic Recorders (ATR). ATR data, also included in the TVT, is useful in determining traffic trends. Because much of this data is "smoothed" and extrapolated, it does not substitute for manual classification counts

B. Traffic Count Data Types and Duration



Clarification on any issues concerning traffic count can be directed to the ODOT Data Section.
http://www.oregon.gov/ODOT/TD/TDATA/index.shtml

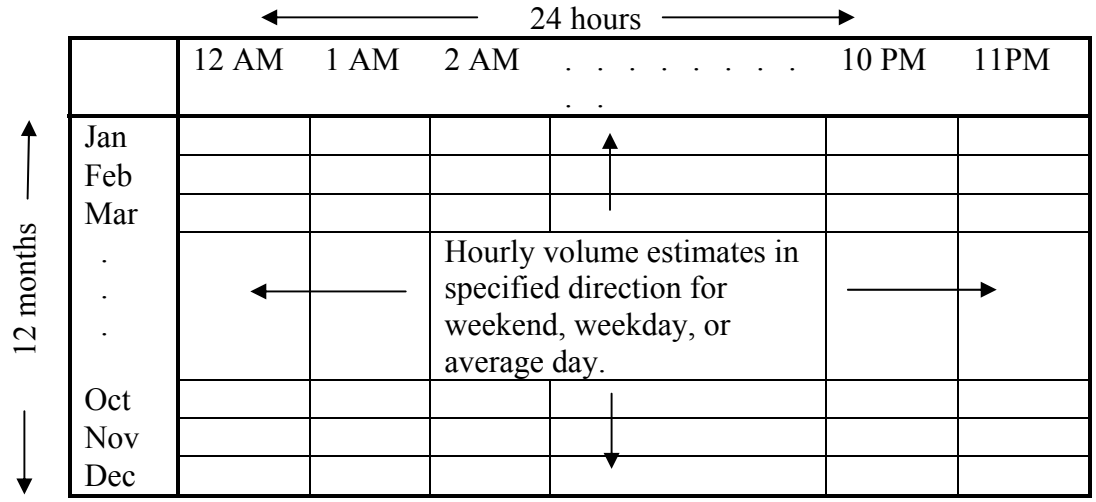
- Ideally, use 24 hour ODOT manual full vehicle classification counts. If these are not available, use 14 to 16 hour counts. Do not use 6 or 8 hour counts.
- Use counts that are no older than 3 years.
- Use full federal vehicle classification counts so you will have the heavy vehicle information. These are available from ODOT's Data Section or from private traffic data consultants.
- Use "Straightaway" counts, if possible. These are counts taken on a segment of highway with no access or turn movement data included. Ramp counts can be confusing and inaccurate and would be a second choice.
- ODOT's TVT's with ADT and ATR data are a great source of traffic trend information but, because much of this data is "smoothed" and extrapolated, they do not substitute for manual classification counts.
- Avoid tube or loop counts. Depending on the source and post-processing, they may not be accurate. The types of counts listed above are preferable to tube or loop counts.

C. The Matrix of Traffic Volume Information

After the traffic volumes have been obtained, the following adjustments must be made so that the volumes reflect:

- The appropriate percentage of heavy vehicles.
- Current year data by "growing out" the volumes.
- Each direction of traffic.
- Twenty-four hours of the day.
- The months during construction.
- Weekday and weekend differences.

When all the adjustments have been made, the data matrix will look like this:



A particular section of highway could potentially have four such matrices (one for each direction of travel) with a set for weekdays and weekends. Weekday and weekend traffic count data can vary significantly. For additional information, see page 6.

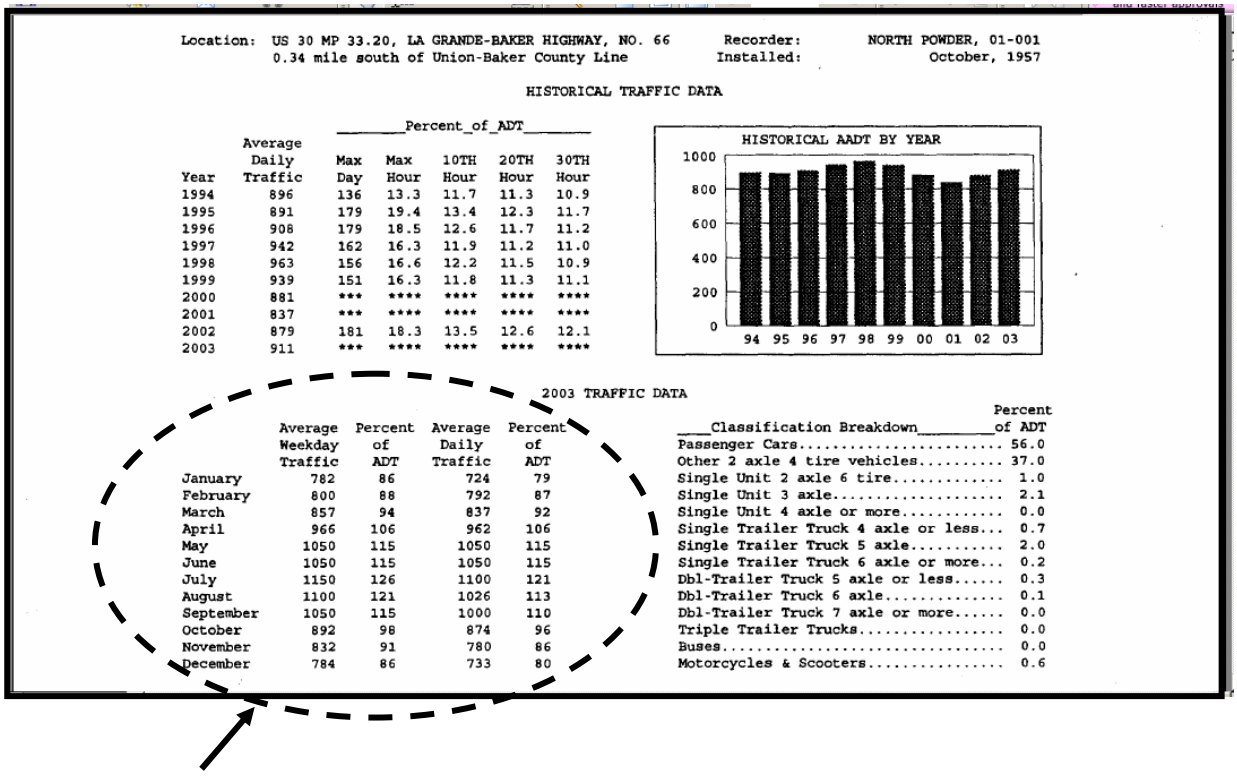
- **Heavy Vehicles Adjustments** - For the purposes of workzone traffic analysis, traffic volumes are discussed in terms of passenger car equivalents (PCEs). Truck equivalency factors range from 1.5, 2.5 and 4.0 with a truck factor of 2.5 being used most commonly. For example, most I-5 applications would use a 2.5 factor to account for the substantial number of larger trucks or the factor may be chosen if the terrain is rolling. A truck factor of 1.5 may represent a flat highway with a lower proportion of large trucks.

