Oregon Department of Transportation

Work Zone Traffic Analysis Manual

Delivery & Operations Division | Traffic-Roadway Section

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Oregon Department of Transportation

Statewide Project Delivery Branch – Engineering & Technical Services Branch

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Preface

The purpose of this manual is to familiarize interested parties with ODOT's Work Zone Traffic Analysis (WZTA) Tool (*1*), WZTA methodologies, guidelines, policies, and procedures to use in their determination of lane closure restriction recommendations and construction delay estimates.

The WZTA methodology outlined in this manual is intended to be utilized by ODOT's analysts as well as analysts for local authorities, consultant analysts and other professionals outside the Department. The WZTA Tool (*1*) is based on the methodology found in this guide. Any exceptions are noted in the text, but they are very few.

Care should be taken in applying the methodology of this manual to projects developed outside the Department. Differences may exist between the ODOT WZTA lane closure policies and those policies established by other agencies. These differences may lead to inconsistencies in the analysis and subsequent lane closure restrictions and construction delay estimates of a particular project.

This manual is intended to supplement existing ODOT analysis policies while enhancing the specific discipline of WZTA. This manual is to be used as a resource, a technical reference and a teaching aide in the area of temporary WZTA. Please contact the Traffic Control Plans Unit within ODOT's Traffic-Roadway Section for clarification or interpretation of any policies and standards within this manual.

This manual is not the only method to perform work zone traffic analysis on state highways, but it is the preferred method. Other methods such as, but not limited to; using the Highway Capacity Manual (HCM) (*2*) or intersection analysis through synchro.

Introduction

Construction and maintenance activities on Oregon's highways often require that traffic lanes be closed and that travel delay be minimized. Work Zone Traffic Analysis informs ODOT when traffic volumes are low enough that lanes can be safely closed and provides delay estimates to quantify the impacts of lane closures and other mobility restrictions.

ODOT's Work Zone Traffic Analysis Tool (*1*) can be found at the ODOT Work Zone Traffic Control website.

Purpose and Goals

Safety is the number one reason for a lane closure analysis. Providing adequate highway capacity is necessary to maintain a safe working and traveling environment.

Project efficiency is another benefit of lane closure analyses. Lane closure restrictions can result in extensive staging changes and/or lengthy project delays. Many project designs have been altered due to lane restrictions.

The idea behind determining lane restrictions is straightforward:

- Determine the volume of traffic expected on the highway.
- Determine the maximum amount of traffic the highway can handle and still maintain a free-flowing situation. This is the "Free Flow Threshold" or FFT. In the WZTA Tool (*1*) it is referred to as the Work Zone Capacity.
- If the anticipated traffic volume is larger than the amount of traffic that allows for free flow movement, lane closure restrictions are recommended.

The methodology and traffic thresholds used by ODOT for WZTA are based of on-the-job experience, technical observation and engineering evaluation. It does not follow the HCM (*2*) 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.

It should also be noted this methodology is designed for highway segment analysis. If intersection analysis is needed for work zone lane closures, a different methodology should be used. Contact the ODOT TCP Unit for details on intersection analysis.

Project Deliverables

The WZTA Tool (*1*) has many features, but it is primary purpose is to develop the lane restriction recommendations; showing time of day for when a lane could be closed without casing significant travel delays.

A work zone traffic analysis memo submitted to Transportation Project Manager (TPM) or Resident Engineer – Consultants Project (RE-CP) should include the following analysis information:

- Highway classification.
- Traffic volumes and percentage of heavy vehicles.
- Lane closure restriction recommendations.
- Information for holidays, weekend restrictions or special events.

Lane closure restrictions are written into the Boiler Plate, or Special Provisions, 00220.40(e). Examples of the specification language are included in the appendix.

- Delay and queue length estimates whenever an extended closure is anticipated to cause significant congestion

Example Project Memos are contained in Appendix C.

