

# Modeling Various Tolling Schemes Using Emme: Seattle Experience

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# Presentation Outline



- Purpose
- Toll modeling methods/approaches
- Seattle Experience
  - Four toll feasibility studies
- Reflections & thoughts

# Presentation Purpose



- Tolling as a tool to finance highways and manage congestion
- Toll feasibility studies in the Seattle Region
- Challenges faced in modeling highway tolls
- Future modeling needs

# Toll Modeling Methods/Approaches



- Ad-hoc non-network-based methods
- 4-Step modeling process
  - Primary reliance on route choice effect using generalized costs assignment process
  - Reliance on toll choice models capable of simulating toll cost effect discretely thru trip distribution, mode choice and assignment steps
- Activity-based models (ABM)
- Role of mesoscopic & micro-simulation models

# Data Requirements



- Survey data
  - Revealed/Stated Preference (VOT)
- Counts data
- Speed measurements
- Network update/refinement
- Model estimation & validation

# Model/Approach Selection



- Assess toll study level & focus
  - Sketch level, Toll feasibility or Investment Grade
  - Congestion management vs. revenue maximization
  - Tolling schemes (e.g., dynamic pricing, single-point, segment, etc.)
  - Tolling general purpose lanes or HOV lanes
  - Budget & schedule
- Determine appropriate method/approach

# Seattle Experience



- All toll studies at feasibility/preliminary assessment level
- Current PSRC 4-step model deemed adequate
- Performed network refinement & validation analysis relevant to the study/project corridor

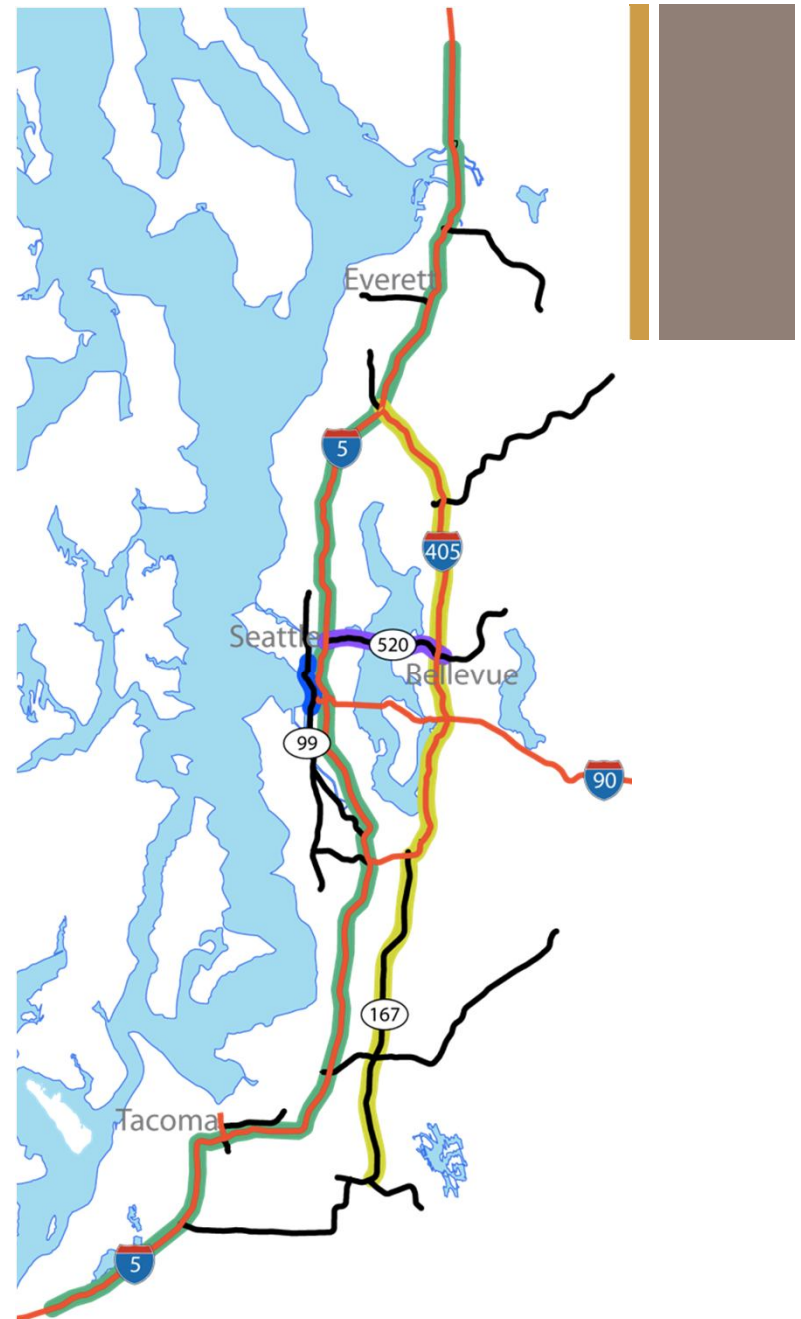
# Tolling Schemes Studied



- Single point tolling
- Segmental tolling
  - Ramp to ramp toll rates (OD level)
  - Toll rates within a defined highway segment and between segments
  - Distance-based tolling and class-specific tolling

# Example Toll Feasibility Studies

- SR 99 Alaskan Way Viaduct Replacement Finance Plan
- SR 520 Toll Traffic and Revenue Technical Report – 2008
- Sketch Level Feasibility Study – East Corridor Tolling Study (I-405/SR 167)
- I-5 Express Lane System Pre-Design Study



