THE WEB-BASED WORK ZONE TRAFFIC ANALYSIS TOOL

USERS’ GUIDE
Web-Based Work Zone Traffic Analysis Users’ Guide

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TRAFFIC CONTROL PLAN
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TO: Work Zone Traffic Analysis Associates

FROM: Scott McCanna, P.E.
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SUBJECT: Web-Based Work Zone Traffic Analysis Users’ Guide

PURPOSE

The purpose of this manual is to familiarize analysts and their leaders with ODOT’s Work Zone (WZ) Analysis methodologies, guidelines, policies, and procedures to use in their determination of lane closure restriction recommendations.

The manual is intended to be utilized by analysts within ODOT; as well as analysts for local authorities, consultant analysts and other professionals outside the Department. Care should be taken in applying any portions of this manual to projects developed outside the Department. Differences may exist between the ODOT WZ Traffic Analysis Manual lane closure policies and those policies established by other agencies. These differences may lead to inconsistencies in the analysis and subsequent lane closure restrictions of a particular project.

This manual is not intended to replace any existing ODOT analysis policy. It is intended to supplement existing ODOT policies, yet enhance the specific discipline of WZ Traffic Analysis. This manual is to be used as a resource, a technical reference and a teaching aide in the area of temporary WZ Traffic Analysis. Please contact ODOT’s Traffic Engineering and Operations Department for clarification or interpretation of any policies and standards within this manual.

UPDATES

This manual is meant to be a living document. It is intended that this manual will be updated on a regular basis; however, suggestions for changes or additions will be accepted at any time. Any analyst may make recommendations with the expectation that the concern may be incorporated into this document.
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WORK ZONE TRAFFIC ANALYSIS (WZTA) 
USERS’ GUIDE

1.0 INTRODUCTION

Construction and maintenance work on our highways often requires that traffic lanes be closed and that travel delay be minimized. Work Zone Traffic Analysis (WZTA) tells the contractor when traffic volumes are low enough that lanes can safely be closed and it calculates travel delay for highway activities.

The Web-Based WZTA tool performs the calculations to generate these deliverables which would take hours to do if performed by hand.

2.0 A REVIEW OF THE ANALYSIS THEORY

The deliverables from WZTA are Lane Restrictions and Estimated Travel Delay.

2.1 Lane closure charts tell the contractor when traffic volumes are low enough to safely close traffic lanes. Manual traffic count volumes and traffic data provide factors that create Passenger Car Equivalents (PCEs) for every hour during the project’s duration. If these PCEs are larger than the roadway’s Free Flow Threshold, Lane Closure Restrictions are initiated.

2.2 Estimated Travel Delay has been calculated from thousands of traffic model runs and is assigned to specific roadway situations; such as a two-lane freeway with one lane closed that has 1200 PCEs, 25% trucks, etc.

Because this manual focuses on the use of the WZTA tool, the methodology and calculations behind the deliverables has been written into the Appendix rather than shown here.
3.0 THREE LEVELS OF USERS
The WZTA tool can be used by anyone with internet access and is commonly used for one of three purposes.

3.1 General Users – Anyone with internet access can use the WZTA tool to look at state highway information. Terrain, Speed Limit, Number of Lanes and Average Daily Traffic are just some of the information that can be shown for all roads on the state highway system. This data can not altered by General Users but it can be viewed without having to “Log-In”. Appendix A gives more complete information on the use of the WZTA tool to gather traffic data.

3.2 Work Zone Traffic Analysts – Lane Closures Restrictions and Travel Delay may be calculated with the help of the Web-Based WZTA tool by Work Zone Traffic Analysts. In order to obtain “Log-In” information to use the tool, an analyst must take the WZTA Class offered by ODOT. If an analyst has taken the class prior to the roll out of the current WZTA tool, an update class may be taken at no additional cost. Please contact ODOT’s Training Center for class information. An analyst can use the tool to produce lane closures restrictions and travel delay estimates. They can also produce aggregate delay reports for several different projects along the same corridor. The tool can also be used to store, edit and share reports and data with other analysts.

3.3 Administrators – These folks will do program and data updates. They will add log-in information for new users and ensure that the tool is working smoothly.
4.0 USING THE WEB-BASED WZTA TOOL

The WZTA tool is an easy way for analysts to get lane closure restrictions and delay estimations. The tool can be found at the https://wztadev.obdp.org/ web-site.

General Notes on the Tool:

- **ATR Graphing Tool** – clicking on this option near the top left of the Traffic Data Page will lead the user to a page where all of the statewide ATRs are shown. When an ATR is clicked on, its number appears in the box at the top as the ATR Number. To see the seasonal trend data for the selected ATR, click on the “Trend Data”. The analyst can also input the ATR number in the ATR Number box and click on Find and the tool will show the location of the ATR on the map. Once an ATR is selected, the analyst can fill in a Start and End date for “Visual ATR Volumes” at the bottom of the left most column and the tool will create a graph of the traffic volumes found at that ATR during the specified dates.

A user does not have to be Logged In to use this function.

To get back to the Traffic Data Sheet, click “Home” or the Green “Back” arrow on Internet Explorer.

- If you leave the tool unattended for more than a few minutes, it will time-out, kick you off and you will have to hit the “Refresh” key to get started again.

- **Help Page** – A link to the Help page is located XXXX. It has helpful information such as the State Highway Cross-Reference Tables, a link to ODOT’s Video Log and to this Manual.
The Work Zone Traffic Analysis Process

The most straightforward way to get Lane Restrictions and Delay estimations is to follow these steps.

1. Log on to the tool at https://wzta.obdp.org/.
2. Identify the project area
3. Verify the traffic data chosen by the Tool.
4. Choose counts
5. Save File and Review Lane Restriction and Delay reports.
6. Manage Report Files

4.1 Logging-In
In order to use the analysis functions of the tool and/or override any of the traffic data a user needs to log in.

Click on “Login” near the top left of the Traffic Data Sheet, a window will open with space for you to type in your User Name and Password. After entering your User Name and Password, hit Enter or click on “Login”.

The tool will return you to the Traffic Data Sheet where you will see “Successfully logged in as ‘Your User Name’ “in the Status Window.

4.2 Map Attributes
Legend - Click on the legend in the lower left corner of the map to change the attributes. You will notice that some of the features are grayed out because they can’t be seen at the given level. If you zoom in you will see these features become active.

Route Maps & Motor Carrier
The Oregon route maps assist Motor Carrier (trucking) users who require up to the minute information on road and bridge restrictions, accidents and road closures. Routes that are restricted for trucks are shown on the maps below.
Group Map 1
Indicates **Legal Length** limits for various **Legal Size** vehicles and combinations hauling **Legal Size Loads**.

Route Map 2
Use for determining **pilot vehicles** required for **Over Width** loads.

Route Map 5
Displays annual **Triples** routes & authorized days of operation.

Route Map 6
Displays authorized annual routes (up to 14’ wide) for **Mobile/Modular Units**.

Route Map 9
Displays authorized annual routes for **Over Width (up to 14’ wide)** and/or **Heavy Haul** loads.

As you experiment with the Legend features you will be able to see ATRs, Count Locations, Truck Percentages and other valuable map attributes.

**Overview** - feature shows where a project area is on the state map.

**TPS** - Gives detailed traffic data within 3 miles of each end of your project area including Elevation, Truck %, ADT, whether or not an ATR is within the area, Horizontal and Vertical curve details, and a legend for interpretation.
4.3 Identify the Project Area

**ODOT Hwy # and Milepoint**, There are two ways to identify the highway number and milepoint of the project:

- Click on “Select” to the right of ODOT Hwy #: and Milepoint. The tool will open a window that will allow you to choose the highway number from a list. Once the Highway Number is chosen, the tool displays the highway’s mile point range and the analyst enters the project’s milepoint.

  If the user does not know the Oregon Hwy Number, they can look it up on the State Highway Cross-Reference Table located on the Help Page.

- The second method to choose a Hwy # and milepoint is to select it from the map. The analyst clicks on the “Get MP” button, and then on the highway on the map at the location of the project. Zooming in on the project area before clicking on the highway can make it easier to pinpoint the project area. The tool will open a “Nearby Highway” window with a selection of highway segments from which the analyst may choose.

After the Highway Number and Mile Point are chosen the tool populates the Location and Traffic Data sections on the left side of the Traffic Data Sheet.

4.4 Verify the Traffic Data Chosen by the Tool.

After the Highway Number and Mile Point are chosen the tool populates the Location and Traffic Data sections on the left side of the Traffic Data Sheet. All of the information shown in blue can be overridden by the analysts.

**How to Override the Chosen Data**

- Click on the factor and the tool will open an override window.

- This window will also show you the Current Default and the Report Default, which will show what the default was at the time of the analysis.

  This is helpful if you come back to this report later and the report defaults have changed. It also shows you what Report Overrides have been made to this factor. These defaults and overrides will be saved with the report.
After overriding the default data, hit enter or click on “Accept” or “Cancel”.

Once data has been changed it will be shown in orange on the traffic data sheet.

A good way to verify highway attributes is to view the ODOT Video Logs. ODOT video tapes all of the state highways once every three years and the video tapes are available for anyone with internet access to review. There is a link to the Video Log on the WZTA’s Help Page located XXXX.

Back to the Verifying the Data on the Traffic Data Sheet . . .

**Region** – you will seldom, if ever, have to change this.

**Area Type, Area Name and Area** (shoulder) are for information only.

**Roadway Type** - There are 3 choices;

- **Bidirectional** - two lanes with one lane of traffic in each direction, with little or no access control.
- **Multilane** – four lanes with two lanes of traffic in each direction. It may or may not have a two way left turn lane (or “twiddle”) or median and may have full, partial or limited access control.
- **Freeway** – Full access controlled divided, multi-lane, usually high speed highway having a minimum of two lanes for exclusive use of traffic in each direction with uninterrupted flow between interchanges.

**Terrain Type** - **Always double check this factor.** This data comes from the ITIS database and the value shown on the Web-Based WZTA tool is often *not correct*. The ITIS database assigns this factor to large highway ranges which may not be correct for the project location. Be sure that you know what the project terrain type is before accepting this factor.

**Existing Posted Speed Limit** - This is the *preconstruction posted speed*. Even if a Work Zone Speed Reduction has been approved, the preconstruction posted speed – not the reduced speed – should be used.
Select # of Existing Lanes - The Integrated Traffic Information System (ITIS) database from which the number of existing lanes is taken has a unique way to counting lanes which makes it necessary for analysts to manually indicate the # of Existing Lanes per Direction

This selection must be made at the beginning of every new WZTA.

Note: Items that require analyst's input are shown in red/orange.

When “Select” is clicked in the orange square the tool opens a window that allows the analyst to choose the # of Existing Lanes.

This is the number of lanes before the project begins and before any lanes are closed.

Here are some examples for existing number of lanes:

- A two-lane road with one lane in each direction would have 1 existing lane in each direction.
- A multi-lane highway with one lane each direction, with a two-way left turn lane (twltl or twiddle) would have 1 existing lane in each direction.
- A multi-lane highway with two lanes each direction, with or without a median or a two-way left turn lane (twltl or twiddle) would have 2 existing lanes.
- A freeway would usually have 2, but sometimes 3 existing lanes in each direction.

NHS Route, OHP Freight Route and National Network (Freight): are all for your information only.

Year of Analysis - This is the year during which the project construction takes place. If the project is going to take more than one year, input the year during which the project begins.

