Simulation and Capacity Analysis User Group

SimCap

Louisiana

user group

Volunteer Network of Professionals Working Together to Support, Promote, and Improve Best Practices in the Application of Traffic Simulation and Capacity Analysis

4/04/2019

Educational Meeting (#3)

Meeting Agenda

- **P1** Microsimulation Study of Crescent City Connection Bridge
- **P2** Introduction to Dynamic Traffic Assignment
- **D** Mini Roundtable

Joey LeFante
Stantec

CCC Toll Plaza Reconfiguration

SimCap Louisiana
April 4, 2019
Joey Lefante, PE, PTOE

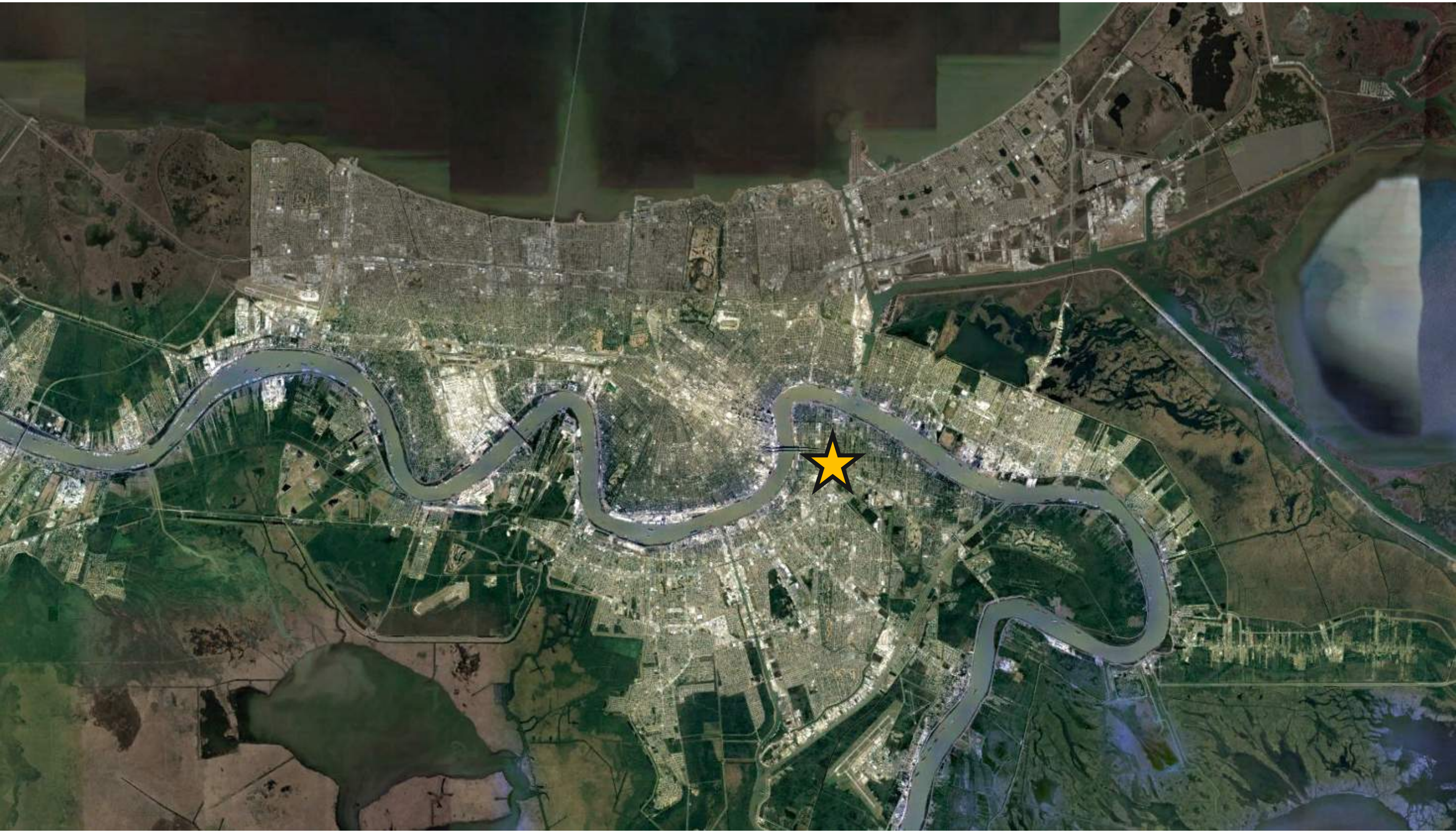
Stantec

Agenda

1. Project Background
2. Modeling Parameters
3. Alternatives Analysis
4. Project Outcome

Project Background

Project Location

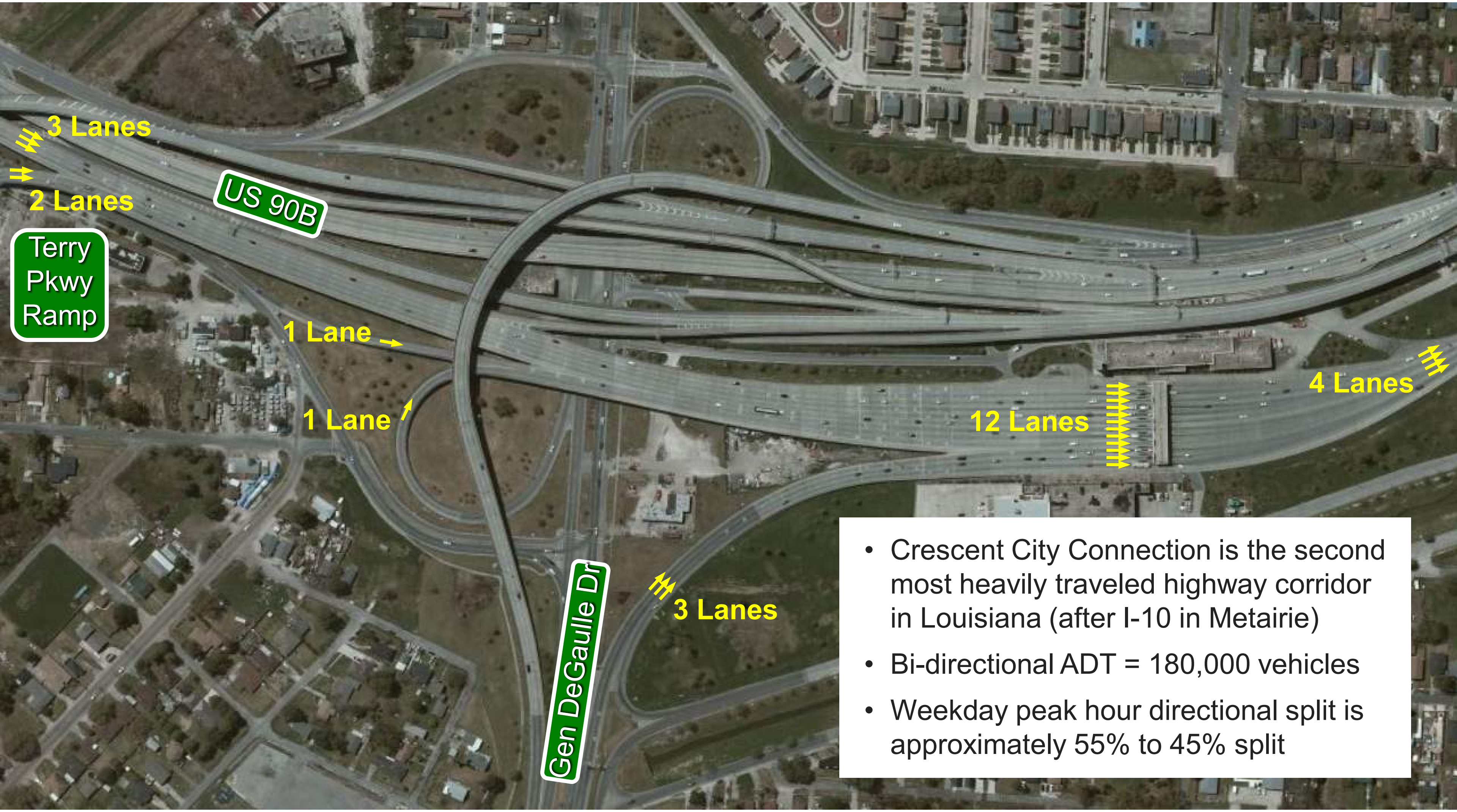


Project History

- Current toll plaza was implemented after opening of second bridge span in 1989 with a scheduled expiration date of December 31, 2012
- A toll renewal referendum was rejected by voters, resulting in an end to tolling on the Crescent City Connection Bridge

Project Background

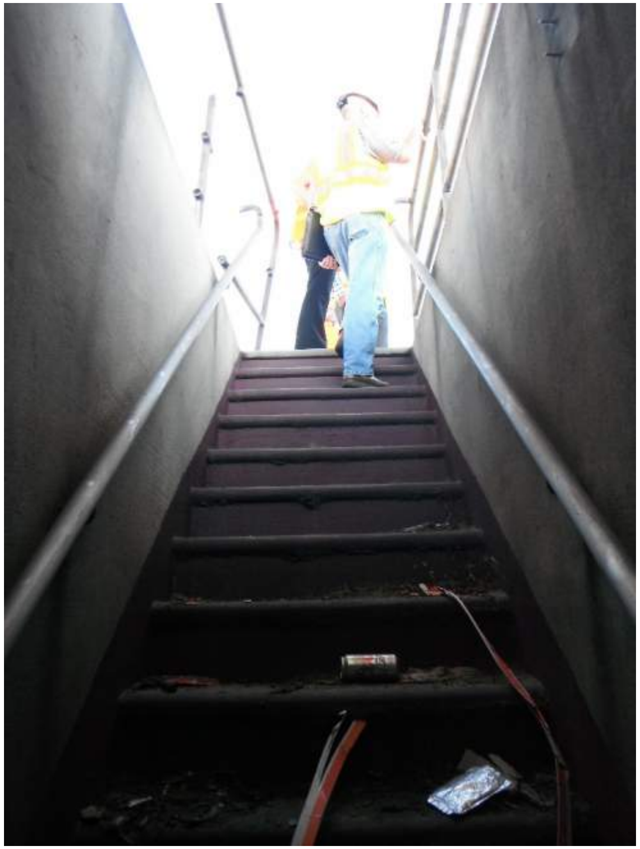
Existing Configuration



- Crescent City Connection is the second most heavily traveled highway corridor in Louisiana (after I-10 in Metairie)
- Bi-directional ADT = 180,000 vehicles
- Weekday peak hour directional split is approximately 55% to 45% split

Project Background

Tunnel



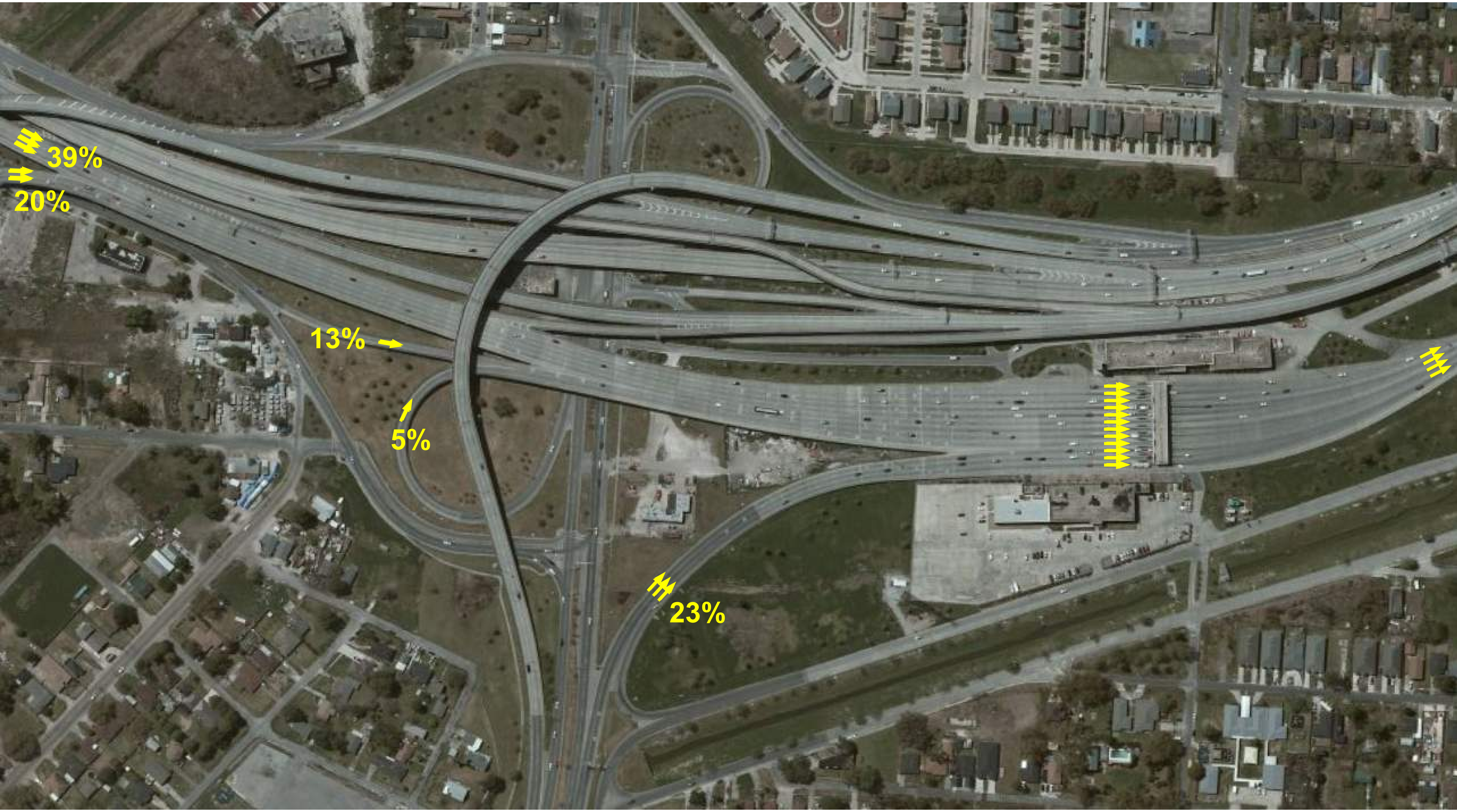
Project Objectives

- Reduce congestion
- Provide a safe merge operation at the bridge approach
- Improve reliability of the corridor
- Protect the investment