- **Growth Rate Adjustments** - If the traffic was counted in a different year than the proposed construction year, traffic volumes need to be "grown out". Growth rates for all state highways are available from ODOT's Transportation Planning Analysis Unit's (TPAU) Growth Rate Tables at: http://www.oregon.gov/ODOT/TD/TP/docs/TADR/Primary2023FVT.pdf .

- **Traffic Volumes for 24 Hours** – Ideally, hourly traffic volumes are taken from manual traffic counts that are less than three years old or from ATR's within or near the project site. Often, 24 hours of traffic data is not available in manual counts, so the matrix may be abbreviated to 14 or 16 hours.

- **Seasonal Adjustments** – This is used to correct the traffic count volumes from the date the count was taken to the date of construction and throughout the year. These seasonal adjustments can be calculated from ODOT's ATR data found on Traffic Volume Tables (TVT). TVTs can be found at: http://www.oregon.gov/ODOT/TD/TDATA/tsm/tvt.shtml.

Below is a sample of ATR data from an ODOT TVT.



Location: US 30 MP 33.20, LA GRANDE-BAKER HIGHWAY, NO. 66
0.34 mile south of Union-Baker County Line
Recorder: NORTH POWDER, 01-001
Installed: October, 1957

HISTORICAL TRAFFIC DATA

Year	Average Daily Traffic	Percent_of_ADT Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
1994	896	136	13.3	11.7	11.3	10.9
1995	891	179	19.4	13.4	12.3	11.7
1996	908	179	18.5	12.6	11.7	11.2
1997	942	162	16.3	11.9	11.2	11.0
1998	963	156	16.6	12.2	11.5	10.9
1999	939	151	16.3	11.8	11.3	11.1
2000	881	***	****	****	****	****
2001	837	***	****	****	****	****
2002	879	181	18.3	13.5	12.6	12.1
2003	911	***	****	****	****	****

2003 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	782	86	724	79
February	800	88	792	87
March	857	94	837	92
April	966	106	962	106
May	1050	115	1050	115
June	1050	115	1050	115
July	1150	126	1100	121
August	1100	121	1026	113
September	1050	115	1000	110
October	892	98	874	96
November	832	91	780	86
December	784	86	733	80

Classification Breakdown	Percent of ADT
Passenger Cars	56.0
Other 2 axle 4 tire vehicles	37.0
Single Unit 2 axle 6 tire	1.0
Single Unit 3 axle	2.1
Single Unit 4 axle or more	0.0
Single Trailer Truck 4 axle or less	0.7
Single Trailer Truck 5 axle	2.0
Single Trailer Truck 6 axle or more	0.2
Dbl-Trailer Truck 5 axle or less	0.3
Dbl-Trailer Truck 6 axle	0.1
Dbl-Trailer Truck 7 axle or more	0.0
Triple Trailer Trucks	0.0
Buses	0.0
Motorcycles & Scooters	0.6

- Note that there is a column for Average Weekday Traffic and one for Average Daily Traffic. The difference, of course, is that the Average Daily Traffic includes the weekend traffic volumes which are on Friday, Saturday and Sunday. To calculate volumes for weekends, use the following formula:
  WkEnd = (7*Daily - 4*WkDay)/3
  The methodology for calculating seasonal factors from ATR data is available from TPAU's web site at:
  http://www.oregon.gov/ODOT/TD/TP/docs/TAPM/DevDHV.pdf

- The ATR chosen should be on the project highway and be near the project site or on a nearby highway with similar characteristics. If you choose an ATR that is not on the workzone highway, be sure that the ATR highway has the same attributes, such as, similar ADT, truck percentages, commuter vs. recreational traffic mix, etc. If no ATR is close, you can use TPAU's Seasonal Factor Table to calculate the seasonal factors. This table and methodology are available at:
  http://www.oregon.gov/ODOT/TD/TP/docs/TADR/2003SFT.pdf

- If TPAU's Seasonal Factor Table is used, the Function Class and Zone of the highway in question will need to be known. This information is available on the table at:
  http://www.oregon.gov/ODOT/TD/TDATA/rics/docs/ORStateHwysFCandNHS.pdf

- **Weekday vs. Weekend Traffic Volumes** – If the project will involve possible lane closures on the weekend, separate matrices need to be developed for the weekday and weekend traffic. Weekend traffic tends to have a distribution of the volume through the day that is much different than the volume distribution on weekdays. Estimates of hourly volumes on the weekend are ideally derived from weekend manual counts on or near the project site. Alternatively, weekend counts from a representative facility may be combined with ADT and ATR information to approximate hourly volumes. The ATR should be on the project highway and near the work area or on a nearby highway with similar characteristics. As shown, the ATR data shows two columns for monthly adjustments for the ADT, one for Average Weekday Traffic and one for Average Daily Traffic. To calculate weekend volumes, use the following formula: WkEnd = (7*Daily - 4*WkDay)/3.

