Travel Model Improvement Program (TMIP) Peer Review Meeting

- Review of Proposed TRPC Model Improvements

Thurston Regional Planning Council
Olympia, WA
June 11th, 2012
OVERVIEW

- TRPC Model Improvements
- TMIP Peer Review Meeting
  - Objectives
  - Program sponsor - FHWA
  - Host Agency
  - Expert Panel
  - TMIP Staff
  - TRPC Model Stakeholders
- Model Advisory Group
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>9:00 am – 9:15 am</td>
<td>Introductions Face-to-Face, Meeting Structure and Logistics - Bharath Paladugu</td>
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<tr>
<td>9:15 am – 9:30 am</td>
<td>Additional Background on TRPC and the Thurston Region - Lon Wyrick</td>
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<td>9:30 am – 10:15 am</td>
<td>Additional Planning Context &amp; Technical Overview of the TRPC Model - Thera Black, Bharath Paladugu</td>
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<td>10:15 am – 10:45 am</td>
<td>Chance for Review Panel to Seek Further Inputs - Review Panel</td>
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<td>10:45 am – 11:00 am</td>
<td>Break</td>
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<tr>
<td>11:00 am – 11:15 am</td>
<td>Additional Information on TRPC Model Enhancements Project</td>
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<td>11:15 am – Noon</td>
<td>Moderated Discussion: Setting the Agenda for Lunch Discussion and Caucus</td>
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<td>New or outstanding panelist questions</td>
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<td>Preview TRPC questions for panel and prioritize with panelist input</td>
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<td>12:00 pm – 1:00 pm</td>
<td>Working Lunch</td>
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<td>Questions for the panel and discussion</td>
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<td>1:00 pm – 3:00 pm</td>
<td>Panel Caucus</td>
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<td>Review/Critique and comment on practices</td>
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<td>3:00 pm – 3:15 pm</td>
<td>Break</td>
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<td>3:15 pm – 4:30 pm</td>
<td>Panel Report, Presentation and Discussion</td>
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<td>4:30 pm – 5:00 pm</td>
<td>Conclusion/Adjourn</td>
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Introductions
- Around the room
Background
– Lon Wyrick & Thera Black
TRPC Overview
Regional Partnership Since 1967

Mission: Provide visionary leadership on regional plans, policies, and issues.

Bucoda, Lacey, Olympia, Rainier, Tenino, Tumwater, Yelm, Thurston County, Confederated Tribes of the Chehalis Reservation, Nisqually Indian Tribe, Intercity Transit, Port of Olympia, LOTT Clean Water Alliance, Thurston PUD #1, North Thurston Public Schools, Olympia School District, TCOMM9-1-1, Thurston County EDC, Lacey Fire District #3, Timberland Regional Library, The Evergreen State College, Puget Sound Regional Council

www.trpc.org
TRPC's mission is to

“Provide Visionary Leadership on Regional Plans, Policies, and Issues.”

To Support this Mission:

A. Support **regional transportation** planning consistent with state and federal funding requirements.

B. Address **growth management, environmental quality**, and other topics determined by the Council.

C. **Assemble** and **analyze data** that support local and regional decision making

D. Act as a “**convener**”, build regional **consensus** on issues through information and citizen involvement.

E. Build **intergovernmental consensus** on regional plans, policies, and issues, and advocate local implementation.
Regional Transportation Planning

Environmental Planning

Rural Programs

Sustainability Planning

Data and Information Services
Thurston Regional Planning Council

Transportation Policy Board

Transportation Technical Advisory Committee
Regional Context
Olympia to Tacoma – 30 miles
Olympia to Seattle – 60 miles
Bordered by:
Pierce County
Mason County
Grays Harbor County
Lewis County

Juncture between urban and rural Washington
Thurston County, WA
State Capitol
MPO Population
176,600
RTPO Population
255,000
Thinking about transportation the Thurston Way –

- Transportation is multi-modal
- Land use is integral to transportation
- We can’t build our way out of congestion
- Inefficiency is wasted capacity
- Managing demand effectively increases supply
- Safety, preservation, efficiency – highest priorities
- Access is the primary goal – access for all
Demographic Snapshot
Thurston County continues to be one of the fastest growing counties in Washington State.

