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

Agenda

9:00 am – 9:15 am	Introductions Face-to-Face, Meeting Structure and Logistics- Bharath Paladugu
9:15 am – 9:30 am	Additional Background on TRPC and the Thurston Region- Lon Wyrick
9:30 am – 10:15 am	Additional Planning Context & Technical Overview of the TRPC Model- Thera Black, Bharath Paladugu
10:15 am-10:45 am	Chance for Review Panel to Seek Further Inputs- Review Panel
10:45 am-11:00 am	Break
11:00 am-11:15 am	Additional Information on TRPC Model Enhancements Project
11:15am-Noon	Moderated Discussion: Setting the Agenda for Lunch Discussion and Caucus *New or outstanding panelist questions* *Preview TRPC questions for panel and prioritize with panelist input*
12:00 pm-1:00 pm	Working Lunch *Questions for the panel and discussion*
1:00 pm-3:00 pm	Panel Caucus *Review/Critique and comment on practices*
3:00 pm-3:15 pm	Break
3:15 pm-4:30 pm	Panel Report, Presentation and Discussion
4:30 pm-5:00 pm	Conclusion/Adjoum

Introductions
- Around the room

Background
– Lon Wyrick & Thera Black

TRPC Overview

Regional Partnership Since 1967

www.trpc.org

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

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.

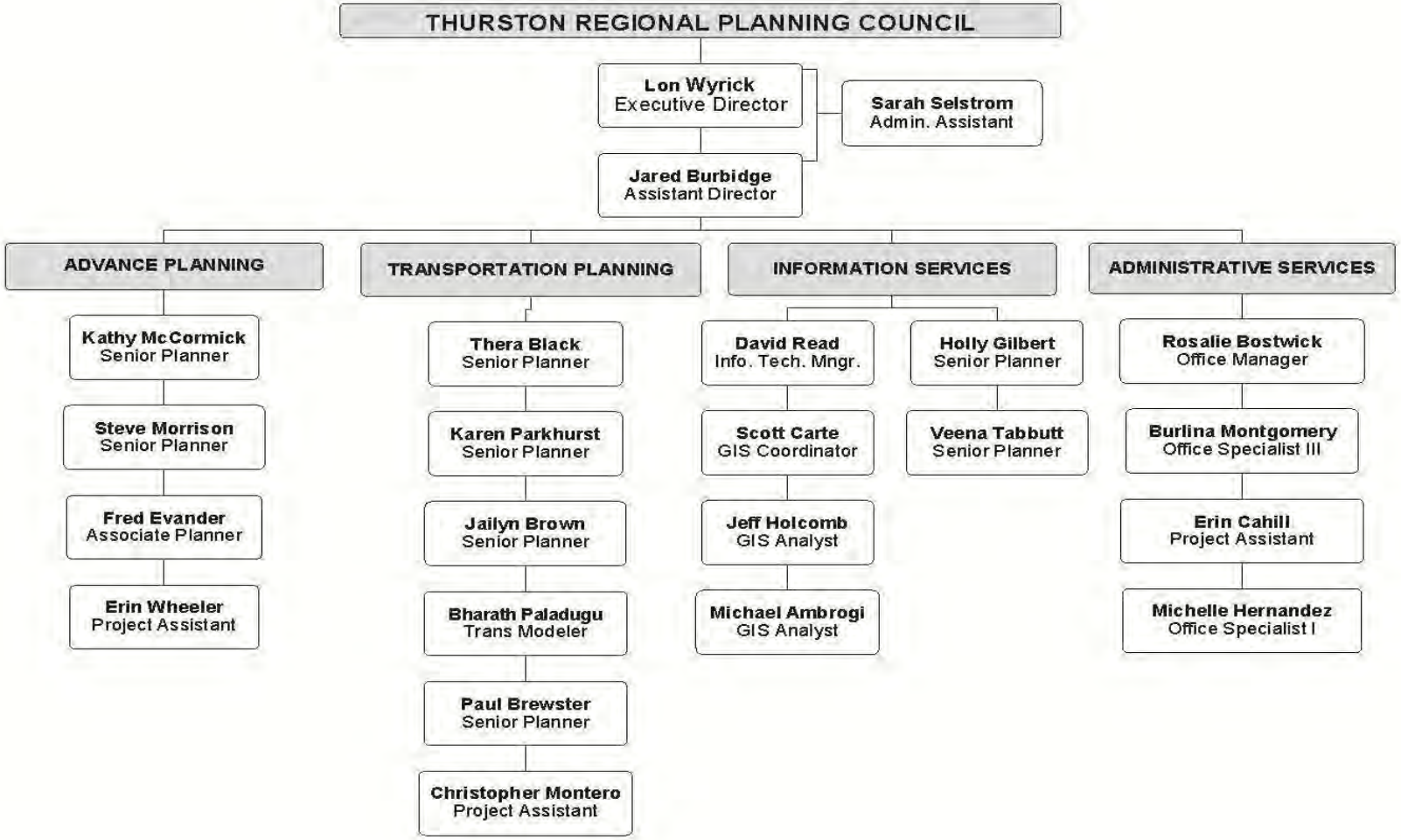
C. **Assemble** and **analyze data** that support local and regional decision making

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.