## SR 99 Alaskan Way Viaduct FP

A two-mile-long tunnel replacing the existing viaduct

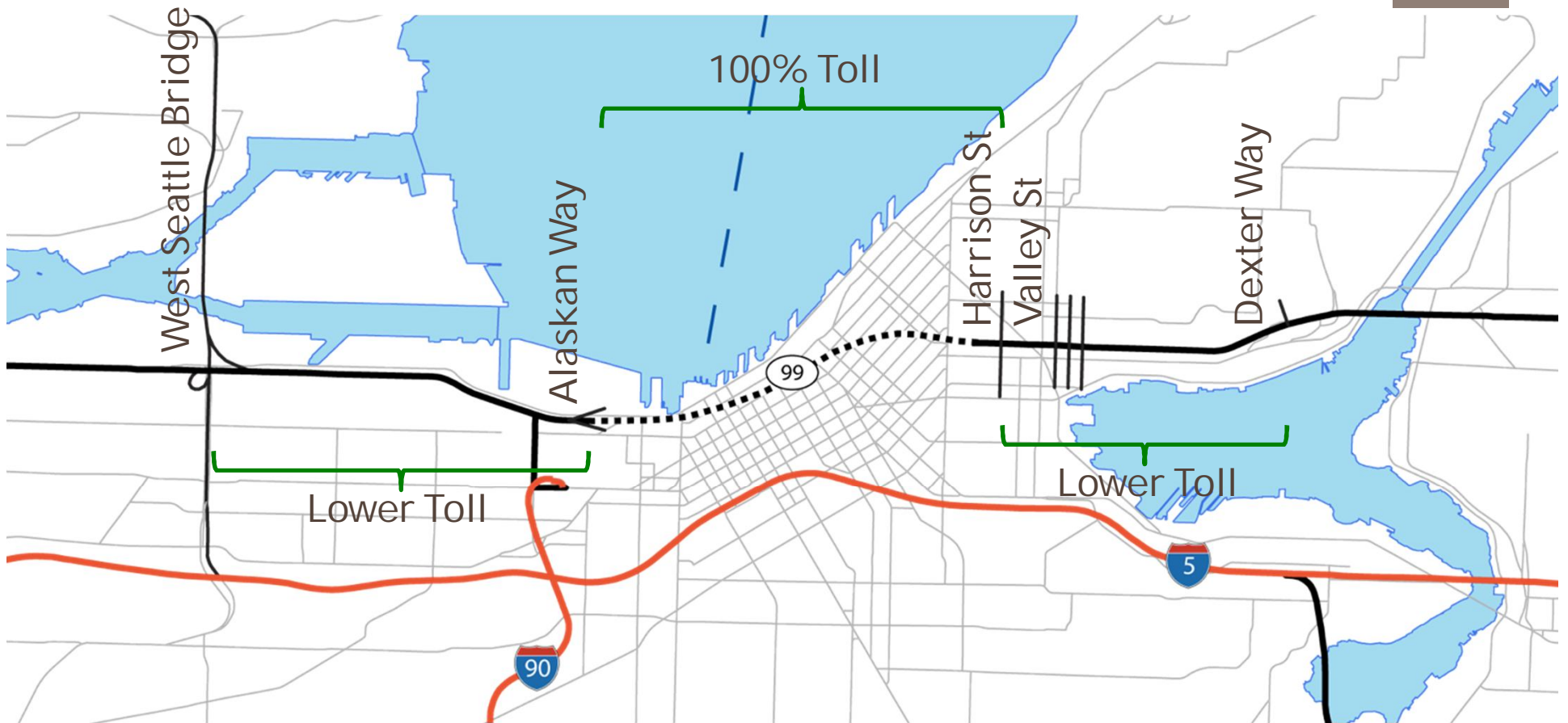
Surface street improvements

Tolls as a funding mechanism

Segmental tolling concept was evaluated



# SR 99 Toll Scheme



Lower tolls are applied only for vehicles not using the tunnel, but using the sections shown above.

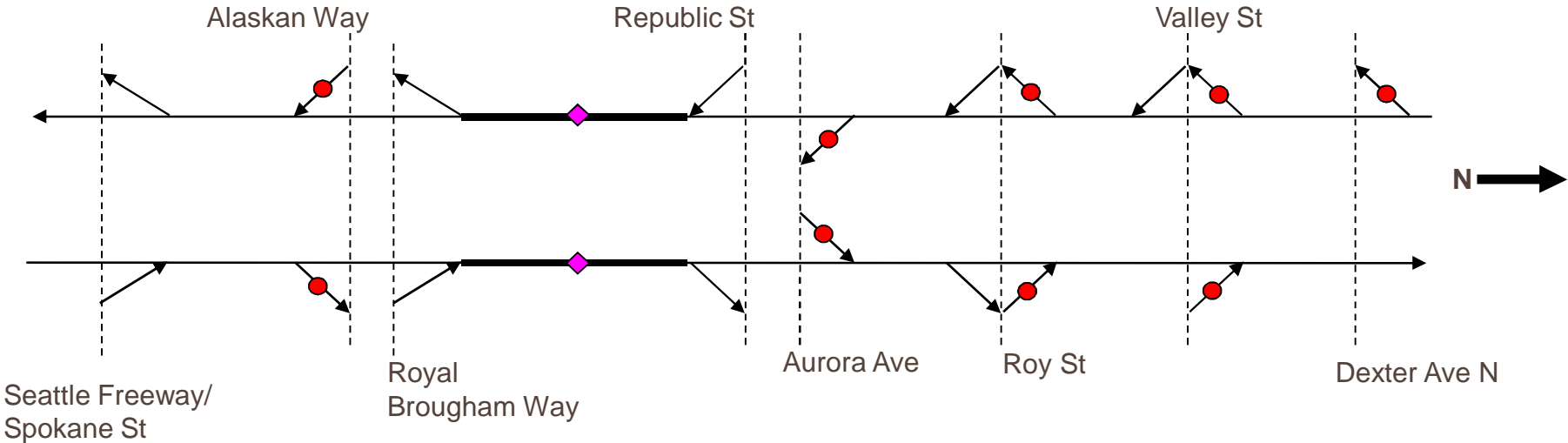


Tolling scheme shown was analyzed but is not planned for implementation.

