I-290 Ramp HOV FREQ Analysis: NW Corridor – I-290/IL 53

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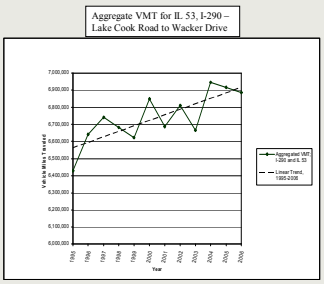
Purpose and Need

- Increase in expressway VMT on I-290/IL 53 not matched by increase in capacity (ln mi)
- System may be underperforming– lower annual VMT recorded in 2005 and 2006 (IDOT)



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Purpose and Need (cont.)

- Key segments of I-290 are major bottlenecks
- IB Mannheim to Cicero (7 miles):
  14.4 m to 19.2 m travel time by 2025
- 7 MM hours of truck travel delay in 2005 from 2 interchanges - @ I-90/94 and @ I-355
- HOV facility bw I-88/294 and Austin included as 2030 RTP Major Capital Project
- Preliminary engineering soon under way for I-290 HOV lane project (IDOT)

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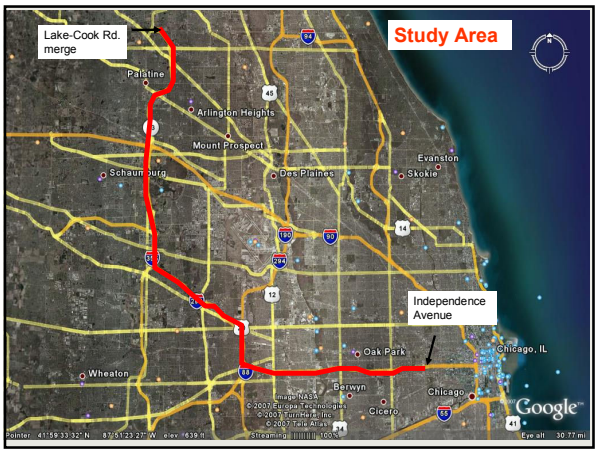

FREQ modeling strategy

FREQ-PE(V.12)
Macroscopic Simulation
For base yr. & 2030
•8 scenarios

Strangler capacity

VISSIM
Microscopic simulation
Objective = determine throughput capacity of "Strangler sections"

Output
•Passenger hours of travel
•VMT
•Fuel consumption
•VOC emission

Analysis
•Benefit w.r.t. 2030 no build

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Scenarios

- 2002 (base year) w/o ramp metering
- 2030 w/o ramp metering (baseline condition)
- 2030 w/ ramp metering - ***W/ and W/O spatial shift***
- 2030 w/ ramp metering w/ HOV priority entry lane (PE) – ***W/ and W/O spatial and modal shift***
- 2030 w/ ramp metering w/ HOV priority entry lane (PE) w/ Bus Service – ***W/ and W/O spatial and modal shift***

Simulation time period: 4 am-12 ("AM"), 12 – 8 pm ("PM") in 1 hour resolution

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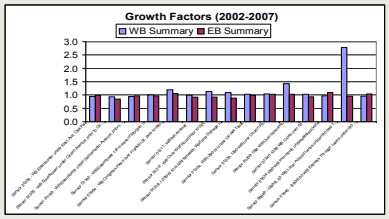
Input Data Overview

- Base year: 2002 (March 5) – (Schermann, 2005)
- Arterial volume, speed and capacity – IDOT AADT, CMAP model
- Mainline/ramp geometric data (Schermann, 2005, CMAP modal)
- Mainline/ramp volume - TSC



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Calibration

- Replicate observed mainline speed and queue extent
  - Obtained from IDOT detector reports for December and November 2003 (Tuesdays and Thursdays – outlier excluded)
- Adjust: speed-flow curve, segment-by-segment mainline capacity, ramp capacity, merge capacity, weaving section capacity
- Same capacity for each section for both AM and PM
- Start value of 2100vph/pl/ph for mainline
- Capacity for Strangler sections estimated by VISSIM

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VISSIM Simulation Screen capture

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FREQ Simulation: Base Conditions using Calibration Results

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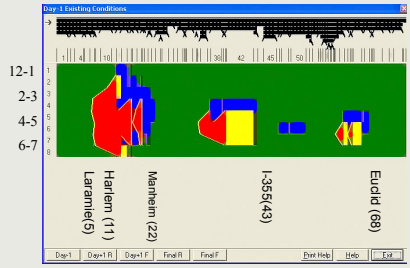

Base year Outbound PM

GREEN: Free-flow conditions
BLUE: .9 <= V/C < 1.00
YELLOW: Bottleneck (V/C =1.00)
RED: Congested flow conditions

Key bottlenecks are:

- Between York Road entrance (S. 38) and the I-355 exit (S. 44)
- Lane drop at the Austin Avenue exit (S. 9)
- Between Harlem Avenue entrance (S. 12) and the 25th Ave interchange (S. 20) ~ ramp and overpass layout reduces effective capacity

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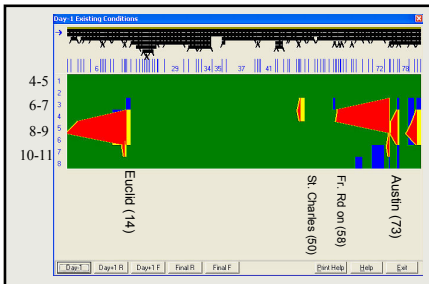

Base year Inbound AM

GREEN: Free-flow conditions
BLUE: .9 <= V/C < 1.00
YELLOW: Bottleneck (V/C =1.00)
RED: Congested flow conditions

Key bottlenecks are:

- Euclid Avenue entrance (S. 16)
- Fly-over bridge at the I-290/I-355 Interchange (S. 35)
- Southbound I-294 connector (S. 50) ~ queue spillover
- Frontage Road merge (S. 59) to Austin Ave. entrance (S. 73) ~ overpasses, left side exits, poor left shoulder clearance, weaving sections below capacity

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2030 Simulation

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2030 Simulation Parameters

- Growth factors for 2030 capped b/w 0.8 and 2.0
- Spatial shift to arterials activated if 5 min. travel time saved
- Modal shift (5 mins TT) b/w SOV, HOV (if HOV PE engaged), and Bus (if Bus Service engaged)
- FREQ provides 4 options for ramp meter optimization:

  "**maximize vehicle input to freeway**", "max vehicle-miles of freeway travel", "**max passenger input to freeway**", and "max passenger-miles of freeway travel

- Ramp queue length is limited to appr. 200 veh. in outer suburbs and 80 veh. in inner suburbs

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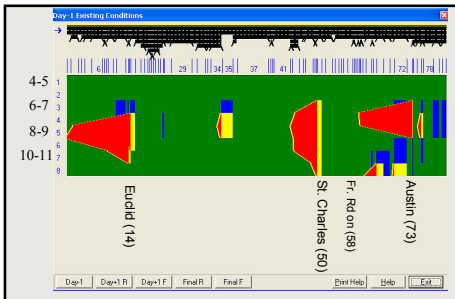

2030 Inbound AM Do Nothing

GREEN: Free-flow conditions
BLUE: .9 <= V/C < 1.00
YELLOW: Bottleneck (V/C =1.00)
RED: Congested flow conditions

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2030 Outbound PM Do nothing

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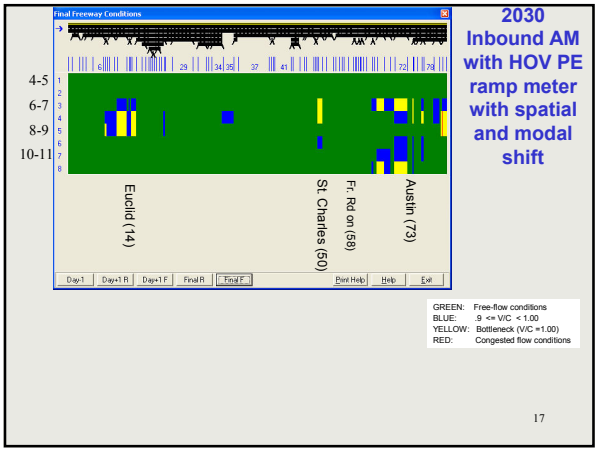

2030 Inbound AM with HOV PE ramp meter with spatial and modal shift

GREEN: Free-flow conditions
BLUE: .9 <= V/C < 1.00
YELLOW: Bottleneck (V/C =1.00)
RED: Congested flow conditions

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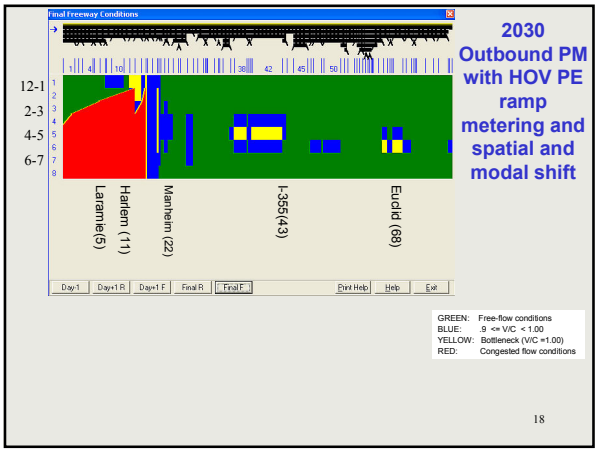