130,000 people in last 30 years
2.4% annual growth rate

140,000 (draft) people forecast for next 30 years
1.5% annual growth rate
Job growth – here and in central Puget Sound - drives our population growth.

- 73,000 jobs in the last 30 years with an annual growth rate of 2.9%.
- 71,000 (draft) jobs forecast for the next 30 years with an annual growth rate of 1.5%.

The graph shows employment from 1970 to 2040, with actual data from 1970 to 2010 and forecast data from 2020 to 2040.
Inbound and outbound commuting plays a strong role in our job growth and residential patterns.

More outbound commuters than state government workers.

+ $20K/year hhold income

Outbound = Share of working Thurston residents.  Inbound = Share of Thurston jobs.
<table>
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<tr>
<th>Summary</th>
<th>2010</th>
<th>2040</th>
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<tr>
<td>Population</td>
<td>255,000</td>
<td>395,000</td>
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<tr>
<td>Employment</td>
<td>97,000</td>
<td>168,000</td>
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Population and employment distributions to fine-grained TAZ structure will be completed by end of CY 2012.

Distributions based on locally-adopted land use plans and buildable lands with input from local agencies.
TRPC Modeling Resources
TRPC Model Update Resources:

• Strong in-house GIS capabilities
• Fresh population and employment forecast
• Recent (2010) I-5/US 101 origin & destination study
• Funding secured for 2012 household travel survey
• Extensive CTR survey data by employment site
• Partner data from various studies

• Close working relationship with local partners
• Collaborative relationship with PSRC & WSDOT
Regional Challenges
DATA GIVEN TO RHEUMART
4-13-55

RED FIGURES ARE VOLUMES WHICH WOULD EXIST IN 1958 IF THE FREEWAY WERE NOT IN USE.
BLUE FIGURES ARE VOLUMES WHICH WILL EXIST IN 1958 WITH THE FREEWAY IN USE.

This analysis assumes that the Plum St. extension is constructed to State St. No estimate is made of the effect on the Fourth St. bridge of construction of the west side connection to Fifth St.
Challenge: Managing I-5
Joint Base Lewis-McChord:

- Single largest employment site in the state
- 80% active duty / 20% civilian
- Generates > 152,000 trips to/from daily
- 80% of those trips access via I-5
- 1/3 of personnel live in Thurston County
- Lacey – #1 residential location

Challenge: Proximity of JBLM
Challenge: Car-oriented suburban arterials
Challenge: Achieving transit-supportive land use
Challenge: Rural mobility

- Main Street is a highway
- Life-line services
- Commuter choices
- Flooding
- Incident response
Anticipated Model Applications
Evaluate & Prioritize I-5 Mobility Alternatives:

• Time-of-day HOV lane conversion
• Managed lanes
  • Pricing
  • Tolls
  • HOV/HOT
  • Variable speeds
• New lanes

Interim and long-range measures
Maximize system efficiency
Inter-regional coordination
Consideration of JBLM needs
Freight mobility
Alternatives Analysis:

- Potential for inter-regional travel
  - Sound Transit connection to Lakewood in 2012
  - Role of HOV and express service in I-5 mobility
- Potential for inter-local travel
  - Capitol Corridor (Lacey-Olympia-Tumwater)
Corridor Analysis:

- Operational characteristics
- Multi-jurisdictional corridors (Smart Corridors)
- State corridors (I-5, SR 510, SR 507)
- Demand management evaluation
- Access management
- Land use effects
- TOD
- Mixed-use
Other Regional Applications:
- Regional Transportation Plan update
- Air quality conformity analysis
- Performance measures
- Sustainability / livable communities analysis
- Support for local and state studies

Local Applications:
- Traffic impact analysis
- Concurrency demonstration
- Interchange studies (IJR processes)
- Transit system & park-and-ride planning
- Sub-area plans
- Local Comprehensive Plan updates

The regional model is the local model.
Technical Overview of the TRPC Model
– Bharath Paladugu
Travel Demand Model

- Model Network and TAZ structure
- HHTS data
- HH sub-models
- Trip Generation
- Trip Distribution
- Mode Choice
- Time of Day
- Network assignments
- Calibration/Validation
Network and Zones