Linear Growth Rate: The growth rate is taken from the TPAU’s 20-year future volume tables. Change this factor if better growth rate information is known.

Existing ADT Year: The tool takes the ADT from the most recent TVT tables that it has access to. The year that is displayed tells you the year of the TVT table that the ADT was taken from.

Existing ADT: The Average Daily Traffic taken from the most recent TVT tables that the tool has access to.

The Analysis ADT, Existing Design Hour Volume (DHV), and Analysis DHV are calculated from the ADT and the growth rate.

% Trucks Truck percentages are taken from tables created by TData.

PCE Factor is used to adjust truck volumes to represent the size and travel characteristics of passenger cars. ODOT WZTA suggests the following: Level 1.5, Rolling 2.5, and Mountainous 4.0. Most analysts use 2.5 for most of ODOT’s main corridors, such as I-5
and US97, due to the size and percentage of trucks on these facilities. A default value is provided based on roadway type and terrain. **Free Flow Threshold** (FFT) is the point at which stable flow is no longer assured which equates to an approximate Level of Service (LOS) of C to D. The FFT is not the capacity. The FFTs are region specific and were developed with the help of the regions.

- Region 1 – 1600 PCE
- Region 2 – 1400 PCE (at their request)
- Regions 3, 4 & 5 1500 PCE

Note: Bidirectional roadways will have the FFT grayed out because stop and go traffic with flaggers or a temporary signal have no free flow traffic.

**Analysis ATR** – An ATR is an Automated Traffic Recorder imbedded within the roadbed to count the number of vehicles. Currently there are over 140 ATRs on Oregon’s Highways; however, several new ATRs are being installed that can report vehicle classification, i.e., types of heavy vehicles, passenger cars, etc. as well as the number of vehicles.

Click on the ATR number shown and the tool will open to a window that shows the project area and the location of the selected ATR. To choose a different ATR, click on ATR in the upper left corner of the map, and then click on another ATR on the map. You may need to zoom out to locate additional ATRs.

If you are not able to find an acceptable ATR, use TPAU’s ATR Characteristic Table. The table and TPAU’s Analysis Procedure Manual (APM) manual are located on TPAU’s web site in ODOT’s Transportation Development section. Be sure to read Chapter 4 of the Analysis Procedure Manual before using the table.

Clicking on “Trend Data” will show seasonal trend data for the chosen ATR. This window also allows Trend Factors to be overridden; however, there will seldom, if ever be a need to change trend factors.

**Visual ATR Volumes** allows the ATR volume data to be graphed and displayed. Seeing the layout of the volumes can help to identify abnormalities. As this feature is explored be aware that the scale of the “Y” axis scale may change from graph to graph.

**4.5 Choose Counts**

**Select Counts** – the tool does not choose a project traffic count; the analyst must specify it. Click on Select Counts and the tool will open a new window.

**To choose an ODOT count**, click on “Select” beside “ODOT” and the tool will open a window that shows your project site and the nearest count(s) to it. If you zoom out, more counts may appear. Click on “ODOT Counts” and select one of the counts.
Information about the count will appear in an additional window. If you click on “Select”, its number will appear in the window in the left column. Click on “Accept”

After choosing “Accept” the tool will allow you to **apply the count** to any days of the week. After choosing the days of the week, click on Apply. The tool will show a **24 Hour Volume** number for your count further down the page and compare it with the existing ADT. That factor, which will be shown in the “Factor” column, needs to be close to 1. If the factor is below 0.70 or above 1.30, it will appear in red, letting you know that the count total isn’t close to the ADT and you may need to choose a different count.

You can go back and choose a different count for each day of the week, but most often you will use one count for all 7 days or one count for Monday through Thursday and a separate count for Friday through Sunday.

**View Counts** is located at the bottom of the ATR Adjustment Summary window. Clicking this will open a window that shows a graph with the minimum and maximum count volumes for each hour during the count duration.

**To use your own counts**, click on “Select” by User and the tool will take you to the “Folders” page. You can store your own counts in the Manual Counts section. To put a count into your Manual Count folder, click on “New Manual Count” near the top right section of the folders page. Enter the count data in the Edit Count window and then save it.
Delay Information

**Work Zone Analysis Length** is automatically set at 4000 ft. About the only reason to change it for a Freeway or Multi-lane project is for visual representation. If you have a bidirectional project, this length will default to 1500 feet with an option for 3000 feet.

**Project Start and End Months** Click on the Start Month and Year shown and the program will take you to a window where you can enter the project’s start information. When you click on **Accept**, the tool will take you back to the Traffic Data Sheet where you can repeat this process for the end month information.

If you accidently enter the start month as later than the end month, the tool will give you an error message and you will be asked to fix the problem.

**Staging**

**Proposed Lane Drop? Proposed Crossover?** In the “Staging” box in the lower left corner of the Traffic Data Sheet, click on the box and change it to “Yes” to tell the tool that the project will have a lane closure and/or crossover. The next window will allow you to change the choice of a lane drop or crossover for any hour during the project duration.

If you only want to see the affect of a lane closure or crossover during the project duration, change the option in the Default Staging box near the bottom of the page under Proposed Lane Closure to Yes and click on “Accept Changes”

The analyst should take the time to work with changing the options for lane drops or crossovers on different days and hours during the project duration to understand how this affects the estimated travel delay.

4.6 Save File and Review Lane Restriction and Delay reports.

**View Reports, Save Data, Clear Data**

**Save Data** – when all the data has been entered and reviewed, click on “Save Data” at the bottom left of the Traffic Data Sheet.

The Folders page will open. Type in the Report Name, record any comments and click on “Save”. The tool will take you back to the Traffic Data Sheet.

A file must be saved before “View Reports” can be used.
View Reports – Once a file is saved, the lane restriction charts and estimated travel delay reports can be viewed. From the bottom left of the Traffic Data Sheet, click on View Reports and the tool will take you to the Folders page. Click on either Lane Closure Charts or Delay Reports. Both windows will show a review of the data and provide an option to view the report in either PDF or Excel report format.

NOTE: The preferred way to view and share a report is PDF. In the Excel format the data can accidentally be changed.

The Delay Summary Report displays one calendar year of data per report. If your project spans more than one year, i.e., if it has activity in 2008 and 2009, you need to specify which year’s data you need, and you will need two reports, one for 2008 and one for 2009. The drop down tool for choosing the year is in the upper left corner of the Delay Summary Report Options window.

When reviewing a Delay Summary, you may find “---” in place of numbers. This tells the analyst that the tool does not have data for the project scenario. For instance, there may be no data for a project with very high truck percentages. HDR is working to close most of these “data holes”. Ask Jeremy for further information.

To return to the Folders section after viewing the reports, close the report and click on “Back”.

Over Capacity Delay – As you remember from WZ Traffic Analysis class, delay can only be expressed as a number when the traffic volume is below capacity. Once it reaches capacity, the operation becomes unstable, unpredictable and reporting a delay is not practical. When the volume is over capacity, about the only way to report delay is to show how bad some times are relative to other times, i.e., the delay from the morning...
peak will be “Bad”, but the afternoon peak will be “Really Bad”. The analyst **can not report** the delay estimate **numbers** given for a project scenario that is over capacity – they are not accurate.

The Over Capacity Delay tool graphs traffic volumes, the capacity and queue volumes and lengths. The graph can be used to show relative times of delay when trying to explain why lanes should not be closed. The values seen on this page should be considered as approximate and qualitative.

**NOTE:** The Over Capacity Delay tool must use numbers to create the graphs; however, these numbers are **not accurate**. The delay estimate numbers come from an unstable, chaotic scenario and are only shown to display the graph data.

*Do not report these numbers!*

### 4.7 Manage Report Files

**Managing Files and Reports**

The **Folders** section of the tool allows the analyst to:
- save and store analysis reports,
- share reports and send them to other analysts,
- store and manage Custom Manual Counts & Custom ATR Trend Factors and
- Create Aggregate Reports.

After a file has been created and saved, click on **My Folders** near the top left corner of the Traffic Data Sheet. The tool will take you to the page where Your Folders can be managed.

**Inbox** – holds reports sent to you by other users.

**Shared** – contains reports that you would like other users to have access to.

**Reports** – stores project reports and provides for file management for them.

**Manual Counts** – contains custom manual counts that you or other users have created. You can create a new manual count by going to the Manual Counts page and selecting **New Manual Count** from the upper right hand page area. Fill in the boxes with count information and be sure to **Save** it.
**ATR Trend Factors** - Just as Custom Manual Counts can be created, stored and used, so can custom ATR Trend Factors. Click on **“New ATR Trend Factors”** in the upper right corner and the tool will open a window that will allow a new ATR Trend Factor file to be created. As stated previously, you will probably never use this feature and should not do so unless there is a compelling reason to do so.

**Aggregate Report** – This feature has the ability to combine the delay affects from several project sites on the same corridor to get an aggregate travel delay report.

- Go to My Folders and click on Aggregate Reports.
- In the Aggregate Reports box at the bottom of right side, click on Create Subfolder
- Give the folder a name, record any comments and click on “Save”.
- Click on Reports and click on those files that you want to include in the Aggregate Report.
- The Choose Aggregate Delay Folder will open and allow you to send the selected file to an Aggregate Delay Sub Folder. Click on the down arrow under “Choose Aggregate Delay Folder” and select the sub folder.
- Click on “Send”.
- Repeat the previous steps for each report you want to add to the Aggregate Report.
- After you have added all of the files, click on Aggregate Reports in the Folders list.
- Select the Aggregate Report sub folder and click on “Generate Aggregate Report” near the top of the right column.
- Select the Direction, Year, then either select the Output Format to view the report or click on View on Map.

The tool will generate a report with a map showing the project locations and an aggregate delay report for the combined projects.

**File Management**

If the user clicks on the file name while in the Folders section, the tool will open the file in the View Report Section. From here the file’s data can be seen in the left column and the reports can be viewed. If “View on Map” is selected, the file will be opened in the Traffic Data Sheet window and the file may then be edited and should be saved with a new name.
Edit (another way to edit a file.)

- On the Reports page, click on “Edit” in the Folders window. The tool will open the “Edit Report” window.
- Rename and resave the file into whatever folder you choose. The tool will go back to the Reports widow.
- Click on the newly saved file and the tool will open the “View Reports” window.
- Click on “View on Map” – the “Traffic Data Sheet” window will open.
- After making edits, click on “Save Data”,
- Save the edited file in the “Edit Report” window.
- Note. A file can be edited by clicking on the file name in the Folders page, but the file needs to be saved before it is altered.

Send

- On the Reports page, click on “Send” in the desired file’s row.
- The tool will open a window that shows details of the selected file.
- Select the user to whom you want to send the file and
- click “Send”.

Copy

- On the Reports page, click on “Copy” in the row of the chosen file and the Edit Report window will open.
- In the “Containing Folder” select which folder you would like the copied file to go to.
- Change the file name in the “Report Name” box as needed.
- Click “Save as New Report” box.
- Click on “Save”.
- You would follow this procedure to transfer a file from one section to another; for instance from the Inbox to the Reports section.
Add to Aggregate - This selection allows you to add the file to an Aggregate report.

- Click on Add to Aggregate
- Click on the down arrow in the “Choose Aggregate Delay Folder” and select the aggregate report sub folder.
- Select Send.