Modeling Parameters

Modeling Parameters

AM Traffic Distributions

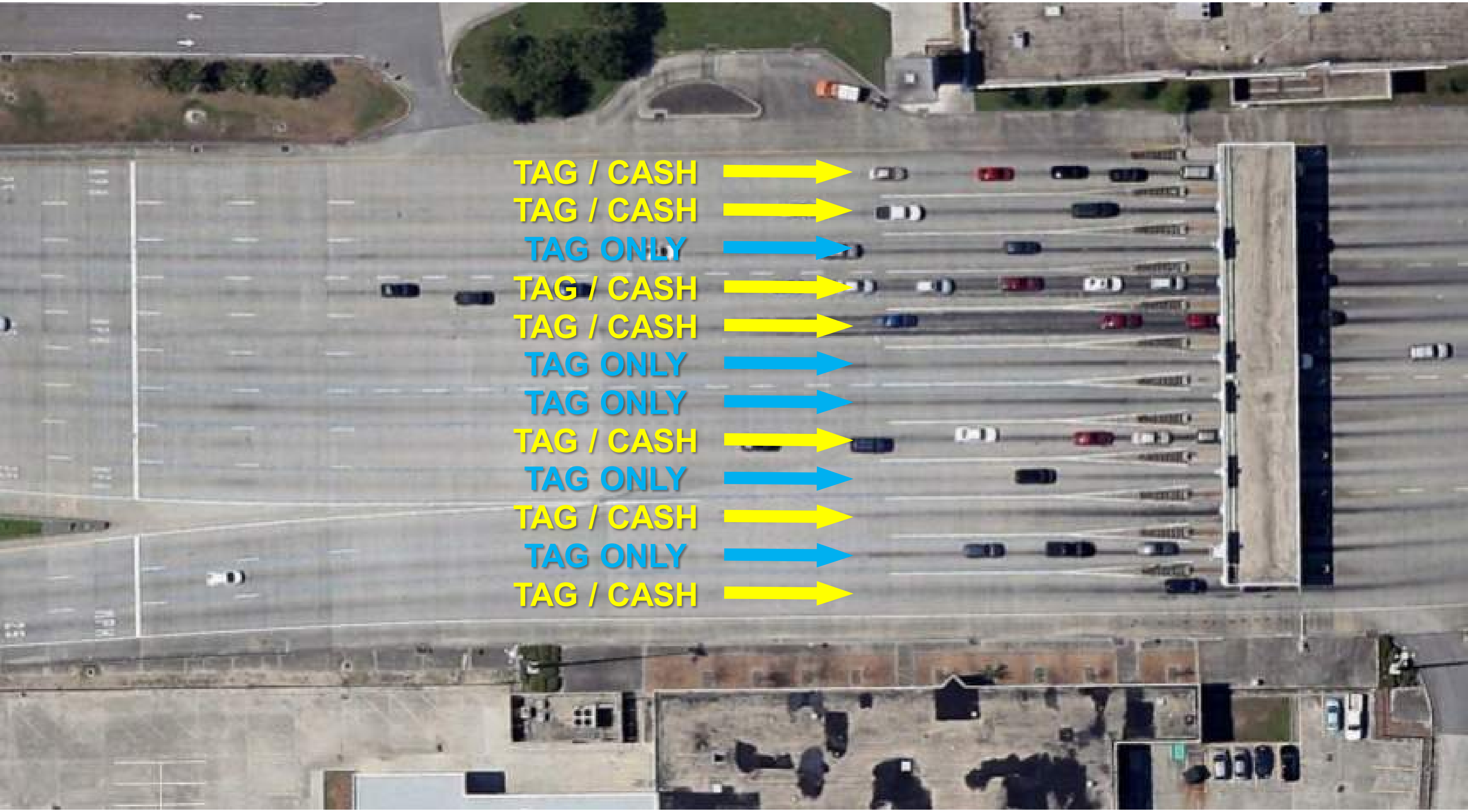


Modeling Parameters

Existing Traffic Conditions

TIME	NUMBER OF VEHICLES PER LANE												TOTAL
	1 CASH	2 CASH	3 TAG	4 CASH	5 CASH	6 TAG	7 TAG	8 CASH	9 TAG	10 CASH	11 TAG	12 CASH	
4/18/2012 5:00	22	14	68	33	34	71	47	13	16	21	60	23	**422**
4/18/2012 5:15	24	27	113	55	58	100	89	24	41	23	66	38	**658**
4/18/2012 5:30	41	49	140	65	74	116	106	32	76	34	104	41	**878**
4/18/2012 5:45	54	56	160	82	77	139	113	37	86	38	118	38	**998**
4/18/2012 6:00	65	62	194	86	82	167	126	48	111	52	132	44	**1169**
4/18/2012 6:15	91	101	230	105	103	230	178	25	143	81	164	64	**1515**
4/18/2012 6:30	125	96	273	115	119	280	249	85	211	96	217	90	**1956**
4/18/2012 6:45	120	132	290	118	102	287	270	83	293	103	274	97	**2169**
4/18/2012 7:00	139	168	243	118	131	237	208	107	262	105	276	126	**2120**
4/18/2012 7:15	151	142	242	122	127	244	209	100	238	122	259	132	**2088**
4/18/2012 7:30	153	160	220	110	131	212	183	118	227	136	249	135	**2034**
4/18/2012 7:45	130	149	190	112	118	187	164	111	202	131	222	126	**1842**
4/18/2012 8:00	140	139	210	109	138	208	168	125	211	126	241	114	**1929**
4/18/2012 8:15	109	112	243	73	109	237	188	115	220	141	216	123	**1886**
4/18/2012 8:30	131	119	232	76	105	247	186	113	203	128	246	107	**1893**
4/18/2012 8:45	90	90	227	90	81	189	176	70	162	89	212	79	**1555**
4/18/2012 9:00	92	72	199	78	76	179	151	52	118	74	170	62	**1323**
4/18/2012 9:15	93	82	212	92	68	201	147	68	115	68	169	68	**1383**
4/18/2012 9:30	95	79	215	82	105	191	138	63	114	78	175	72	**1407**
4/18/2012 9:45	92	74	212	81	99	167	155	71	120	84	195	77	**1427**
4/18/2012 10:00	82	54	181	66	89	145	116	50	79	68	143	63	**1136**
4/18/2012 10:15	92	66	174	70	89	155	107	58	85	79	137	57	**1169**
4/18/2012 10:30	87	68	191	93	79	165	106	70	74	73	137	71	**1214**
4/18/2012 10:45	88	76	173	78	84	146	117	63	68	69	149	66	**1177**

Lane Distribution



Modeling Parameters

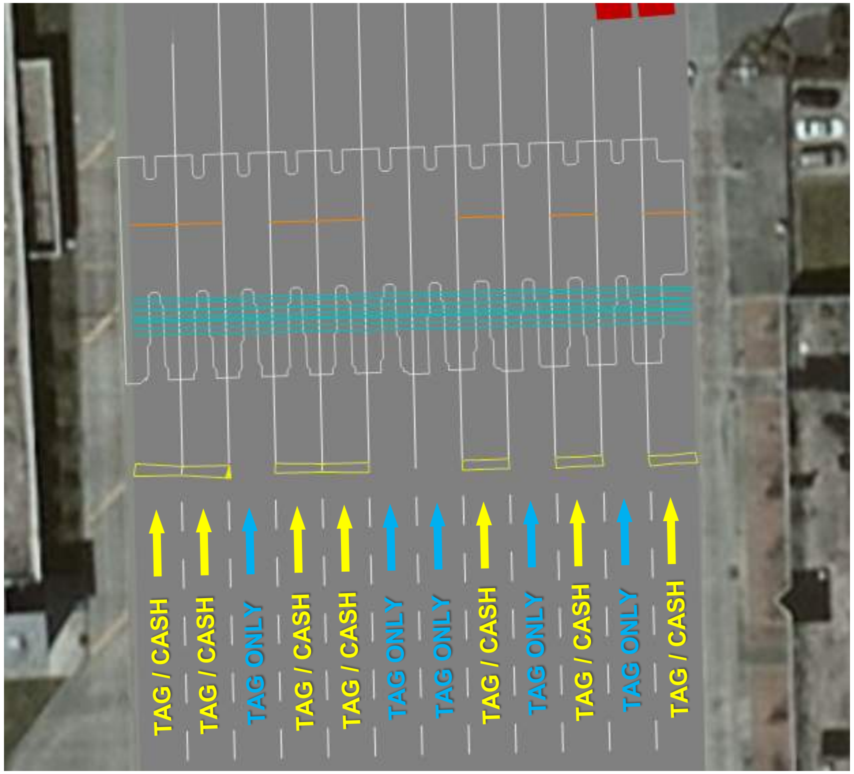
Lane Distribution

Vehicle Compositions / Relative Flows

Select layout...

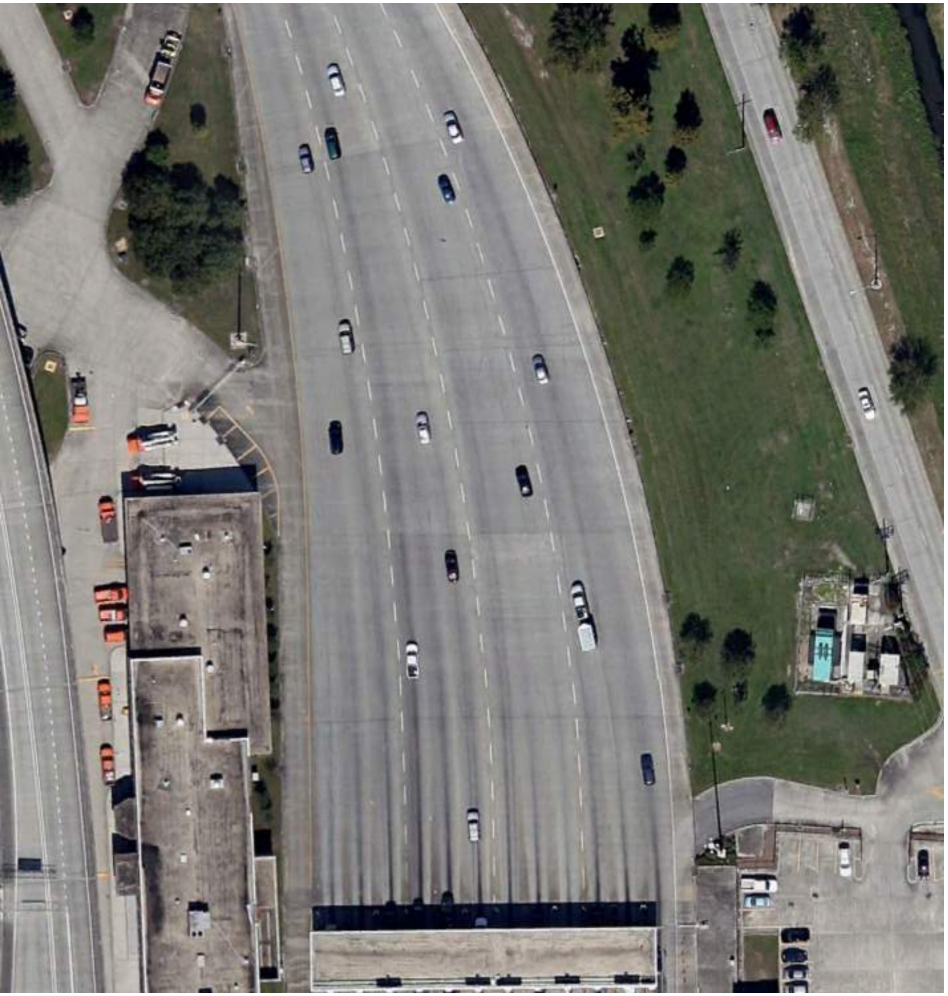
Coun	No	Name
1	1	Default
2	2	Cash vs Tag

