

Applications of Microscopic Traffic Simulation Model for Integrated Networks



by

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*Center for Transportation Research and Education
Iowa State University*



Our Location





Infrastructure





International Port & Hub





Agenda

- *CORSIM*
- *Modules in Traffic Simulation Models*
- *Applications of Traffic Simulation Models*
- *Related Research @ NJIT*



CORSIM

- A microscopic, stochastic traffic simulation model that represents the real world dynamic traffic environment for freeways and streets
- A powerful traffic engineering tool producing a variety of MoE's and graphics files for analysis

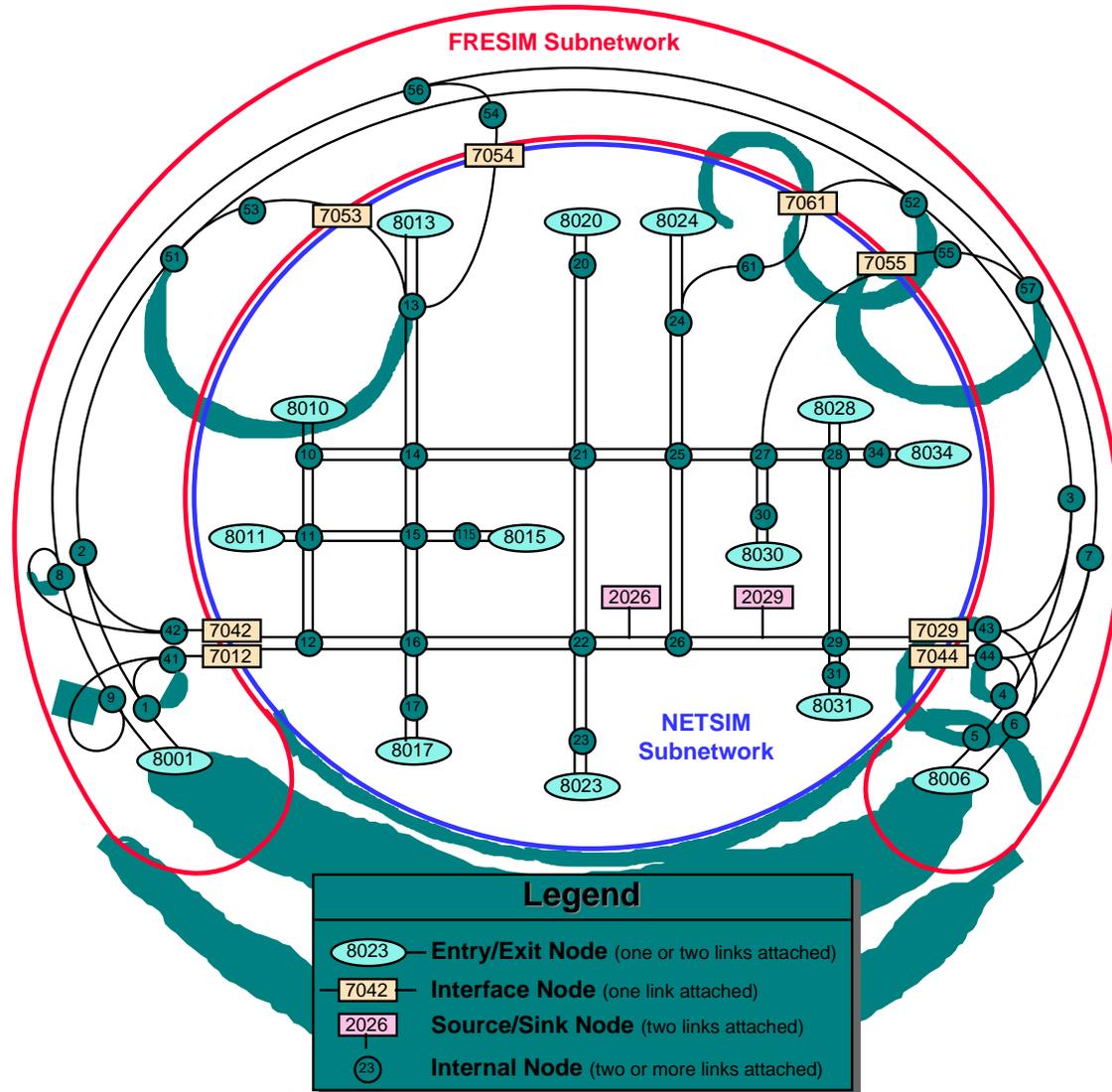


Model Representation

- Network representation
 - Link-node concept
 - Nodes depict
 - changes in geometry;
 - trip generators;
 - sign and signal control points
 - Links depict roadways between two nodes
- Traffic representation
 - Up to 4 different fleet components
 - Cars, carpools, buses, and trucks