Significant Figures

Experienced analysts understand that analysis results are not set in stone. Highway free flow thresholds and traffic volumes can be highly variable and will contain a degree of uncertainty. For instance, reporting traffic volumes of 732.2 vehicles is not practical or appropriate. Depending on the level of confidence that an analyst has in the data, they may need to revisit it to see how sensitive the data is to change. Analysis results are often challenged by the contractor, Resident Engineers and others. Therefore, an analyst must understand the amount of flexibility that the results contain.

Special Operations

When the WZTA Tool (*1*) is used for the purpose of producing recommendation for a typical weekday closure under normal traffic conditions throughout the year.

If planning to do work on days that are, weekends, or holidays or major traffic generating special events, a separate analysis of those days is required.

Previous volumes from collected on weekends, specific events or holidays should be used to forecast the specific traffic analysis for that event or holiday.

Work Zone Traffic Analysis Methodology

The ODOT Methodology for performing work zone traffic analysis is document in greater level of details in the WZTA Tool (*1*) and the steps are in the following sequence:

- Gather traffic data.
- Adjust the data to represent traffic volumes as PCEs.
- Adjust the data for future growth.
- Adjust the data for location.
- Adjust the data for seasonal trends.
- Establish work zone type and capacity.
- Generate lane restrictions graph.
- Generate delay and queue length estimates for freeway projects with extended closures.
- Produce a work zone traffic analysis memo summarizing the findings mentioned in the previous page.

Traffic Volumes

Traffic volume data is available from ODOT, city and county sources. In most cases, traffic volume data from several sources is required to make a reasonable assessment of work zone traffic analysis.

Traffic counts can be obtained from the following sources:

- ODOT Counts – ODOT has an extensive library of manual and machine traffic counts from all over the state. ODOT's Traffic Counting web page is a good starting place. ODOT's individual counts cannot be retrieved by parties outside of ODOT at this time. If a particular count cannot be found, please contact the ODOT Transportation Data section or the TCP Unit for help with ODOT traffic count data.
- Talk to ODOT's Regional Traffic Analysts and the Transportation Planning Analysis Unit (TPAU) for manual counts and for unique traffic characteristics in the project area.
- City and County Counts - City and County manual and machine counts may also be available. Contact the local agencies directly for this count data.
- New Counts - If count data is not available from other sources, new counts can be collected. Contact the ODOT Traffic Data Section to order new counts.
- Manual Counts - One of the best ways to get traffic volume data is for the analyst to go to the project site and record the count information at the site. This will provide limited duration count information, but it is a great opportunity to observe the dynamics of the traffic in the area.

Traffic Count Data Types and Duration

In is best to use the following practices for vehicle counts:

- Use a 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 not older than three years.
- Use "straightaway" counts, if possible. These are counts taken on a segment of highway with no access or turn movement data included. Use intersection or ramp counts as a second choice.

For an explanation of how to use intersection counts see the "READ ME" tab of the Work Zone Traffic Analysis Tool (1)

- Machine or tube counts are also available for use. ODOT maintains an extensive database of machine and tube counts that can provide 365 days of traffic volumes. If a manual traffic count is unavailable, counts from Oregon's Automatic Traffic Recorders or other machine counters are an acceptable source of volume data.

Other Traffic Data

The remaining traffic data needed for work zone traffic analysis include:

- Annual Average Daily Traffic Volumes (AADT)
- Annual growth rates
- Truck percentages
- Seasonal trend data

Obtaining this data will be covered in the following section which explains how to adjust the traffic data for use in work zone traffic analysis.

Adjusting Traffic Data

When performing work zone traffic analysis, the traffic count data needs to be adjusted so that each hour during the project duration is represented by appropriate traffic volume data. Adjustments are needed to account for:

- Heavy vehicle percentage so that "truck" volumes can be recalculated as "Passenger Car Equivalents" or PCEs.
- Year of analysis by "growing out" the volumes if the counts were taken in a year other than the year of the project or if the project's duration is longer than 12 months.
- AADT differences between project site and traffic count site.

