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Cc: Shaun Quayle, PE  
From: Marc Butorac, PE, PTOE, Patrick Marnell, and Zachary Horowitz  
Date: September 30, 2015  
Subject: Phase 1A Methodology & Assumptions Memorandum (Task 1.9)

This memorandum documents the methodology and assumptions of the transportation system operations analyses for Phase 1A of the Medford Viaduct Planning and Environmental Study. The methodology and assumptions included in this memorandum are based on guidance provided in the Oregon Department of Transportation (ODOT) Analysis Procedures Manual Versions 1 and 2 (APM1 and APM2 – References 1 and 2). This memorandum identifies the study area; summarizes the available data, describes the methodology and assumptions for project Tasks 1.1 through 1.7, and identifies the ODOT technical leads for each deliverable (Tasks 1.1 - 1.7).

STUDY AREA

The project study area includes the Interstate-5 (I-5) Medford Viaduct; approximately nine miles of I-5 between the Central Point (MP 33) and Fern Valley (MP 24) interchanges; and nine related ramp terminals and intersections in Medford, Oregon. Figure 1 illustrates the study area. The study interchanges, freeway segments, and intersections for the project were determined in coordination with ODOT during the development of the scope of the work are shown in Table 1.

Table 1. Study Area and Data Collection Plan

<table>
<thead>
<tr>
<th>Study Interchanges (4)</th>
<th>Study Freeway Segments (3)</th>
<th>Study Intersections (9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Central Point (MP 33)</td>
<td>1. Between Central Point &amp; North Medford</td>
<td>1. OR 62/OR 99</td>
</tr>
<tr>
<td></td>
<td>4. Fern Valley (MP 24)</td>
<td>4. OR 62/Biddle Road Ramp</td>
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<td></td>
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<td>5. OR 62/Poplar Drive</td>
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<tr>
<td></td>
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<td>6. OR 99/Garfield Street</td>
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<tr>
<td></td>
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<td>7. Garfield Street/Center Drive</td>
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<td></td>
<td></td>
<td>8. Highland Drive/Barnett Road</td>
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<td></td>
<td></td>
<td>9. I-5/Highland Drive (Single Point Interchange - SPI)</td>
</tr>
</tbody>
</table>
Study Area and Data Collection Plan
Medford, Oregon

Figure 1
Existing Data

This section summarizes the existing data that has been or will be collected for the study.

**HERE™ Travel Time Data**

HERE™ travel time and speed “probe” data was provided by ODOT, as permitted by the “Here Licenses”, from October 2011 to March 2015. HERE™ data prior to October 2011 is not available. The data consists of travel times, as measured by probe vehicles, aggregated into 5-minute periods. ODOT provided data for six traffic message channels (TMC) in the project vicinity.

**Weather Data**

Historical weather data will be obtained from the National Oceanic and Atmospheric Administration’s (NOAA), [http://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/automated-weather-observing-system-awos](http://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/automated-weather-observing-system-awos). This data includes total precipitation, total snow fall, and maximum and minimum temperature.

**Crash Data**

Reported crash data for the five-year period from January 1, 2010 to December 31, 2014 was provided by ODOT’s Crash Analysis and Reporting Unit for the Medford I-5 segments, interchanges, and study intersections. ODOT provided a complete set of 2014 crash data, but the data set is still considered preliminary.

**TOCS Incident Data**

ODOT provided Traffic Operations Center System (TOCS) incident data for October 2009 through August 2015. This data was provided for I-5 between mile posts 26 and 31. This data set includes the date, time, duration, location, type of incident, and number of lanes impacted.

**Travel Demand Model**

ODOT provided outputs from the RVMPOv3.1 Travel Forecasting Demand Model. This model has a base year of 2006, an interim year of 2015, and a horizon year of 2038. The following data was provided by ODOT for both the interim year 2015 and the horizon year 2038.

- Peak hour and daily link volumes
- Peak hour demand-to-capacity ratios
- Peak hour I-5 northbound select link volumes for the segment between the North and South Medford interchanges
- Peak hour I-5 southbound select link volumes for the segment between the North and South Medford interchanges
Turning Movement Counts

16-hour turning movement count data was collected via video on May 26, 2015 from 6:00 AM to 10:00 PM at the nine study intersections. The data from 6:00 to 9:00 AM (morning peak period) and 3:00 to 6:00 PM (evening peak period) will be summarized in 15-minute intervals. Other time periods will be summarized in 60-minute time intervals.

Automated Traffic Recorder Data

Mainline segment volumes on I-5 were collected via the Medford Viaduct Automated Traffic Recorder (ATR 15-019). ODOT provided hourly traffic volume from this ATR location for the three-month period from April 1, 2015 to June 30, 2015.