- **Low Volume Roads** – If the highway ADT is below 3000 and the seasonal factor is below 1.30, a full matrix may not need to be done. An acceptable option is to show that the highest ADT expected during the year doesn't come close (approximately 25%) to reaching the capacity of the road. If the ADT is much over 3000, complete the full analysis.

V. Highway Capacity

A. Lane Capacity Default Values

When possible, lane closures are restricted during those hours when the traffic volumes are expected to exceed the capacity of the reduced highway. Several default values for capacity have been developed through many years of workzone observations, experience and engineering capacity studies. They are intended to represent the highest **sustainable** capacity for construction analysis while restricting driver delay to less than 20 minutes.

B. Capacity for Two-lane highways

This is the hourly sum capacity of a one-lane, two-way, both directional section with *flagger control*:

- 550 PCEs, Closure Length 2.0 miles
- 750 PCEs, Closure Length 1.0 mile
- 900 PCEs, Closure Length 0.5 mile

Closures in excess of 2.0 miles should be avoided since they can lead to dangerous access conflicts and other unsafe situations.

C. Capacity for Multi-Lane Highways and Freeways

This is the capacity of a one-lane, one-way section with **continuous flow.** At this capacity level we assume that there are no interruptions (signals, stop signs, flaggers, etc.) for the highway traffic. Signalized intersections and other interrupted flows are analyzed separately.

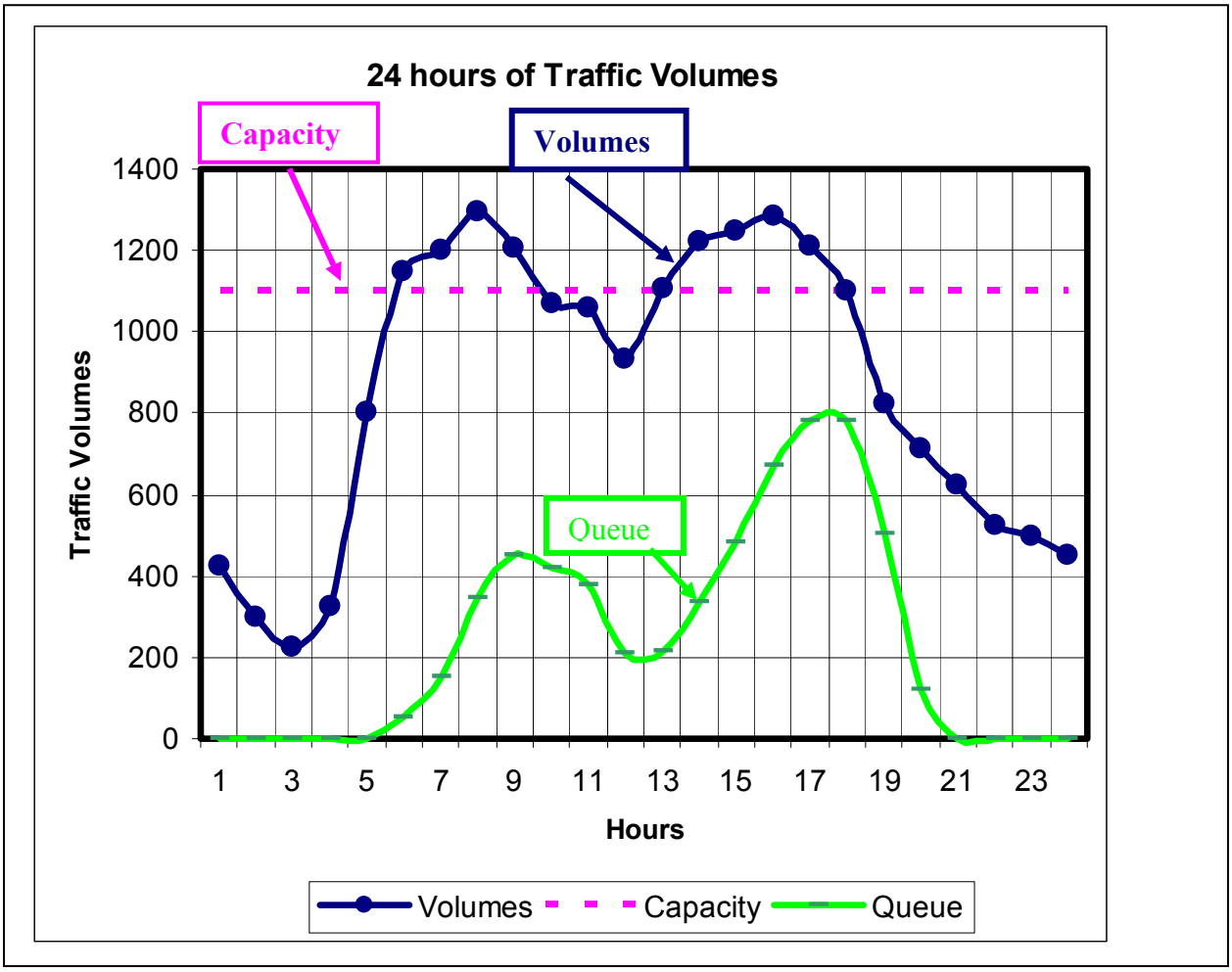
- 1200 - 1400 PCEs for rural freeway & multi-lane capacity
- 1400 - 1600 PCEs for suburban and urban freeways and multi-lane capacity

D. Capacity Reducing Factors

The above capacities are based on 12 foot lanes with at least 2 feet of clearance on each side. Narrower lanes or clearances will result in reduced capacities. Other factors that could reduce capacity are steep grades, relaxed or unfamiliar driver population, and poor pavement conditions.