Sample Network





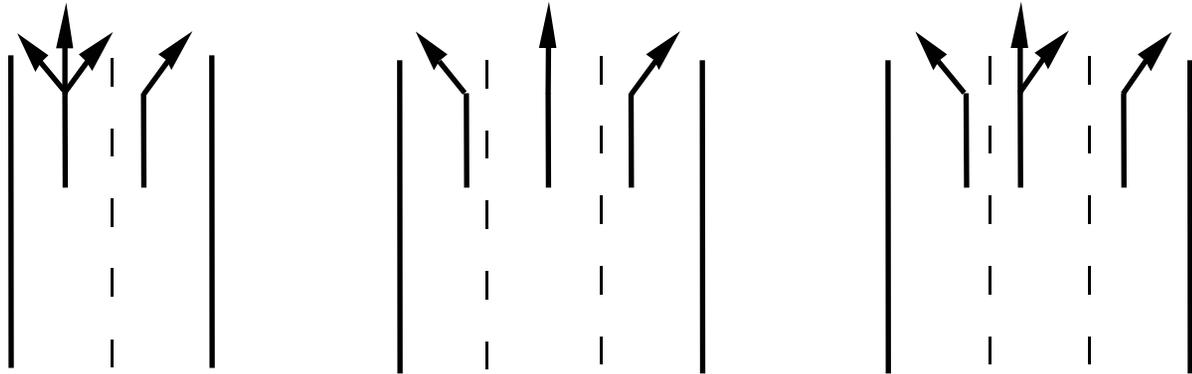
Model Features

- Network geometry
- Sign & signal control
- Human behavior
- Vehicle movements
- Stochastic Simulation
- Others

