

VE-STATE Meeting #2

Presentation to Project and Oversight Team

7/5/18

Series of Meetings

VE-State pilot project

Consultant team:

Oregon Systems Analytics & RSG

Oversight Group: FHWA, Volpe, MdDOT-BWI, WSDOT, ODOT

Oversight Group charge: Review the plan/methods with the objective to further this pilot's findings/products as part of future pooled fund activities, and participate in necessary changes to the VE framework.

Note: Funding/schedule limit the oversight role to one of primarily review and advice.

Oversight Group Expectations:

Influence direction of work

Understand approach to work

“Concept” level background

Schedule: June-November 2018, roughly 4-5 monthly 1.5 hour meetings

1. May 30, 2018 – Kickoff
2. July 5, 2018 – Input on “Integration Plan” approach
3. Oct 3 (TBD) – Report out, prior to final “real world” Test
4. Dec 4-6 (TBD) – Final Report

Other: E-forum (between meetings); Post-meeting Oversight Group Qs

Product: “Integration Plan”; code & inputs; Documentation of Issues for future efforts

Comments from Kickoff

1. Use of Synthetic Population (e.g. ABM)

- Aggregate/replace VE-State Synth HHs (local task)
- Consistency in controls? Use similar in VE-State?

MD: HHsize, income, workers, age, sex, (kids/not implicit in activity pattern)

OR: HHsize, income, workers, age, family/non, dwelling type, occupation

Scenarios: Aging (age in place?), School age pop (fertility), migration

→ Shared Oregon statewide 2010 Synthetic Pop

2. Auto Ownership/Income issues with EERPAT

→ Allow for Variation in household income

3. Use Multiple Test Cases for Task 3 (WSDOT) → TBD

Today's Agenda

VE-State Meeting #2 **7/4/18 9-10:30 pacific**

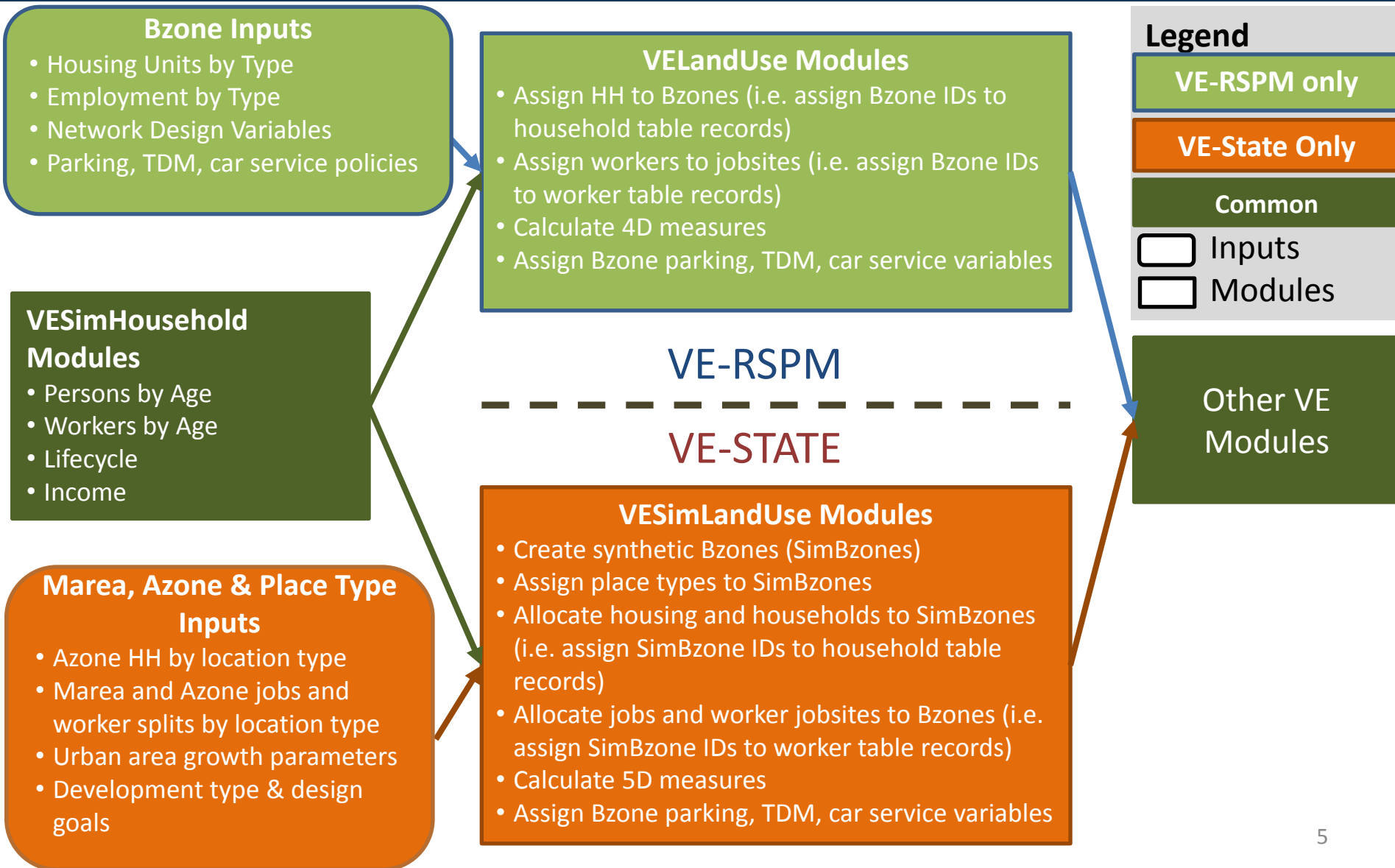
Introduction (Tara Weidner – 10 min)