- Seasonal adjustments that allow for traffic fluctuations during the project's duration.
- Daily, Weekday, and weekend traffic volume differences.

When all the adjustments have been made, a matrix is developed that provides 24 hours of traffic data (if available) for each month of the project's life. This matrix has a drop-down menu where various weekday and weekend closures patterns can be selected from.

Please note that a specific weekend count is needed when selecting the weekend closure from the drop-down menu. Selecting the weekend closure from the drop-down menu with a weekday count will yield in-accurate results.

For each freeway segment, at least two matrices will be generated; one for each direction of travel. Additionally, matrices could be developed for specific daily trends such the weekends if needed. The following are the traffic behavior patterns available in the Work Zone Traffic Analysis Tool (*1*):

- Weekday – *conventional commuting pattern*
- Weekday (Daily trend) – *traffic peaking at mid-day such as recreational and costal routes*
- Weekend traffic patterns – *weekend closure*

If more than one manual count is used, another worksheet of the Work Zone Traffic Analysis Tool (*1*) will be needed. When multiple counts or multiple traffic patterns are needed, additional unique matrices can be developed for each day of the week for each direction of travel.

Growth Rate Adjustments

If the traffic was counted in a different year than the construction year or if construction will take longer than 12 months, traffic volumes need to be "grown out" to represent the additional traffic on the roadway between the time that the count was taken and the construction year. Growth rates for all state highways can be calculated from ODOT's Future Highway Volume Table, which can be found on The Analysis Procedure Manual web page. For analysis purposes, ODOT uses a linear growth rate rather than an exponential growth rate. When the data from the Future Highway Volume Tables is inputted the annual growth rate will automatically calculate.

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if the growth rate is less than 1% the WZTA Tool (1) will use a value of 1% annual growth rate.

Count Adjustment Factor and Checks

The ratio of the AADT at the project site to the AADT at the count site is the ratio should be between 0.7 and 1.30 and the closer the ratio is to 1.0 the better. Factors outside this range note that the volumes may become unreliable.

Seasonal Adjustments

Seasonal adjustment factors are taken from ODOT's Automatic Traffic Recorders (ATRs) and account for the variations in traffic volumes from month to month during the year. They also show the difference between weekday traffic volumes (Monday through Thursday) and weekend traffic volumes (Friday through Sunday) as discussed in the next section.

Note that there is a column for Average Weekday Traffic and one for Average Daily Traffic. The Average Daily Traffic includes all seven days of the week, including the weekend traffic volumes. The Average Weekday traffic only includes volumes for Monday through Thursday.

There are also columns that show the percentage of the Annual Average Daily Traffic (AADT) that the highway carries each month.

The ATR chosen to produce these factors should be on the project highway and should be near the project site. If an ATR is chosen that is not on the work zone highway, be sure that the ATR is on a highway that has similar characteristics, such as similar AADT, truck percentages, commuter vs. recreational traffic mix, etc.

If there is no ATR close to the project location, the ATR Characteristic Table from the Analysis Procedure Manual web page can be used. The purpose of the ATR Characteristic Table is to provide general characteristics for each ATR in Oregon. The filtering capabilities of the table allow the user to find an applicable ATR on a roadway segment that has defined characteristics.

Detailed information on using the ATR Characteristic method for finding an applicable ATR can be found in the Analysis Procedures Manual (APM) (*3*).

In the event that a characteristic ATR cannot be found, the Seasonal Trend Table can be used. The Seasonal Trend Table is designed to provide analysts with a default set of monthly trend data based on a generalized trend type, i.e. Commuter or Recreational Summer. Seasonal Trend Table factors are based on previous year ATR data and are updated annually.

The Seasonal Trend Table can be found on the Analysis Procedure Manual web page and instructions on how to use it can be found in the APM (*3*).

The Seasonal Trend Table provides monthly factors for both the 1st and 15th of the month, but for purposes of work zone traffic analysis, values for the 15th are used and applied to both weekdays and weekends.