Show Other Users –
To access files that have been shared by other users:

- Click on Show Other Users
- Select the down arrow in the Other Users’ Folder window.
- If you are not sure of the user’s name, type an initial, first letter or part of the name in the Search box, click on Search and then click on the down arrow.
- Once the name of the other user is found, click on Shared and the shared files will be available to for your use.

5.0 WRAPPING IT UP

The Web-Based Work Zone Traffic Analysis Tool can be used as a quick and easy way to get Lane Closure Restrictions and Delay Estimates for highway construction, maintenance and incidence response projects. Providing this vital information will help to keep Oregon’s highways safe and operating efficiently.

The analyst needs to be familiar with WZTA methodology in order to verify the data chosen by the tool and to understand how that data affects the project reports. Being able to recognize accurate and appropriate output from the tool is an essential part of the Analyst’s job.
APPENDIX A – WZTA TOOL FOR DATA COLLECTION
ODOT's Work Zone Traffic Analysis Tool

Explore Oregon’s Highway System
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INTRODUCTION

ODOT’s Web-based Highway Data Tool makes Oregon’s highway data available to anyone with internet access. Just point and click to find traffic data such as the Average Daily Traffic (ADT), average truck percentage, horizontal curve and vertical grade (slope) information, and more.

The tool was developed to help traffic analysts who provide information to make highway construction projects safer and more efficient. Because the calculations that analysts run requires extensive traffic data, that data is now available to everyone.

To find more in-depth traffic data, look on ODOT’s web pages for the Transportation Data Section. Using the Subject Index or the Search feature is a good way to find information.

FINDING THE WEB-BASED SQL TOOL

Go to the web-site https://wzta.obdp.org/.

Note: You will see many acronyms used in this guide. Don’t worry about remembering what they mean; there is an acronym list in Appendix C.
USING THE TOOL

We will step through each feature of the tool, starting at the top.

Note: If several folks are using the on-line tool at the same time, you may find that it moves slowly. Please be patient.

If you come back to the tool after being away from your computer for a few minutes, you will need to “Refresh” the page to get back into the program.

Click on “Home” to return to the main page instead of using Internet Explorer’s green back arrow.

ATR GRAPHING TOOL

There are over 160 Automatic Traffic Recorders (ATRs) built into many state highways that count each passing vehicle in Fall of 2008. Clicking on ATR Graphing Tool on the top left section of the front page will open a map that shows the ATR locations.

You may need to click on “Zoom In” and draw a rectangle around the area that you want to look at to see enough detail.

Note: About Zooming In or Out – When you click on Zoom-In or Zoom-Out and draw a small rectangle, the tool will zoom in or out farther than if you draw a larger rectangle.

To get ATR information, click on ATR Graphing Tool, and it will open a new window with a map of the ATRs shown as blue diamonds.

Click on the ATR icon in the upper left corner of the map and then click on an ATR diamond. Click on “Select” in the box that pops up. The ATR’s Number will appear in the box in the top left area.

The “ATR Details” box will also appear that shows the name, location and Date-Range of the ATR.

If you know the number of an ATR, you can enter it in ATR Number box and click on “Find”. The tool will show where the ATR is on the map and will list its details.
To see the **Seasonal Trend Data** for the selected ATR, click on the “Trend Data” link.

Seasonal Trend Data is the percentage of the Average Daily Traffic that uses the highway during the year. This is one way to see how the traffic fluctuates throughout the year.

See Appendix B for more information about Seasonal Trend Data and Average Daily Traffic.

**“Visual ATR Volumes”** - The tool will show you a graph of the ATR traffic volumes if you scroll down to the “Visual ATR Volumes” section and select the year and months of the data you would like to see. Click on either the PDF or Excel icon to select the format of the graph. This is another way to see how traffic fluctuates throughout the year as well as day to day.

Keep an eye on the range of traffic volumes along the left side of the graph (the Y axis) as this can change as you scroll through the graphs.

**Login** – Traffic Analysts who use this tool for Work Zone Traffic Analysis are given a username and password when they complete specialized training. Unless you are a Traffic Analyst you won’t be logging in.

To get back to the **Traffic Data Sheet**, which is where we started, click “Home”.

![Image of traffic analysis tool interface]

[Home] [ATR File] [Login] [Visual Trend Data]
STATE HIGHWAY NUMBERS
Before we can look at highway information, we have to tell the tool what section of highway we are interested in.

State Highway Numbers
Highways in Oregon are numbered based on whether they are:

- Interstate Routes, like I-5 or I-84,
- US Routes, like US 101 or US 10, or
- State Routes, like OR 120 or OR 126.

Jurisdictions such as cities, counties and the state have responsibility for (or “have jurisdiction over”) these highways. The highways that the State of Oregon is responsible for also have a distinct “State Highway Number”.

For more information on the numbering of Oregon’s highways see Appendix B.

The Tool uses State Highway Numbers to identify highway locations. To help you find a State Highway Number a State Highway Number Cross Reference Table is included in Appendix I.
FINDING TRAFFIC DATA FOR A HIGHWAY

There are two ways to identify a section of highway to find traffic data for.

If you know the State Highway Number and Milepoint:

- On the main page, click on “Select” to the right of ODOT Hwy #: and Milepoint.
- The tool will open a window that will allow you to choose the highway number from a drop down list.
- Once the Highway Number is chosen, the tool displays the highway’s milepoint range and you can select the milepoint for your area of interest.
- When you enter the ODOT Hwy # and Milepoint in the Highway/Milepoint window and click on “Find on Map”, the tool will show you where that location is on the map.
If you do not know the State Highway Number and Milepoint:

- Click on the “Get MP” button in the upper left portion of the Map,
- Click on the section of highway on the map.
- Zooming in to the area before clicking on the highway can make it easier to pinpoint the area.
- The tool will open a “Nearby Highway” window with a selection of highway segments from which to choose.

For more information on Increasing and Decreasing Mileage, see Appendix D.

After you are satisfied that the ODOT Hwy # and Milepoint are correct, click “Accept” and the tool will return to the “Traffic Data Sheet”.

To return to the “Traffic Data Sheet” at any time, click on “Home” in the upper left corner of the Sheet.

After the ODOT Highway # and Milepoint has been chosen and approved, the tool will populate the Location and Traffic Data sections on the left side of the Traffic Data Sheet.
HIGHWAY DATA
After the Highway # and Milepoint have been selected, the following Location Data can be seen on the Traffic Data Sheet.

- **ODOT Region** – the State of Oregon is geographically divided into 5 Regions. For more information on ODOT’s Regions, please see ODOT’s web site.

- **Area Type**: Provides information about the surrounding area. MPO is Metropolitan Planning Organization, which are larger cities, , UGB are areas within an Urban Growth Boundary, and Rural.

- **Roadway Type** will either be
  - **Bidirectional** - two lanes with one lane of traffic in each direction, with little or no access control.
  - **Multilane** – four lanes with two lanes of traffic in each direction. It may or may not have a two way left turn lane (or TWTLT “twiddle”) or median and may have full, partial or limited access control.
  - **Freeway** – Full access controlled, divided multi-lane, usually high speed highway having a minimum of two lanes for exclusive use of traffic in each direction with uninterrupted flow between interchanges.

- **Terrain Type** will either be
  - **Level,**
  - **Rolling or**
  - **Mountainous.**

- **Existing Posted Speed Limit**. Even if there is construction in the area, this will always show the preconstruction posted speed.

- **Number of Existing Lanes** will show the total number of lanes across both directions of the highway. The exception is major
highways, such as I-5 which will show only the number of lanes in one direction of travel. See Appendix D for more information on Existing Number of Lanes.

- **Total Paved Surface Width**, which includes travel lanes and shoulders.

- **NHS Route** indicates if it is a National Highway System roadway.

- **OHP Freight Route** indicates if it is an Oregon Highway Plan designated freight route, which is a route over which large trucks travel.

- **National Network (Freight)**: indicates if it is part of the National Freight Network.

After the Highway # and Milepoint have been selected, the following Traffic Data can be seen on the Traffic Data Sheet.

- **Year of Analysis** – This is the year for which you want information.

- **Linear Growth Rate** shows the growth rate of the traffic on that roadway over the last 20 years.

- **Existing ADT Year** is the year in which the Average Daily Traffic, that is shown below, was recorded.

- **Existing ADT** is the Average Daily Traffic recorded on the year shown above.

- **Analysis ADT** - If the Year of Analysis is different from the Existing ADT Year, the Existing Year ADT is increased by the Linear Growth Rate to show its value in the Year of Analysis. These options are normally only used by Traffic Analysts.

- **Existing DHV and Analysis DHV** are Existing and Analysis Year Design Hourly Volumes. These factors are typically used by Transportation Analysts.
• **% Trucks** shows the percentage of Heavy Vehicles. For the work done by this tool, Vehicles are classified as either Passenger Cars or Trucks. Trucks, or “Heavy Vehicles”, usually have three or more axles and/or six or more tires.
ENHANCING THE MAP

The map can be changed to see additional attributes and features.

LEGEND

The “Legend” button is located in the lower left corner under the map. Click on the legend to change the attributes of the map.

You will notice that some of the features are grayed out. This is because they can’t be seen at the given level. If you zoom in you will see these features become active.

Map Layers:

**ODOT Counts** - Selecting this option will show you where there have been manual traffic counts taken on the highway.

**ATR** – Shows the location of ATRs.

**Other Features** can be seen by selecting more map layer options.

Road Geometry:

The following information can also be selected to be shown on the map.

**ADT** – The Average Daily Traffic Volumes

**Horizontal and Vertical Grade Information**

**Linear Growth Rate**

**Truck Percentage**

**And More**

Again, you may have to zoom in to see all of these features.
OVERVIEW
Clicking on the Overview, which is located just right of the Legend button, will show you where your selected area is on the state map.

TRAFFIC PLANNING SHEET (TPS)
The TPS is a small square button near the lower left corner of the map, just above the Legend button. Clicking this will generate a detailed traffic report for the area three miles on both sides of your selected area.

The Road Profile will show the elevation in feet.

The Straightline Diagram will graphically show

- Truck %,
- ADT,
- Horizontal and Vertical curve details,
- Whether or not an ATR is within the area.

A legend to help with interpretation of the graphics is also provided.
SUMMARY

ODOT’s Web-based Highway Data Tool makes it quick and easy to access Oregon’s highway data. Information on the Average Daily Traffic (ADT), average truck percentage, seasonal trends and more are easily accessible.

The tool was originally developed to provide a tool for traffic analysts; however, because the calculations that they run require extensive traffic data, that data is now available to everyone.

If more in-depth data information is required, go to ODOT’s web pages (http://www.oregon.gov/ODOT) where there is a wealth of traffic data available in the Transportation Data Section as well as other sections. You can look in the Subject Index or use the Search tool to guide you.
APPENDIX B – WZTA METHODOLOGY
WORK ZONE TRAFFIC ANALYSIS

OREGON'S METHODOLOGY

FALL 2008
WORK ZONE TRAFFIC ANALYSIS
OREGON’S METHODOLOGY

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WORK ZONE TRAFFIC ANALYSIS
OREGON’S METHODOLOGY

1.0 Introduction

The purpose of this paper is to examine the Work Zone Traffic Analysis (WZTA) methodology used by the Oregon Department of Transportation. This is the methodology that is used in the WZTA Web-Based Tool. This WZTA methodology and the steps followed during the analysis are laid out along with examples and a chance for the reader to work through analysis problems by hand.

The Web-Based WZTA tool is based on the methodology found in this guide. Any exceptions are noted in the text, but they are very few.