VI. Queuing and Vehicle Delay Calculations

Queuing and vehicle delay are an important part of the WZ Traffic Analysis. There are several ways to calculate these factors, including setting up a spreadsheet to graph the Time vs. Traffic Volume and queuing in a visual representation as shown below:



The graph shows how traffic volumes compare with highway capacity over time. When the volumes exceed the capacity, it means that not all of the demand is being served. This can result in driver inconvenience, delay and congestion. The bottom line on the graph shows how queuing can develop when traffic volumes exceed capacity, as shown starting at about hour 6. Once the queue starts to build, it will continue to grow cumulatively, and will not decrease until the traffic volumes are lower than the capacity, as seen at about hour 10. The queue will not totally dissipate until approximately hour 21.

Delay, defined as “vehicle-hours of delay”, can be seen on the graph from hour 6 to hour 21. The area under the queue line represents vehicle-hours of delay. This graphing technique can give a quick visual evaluation of the hours when there is insufficient highway capacity to meet the demands.

VII. Unique Project Circumstances

A. Special Events That Draw Additional Traffic

Determine if there are local events which will seriously impact the flow of traffic through the workzone if lanes were closed during the event. Special events would include school athletic events, i.e. an OSU football game, community celebrations such as the Rose Festival, Seattle to Portland bicycle event, Washington County Fair, Eugene Celebration, etc. Talk to the Area Maintenance Manager or other Region folks to see if there any special events in the area.

B. What Happens If The Volume Always Exceeds The Capacity?

Some projects may have no construction alternatives that would lessen impacts to the traveling public. In those cases, the objective of the workzone traffic analysis is to identify the best times of the day and months of the year for lane closures. Analysts should make assessments of possible queue lengths and delays, as well as the potential for traffic diversion or reduction of demand in these over-capacity situations. See page 14 for how this is done.

C. When Suggesting Lane Restrictions

Practical considerations need to be made when "blocking out" actual times for lane restrictions. For example, even if the analysis indicates that one hour **will not be** over capacity while the hours immediately before and immediately after **are** over capacity, there is little point in allowing a lane to be closed for that particular hour. One hour is seldom long enough to accomplish enough work to justify the opening. Traffic control set up and take down need to be considered as well.

VIII. Example of a WZ Traffic Analysis

Here is an example of how the analysis would be done step-by-step.

The Project Leader for the Irrigation Creek Suspension Bridge Project, M.P. 120 on US97, ODOT #7 The Dalles / California Highway, Redmond, Deschutes County calls and asks for a WZ Traffic Analysis to see if there will be any lane closure restrictions during construction of the bridge during June, July and August of 2005.

Staging is planned such that one-half of the bridge will be built at a time, thereby reducing the travel lanes from four to two.

1. Gather Data - Call the Regional Tech. Center and the ODOT Transportation Systems Monitoring (TSM) folks to see if there are recent counts for you to use. Also see where the closest and most appropriate ATR is. In this case, there is a recent count and a close ATR.

   Also, get maps of the area, straightline charts, ADT data, etc. Go out to the site and watch traffic, do a couple of one to two hour counts and get a feel for the highway capacity and the dynamics of the area.

2. To keep the example short, we are only going to go through one of the matrices, the southbound weekday. Actual analysis would involve developing four matrices, southbound weekday and weekend, and northbound weekday and weekend.

3. Make adjustments to the counts for:
   - The appropriate percentage of heavy vehicles.
   - Current year data by "growing out" the volumes.
   - Each direction of traffic.
   - Twenty-four hours of the day.
   - Seasonal factors for the months of construction.

The N-S count data looks like this for Total Vehicles. The traffic volume for 6 am represents the number of vehicles passing a point in the workzone between 6:00 a.m. and 6:59.99 a.m. If the count had been broken down into 15 minute segments, it would need to be combined into 1 hour increments. Also, lucky for us, the count was a straightaway (segment) count instead of an intersection count. This way we don't have to add the side street traffic to the main street volumes.

Sisters at US97, 7-03, Southbound, Weekday Volumes														
	6 am	**7 am**	**8 am**	**9 am**	**10 am**	**11 am**	**12 am**	**1 pm**	**2 pm**	**3 pm**	**4 pm**	**5 pm**	**6 pm**	**7 pm**
N-S	424	578	668	742	784	850	866	988	1170	1316	1112	876	530	454

- **Adjust for Heavy Vehicles** – This changes the total vehicles into Passenger Car Equivalents (PCEs). Sum all of the vehicles in the count except passenger cars, other two axle vehicles and motorcycles. There are several ways that this can be done. You can calculate the truck percentage for each individual hour or add all the heavy vehicles and divide by the total vehicles to get an average truck percentage. In this example, and the way it is usually done by experienced analysts, we will calculate an average truck percentage. For this count, the number of heavy vehicles is 1054 / 5679 total vehicles = 18.6%.

To adjust the 6 am total volume of 424, for heavy vehicles:

- Subtract out 18.6% of the total, which is 79 heavy vehicles, this leaves 345 passenger cars
- Multiply the heavy vehicles by the heavy vehicle factor, 2.5 (2.5*79=197)
- Add the adjusted heavy vehicles back into the passenger cars (345 + 197 = 542) vehicles
- Repeat the technique for each hour

- **Adjust the volumes to the build year of 2005 –** Check TPAU's historic growth rates for this highway and find it is 2.0%. Using straightline (linear) growth methods, grow out each hour of traffic volume.

- **Develop a matrix** for each direction for weekdays and weekends. (For our example, we are only going to do one direction for weekdays.)

- Ideally we would have a **24 hour count** for the workzone, but since we only have a 14-hour count, we will not be able to account for all 24 hours.

- **Seasonal Adjustments** – Adjust the volumes for the months of the construction. This is where the ATR data comes in. See the ATR data example below:

ATR:	09-020		
Location	Redmond	Ave. Week	Ave. Daily
	JANUARY	0.900	0.860
	FEBRUARY	0.980	0.930
	MARCH	1.010	0.960
	APRIL	1.050	1.010
	MAY	1.060	1.020
	JUNE	1.140	1.090
	JULY	1.170	1.080
	AUGUST	1.150	1.100
	SEPTEMBER	1.100	1.040
	OCTOBER	1.060	1.010
	NOVEMBER	1.010	0.960
	DECEMBER	0.980	0.940

Note that the ATR data has a column for Average Weekday Traffic and one for Average Daily Traffic. To calculate volumes for weekends, use the following formula: WkEnd = (7*Daily - 4*WkDay)/3

Our count was taken in July and our construction months are June, July and August. We need to adjust the volumes for June and August. The methodology for calculating seasonal factors from ATR data is available from TPAU's web site at http://www.oregon.gov/ODOT/TD/TP/docs/TAPM/DevDHV.pdf .