# SR 99 Toll Coding

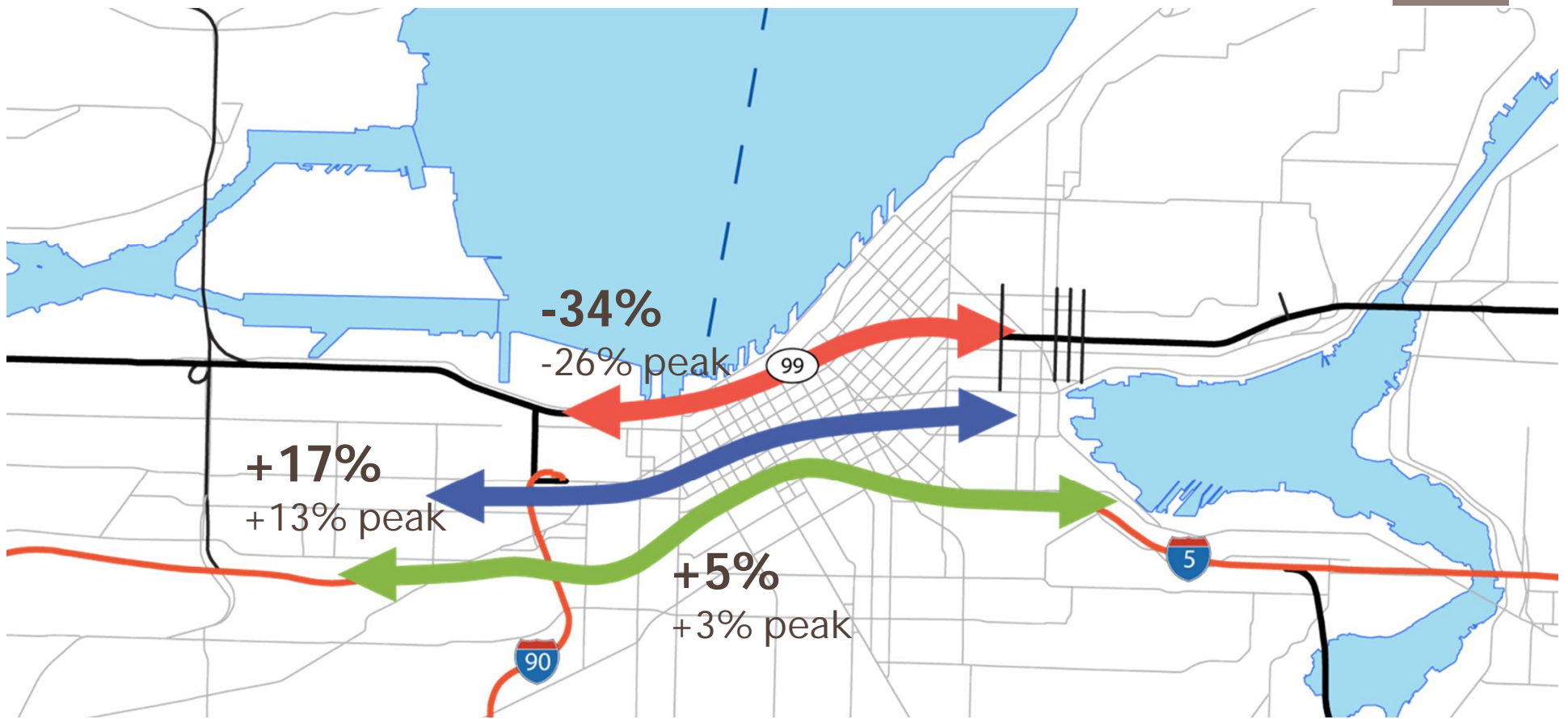


Southbound



- Segmental Tolling
- ◆ Tunnel Tolling

# SR 99 Toll Diversion



N →

# SR 99 Highlights

## Challenges

- Capturing toll diversion on the local streets
- Level of Service issues on the local streets

## Approaches/Resolutions

- Diverting trips are captured by tolling ramps
- Dense network – difficult to capture true diversion
- Need for a mesoscopic and microscopic level of analysis