2030 Outbound PM with HOV PE ramp metering and spatial and modal shift

GREEN: Free-flow conditions
BLUE: .9 <= V/C < 1.00
YELLOW: Bottleneck (V/C =1.00)
RED: Congested flow conditions

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Findings – without and with HOV Priority Entry

Ramp Metering Only (without PE Engaged)

Scenario			1	2	3	
Mainline, Ramp & Arterial	2002 base	2030 base	2030 ramp meter only	2030 ramp meter and spatial shift	% change (3-1)	% change (2-1)
Passenger hours	305,181	411,692	421,618	403,560	-2.0%	2.4%
Total Vehicle miles traveled	7,822,471	7,932,117	7,944,586	7,952,905	0.3%	0.2%
Total Gas consumption (gallons)	2,005,356	1,751,407	1,749,918	1,761,107	0.6%	-0.1%
Total VOC (tons)	2,303	3,239	3,296	3,162	-2.4%	1.8%

Ramp Metering with Priority Entry (PE) Engaged

Scenario			1	2	3	4		
Mainline, Ramp & Arterial	2002 base	2030 base	2030 PE ramp meter only	2030 PE ramp meter + spatial shift	2030 PE ramp meter, spatial and modal shift	% change (4-1)	% change (3-1)	% change (2-1)
Passenger hours	305,181	411,692	444,451	435,288	374,382	-9.1%	5.7%	8.0%
Total Vehicle miles traveled	7,822,471	7,932,117	7,949,948	7,952,225	7,917,178	-0.2%	0.3%	0.2%
Total Gas consumption (gallons)	2,005,356	1,751,407	1,764,694	1,872,486	1,844,407	5.3%	6.9%	0.8%
Total VOC (tons)	2,303	3,239	3,457	3,360	2,880	-11.1%	3.7%	6.7%

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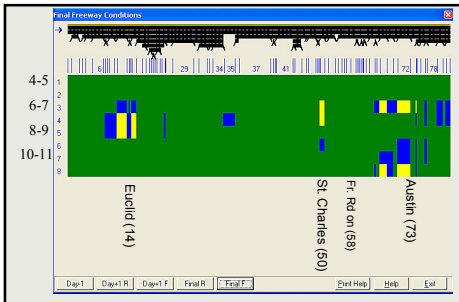

2030 Inbound AM with HOV PE ramp meter with with bus service with spatial and modal shift

GREEN: Free-flow conditions
BLUE: .9 <= V/C < 1.00
YELLOW: Bottleneck (V/C =1.00)
RED: Congested flow conditions

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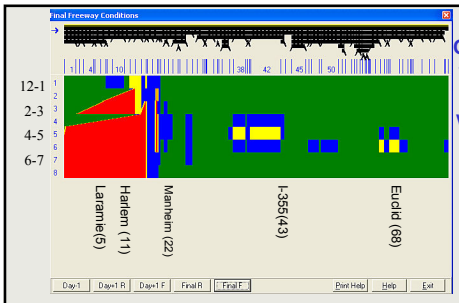

2030 Outbound AM with HOV PE ramp meter with with bus service with spatial and modal shift

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RED: Congested flow conditions

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Findings – with HOV Priority Entry with Limited Stop Bus Service

Ramp Metering with Priority Entry (PE) Engaged plus Bus Services

Scenario		1	2	3	4			
Mainline, Ramp & arterial	2002 base	2030 base	2030 PE ramp meter only	2030 PE ramp meter + spatial shift	2030 PE ramp meter, spatial and modal shift	% change (4-1)	% change (3-1)	% change (2-1)
Passenger hours	305,181	434,443	470,014	459,727	367,621	-15.4%	5.8%	8.2%
Total Vehicle miles traveled	7,822,471	7,932,117	7,949,980	7,953,389	7,900,814	-0.4%	0.3%	0.2%
Total Gas consumption (gallons)	2,005,356	1,751,408	1,764,709	1,868,035	1,834,773	4.8%	6.7%	0.8%
Total VOC (tons)	2,303	3,239	3,457	3,362	2,802	-13.5%	3.8%	6.7%

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Summary of Findings

- Ramp metering without HOV PE lanes will not improve the overall travel condition along the corridor significantly
- With HOV PE lanes, however, ramp metering is expected to reduce total passenger travel time by 9.1 % for the 2030 condition
- Vehicle miles traveled and total emission of volatile organic compound (VOC) are projected to decrease by 0.2% and 11.1%, respectively
- Express bus service will further increase the benefit of HOV PE, to 15.4% for the 2030 condition.
- Queue length limit – dependent on available ramp, turn lane, and arterial capacity – is the critical parameter

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