Technical Memorandum

April 1, 2019

TO: Megan Channell, Oregon Department of Transportation

FROM: No More Freeways Traffic Technical Advisory Committee
Buff Brown
Joseph Cortright
Brian Davis
Jesse Lopez

RE: Problems with the Rose Quarter Modeling

Please consider this a comment on the Rose Quarter Freeway Widening Project.
Members of the No More Freeways Traffic Technical Advisory Committee include traffic engineers and modelers, and economists with extensive experience in constructing and operating traffic models and analyzing model accuracy. The Committee was also advised in its work by Mr. Norm Marshall, a nationally recognized expert in transportation modeling.

The following document describes the most glaring shortcomings of the Environmental Assessment (EA) in providing accurate environmental impacts and in disclosing the scientific data and analyses methods such that the public -- and even those of us in the transportation and pollution profession -- can grasp the methods, and reproduce the results.

NEPA's twin goals are: (1) to foster informed decision making by "ensur[ing] that the agency, in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts," and (2) to promote informed public participation by requiring full disclosure of and opportunities for the public to participate in governmental decisions affecting environmental quality.11 To that end, agencies must disclose the scientific information and analyses on which they rely in their environmental effects analyses and decision-making processes.

This document is a product of professionals in the field of transportation. We conclude that the methods are highly flawed and inaccurate, the methods of analysis are hidden and undeterminable from the given information, and the environmental impacts are negative and substantial, and continue our practices of GHG emissions and transportation injustice. At the least, an EIS should be required. At the very least, an extension for public input should be granted and methodologies and data disclosed to be able to understand and reproduce the results.

1. There are no Average Daily Traffic (ADT) data

Average daily traffic (ADT) is the most common measure of levels of traffic. The Rose Quarter Freeway Widening Project's "Traffic Analysis Technical Report" which purports to discuss how the traffic will affect the flow of vehicles on the freeway–which after all, is the project's purpose–conspicuously omits the most common and widely used metric of traffic volume: average daily traffic or ADT.

How common is ADT? It's basically the standard yardstick of describing traffic. ODOT uses it to decide how wide roads should be. It's the denominator in calculating road safety. Average daily traffic is also, not incidentally, the single most important variable in calculating how much carbon and other air pollutants cars will emit when they drive on this section of road. ODOT maintains a complicated system of recording stations and estimation, tracking traffic for thousands of road segments on highways. ODOT's annual report, Traffic Volume Trends details average daily traffic for about 3,800 road segments statewide. It also turns out that predicted future ADT is an essential input into the crash modeling software that ODOT used to predict crash rates on the freeway ("ADT" appears 141 times in the model's user manual). ODOT uses ADT numbers throughout the agency: Google reports that the Oregon DOT website has about 1,300 documents with the term "ADT" and nearly 1,000 with the term "average daily traffic." Chapter 5 of ODOT's Analysis Procedure Manual, last updated in July 2018, contains 124 references to the term "ADT" in just 55 pages. "Average daily traffic" is as fundamental to describing traffic as degrees fahrenheit is to a weather report.

But there's one place you'll find absolutely no references to ADT: The Rose Quarter I-5 Traffic Analysis Technical Report. We conducted an electronic search of the Adobe acrobat file containing the document; no instances of "ADT" appear in that document.

Without ADT figures, it is impossible for the public or independent third parties to check the accuracy of claims made about traffic levels, noise levels, pollution levels or carbon emission levels from the project.

2. The nature of the 2015 and 2045 transportation networks are not specified

An essential element in transportation modeling is defining the transportation network, the set of roads and intersection and estimates of their capacity that will form the basis of model computations. The material contained in the EA and subsequent disclosures does not describe specifically what transportation facilities will are included in the travel model. Project staff

confirmed only on March 26 that their modeling included the Columbia River Crossing--a widening of I-5 to 12 lanes. Yet the EA makes no mention of the CRC, nor does the EA provide information on when it would be built, and the modeled 2015 volumes appear to be based on the presence of a non-existent CRC project.

3. Volumes inexplicably inflated from current levels

The ODOT March 13 delayed disclosure contains information on peak AM and peak PM hour traffic volumes on various segments of Interstate 5. The report contains data labeled "existing conditions," and two sets of modeled values from the VISUM model, one for 2015 and a second labeled 2045. In general, the VISUM 2015 model values for I-5 are much higher than the reported "existing" values. To summarize these differences, the following table displays modeled 2015 values and existing 2016 values for the area immediately north of the Rose Quarter Project Area (i.e. North of Going Street). These data are taken from the documents contained in the March 13 delayed disclosure, and are for the No Build Scenario.