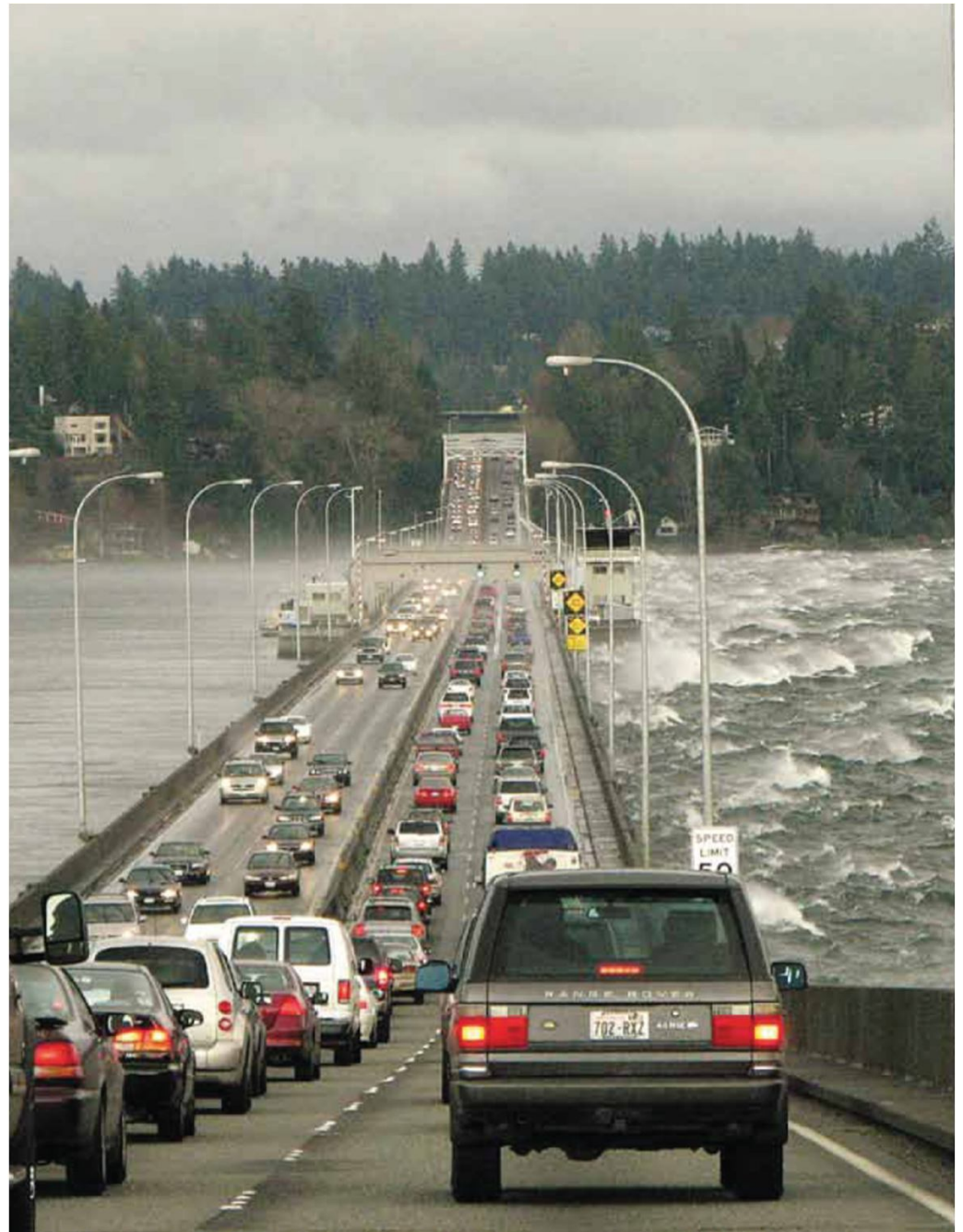
# SR 520 Tolling & Revenue Report

Replacement of the aging floating bridge

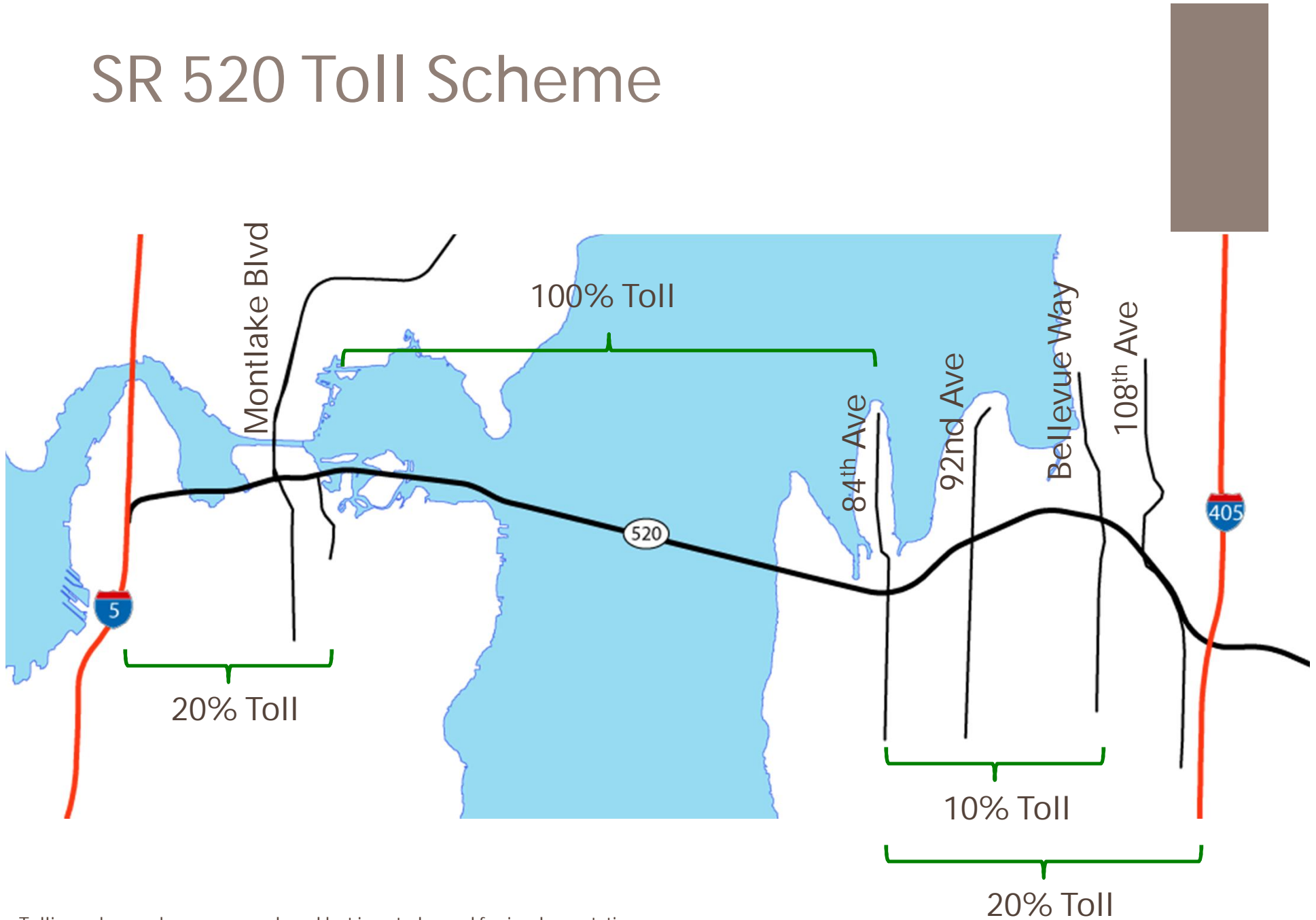
Other corridor and interchange improvements

Tolls as a funding mechanism

Segmental tolling concept was evaluated

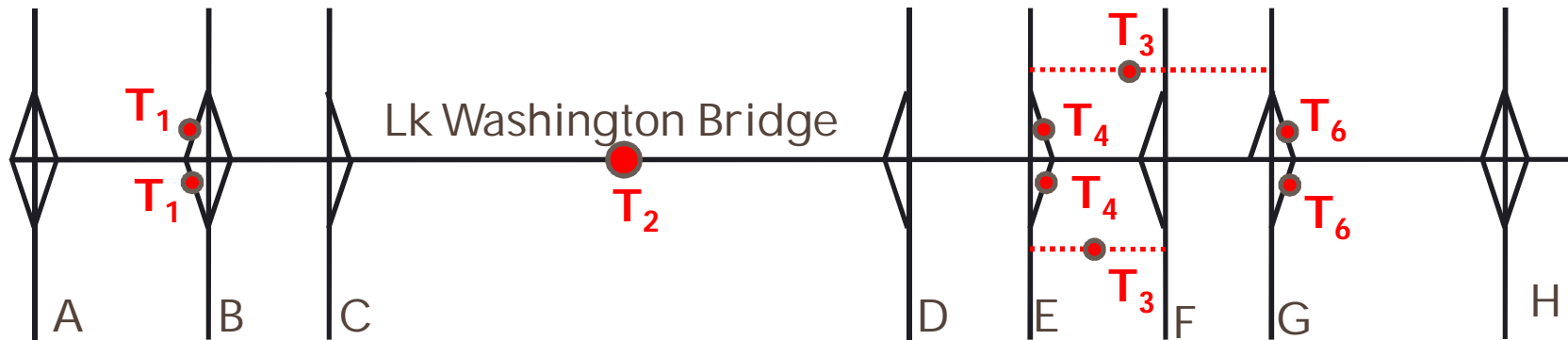


# SR 520 Toll Scheme



Tolling scheme shown was analyzed but is not planned for implementation.