Bluetooth Origin-Destination Data

Portable, temporary Bluetooth™ media access control (MAC) readers (BlueMAC™) were used to collect origin-destination data to/from 13 devices in operation from May 26, 2015 through July 8, 2015. The Bluetooth™ readers timestamp passing vehicles based on passive Bluetooth™ signals from Bluetooth enabled devices, such as smartphones. Using the MAC address (a unique identifier assigned to an individual communications device by the FCC) from the Bluetooth™ signal read by the BlueMAC™ devices, the vehicles are matched as they pass each BlueMAC™ device location. This matched pairing allows a trip to be determined with a defined origin and destination, and travel time relative to the BlueMAC™ readers. The data is anonymous (MAC addresses are truncated to prevent the full unique identifying from being known by each BlueMAC™ reader) and cannot be linked to individual vehicles or people.

GIS Data

Readily available GIS data will be collected from the City of Medford, Jackson County, ODOT, Rouge Valley Metropolitan Planning Organization (RVMPO), and the Oregon Department of Fish and Wildlife.

ODOT Cost Estimates & ODOT Seismic Plus Report

ODOT will provide current agency cost estimates related to bridge repair and replacement and the Seismic Plus Report parameters.

Inspection Reports

ODOT will provide recorded inspection reports for the Medford Viaduct structure.
Task, Methodologies, and Assumptions

The following sections describe tasks 1.1-1.9, task deliverables, and specific methodologies and assumptions for each project Task.

Task 1.1 Travel Time Reliability Assessment

The travel time reliability assessment will analyze HERE™ vehicle probe data, over the course of a 3.5-year period, to determine the location, frequency, and magnitude of congestion to determine travel time trends. Though the analysis will examine the data over the 3.5-year period, the focus will be on the most recent year of data. The Planning Time Index (PTI - the ratio of the 95th percentile travel time to the free-flow travel time) will be calculated and summarized for the available HERE™ data. Free-flow travel times will be estimated based on the posted speed limits and the length of facilities as measured on scaled aerial photography. To identify travel time trends related to seasonal variation of weather, seasonal histograms of speed will be created and compared.

To identify specific instances of freeway slowing, the HERE™ data will be filtered to examine events during which **two** consecutive 5-minute periods are reported with a speed less than 30 mph and for speeds between 30 and 45 mph. The use of both speed thresholds will enable the analysis to identify and classify different levels of traffic congestion. This step of looking at sequential time period thresholds will significantly reduce the “noise” of outliers in the data set; particularly given the HERE™ data set does not provide a sample size for reported results. These slowdowns will be compared to the TOC incidents logs and historical weather events to infer trends and relationships for slow down causes.

**Deliverable:** A graphics-based summary memorandum illustrating the results of the reliability assessment, identification of problem spots and contributing causes.

Task 1.2 Demand Model Capacity Assessment

This task will assess operation on the I-5 freeway segment between the North Medford and South Medford interchange under existing year 2015 and forecast future year 2040 conditions.

**Existing Traffic Volumes** will be developed as 30th Highest Hour Volumes (30HV) based on the collected traffic counts by the application of seasonal adjustment factors consistent with the methodology identified in the APM. The seasonal adjustment factors for I-5 traffic will use the **On-Site ATR Method** with data from the Medford Viaduct ATR.

**Year 2040 forecast AM and PM peak hour traffic volumes** will be developed based the existing and horizon year weekday PM peak hour (AM peak hour model is not available) and daily RVMPoVo3.1 travel demand models. AM peak hour travel demand model data will be developed by applying a K-factor (based on ATR data) to the daily model assignment. Link volumes,
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demand-to-capacity ratios, and select link plots will be reviewed for the PM peak hour. Future volumes will be post-processed using the National Cooperative Highway Research Program (NCHRP) Report 255 *Highway Traffic Data for Urbanized Area Project Planning and Design* methodology. The methodology combines the existing year 30HV traffic volumes with data from the existing and horizon year travel demand models to forecast future year traffic volumes. Because the horizon year of the RVMPOv3.1 model is 2038, the NCHRP Report 255 methodology can only be applied to year 2038. The average annual growth rate observed in the RVMPOv3.1 model from 2015 to 2038 will be extrapolated using a straight-line method and will be applied for two additional years to forecast 2040 volumes.

A Highway Capacity Manual (HCM) 2010 analysis will be conducted for the freeway segment between the North Medford and South Medford interchanges and the four associated on- and off-ramps. This analysis will use HCS2010 software and apply the HCM2010 merge, diverge, and weaving analyses as applicable. Existing year 2015 and future year 2040 conditions will be analyzed for weekday AM and PM peak hours. Volume-to-capacity (V/C) ratios will be reported for applicable study segments.

*Intersection/Roadway Geometry* (for example, number of lanes, lane configurations, length of ramps, and grade) will be reviewed through readily available web-based aerial photography, and confirmed through site observations. Available as-built data may also be used to verify existing roadway geometry. Additionally, *operational data* (such as posted speeds and advisory speeds) will be reviewed based on readily available web-based photography and confirmed through site observations.