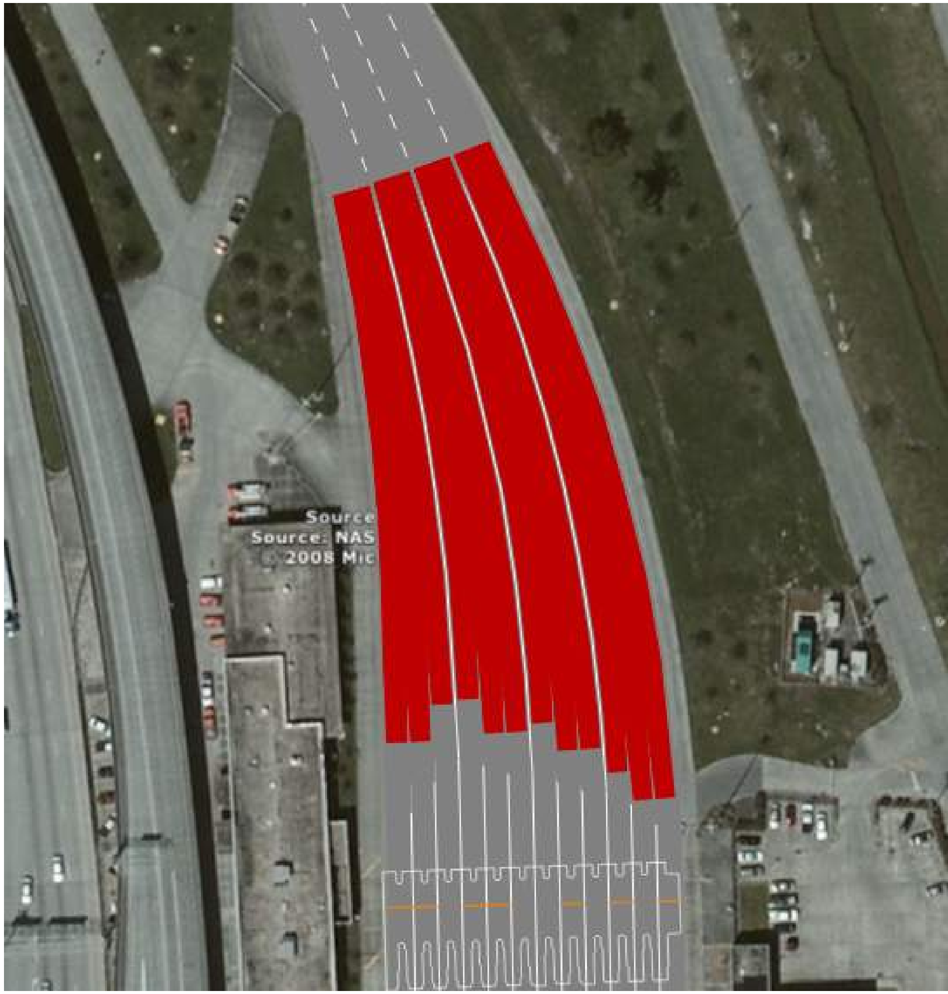
Count: 4	VehType	DesSpeedDistr	RelFlow
1	101: Car Cash	50: 50 km/h	0.316
2	102: Car Tag	50: 50 km/h	0.664
3	201: HGV Cash	50: 50 km/h	0.006
4	202: HGV Tag	50: 50 km/h	0.014



Modeling
Parameters

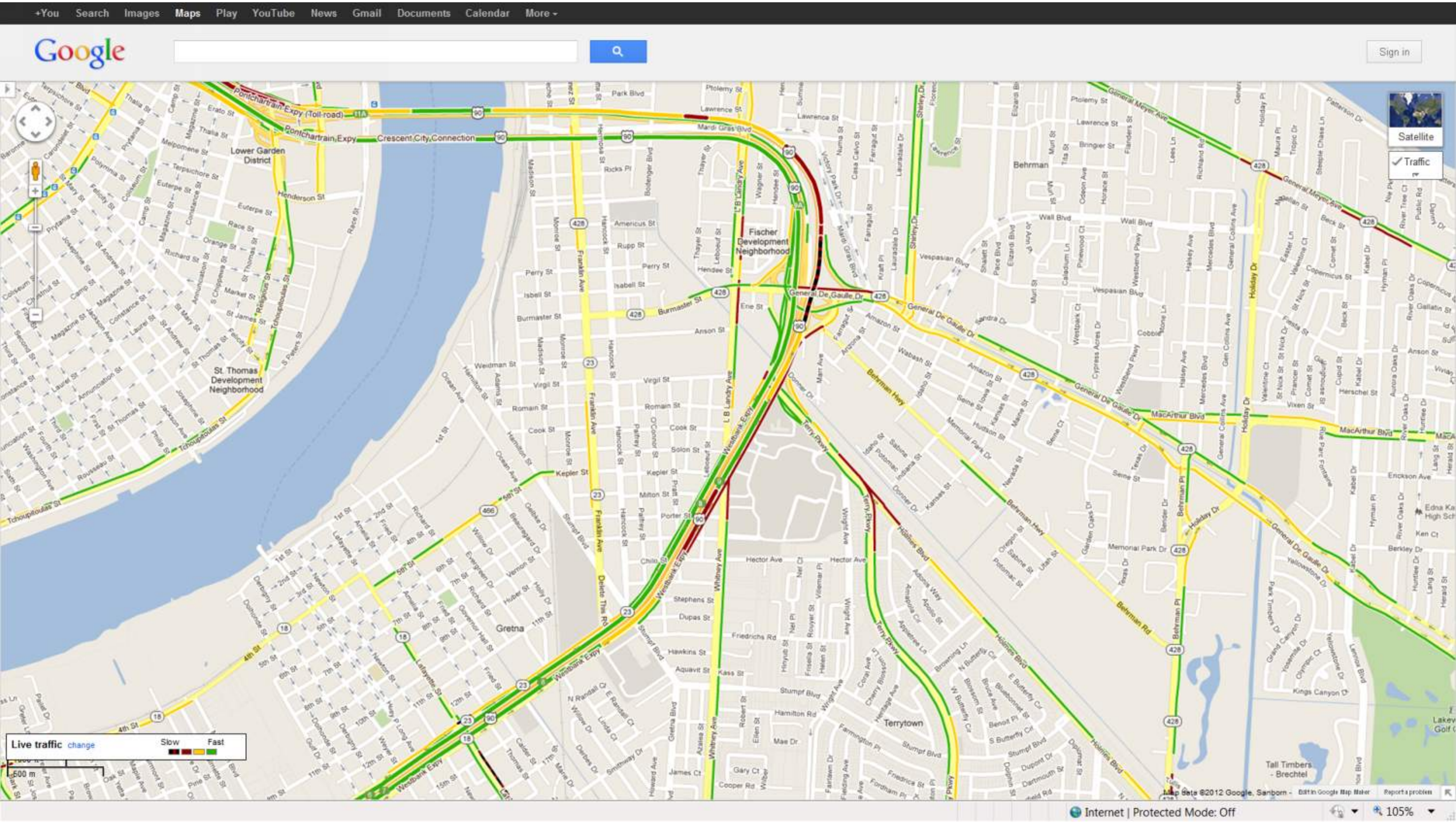
Post-Toll Booth Merge Area





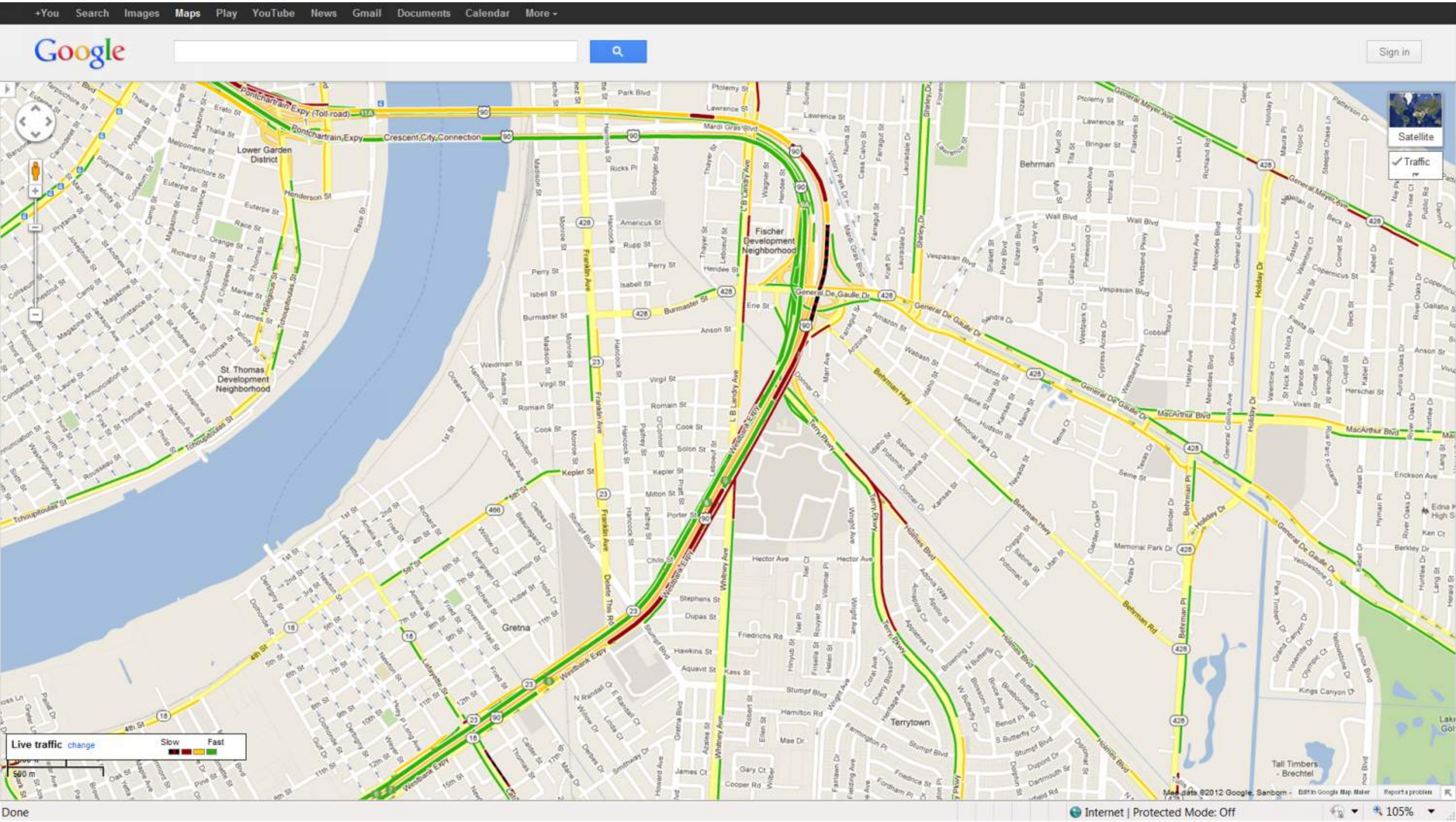
Modeling Parameters

Existing Traffic Conditions September 10, 2012 7:30 AM



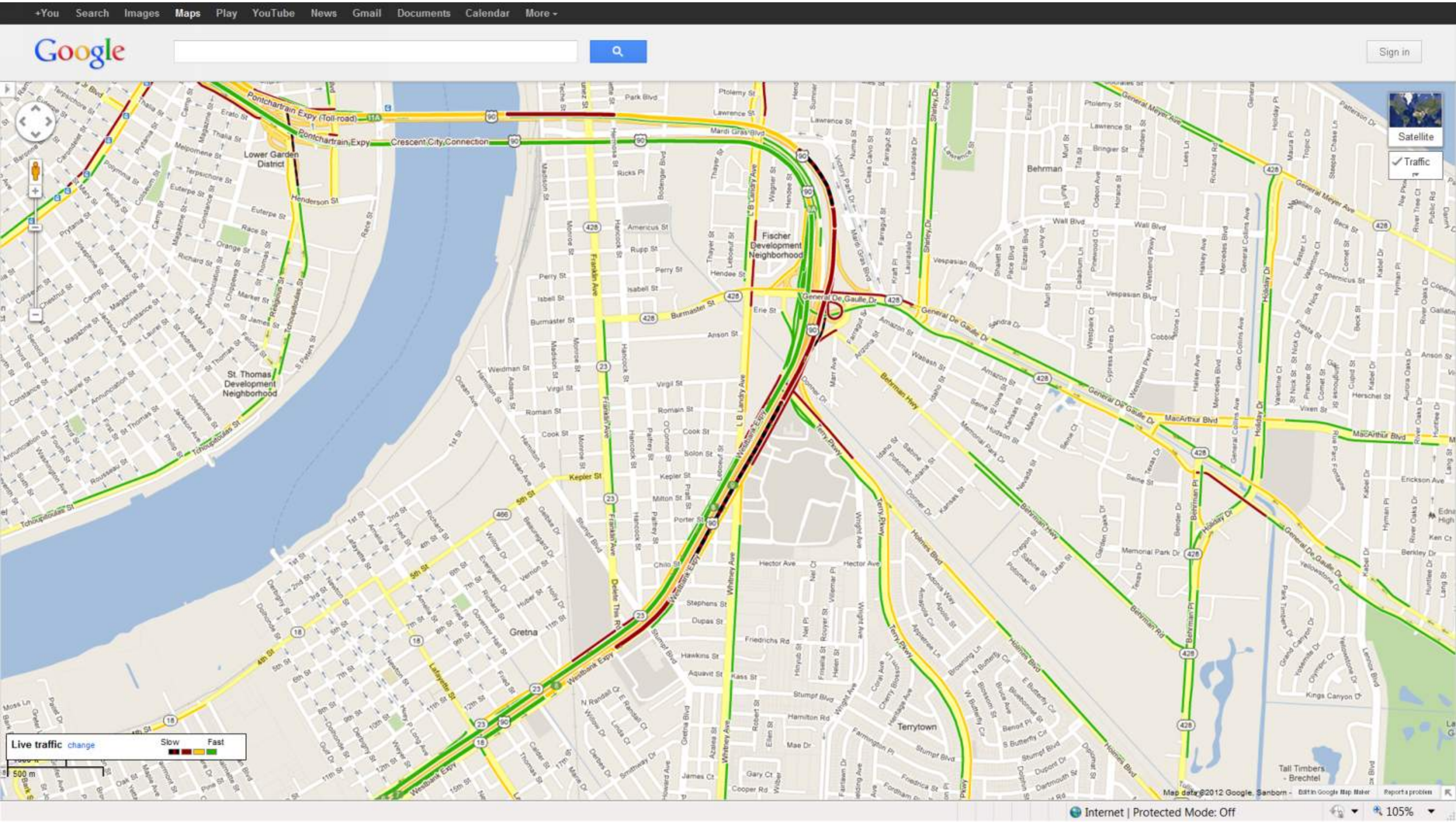
Modeling Parameters

Existing Traffic Conditions September 10, 2012 7:45 AM



Modeling
Parameters

Existing Traffic Conditions
September 10, 2012 8:00 AM



Modeling Parameters

Downstream Impacts on Congestion

Alternatives Analysis

Considered Alternatives

- Existing Configuration
  - w/ Toll Collection
  - w/o Toll Collection
- 2x4 Merge Configuration
  - w/o Ramp Meters
  - w/ Ramp Meters
- Freeway Merge Configuration
  - w/o Ramp Meters
  - w/ Ramp Meters