Weekday vs. Weekend Traffic Volumes

Separate matrices are needed for weekday and weekend traffic. Weekend traffic may have a distribution of traffic throughout the day that is different than that on weekdays. To estimate lane restrictions for a weekend a weekend count is required. To calculate trend factors for weekends, use this formula:

Weekend = [(7 * Daily Trend) – (4 * Weekday Trend)] / 3.

This value is calculated by the Work Zone Traffic Analysis Tool (*1*) after the Percent if AADT for the Average Weekday and Average Daily are entered.

If the project is on a route with significantly different traffic patterns on the weekdays than on the weekends, like a recreational route, it may be necessary to obtain multiple sets of traffic counts. This requires additional work and resources, but it is the only way to adequately account for the different traffic patterns.

Heavy Vehicle Adjustments

For the purposes of work zone traffic analysis, traffic volumes are discussed in terms of passenger car equivalents (PCEs). Truck volumes are converted to passenger car equivalents by applying a truck equivalency, or PCE factor, which ranges from 2.0 to 4.5, depending on terrain. The breakdown of PCE factors by terrain are shown in the "READ ME" tab of the WZTA Tool (*1*).

Also, the types of trucks that use Oregon's freeways are not usually smaller delivery trucks, but large semi-tractor trailers, including triple tractor trailers. Therefore, a truck factor of 2.5 is appropriate for most areas of Oregon's interstate system and heavy use highways, such as U.S. 26 and U.S. 97. The HCM (*2*) can also be used as a starting point for determining appropriate PCE factors based on facility type and terrain.

Low Volume Roads

If the highway AADT is below 5,000 vehicles per day it is not necessary to complete an analysis. An analyst can document that the anticipated peak hour volume will not come close to reaching the free flow threshold of the highway

Establish Work Zone Capacity

The free flow threshold (FFT) represents the traffic flow rate beyond which traffic can no longer operate under a free flow condition. The free flow threshold is the point at which stable flow can no longer be sustained.

At traffic flow rates above the free flow threshold, traffic begins to increase in density and decrease in speed and queuing begins to form upstream of the work zone. Traffic flow in this area becomes unstable as the influence of the work zone congestion begins to hinder traffic

operations. This congested area will continue to expand if traffic volumes remain above the free flow threshold. As queues continue to form, traffic operations will break down.

Traffic volumes that exceed the free flow threshold passing through a work zone at free flow speeds can be observed; however, this situation cannot be sustained. The free flow threshold is set at a point where the traffic flow rate can be sustained at free flowing operations for extended periods of time. For the WZTA Tool (*1*) the FFT is referred to as the work zone capacity.

Once traffic volumes exceed the work zone capacity and traffic operations break down, queues will form. The traffic volume that can pass through the work zone is less than the traffic demand (the traffic volume that wants to pass through). The volume that actually passes through the work zone is the capacity of the work zone. The queue will continue to grow until the traffic demand becomes less than the work zone capacity.

The HCM (*2*) uses the concept of level of service (LOS) to describe traffic flow characteristics. LOS C is commonly seen as the minimum acceptable LOS for rural roads and LOS D as the minimum traffic level for urban roadways. ODOT uses volume to capacity (v/c) ratios between 0.6 (rural) and 0.85 (urban) for highway design purposes.

The HCM (*2*) describes LOS C and LOS D as:

> *"LOS C provides for flow with speeds at or near the FFS [free flow speed] of the freeway. Freedom to maneuver within the traffic stream is noticeably restricted, and lane changes require more care and vigilance on the part of the driver. Minor incidents may still be absorbed."*

> *"LOS D is the level at which speeds begin to decline slightly with increasing flows, and density begins to increase somewhat more quickly. Freedom to maneuver within the traffic stream is more noticeably limited, and the driver experiences reduced physical and psychological comfort levels. Even minor incidents can be expected to create queuing, because the traffic stream has little space to absorb disruptions."*

The HCM (*2*) shows that free flow operations begin to deteriorate at LOS C. Further, the inability to absorb minor incidents in LOS D implies that the traffic flow has become unstable. This tells analysts that the work zone capacity is a point somewhere between LOS C and LOS D. Looking at the table, the v/c ratio associated with LOS C and LOS D is between 0.64 and 0.90 depending on the criteria. This is well below a v/c ratio of 1.0 which represents capacity; therefore the capacity will always be higher than the free flow threshold.