Thurston Regional Planning Council
Organizational Chart

December 2011



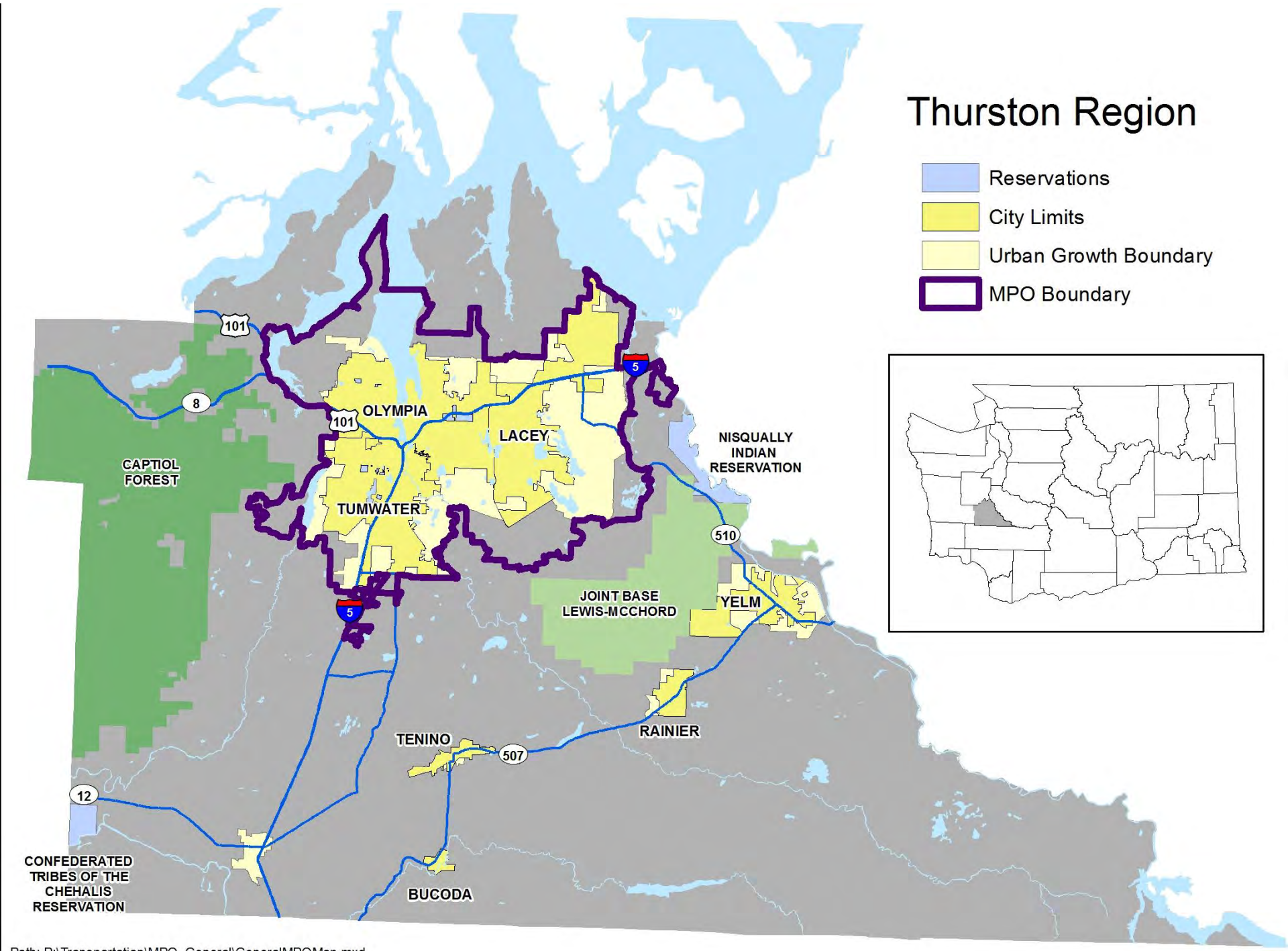
Regional Transportation Planning

Environmental Planning

Rural Programs

Sustainability Planning

Data and Information Services



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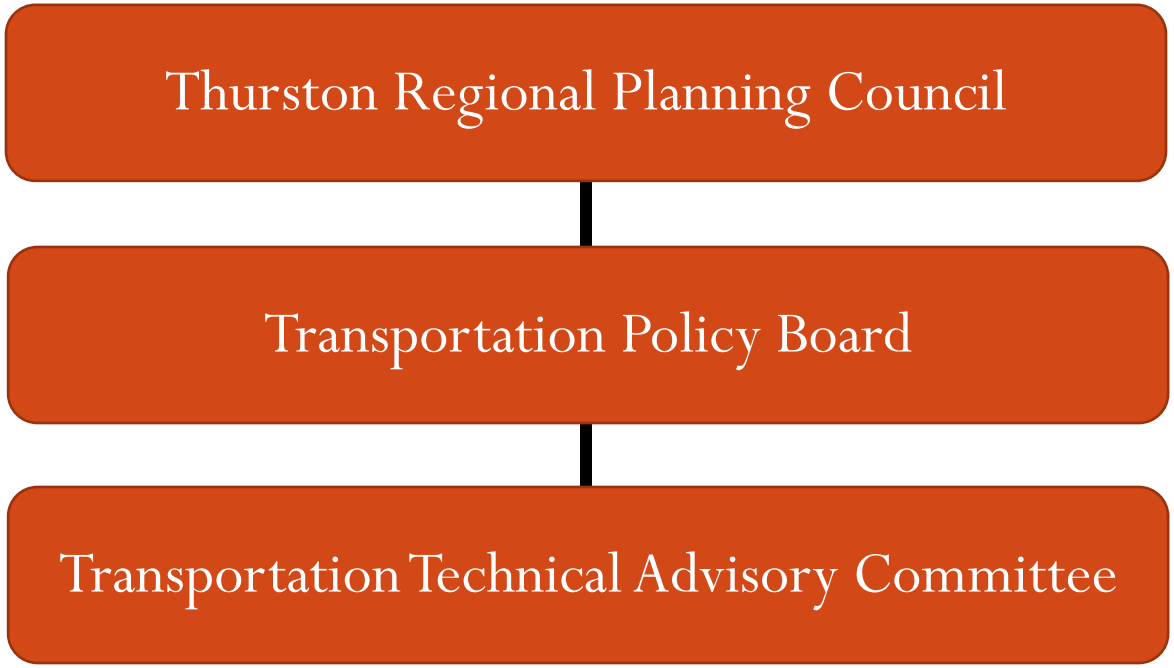
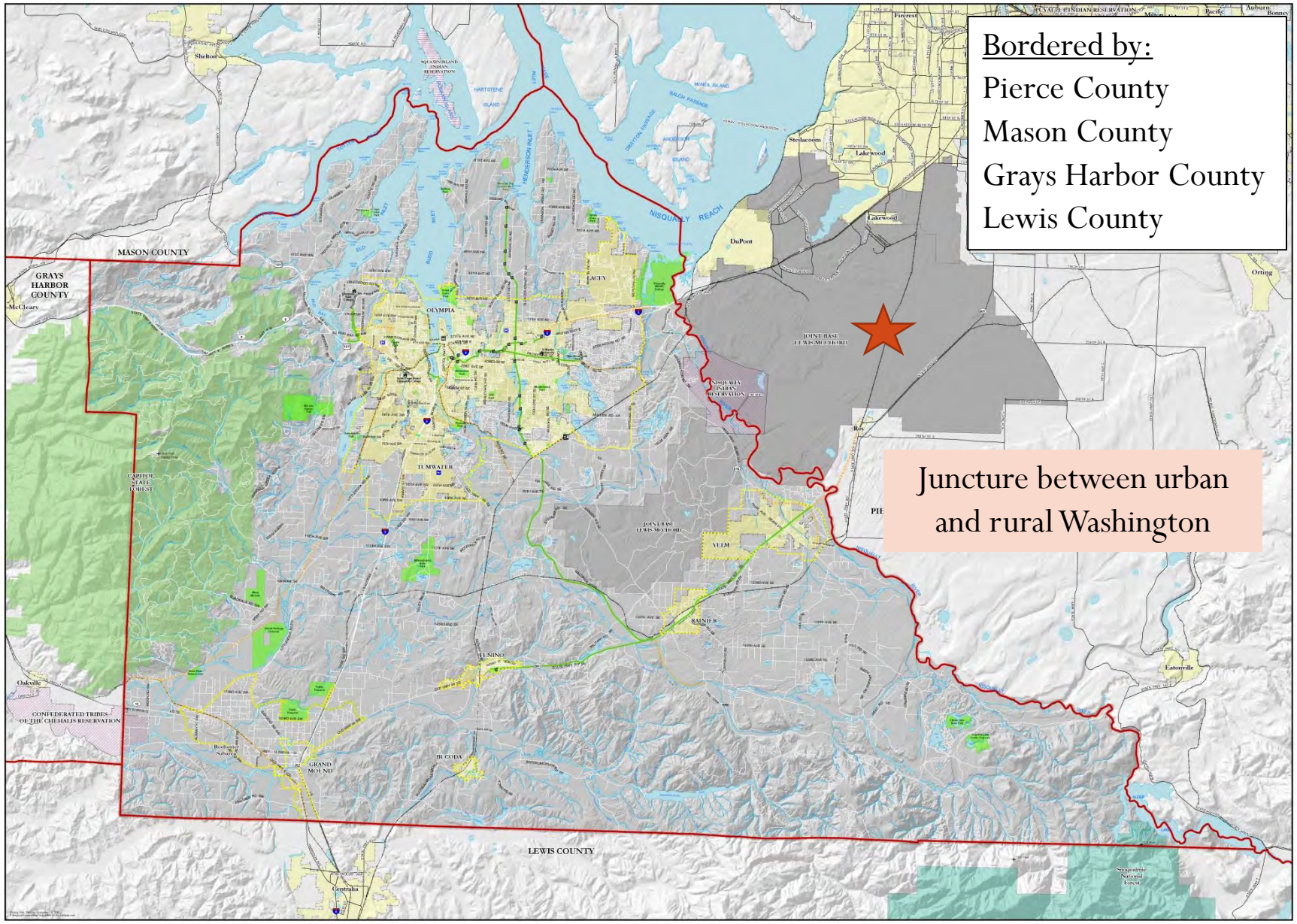
Transportation Committee Organizational Chart