Draft Approach (Brian Gregor – 60 min)

- Background – What needs to be accomplished
- Testing VE-RSPM modules for use in VE-STATE
- SimBzone synthesis approach

Next steps (Tara Weidner – 20 min)

Differences Between VE-RSPM and VE-STATE



VE-RSPM Modules and Packages

CreateHouseholds
PredictWorkers
AssignLifeCycle
PredictIncome

SimHouseholds
Package

CalculateHouseholdDvmt
CalculateAltModeTrips
CalculateVehicleTrips
DivertSovTravel

HouseholdTravel
Package

PredictHousing
LocateEmployment
AssignDevTypes
Calculate4DMeasures
CalculateUrbanMixMeasure
AssignParkingRestrictions
AssignDemandManagement
AssignCarSvcAvailability

LandUse
Package

CalculateCarbonIntensity
AssignHhVehiclePowertrain

PowertrainsAndFuels
Package

AssignTransitService
AssignRoadMiles

TransportSupply
Package

- . *Iterate X Times*
- . CalculateBaseRoadDvmt
- . CalculateFutureRoadDvmt
- . CalculateRoadPerformance
- . CalculateMpgMpkwhAdjustments
- . AdjustHhVehicleMpgMpkwh
- . CalculateVehicleOperatingCost
- . BudgetHouseholdDvmt
- . *End Iteration*

TravelPerformance
Package

AssignDrivers
AssignVehicleOwnership
AssignVehicleType
AssignVehicleTable
AssignVehicleAge
CalculateVehicleOwnCost
AdjustVehicleOwnership

HouseholdVehicles
Package

CalculateComEnergyAndEmissions
CalculatePtranEnergyAndEmissions

VE-State can be created from VE-RSPM with a few focused changes

CreateHouseholds
PredictWorkers
AssignLifeCycle
PredictIncome

SimHouseholds
Package

CalculateHouseholdDvmt
CalculateAltModeTrips
CalculateVehicleTrips
DivertSovTravel

HouseholdTravel
Package

Modules that create
simulated Bzones
(SimBzones)
with simulated land
use characteristics

SimLandUse
Package

CalculateCarbonIntensity
AssignHhVehiclePowertrain

PowertrainsAndFuels
Package

AssignTransitService
AssignRoadMiles

TransportSupply
Package

AssignDrivers
AssignVehicleOwnership
AssignVehicleType
AssignVehicleTable
AssignVehicleAge
CalculateVehicleOwnCost
AdjustVehicleOwnership

HouseholdVehicles
Package

- . Iterate X Times
- . CalculateBaseRoadDvmt
- . CalculateFutureRoadDvmt
- . CalculateRoadPerformance
- . CalculateMpgMpkwhAdjustments
- . AdjustHhVehicleMpgMpkwh
- . CalculateVehicleOperatingCost
- . BudgetHouseholdDvmt
- . BalanceRoadCostsAndTaxes

TravelPerformance
Package

End Iteration

CalculateComEnergyAndEmissions
CalculatePtranEnergyAndEmissions

Tasks

1. Test VE-RSPM code with multiple Mareas and Azones
2. Develop synthetic zone generation modules
3. Develop complete VE-STATE test dataset and test all modules

Approach to Task 1 &2 covered today...

Task 1: Testing VE-RSPM Modules to be Used in VE-STATE

- VE-RSPM tested using data for RVMPO area which has one Azone and one Marea
- VE-RSPM modules need to be tested with multiple Azones and Mareas if they are to work in VE-STATE
- Testing will be done by duplicating RVMPO Azone and Marea geography and input file entries so that they have the same values but new names.
 - Add a Marea that has 2 Azones so that the data will have 2 Mareas and 3 Azones
 - Will entail duplicating corresponding Bzone geography
 - Write an R script to make the modifications to simplify the process
- Any module errors that are found will be corrected

Task 2: Bzone Synthesis

- VE models have 4 levels of geography*
 - Region: the whole model area
 - Azone: large subdivisions of the region – e.g. counties, PUMAs
 - Bzone: subdivisions of Azones – e.g. census block groups
 - Marea: metropolitan areas – all or portions of one or more Azones that are part of an urbanized area
- VE-RSPM has a number of land use inputs at the Bzone level (modules in the VELandUse package)
- VE-STATE, like GreenSTEP and EERPAT will operate at a higher level of abstraction with no Bzone level inputs
- Bzone synthesis will create a likely set of SimBzones based on Azone and Marea level inputs so that all other modules that expect Bzone level datasets can be run