Existing Configuration w/ Toll Collection

- The existing lane configuration with the tolls in place

Existing Configuration w/ Toll Collection

Existing Configuration w/o Toll Collection

- The existing lane configuration with the tolls expiring and no capacity improvements
- Improvements Necessary
  - None

Existing Configuration w/o Toll Collection

2x4 Merge Configuration w/o Ramp Meters

- The existing lanes at the toll plaza are converted from 12 lanes to 8 lanes through a series of lane reductions
- The 8 lanes are brought up to toll booths in pairs
- Merges 2 lanes (as opposed to 3) into each bridge lane
- Improvements Necessary
  - Restriping of toll plaza

2x4 Merge Configuration w/o Ramp Meters

Alternatives Analysis

2x4 Merge Configuration w/o Ramp Meters

2x4 Merge Configuration w/ Ramp Meters

- Applies ramp meters to the 2x4 merging method
- Existing toll booths could remain and be retrofitted for ramp meters
- Improvements Necessary
  - Restriping of toll plaza
  - Ramp meters constructed at current toll booths

2x4 Merge Configuration w/ Ramp Meters

Freeway Merge Configuration w/o Ramp Meters

- Uses new roadway striping to merge each individual ramp merging separately onto a free flowing mainline
- Improvements Necessary
  - Restriping from Terry Pkwy through toll plaza
  - Demolition of toll booths and roadway reconstruction to eliminate speed reduction areas

Alternatives Analysis

Freeway Merge Configuration w/o Ramp Meters

Freeway Merge Configuration w/ Ramp Meters

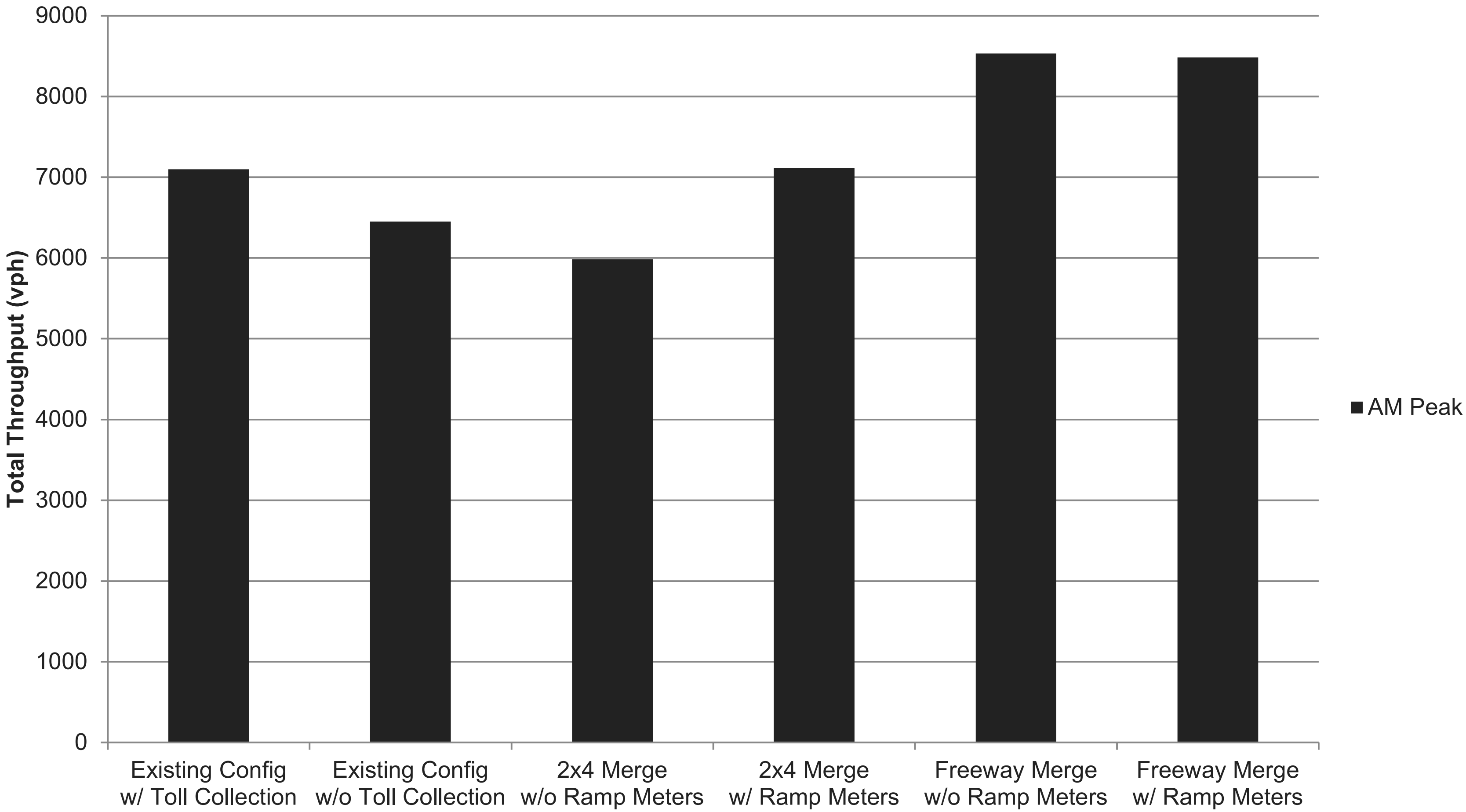
- A traditional ramp meter installation with meters on each individual ramp merging onto a free flowing mainline
- Improvements Necessary
  - Restriping from Terry Pkwy through toll plaza
  - Demolition of toll booths and roadway reconstruction to eliminate speed reduction areas
  - Ramp meters constructed on ramps