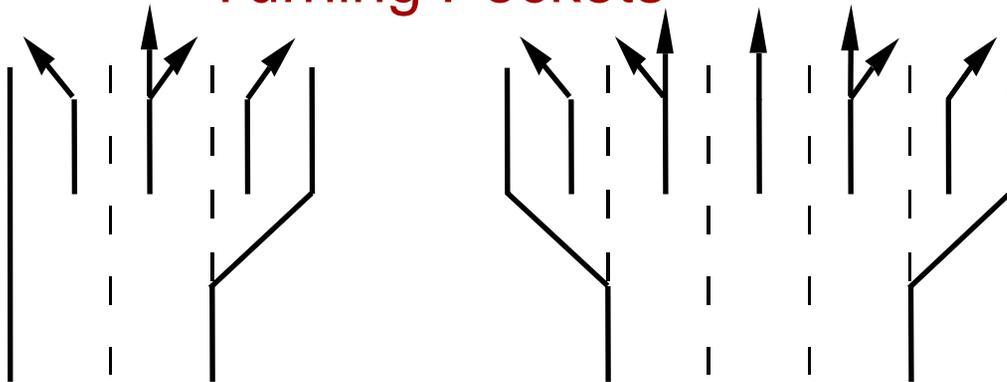


Network Geometry

Lane Channelization at Intersections



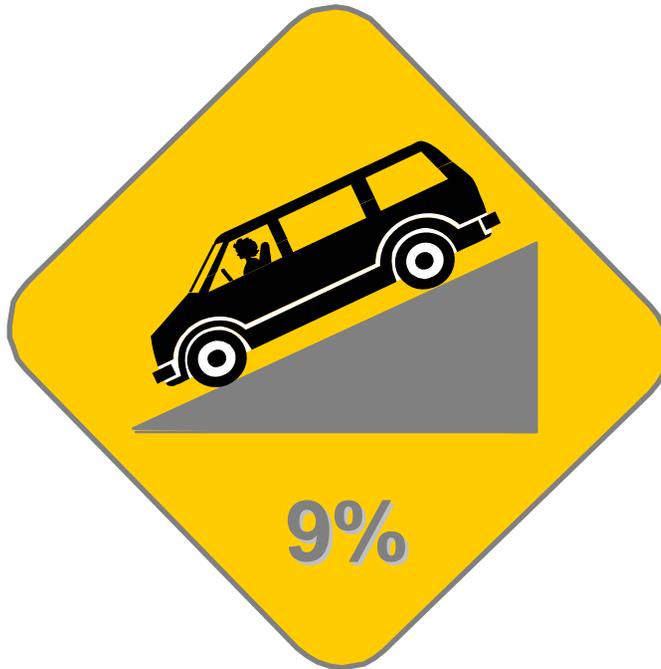
Turning Pockets



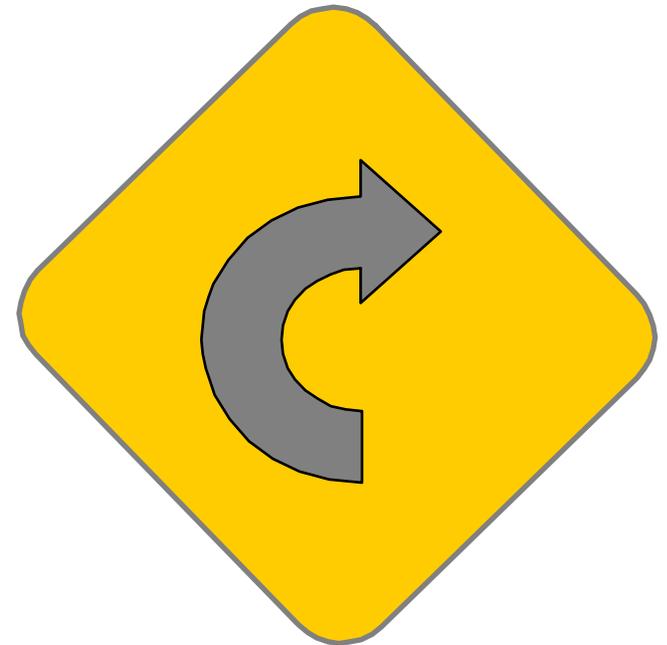


Network Geometry

Grade (%)



Radius of Curvature &
Super-Elevation





Network Geometry

Grade Separation (Up to 8 Levels)

The screenshot displays the TRAFVU simulation environment. The main window shows a top-down view of a road network with multiple levels of grade separation, represented by different shades of gray and black. The roads are set against a green background representing grass. Several vehicles are visible on the roads, including a red car and a blue truck. The interface includes a menu bar (File, View, Display, Options, Animation, Window, Help) and a toolbar with various icons for simulation control. A legend on the left side lists 'VEHICLE COLORS' and 'INCIDENTS'. A 'Total Anim. time' window in the top right shows a total time of 4.44 seconds and frame delay settings. A 'Vehicle Truck' window in the bottom right provides detailed information about a selected vehicle.

Vehicle Truck	
Vehicle Id:	1978
Vehicle Fleet:	Truck
Vehicle Type:	3
Vehicle Length:	35
Driver Type:	10
USH Id:	226
OSH Id:	227
Lane Number:	3
Changing Lane:	No
Candidate Lane:	0
Dist. from USH:	438
Acceleration:	1
Speed (ft/sec):	84
Turn Code:	Through
Destination:	238
Leader Id:	1984
Follower Id:	1985
In Queue:	No

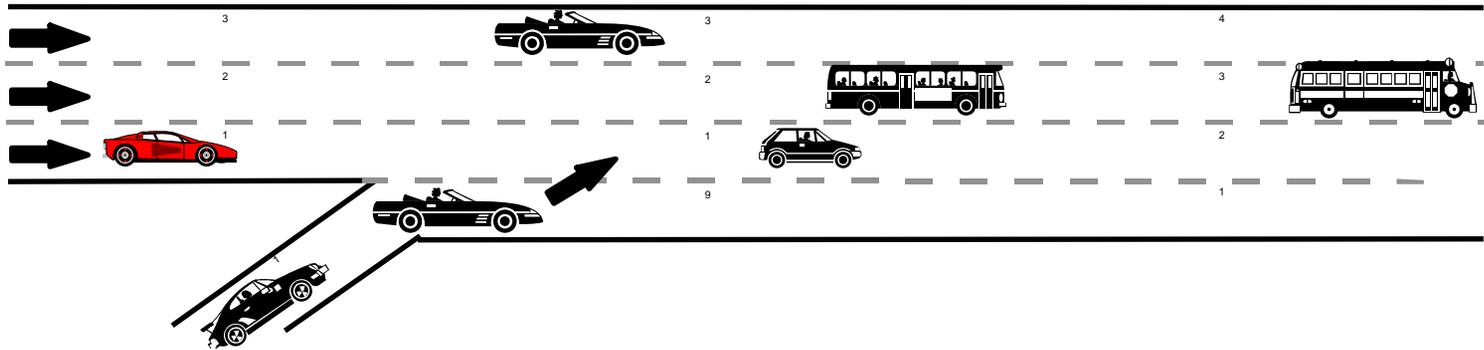
Windows visible in the taskbar: Start, Exploring - C:\SIS\Ver10..., Microsoft Developer Stud..., TRAFVU - denver2.tbl, Microsoft Word - Document1