The closest appropriate ATR is very close to the build location. If no ATR is close, use TPAU's Seasonal Factor Table to calculate the seasonal factors. This table is available at http://www.oregon.gov/ODOT/TD/TP/docs/TADR/2003SFT.pdf .

If TPAU's Seasonal Factor Table is used, the Function Class and Zone of the highway in question will be needed. This information is available on the table at http://www.oregon.gov/ODOT/TD/TDATA/rics/docs/ORStateHwysFCandNHS.pdf

After checking the last five years of ATR data, averaging and adjusting the July count for June and August volumes, we get the following adjustment factors: June = 1.03, August = 1.02. We now have 3 sets of adjusted southbound weekday volumes: one each for June, July and August. A complete analysis would have nine additional sets of data: 3 for southbound weekends, 3 for northbound weekdays, and 3 for northbound weekends. The weekend traffic would need to be estimated from a weekend count on this road or a road with similar travel characteristics.

By now, our volumes look like this:

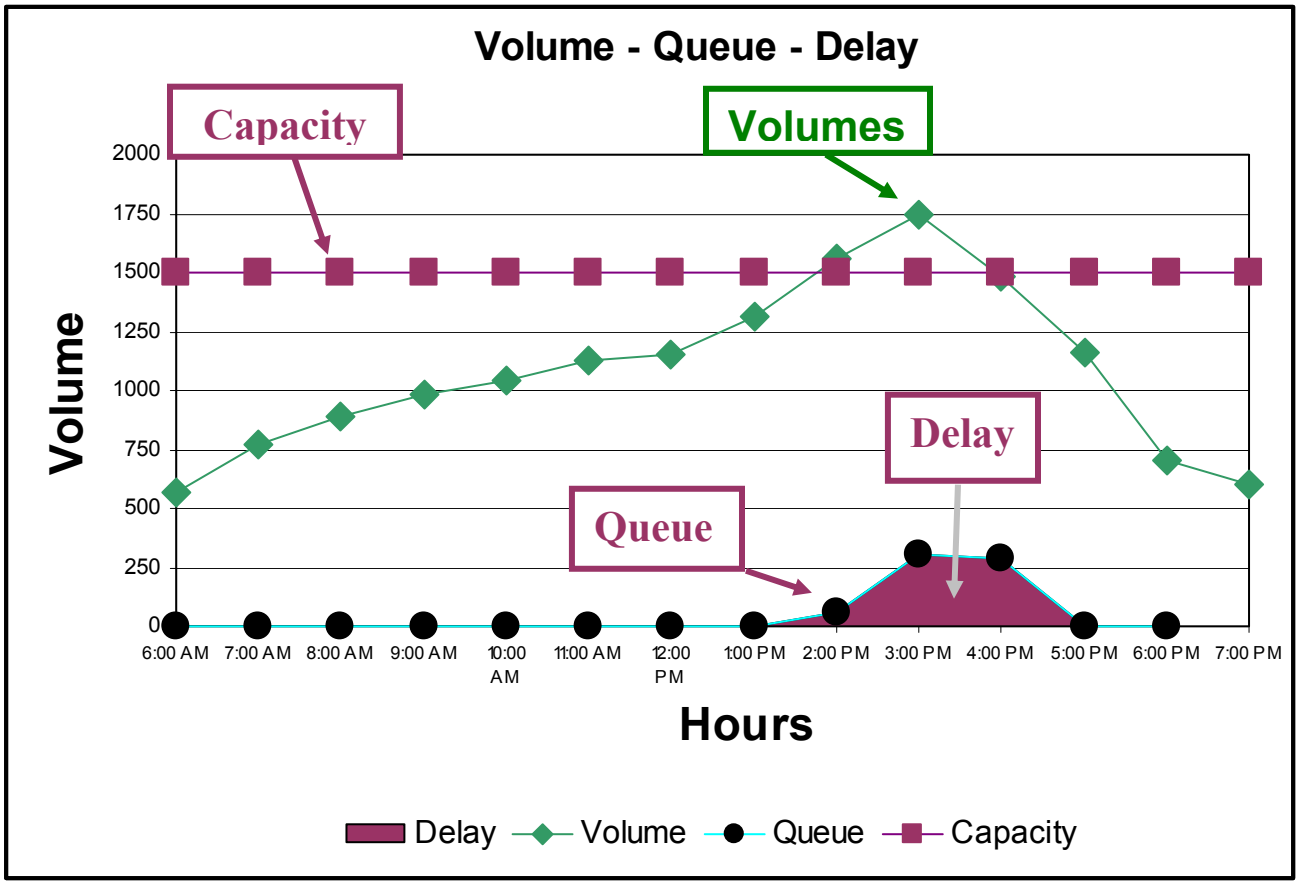
Sisters at US97, 7-03, Southbound, Weekday Volumes														
Time	**6 am**	**7 am**	**8 am**	**9 am**	**10 am**	**11 am**	**12 pm**	**1 pm**	**2 pm**	**3 pm**	**4 pm**	**5 pm**	**6 pm**	**7 pm**
Original Total Vehicles	424	578	668	742	784	850	866	988	1170	1316	1112	876	530	454
Truck & = 18.6	542	739	854	949	1003	1087	1108	1264	1496	1683	1422	1120	678	581
Growth Rate (Linear) 2% * 2 Yrs = 1.04	564	769	889	987	1043	1131	1152	1314	1556	1750	1479	1165	705	604
Seasonal Adjust June = 1.03	581	792	915	1017	1074	1165	1186	1354	1603	1803	1524	1200	726	622
Seasonal Adjust July = 1.00	564	769	889	987	1043	1131	1152	1314	1556	1750	1479	1165	705	604
Seasonal Adjust Aug. = 1.02	575	784	906	1007	1064	1153	1175	1340	1587	1786	1509	1189	719	616

Capacity Multi-Lane Highways and Freeways is between 1400 and 1600 PCEs for each remaining lane in areas with one lane closed. This is the capacity of a one-lane, one-way section with *continuous flow* – no interruptions such as signals, stop signs, or flaggers. These capacities are based on 12 foot lanes with at least 2 feet of clearance on each side. Narrower lanes or clearances will result in reduced capacities. Other factors that could reduce capacity are steep grades, relaxed or unfamiliar driver population, and poor pavement conditions. If we had a signalized intersection in the work area, the analysis would be completely different.