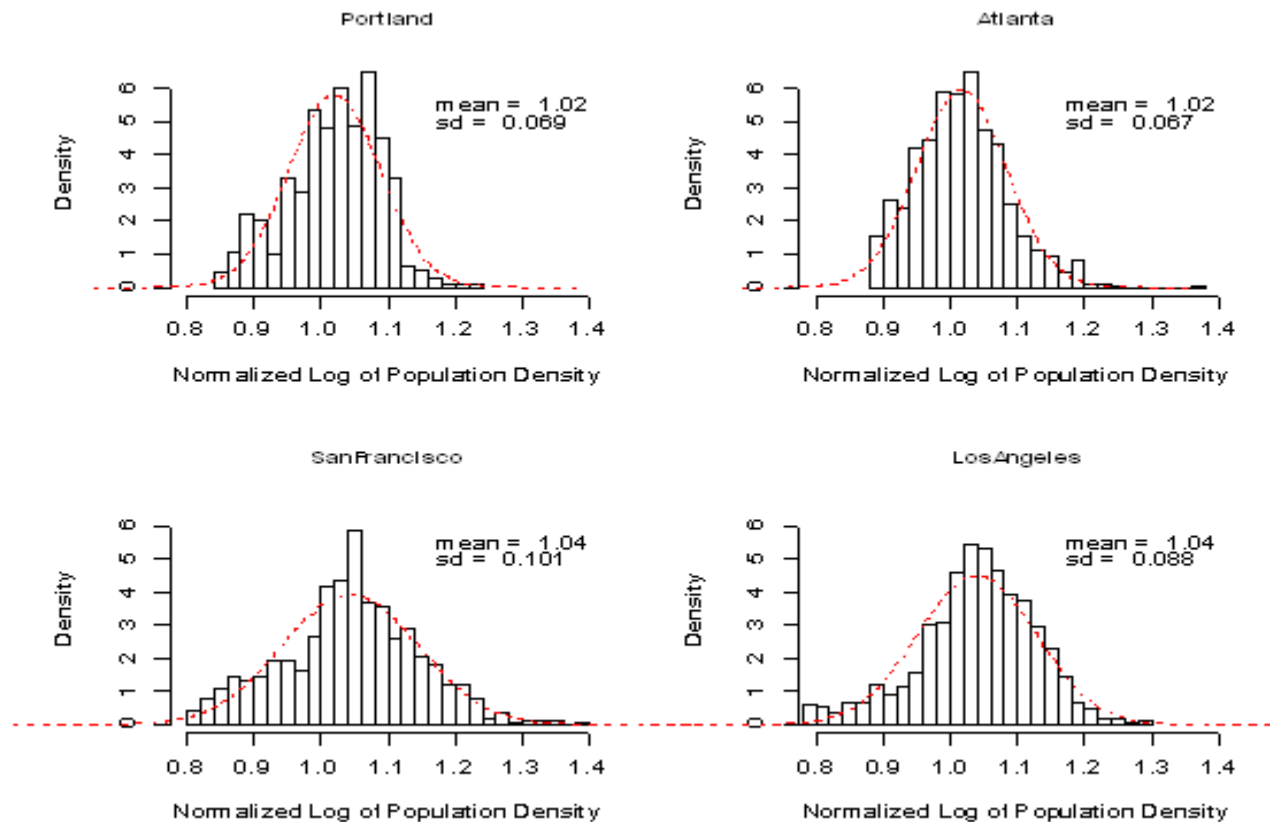
* The VE design also identifies a Czone level, but this has not been implemented in any modules

Bzone Synthesis Overview and Goals

- Create a new package – VESimLandUse – which contains modules that substitute for modules in VELandUse package
- Modules in new package will include same functionality as RSPM modules in VELandUse package but will synthesize Bzone level attributes from Azone and Marea level attributes
- Land use modeling is more complex in VE-RSPM
 - Produces 5-D measures used by new multi-modal household travel model
 - Better travel demand management and parking pricing modeling by modeling workers and assigning to worksites
 - Housing model (in RSPM but not GreenSTEP/EERPAT) produces more realistic assignment of households to density level
- VE-State Bzone Synthesis Goals
 - Mirror the land use functionality of VE-RSPM
 - Have logical and manageable inputs at the Azone and Marea level

Zone Synthesis Concept is not Foreign to GreenSTEP and EERPAT

The models synthesize a distribution of neighbor population density as a function of metropolitan area population density.



Land Use Functionality in VE-RSPM

- PredictHousing
- LocateEmployment
- AssignDevTypes
- Calculate4DMeasures
- CalculateUrbanMixMeasure
- AssignParkingRestrictions
- AssignDemandManagement
- AssignCarSvcAvailability
- RSPM predicts housing type: single family vs. multifamily
- Better assignment of households to neighborhood density
- Housing type influences other choices: vehicle ownership, vehicle type, vehicle powertrain
- Enables other performance metrics such as average income by housing type (proxy for housing cost)

Land Use Functionality in VE-RSPM

- PredictHousing
- LocateEmployment
- AssignDevTypes
- Calculate4DMeasures
- CalculateUrbanMixMeasure
- AssignParkingRestrictions
- AssignDemandManagement
- AssignCarSvcAvailability
- Assigns household workers to workplace zones
- Enables workplace parking pricing and travel demand management policies to be more targeted