Alternatives Analysis

Freeway Merge Configuration w/ Ramp Meters

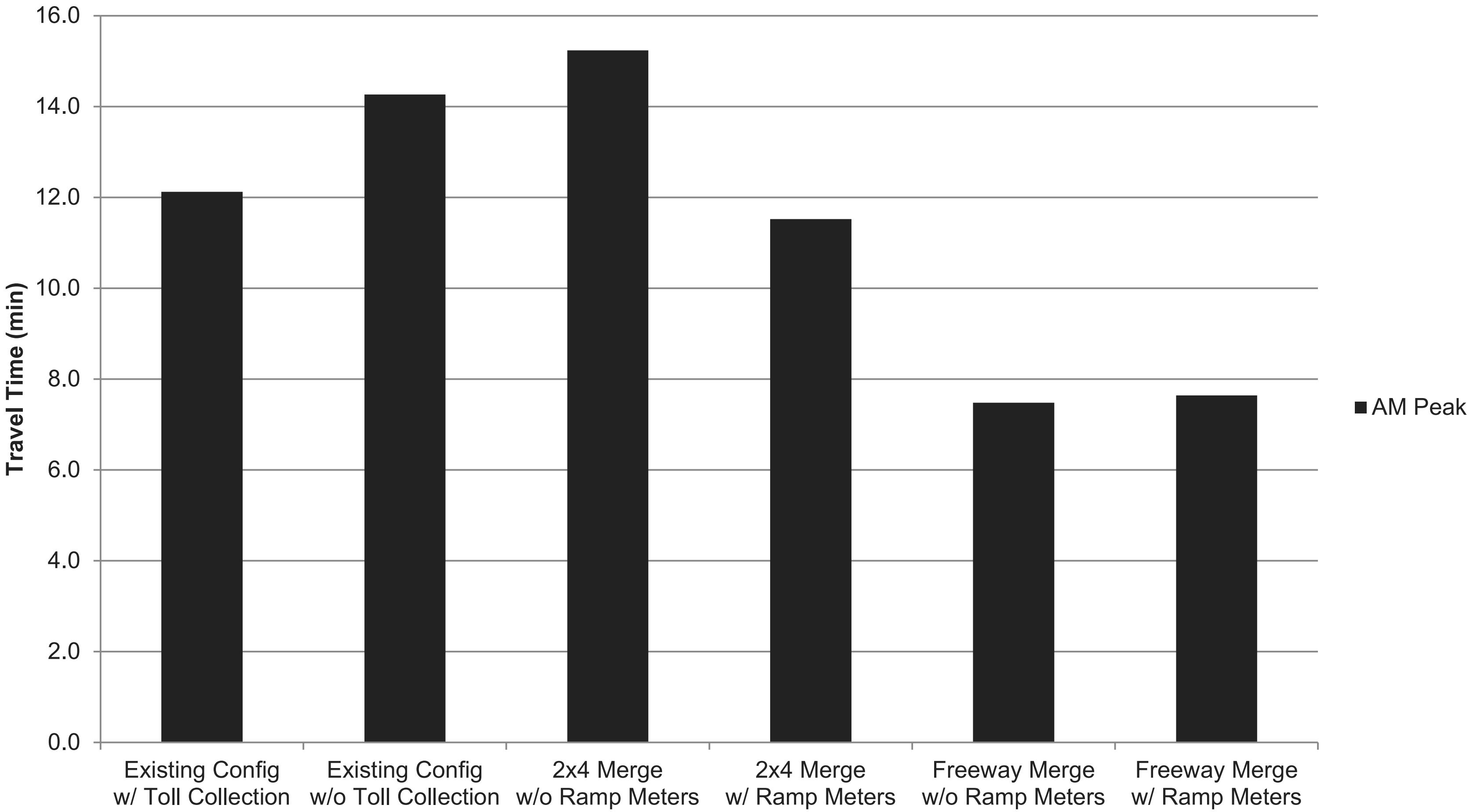
Alternatives Analysis

Total Throughput



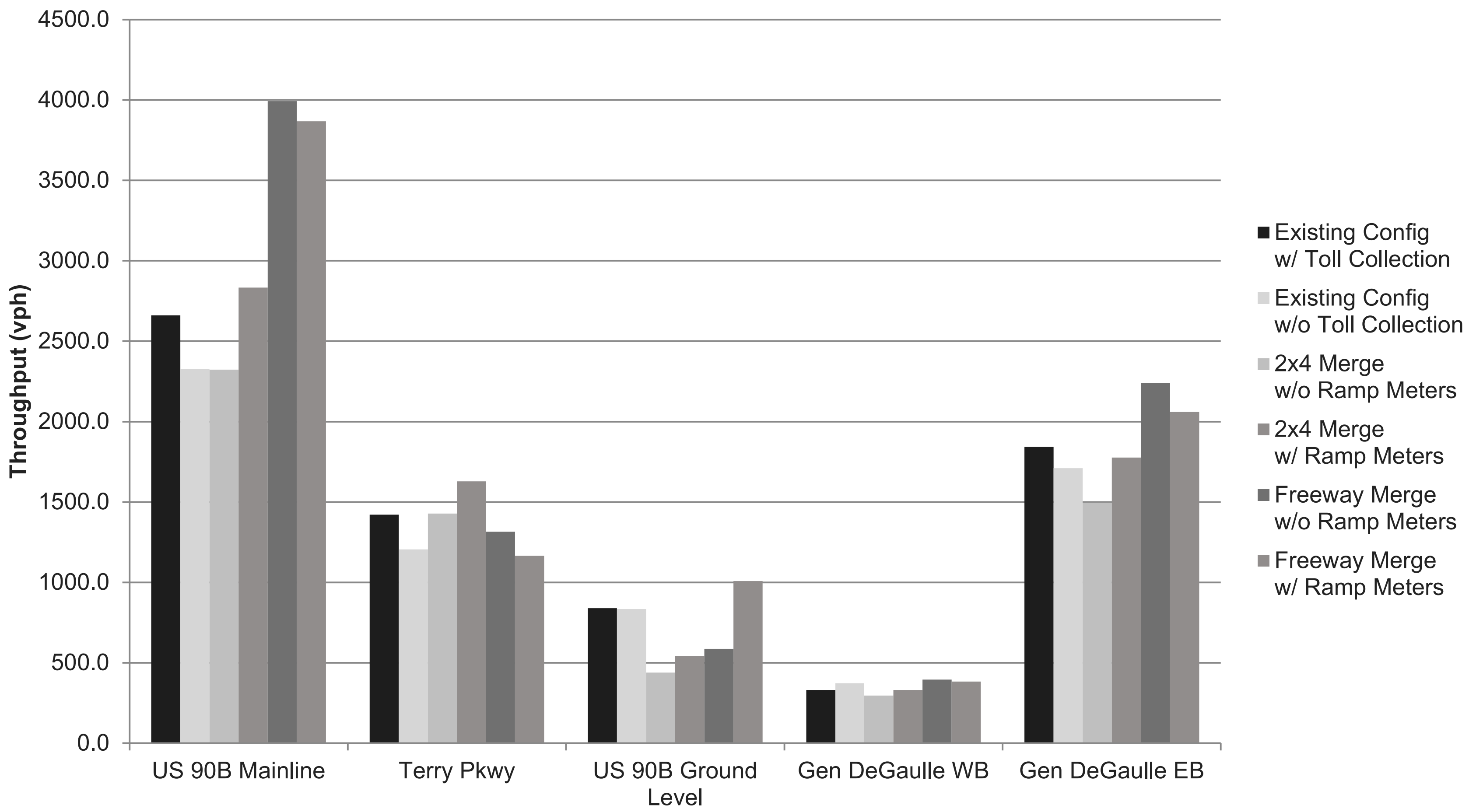
Alternatives Analysis

Travel Time

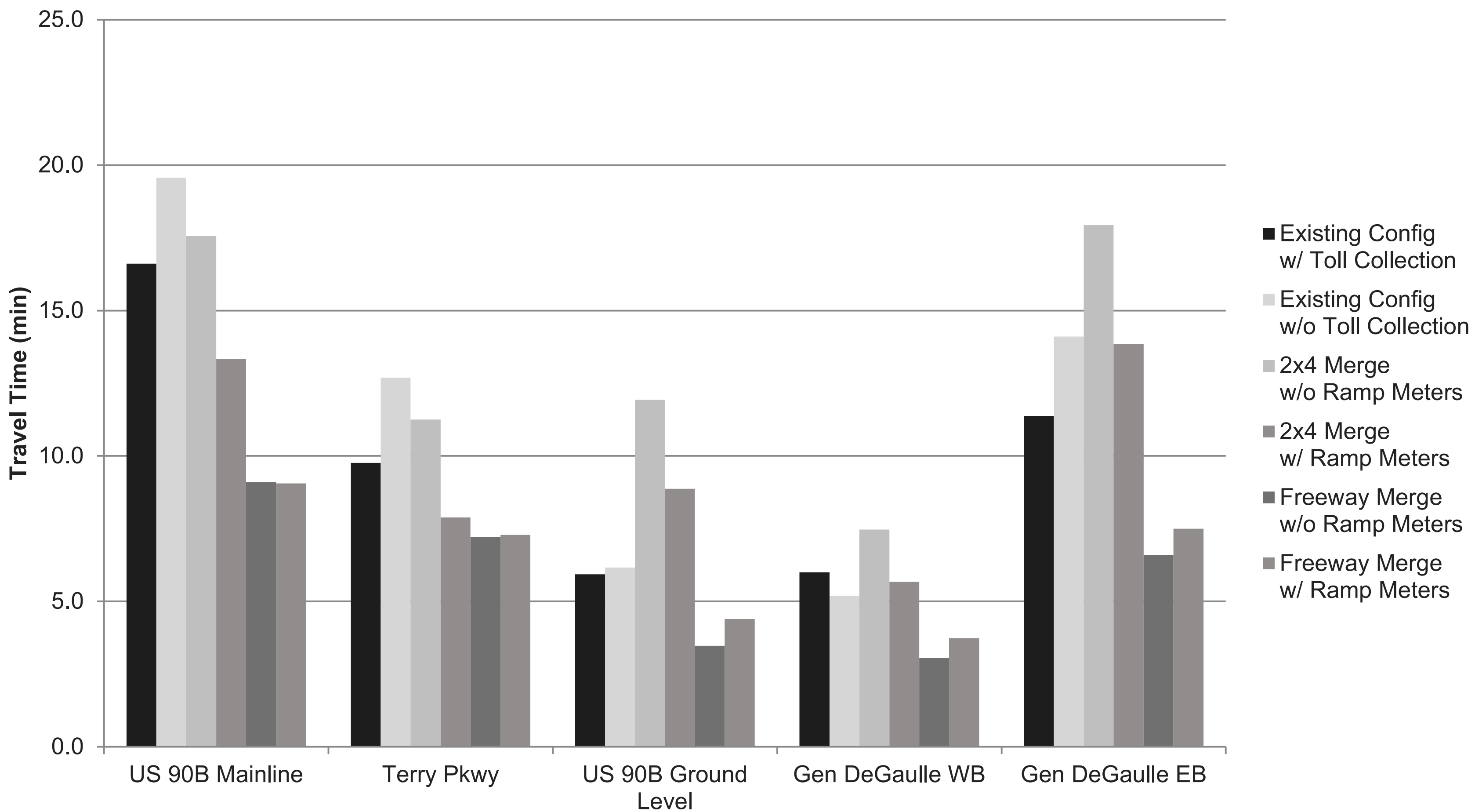


Alternatives Analysis

Throughput by Approach



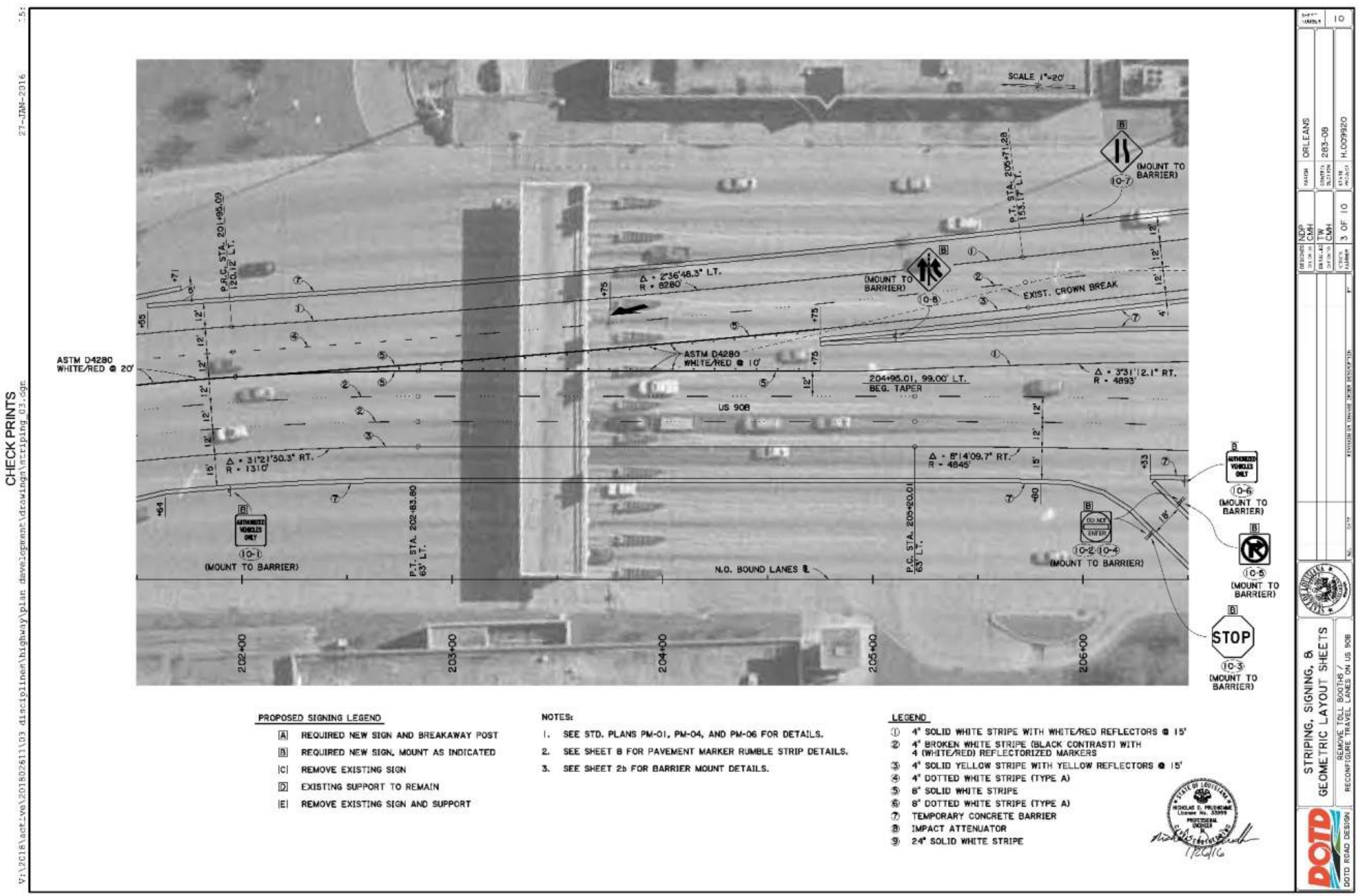
Travel Time by Approach



Project Outcome

Project
Outcome

Roadway Plans



Project Outcome

Michael Mahut

INRO

Introduction to Dynamic Traffic Assignment

Michael Mahut, VP Simulation, INRO

Louisiana SimCap, April 4 2019

INRO

Introduction to Dynamic Traffic Assignment

| What is DTA?

| What is Equilibrium Assignment?

| Traffic Models used in DTA

What is Dynamic Traffic Assignment?

- Time-dependent ("dynamic") model for predicting drivers' route choices along with the corresponding traffic flows and speeds in a transportation network
- Two main computational components
  - Traffic (simulation) model
  - Assignment (route choice) model
- Complementary tool to existing transportation network models
  - Static assignment (travel demand forecasting) models
  - Traffic micro-simulation models
- DTA is designed to address applications that fall in-between static-assignment and micro-simulation applications

Typical DTA Models

- Large networks and congested traffic conditions, resulting in complex route choices
  - Network subareas, Long corridors, Citywide models
- Traffic congestion is captured using a traffic simulation approach
  - More sensitive and realistic than TDM, more detailed with respect to causes and effects of traffic congestion, explicit traffic control
  - Fewer parameters than micro-sim models; parameters have physical interpretation
- Modeling average-day conditions requires equilibrium route choice (DTA) which is stable and optimal
  - Route choices are not determined by the user

Route Choice in Dynamic Traffic Assignment

- "Assignment" refers to drivers' route choices
  - mathematical approach to route choice which produces a solution (set of route choices) that has well-defined properties
  - Defined as path proportions for each Origin-Destination pair for each departure-time interval
- "Equilibrium" property = every driver has found the best path for his/her trip
  - Travel times (costs) on all used paths are approximately equal for each Origin-Destination pair and each departure-time interval
  - Thus: if drivers could know how long the trip would have taken via all other possible routes, every driver would be satisfied that they had made the best choice
  - "optimal solution" (equilibrium solution)

Route Choice in Dynamic Traffic Assignment

- The “Equilibrium” property is very important:
  - Mathematically defensible way to determine link volumes – based on assumptions and not on the modeler’s judgement
  - Yields “consistent” route choices: i.e. subsequent changes to the inputs will produce changes to the outputs that makes sense and are directly linked to the input changes
- Equilibrium assignment is a hard problem to solve:
  - Route choices depend on travel times, but travel times depend on route choices: circular problem
  - Can only be solved by running the simulation iteratively, many times over, and adjusting route choices (path proportions) until the equilibrium route solution is achieved

Traffic models used in DTA

- "DTA" encompasses a wide range of traffic models with different levels of detail and realism
- Macroscopic ("analytical"): based on vdf function with time dimension
  - Does not satisfy basic traffic flow theory e.g. flow capacities, spill-back (ref. DTA Primer)
- Conventional mesoscopic: hydrodynamic traffic flow model (macro TFT)
  - Respects flow-density relationship but does not explicitly represent individual lanes
  - Limitations in handling traffic flow breakdowns due to choke effects, lateral spillover
- Lane-based mesoscopic: based on micro TFT
  - Overcomes many limitations of conventional non lane-based mesoscopic models
  - Level of realism and fidelity varies depending on the software

Sample DTA Applications with Dynameq

| Subarea models

| Citywide models

| Freeway models

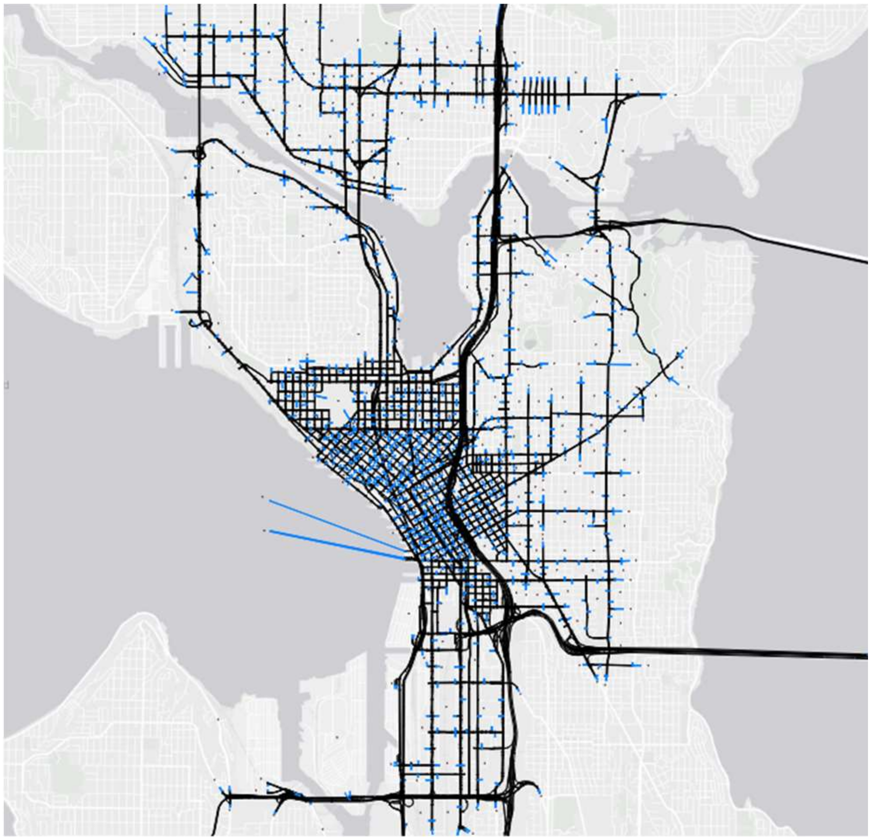
INRO

Seattle Alaskan Way Viaduct Replacement

- Tolled tunnel to replace urban freeway

Level 2 and 3 (investment grade) Toll Studies & EIS

- Toll forecasting
- Route diversion
- Construction mitigation
- Reversible lanes
- Traveller response to tolls and HOT lanes