These data show that the modeled values from VISUM for 2015 are 11 to 26 percent higher than those reported in the existing volumes field.

The material contained in the EA does not explain why traffic volumes are so much higher in the model than actually observed. This exaggeration of base value will exaggerate initial congestion and future congestion benefits, and is consistent with the critique of static assignment models described below.

I-5 North Volumes Modeled v. Existing					
		Northbound	Southbound	Total	Difference
Time Period		**RQ VISUM Model (2015)**			
AM Peak	8AM-9AM	3,945	6,204	10,149	54%
PM Peak	5PM-6PM	5,052	5,175	10,227	33%
		RQ Existing Conditions (2016)			
AM Peak	8AM-9AM	3,848	4,225	8,073	

PM Peak	5PM-6PM	3,584	3,807	7,391	
RQ VISUM Model, "Mainline North of Going, 2015 No Build"					
RQ Existing, "2016 Existing Conditions" "Mainline North of Going"					

4. Rose Quarter I-5 projections are inconsistent with other ODOT projections developed contemporaneously for analyzing congestion pricing forecasts

In May 2018, at the same time it was preparing I-5 forecasts for the Rose Quarter project, ODOT also contracted for modeling of I-5 traffic for the legislatively adopted congestion pricing plan. These are contained in a report from ODOT: https://www.oregon.gov/ODOT/Value%20Pricing%20PAC/VP_TM3-Final-InitialConceptEvaluation.pdf

These data include baseline estimates of traffic on Interstate 5 in the Portland metropolitan area for the year 2027. The study has baseline estimates, that project future traffic conditions in the absence of congestion pricing. This study uses an I-5 cordon line North of the project area corresponds to N. Skidmore Street, which is just two blocks from the I-5 cordon line used for the Rose Quarter projections. The following table compares the projected 2027 volumes in the congestion pricing study at this cordon line with the VISUM Rose Quarter 2015 volumes. This shows that the volumes used in the VISUM model for 2015 are 21 to 37 percent higher than the expected volumes in 2027, according to the congestion pricing baseline model.

I-5 North Volumes from two ODOT models					
		Northbound	Southbound	Total	Difference
Time Period		**RQ VISUM Model (2015)**			
AM Peak	8AM-9AM	4,370	4,631	9,001	37%
PM Peak	5PM-6PM	4,424	4,855	9,279	21%

		Congestion Pricing Study (2027)			
AM Peak	8AM-9AM	3,255	3,337	6,592	
PM Peak	5PM-6PM	3,803	3,860	7,663	
RQ VISUM Model, "Mainline North of Going, 2015 No Build"					
Congestion Pricing Study, "Interstate Br.-Skidmore" Baseline Traffic Performance					

This analysis suggests that the traffic numbers, particularly north of the Rose Quarter project area are much higher than would be expected in another arguably reasonable forecast of traffic conditions. Given the expectation of growing traffic levels in the ODOT rose quarter modelling, one would expect that 2027 I-5 traffic levels would be considerably higher, not lower than 2015 levels. The fact that two models, prepared for the same agency, in the same month, produce two such different pictures of traffic levels suggests that the model results are highly sensitive to the assumptions and input values used by the modelers. These key values and assumptions have generally not been provided to the public for review, making it impossible for independent, third parties to understand, replicate, and analyze the summary results presented in the EA.

5. Static Trip Assignment Modeling produces exaggerated no build traffic, which overstates congestion benefits and emission savings from the build scenario.

5.1 Static Trip Assignment Produces Biased Future Estimates

Transportation modeling experts have long recognized the limitations inherent in static trip assignment. Here is a summary of the problems with static models and induced travel (Marshall, 2018):

- the static models show unrealistic future traffic volumes (i.e. induced travel is baked in even if there isn't additional capacity)
- the unrealistic traffic volumes translate into unrealistic congestion, emissions, and safety issues
- as the traffic growth is baked into the no-build alternative, there is little additional traffic growth with road expansion
- the static model shows false expansion benefits in congestion, emissions and safety

ODOT concedes the limitations of static trip assignment even with modeled peak spreading (documented below).