Land Use Functionality in VE-RSPM

- PredictHousing
- LocateEmployment
- AssignDevTypes
- Calculate4DMeasures
- CalculateUrbanMixMeasure
- AssignParkingRestrictions
- AssignDemandManagement
- AssignCarSvcAvailability
- Assigns development types: urban vs. rural
- This will be more complex place types in VE-STATE to use place types as way to discriminate land use policies in simple way (explained in later slide)

Land Use Functionality in VE-RSPM

- PredictHousing
- LocateEmployment
- AssignDevTypes
- Calculate4DMeasures
- CalculateUrbanMixMeasure
- AssignParkingRestrictions
- AssignDemandManagement
- AssignCarSvcAvailability
- 4D measures are:
 - Density
 - Diversity (land use mixing)
 - Design (multi-modal network design)
 - Destination Accessibility
- 5th D (distance to transit) will be in this package rather than in VETransportSupply package
- Measures are used in new multi-modal travel demand module

Land Use Functionality in VE-RSPM

- PredictHousing
- LocateEmployment
- AssignDevTypes
- Calculate4DMeasures
- CalculateUrbanMixMeasure
- AssignParkingRestrictions
- AssignDemandManagement
- AssignCarSvcAvailability
- Calculates whether household is in urban mixed-use neighborhood from density
- Used in current travel model
- Will be reconciled with place type designations (see below)

Land Use Functionality in VE-RSPM

- PredictHousing
- LocateEmployment
- AssignDevTypes
- Calculate4DMeasures
- CalculateUrbanMixMeasure
- AssignParkingRestrictions
- AssignDemandManagement
- AssignCarSvcAvailability
- Parking restrictions assigned at the residence location and at the workplace location
- New residence location restrictions enable better modeling of effect of high density on auto ownership
- Assignment of workplace enables better relationship between workplace parking restrictions and household behavior

Land Use Functionality in VE-RSPM

- PredictHousing
 - LocateEmployment
 - AssignDevTypes
 - Calculate4DMeasures
 - CalculateUrbanMixMeasure
 - AssignParkingRestrictions
 - AssignDemandManagement
 - AssignCarSvcAvailability
- Better targeting of employee commute options (ECO) programs because household workers have a work location
 - Will enable better demand management models in the future because ECO program assumptions can be interacted with land use characteristics

Land Use Functionality in VE-RSPM

- PredictHousing
- LocateEmployment
- AssignDevTypes
- Calculate4DMeasures
- CalculateUrbanMixMeasure
- AssignParkingRestrictions
- AssignDemandManagement
- AssignCarSvcAvailability
- Replaces car-sharing model in GreenSTEP and EERPAT
- Enables modeling of transportation network company (TNC) and future automated car services

Bzone Attributes to be Synthesized

- **Destination Accessibility** – access to jobs and housing, measured consistent with the measurement in VE-RSPM
- **HHs:** Number of Households
- **Dwelling Type:** Split of Housing Unit Types (single family, multifamily)
- **Jobs:** Number of Jobs by Sector – retail, service, other
- **Place types:*** Somewhat like ‘development types’ (metropolitan, town, rural) used in GreenSTEP and EERPAT but including more categories
- All other SimBzone variables built from these, including:
 - Density “D” – jobs and households
 - Diversity “D” – mix of jobs and households, esp retail/service jobs
 - Design “D”
 - Distance to Transit “D” – including service frequency range
 - PlaceType – DevType *:(TOD, MixedUse, Emp, Res, Rural/Low Density)

Households are assigned to SimBzones (i.e. the SimBzone ID that each household is assigned to is added to the corresponding household record)

**PlaceTypes (AreaType & DevType) and Azone (county) designations used in specifying policy inputs*

Place Types will be similar to or the same as those used in the RPAT model

RPAT Place Types

		Regional Role (Area Type)			
		Regional Center	Close In Community	Suburban/Town	Low Density/Rural
Neighborhood Character (Development Type)	Mixed Use	✓	✓	✓	
	Employment	✓	✓	✓	
	Residential	✓	✓	✓	
	Transit Supported Development	✓	✓	✓	
	Low Density/ Rural				✓

- RPAT place types are composed of two dimensions: ‘Area Type’ and ‘Development Type’
- **‘Area Type’** in RPAT characterizes the general location and destination accessibility of the place in the region.
- **‘Development Type’** characterizes the nature of development in the place.

VE-STATE will use the RPAT meanings for ‘Area Type’ and ‘Development Type’

- **‘Development Types’** are new (not the same meaning as GreenSTEP/EERPAT ‘Development Types’)
- **‘Area Types’**
 - GreenSTEP/EERPAT ‘Development Types’ (Metropolitan, Town, Rural) will be called **Location Types**
 - Area Types will be subdivisions of ‘Location Types’

Datasets to be used to develop Bzone synthesis parameters

- **EPA Smart Location Database (SLD)** – information for the entire U.S. on estimated population, employment, area (protected and unprotected), transportation characteristics, etc. by block group (2010)
- Augmentation of SLD with:
 - Texas Transportation Institute's **Urban Mobility Study** (e.g. road lane miles)
 - **National Transit Database** (e.g. transit revenue miles)
- **Census** data on housing types at the block group level

Bzone Synthesis Steps

Creating SimBzones

User provided inputs:

- Azone proportional split of dwelling units by location type*
- Azone proportional split of workers by jobsite location type*
 - For example proportions of rural residents in the Azone who work in rural locations, town locations, or the metropolitan area
- Marea proportional split of Marea employment among Azones

VE-State calculates:

1. Total activity – households and jobs – is calculated by Azone and location type
2. The number of synthetic Bzones is calculated using an average amount of activity per SimBzone estimated from SLD (may vary by location type)

* Location Types: Metro/Town/Rural

Bzone Synthesis Steps

Calculating Azone Activity Density

User provided inputs:

- Azone base year developable area by location type*
 - i.e. the urbanizable area within cities that is not excluded from development (waterways, large parks)
- Azone ratio of growth of developable area to activity growth by location type*
 - e.g. a value of 1 means that developable area grows in direct proportion to activity which implies that activity density does not change over time

VE-State Calculates:

1. Future year developable area is calculated from base year developable area, the change in activity from base to future, and relationship of developable area growth to activity growth
2. Activity density by Azone and location type* is calculated from the amount of activity and developable area
 - Different approach for rural locations

Bzone Synthesis Steps

Calculating SimBzone Destination Accessibility

1. Destination accessibility is a measure of the amount of activity that can be reached from a location within some parameters of distance (VE-RSPM), time, or cost. If destination accessibility is measured in terms of distance, then it is in effect a larger scale density measure.
2. Destination accessibility in VE-STATE will be represented in the same terms as in VE-RSPM, but since VE-STATE has no distances a model will be developed using data from the SLD to predict a likely distribution of destination accessibility as a function of metropolitan activity density and other characteristics.
3. The destination accessibility of each SimBzone in a metropolitan area will be determined by applying the destination accessibility model to get the distribution of values and then sampling from the distribution.

Bzone Synthesis Steps

Calculating SimBzone Activity Density

1. A model will be developed using SLD data which estimates the relationship between SimBzone activity density and destination accessibility.
2. The model will be applied to calculate a preliminary value of activity density for each SimBzone.
3. Iterative proportional fitting will be used to adjust densities and destination accessibilities so that the activity levels by Azone and location type* match the values calculated earlier

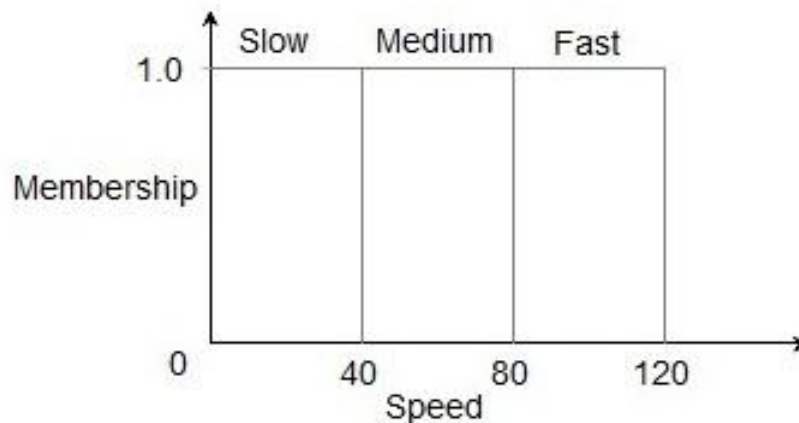
* Location Types: Metro/Town/Rural

Bzone Synthesis Steps

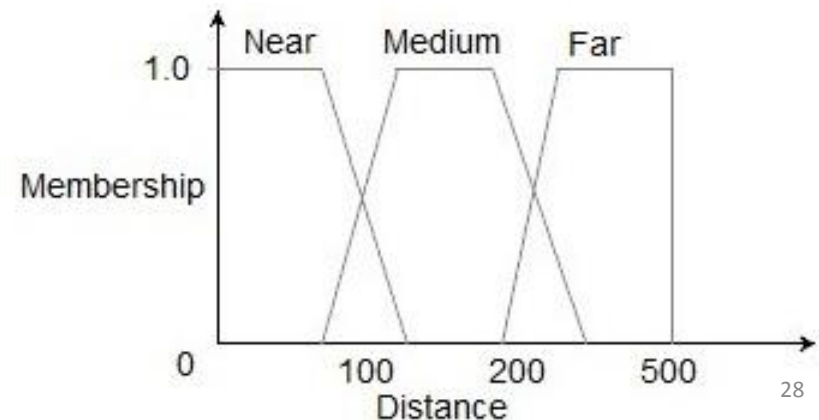
Assigning SimBzone Area Type

1. Bzone area types – regional center, close-in community, suburban/town, low density/rural – will be assigned to each SimBzone as a function of destination accessibility and activity density
2. Area type designations will be ‘fuzzy sets’ in which SimBzones will have degrees of membership
 - Smoother policy response, eliminating boundary effects
 - Better representation of uncertainty

Example of Crisp Set



Example of Fuzzy Set



Bzone Synthesis Steps

Splitting SimBzone Activity into Housing and Jobs

VE-State calculates SimBzone attributes:

1. A model will be developed from the SLD data to calculate the proportions of housing and jobs in a SimBzone. Independent variables could include destination accessibility, area type, and activity density.
2. The model will be applied to determine initial SimBzone splits for SimBzones in metropolitan areas. Numbers of households and jobs will be computed from the initial splits and SimBzone activity.
3. Iterative proportional fitting or some other technique will be used to adjust the initial SimBzone household and job values so that they match metropolitan area and Azone controls previously calculated.