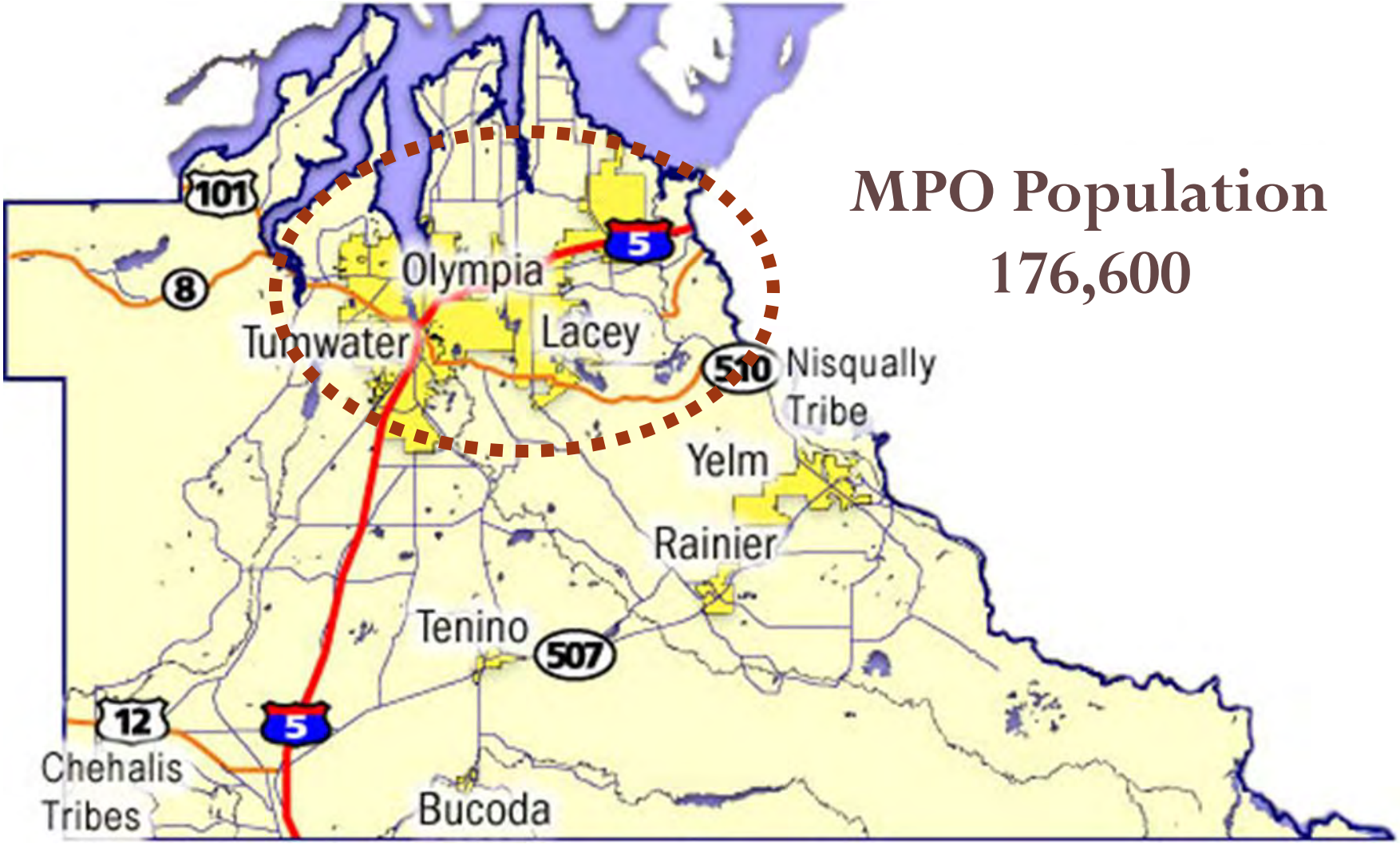
Regional Context

Olympia to Tacoma – 30 miles
Olympia to Seattle – 60 miles

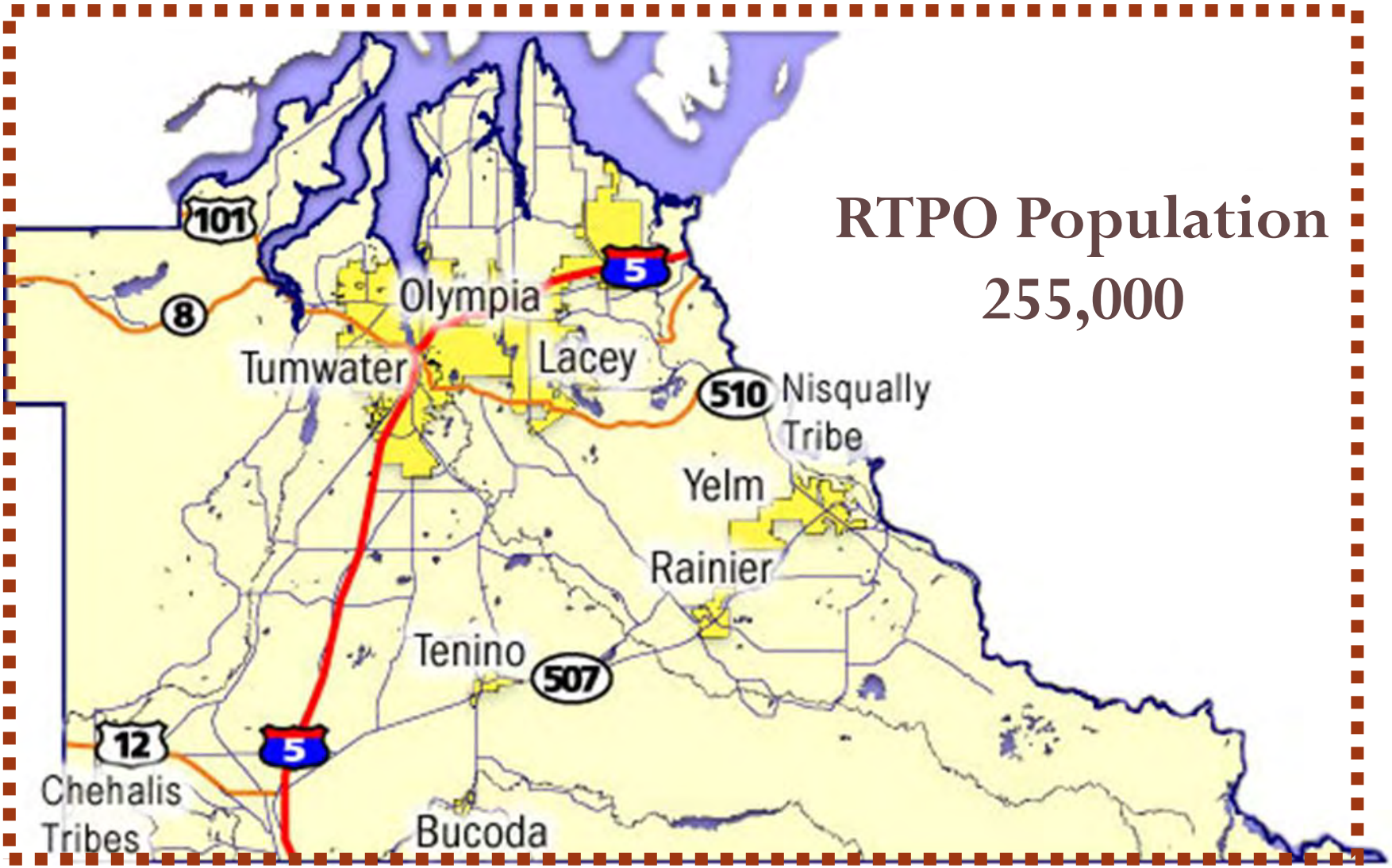

Bordered by:
Pierce County
Mason County
Grays Harbor County
Lewis County
Juncture between urban and rural Washington
MASON COUNTY
GRAYS HARBOR COUNTY
LEWIS COUNTY
OLYMPIA
LACEY
TUMWATER
YELM
RAINIER
TENINO
BUCODA
GRAND MOUND
Centralia
Shelton
McCleary
Oakville
Steilacoom
Lakewood
DuPont
Orting
Eatonville
NISQUALLY REACH
JOINT BASE LEWIS-MCCHORD
CAPITOL STATE FOREST
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION

Thurston County, WA

State Capitol



MPO Population
176,600



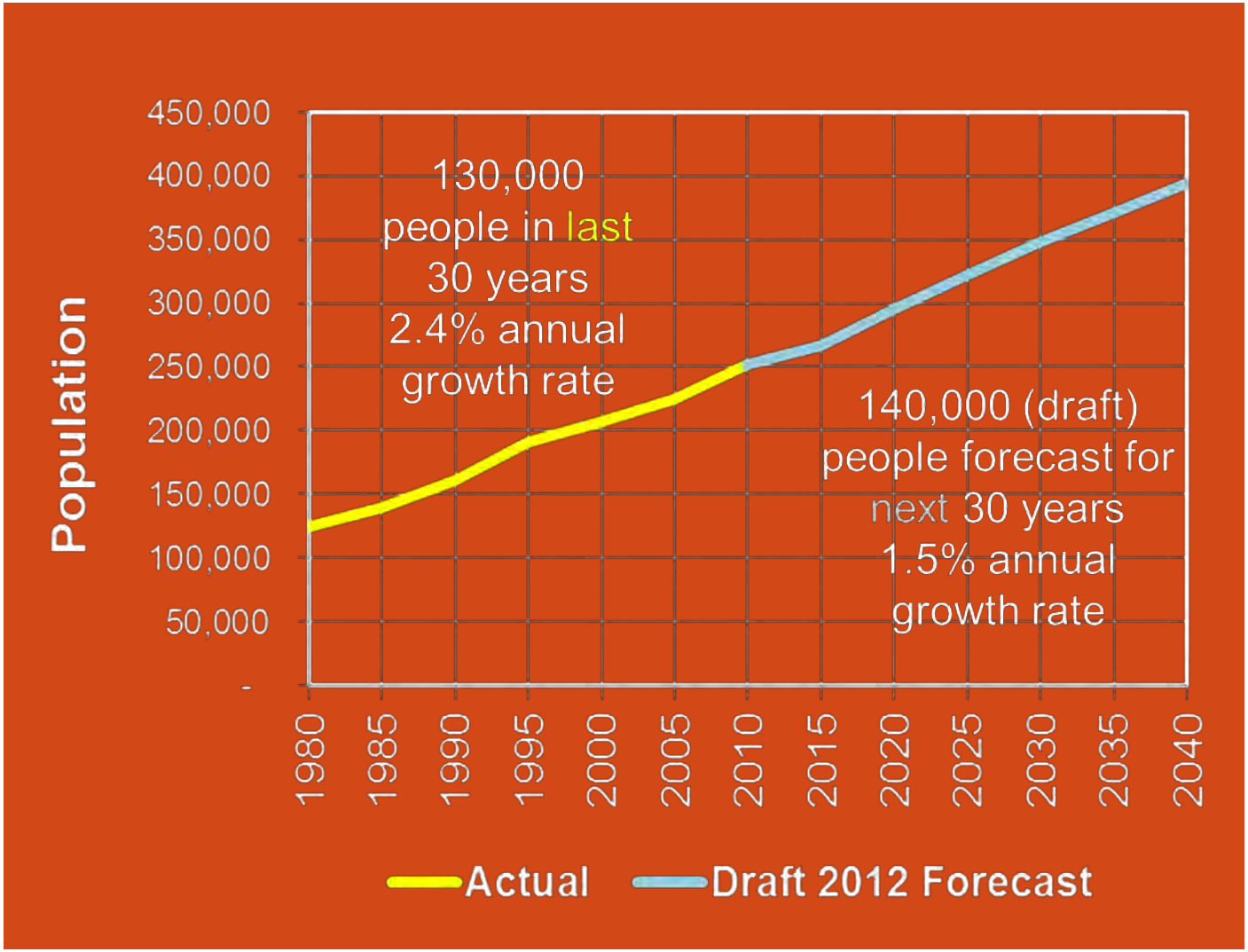
RTPO Population
255,000

Thinking about transportation the Thurston Way –

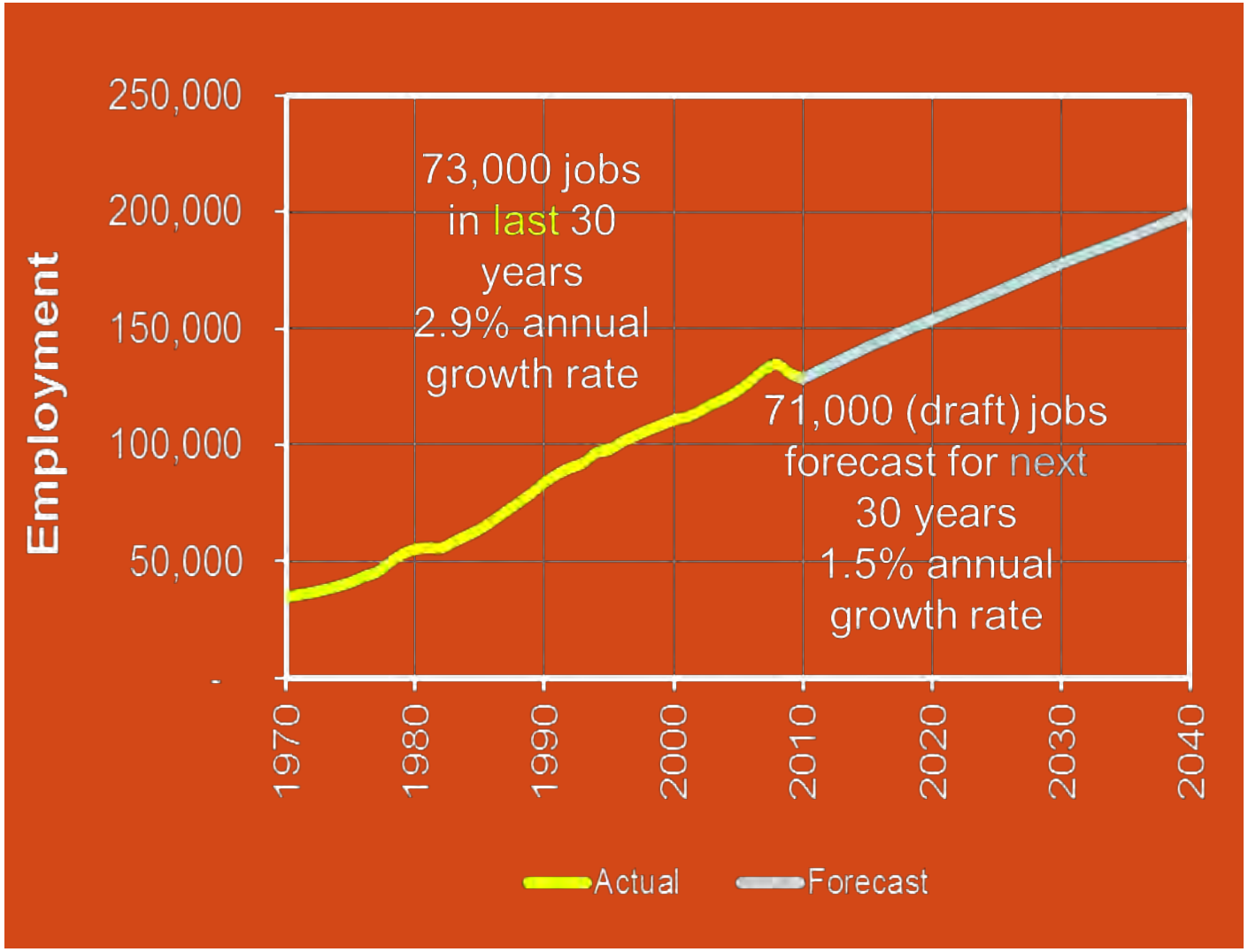
- Transportation *is* multi-modal
- Land use is integral to transportation
- We can't build our way out of congestion
- Inefficiency is wasted capacity
- Managing demand effectively increases supply
- Safety, preservation, efficiency – highest priorities
- Access is the primary goal – access for all

Demographic Snapshot

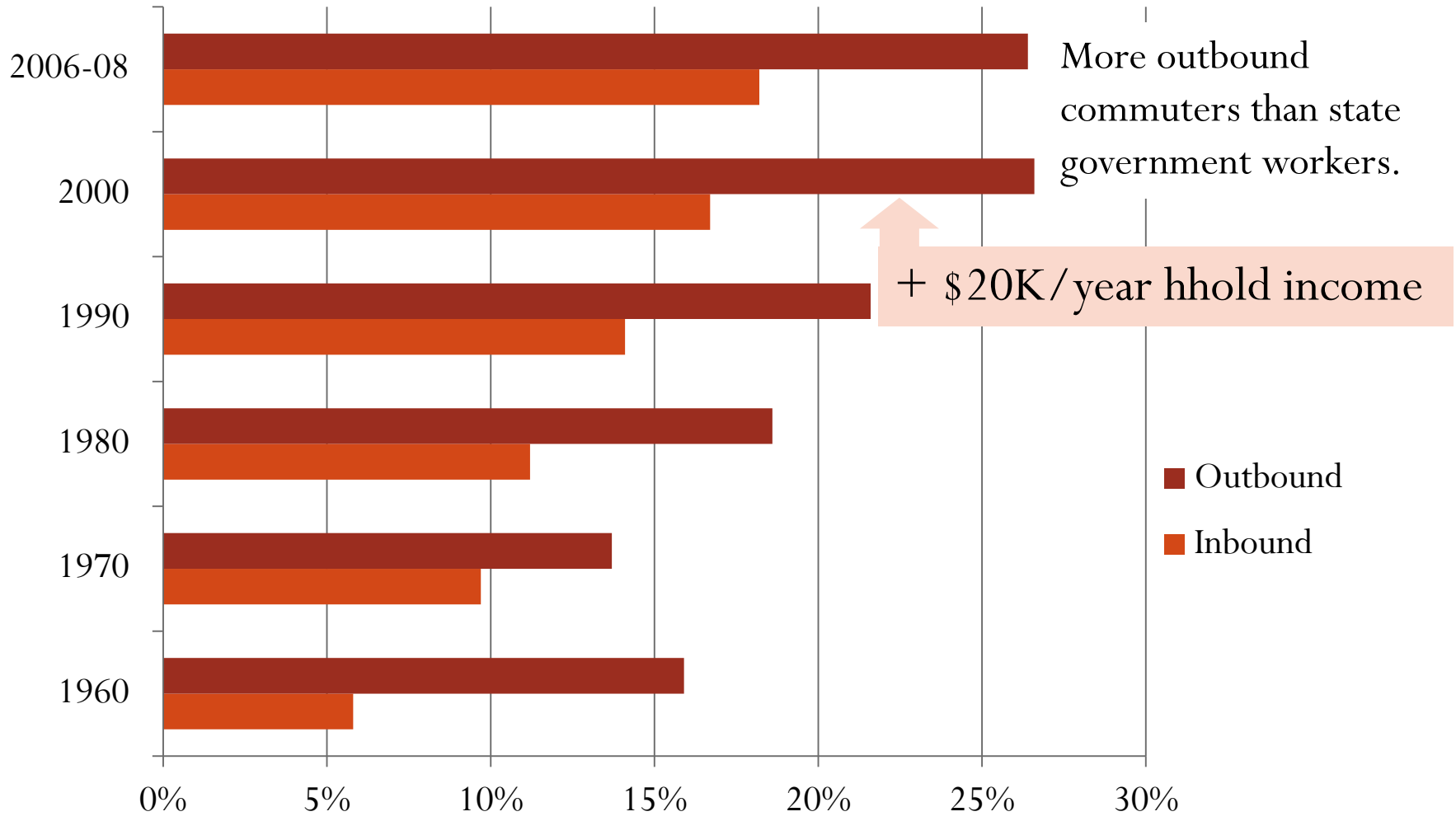
Thurston County continues to be one of the fastest growing counties in Washington State.



Job growth – here and in central Puget Sound - drives our population growth.



Inbound and outbound commuting plays a strong role in our job growth and residential patterns.



Outbound = Share of working Thurston residents. Inbound = Share of Thurston jobs.

Summary	2010	2040
Population	255,000	395,000
Employment	97,000	168,000

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.