*Peak Hour Factors* (PHF) will be calculated based on observed data and applied to the existing year 2015 analyses. A PHF of 0.95 will be used for the year 2040 analysis. If the existing PHF is greater than these default future values, the existing PHF will be applied.

The results from the Task 1.2 analysis will only apply to Phase 1A of the study. Future study phases will need to use RVMPO Version 4.1 for analysis of both the year 2010 and year 2040 to be consistent with the RVMPO Regional Transportation Plan.

**Deliverable:** A graphics-based summary memorandum displaying existing and horizon year weekday AM and PM peak hour model volumes and demand-to-capacity ratios, and the results of the HCM 2010 freeway segment and merge/diverge analysis.

**Task 1.3 O-D Analysis to Distinguish Short-Distance from Long-Distance I-5 Trips**

Origin-destination data, collected via Bluetooth™ MAC address probe readers, will be analyzed to determine the proportions of short-distance “local” trips in comparison with “other” longer-distance trips. “Local” trips will be defined as beginning at the North Medford Interchange and ending at the South Medford Interchange, or vice versa. “Other” trips may have recorded origins or destinations in Medford (but not both) or they may be through traffic on I-5 that does not use
either of the Medford interchanges. The online BlueMAC™ analysis suite will be used to match first point of detection and last point of detection for each vehicle record and classify vehicles into these two categories.

This analysis will examine variations during different times of the day and throughout the week based on prevailing Bluetooth™ device sample rates. Further, to provide information about the seasonal variation, the data will be analyzed in two parts, one collected during the school year and one conducted during the summer when school was out of session. For the purpose of this analysis the population of drivers sampled via BlueMAC™ will be assumed to be representative of the overall driving population.

**Deliverable:** A graphics-based summary memorandum identifying and illustrating the origins and destinations of local and through trips using the I-5 freeway within the study area.

**Task 1.4 Five-Year Safety Assessment**

Five years of crash data (years 2010 - 2014) and TOCS incident log data will be reviewed and summarized for the I-5 segment between the North Medford and South Medford interchanges. The crash data will be analyzed for number, type, severity, and location to identify potential crash patterns and crash rates per million entering vehicle (MEV). In addition, ODOT’s top 10% ODOT Safety Priority Index System (SPIS) sites will be reviewed, as appropriate. Potential countermeasures that may address safety issues and their crash modification factors, if available, will be identified.

**Deliverable:** A graphics-based safety assessment memorandum.

**Task 1.5 Compilation and Review of Existing Bridge Repair and Replacement Information**

Bridge inspection reports and current ODOT cost estimates for bridge improvements for the existing I-5 Viaduct structure will be reviewed and adjustments made to existing retrofit cost estimates based on input from the current study. Modifications may include bridge widening and recommended maintenance and repairs based on the latest bridge inspection findings. Adjustments of bid item quantities will be made if study parameters differ from the ODOT Seismic Plus Report parameters. Adjustments to previous unit cost assumptions will not be made.

It is assumed that all estimates are high level estimates based on a lack of design-level information. All assessments will be based on previously completed inspections.

**Deliverable:** A memorandum describing the condition of the Viaduct, revised cost estimates for retrofit and replacement options, and the required maintenance work needed to extend the useful life of the structure for thirty or more years will be provided for one review cycle.
Task 1.6 Development of Seismic Modeling Approach

This task will result in the development of a preferred method for seismic modeling of the existing Viaduct structure in consultation with ODOT Bridge staff. Evaluation of methodologies will account for several factors, including properties of the existing structure, soil interaction, and end conditions. A seismic model of the bridge will not be prepared.

**Deliverable:** A memorandum describing the preferred approach to modeling the complete Viaduct structure including model type, proposed methods to model support conditions, proposed techniques to model joint conditions, and other pertinent information and a summary of the typical structural calculations needed for the model development will be provided to ODOT Bridge Staff for one review cycle.

Task 1.7 Project-Specific GIS Data Inventory & Gap Identification

This task will collect and organize readily available GIS data within the project area such as roadway, transit, environmental, land use, utilities, census, safety, and other relevant data. This GIS data will be collected from ODOT, City of Medford, Jackson County, RVMPO, and ODFW data-warehouses. The collected GIS data will be mapped using Oregon State Plane Coordinates (South) and the North American Datum of 1983 (NAD83) datum.

**Deliverable:** Up to four project-based thematic maps and the referenced feature classes in ESRI geodatabase format.

**ODOT Technical Leads**

**Task 1.1:** Peter Schuytema and Rich Arnold

**Task 1.2:** Peter Schuytema

**Task 1.3:** Peter Schuytema

**Task 1.4:** Dan Dorrell

**Task 1.5:** Bob Grubbs

**Task 1.6:** Bob Grubbs

**Task 1.7:** Susan Mead

**References:**