Bzone Synthesis Steps

Assigning Housing Types and Households

VE-State calculates SimBzone distributions:

1. A model will be developed to calculate the ratio of single family and multifamily dwellings in a SimBzone as a function of the SimBzone activity density. This will draw on earlier work done for GreenSTEP but not implemented.
2. Application of the model will provide an inventory of the numbers of single family and multifamily dwelling units in each Bzone. These numbers will be summed up for SimBzones in a metropolitan area to get the metropolitan area supply.

VE-State Household assignment to SimBzones:

1. The RSPM housing model will be applied to assign each household a housing type.
2. Households in each Azone will be randomly assigned to SimBzones in the Azone based on their housing type and the supply of housing of that type in each SimBzone. Assigned SimBzone IDs are attached to household table records.

Bzone Synthesis Steps

Assigning Job Types and Worker Locations

VE-State calculates SimBzone distributions

1. Three types of jobs (i.e. employment sectors) are recognized in VE-RSPM and the land use measures used in the multi-modal travel model: retail, service, other.
2. A model will be developed using the SLD data to split SimBzone jobs into the 3 types. Possible independent variables include destination accessibility, area type, jobs/housing mix, and activity density.
3. The model will be applied to determine the SimBzone jobs by type.
4. Thought needs to be given as to whether there should be control totals on the mix for a metropolitan area. If so, IPF or some other adjustment process would need to be used to match the totals.

VE-State worker jobsite assignment to SimBzones

1. Workers will be assigned to SimBzone job locations based on SimBzone job quantities, Azone splits of worker location types, and possibly worker and jobsite area types. Assigned SimBzone IDs are attached to worker table records.

Bzone Synthesis Steps

Assigning Development Types

User provided input:

- Target Proportional split of Development types by Marea

VE-State calculates SimBzone “Diversity” & “Transit” Ds & Development Types:

1. Density and diversity land use measures will be calculated consistent with how the measures are calculated for the VE-RSPM.
2. The distance to transit measure will be modeled for metropolitan SimBzones as a function of the metropolitan-level transit supply measure and the SimBzone attributes for destination accessibility, density, and mixing. A combination of National Transit Database (NTD) and SLD data will be used to develop this model. The structure is to be determined.
3. Development types – mixed use, employment, residential, transit-oriented development – will be assigned to SimBzones based on the density, diversity, and distance to transit measures. These development types, like the area types may be fuzzy sets. The SLD will be used to create the development type specifications.

Bzone Synthesis Steps

Assigning Network Design Measures

User provided input:

- Target Proportional split of Design Level by Azone & Place Types (DevType & AreaType), TBD

VE-State calculates SimBzone “Design” D:

1. Network design measures used by multi-modal travel model are measures of multi-modal transportation network density and pedestrian-oriented network density (e.g. links per square mile).
2. The SLD will be used to identify ranges of values by area and development type.
3. Values will be assigned to SimBzones based on the estimated values and user goals.

Bzone Synthesis Steps

Assigning Parking, TDM, and Car Services

User provided input:

- Target Proportional split of Design Level by Azone & Place Types (DevType & AreaType), TBD

Notes:

- The assignment of parking pricing policies, travel demand management (TDM) policies, and car service availability assumptions is done at the Bzone level in VE-RSPM.
- Assignment of these in VE-STATE will be done at the Azone level combined with area type and development type.
 - For example with parking pricing, there might be a charge for parking in a regional center area type within an Azone but not in any other area.
- Since every SimBzone has an associated area type and development type, user inputs will be mapped to SimBzones.
- More thought needs to be given to how to make the inputs manageable because if values are required for all area type and development type combinations, the user would have to supply 13 entries for each value (e.g. parking cost, available free parking spaces, etc.)

Comments on Approach

Question, Ideas, Concerns?



Next Steps

Meeting #2: **July 5, 2018** 9:30-11am pacific

- ❑ Share “Integration Plan” pre-meeting
 - Lit review, data sources, place types, EEPAT/RPAT
 - VE-State inputs, synthesize Bzone approach
 - Validation tests of synthesized zone
 - VisionEval framework impacts
 - Build in development branch (test log/modules)
- ❑ Discuss Plan @ Meeting #2, for input prior to implementation

MODULE TESTING/IMPLEMENTATION

Interim Status Updates

- Post-meeting wrap-up
- Monitor/comment at interim points
 - 2-3 points, 1st in mid-August
 - Status Reports on Wiki
 - Email comments; post to Wiki
- Contact team if you have Qs

Meeting #3: **Oct 3** 11-12:30pm pacific – Report out, prior to final “real world” Test