Work Zone Capacity Threshold

When possible, lane closures are restricted during those hours when the traffic volumes are expected to exceed the free flow threshold. Several default values for this threshold have been developed through many years of work zone observations, experience, engineering capacity studies and Region preferences. The WZTA Tool (*1*) has guidance for work zone capacity

values. These values are a good starting point and can be modified depending on the scenario of the work zone.

Threshold Reducing Factors

The work zone capacities given in this manual are based on 12 foot travel 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, poor pavement conditions and visually complex surrounding environments.

Work Zone Capacity for Freeways & Multilane Highways

These thresholds are for a highway with two or more lanes in one direction; at least one lane is closed and the other lane is carrying the traffic with continuous flow. There are no interruptions (signals, stop signs, flaggers, etc.).

Work zone capacities are in Passenger Car Equivalents (PCEs) per hour - per lane for 1 or more lane closures. Table 2 contains the default work zone capacity values for the WZTA Tool (*1*) .

Table 1: Divided Highways and Freeway Closure Work Zone Capacity Values

Roadway Type	Work Zone Capacity
Multilane Highways	1,400 PCE per Open Lane
Freeways	1,500 PCE per Open Lane

The default values for the free flow threshold are based on decades of experience observing Oregon work zones and are provided as a starting point for analysis. Unique project circumstances and/or engineering judgment should always be taken into account when determining if the default value is appropriate.

Work Zone Capacity for Bi-directional Closure

A bi-directional work zone is a two-lane highway, one lane in each direction, with one lane closed for construction. The remaining lane must carry traffic from both directions by using flaggers, pilot cars, or temporary signals. The work zone capacity listed in Table 3 include the combined traffic from both directions.

Table 2: Two Lane Highways with Bi-directional Closure Work Zone Capacity

Closure Length (miles)	Work Zone Capacity
1.0 to 2.0	550 PCE
0.5 to 1.0	750 PCE
0.0 to 0.5	900 PCE

Closures in excess of 2.0 miles should be avoided since they can lead to dangerous access conflicts and because the traffic stream may begin to form discrete platoons.

The free flow thresholds for longer bi-directional work zones are lower due to the additional time it takes to travel through the work zone and the extra time that it takes for the work zone to clear when there is a change in the traffic's direction.

Special Operations

Certain work zone operations and construction strategies that are employed in the field can have significant impacts on work zone traffic analysis. The free flow thresholds discussed earlier in this section apply to typical lane closures. Work zone operations such as beam swings or other intensive work near the travel lanes have a significantly lower free flow threshold than an ordinary lane closure due to the slower speeds and/or rubbernecking. Analysis requests may also be made asking for windows during which rolling slowdowns or stop and hold operations may be used. For these circumstances, the work zone capacity values that follow are being recommended for use based on observations and may change in the future as additional data is collected.

Beam Swings and Paving Operations

This threshold applies to beam swings and other intensive work that causes significant rubbernecking when taking place next to live traffic. The threshold is based on observations made during beam swing and paving operations in 2005 and 2007. Observations specifically to determine the work zone capacity for beam swings were made after observing significant delays occurring repeatedly while traffic volumes were below the thresholds typically used for lane closures. These observations have led to the beam swing and paving operation work zone capacity of 1200 PCEs/hr/lane.