# SR 520 Toll Coding

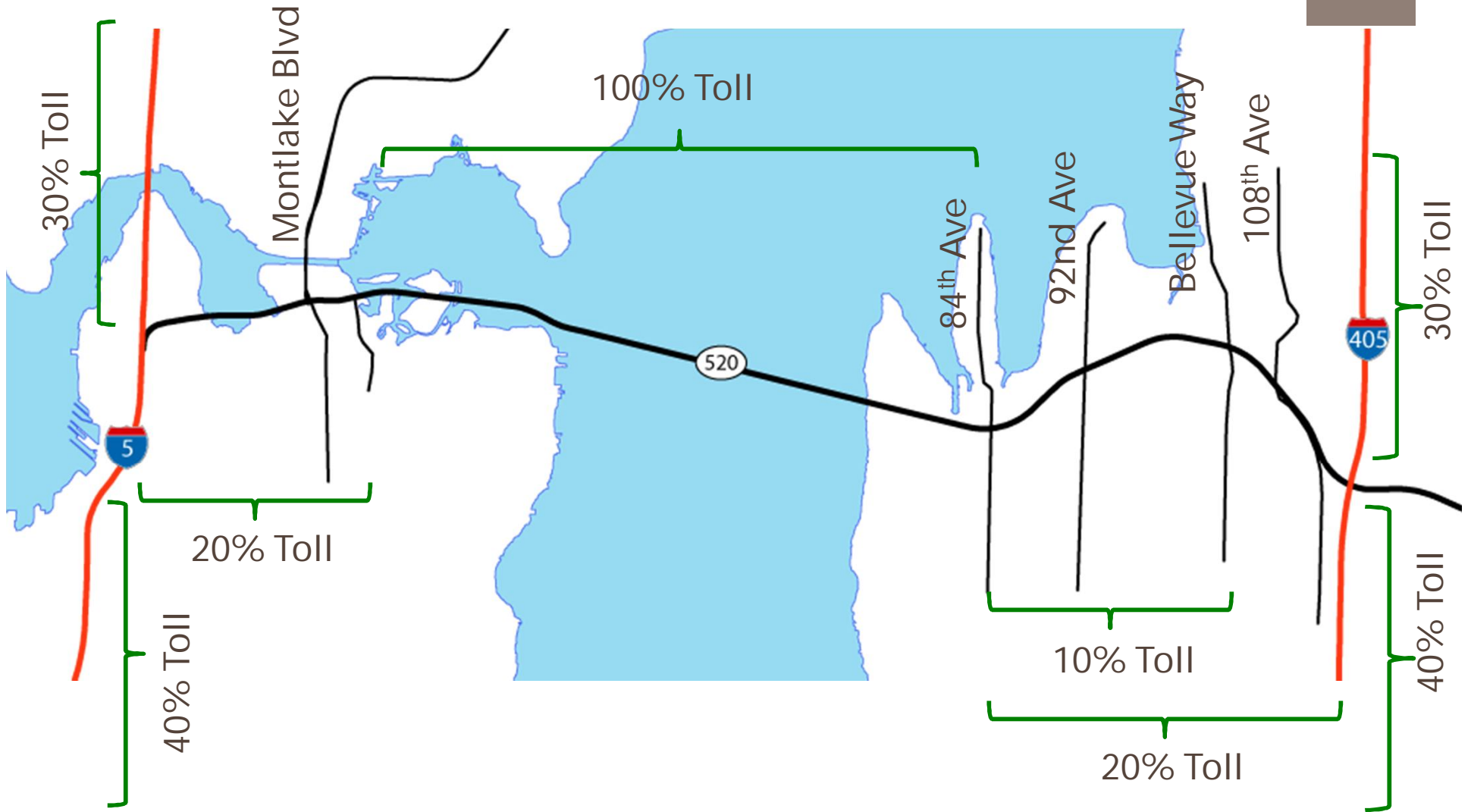


..... Dummy links for tolling

	A	B	C	D	E	F	G	H
A	-	T <sub>1</sub>	-	T <sub>2</sub>	-	T <sub>2</sub>	-	T <sub>2</sub>
B	T <sub>1</sub>	-	-	T <sub>2</sub>	-	T <sub>2</sub>	-	T <sub>2</sub>
C	-	-	-	T <sub>2</sub>	-	T <sub>2</sub>	-	T <sub>2</sub>
D	T <sub>2</sub>	T <sub>2</sub>	T <sub>2</sub>	-	-	-	-	-
E	-	-	-	-	-	T <sub>3</sub>	-	T <sub>4</sub>
F	T <sub>2</sub>	T <sub>2</sub>	T <sub>2</sub>	-	T <sub>3</sub>	-	-	-
G	T <sub>2</sub>	T <sub>2</sub>	T <sub>2</sub>	-	T <sub>3</sub>	-	-	T <sub>6</sub>
H	T <sub>2</sub>	T <sub>2</sub>	T <sub>2</sub>	-	T <sub>4</sub>	-	T <sub>6</sub>	-

- T<sub>1</sub> - 20% Toll**
- T<sub>2</sub> - 100% Toll**
- T<sub>3</sub> - 10% Toll**
- T<sub>4</sub> - 20% Toll**
- T<sub>6</sub> - 20% Toll**

# SR 520 - Extended Tolling Scheme



# SR 520 Highlights

## Challenges

- Imposing ramp-to-ramp, OD level tolls using currently available tools in Emme

## Approach/Resolutions

- OD level tolls modeled using dummy links
- Dummy links concept worked because:
  - Fewer number of interchanges
  - Relatively simple tolling scheme
  - Nearly impossible for more involved schemes or longer corridors