System clock: 9:32 AM

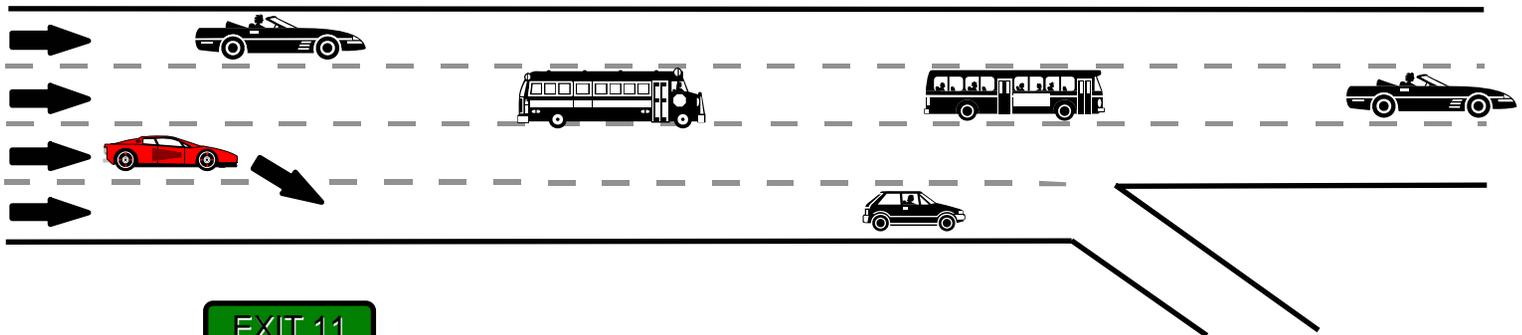


Network Geometry

On-Ramp Traffic Merging Operations



Off-Ramp Traffic Diverging Operations



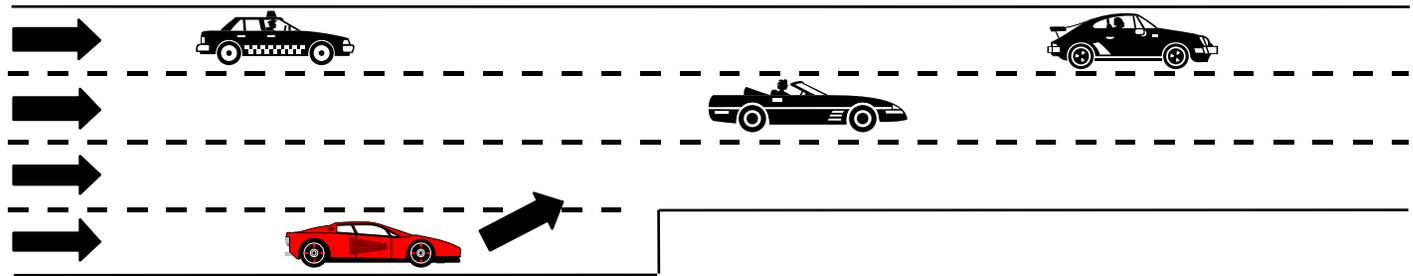
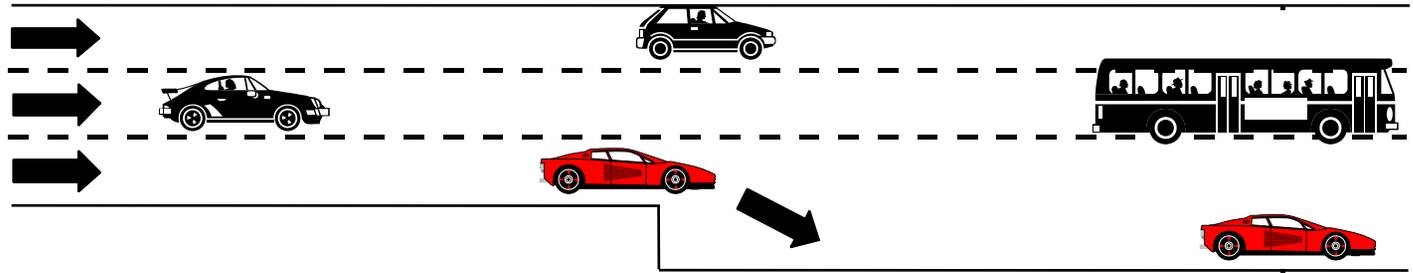
EXIT 11