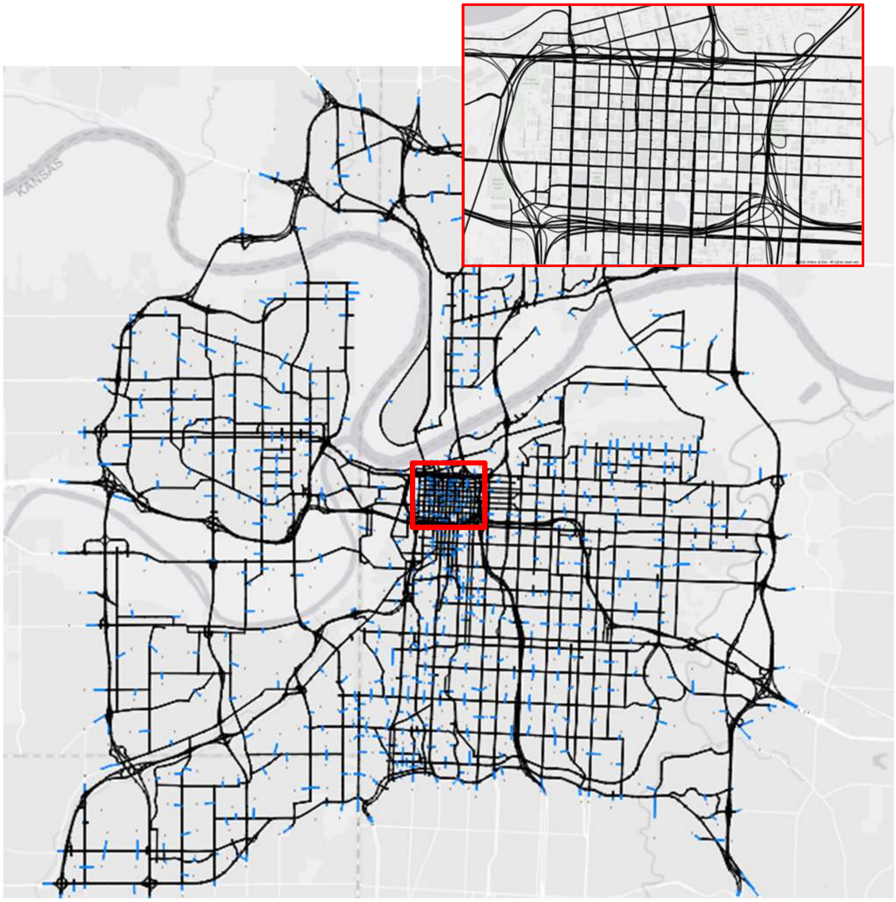


Kansas City, USA

- Dense CBD core with physical constraints
- Base year calibration completed 2017

Objectives

- Improvements to overall traffic flow and accessibility in CBD core
- Evaluating alternatives to the US-169 corridor
- Focus on I-70 corridor and connections to street grid in the downtown area



San Francisco

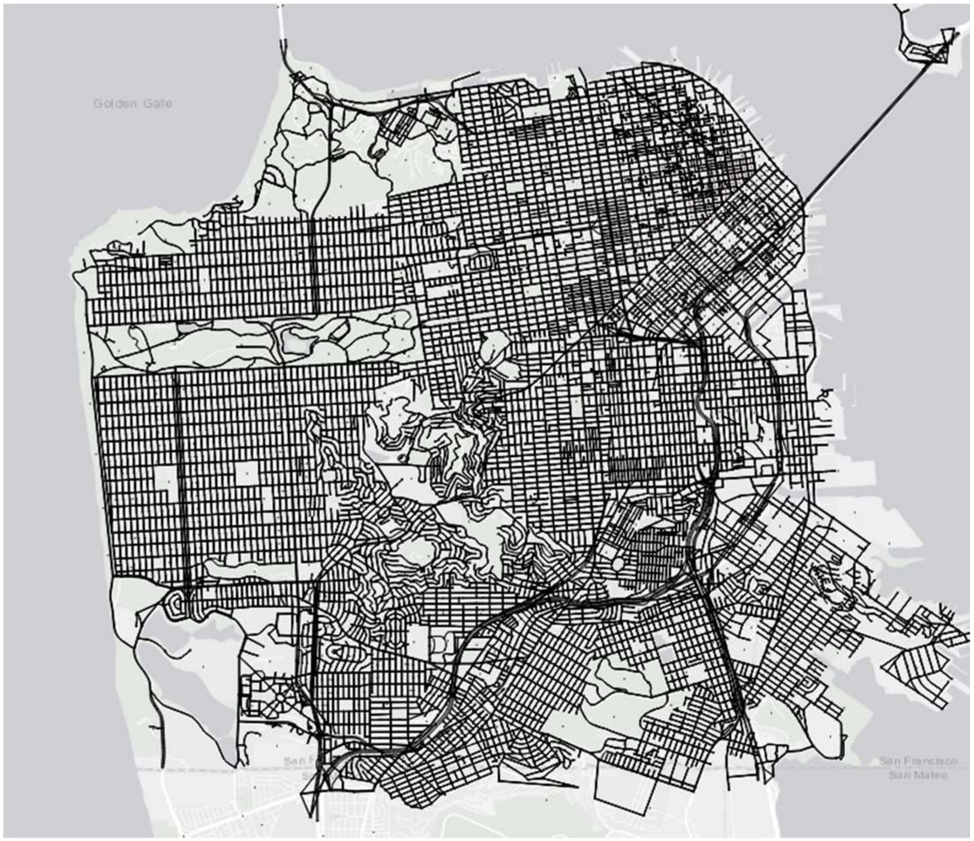
- Citywide model used to study a wide range of development plans

Applications

- Reconstruction of major roadways
- Bus rapid transit corridors
- Corridor Management
- Neighbourhood Transportation Plans
- Site Development

Model Specs

- 170 km^2
- 5 hr demand / 625,000 trips
- 2 classes + transit
- RAM = 14 GB



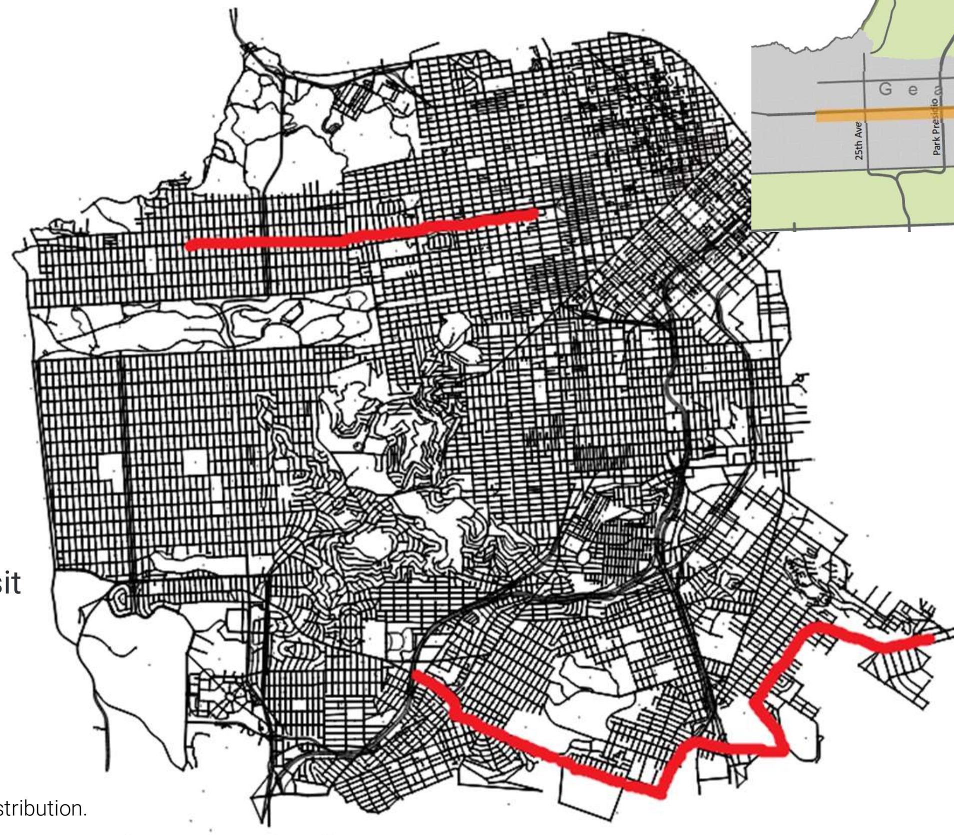
San Francisco Studies

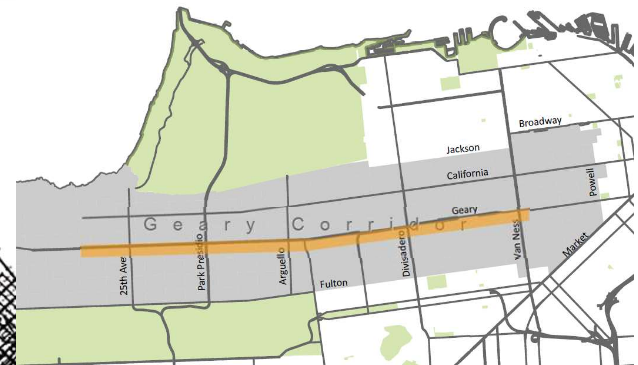
Presidio Parkway Project

Reconstruction of the approach to the Golden Gate Bridge:

- Diversions and construction mitigation during ramp closures
- Dynameq used to predict left-turn queue length at temporary signal to determine required length of storage bay

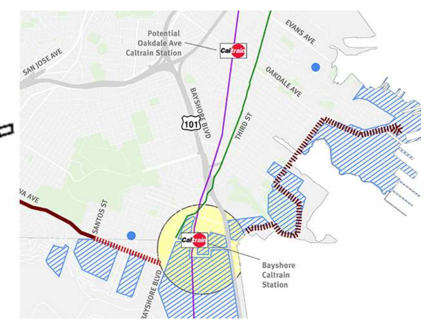
San Francisco Studies





Geary Blvd Bus Rapid Transit

- Evaluate BRT alternatives



Geneva Avenue Bus Rapid Transit

- Evaluate BRT alternatives

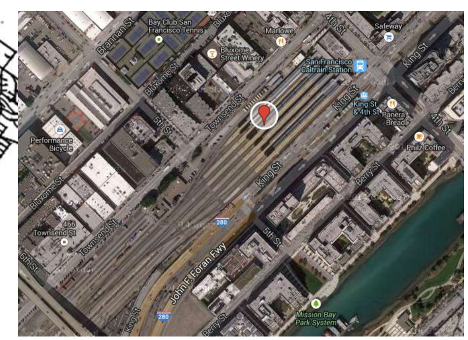
San Francisco Studies

Better Market Street

- Redesign of CBD streets, transit priority

Mission Bay, I-280, Caltrain Railyards Study

- Major area redevelopment project

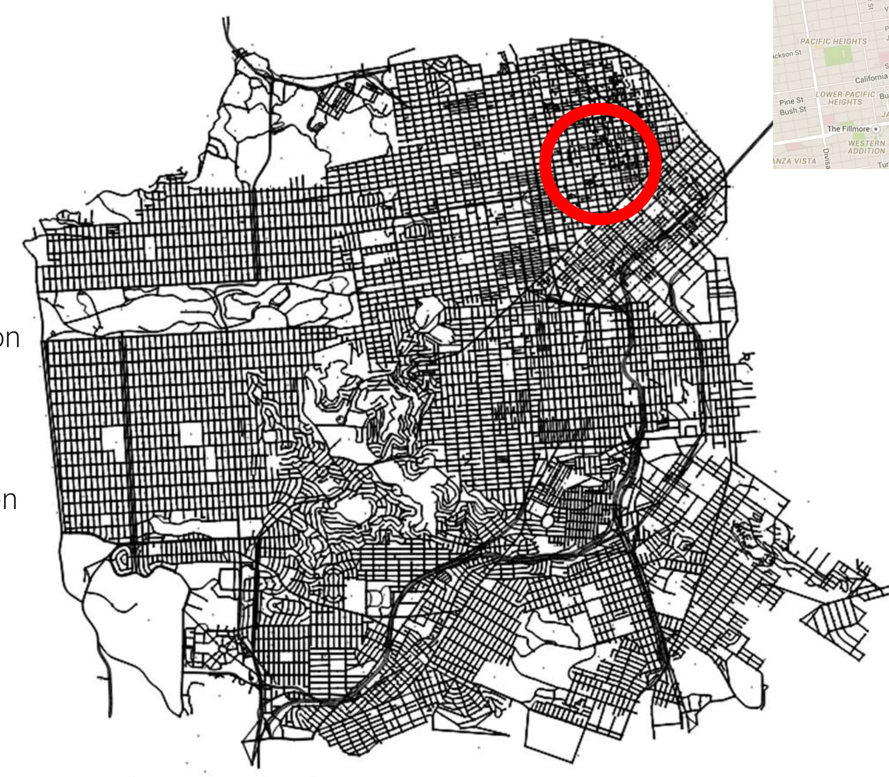


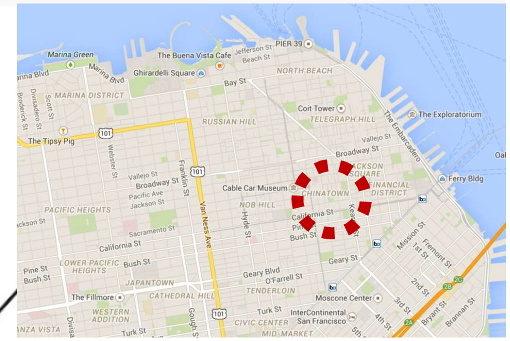
San Francisco Studies

Chinatown Neighborhood Transportation Plan

Evaluate neighborhood traffic calming strategies:

- Reduce:
  - Volumes and movements on Broadway
  - Speeds on Broadway
- Maintain or modest increase :
  - Volumes and travel times on other Chinatown streets
- Maintain or reduce:
  - Queue lengths
  - Public transit travel times





I5 Freeway Corridor

- Linear corridor freeway model
- Freeway, expressway and interchanges
- 26 km (16 mile)

Objectives

- Time-of-day reversible lanes
- Testing of operational strategies:
  - Tolls, Ramp Metering
  - Hard Shoulder Running
  - Reserved Lanes
- Fast-tracked project
  - 8 weeks development and calibration (am/pm)