Sketch level  
feasibility:  
I-405/SR167

Variety of corridor  
improvement, including  
widening

Tolls as a funding  
mechanism

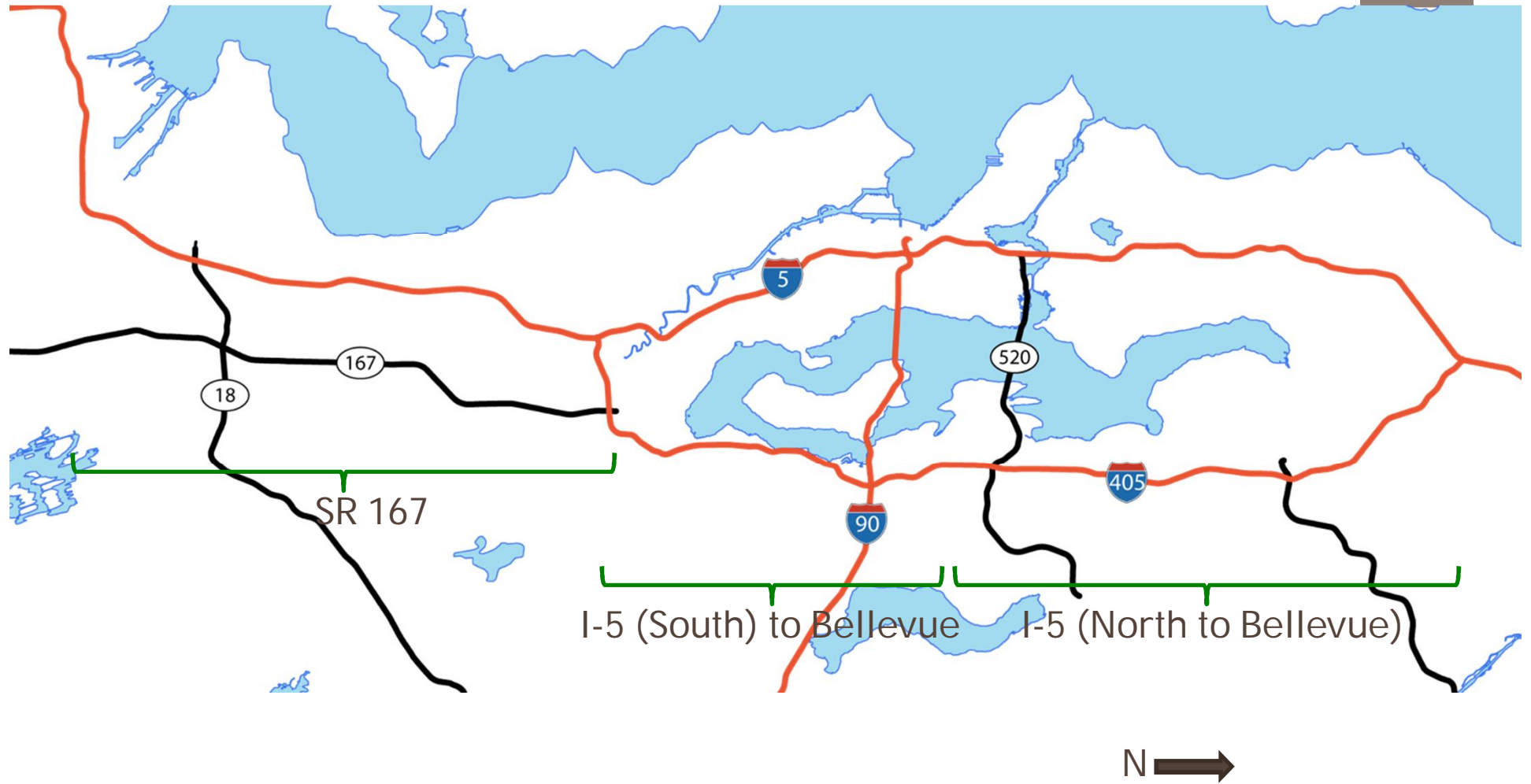
Tolling GP lanes as an  
alternative to HOT lanes

Tolling I-405 and SR 167  
at a simple segmental  
rate

Quick study



# I-405 Toll Scheme



Tolling scheme shown was analyzed but is not planned for implementation.

# I-405/SR 167 Highlights

## Challenges

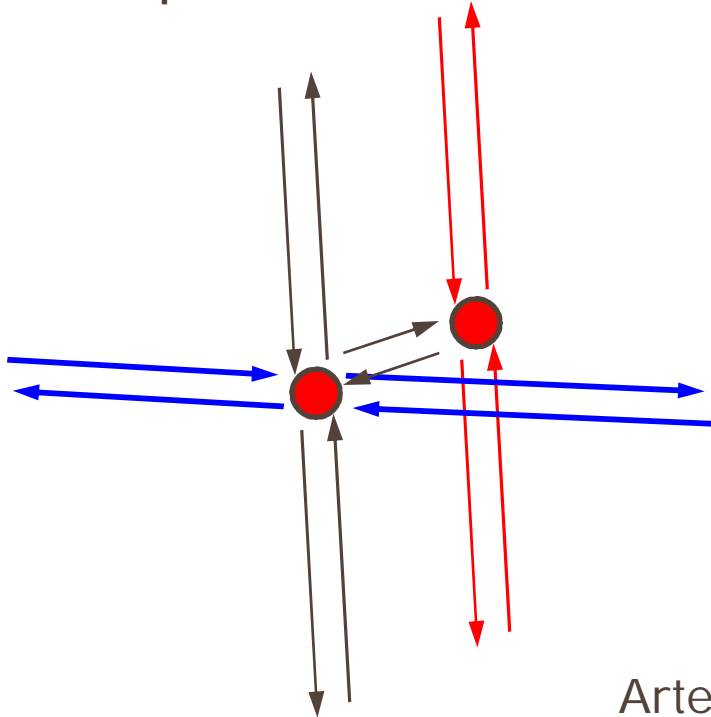
- Perform the study within 3 weeks to support policy discussion
- Segregating the freeway movements to capture all toll movements on links
- Keep HOV trips toll-free and using the HOV links