The goals of WZTA are two fold:

Lane Closure Restrictions, also known as lane restrictions.

Delay Estimates resulting from highway construction, maintenance, utility work or incidence response.

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 a traffic lane closed. If there is too much traffic demand for the remaining travel lanes with a lane closure, lane closure restrictions are put into place.
Purpose and Goals

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

Project Efficiency - lane closure restrictions can result in extensive staging changes and/or lengthy project delays. Project designs have been altered due to lane restrictions.

The idea behind determining lane restrictions is straightforward:

- 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.
- Determine the volume of traffic expected on the highway.
- If the anticipated traffic volume is larger than the amount of traffic that allows for free flow movement, lane restrictions are recommended.

The methodology and traffic thresholds used by ODOT for WZTA 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.

Note: This methodology is designed for highway segment analysis. If intersection analysis is needed for workzone lane closures, a completely different methodology must be used. Contact the ODOT TCP Unit for details on intersection analysis.
Deliverables

Stand-alone reports (see attached samples) should be submitted with the following analysis information:

- Lane Restrictions recommendations, ramp closures and potential detours. Include closure information for holidays, weekend restrictions and/or special events. Lane Restrictions are written into the Boiler Plate, or Special Provisions, 00220.40(e). Examples of the specification language are included in the appendix.
- Delay Estimates are submitted to the Project Manager and the Regional Mobility Liaison.

Significant Figures

Anyone who has done traffic analysis will tell you 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 revisit it to see how sensitive they are to change. Analysis results will be challenged by the contractor, project manager and others – the analyst must understand the amount of flexibility that the results contain.
WORK ZONE TRAFFIC ANALYSIS METHODOLOGY

The most efficient way to do WZTA is by following this sequence:

- Gather Traffic Data
- Adjust the data to represent traffic volumes as PCEs for 24 / 7 / 365.
- Establish a Free Flow Threshold (FFT)
- Compare PCEs & FFT to establish Lane Restrictions
- Determine Delay Estimates
- Write reports for Lane Restrictions and Delay Estimates.

GATHERING TRAFFIC DATA

Traffic Volumes
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 work zone traffic analysis.

The following sources are in order of preference:

- ODOT Manual Counts – ODOT has an extensive library of manual traffic counts from all over the state. ODOT’s Transportation Data web site is a good starting place. Check the appendix for a list of helpful web sites for traffic analysts. 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 for help with manual traffic count data.
- Talk to ODOT’s Regional Tech Centers and the Area Maintenance Manager for manual counts and for unique traffic characteristics in the area.
• 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 do this.

• 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 is a great opportunity to observe the dynamics of the traffic in the area.

• ODOT’s Transportation Volume Tables (TVTs) are available on ODOT’s web pages. 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; however, because much of this data is “smoothed” and extrapolated, it can not substitute for manual classification count data.
Traffic Count Data Types and Duration

- Ideally, use 24 hour ODOT manual full vehicle classification counts. If these are not available, use 14 to 16 hour counts. It is necessary to have 24 hour count data because a lot of construction work is done at night.
- Do not use 6 or 8 hour counts.
- Use counts that are no older than three to five years.
- Use full federal vehicle classification counts so you will have the heavy vehicle information.
- 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 TVTs 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. They do not record the data necessary for work zone traffic analysis.

Other Traffic Data
The remaining traffic data needed for WZTA, such as

- Annual Average Daily Traffic Volumes,
- annual growth rates,
- truck percentages,
- seasonal trend data, etc. . . .

is covered in the following section which explains how to Adjust Traffic Data
ADJUSTING TRAFFIC DATA

Introduction
The 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.
- Current year data by “growing out” the volumes if the counts were taken in other than the year of the project and/or if the project’s duration is longer than 12 months.
- Twenty-four hours of the day – so that all hours during construction have a representative traffic volume.
- Seasonally adjustments to allow for traffic fluctuations during the project’s duration.
- Weekday and weekend traffic volume differences.

When all the adjustments have been made, the data is laid out in a matrix:

<table>
<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>24 hours</strong></td>
<td><strong>12 AM</strong></td>
<td><strong>1 AM</strong></td>
<td><strong>2 AM</strong></td>
<td><strong>3 AM</strong></td>
<td><strong>4 AM</strong></td>
<td><strong>5 AM</strong></td>
<td><strong>6 AM</strong></td>
<td><strong>7 AM</strong></td>
<td><strong>8 AM</strong></td>
<td><strong>9 AM</strong></td>
<td><strong>10 AM</strong></td>
</tr>
<tr>
<td><strong>Hourly volume estimates in each direction for weekend, weekday, or average day.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ODOT’s Workzone Traffic Analysis 7 Fall 2008
Each highway segment will need four matrices; one for each direction of travel, with a set for weekdays and weekends as weekday and weekend traffic patterns can vary significantly.

**Heavy Vehicles Adjustments**
- For the purposes of workzone 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 factor which ranges from 1.5, 2.5 and 4.0. 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. Also the types of trucks that use I-5 are not usually smaller delivery trucks, but large semi-tractor trailers. Therefore, a truck factor of 2.5 is appropriate for most areas of I-5.

**Growth Rate Adjustments**
- If the traffic was counted in a different year than the construction year or if the construction will take more 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 are available from ODOT’s Transportation Planning Analysis Unit’s (TPAU) Growth Rate Tables, which can be found on ODOT’s web pages.

**Traffic Volumes for 24 Hours**
- Ideally, traffic volumes are taken from a 24 hour manual traffic count that is less than three to five years old. If 24 hour counts are not available, the volume matrix will be abbreviated to 14 or 16 hours.
Seasonal Adjustments

- Seasonal Adjustments are used to extrapolate the traffic count volumes from the date the count was taken to the hours during the duration of construction. These seasonal adjustments can be calculated using ODOT’s ATR seasonal trend data found on Traffic Volume Tables (TVT). This data is also available on ODOT’s web pages.

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Traffic</th>
<th>Max</th>
<th>Max</th>
<th>10PM</th>
<th>20PM</th>
<th>30PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>894</td>
<td>136</td>
<td>13.3</td>
<td>11.7</td>
<td>13.3</td>
<td>10.9</td>
</tr>
<tr>
<td>1995</td>
<td>898</td>
<td>137</td>
<td>13.4</td>
<td>12.3</td>
<td>11.7</td>
<td>11.7</td>
</tr>
<tr>
<td>1996</td>
<td>895</td>
<td>140</td>
<td>13.8</td>
<td>11.7</td>
<td>11.7</td>
<td>11.7</td>
</tr>
<tr>
<td>1997</td>
<td>902</td>
<td>152</td>
<td>13.9</td>
<td>11.2</td>
<td>11.3</td>
<td>13.0</td>
</tr>
<tr>
<td>1998</td>
<td>905</td>
<td>156</td>
<td>16.6</td>
<td>12.3</td>
<td>11.6</td>
<td>10.9</td>
</tr>
<tr>
<td>1999</td>
<td>933</td>
<td>126</td>
<td>13.8</td>
<td>11.3</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>2000</td>
<td>881</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>2001</td>
<td>887</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>2002</td>
<td>879</td>
<td>151</td>
<td>13.3</td>
<td>12.6</td>
<td>12.6</td>
<td>12.1</td>
</tr>
<tr>
<td>2003</td>
<td>911</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>

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. To calculate volumes for weekends, use this formula: \[ \text{Week End} = \left(\frac{7 \times \text{Daily}}{4 \times \text{Week Day}}\right) / 3. \]

The methodology for calculating seasonal factors from ATR data is available from TPAU’s web site.
There are also columns that show the percentage of the Annual Average Daily Traffic (AADT) that the highway carries each month. In the chart above, the AADT is 911, and the percent of AADT in January is 0.86, or 782 vehicles (911 * 0.86 = 782).

The ATR chosen should be on the project highway and should be near the project site. If you choose an ATR that is not on the workzone highway, be sure that the ATR is on a highway that has the same attributes, such as, similar ADT, truck percentages, commuter vs. recreational traffic mix, etc.

If there is no ATR is close, you can use TPAU’s ATR Characteristic Table, which is located on their web site, to find an ATR on a highway that has the same characteristics as the project highway. Be sure to read Chapter 4 of TPAU’s Analysis Procedure Manual to understand how to use the table and what the results mean.

Their web pages also include a Seasonal Factor Table based on Functional Class and Zone. More information on seasonal factors and analysis methodology are available on their web site.

**Week-day vs. Week-end Traffic Volumes**

Separate matrices are needed for the week-day and week-end traffic. Week-end traffic may have a distribution of traffic through the day that is different than that on week-days. If the weekday vs. weekend traffic patterns are not significantly different, the week-end volumes can be approximated from the TVT ATR trend data. To calculate volumes for weekends, use this formula: Week End = [(7 * Daily) – (4 * Week Day)] / 3.

If the project is on a route with significantly different traffic patterns on the week-days than on the week-ends, like a recreational route, it is necessary to obtain two sets of traffic counts. This requires additional work and resources, but it is the only way to adequately account for the different traffic patterns.
Low Volume Roads

- If the highway ADT is below 3000 and the seasonal factor is between 0.70 and 1.30, it is not necessary to complete four full matrices. An analyst can document that the highest anticipated ADT come close to reaching the FFT of the road.

UNDERSTANDING FREE FLOW THRESHOLD (FFT)

The free flow threshold represents the traffic flow rate beyond which traffic can no longer operate at 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. 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 hamper traffic operations. This congested area will continue to expand if traffic volume remains above the free flow threshold. As queues continue to form, traffic operations break down.

You can observe traffic volumes that exceed the free flow threshold passing through a work zone at free flow speeds; however, this situation can not 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.

Once traffic volumes exceed the free flow threshold 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.
Key Concept

The CAPACITY is the maximum volume that can pass through a work zone. A work zone operating at capacity will incur delays, queues and will operate below free flow speed.

The CAPACITY of a work zone is ALWAYS higher than the free flow threshold.

To illustrate the concept of free flow threshold and capacity, let’s take a look at the Highway Capacity Manual (HCM). The HCM 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 v/c ratios that correlate with LOS C or LOS D are shown in Table 4-1 taken from the HCM.

The Highway Capacity Manual 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.