5.2 Modeling for the Rose Quarter estimates rely on STA

From the Traffic Analysis Technical Report it appears that traffic forecasts are based on Metro's 2014 RTP model and projects (rather than the recently-adopted 2018 RTP). In either case, it appears that this is the trip-based model rather than the tour-based model that is under development (by Metro). The static assignment used in the trip-based model is described briefly on p. 49 of https://www.oregonmetro.gov/sites/default/files/2015/04/16/trip-based_travel_demand_model_methodology.pdf

6. ODOT has not revealed the assumptions or inputs used to generate its forecasts.

In response to No More Freeways request for the methodology it used to prepare its forecasts, ODOT submitted a copy of a National Cooperative Highway Research Project Report (NCHRP Report #765), which is essentially an encyclopedic description of all the different methods used to forecast traffic volumes. ODOT provided neither the exact methodology or assumptions it used in constructing its model. Asked what ingredients were in their dish, and how it was prepared, ODOT has essentially just handed us a cookbook.

The Traffic Operations Analysis Study (TOAS) from Jan 21, 2015 contains two impact analyses that begin with the assumption that the build scenario will generate no additional traffic. Both the travel time and the crash analyses use traffic speeds based on the same traffic volumes for the build and no-build scenarios. This assumption has no credibility. Freeing up space on a congested roadway will prompt more drivers to use this route.

It is noted that the TOAS from 2015 was originally released in “Draft” form, with several figures and all appendices missing. Following the No More Freeways data request, a finalized version that was dated January 21, 2015 (the same date as the originally-released draft) was released on March 14, 2019. This report claims that future volumes were derived using NCHRP Report #255 (A document from 1982 that including methodologies for forecasting future traffic volumes that was superseded in 2014 by NCHRP Report #765). No information was provided regarding the differences between the volumes and assumptions within these, though the modeling described by the TOAS appears to form the basis for the results described within the Traffic Analysis Technical Report.

It has been impossible, from a lack of data and methodology, to determine what assumptions are used to create Table 6, p 53, of the Transportation Safety Technical Report, and the lane-by-lane traffic speeds claimed in chapter 5 of the Traffic Analysis Technical Report. The summaries of both of appear very similar to the TOAS results, suggesting that these analyses likely use similar unreasonable assumptions.

Unlike the simulation models used for these analyses, four-step travel models assign more trips to a road that is modified for higher speeds, although they generally are poor at correctly estimating mode shifts or induced travel. Appendix A of the Air Quality Technical Report indicates that the regional travel model was used, and runs from the 2040 regional model show a regionwide 4,750,000 increase in Annual VMT (2.4%), and a 5,770,000 increase (2.9%) in 2045 caused by building this project. Is it reasonable to suggest that adding 5 million miles of travel to our region is going to lower our crashes and lower our carbon emissions? It is not. The crash and speed analyses should be using these VMT assumptions.

7. ODOT has improperly extrapolated 2040 data to 2045 levels

The VISUM model runs were done for a target year of 2040, the project linearly extrapolated these levels, as well as estimates of congestion for five additional years. Rather than running the model separately for this later time period (and adjusting all outputs) this simply increases the levels for 2045 without meaningfully analyzing what would be likely to happen in that five year period.

The 2040 traffic volumes are extrapolated to 2045, a fact revealed in the Traffic Technical Report:

> "The volume growth from the 2015 base year and 2040 future financially constrained regional travel demand models was used to identify an annual growth rate using a straight-line growth method. This growth rate was applied to the 5-year increment between 2040 and 2045 to define the demand model for the Project's horizon year." (p. 29)

This is poor modeling practice even for static models as it takes over-capacity volumes and makes them even larger without any feedback from congestion. The model does a certain amount of "peak spreading" that is intended to reduce the over-capacity problem. This already is somewhat defeated by the 2040-2045 extrapolation. But peak spreading doesn't solve the problem anyway. ODOT's own planning documents identify the limitations in this approach.

> "Using the peak spread trips tables with a static assignment cannot be considered a substitute for micro- or meso-simulations Dynamic Traffic Assignment (DTA). Both of these simulations restrict volume through links and intersections to saturated flow rates, and reflect congested conditions through queuing, while static assignments cannot accurately reflect this particular result of congested networks."
>
> "Using the static assignment with the peak spread trip tables will provide more realistic assignment results on a very saturated network compared to a static assignment with

non-peak spread tables. However, even with the peak spread trip tables, the path results are still subject to the nuances of the static assignment, resulting in V/C ratios on links and intersections that can still exceed 1.0 in many locations."
https://www.oregon.gov/ODOT/Planning/Documents/APMv2_App8A.pdf

Any V/C greater than 1 is a model error that also affects other road segments and intersections throughout the network. The problem with traffic volumes with V/C greater than 1 is amplified when the static model outputs are transferred to microsimulation model as is done in the Rose Quarter study. Unrealistically high VISSIM microsimulation model inputs produce unrealistically large VISSIM model delays.