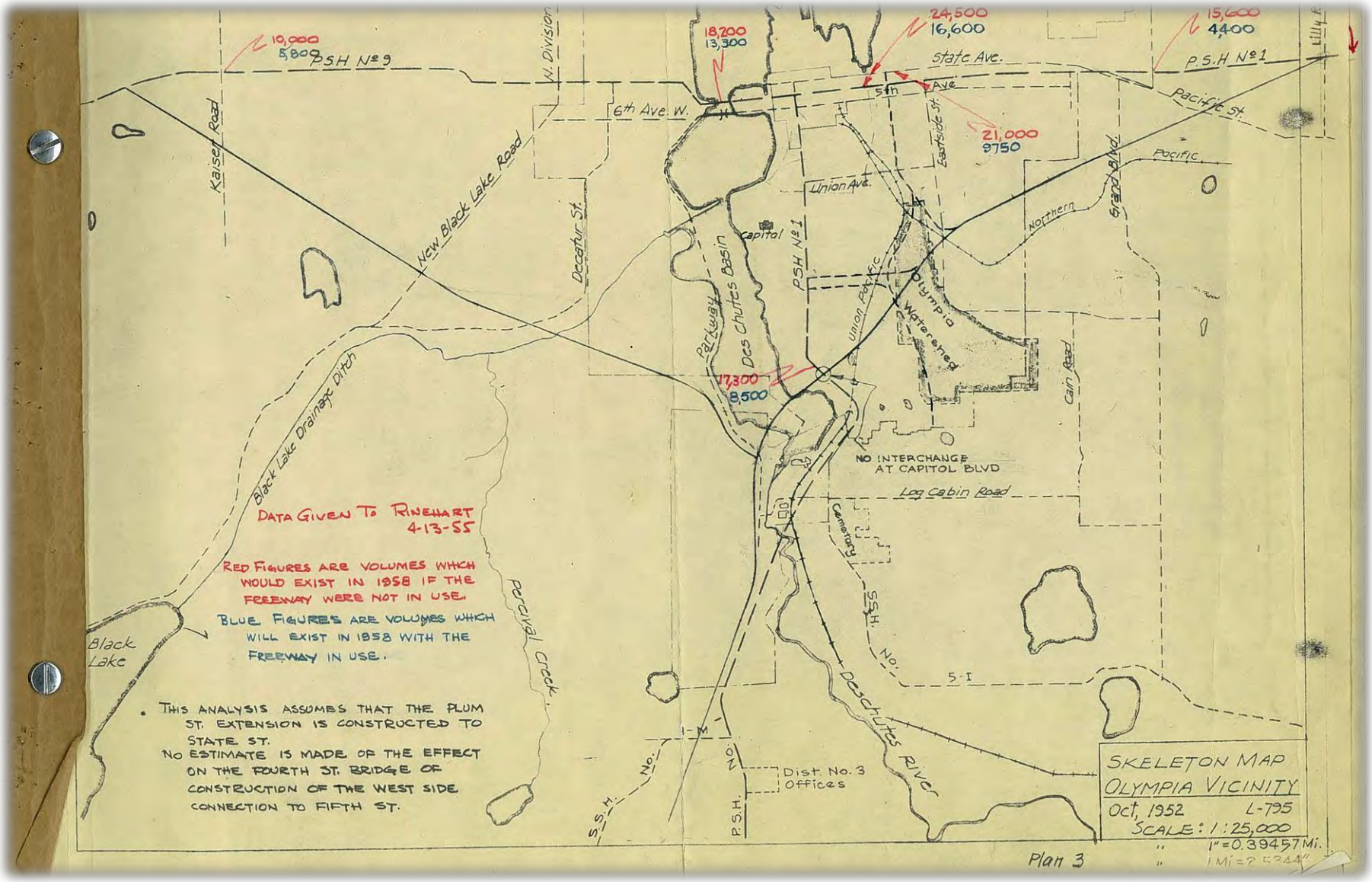
TRPC Modeling Resources

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

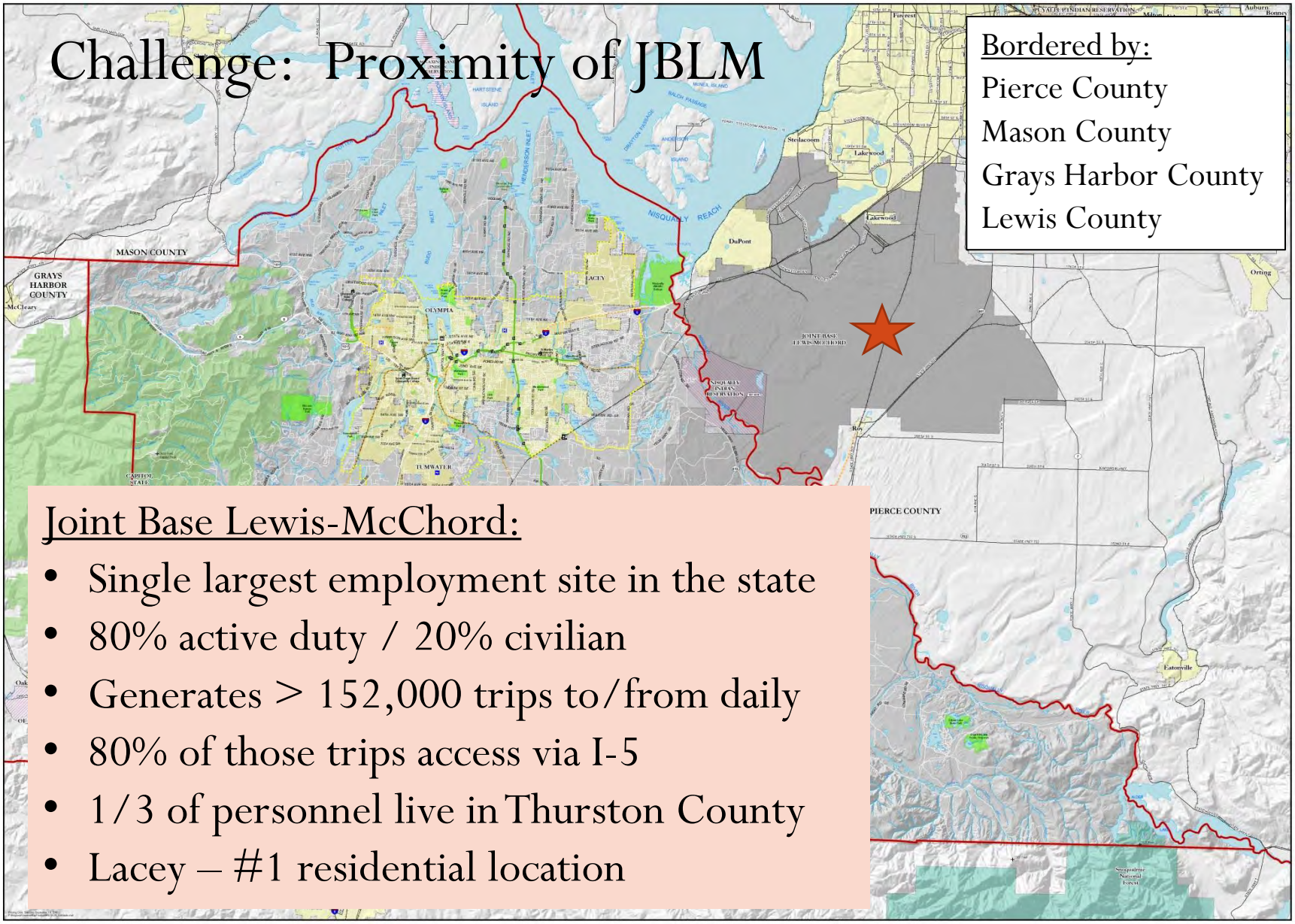
Regional Challenges


10,000
5,800
PSH Nº 9
18,200
13,300
24,500
16,600
15,600
4,400
State Ave.
P.S.H Nº 1
5th Ave
21,000
9750
6th Ave. W.
N. Division
Kaiser Road
New Black Lake Road
Decatur St.
Eastside St.
Pacific St.
Pacific
Grand Blvd.
Union Ave.
Northern
Capitol
PSH Nº 1
Union Pacific
Olympia Watershed
Parkway
Des Chutes Basin
17,300
8,500
Cain Road
Black Lake Drainage Ditch
NO INTERCHANGE AT CAPITOL BLVD
Log Cabin Road
Cemetary
DATA GIVEN TO RINEHART 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.
Black Lake
Percival Creek
S.S.H. No.
5-I
Deschutes River
1-M
S.S.H. No.
P.S.H. No.
Dist. No. 3 Offices
• 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.
SKELETON MAP
OLYMPIA VICINITY
Oct, 1952 L-795
SCALE: 1:25,000
1" = 0.39457 Mi.
Plan 3

PRIMARY STATE HIGHWAY NO. 1 and F.S.H. NO. 9
FREEWAY WITH INTERCHANGES
OLYMPIA - TUMWATER - CAPITOL LAKE
THURSTON COUNTY

Challenge: Managing I-5

Challenge: Proximity of JBLM



Bordered by:

Pierce County
Mason County
Grays Harbor County
Lewis County

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: 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

The regional model is the local model.

Local Applications:

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

Technical Overview of the TRPC Model

– Bharath Paladugu

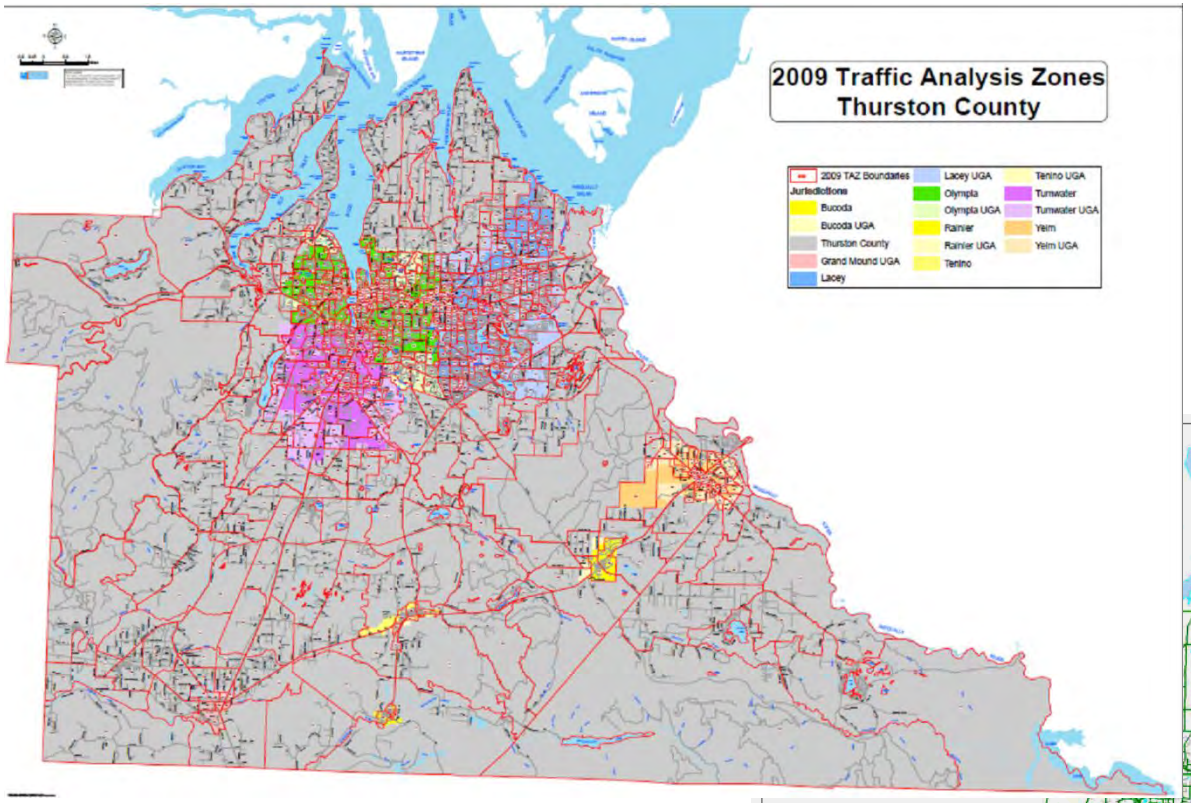
Travel Demand Model

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

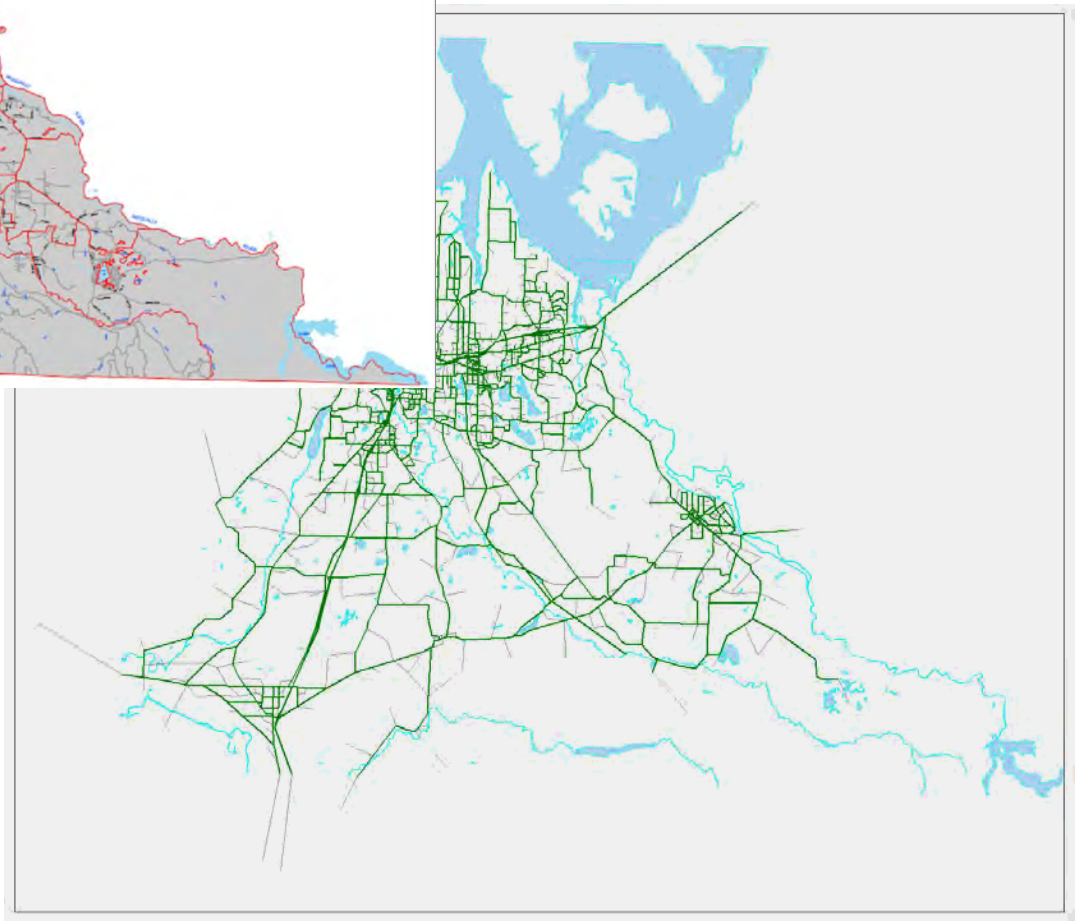
Network and Zones

- 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

Model TAZs



Model Network



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 multinomial 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
  - 1997 I-5/US 101 OD Survey
    - 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

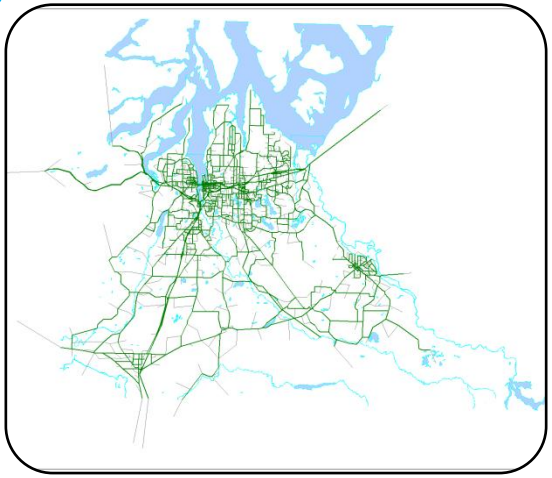
Model Development (1/2)

- 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)

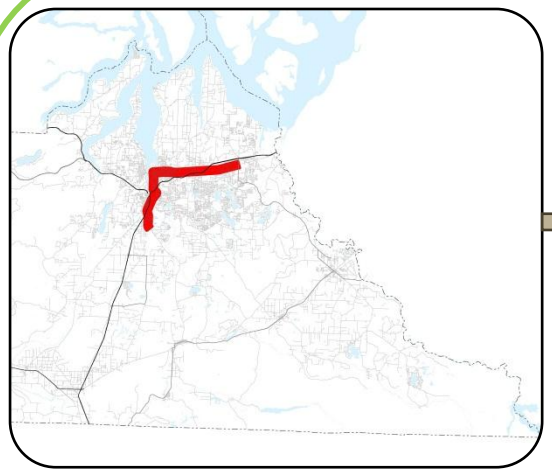
- Modes: SOV, HOV, Trucks
- PM Peak Period - 2 hours
- PM peak hour demand from EMME model
- 30 minute shoulders
- Peaking factors
- Calibration/Validation:
  - Link counts and Intersection turning movement counts
  - Travel time and speed data
  - Lane queues

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

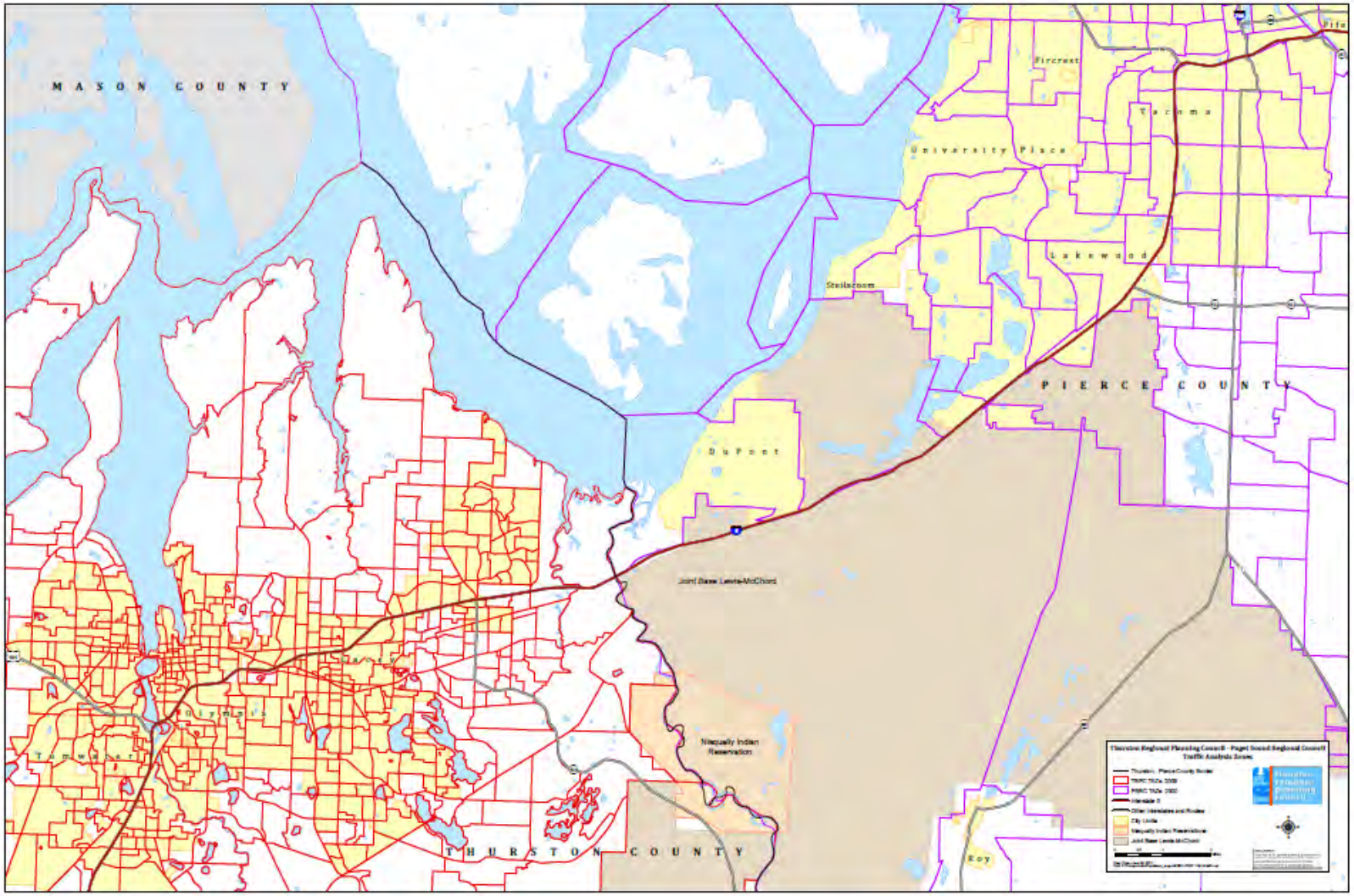
Chance for the peer review team to seek further inputs