Table 4-1: HCM exhibit showing LOS and v/c ratios

<table>
<thead>
<tr>
<th>Criteria</th>
<th>LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A E C D E</td>
<td></td>
</tr>
<tr>
<td>FFS = 75 n/a</td>
<td></td>
</tr>
<tr>
<td>Maximum density (pcu/mi/hr)</td>
<td>11</td>
</tr>
<tr>
<td>Minimum speed (mph)</td>
<td>75.0</td>
</tr>
<tr>
<td>Maximum v/c</td>
<td>0.34</td>
</tr>
<tr>
<td>Maximum service flow rate (pcu/mi/hr)</td>
<td>8.20</td>
</tr>
<tr>
<td>FFS = 70 n/a</td>
<td></td>
</tr>
<tr>
<td>Maximum density (pcu/mi/hr)</td>
<td>11</td>
</tr>
<tr>
<td>Minimum speed (mph)</td>
<td>70.0</td>
</tr>
<tr>
<td>Maximum v/c</td>
<td>0.32</td>
</tr>
<tr>
<td>Maximum service flow rate (pcu/mi/hr)</td>
<td>7.70</td>
</tr>
<tr>
<td>FFS = 65 n/a</td>
<td></td>
</tr>
<tr>
<td>Maximum density (pcu/mi/hr)</td>
<td>11</td>
</tr>
<tr>
<td>Minimum speed (mph)</td>
<td>65.0</td>
</tr>
<tr>
<td>Maximum v/c</td>
<td>0.30</td>
</tr>
<tr>
<td>Maximum service flow rate (pcu/mi/hr)</td>
<td>7.10</td>
</tr>
<tr>
<td>FFS = 60 n/a</td>
<td></td>
</tr>
<tr>
<td>Maximum density (pcu/mi/hr)</td>
<td>11</td>
</tr>
<tr>
<td>Minimum speed (mph)</td>
<td>60.0</td>
</tr>
<tr>
<td>Maximum v/c</td>
<td>0.29</td>
</tr>
<tr>
<td>Maximum service flow rate (pcu/mi/hr)</td>
<td>6.60</td>
</tr>
<tr>
<td>FFS = 55 n/a</td>
<td></td>
</tr>
<tr>
<td>Maximum density (pcu/mi/hr)</td>
<td>11</td>
</tr>
<tr>
<td>Minimum speed (mph)</td>
<td>55.0</td>
</tr>
<tr>
<td>Maximum v/c</td>
<td>0.27</td>
</tr>
<tr>
<td>Maximum service flow rate (pcu/mi/hr)</td>
<td>6.00</td>
</tr>
</tbody>
</table>

Note: The exact mathematical relationship between density and v/c has not always been maintained at LOS boundaries because of the use of rounded values. Density is the primary determinant of LOS. The speed criterion is the speed at maximum density for a given LOS.
The HCM show 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 free flow threshold a point somewhere between LOS C and LOS D. Looking at Table 4-1 the v/c ratio associated with LOS C and LOS D between 0.64 and 0.90 depending on the criteria. This is well less than a v/c of one which represents capacity; therefore the capacity will always be higher than the free flow threshold.

**Free Flow Threshold Values**

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 workzone observations, experience, engineering capacity studies and Region preferences.

**Threshold Reducing Factors**

The capacities mentioned above 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 and visually complex surrounding environments.

**Free Flow Threshold for Multi-Lane Hwy & Freeway Work Zones**

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

These thresholds are in Passenger Car Equivalents (PCEs) per hour - per lane for a single direction with continuous flow.
Region 1 – 1600 PCE
Region 2 – 1400 PCE (at their request)
Regions 3, 4 & 5 1500 PCE

**Free Flow Threshold for Bi-directional Work Zones**

A bidirectional 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. Because traffic in a bidirectional work zone is stop and go, the term “free flow” is used loosely. The free flow thresholds listed include the traffic from both directions.

Example of a bi-directional work zone
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.
COMPARING PCEs & FFT

Once all of the traffic volumes have been adjust and the Free Flow Threshold has been established, these two values are compared for each hour during the project’s duration. If the PCEs are larger than the FFT, when possible, lane closures are restricted.

The four matrices that were created earlier are now completed by comparing the FFT with the PCEs. Those hours during which the PCE is greater than the FFT, lane closures are restricted.

The table below shows one bi-directional work zone matrix. Since the FFT in a bi-directional work zone is dependent on length, three types of restrictions are shown.
For example, even if the analysis indicates that one hour will not be over the free flow threshold while the hours immediately before and immediately after are over free flow threshold, 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 needs to be considered as well.

On the flip side, the chart to the left is a part of the previous example. In this case, the free flow threshold being used is 1500 PCEs/hr. No other hours are blocked out except for the two shown above. The results taken literally would imply that lanes should not be closed during July and August between 3 and 4pm. Since the flow rate is only 1517, the recommendation was made at this particular location to allow lane closures during July and August, even during the 3-4pm hour.

2.0 DELAY ESTIMATES

For the purposes of Work Zone Traffic Analysis the concept of travel delay is defined as the additional average 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 geometric deficiencies and from incidents are not included. To estimate delays, traffic microsimulation tools were used in combination with regression analysis to create best-fit curves to the analysis results.

Traffic microsimulation was performed using the Federal Highway Administration (FHWA)’S Traffic Software Integrated System (TSIS) software (also known as CORSIM, short for corridor simulation). Each project area was modeled twice,

- Once with no restrictions on traffic flow, and
- Once with construction restrictions in place.
In this manner, the additional travel time resulting from construction activities could be estimated. Each of the models is simplistic, taking into account the construction restrictions only, without consideration of project-specific characteristics such as access points, ramps, or signals that may also impact traffic flow.

Model runs for the pre-construction scenario utilized industry-accepted lane capacities and a free-flow speed equal to the posted speed limit plus 5 miles per hour. Model runs for construction scenarios utilized a free flow speed equal to the free flow speed of the pre-construction scenario less 10 miles per hour.

Within CORSIM, OBDP modeled simple work zone scenarios for almost 14,000 combinations of roadway types, traffic volumes, truck percentages, terrain, and staging strategies. The additional travel time between two points could be determined, yielding the travel delay for the work zone. This methodology also avoids the need to calibrate each of the 5,000 plus models1.

A “rubbernecking” or “gawk” factor was used to restrict the capacity of the work zone by a given percentage.

The results of each individual analysis were grouped by model characteristics to allow for the development of volume vs. delay graphs for sets of model runs. For example, one set contains all of the freeway runs with two lanes in each direction in level terrain with a lane drop, no crossover, and truck percentages between 10 and 15 percent with hourly traffic volumes between 0 and 3500 vehicles per hour (vph).

The data within these groupings were exponentially regressed. The plot of the regression results forms a best-fit exponential curve through the microsimulation results. The regression

---

1 Calibration of a microsimulation model typically involves modeling the existing conditions within a model and collecting data on delays, travel times, speeds, or other parameters in the field and comparing the collected data to the model results. The model’s parameters are then modified to calibrate the model so that the model of the existing conditions matches existing performance. The model, with modified parameters, is then used to predict proposed conditions. By modeling both the existing and proposed conditions using identical parameters, OBDP intended to minimize the loss of accuracy created by skipping the calibration step, which, for the sheer number of models that were analyzed, would have been impractical.
results are compiled in lookup tables that allow a delay estimate to be easily provided for any combination of staging type, traffic volume, truck percentage, and terrain type.

These tables are embedded in the Work Zone Traffic Analysis tool.

**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, where drivers find alternate routes, as well as change their schedules or simply avoid making the trip, significantly alters traffic patterns. 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.

**Special Events That Draw Additional Traffic**

The analysis needs to 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.

**WRITING LANE RESTRICTIONS AND DELAY ESTIMATE REPORTS**

One of the last steps to be completed is to write a memo that explains the results of the WZ Traffic Analysis. Examples of WZTA memos are included in the Appendix. The exact format of these memos will vary from group to group; however, there needs to be a lane restriction and delay estimate memo 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 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). Examples of simple and not so simple lane closure reports are found in the Appendix.

**Delay Estimate Reports**
There are two different ways to report the results of delay estimates.

The **general methodology** is used for traffic volumes that are near or below the capacity of the work zone. The delay estimate need to be reported to the project leader, project manager and to the Region Mobility Liaison and should be written up so that it can be included in the project documentation. These delay estimate numbers come from Delay Tables created by OBDP. For more information on these tables, contact the TCP WZTA engineer.

The **over-capacity methodology** is best used in situations where the traffic volumes are *well in excess* of the work zone capacity. Traffic volumes over the work zone capacity will result in unrealistic results as the exponential portion of the delay curve approaches infinity.

This analysis type is a basic comparison between the cumulative demand and the cumulative capacity.

**Over-Capacity Delay Analysis**

The over-capacity methodology described in the following section should be applied when traffic volumes are in excess of the capacity of the work zone.

In these instances, long queues and substantial delays should be expected. Delays will be significant enough to be described in vehicle-hours. In these situations, traffic behavior is chaotic and the analysis loses quantitative accuracy as a number of factors begin to impact the quality of the traffic projections.

Queuing and vehicle delay in Over-Capacity situations can be illustrated by setting up a spreadsheet and graphing the traffic volume over time to develop a visual representation of queuing as shown in Figure 1.

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 delay, queuing 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 be dissipated until approximately hour 21.

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

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 longer exceeds the capacity.

- **The delay in vehicle-hours** is seen as the area under the queue line. If we use 1600 for capacity, the area and our **total delay** is roughly **1180 vehicle-hours**.
• The **time during which a queue is present** will be about 2 hours in the morning peak and 6 hours in the afternoon peak. 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 9 am for 180 vehicles will be shorter than at 6 pm for 600 vehicles.

• **The longest queue** can be seen at 7 pm. The longest **wait time may be estimated** by dividing the longest queue by the saturation flow rate, or 630 veh/1600 vehicles per hour which is about 25 minutes. The estimate of wait time is very rough and imprecise.

The values shown by the graph are **very rough estimations**, but they can be useful when explaining delay information to non-technical people.
3.0 Step by Step Analysis Example

This example will give folks a chance to work through the sequence of WZTA calculations as though they were doing the analysis by hand.

PROJECT SCOPE - The Project Leader for the Irrigation Creek Suspension Bridge Project, MP 120 on US97, ODOT #7 The Dalles / California Highway, Redmond, Deschutes County calls with a request for a WZ Traffic Analysis to determine the estimated delay and to find out if there will be any lane closure restrictions during construction of the bridge in 2009.

The bridge construction is staged so that that one-half of the four-lane bridge will be built at a time, while reducing the travel lanes from four lanes to two.

GATHER DATA

a. Check with ODOT’s Traffic Data Section to see if there are recent full-classification counts for this section of highway. A recent full-classification 14-hour count is found near the project site.

b. Contact the Region 4 Tech Center to see if there are additional counts. Also ask about any special events for which lane closures would not be advised.

c. Check a TVT to see where the closest and most appropriate ATR is. There is an ATR on the project highway near the project site. If no ATR was close, the TPAU ATR Characteristic Table would be used to choose an appropriate ATR.

d. Get maps of the area, straightline charts, grade, horizontal and vertical curve information, any geographical constrains, etc.

e. Gather ADT information from the most recent TVT.

f. Choose a truck percentage from the manual count and from the ODOT Trans Data Section’s Truck % Table.

g. Use TPAU’s Highway Growth Rate table to get a growth rate for traffic on the project site.
h. Go out to the site and watch traffic; do some one to two hour counts and get a feel for the highway capacity and the dynamics of the area. Make note of any grade, horizontal and vertical curve situations, or any geographical constrains.

To keep the example short, we are only going to work through part of one matrix - the southbound weekday. Actual analysis would involve developing four matrices; southbound weekday and weekend, and northbound weekday and weekend.

Each of the four matrices will have PCEs for 24 hours a day for each of the 12 months; therefore, the matrices would result in PCEs for 4 x 24 x 12 or 1152 PCEs. Each PCE is created by taking the manual count volumes through several calculations using the gathered data in step 1. The bottom line is that each WZ traffic analysis requires thousands of calculations, which is why an automated system was developed.

**ADJUST THE DATA:**

- The appropriate percentage of heavy vehicles.
- Current year data by "growing out" the volumes.
- Twenty-four hours of the day.
- Seasonal factors for the months of construction.