Rolling Slowdowns

These thresholds were established based on a limited number of observations made during rolling slowdown operations on Oregon interstates. Future changes to this threshold will be made as additional data is collected. For obvious reasons, the term free flow threshold is not entirely accurate for this operation. The threshold refers more accurately to the highest traffic flow rate at which the queues that developed during the slowdown quickly dissipate without the lingering impacts cause by residual queues. The threshold to be used for these operations is 500 PCEs/hr/lane.

Traffic Generating Special Events

The analyst needs to determine if there are local events which will seriously impact the flow of traffic through the work zone 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. Analysts should talk to the Area Maintenance Manager or other Region employees to see if there are any special events in the area.

Comparing PCEs & Work Zone Capacity

Once all of the traffic volumes have been adjusted and the work zone capacity has been established, these two values are compared for each hour during the project's duration. If the PCEs are larger than the work zone capacity lane closures restrictions are recommended.

The matrices of adjusted volumes that were created earlier are now completed by comparing the free flow threshold with the calculated PCEs. Those hours, during which the PCE volume is greater than the work zone capacity, are restricted from allowing lane closures.

Blocking

The goal of blocking is to make the lane restriction recommendations more uniform to take into account what is practical for construction in the field. Some closure charts that may be developed will be very jagged, with almost every month and weekend/weekday scenario yielding a different result. In other cases, the chart may be almost completely blank with the exception of a few scattered hours here and there. Uniform recommendations will make construction scheduling and staging more realistic.

For example, even if the analysis indicates that one hour will not be over the work zone capacity while the hours immediately before and immediately after are over the work zone capacity, there is little point in allowing a lane to be open for that particular hour. One hour is seldom long enough to accomplish enough work to justify the opening. The time it takes to set-up and take-down traffic control needs to be considered as well.

In other cases for example, judgment is needed if the analysis results in no other hours that exceed the work zone capacity except for two on the matrix. The results taken literally would imply that lanes should not be closed during that month 2 hours out of the day. It may be better in that case to not request a two hour lane closure for only part of the summer. The analyst should remember that volumes are adjusted by numerous factors and that these factors are often rounded, resulting in PCEs that are not exact or set in stone.

Delay Estimates

For the purposes of work zone traffic analysis, the concept of delay is defined as the average additional travel time that will be required to travel from one point to another as a result of construction activities. Existing delays resulting from current capacity and/or geometric deficiencies and from incidents are not included. To estimate delays, volume over the work zone capacity is used in combination with the jam density and the number of open lanes. This will generate a queue length in miles expected from the lane closure as well as a time to clear the queue. The WZTA Tool (*1*) also generates a cost estimate for the delay caused. It uses the

estimated value of one hour of travel-time by vehicle class. These values are published by the ODOT Program Implementation and Analysis Unit.

Diversion

For one-time events, if delays are severe enough, drivers may find other ways to arrive at their destination. For a work zone that will be in place for more than a day, this phenomenon, known as traffic diversion, will significantly alter traffic patterns. With diversion, drivers will find alternate routes as well as change their schedules or simply avoid making the trip. Long term work zones, especially work zones that do not involve lane closures, may lose their impact on traffic operations as drivers become more familiar with the new traffic pattern.

Producing Project Reports

One of the last steps to be completed when performing work zone traffic analysis is to document the results of the analysis. Examples of work zone traffic analysis memos or reports are included in Appendix C. The exact format of these documents will vary from group to group; however, there needs to be a lane restriction and delay estimate memo or report that can be included in the project documentation so that details of the analysis can be traced back as needed at some future date.

Lane Closure Restriction Reports

Lane restrictions tell the contractor when it is safe to close traffic lanes so that highway construction, maintenance and utility work can be carried out. The goal of lane restrictions is to ensure that there is enough capacity to carry the anticipated traffic with one or more traffic lanes closed. If there is too much traffic demand for the remaining travel lanes with a lane closure, then lane closure restrictions are put into place.

Lane restrictions not only need to be documented for the project documentation, but they are also included in the project's Special Provisions (or Boiler Plate) in section 00220.40(e).