- Travel Demand Model developed in-house during 1999-2000
- T-model network to EMME network conversion
  - refined later using GIS shapefiles and aerial maps
- Multi-modal network
  - Auto, bus, truck, bike and walk
  - 1998 Intercity Transit operations schedule
  - 40 regional transit lines
- TAZs: (Expanded from 480 in Tmodel to) 800 zone structure
- Volume delay functions modified from Portland Metro’s conical delay functions
HHTS - Sample monitoring

- **Geographic distribution**
  - Sampled per 15 regional districts (TAD) covering the 800 model TAZs
  - 3 area types - 55% urban, 30% suburban, 15% rural households
  - Sample represented the distribution of dispersed employers

- **Socioeconomic distribution**
  - Employment type, Auto-ownership, # workers per hh & hh size
  - Government – biggest employer in the region; then service and retail.
  - Other observations - decreasing hh size and aging population.

- **Sample expansion**
  - Underrepresented sample such as low-income and small households
  - Weights attached to reflect the same
HHTS

- HHTS conducted in 1998-99 by NuStats
  - 2,464 (of 4,329) households recruited by telephone
  - 1,537 households completed survey and reported data (36%)
    - 3,653 individuals reported a total of 25,277 trips
  - 2-day travel diaries collected household data, person data, vehicle data, and trip data.
  - 1990 CTPP used to validate HHTS – hh size, #vehicles/hh, #workers/hh
- Other observations from the survey which may no longer be true –
  - Increasing vehicle ownership;
  - Downtown Olympia and Capitol Campus dominant trip attractors;
HH sub model development (1/2)

- Multinomial logit choice estimation using ALOGIT
- 33 variables tested to develop HH sub models (pg 32, Table 4-1)
- Worker sub-model
  - HBW, HBO, HB-College, HB-Shopping, WO, OO
  - #workers(0,1,2,3+) by hh size(1,2,3,4+), dwelling type (single family, other), income (4 classes), and age (4 classes)
- K-12 School Children sub-model
  - HB-School
  - #children(0,1,2,3+) by hh size(1,2,3,4+), #workers, age, and dwelling type
- Auto-ownership sub-model
  - Model segmentation and mode choice modeling
  - #vehicles(0,1,2,3+) by hh size (1,2,3,4+), #workers, income, land use, intersection density and dwelling type
HH sub model development (2/2)

- Travel Skims: Network level of service - cost/time/distance
- Auto assignments
  - TAZ to TAZ, auto travel time & distance matrices
- Intra-zonal auto travel time and distance estimation
- Walk travel time and distance
- Transit network - travel time and distance
Trip Purpose

- 8 trip purposes derived from Activity and Place Type responses
  - HBW (17%)
  - HB-Shopping (10%)
  - HB-School (7%)
  - HB-College (1%)
  - HBO (31%)
  - WO (11%)
  - OO (22%)
  - Commercial freight

- Trip chaining phenomenon was examined from the survey data, but not incorporated in the model for simplicity.
Trip Generation

- ANOVA used to determine the key hh socioeconomic variables
- Cross-classification schemes –
  - HBW = f(#workers)
  - HB-Shopping = f(hh size, #workers)
  - HB-School = f(#students K-12)
  - HB-College = f(hh size)
  - HB-Other = f(hh size, #vehicles)
  - WO = f(#workers)
  - OO = f(hh size)
- Trip production rates obtained from HHTS
- Daily person trips by all modes by trip purpose = productions rates * cross-classified hh
- Trip production calibration factor (Under-reporting) = 1.10
Trip Distribution

- Logit multinominal destination choice model (Singly Constrained)
- Regional trip distributions = Trip production at origin TAZ * Choice probability of destination TAZ
- OD daily trip tables by trip purpose
  - HBW, HBO, HB-Shopping, WO, OO, Freight
    - Destination choice model
    - \( f \) (Employment by sector, # of households, auto travel time)
  - HB-School
    - OD by assigning school trip productions to corresponding school district
  - HB-College
    - OD by balancing college productions with attractions
- Validation: Comparing model estimated trip length frequency curves with observed data
External & Truck trip distributions