The N-S counts are shown in Table 1 as vehicles per hour. 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, the count was a straightaway (segment) count instead of an intersection count. An intersection count would have required that the side street traffic be folded in with the main street volumes.
Table 1 Raw Manual Count Data

<table>
<thead>
<tr>
<th></th>
<th>AM</th>
<th>AM</th>
<th>AM</th>
<th>AM</th>
<th>PM</th>
<th>PM</th>
<th>PM</th>
<th>PM</th>
<th>PM</th>
<th>PM</th>
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<tbody>
<tr>
<td>6:00</td>
<td>424</td>
<td>578</td>
<td>668</td>
<td>742</td>
<td>784</td>
<td>850</td>
<td>866</td>
<td>988</td>
<td>1170</td>
<td>1316</td>
</tr>
<tr>
<td>7:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1112</td>
</tr>
<tr>
<td>8:00</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1112</td>
<td>876</td>
</tr>
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<td>9:00</td>
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<td></td>
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<td></td>
<td></td>
<td>530</td>
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<td>10:00</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>454</td>
</tr>
</tbody>
</table>

- **Adjust for Heavy Vehicles** – This step changes the “vehicles per hour” into Passenger Car Equivalents (PCEs). Trucks not only take additional roadway space, but also have different operational characteristics than passenger cars. To account for these differences, the number of trucks is recalculated to represent an equivalent number of passenger cars.

  - To calculate an average truck percentage, divide the total number of trucks by the total number of vehicles in the manual count. For this example, the percentage of heavy vehicles is \( \frac{2112}{5679} \) total vehicles = 18.6%.

  - To adjust the truck volumes to PCEs for the 6:00 am volume of 424:
    - Subtract 18.6% of the 424 vehicles = 79 heavy vehicles. This leaves 345 passenger cars.
    - Multiply the 79 heavy vehicles by the heavy vehicle factor, \( 2.5^2 \) (2.5*79=197)
    - Add the adjusted heavy vehicles back into the passenger cars
      \[ 345 + 197 = 542 \text{ vehicles} \]

  - Repeat the technique for each hour of every matrix.

---

2 Truck volumes are converted to passenger car equivalents by applying a Truck equivalency factor which ranges from 1.5, 2.5 and 4.0. Most I-5 and US97 applications would use a 2.5 factor to account for the large number of trucks and that most of the trucks on I-5 and US97 are semi-tractor trailers, not smaller delivery trucks. Therefore, a truck factor of 2.5 is appropriate for most areas of I-5 and US97.
Here is a summary of the calculations to this point. The numbers in the last row are the PCEs.

<table>
<thead>
<tr>
<th>Time</th>
<th>Vehicles / Hour</th>
<th>Number of Trucks</th>
<th>Trucks * Factor 2.5</th>
<th>Veh / Hr - Trucks</th>
<th>Pass Cars + Trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 AM</td>
<td>424</td>
<td>79</td>
<td>197</td>
<td>345</td>
<td>542</td>
</tr>
<tr>
<td>7 AM</td>
<td>578</td>
<td>108</td>
<td>269</td>
<td>470</td>
<td>739</td>
</tr>
<tr>
<td>8 AM</td>
<td>668</td>
<td>124</td>
<td>311</td>
<td>544</td>
<td>854</td>
</tr>
<tr>
<td>9 AM</td>
<td>742</td>
<td>138</td>
<td>345</td>
<td>604</td>
<td>949</td>
</tr>
<tr>
<td>10 AM</td>
<td>784</td>
<td>146</td>
<td>365</td>
<td>638</td>
<td>1003</td>
</tr>
<tr>
<td>11 AM</td>
<td>850</td>
<td>158</td>
<td>395</td>
<td>692</td>
<td>1087</td>
</tr>
<tr>
<td>12 PM</td>
<td>866</td>
<td>161</td>
<td>403</td>
<td>705</td>
<td>1108</td>
</tr>
<tr>
<td>1 PM</td>
<td>988</td>
<td>184</td>
<td>459</td>
<td>804</td>
<td>1264</td>
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<tr>
<td>2 PM</td>
<td>1170</td>
<td>218</td>
<td>544</td>
<td>952</td>
<td>1496</td>
</tr>
<tr>
<td>3 PM</td>
<td>1316</td>
<td>245</td>
<td>612</td>
<td>1071</td>
<td>1683</td>
</tr>
<tr>
<td>4 PM</td>
<td>1112</td>
<td>207</td>
<td>517</td>
<td>905</td>
<td>1422</td>
</tr>
<tr>
<td>5 PM</td>
<td>876</td>
<td>163</td>
<td>407</td>
<td>713</td>
<td>1120</td>
</tr>
<tr>
<td>6 PM</td>
<td>530</td>
<td>99</td>
<td>246</td>
<td>431</td>
<td>678</td>
</tr>
<tr>
<td>7 PM</td>
<td>454</td>
<td>84</td>
<td>211</td>
<td>370</td>
<td>581</td>
</tr>
</tbody>
</table>

- **“Grow Out” the PCEs** - from the year that the count was taken in 2007 to the year of construction 2009. Checking TPAU’s historic growth rates for this highway reveals a 2.0% per year growth rate. Using straightline (linear) growth methods, each PCE in every Matrix multiplied by 2.0% x 2 years, or 4.0%.
• **Seasonal Adjustments** – This is where the ATR data comes in. The count used for this project was taken in July. We use the ATR’s seasonal trend data to tell us what percent of the Annual Average Daily Traffic (AADT) can be expected each month and we use these factors to adjust the count PCEs to reflect the estimated traffic volumes during construction.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>JANUARY</td>
<td>0.900</td>
<td>0.860</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEBRUARY</td>
<td>0.980</td>
<td>0.930</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MARCH</td>
<td>1.010</td>
<td>0.960</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APRIL</td>
<td>1.050</td>
<td>1.010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAY</td>
<td>1.060</td>
<td>1.020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JUNE</td>
<td>1.140</td>
<td>1.090</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JULY</td>
<td><strong>1.170</strong></td>
<td>1.080</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUGUST</td>
<td>1.150</td>
<td>1.100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEPTEMBER</td>
<td>1.100</td>
<td>1.040</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCTOBER</td>
<td>1.060</td>
<td>1.010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOVEMBER</td>
<td>1.010</td>
<td>0.960</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DECEMBER</td>
<td>0.980</td>
<td>0.940</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Seasonally adjusting volumes is a three-step process.
  - The July count data is adjusted to correspond to the AADT; therefore, the count volumes are multiplied by the July factor. The 6 am PCE of 542 * (1/1.170) = 482 PCE.
  - Then each adjusted PCE is multiplied by the seasonal factors for each month. This is how we end up with a 12 month x 14 hours (our count was only 14 hours instead of 24 hours long) matrix.
The methodology for calculating seasonal factors from ATR data is available from TPAU's Analysis Procedures Manual available on their web site. TPAU is in the Transportation Development Section of ODOT.

- **Weekday vs. Weekend** PCEs - Note that the ATR data has a column for Average Weekday Traffic and one for Average Daily Traffic. The Average Weekday Traffic is for Monday through Thursdays and the Week-end Traffic is for Friday, Saturday and Sunday. To calculate volumes for weekends, use the following formula:

\[
\text{Weekend} = \frac{[(7 \times \text{Daily}) - (4 \times \text{Week Day})]}{3}
\]

- This last calculation accounts for the change in magnitude between the week-day and the week-end volumes; however, it does not account for the difference in hourly patterns. For instance, it does not show that the morning peak on the week-ends is later than during the week.

- If your project area has significantly different traffic patterns on the weekends than on weekdays, such as a recreational area, you will need to get additional counts and do one analysis for weekdays and one for week-ends.
The PCEs in one matrix looks like this. Remember that there will be three additional matrices in each completed analysis.

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The count volumes have been
- adjusted to account for truck percentages,
- "grown out" to account for traffic growth from the time the count was taken through the construction period,
- adjusted for seasonal trend factors,
- adjusted to differentiate the weekday from the weekend traffic.

CHOOSING A FREE FLOW THRESHOLD

The free flow threshold represents the traffic flow rate beyond which traffic can no longer operate at free flow condition. The FFT is the point beyond which stable free flow travel can not be sustained.

Remember that the FFT is not the capacity. A work zone operating at capacity will incur delays, queues and will operate below free flow speed.
FFT Reduction Factors
Factors that can reduce the FFT include

- lane widths less than 12 foot lanes
- clearance of less than 2 feet of on each side.
- steep grades,
- unfamiliar driver population,
- poor pavement conditions and
- visually complex surrounding environments.

Free Flow Threshold for Multi-Lane Highway and Freeways
This is the free flow threshold for a one-lane, one-way section with continuous flow - there are no interruptions (signals, stop signs, flaggers, etc.) for the highway traffic. These thresholds are in PCEs per hour per lane for a single direction with continuous flow. FFT have been chosen based on the Regions traffic characteristics and their preferences.

- Region 1 – 1600 PCE
- Region 2 – 1400 PCE (at their request)
- Region 3 – 1500 PCE
- Region 4 – 1500 PCE
- Region 5 – 1500 PCE

Free Flow Threshold for Bi-directional Work Zones
A lane closure on a two-lane roadway results in a work zone that maintains a single lane of traffic while carrying traffic from both directions. They are typically controlled by flaggers, pilot cars, or temporary signals. The free flow thresholds listed below include the sum of both directions of traffic.

- 550 Total PCEs - Closure Length up to 2.0 miles
- 750 Total PCEs - Closure Length up to 1.0 mile
- 900 Total PCEs/ - Closure Length up to 0.5 mile

Closures in excess of 2.0 miles should be avoided.
**COMPARING PCEs WITH FFTs**

Now that the traffic volumes have been adjusted and the FFTs are chosen, all that remains is to compare the two. On the following table, the red cells contain PCEs that exceed the FFT of 1500 PCE. When highway volumes excel free flow thresholds, lane closures should be avoided.

**Table 2 Lane Closure Restrictions**

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**WRITING LANE RESTRICTIONS AND DELAY ESTIMATE REPORTS**

One of the last steps is to write a report that shows the results of the Lane Restrictions and Delay Estimates. Examples of WZTA memos are included in the Appendix. The reports are included in the project documentation.

Lane Closure Restriction Reports –

Lane Restrictions need to be documented for the project documentation and they are included in the project’s Special Provisions (or Boiler Plate) in section 00220.40(e). Examples of simple and not so simple lane closure reports are found in the Appendix.
**DELAY ESTIMATE REPORTS**

There are two ways to report the results of delay estimates.

The **general methodology** is used when traffic volumes are near or below the capacity of the work zone. The delay estimate numbers need to be reported to the project leader, project manager and to the Region Mobility Liaison and other project team members. These delay estimate numbers come from Delay Tables created by OBDP. For more information on these tables, contact the TCP WZTA engineer.

The **over-capacity methodology** is best used in situations where the traffic volumes are well in excess of the work zone capacity, which will result in chaotic results.

This analysis type is a basic comparison between the cumulative demand and the cumulative capacity.

Over-Capacity Delay Analysis describes circumstances with long queues and unrealistic delays described in vehicle-hours. Traffic behavior is chaotic and the reported numbers can not be trusted.

Queuing and vehicle delay in Over-Capacity situations can be illustrated by setting up a spreadsheet and graphing the traffic volume over time to develop a visual representation of queuing as shown in Figure 2.

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 delay, queuing 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 be dissipated until approximately hour 21.

Delay can be seen on the graph from hour 6 to hour 21 and is defined as the area under the queue line. The graphing technique can give a quick visual evaluation of the hours when the highway capacity can not meet the demands.

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 longer exceeds the capacity.