8. Apparently manually added trips to model; inconsistencies with modeling for noise and pollution

The ODOT modeling spreadsheet “NB Mainline Volume Forecasts.xlsx” (not publicly disclosed by ODOT but obtained by No More Freeways from a separate source) contains a notation that was suppressed from the PDF version of the same sheet included in the March 13 delayed disclosure. That suppressed information indicates that ODOT modelers manually adjusted highway volumes North of Going Avenue, by adding 976 vehicles in the Northbound direction in the morning peak hour (8AM to 9AM). Cell B44 of this spreadsheet (suppressed from the PDF included in the delayed disclosure by ODOT) reads (colored font in original):

“Demand vol added to I-5 Mainline south of Going St to equal or exceed Segment Check”

It also appears from the notations in this “NB Mainline Volume Forecasts.xlsx” spreadsheet (again, suppressed from the publicly released PDF created from this file) that the figures in this spreadsheet were adjusted because they were not consistent with the data used in the project’s noise and pollution analyses. Cell G44 of this spreadsheet (suppressed from the PDF included in the delayed disclosure by ODOT) reads:

> “- Didn't use this as HDR wanted to be consistent with Air/Noise analysis”

9. Unrealistic headways used in traffic analysis.

For modeling purposes, ODOT assumed an unreasonably high volume of traffic moving into the Rose Quarter area by unrealistically shortening the headways (following distance) for vehicles coming into the area from I-84. Standard headways are 1.5 seconds per vehicle, these were shorted to 1.0 seconds per vehicle, a level unsupportable in calibrated VISSUM models (Dong, 2015).

To illustrate the unrealism of this assumption, it is noted that the assumed speeds where headways are 1.0 seconds is 13-20 mph. A vehicle will thus travel between 19.07 feet and approximately 30 feet in one second. Typically, a passenger car is assumed to be 19 feet in length (aka the "P" Design Vehicle from AASHTO's *A Policy on Geometric Design of Highways and Streets).* Thus, following distances between cars are assumed to average as little as *half an inch* for an hour. For trucks and other large vehicles, these headways aren't even possible. It is entirely unrealistic to assume headways could average as little as 1.0 seconds over an entire hour.

10. Indications that Columbia River Crossing is assumed

The document "Vissim Modeling Notes.docx" (not publicly disclosed by ODOT but obtained by No More Freeways from a separate source) and not disclosed either in the EA or in the March 13 delayed disclosure alludes to assumptions used in the model which are consistent with the construction of the Columbia River Crossing (CRC). The assumptions show forced congestion in the AM peak occurring in the Rose Quarter, but not to the North (the location of CRC), and that force congestion was removed from the model "to reflect future improvements north of the study area".

> 4. C. No "forced" congestion was used in the AM peak period model as the congestion is either contained within the study area or starts in the study area and extends outside, i.e. SB I-5 approaching the I-405 split.
>
> 5. B. The forced congestion on I-5 NB was removed from the model to reflect future improvements on I-5 north of the study area."

11. Issues with Synchro Modeling

The Traffic Analysis Technical Report includes a capacity analysis for a number of surface street intersections that are expected to be impacted by the proposed project, conducted with the modeling software *Synchro*. However the initial release failed to include any of the data from the model runs. Invariably, these data are included in appendices of reports where Synchro results

are reported; the output sheets are well-known for the comprehensive information they include, much of which is essential for verifying the veracity of claims.

Following the No More Freeways data request, Synchro output data were released publicly on March 14, 2019. This release failed to include data for the morning peak hour under existing conditions. Notably, the output sheets for the evening peak hour analysis scenario were dated March 12, 2019, while other sheets were undated; it is unclear why output sheets from the original model runs used to generate the reported results were not provided per standard practice. A cursory evaluation of the Synchro results revealed a number of issues where input volumes were inconsistent with volumes from the counts and/or VISUM model, odd or unclear assumptions regarding traffic signal phasing, or inaccurate/unclear lane configurations. The timing of the release late in the public comment period precluded a comprehensive review of these data; there are a number of other questions or inaccuracies that the team would have liked to explore. Ideally, the release of these data along with current plan drawings (released March 26th) would have allowed sufficient time for the public to cross-reference these documents to fully appreciate the proposed changes to traffic patterns and their projected impacts. The late release of these crucial documents leaves many important questions about the impacts of this project unexplored or unresolved.