- Peer Review Panel

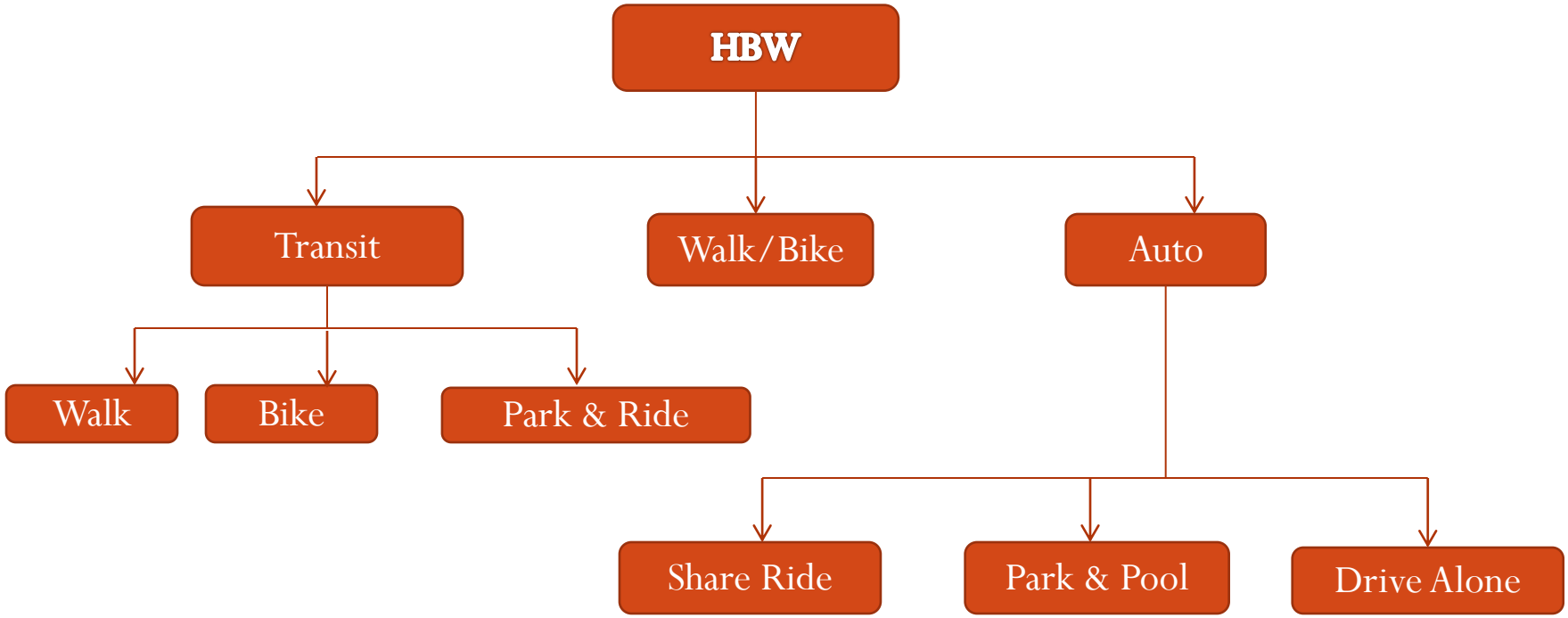
1. TRPC/PSRC model coordination (1/2)

- 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)

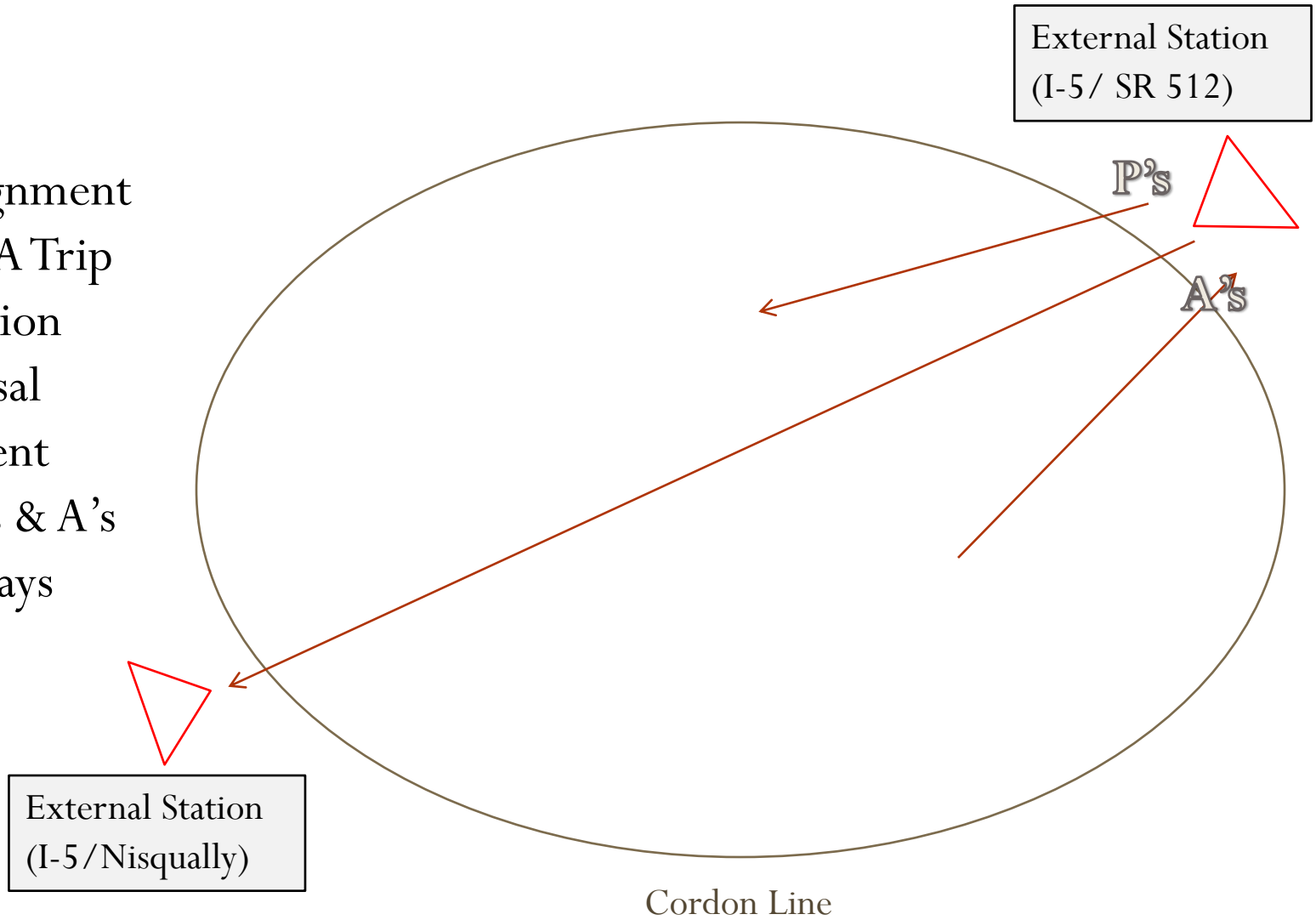


2. Desired mode choice structure

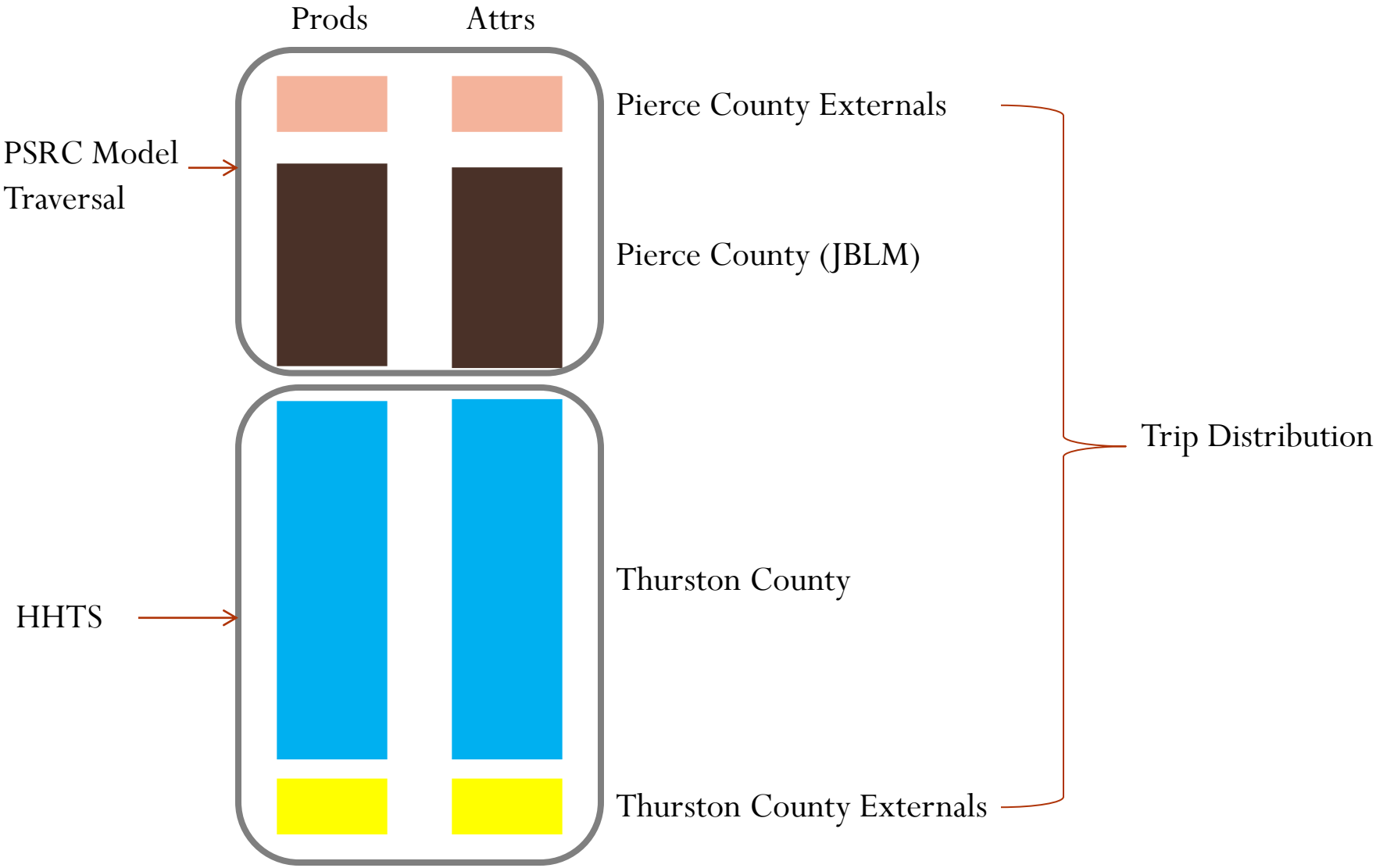


EMME's Traversal Procedure

- AM Assignment
- HBW P-A Trip Distribution
- Transversal Assignment
- HBW P's & A's at Gateways