Meeting #4: **Dec 4-6 (TBD)** – Final Report

VE-State Pilot -- Work Program

Draft VisionEval-State (GreenSTEP) Conversion Schedule										May	June	July	Aug	Sept	Oct	Nov	
0. Task Management, Oversight Group/project meetings											OT		OT		OT		OT
1. Test RSPM Code with Multiple Mareas and Azones																	
1.A. Create Multiple Azone/Marea Test Dataset																	
1.B. Test RSPM Code with Multiple Azone/Marea Test Dataset and Correct Errors																	
2. Develop GreenSTEP Synthetic Zone Generation Modules																	
2.A. Create Project Package and Identify Necessary Zone Attributes																	
2.B. Review Spatial Simulation Literature and Develop Concepts to Test																	
2.C. Test Concepts and Choose Approach																	
2.D. Develop Zone Synthesis Modules																	
3. Develop Complete GreenSTEP Dataset and Test Full Model Run																	
3.A. Create State Test Dataset																	
3.B. Test Modules with State Test Dataset and Correct Errors If Any																	



VisionEval Geography

VisionEval Geography	VE-RSPM	VE-State
Region	Metropolitan region	State
Azone	Division (city jurisdiction)	County
Bzone	District (block group)	[SimBzone, aspatial]
Czone	[optional]	[optional]
Marea	Single	Multiple

+ Real World Test

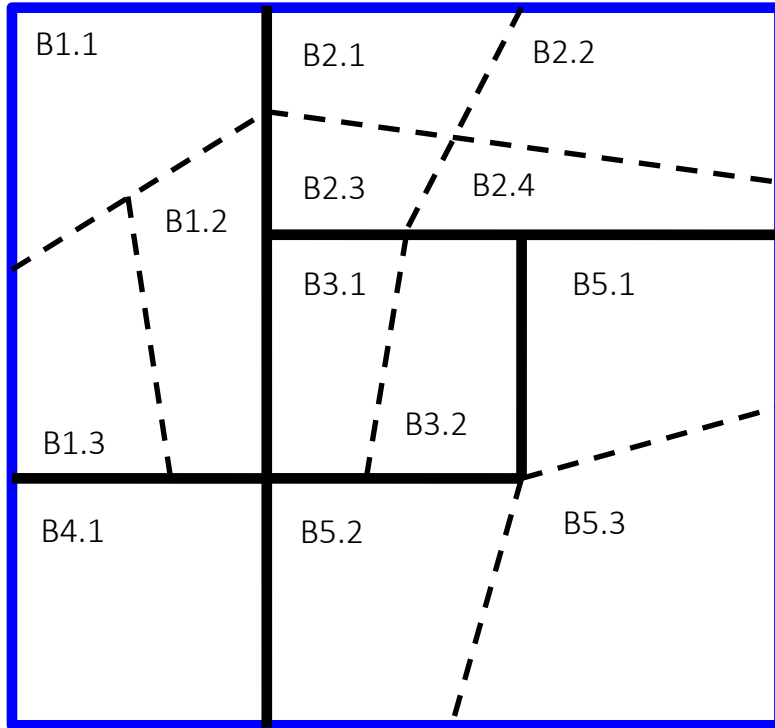
(Replace Metro-Town-Rural with AreaType-DevType/5Ds)

Other uses of VE-State's Synth Zone Module:

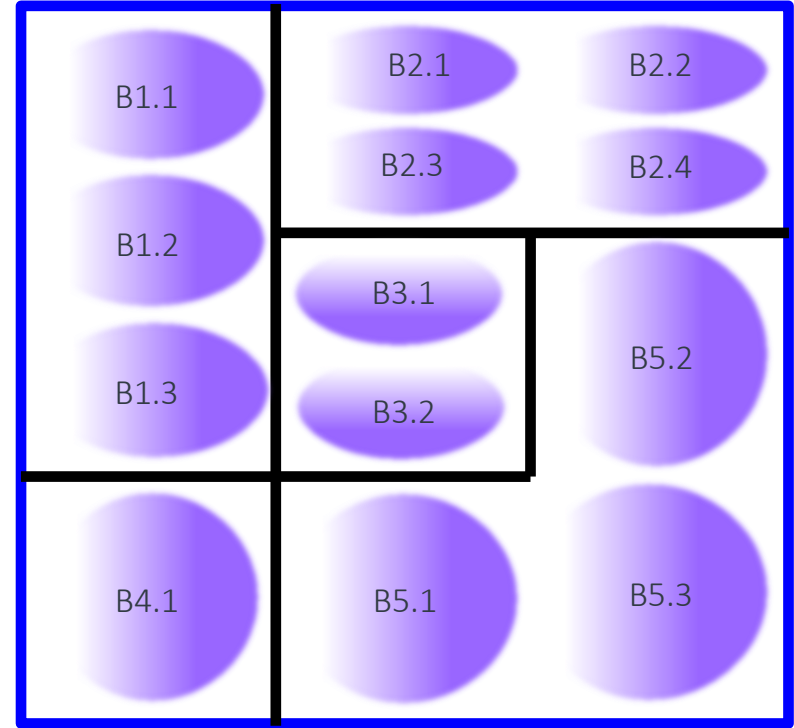
- Alternative Inputs to VE-RSPM
- Allow VE-RPAT to use VE-RSPM modules
- Develop land use scenarios to use/disaggregate in outside travel demand models




The Region is subdivided into Azones that are subdivided into Bzones. Bzones may be real or synthesized.