Biographies

Buff Brown has degrees in engineering, environmental science, and law. Buff has been in transportation planning for 17 years beginning in the field of transportation-related emissions, then as the senior travel demand modeler for the Indiana DOT, as the Director of an Indiana MPO, and most recently as the Senior Transportation Planner for municipalities in Oregon and Washington.

Joseph Cortright is Director of City Observatory, an urban policy think tank, and an Economist with Impresa. He has researched and written extensively on transportation policy and urban development and is author of “Measuring Urban Transportation Performance” (CEOs for Cities, 2010), a detailed examination of methodologies used for characterizing congestion, delay and performance of transportation systems in urban settings. Cortright is chair of the Oregon Governor’s Council of Economic Advisers and a former Non-Resident Senior Fellow at the Brookings Institution.

Brian Davis is Project Manager at Lancaster Engineering, where he has worked for the last eight years in a hybrid planning/engineering role advising public and private sector clients on transportation and urban design issues. He has written and reviewed countless transportation studies for developments and infrastructure projects, and has significant experience developing Synchro and VISSIM models and conducting related analyses. He is an alumnus of Portland

State University's Transportation Engineering program and an adjunct instructor at PSU's College of Urban and Regional Planning, with research interests in urban freight, parking management, and performance metrics.

Jesse Lopez has a PhD in Environmental Science & Engineering. He works as a Computational Scientist managing and analyzing diverse and large-scale environmental datasets for non-profit, for-profit, and governmental organizations. Lopez has acted as an expert reviewer of environmental impact statements on behalf of numerous organizations.

Norman Marshall, President of Smart Mobility, Inc., has a B.S. in Mathematics from Worcester Polytechnic Institute and an M.S. in Engineering Sciences from Dartmouth College. He has over 30 years of transportation modeling experience and has completed projects in more than 30 U.S. states. He has many peer-reviewed publications and presentations. Mr. Marshall is co-leader of the Congress for the New Urbanism project for Transportation Modeling Reform.

REFERENCES

Dong, J., Houchin, A. J., Shafieirad, N., Lu, C., Hawkins, N. R., & Knickerbocker, S. (2015). Vissim calibration for urban freeways. https://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1205&context=intrans_reports
File: VISSIM Calibration for Urban Freeways.pdf

Marshall, N. L. (2018). Forecasting the impossible: The status quo of estimating traffic flows with static traffic assignment and the future of dynamic traffic assignment. Research in Transportation Business & Management. https://www.sciencedirect.com/science/article/pii/S2210539517301232?via%3Dihub
File: Marshall_2018.pdf

NCHRP 765, aka: National Cooperative Highway Research Program Report 765, Horowitz, A., Creasey, T., Pendyala, R., & Chen, M. (2014). Analytical travel forecasting approaches for project-level planning and design (No. Project 08-83).
File: Volume-Tables.pdf

Department of Transportation (undated), Analysis Procedures Manual - Version 2 - Appendix 8A - Peak Spreading Oregon Procedure https://www.oregon.gov/ODOT/Planning/Documents/APMv2_App8A.pdf
File: APMv2_App8A.pdf

Oregon Department of Transportation, (2019), I-5 Rose Quarter Traffic Technical Report,

Oregon Department of Transportation, (2018), VOLUME TABLES, pages 333-340, https://i5rosequarter.org/wp-content/uploads/2019/03/Volume-Tables.pdf [Part of the March 13 Delayed Disclosure: These documents were not publicly disclosed by ODOT until March 13, 2018, pursuant to a public records request from No More Freeways,]
File: Volume-Tables.pdf

Oregon Department of Transportation, (2018), Portland Metro Area Value Pricing Feasibility Analysis, Final Round 1 Concept Evaluation and Recommendations Technical Memorandum #3.
https://www.oregon.gov/ODOT/Value%20Pricing%20PAC/VP_TM3-Final-InitialConceptEvaluation.pdf
File: Tolling_TechnicalMemo4_Evaluation.pdf

OTHER ODOT DOCUMENTS (NOT PUBLICLY RELEASED BY ODOT)

ODOT Excel Worksheet: Folder: “Final Balanced Volumes with road diet”
File: “NB Mainline Volume Forecasts.XLSX”

ODOT, Word Document:
File: “I5 RQ_Vissim Modeling Notes.docx.