Now all we have to do is compare the volume to the capacity. On the following table, the cells with gray show that the adjusted volume lies within the 1400 to 1600 capacity; the black cells represent exceeded capacity. When the highway exceeds capacity with one lane is closed, recommend appropriate lane restrictions.

Sisters at US97, 7-03, Southbound, Weekday Volumes														
Time	**6 am**	**7 am**	**8 am**	**9 am**	**10 am**	**11 am**	**12 am**	**1 pm**	**2 pm**	**3 pm**	**4 pm**	**5 pm**	**6 pm**	**7 pm**
Seasonal Adjust June = 1.03	581	792	915	1017	1074	1165	1186	1354	1603	1803	1524	1200	726	622
Seasonal Adjust July = 1.00	564	769	889	987	1043	1131	1152	1314	1556	1750	1479	1165	705	604
Seasonal Adjust Aug. = 1.02	575	784	906	1007	1064	1153	1175	1340	1587	1786	1509	1189	719	616

The queuing and delay can be derived from graphing the volumes and capacity. This graph shows July's volumes.



What the Volume – Queue – Delay graph shows:

- **The queue** is shown as the lowest line on the graph. The queue begins to build when the demand exceeds capacity and builds ***cumulatively*** until the demand no long exceeds the capacity.

- **The delay in vehicle-hours** is seen as the area below the queue line. If we use 1500 for capacity, the area and our **total delay** is roughly **620 vehicle-hours**.

- The **time that a queue is present** will be about 3.5 hours. During that time, some vehicles will be slowed to a stop. The amount of **individual vehicle wait time** will vary based on queue length. The wait time at 2 pm for 50 vehicles will be shorter than at 3 pm for 300 vehicles.

- **The longest queue** can be seen as around 300 vehicles at 3 pm. The longest **wait time may be estimated** by dividing the longest queue by the saturation flow rate, or 300 veh/1500 vehicles per hour which is about 12 minutes.

The values shown by the graph are very rough estimations, but they may be useful when figuring delay.

Conclusion: Calculating workzone traffic analysis for lane restrictions is simply a matter of comparing the collected and adjusted volume to the appropriate capacity. Gathering the appropriate data, adjusting it to reflect the correct time and location, using the suitable capacity and calculating queuing and delay is where experience, skill and engineering judgment is needed.

IX. Useful Resources

- *ODOT Traffic Manual* **–** Within the "Practices" section, see topic titled "Workzone Zone Analysis" at: http://www.odot.state.or.us/traffic/trafficmanual041015.pdf

- *ODOT Highway Design Manual* **–** See Section 5.6 "Traffic Control" for discussion regarding detours, restricted lane width, and other aspects of traffic control plans at: http://www.odot.state.or.us/tsroadway/2003-english-hdm.htm

- *Highway Capacity Manual* **–** Chapter 22 of the 2000 HCM contains some guidance for evaluating freeway segments under construction conditions. http://www.a3a10.gati.org/?hcm2000

- *ODOT Standard Specs, Special Provisions, Unique Specifications, Standard Details, and Standard Drawings* can all be accessed from: http://www.odot.state.or.us/tsspecs/2002-std-specs.htm

- *Manual on Uniform Traffic Control Devices* (MUTCD) **–** The manual itself can be downloaded from: http://mutcd.fhwa.dot.gov/pdfs/2003/pdf-index.htm

X. Glossary

- **ADT –** Average Daily Traffic.

- **ATR –** Automatic Traffic Recorder.

- **Capacity –** The maximum number of vehicles that can pass a point on the highway under prevailing highway, traffic and control conditions.

- **Deliverables –** Engineering work to be submitted**.**

- **Delay –** Additional travel time experienced by a vehicle; this value can also be determined graphically, as show on page 7 of this report.

- **Demand –** The number of users desiring service on the highway system.

- **Freeway –** A fully access controlled highway.

- **Highway** – (ORS 801.305) Every public way, road, street, thoroughfare and place, including bridges, viaducts and other structures within the boundaries of this state, open, used or intended for use of the general public for vehicles or vehicular traffic as a matter of right.

- **Highway Capacity Manual (HCM)** – The Highway Capacity Manual is the standard "Bible" for most traffic analysis; however, the HCM does not provide procedures that are appropriate for workzone analysis.

- **Lane Closure Restrictions or Lane Restrictions –** ODOT often limits the hours that workzone traffic lanes and roads may be closed in an effort to reduce motorist delay, inconvenience and crash potential.

- **Manual Classification of Traffic Counts** – Federal Government directed vehicle classification that breaks the class of vehicles into 16 types. Traffic counts with vehicles broken down into their 16 types are necessary for most ODOT project work.

- **Manual Traffic Counts –** Performed by ODOT personnel and available from ODOT Traffic Data Section in the Transportation Development Branch. Traffic counts used for analysis should be close to the work area and on the same type of highway designation and should also have been taken in the last three year.

- **MUTCD –** The Manual of Uniform Traffic Control Devices and the ODOT supplements are standard handbooks used by all designers in the state. Traffic Control Plans are guided by these standards.