The values shown by the graph are very rough estimations, and the only reported values would be hours of relative problems.
4.0 WINDING IT UP

Doing Work Zone Traffic Analysis by hand takes hours of data searching and thousands of calculations but it is necessary for the analyst to understand the methodology and factors that go into the analysis so that the inputs and results can be evaluated. WZTA is an important part of project construction and the analyst is a key player in making sure that the construction is carried out in a safe and efficient manner.
SAMPLE DOCUMENTS

ODOT’S LANE CLOSURE RESTRICTIONS, SECTION 220.40 (e):
   Standard Specifications
   Special Provisions

SPECIAL PROVISIONS - LANE RESTRICTION EXAMPLE:
   Simple Project Example
   Not-so-Simple Project Example

SAMPLE OF WORKZONE ANALYSIS REPORT LETTERS:
   Two-Lane Highway Lane Restriction Letter
   Six-Lane Highway Lane Restriction Letter
ODOT’S LANE CLOSURE RESTRICTIONS

Section 220.40 (E) - Standard Specifications

Construction

00220.40 General Requirements - Provide the following for public traffic in all construction areas:

(e) Lane Restrictions - Do not close any traffic lanes during the periods listed below:

(1) Weekdays:
   • Between 7:00 a.m. and 9:00 a.m. and between 4:00 p.m. and 6:00 p.m. Monday through Thursday.
   • Between 7:00 a.m. and 9:00 a.m. Friday morning.

(2) Weekends - Between 3:00 p.m. on Friday and midnight on Sunday.

(3) Holidays - Between noon on the day preceding a legal holiday or holiday weekend and midnight on a legal holiday or the last day of holiday weekend, 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.

(4) Special Events - Between noon on the day preceding and midnight on the final day of the special event.
ODOT’S LANE CLOSURE RESTRICTIONS

Section 220.40 (E) - Special Provisions

SECTION 00220 - ACCOMMODATIONS FOR PUBLIC TRAFFIC

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

00220.40(e) Lane Restrictions - Replace the paragraph that begins "Do not close any..." with the following paragraph:

Do not close any traffic lanes and remove all barricades and objects from the roadway during the following periods:

(Use the following lead-in paragraph, and subsections (1) and (2) when modifying lane restrictions. Submit a Traffic Analysis Work Request Form to the Region Traffic Office for the lane restrictions.)

Replace subsections (1) and (2) with the following:

(1) Weekdays:
   • Between _____ a.m. and _____ a.m. and between ____ p.m. and ____ p.m. Monday through Thursday
   • Between _____ a.m. and _____ a.m. Friday morning

(2) Weekends - Between ____ p.m. on Friday and midnight on Sunday.

(Use the following subsection (4) to list special events. List the names, times, and dates of the events.)

(4) Special Events - Add the following to the end of this subsection:

The following special events will occur during this Project:

• ___________________
Special Provisions - Lane Restrictions Simple Example

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

10:00 a.m. - 6:00 p.m.

Milepoints -0.04 to 7.00 and Milepoints 27.20 to 56.06

Maintain a minimum of one lane with maximum closure length of 4000 m (2.5 miles), except through the towns of Valley and Townsend the maximum closure length shall be reduced to 800 m (1/2 mile).

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.

Roadways shall be free of barricades or other objects and all lanes opened to traffic during the restrictive periods listed above.
Special Provisions - Lane Restrictions Not-So-Simple Example

S00220.40 General Requirements - Add the following subsection(s):

Lane Restrictions - Do not close any traffic lanes on Caine Highway (ORE XXX) and Bluebird Highway (ORE XXX), as follows:

**Caine Highway (ORE XX) MP 0.00 to MP 4.31**

Single Lane Closure:

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**Caine Highway (ORE XXX) / Landfall Freeway (I-XXX) MP 4.31 to MP 4.91 And Clear Highway North (ORE XXX) / 2nd Ave.**

Single Lane Closure:

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Two Lane Closure:

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**Caines Highway (ORE XXX) MP 4.91 to MP 5.06**

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In addition, do not close any traffic lanes between:

12:00 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 to traffic during these periods.
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
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
# ACRONYM LIST

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>Annual Average Daily Traffic</td>
</tr>
<tr>
<td>ADT</td>
<td>Average Daily Traffic</td>
</tr>
<tr>
<td>ATR</td>
<td>Automatic Traffic Recorder</td>
</tr>
<tr>
<td>CTWLTL</td>
<td>Continuous Two-Way Left Turn Lane, “Twiddle”</td>
</tr>
<tr>
<td>DHV</td>
<td>Design Hourly Volume</td>
</tr>
<tr>
<td>FHWA</td>
<td>Federal Highway Administration</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>MCTD</td>
<td>Oregon Motor Carrier Transportation Division</td>
</tr>
<tr>
<td>MP</td>
<td>Milepoint, Milepost</td>
</tr>
<tr>
<td>MPO</td>
<td>Metropolitan Planning Organization</td>
</tr>
<tr>
<td>NHS</td>
<td>National Highway System</td>
</tr>
<tr>
<td>OAR</td>
<td>Oregon Administrative Rules</td>
</tr>
<tr>
<td>ODOT</td>
<td>Oregon Department of Transportation</td>
</tr>
<tr>
<td>ORS</td>
<td>Oregon Revised Statutes</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration (U.S.)</td>
</tr>
<tr>
<td>OSP</td>
<td>Oregon State Police</td>
</tr>
<tr>
<td>OTC</td>
<td>Oregon Transportation Commission</td>
</tr>
<tr>
<td>OTIA</td>
<td>Oregon Transportation Investment Act</td>
</tr>
<tr>
<td>OTP</td>
<td>Oregon Transportation Plan</td>
</tr>
<tr>
<td>PCE</td>
<td>Passenger Car Equivalents</td>
</tr>
<tr>
<td>PE</td>
<td>Professional Engineer (registered licensed)</td>
</tr>
<tr>
<td>STIP</td>
<td>Statewide Transportation Improvement Plan</td>
</tr>
<tr>
<td>TSP</td>
<td>Transportation System Plan</td>
</tr>
<tr>
<td>TVT</td>
<td>ODOT’s Transportation Volume Tables</td>
</tr>
<tr>
<td>UGB</td>
<td>Urban Growth Boundary</td>
</tr>
<tr>
<td>VMT</td>
<td>Vehicle Miles Traveled</td>
</tr>
<tr>
<td>Xing</td>
<td>Crossing</td>
</tr>
</tbody>
</table>
APPENDIX D – TRAFFIC TERMS
COMMON TRAFFIC TERMS

Seasonal Trend Data shows how much fluctuation there is in traffic throughout the year by displaying a percentage of the Annual Average Daily Traffic, or AADT, that the highway carries.

Most ATRs show that the highway carries more traffic in the summer and less in winter. For example, this trend table shows 1.4 times the ADT for a Friday in August, while a Tuesday in January is 0.74 times the AADT. This means that if the ADT was 10,000, we would expect to see 14,000 vehicles on a Friday in August and 7,400 vehicles on a Tuesday in January.

The Annual Average Daily Traffic is the total number of vehicles that uses the highway during the year, divided by 365 days.

Numbering of Oregon Highways

The highways in Oregon are numbered based on whether they are

- Interstate Routes, like I-5 or I-84,
- US Routes, like US 101, US 10, or
- State Routes, like OR 120 or OR 126.

The State of Oregon is responsible for all three of these types of roadways. All roadways for which the State of Oregon is responsible for also have a distinct “State Highway No.” The I-5 freeway is State Highway No. 1. Part of I-205 in Portland is State Highway No. 64 and part of it is State Highway No. 171.

There is a Highway Cross Reference Table that will show you what the State Highway Number is for the highways in Oregon. For example, if you want to look up US 101 on the Oregon Coast, go to the Highway Cross Reference Table and look up US 101 in the list for US Routes and it will tell you that the State Highway Number is 9.
**Decreasing and Increasing Mileage**  This is a way to differentiate between northbound and southbound, or westbound and eastbound. For instance, increasing mileage on US 97 is southbound, because the milepoints increase as you travel from Washington to California. *Usually* increasing mileage is southbound for north / south highways, and eastbound for east / west highways.

If you are unsure about which direction is Decreasing or Increasing, you can look on the State Highway Map, available on ODOT’s web page where mile points are shown.

**Existing Number of Lanes:**

- A two-lane road with one lane in each direction would show 2 existing lanes.
- A multi-lane highway with one lane each direction, with a two-way left turn lane (TWLTL or “twiddle”) would have 3 existing lanes.
- A multi-lane highway with two lanes each direction, and a median or a two-way left turn lane (TWLTL or “twiddle”) would have 5 existing lanes.
- A freeway is the exception. It will usually show 2, but sometimes 3 existing lanes which is the number of lanes in each (one) direction.
APPENDIX E – ANALYSIS REPORT EXAMPLE
INTER OFFICE MEMO

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 7 Traffic Section recommends the following lane usage for construction:

The passing lane on US 111 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 13 seconds (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 503 987-6543.
APPENDIX F – WZTA SPECIAL PROVISIONS EXAMPLES
STANDARD SPECIFICATIONS FOR WZTA

00220.40 (e) Lane Restrictions - Do not close any traffic lanes during the periods listed below:

(1) Weekdays:
   • Between 7:00 a.m. and 9:00 a.m. and between 4:00 p.m. and 6:00 p.m. Monday through Thursday
   • Between 7:00 a.m. and 9:00 a.m. Friday morning

(2) Weekends - Between 3:00 p.m. on Friday and midnight on Sunday.

(3) Holidays - Between noon on the day preceding a legal holiday or holiday weekend and midnight on a legal holiday or the last day of holiday weekend, 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.

(4) Special Events - Between noon on the day preceding and midnight on the final day of the special event.
00220.40(e) Lane Restrictions - Replace the paragraph that begins "Do not close any…" with the following paragraph:

Do not close any traffic lanes and remove all barricades and objects from the roadway during the following periods:

(Use the following lead-in paragraph, and subsections (1) and (2) when modifying lane restrictions. Submit a Traffic Analysis Work Request Form to the Region Traffic Office for the lane restrictions.)

Replace subsections (1) and (2) with the following:

(1) Weekdays:

• Between _____ a.m. and _____ a.m. and between _____ p.m. and _____ p.m. Monday through Thursday
• Between _____ a.m. and _____ a.m. Friday morning

(2) Weekends - Between _____ p.m. on Friday and midnight on Sunday.

(Use the following subsection (4) to list special events. List the names, times, and dates of the events.)

(4) Special Events - Add the following to the end of this subsection:

The following special events will occur during this Project:

• ___________________
00220.40(e) Lane Restrictions - Replace the paragraph that begins "Do not close any..." with the following paragraph:

Do not close any traffic lanes and remove all barricades and objects from the roadway during the following periods:

*(Use the following lead-in paragraph, and subsections (1) and (2) when modifying lane restrictions. Submit a Traffic Analysis Work Request Form to the Region Traffic Office for the lane restrictions.)*

Replace subsections (1) and (2) with the following:

(1) Weekdays:

Do not close any traffic lanes on Example Highway (US XX) Milepoints -0.04 to 7.00 and Milepoints 27.20 to 56.06, Monday through Thursday, between:

10:00 a.m. - 6:00 p.m.

Maintain a minimum of one lane with maximum closure length of 4000 m (2.5 miles), except through the towns of Valley and Townsend the maximum closure length shall be reduced to 800 m (1/2 mile).