## Approaches/Resolutions

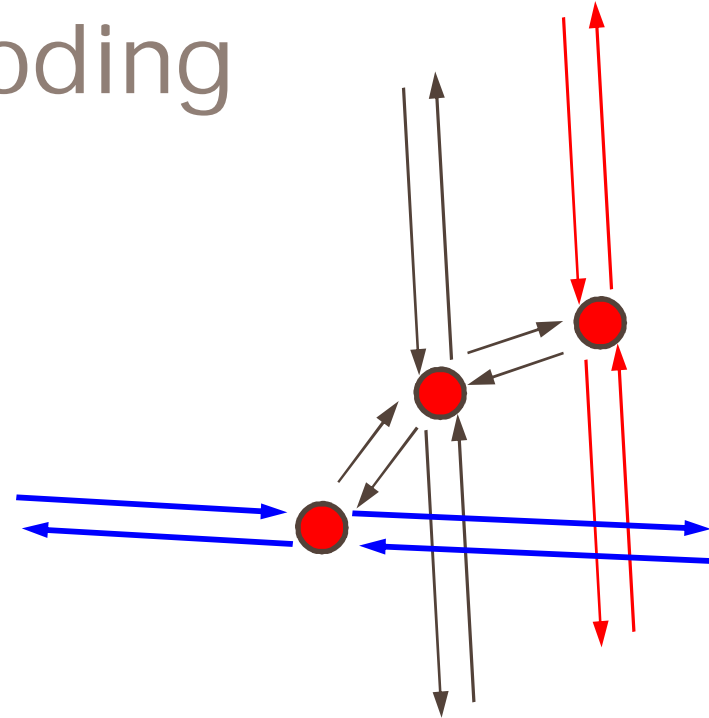
- Minimize model changes:
  - Network
  - VOT
  - Model Procedures
- Captured all the required tolling movements
- The coding scheme does not identify highway ramp movements by direction
- Assignment properly handled HOV trip assignment

# I-405/SR 167 Toll Coding

Arterial through movement  
not separated from the  
ramp volumes



Arterial-HOV movement  
prohibited through  
turning restrictions



Highway ramp movement  
separated – by entry/exit.  
Not by direction.

- I-5 GP
- I-5 HOV
- Arterial



# I-5 Express Lane System: Pre-Design Study

91-mile corridor

Variety of highway improvements

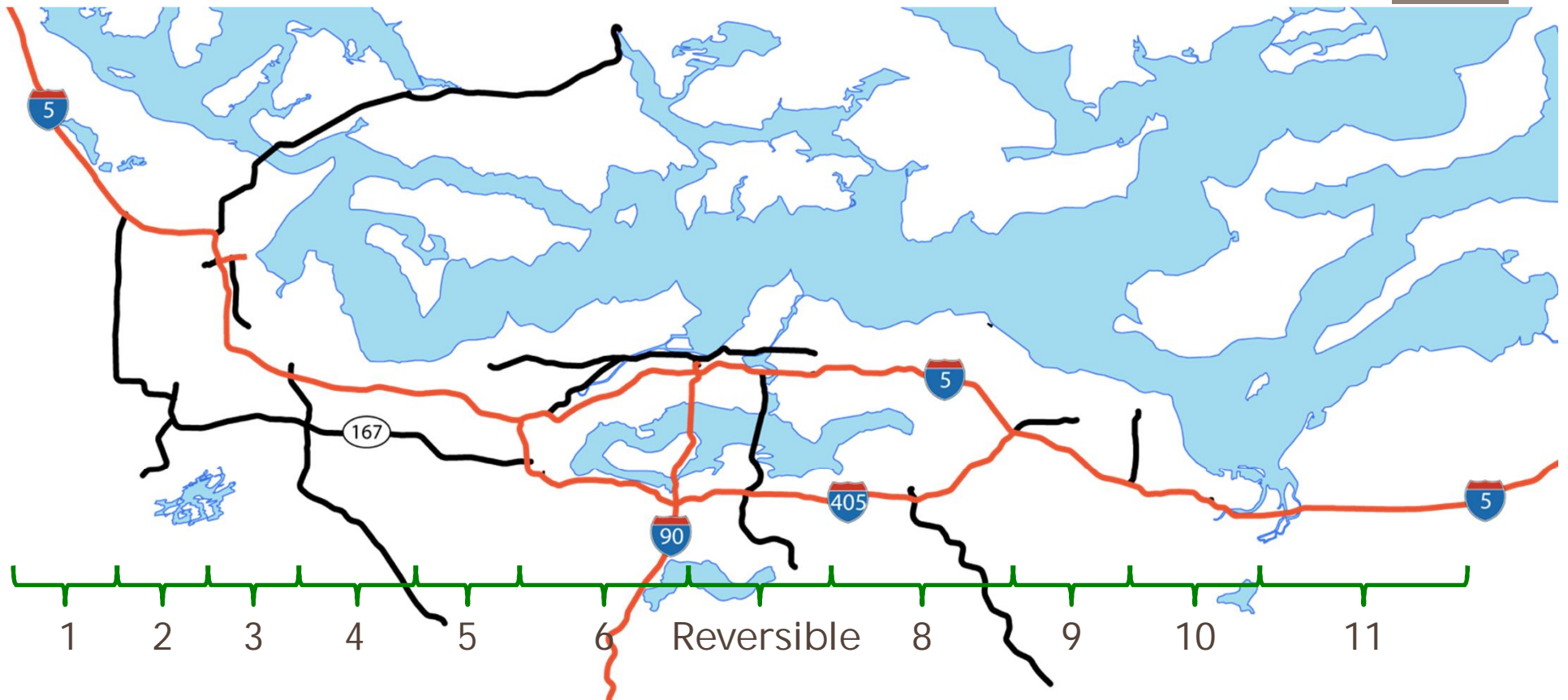
Tolls as a funding mechanism while creating travel options

Three Toll Facilities

- HOV to HOT conversion
- New HOT lanes
- Tolling of existing Reversible Lanes



# I-5 Toll Scheme



Tolling scheme shown was analyzed, but will not necessarily be selected for implementation.