Delay Estimate Reports

Delay estimates determined for a project need to be reported to the project leader, project manager, and to the Region Mobility Liaison. The reports should also be written up so that it can be included in the project documentation.

Appendix A – Acronym Glossary

Acronym	Meaning
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
APM	Analysis Procedures Manual
ATR	Automatic Traffic Recorders
FFT	Free Flow Threshold
HCM	Highway Capacity Manual
LOS	Level of Service
ODOT	Oregon Department of Transportation
ORS	Oregon Revised Statutes
PCE	Passenger Car Equivalents
TPAU	Transportation Planning Analysis Unit
WZTA	Work Zone Traffic Analysis

Appendix B – Definitions

Bi-directional – Two travel lanes with one lane of traffic in each direction, with little or no access control.

Capacity – The maximum number of vehicles (vehicle capacity) or passengers (person capacity) that can pass a given section of roadway or transit line in one or both directions during a given period of time under prevailing roadway and traffic conditions.

Delay – In this context, additional average travel time experienced per vehicle hour.

Freeway – A fully access controlled throughway.

Highway – See ORS 801.260

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

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 years.

Peak Hour – Hour of the day with the most traffic, usually during morning and evening commute times. Generally not the design hour.

Queue – A line of vehicles waiting to be served by the highway system.

Roadway – See ORS 801.450.

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.

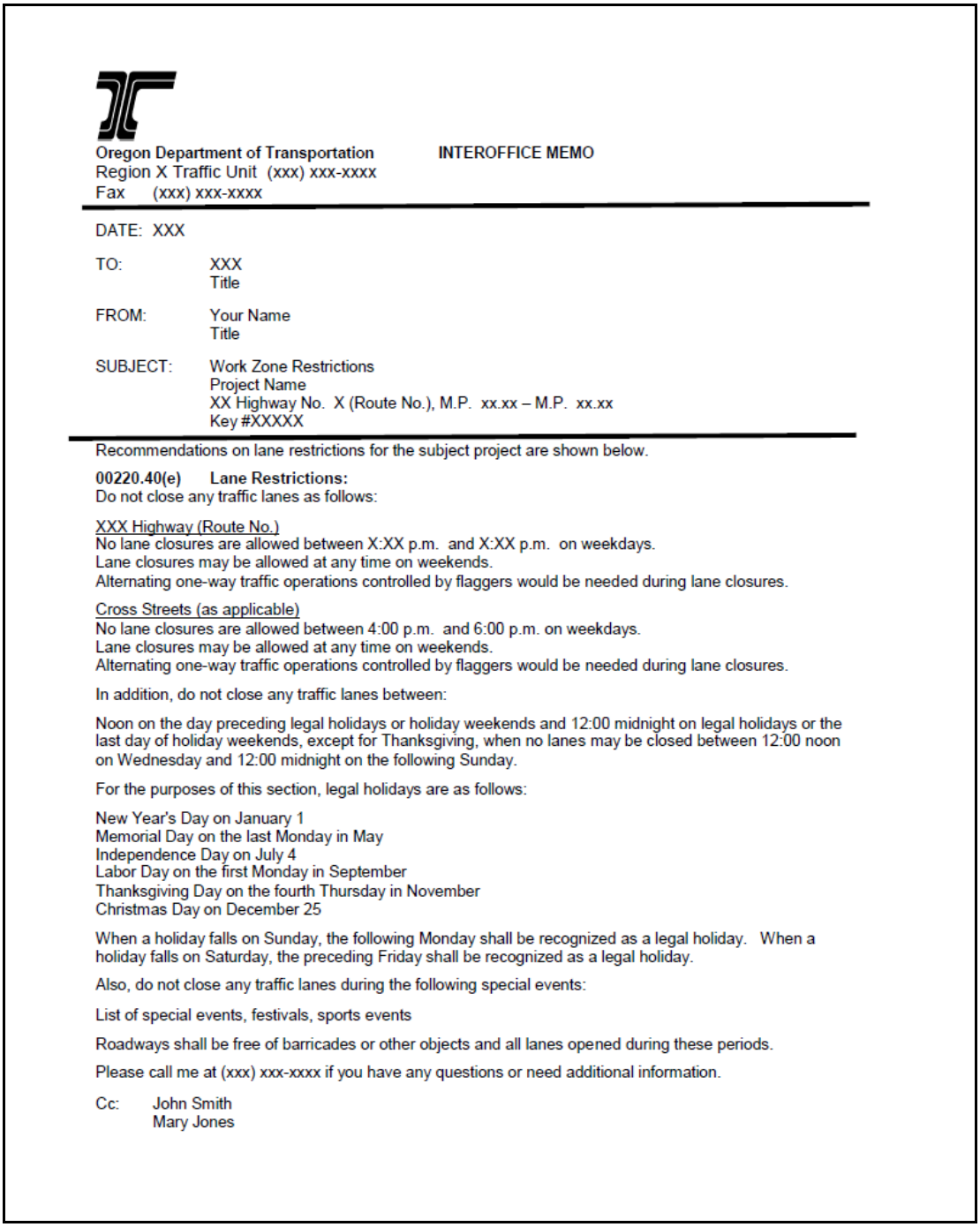
Shoulder – See ORS 801.480.