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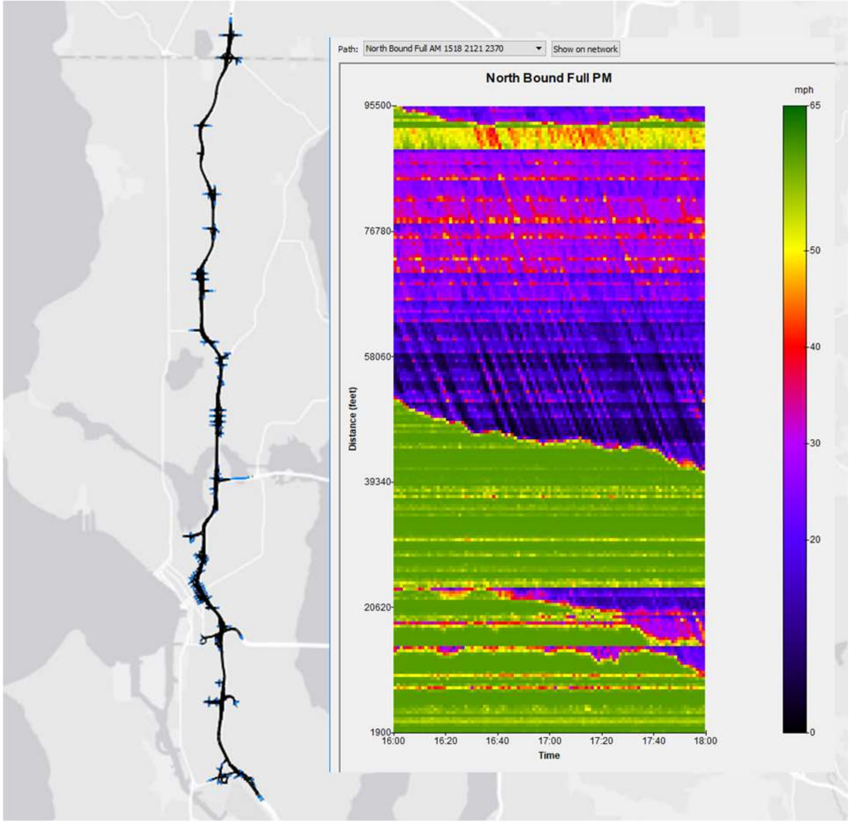


I5 Freeway Phase 2

- Full corridor including main parallel facilities and city core from SR99 project

Coverage

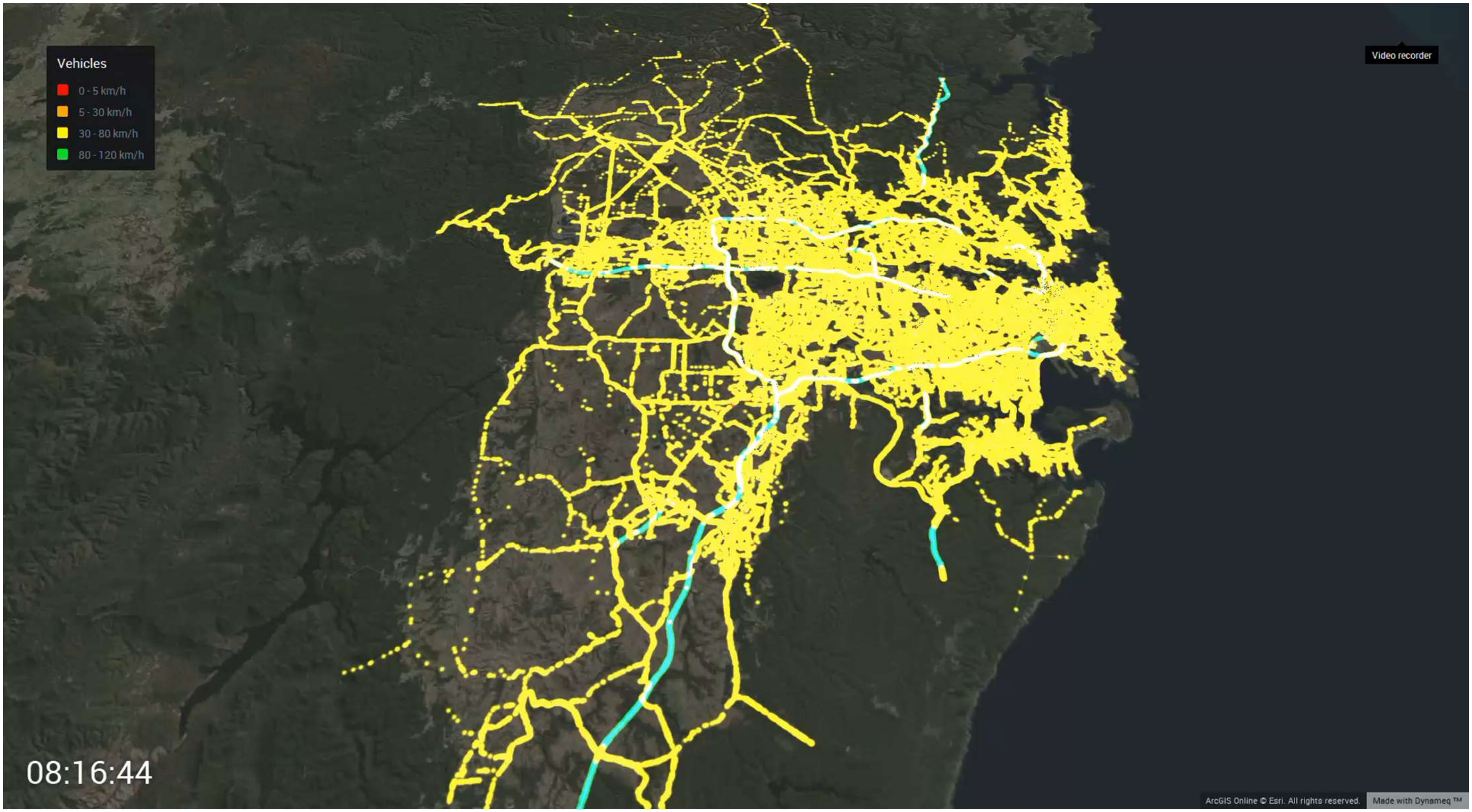
- I-5 from Georgetown to Mountlake Terrace
  - Mainline, Express Lanes, all ramps, connecting arterials, and ramp termini signals
- Other Facilities between SR 99 and 15th Ave

- Currently in model development / base year calibration stage

Performance

	Time Period	Classes	Trips	CPU time	CPU / iteration
Kansas City	4 h	3	673,000	3.1 h	3.7 min
Seattle SR-99	5 h	6 + transit	543,000	4.2 h	5 min
Birmingham, UK	3 h	3	335,000	40 min	1.2 min
I-5 Freeway Seattle	5 h	6 + transit	410,000	65 min	2.2 min
San Francisco	5 h	2 + transit	623,500	2.5 h	3.3 min
Edmonton, Canada	3 h	3 + transit + LRT	901,500	2.2 h	5.2 min

Hardware: Xeon E5 – 3.1 GHz / 20 threads Version: Dynameq 4.1


Vehicles
0 - 5 km/h
5 - 30 km/h
30 - 80 km/h
80 - 120 km/h
Video recorder
08:16:44
ArcGIS Online © Esri. All rights reserved.
Made with Dynameq™

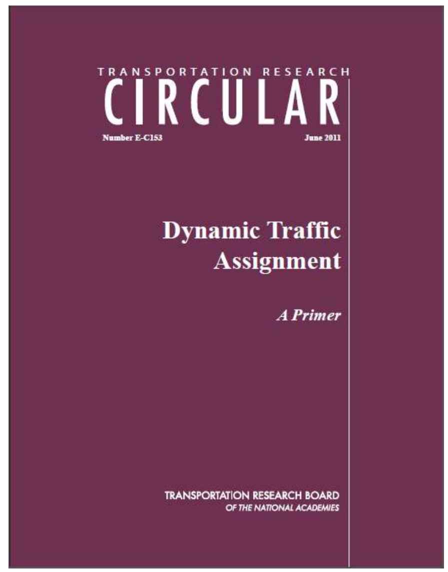
Further Reading

DTA Motivation and Overview

- "Interest has grown in applying traffic analysis tools capable of analyzing travel activities and dynamic network performance for a corridor or region over peak hours or even extended daily hours."

- "DTA models supplement existing travel forecasting models and microscopic traffic simulation models."

http://onlinepubs.trb.org/onlinepubs/circulars/ec153.pdf

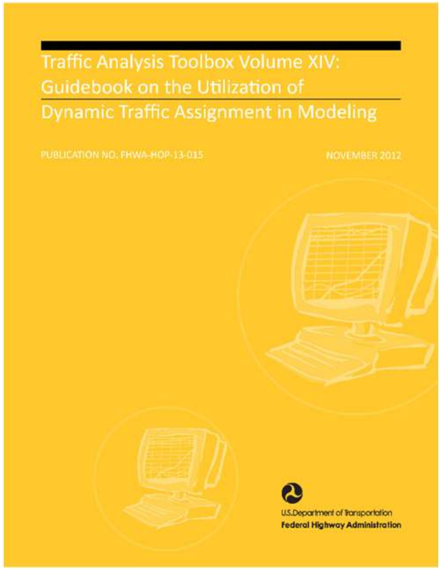


DTA Guidelines Document (FHWA – USA)

- “The purpose of this guide is to provide practitioners with guidance on how to apply DTA within transportation models.”

- “This guide provides a set of proven approaches to model building, calibration, and alternatives analysis.”

http://ops.fhwa.dot.gov/trafficanalysistools/



Edmonton Case Study

Learn how the City of Edmonton is leveraging a Dynameq^{TM} citywide traffic simulation and dynamic traffic assignment (DTA) model to consistently inform multiple operational planning studies in support of the city's Transportation Master Plan and its holistic view of transport as an interconnected, multi-modal system.


INRO Case Study

Traffic Modelling for Planning and Operations:

Citywide DTA at the city of Edmonton

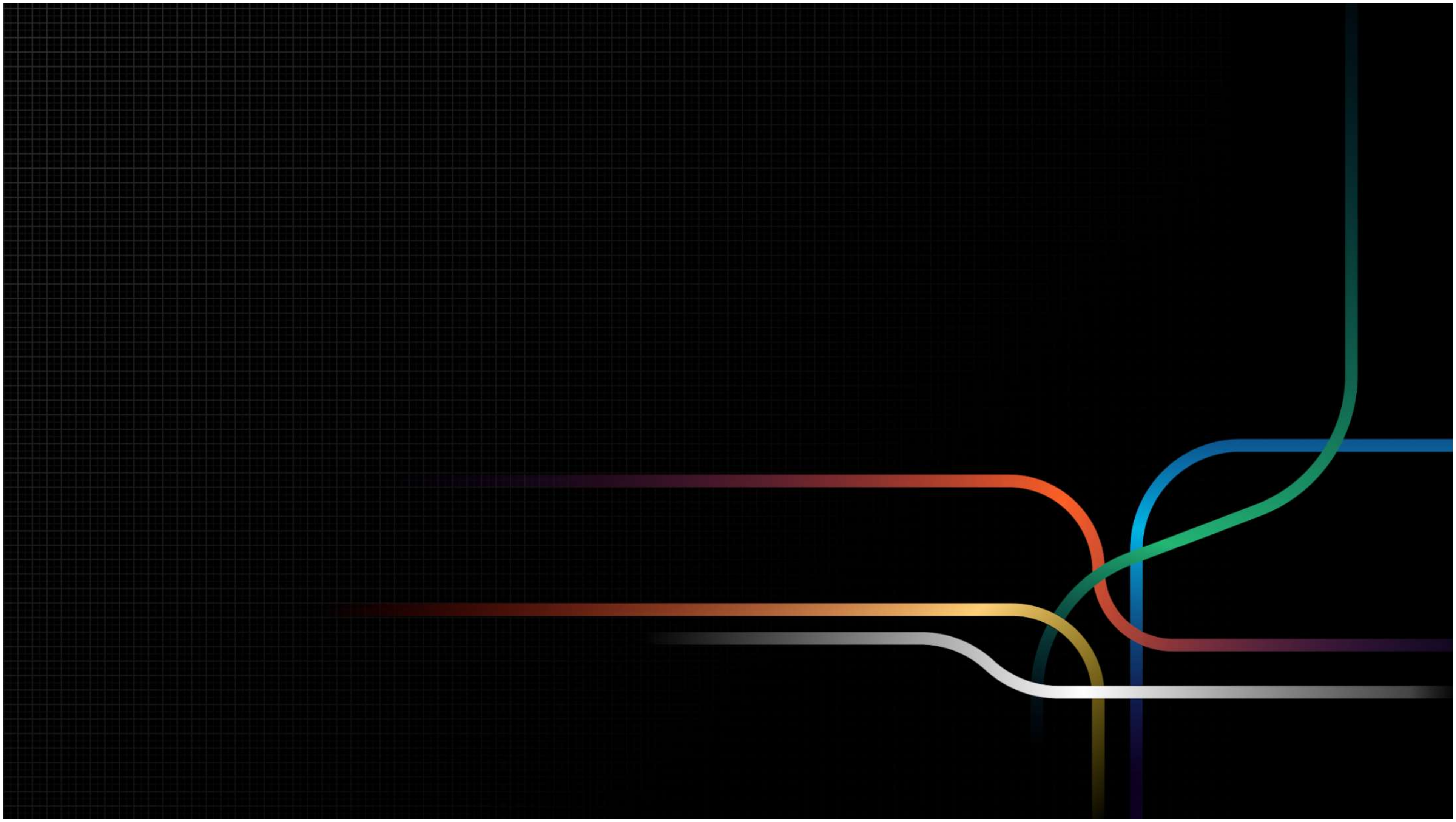
Edmonton

Transforming Edmonton: The City Vision

Learn how the City of Edmonton is leveraging a Dynameq^{TM} citywide traffic simulation and dynamic traffic assignment (DTA) model to consistently inform multiple operational planning studies in support of the city's Transportation Master Plan and its holistic view of transport as an interconnected, multi-modal system.