- **Passenger Car Equivalent (PCE) –** Accounting for the presence of heavy vehicles in the traffic stream. For the purposes of workzone traffic analysis, traffic volumes are discussed in terms of passenger car equivalents (PCEs). Depending on the terrain, truck equivalency factors range from 1.5, 2.5 and 4.0 for flat, rolling, or mountainous terrain, respectively. A truck factor of 2.5 is used most commonly. For instance, most I-5 applications would use a 2.5 factor to account for the substantial number of large trucks.

- **Queue –** A line of vehicles waiting to be served by the highway system. The queue can be determined graphically, as shown on page 7 of this report.

- **Seasonal Adjustments** – Adjusting the traffic count data so that it reflects the time of year during which construction will take place if different from the traffic count date.

- **Special Event –** Any planned activity that brings together a community or group of people for an expressed purpose including, but not limited to, parades, bicycle races, road runs and filming activity that may result in total or partial closure of state highways or state highway sections.

- **TCD –** Traffic Control Devices.

- **TCP –** Traffic Control Plans.

- **TCPU –** Traffic Control Plans Unit.
- **TCS –** Traffic Control Supervisor.
- **TP&DT –** Temporary Protection and Direction of Traffic.
- **TPAU –** Transportation Planning Analysis Unit.
- **TVT –** ODOT's Transportation Volume Tables.
- **Workzone (WZ) –** An area of a highway with construction, maintenance or utility work activities. It extends from the first warning sign to the "End Road Work" sign or the last traffic control device.
- **WZ Traffic Analysis Request Form –** The form requesting to have WZ Traffic Analysis performed for a project. Most commonly filled out by TCP Designers or Project Leaders and sent to a WZ Traffic Analyst. A copy of the ODOT request form is attached.

ODOT's Traffic Analysis Work Request Form

Key No: _____ Prefix: _____ County: _____

Project Name: _____

Hwy. Name: _____ Hwy. No.: _____

Beginning MP: _____ End MP: _____

Requested by: _____ Phone: _____

Section:

Request Date: _____ Due Date: _____ Date Out: _____

Job Field Options

- ☐ Project Analysis
- ☐ Interchange Analysis
- ☐ Signal Analysis
- ☐ Storage Analysis
- ☐ Cost Analysis
- ☐ Detour Analysis
- ☐ Workzone

Projected Work Required

- ☐ Two Way - One Lane
- ☐ Daily Lane Closures
- ☐ Extended Lane Closures
- ☐ Limited Total Closures/Blasting
- ☐ Full Closures/Detour
- ☐ Chip Seal
- ☐ Left Turn Storage
- ☐ Signals
- ☐ Slow Downs
- ☐ Extra Closure Lengths

Instructions: Fill out the form as indicated. Due dates should be a minimum of 2 weeks unless a prior arrangement for rush work has been made. If no date is given, a due date of 4 to 6 weeks will be applied, depending upon the current volume of work. Please note the following: Highway Name is the official ODOT Highway Name. Highway Number is the official ODOT Highway Number and not a route number. Do not enter US or OR designations. EA is the Prefix to be charged.

Brief Project Summary:

ODOT's Lane Closure Restrictions, Section 220.40 of the Project Special Provisions

SECTION 00220 - ACCOMMODATIONS FOR PUBLIC TRAFFIC

(Unless otherwise indicated by instruction, use all the subsections, paragraphs, and sentences on all projects.)

Comply with Section 00220 of the Standard Specifications supplemented and/or modified as follows:

00220.02 Public Safety and Convenience - Replace the last bulleted item with the following bullet:

- Allow emergency vehicles and incident response units immediate passage at all times.

(Use the following lead in sentence when adding bulleted items. Remove the "(s)" if only adding one bullet. Remove the parentheses if adding more than one bullet.)

Add the following bulleted item(s) to the end of this subsection:

(Use the following two bullets when sidewalks or sidewalk ramps are closed and alternate pedestrian routes are used. Modify the second bullet by filling in the blank with the city or county name and removing the city or county text that is not required.)

- When construction requires the closure of a sidewalk or sidewalk ramp, place a Type "W1" "SIDEWALK CLOSED" (OR22-12-533) sign at each point of closure. Use a Type "W1" directional arrow (M6-1-381) rider, as needed, to direct pedestrian traffic. Mount each sign above the striped panel of a Type II barricade placed across the sidewalk, facing pedestrians approaching the work area. Close the sidewalk at a point where there is an alternate way to proceed or provide an alternate pedestrian route. Pave the alternate pedestrian route surface or provide an approved, non-slip 910 mm (36 inch) minimum wide surface meeting the requirements of the Americans with Disabilities Act (ADA). If appropriate, delineate this route and protect pedestrians by placing pedestrian workzone delineation fencing. Fencing is to remain in place, except as required for actual work, until the sidewalk is reopened to pedestrian traffic. Reopen the sidewalk during non-work hours or continue to provide an alternate route for pedestrians.

- When construction requires the closure of a sidewalk, notify, in writing, the City of _____ (County Public Works Department) at least 14 days in advance of the closure. Do not close the sidewalk until the City (County) provides written approval. After approval, provide 48 hour public notification prior to closing the sidewalk.

(Use the following bulleted item with the portable changeable message signs pay item.)

- Use portable changeable message signs to provide appropriate workzone information to the public. Place signs and display messages as directed or approved. When signs are in use, protect them according to 00225.46(b) and the "Portable Changeable Message Sign (PCMS) Installation" detail shown on Standard Drawing RD945.

00220.40(a) Traffic Nuisance Abatement - Replace the first bulleted item with the following bullet:

- Use flaggers or flaggers with pilot car(s)

(Use the following lead in heading with any of the following subsections .40(e), .40(f), and .40(g). Remove "(s)" or the parentheses when appropriate.)

Add the following subsection(s):

(Use the following subsection .40(e) with lane restrictions. To obtain the restrictions and information to fill in the blanks, submit a written request as follows: For Portland and Region 1 projects, contact the Region Traffic Office, Fax 503-731-8259. For Regions 2 through 5 projects, contact the Traffic Engineering and Operations Section, Fax 503-986-4063 or the local Traffic Office. ODOT staff submits a Traffic Analysis Work Request Form to the appropriate office listed above.)