- Developed using several Data Sources
  - 1999 vehicle class counts
    - # trucks and % trucks
    - IE/EI/EE trip % for autos
    - Assume same IE/EI/EE % for trucks
  - 1997 Reebie Freight data
    - Total # trucks – IE/EI/EE = Internal truck movements
- Forecasts: Increasing the external and truck trips using a growth rate factor
Mode Choice and TOD

- 6 modes - DA, DWP, SR, Transit, Walk, Bike
- Mode choice estimated separately for each trip purpose
- Choice of mode function of –
  - Travel time, cost, employment density, transit accessibility, and parking
  - HHTS, model outputs, GIS data
  - All modes in a single nest
- Time of day peaking factors
  - Developed from the HHTS
  - % daily trips by mode by direction by trip purpose
  - AM, Mid-day and PM peak hours, and Off-peak period
Auto/transit assignments

- Emme multi-class auto assignment
- Simultaneous trip assignment with link prohibitions
- Volume Delay Functions (VDF)
  - Estimate link travel time based on demand and capacity
  - Developed from Portland Metro’s conical VDFs
  - 2 VDFs correspond to roadways with speed limit less than or greater than or equal to 55 mph
- AM, Mid day and PM peak hour assignments
- Emme multi-path route choice transit assignment
- Walk and bike access modeled, no auto access
- 3 full model feedback loops used for system equilibrium to provide direct feedback
Calibration/Validation

- R-square tests - AM, Midday and PM model assignments VS traffic counts
- Screenline analysis – Calibration performed for the 18 screenlines that were developed in 1998
- AM, Midday and PM Transit assignments VS daily ridership
- Results within generally acceptable ranges
DYNAMIC TRAFFIC ASSIGNMENT MODEL
Smart Corridors
Model Development (1/2)

- Import regional model from EMME
- Network refinements:
  - Intersection controls and geometry
  - Signal timing data for about 80 signalized intersections
  - Centroid loading points
- OD Trip Matrices:
  - SOV, HOV, Trucks
  - PM Peak 1-hour trip tables from EMME
  - 30-minute shoulders
Model Development (2/2)

- Modes: SOV, HOV, Trucks
- PM Peak Period - 2 hours
- PM peak hour demand from EMME model
- 30 minute shoulders
- Peaking factors
- Calibration/Validation:
  - Link counts and Intersection turning movement counts
  - Travel time and speed data
  - Lane queues
Models Set up and Vision

4-step model
• Long range planning
• Land use and policy evaluation

Smart Corridors
• Corridor study
• Traffic operations
• Air Quality

Regional DTA model
• Priority corridors
• Regional traffic operations
Chance for the peer review team to seek further inputs

- Peer Review Panel
1. TRPC/PSRC model coordination (1/2)

- Traditional 4-step trip based travel demand models
- EMME platform
- Year of model build (1998/99)
- Geographies of focus & zonal detail
- Level of complexity
- Transit
- Policy
- Time period
- Base year volumes versus counts
- Forecast growth assumptions
1. TRPC-PSRC Model Coordination (2/2)
2. Desired mode choice structure

- **HBW**
  - Transit
    - Walk
    - Bike
    - Park & Ride
  - Walk/Bike
    - Share Ride
  - Auto
    - Park & Pool
    - Drive Alone
EMME’s Traversal Procedure

- AM Assignment
- HBW P-A Trip Distribution
- Transversal Assignment
- HBW P’s & A’s at Gateways
3. Possible zonal assembly and Trip Generation for expanded model

- Pierce County Externals
- Pierce County (JBLM)
- Thurston County
- Thurston County Externals

PSRC Model
Traversal

HHTS

Trip Distribution
4. I-5 OD Survey

- PnR vehicle survey
- I-5 License plate data
- Follow up Questionnaire
I-5 at Mounts Road SW - Location #2
Summary of Traffic Flow
AM & PM

Study area:

Our Study Area covers the urban limits of Lacey, Olympia and Tumwater. Location #2 refers to the flow of traffic observed at the Mounts Road SW overpass on Freeway I-5 (Exit 116).