# I-5 Highlights

## Challenges

- Coding segment tolls with a new network coding convention
- Study area length, 91miles, along with the links involved
- Existing VOTs do not necessarily consider variability in VOT by trip
- Limited time and budget for model updates




## Approaches/Resolutions

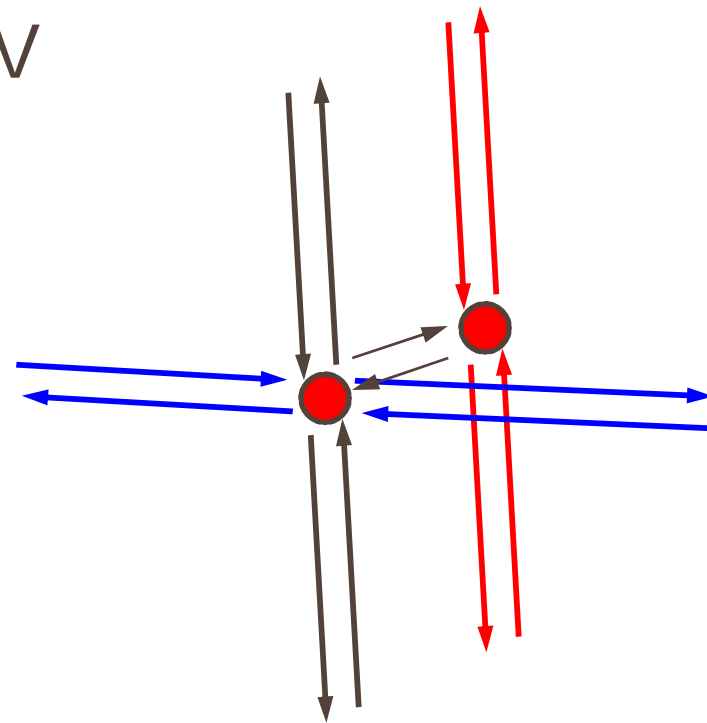
- The coding convention allows for identification of highway ramp movements by direction directly on the links
- Captured all the required tolling movements, including open tolling
- Existing PSRC VOT used
- Extensive QC of turning movements and tolled links

# I-5 Express Toll Lanes Coding

Arterial through movement  
not separated from the  
ramp volumes or GP-HOV  
connector

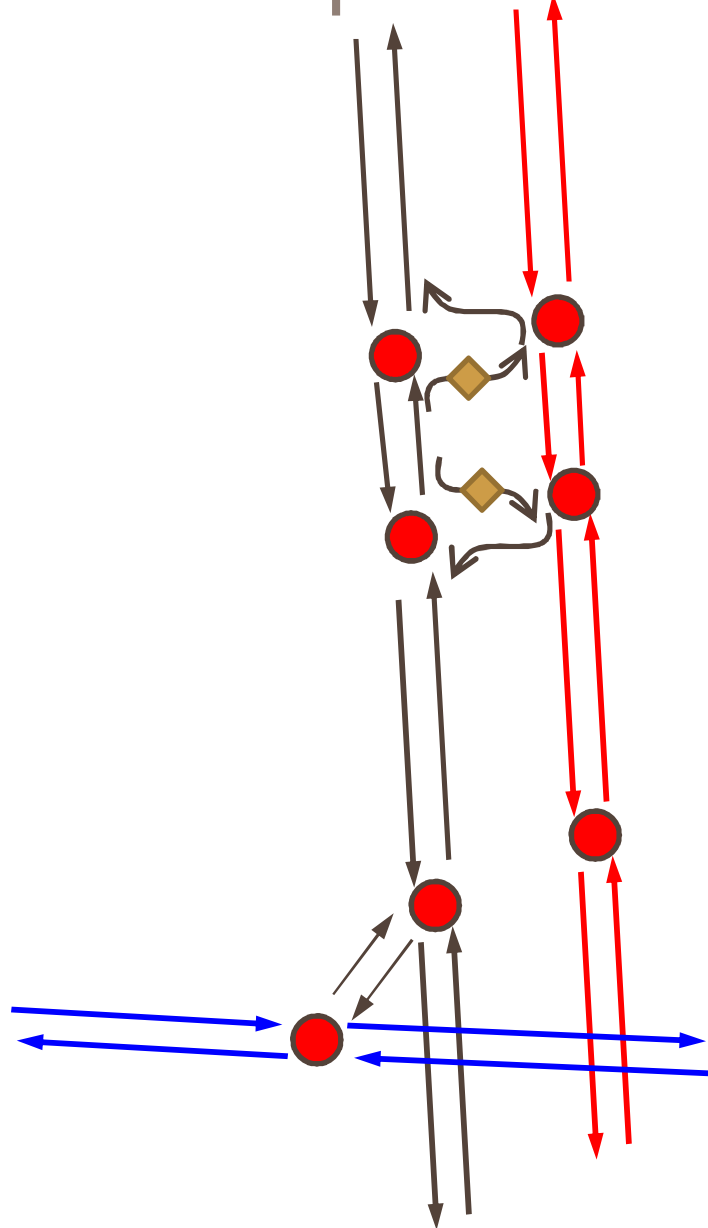


-  I-5 GP
-  I-5 HOV
-  Arterial






Arterial-HOV movement  
prohibited through  
turning restrictions

# I-5 Express Toll Lanes Coding



GP-HOV movements separated from interchange.

GP-HOV movements segregated by directional movements.

-  I-5 GP
-  I-5 HOT
-  Arterial

GP-HOT movement controlled through turning restrictions

# Reflections & Thoughts



- Assess Study Level & Focus
  - Sketch Level
  - Investment Grade
  - Does it require micro-simulation?
- Available Modeling Procedures
  - Data Collection
  - Model Estimation/Validation
- Available Resources and Schedule

# Reflections & Thoughts

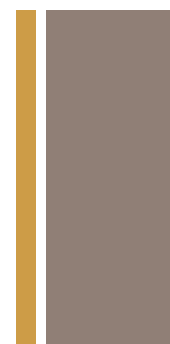


- Focus on the study area
  - Network refinements
  - Validation checks

# Reflections & Thoughts



- Procedural Limitations in the Software
  - Ramp-to-ramp, OD level tolls
  - A distribution of VOT



Questions?