00220.40(e) Lane Restrictions - Do not close any traffic lanes on _____ Highway, Monday through Friday, between:

__:00 a.m. - __:00 a.m.
and
__:00 p.m. - __:00 p.m.

In addition, do not close any traffic lanes between:

- 3:00 p.m. on Fridays and midnight on Sundays.
- Noon on the day preceding legal holidays or holiday weekends and midnight on legal holidays or the last day of holiday weekends, except for Thanksgiving, when no lanes may be closed between noon on Wednesday and midnight on the following Sunday.

For the purposes of this section, legal holidays are as follows:

- New Year's Day on January 1
- Memorial Day on the last Monday in May
- Independence Day on July 4
- Labor Day on the first Monday in September
- Thanksgiving Day on the fourth Thursday in November
- Christmas Day on December 25

When a holiday falls on Sunday, the following Monday shall be recognized as a legal holiday. When a holiday falls on Saturday, the preceding Friday shall be recognized as a legal holiday.

(Use the following paragraph and bullet for special events. Obtain times and dates from the Designer.)

Also, do not close any traffic lanes between ___(time)___ on ___(date)___ and ___(time)___ on ___(date)___ during the following special events:

- _____

Roadways shall be free of barricades or other objects and all lanes opened to traffic during all the restrictive periods listed above.

SAMPLE OF WORKZONE ANALYSIS REPORT LETTERS
Two Lane Highway Lane Restrictions

Oregon Department of Transportation **INTEROFFICE MEMO**
Region X Traffic Unit (xxx) xxx-xxxx
Fax (xxx) xxx-xxxx

DATE: XXX

TO: XXX
Title (Traffic Control Plans Designer?)

FROM: Your Name

Title

SUBJECT: Workzone Restrictions
Project Name
XX Highway No. X (Route No.), M.P. xx.xx – M.P. xx.xx
Key #XXXXX

Recommendations on lane restrictions for the subject project are shown below.

00220.40(e) Lane Restrictions:

Do not close any traffic lanes as follows:

XXX Highway (Route No.)

- No lane closures are allowed between X:XX p.m. and X:XX p.m. on weekdays.
- Lane closures may be allowed at any time on weekends.
- Alternating one-way traffic operations controlled by flaggers would be needed during lane closures.

Cross Streets (as applicable)

- No lane closures are allowed between 4:00 p.m. and 6:00 p.m. on weekdays.
- Lane closures may be allowed at any time on weekends.
- Alternating one-way traffic operations controlled by flaggers would be needed during lane closures.

In addition, do not close any traffic lanes between:

- Noon on the day preceding legal holidays or holiday weekends and 12:00 midnight on legal holidays or the last day of holiday weekends, except for Thanksgiving, when no lanes may be closed between 12:00 noon on Wednesday and 12:00 midnight on the following Sunday.

For the purposes of this section, legal holidays are as follows:

- New Year's Day on January 1
- Memorial Day on the last Monday in May
- Independence Day on July 4
- Labor Day on the first Monday in September
- Thanksgiving Day on the fourth Thursday in November
- Christmas Day on December 25

When a holiday falls on Sunday, the following Monday shall be recognized as a legal holiday. When a holiday falls on Saturday, the preceding Friday shall be recognized as a legal holiday.

Also, do not close any traffic lanes during the following special events:

- List of special events, festivals, sports events

Roadways shall be free of barricades or other objects and all lanes opened during these periods.

Please call me at (xxx) xxx-xxxx if you have any questions or need additional information.

Cc: John Smith
Mary Jones

Two Lane Highway Lane Restrictions

Oregon Department of Transportation **INTEROFFICE MEMO**
Region X Traffic Unit (xxx) xxx-xxxx
Fax (xxx) xxx-xxxx

DATE: XXX

TO: XXX
Title (Traffic Control Plans Designer?)

FROM: Your Name

Title

SUBJECT: Workzone Restrictions
Project Name
XX Highway No. X (Route No.), M.P. xx.xx – M.P. xx.xx
Key #XXXXX

Recommendations on lane restrictions for the subject project are shown below.

00220.40(e) Lane Restrictions:

Do not close any traffic lanes as follows:

XXX Highway (Route No) Northbound and Southbound

No single lane closures are allowed:
- between 6:00 a.m. and 7:00 p.m., Monday - Friday
- between 10:00 a.m. and 6:00 p.m., Saturday - Sunday

No two-lane closures are allowed:
- between 5:00 a.m. and 8:00 p.m., Monday - Friday
- between 9:00 a.m. and 7:00 p.m., Saturday - Sunday

In addition, do not close any traffic lanes between:

- Noon on the day preceding legal holidays or holiday weekends and 12:00 midnight on legal holidays or the last day of holiday weekends, except for Thanksgiving, when no lanes may be closed between 12:00 noon on Wednesday and 12:00 midnight on the following Sunday.

For the purposes of this section, legal holidays are as follows:

- New Year's Day on January 1
- Memorial Day on the last Monday in May
- Independence Day on July 4
- Labor Day on the first Monday in September
- Thanksgiving Day on the fourth Thursday in November
- Christmas Day on December 25

When a holiday falls on Sunday, the following Monday shall be recognized as a legal holiday. When a holiday falls on Saturday, the preceding Friday shall be recognized as a legal holiday.

Roadways shall be free of barricades or other objects and all lanes opened during these periods.

Short-Term Road Closure – The Contractor will be permitted to close all travel lanes of Pacific Highway East (OR99E) for periods not to exceed 20 minutes in duration during bridge steel arch segments and precast deck panels erection over the travel lanes between 11:00 p.m. and 5:00 a.m., Monday – Sunday. Succeeding roadway closures will not be permitted until traffic clears from preceding closure.

Please call me at (xxx) xxx-xxxx if you have any questions or need additional information.

Cc: John Smith
Mary Jones