AM Peak Period:
6:00am to 9:30am

PM Peak Period:
2:30pm to 6:00pm

Total Daily Traffic: 109900 vehicles

Rush Hours:
50% 55200 vehicles

Number of Vehicles:

Traffic through 2 then through 1
Traffic through 2 into Study Area
Traffic through 2 then through 3
Traffic through 1 then through 2
Traffic from Study Area through 2
Traffic through 3 then through 2

Incoming traffic:

2290 27%
6737 67%
415 6%

Outgoing traffic:

11810 80%
3800 14%
930 6%

Vehicle Types:

Passenger: 90800
Commercial: 19100
5. Thurston Census Tracts/PUMA
6. Targeted model improvement areas

- Transit - Park and Ride?
- Shared Ride – differentiate Park and Pool?
- Transit – differentiate walk and bike access?
- Truck model – generation and distribution
- External model
- Time of Day – peak spreading
- Travel demand management – Tolling, CTR, ..
- Stated preference data – Tolling, GP to HOV conversion, ..
TRPC Model Enhancements Project
– Bharath Paladugu
# TRPC Travel Demand Model Update Timeline

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<th>2012</th>
<th>2013</th>
<th>2014</th>
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<td>Kick off/ Ground work</td>
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<td>Hire Model Development Team</td>
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<td>TMIP Peer Review</td>
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<td>EMME Model Structure Update</td>
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<td>Data Collection and Analysis</td>
<td>Model Developer and Model Consultant on-board</td>
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<td>2010 and 2040 EMME Models</td>
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<td>2010 and 2017 DYNAMEQ Models</td>
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<td>Traffic Intern</td>
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<td>Conduct HHTS</td>
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<td>TMIP Review</td>
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<td>Hire Household travel survey</td>
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1. Update Model Structure (June 2012 - December 2012)

- Revise current internal TAZ structure to accommodate zonal refinements
- Expand model boundary to the north up to SR512: Add zones and network detail
- Revise network attributes: lanes, speeds and capacities
- Transit network: add walk and bike access, auto access, park and ride lots, and review transit routes
- Refresh existing screenlines
- Revise trip distribution criteria of current truck model and external model
- Develop a new district system for model validation
2. Data Collection and Analysis (June 2012 – January 2013)

- Household travel survey:
  - Fall 2012
  - Assess various technologies
  - Develop the scope of the survey and design the survey
  - Conduct statistical analysis

- Database of region wide traffic counts

- Work with Intercity Transit to obtain the most recent on-board data

- Supplementary traffic data collection
  - At strategic locations
  - Travel time, speed, intersection geometry, signal timing, intersection queues

- Estimate new model coefficients in all stages of the model
- Move from current peak hour trip assignments to peak period modeling
- Update external trip distribution models using recent Origin & Destination data
- Work with the Puget Sound Regional Council to develop interregional trip tables for consistency in the two models
- Conduct base year model validation
- Develop 2040 forecast year model

- Identify priority corridors for which the DTA model will be built
- Refine the model network on priority corridors: add intersection geometry, traffic control, and signal timing data
- Calibrate the DTA model assignments on priority corridors using travel time, speed, and intersection queue data.
Moderated Discussion: Setting the Agenda for Lunch Discussion and Caucus

– Bharath Paladugu & Thera Black
QUESTIONS FOR THE PANEL (1/2)

• Overall review of TRPC Model Enhancements scope of work
• Travel Demand Model
  • Modeling TDM strategies
  • Expansion of model boundary
  • Peak hour to Peak period
  • Resolving TRPC/PSRC model discrepancies
  • TWLT, freeway auxiliary lanes, hard shoulder running
• HHTS
  • Augmenting older survey versus entirely independent
  • Innovative technologies
  • Borrowing data from other surveys
  • Outbound commute pattern
  • NHTS
  • Extra sampling in high growth areas
  • JBLM population
QUESTIONS FOR THE PANEL (2/2)

- Transit
  - Park and Ride
  - Park and Pool
  - Walk/Bike/Auto access
  - Data for periodic validations
- Freight
  - Modeling freight distribution centers
- DTA
  - Frequency of model updates
  - Addition of new corridors (piecemeal) versus regional operations model network
LUNCH!
Panel Caucus
– Dick Walker & Elizabeth Sall
Discussion items

- Review/Critique and comment on practices
- Prioritized list of questions
Panel Report & Discussion
– Dick Walker & Elizabeth Sall
Conclusion/ Adjourn
– Bharath Paladugu