Edmonton, Alberta is now the fastest growing city in Canada. A near 15% population growth over the last five years and a new transportation master plan emphasizing greater multi-modality are bringing a variety of new infrastructure and development projects including a major new $1.8B light rail and over $1B in freeway conversion investments.

To support transportation investments, city engineers/planners have become more interested in analyzing network wide traffic diversion and impacts. They studied construction mitigation and preserved downtown accessibility during work phases, and evaluated the design of new facilities including light rail, transit signal priority and corridor improvements.



Simulation and Capacity Analysis User Group

SimCap

Louisiana

user group

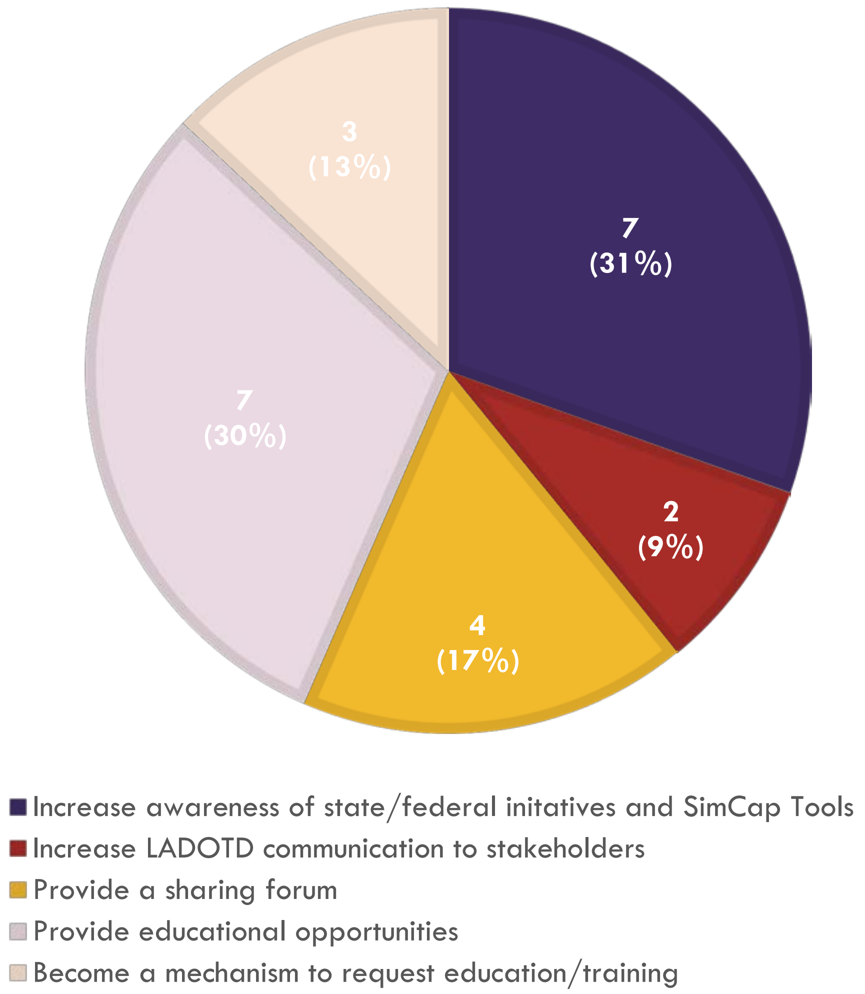
Mini Roundtable

DOTD and SimCap

- What can you do for DOTD?
  - Calibration procedures
  - Default settings
  - Formats
  - Uses for simulation
  - New software tools

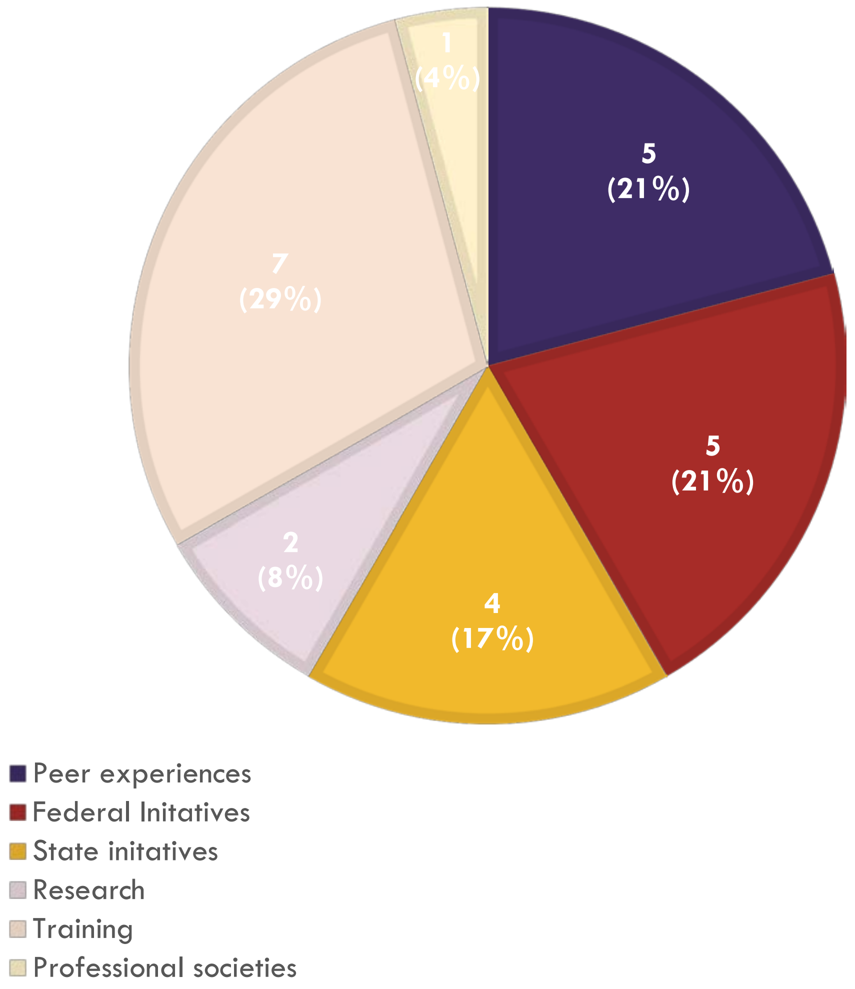
Survey Results (1/4)

- **Objectives:** Please choose SimCap Louisiana's two most important objectives
  - *Increase awareness* of LADOTD initiatives, national activities, and the latest SimCap tools (64%)
  - *Provide educational opportunities* to learn of more appropriate and efficient ways of conducting SimCap analysis (64%)



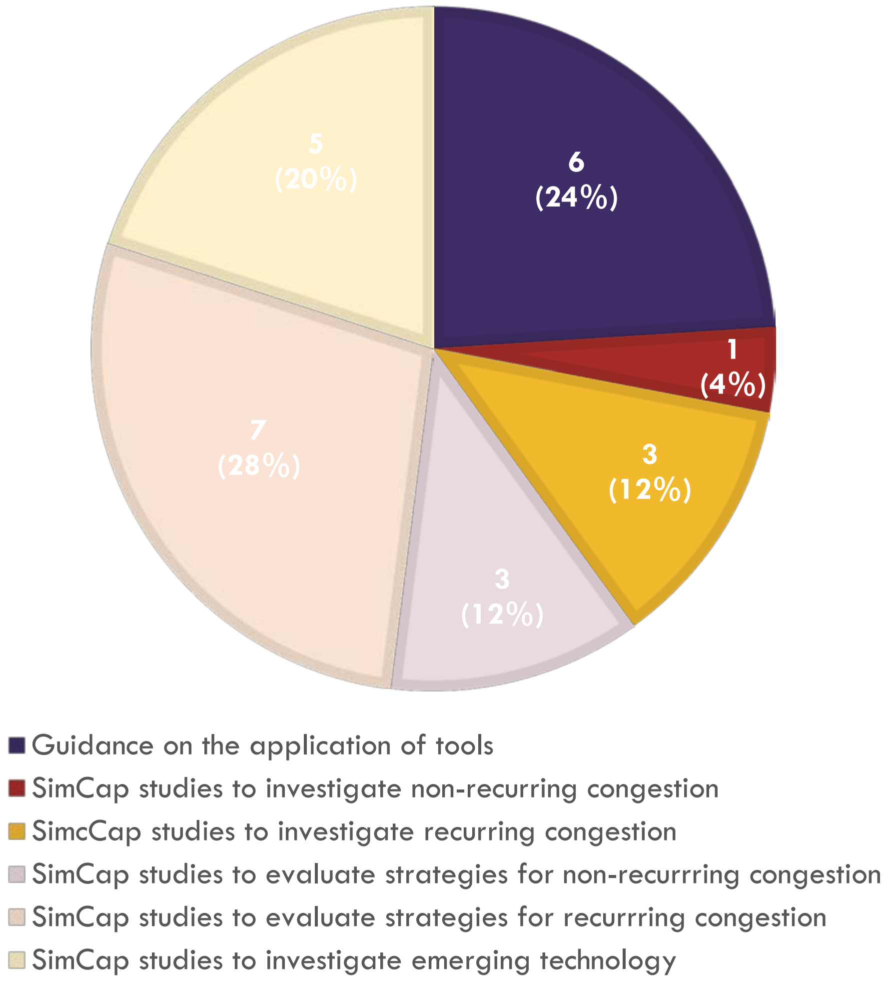
Survey Results (2/4)

- **Purpose of Educational Meetings:** Please choose the two most beneficial activities you would like featured at the educational meetings
  - *Training:* internal or external speakers provide training on specific SimCap tools and software (64%)
  - *Peer experiences:* practitioners present on their experiences with a current SimCap analysis method or tool (46%)
  - *Federal initiatives:* external speakers present on current, SimCap-related FHWA projects, programs, initiatives, or guidance documents (46%)



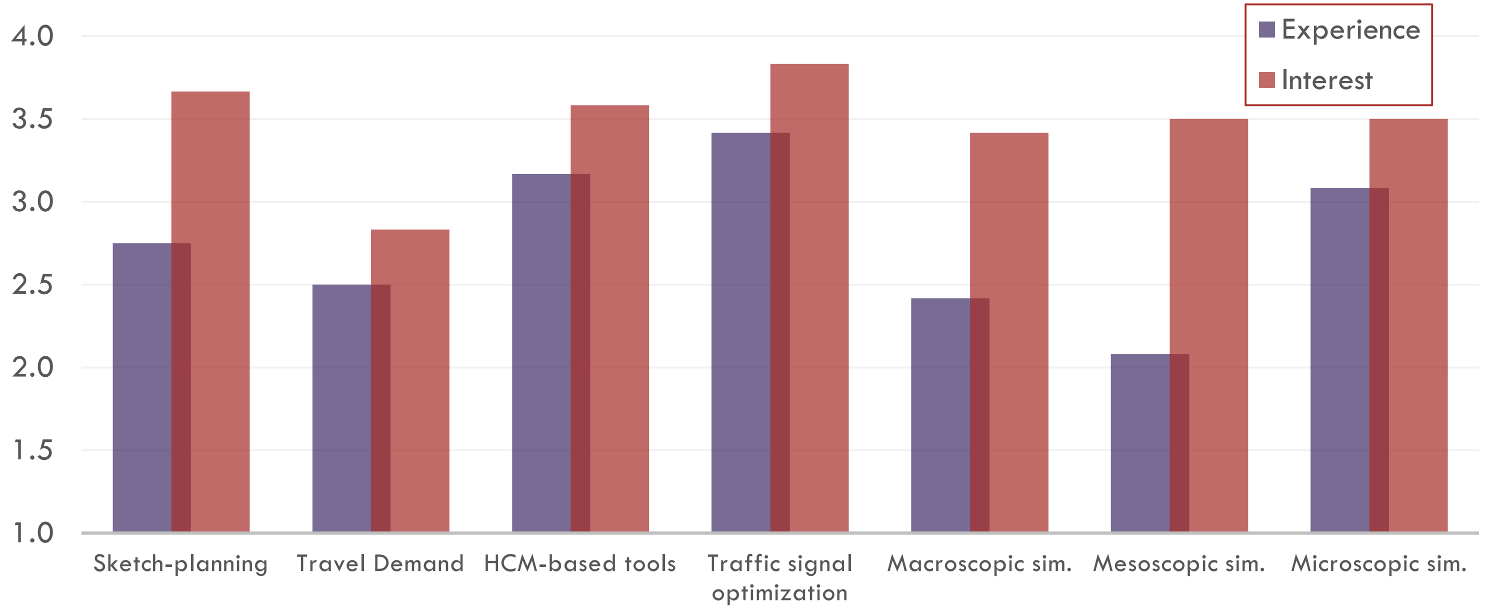
Survey Results (3/4)

- **Topics at Educational Meetings:** Select the topic(s) you would like discussed at the educational meetings
  - *SimCap studies* to evaluate mitigation/management strategies for *recurring congestion* (64%)
  - *Guidance on the application* of SimCap tools (55%)
  - *SimCap studies* to investigate the impact of *emerging technology* (46%)



Survey Results (4/4)

- **Tool-Specific Topics:** Experience vs. interest level
  - Experience mainly with: (1) traffic signal optimization, (2) HCM-based tools, and (3) microscopic sim.
  - Variety of topics of interest
  - Top-Ranked: Traffic signal optimization
  - High Interest and greatest knowledge gap: (1) mesoscopic sim., (2) macroscopic sim., and (3) sketch-planning



THANK YOU FOR ALL ATTENDING!!