REAL



SYNTHESIZED



	VE-RSPM	VE-State
	Region	Metropolitan region
	Azone	Division (city jurisdiction)
	Bzone	District (block group)
		[SimBzone, aspatial]

VE-RSPM Multi-Modal Model

ODOT Research Project #788, Liming Wang/PSU

- Updating Models with the Latest and Best Data Available
- Added Built Form 5Ds available for other modules (EPA SLD data)
- Better Representation of Multi-Modal Travel
- Improved Auto Ownership Model
- Implemented in VE-RSPM

BZone variables in the future VE-RSPM multi-modal

BlockGroup Attributes	
GEOID10	Census block group 12-digit FIPS code
SFIPS	State FIPS Code
TOTPOP10	Total Population , 2010
WORKERS	Number of workers (home location), 2010
EMPTOT	Total Employment , 2010
E5_RET10	Retail jobs within a 5-tier employment classification scheme (LEHD:CNS07)
E5_SVC10	Service jobs within a 5-tier employment classification scheme (LEHD: CNS12 + CNS14 + CNS15 + CNS16 + CNS19)
Metropolitan-wide Measures	
	US Census Region (CENSUS_R: 01="NE", "02"="MW", "03"="S", "04"="W")
	Transit miles per cap (NTD-based)
	Freeway lane miles per cap (TTI, UMR)
	Arterial lane miles per cap (TTI, UMR)
DENSITY	
D1B	Gross population density (people/acre) on unprotected land
DIVERSITY	
D2A_EPHHM	Employment and household entropy
D2A_WRKEMP	Household workers per job
D1b*D2a_EPHHM	<i>Interaction</i> : Residential density & Employment per Household diversity
DESIGN	
D3bpo4	Intersection density (pedestrian-oriented intersections having four or more legs per square mile)
DISTANCE (TO DECENT TRANSIT)	
D4c	Aggregate frequency of transit service (within 0.25 miles of block group boundary per hour during evening peak period)
D4c*TrSvcMiPerCap	<i>Interaction</i> : Local Transit Access & Regional Transit Service Level
(ACCESS TO) DESTINATIONS	
ACCESS	Harmonic mean of Employment within 2 mi and Pop within 5mi $((2 * JOBS * POP) / (JOBS + POP))$

Example of How to Develop Place Types 5Ds -> Oregon Place Types

1 BUILT ENVIRONMENT VARIABLES

Built Environment Variables	Destination Accessibility	Share of Regional Jobs within 5 miles (ratio)	H-M-L-VL
	Density	Jobs & Households per acre within 0.25 mile	H-M-L-VL
	Design	Multi-modal & Pedestrian-Oriented street density (links per sq mile)	H-L
	Diversity	Jobs (total or retail- service) to household ratio, within 0.25 mile	H-L
	Transit Service Level	PM Peak hourly transit service within 0.25 mile	H-M-L-VL

2 REGIONAL ROLE (Area Type)

		Destination Accessibility			
		H	M	L	VL
Design	H	Regional Center	Close In Community	Suburban/Town	
	M				
	L VL				
Density	VL	Low Density/Rural			

3 NEIGHBORHOOD CHARACTER (Development Type)

	Density	Design	Diversity	Transit
Mixed Use	M	M	H	
	H	H	H	
Employment	Not MIXED		Jobs>HHs	
Residential	Not MIXED		HH>Jobs	
Transit Supported Development	H	H	H	H
	H	H	Jobs>HHs	H
Low Density/Rural	VL			



4 LAND USE PLACE TYPES

Neighborhood Character (Development Type)	Regional Role (Area Type)			
	Regional Center	Close In Community	Suburban/Town	Low Density/Rural
	Mixed Use	✓	✓	✓
	Employment	✓	✓	✓
	Residential	✓	✓	✓
	Transit Supported Development	✓	✓	✓
Low Density/Rural				✓

Source: Oregon Place Types, 2018.

VE-State Inputs – 1st cut

Existing Inputs:

Data: PUMS, NHTS data

- **County Population** by age (baseyear and growth relative to pop growth)
- County Population by DevType* (baseyear and growth relative to pop growth)[**Marea pop**]
- Land Use acres by DevType* (baseyear and growth relative to pop growth)[**Density**]
- Statewide per Capita Household **Income**
- **Unchanged Policy Inputs, e.g.** Vehicles & Fuels, etc.

**Current Development Type (Metropolitan, Town, Rural) replaced with Place Type-- DevType and/or AreaType*

Potential New Inputs:

Data: SLD; Placetypes_USA

- **Employment** by type by DevType*
- **%Workers that work outside** County/MArea by MArea and DevType/AreaType* (e.g., LEHD)
- **Average Household size** by county & Marea, DevType/AreaType*
- **Housing Supply** (SF/MF) by county & MArea and DevType/AreaType*
- **% HHs within walking/biking distance to Transit** by County/MArea and DevType/AreaType*
- **%Design level** by County/MArea and DevType/AreaType*
- **Changed Policy inputs** by County(AZone), MArea and DevType/AreaType*
 - **Parking price & Coverage***
 - **TDM*** (work location AZone/County) & Individualized Marketing Program* (home location AZone/County only)
 - **Car Service**, coverage and cost by County(AZone), MArea and DevType/AreaType