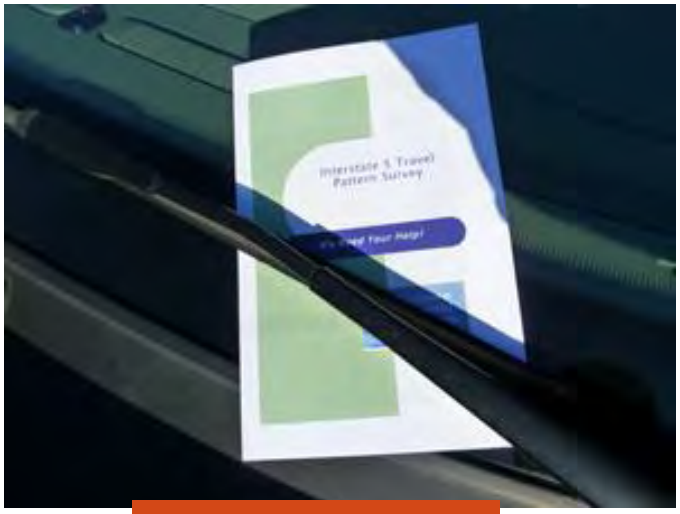


3. Possible zonal assembly and Trip Generation for expanded model



4. I-5 OD Survey

I-5 License plate data



PnR vehicle survey

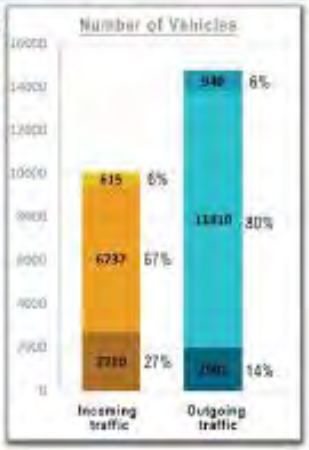
Follow up Questionnaire

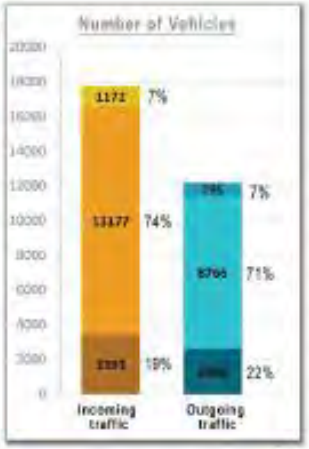
I-5 OD Survey

I-5 at Mounts Road SW - Location # 2
Summary of Traffic Flow
AM & PM

Study area:

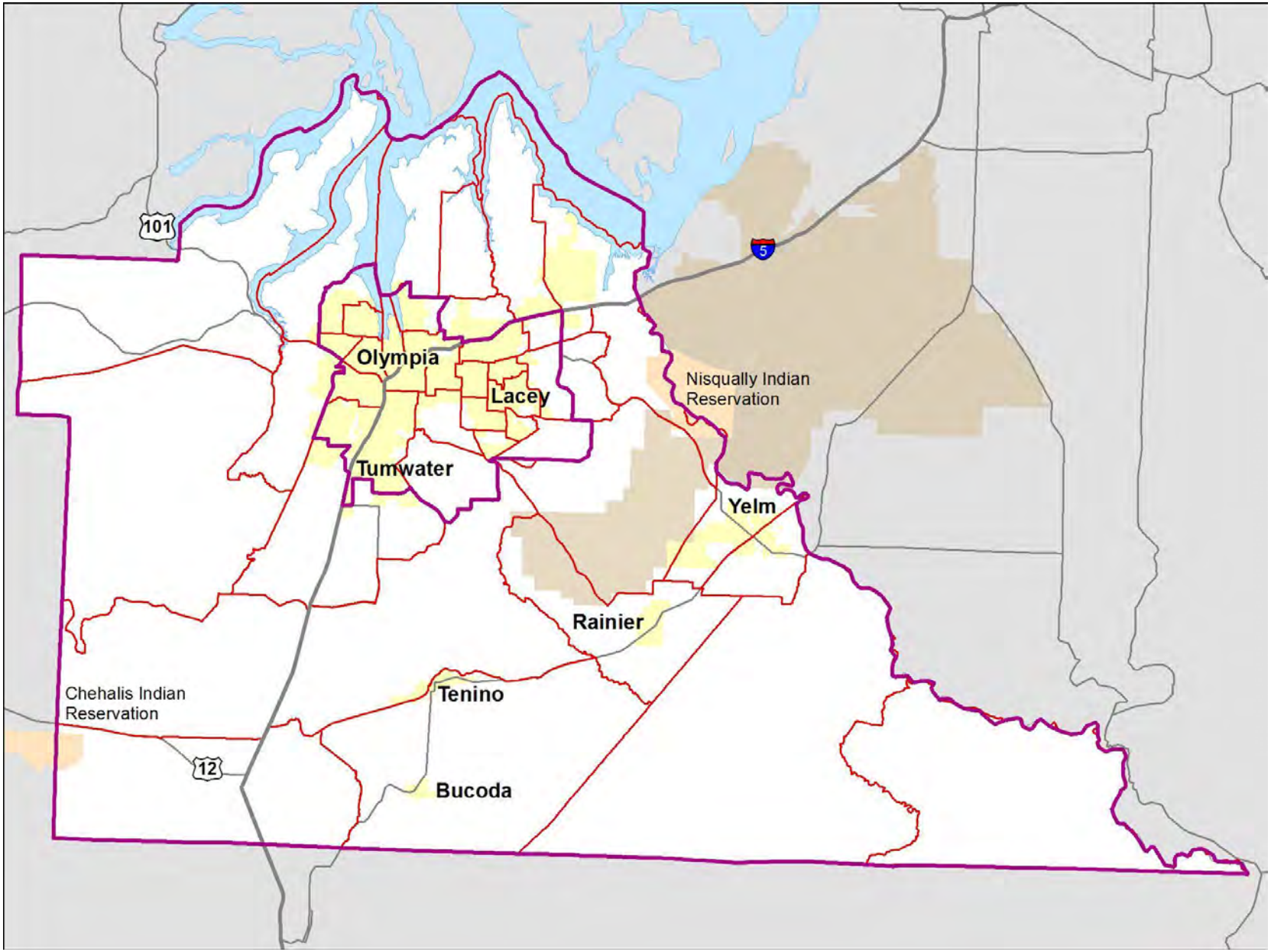
Our Study Area covers the urban limits of Lacey, Olympia and Tumwater. Location #2 refers to the flow of traffic observed at the Mounts Road SW overpass on Freeway I-5 (Exit 116).





Total Daily Traffic: 109900 vehicles

5. Thurston Census Tracts/PUMA



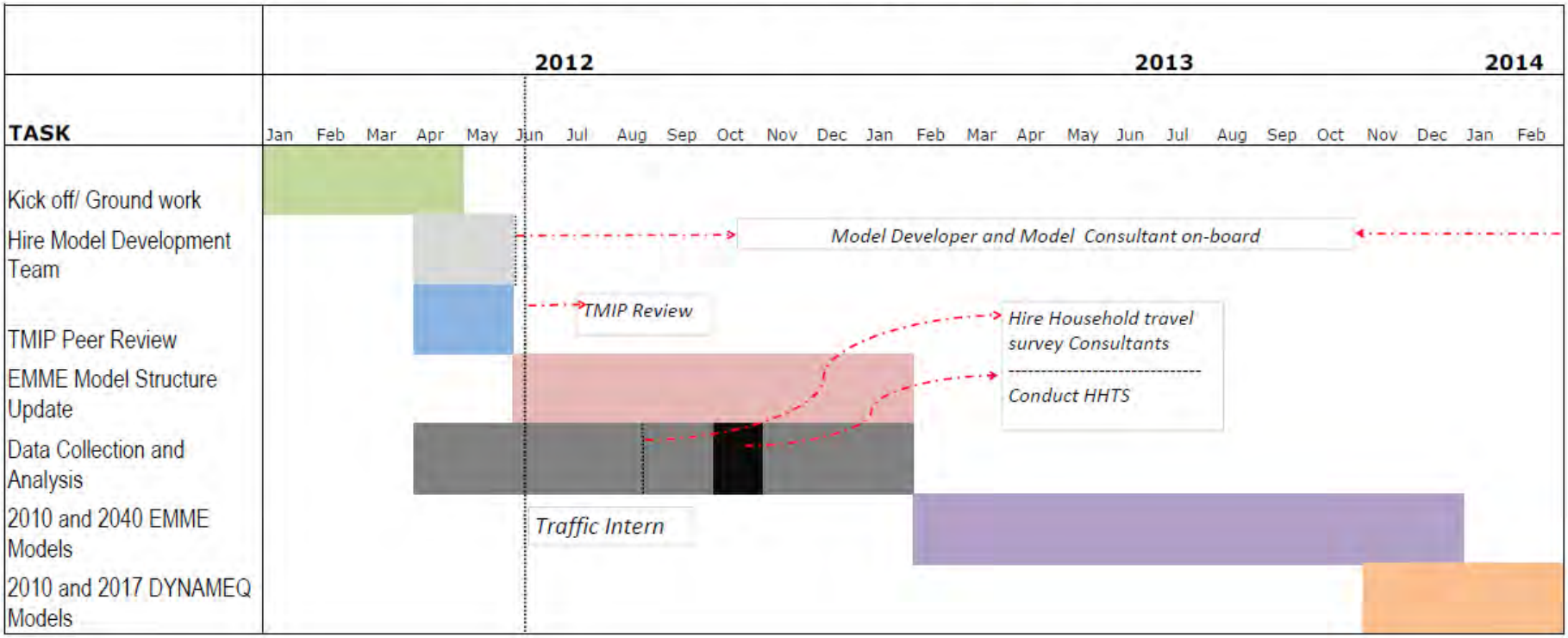
6. Targeted model improvement areas

- 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



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

3. Model Calibration and Forecasts (January 2013 – December 2013)

- 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

4. Develop 2010 and 2017 DTA Models (August 2013 – January 2014)

- 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