(2) Weekends –

Between 3:00 p.m. on Friday and midnight on Sunday.

*(Use the following subsection (4) to list special events. List the names, times, and dates of the events.)*

(4) Special Events - Add the following to the end of this subsection:

The following special events will occur during this Project:

Strawberry Festival. Do not close any traffic lanes on Example Highway (US XX) Milepoints -0.04 to 7.00 and Milepoints 27.20 to 56.06, June 2, 3, & 4 Wednesday through Friday, between:

6:00 a.m. - 11:00 p.m.
00220.40(e) Lane Restrictions - Replace the paragraph that begins "Do not close any…" with the following paragraph:

Do not close any traffic lanes and remove all barricades and objects from the roadway during the following periods:

(Use the following lead-in paragraph, and subsections (1) and (2) when modifying lane restrictions. Submit a Traffic Analysis Work Request Form to the Region Traffic Office for the lane restrictions.)

Replace subsections (1) and (2) with the following:

Caine Highway (ORE XXX) and Bluebird Highway (ORE XXX), as follows:

Caine Highway (ORE XX) MP 0.00 to MP 4.31

Single Lane Closure:

Westbound Eastbound

(1) Weekdays:
Mondays - Thursdays 6:00 AM – 7:00 PM 6:00 AM – 7:00 PM

(2) Weekends –
Fridays 9:00 AM – 6:00 PM 9 AM – 6:00 PM
Saturdays 10:00 AM – 6:00 PM 10:00 AM – 6:00 PM
Sundays 11:00 AM – 6:00 PM 11:00 AM – 6:00 PM

Caine Highway (ORE XXX) / Landfall Freeway (I-XXX) MP 4.31 to MP 4.91 & Clear Highway North (ORE XXX) / 2nd Ave.
### Single Lane Closure:

<table>
<thead>
<tr>
<th></th>
<th>Westbound</th>
<th>Eastbound</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(1) Weekdays:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mondays - Thursdays</td>
<td>6:00 AM – 7:00 PM</td>
<td>6:00 AM – 7:00 PM</td>
</tr>
<tr>
<td><strong>(2) Weekends –</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fridays</td>
<td>9:00 AM – 6:00 PM</td>
<td>9 AM – 6:00 PM</td>
</tr>
<tr>
<td>Saturdays</td>
<td>10:00 AM – 6:00 PM</td>
<td>10:00 AM – 6:00 PM</td>
</tr>
<tr>
<td>Sundays</td>
<td>11:00 AM – 6:00 PM</td>
<td>11:00 AM – 6:00 PM</td>
</tr>
</tbody>
</table>

### Two Lane Closure:

<table>
<thead>
<tr>
<th></th>
<th>Northbound</th>
<th>Southbound</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(1) Weekdays:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday - Thursdays</td>
<td>5:00 AM – 12 Midnight</td>
<td>5:00 AM – 12 Midnight</td>
</tr>
<tr>
<td><strong>(2) Weekends –</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friday</td>
<td>6:00 AM – 12 Midnight</td>
<td>12 Midnight Friday – 12 30 AM</td>
</tr>
<tr>
<td></td>
<td>6:30 AM – 12 Midnight</td>
<td></td>
</tr>
<tr>
<td>Saturdays</td>
<td>6:00 AM – 12 Midnight</td>
<td>12 Midnight Friday – 12 30 AM</td>
</tr>
<tr>
<td></td>
<td>6:30 AM – 12 Midnight</td>
<td></td>
</tr>
<tr>
<td>Sundays</td>
<td>8:00 AM – 12 Midnight</td>
<td>8:00 AM – 12 Midnight</td>
</tr>
</tbody>
</table>

Caines Highway (ORE XXX)  MP 4.91 to MP 5.06

### Single Lane Closure:

<table>
<thead>
<tr>
<th></th>
<th>Westbound</th>
<th>Eastbound</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(1) Weekdays:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday - Thursdays</td>
<td>5:00 AM – 8:00 PM</td>
<td>5:00 AM – 8:00 PM</td>
</tr>
<tr>
<td><strong>(2) Weekends:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friday</td>
<td>6:00 AM – 12 Midnight</td>
<td>12 Midnight Friday – 12 30 AM</td>
</tr>
<tr>
<td></td>
<td>6:30 AM – 12 Midnight</td>
<td></td>
</tr>
<tr>
<td>Saturdays</td>
<td>10:00 AM – 7:00 PM</td>
<td>10:00 AM – 7:00 PM</td>
</tr>
<tr>
<td>Sundays</td>
<td>11:00 AM – 7:00 PM</td>
<td>11:00 AM – 7:00 PM</td>
</tr>
</tbody>
</table>
APPENDIX G – WEBSITES FOR ANALYSTS
WEBSITES FOR WZTA ANALYSTS

The Internet is dynamic and these addresses may change or vanish! If you find a link that is not correct, please call Don Wence at 503 986-3791.

ODOT TRAFFIC-ROADWAY SECTION
http://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/

ODOT SPECIFICATIONS
Standard Specifications:
http://www.oregon.gov/ODOT/HWY/SPECS/
Special Provisions
http://www.oregon.gov/ODOT/HWY/SPECS/special_provisions.shtml

ODOT DATA SECTION
Transportation System Monitoring Unit (ODOT DATA Section):
http://www.oregon.gov/ODOT/TD/TDATA/
State Highway Cross Reference Tables

OTHER ODOT SITES
ODOT Home (Internet): http://www.oregon.gov/ODOT/
ODOT Traffic Control Plans Information
http://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/traffic_control.shtml
ODOT Video Log for Folks External to the ODOT Computer System
http://www.oregon.gov/ODOT/TD/TDATA/rics/PublicRoadsInventory.shtml#Digital_Video_Log
Oregon Bridge Delivery Partners (OBDP) http://www.obdp.org/
TripCheck: http://www.tripcheck.com/
SITES FOR NATIONAL TRANSPORTATION ORGANIZATIONS

AASHTO Home: http://www.transportation.org/

Federal Highways Administration (FHWA) Sites:

http://www.fhwa.dot.gov/

MUTCD 2003 Manual on Uniform Traffic Control Devices (MUTCD):

Transportation Research Board (TRB)

Hard copies of the “Highway Capacity Manual”, (HCM) 2000 Edition can be purchased through this site: http://gulliver.trb.org/
APPENDIX H – GLOSSARY OF TERMS
### GLOSSARY OF TERMS

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bidirectional Roadway</td>
<td>Two travel lanes with one lane of traffic in each direction, with little or no access control.</td>
</tr>
<tr>
<td>Capacity</td>
<td>The maximum number of vehicles that can pass a given section of roadway during a given period of time under prevailing roadway and traffic conditions.</td>
</tr>
<tr>
<td>Continuous Two-Way Left-Turn Lane</td>
<td>A traversable median to accommodate left-turn egress movements from opposite directions; aka “Twiddle”</td>
</tr>
<tr>
<td>Delay</td>
<td>In this context, additional average travel time experienced per vehicle per hour.</td>
</tr>
<tr>
<td>Freeway</td>
<td>A fully access controlled highway.</td>
</tr>
<tr>
<td>Highway</td>
<td>(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.</td>
</tr>
<tr>
<td>Lane Closure Restrictions</td>
<td>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.</td>
</tr>
<tr>
<td>Lane Drop</td>
<td>Lane Closure. When a travel lane is closed for construction</td>
</tr>
<tr>
<td>Manual Traffic Counts</td>
<td>Traffic counts used for analysis should be close to the work area, on the same type of highway designation and should also have been taken in the last three to five years.</td>
</tr>
<tr>
<td>Multilane Roadway</td>
<td>Four travel lanes with two lanes of traffic in each direction. It may or may not have a two way left turn lane (or “twiddle”) or median and may have full, partial or limited access control.</td>
</tr>
<tr>
<td>MUTCD</td>
<td>The Manual of Uniform Traffic Control Devices and the ODOT supplements are standard guidance handbooks used by all designers in the state. This is mandated by Oregon state law.</td>
</tr>
<tr>
<td>OAR</td>
<td>Oregon Administrative Rules – Rules written by a government agency intended to clarify the intent of an adopted law.</td>
</tr>
<tr>
<td>ORS</td>
<td>Oregon Revised Statues – The laws that govern the State of Oregon.</td>
</tr>
<tr>
<td>Peak Hour</td>
<td>Hour of the day with the most traffic, usually during morning and evening commute times. Generally not the design hour.</td>
</tr>
<tr>
<td>Queue</td>
<td>A line of vehicles waiting to be served by the highway.</td>
</tr>
<tr>
<td>Raised Median</td>
<td>A non-traversable median where curbs delineate the median and the adjacent traffic lane.</td>
</tr>
<tr>
<td>TERM</td>
<td>DEFINITION</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Roadway</td>
<td>That portion of a highway improved, designed, or ordinarily used for vehicular travel, exclusive of the berm or shoulder.</td>
</tr>
<tr>
<td>Seasonal Adjustments</td>
<td>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.</td>
</tr>
<tr>
<td>Shoulder(s)</td>
<td>[ORS 801.480] The portion of a highway, whether paved or unpaved, contiguous to the roadway that is primarily used by pedestrians, stopped vehicles, for emergency use, exclusive of auxiliary lanes, curbs, and gutters.</td>
</tr>
<tr>
<td>Work Zone (WZ)</td>
<td>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.</td>
</tr>
</tbody>
</table>
APPENDIX I – HIGHWAY CROSS REFERENCE TABLES
### State Highway Cross Reference Tables

<table>
<thead>
<tr>
<th>Route No.</th>
<th>Oregon Highway Name</th>
<th>Highway No.</th>
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<tbody>
<tr>
<td>I-5</td>
<td>PACIFIC</td>
<td>1</td>
</tr>
<tr>
<td>I-82</td>
<td>MCNARY</td>
<td>70</td>
</tr>
<tr>
<td>I-84</td>
<td>COLUMBIA RIVER</td>
<td>2</td>
</tr>
<tr>
<td>I-84</td>
<td>OLD OREGON TRAIL</td>
<td>6</td>
</tr>
<tr>
<td>I-84</td>
<td>BAKER-COPPERFIELD</td>
<td>12</td>
</tr>
<tr>
<td>I-84</td>
<td>HISTORIC COLUMBIA RIVER</td>
<td>100</td>
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<tr>
<td>I-105</td>
<td>EUGENE-SPRINGFIELD</td>
<td>227</td>
</tr>
<tr>
<td>I-205</td>
<td>EAST PORTLAND FREEWAY</td>
<td>64</td>
</tr>
<tr>
<td>I-205</td>
<td>CLACKAMAS</td>
<td>171</td>
</tr>
<tr>
<td>I-405</td>
<td>STADIUM FREEWAY</td>
<td>61</td>
</tr>
<tr>
<td>US 20</td>
<td>ALBANY-CORVALLIS</td>
<td>31</td>
</tr>
<tr>
<td>US 20</td>
<td>ALBANY-JUNCTION CITY</td>
<td>58</td>
</tr>
<tr>
<td>US 20</td>
<td>CENTRAL OREGON</td>
<td>7</td>
</tr>
<tr>
<td>US 20</td>
<td>CORVALLIS-LEBANON</td>
<td>210</td>
</tr>
<tr>
<td>US 20</td>
<td>CORVALLIS-NEWPORT</td>
<td>33</td>
</tr>
<tr>
<td>US 20</td>
<td>MCKENZIE</td>
<td>15</td>
</tr>
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