Work Zone – 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.

Appendix C – Example Project Memos

Example 1 – Two-Lane Highway

Figure 1: Example Two-Lane Highway Project Memo



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

DATE: XXX

TO: XXX
Title

FROM: Your Name
Title

SUBJECT: Work Zone 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

Example 2 – Multilane Highway

Figure 2: Example Multilane Project Memo

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

DATE: XXX

TO: XXX
Title

FROM: Your Name

Title

SUBJECT: Work Zone 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

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.

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

Cc: John Smith
Mary Jones

Example 3 Passing Lane Closure

Figure 3: Example Project Memo

Oregon

Theodore R. Kulongoski, Governor

Department of Transportation
Traffic Unit
63055 N Hwy 97
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(503) 555-1234

INTER OFFICE MEMO

30 June 2050

TO: John Smith, Project Leader

FROM: Jane Doe, TCP Designer & Traffic Analyst

SUBJECT: Work Zone Lane Restrictions & Travel Delay Estimate
Specified Project Name and Location

ODOT Region 4 Traffic Section recommends the following lane usage for construction:

The passing lane on US 97 in the 20th Century Drive area may be closed during construction. Due to the volume of traffic, the contractor will be required to maintain at least one lane of travel each way. The anticipated delay generated by this passing lane closure is calculated at less than 1 minute.

For this project the standard holiday and weekend restrictions will apply. Holidays that fall on a Monday have restrictions that run from the preceding Friday at noon through the midnight of the following Monday/Tuesday evening. Holidays that fall during the work week have restrictions that run from the noon of day before to midnight of the holiday. For those holidays that fall on a Friday, restrictions from the noon of the Thursday before, to the midnight of the following Sunday/Monday evening. Weekend restrictions extend from Friday at noon to midnight of the following Sunday/Monday evening. Construction is not allowed during the July 4th Independence Day holiday and the July 28 through July 30 All-State Mosquito Festival.

If you have any questions or concerns on the lane restrictions or travel delay estimates, please call me at (503) 555-1234.

Appendix D – Key References

1. Oregon Department of Transportation. Work Zone Traffic Analysis Tool. 2019. https://www.oregon.gov/ODOT/Engineering/Pages/Work-Zone.aspx.

2. Transportation Research Board. *Highway Capacity Manual*, 6th ed. Transportation Research Board, Washington, D.C., 2016.

3. Oregon Department of Transportation. *Analysis Procedures Manual*. Oregon Department of Transportation, Salem, Oregon. https://www.oregon.gov/ODOT/Planning/Pages/APM.aspx.

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