CORSIM
1 MILE



Network Geometry

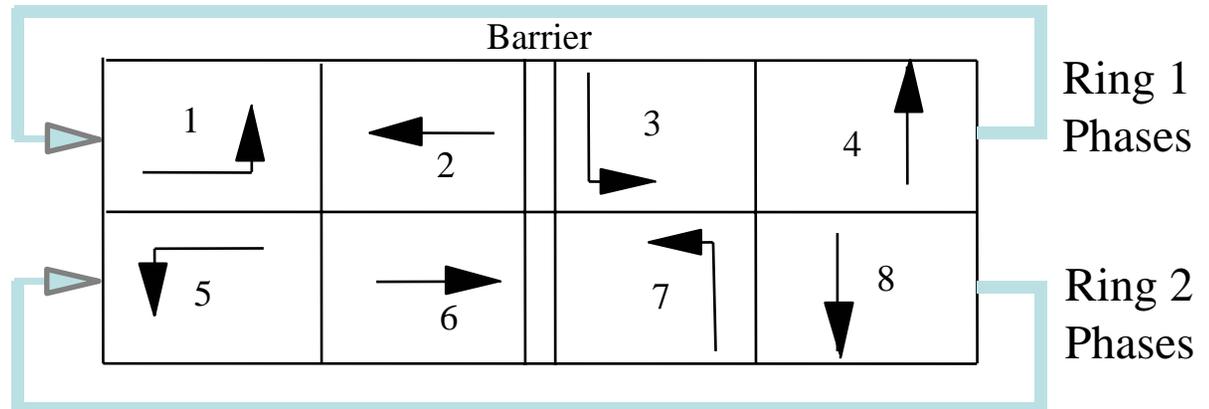
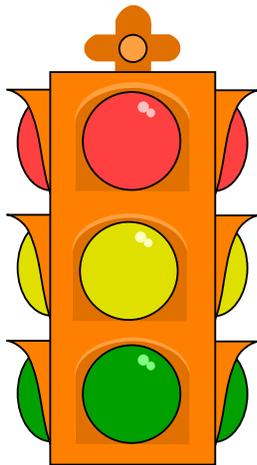
Lane Additions & Drops





Sign & Signal Control

Pre-timed Signals
Actuated Signals (Type 170 & NEMA)



Yield and 2-Way Stop Signs

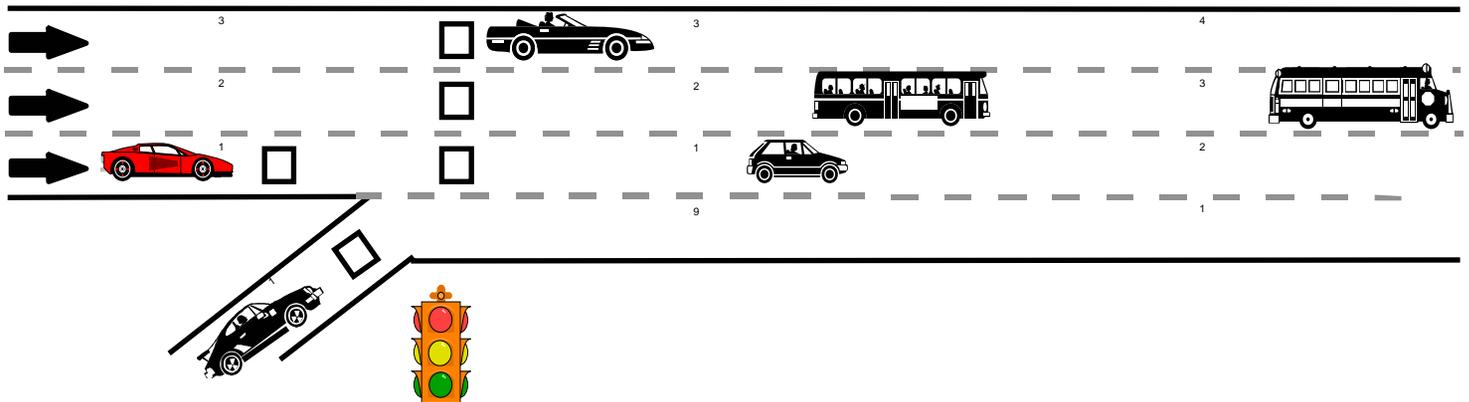




Sign & Signal Control

Ramp-Metering Control:

- Clock Time
- Demand/Capacity
- Speed
- Occupancy





Stochastic Simulation

10 Types of Driver Behaviors





Stochastic Simulation

Major parameters affected by driver types:

Desired free flow speed

Headway for car-following

Gap acceptance for lane-changing

Start-up lost time and queue discharge headway

Gap acceptance for minor street traffic

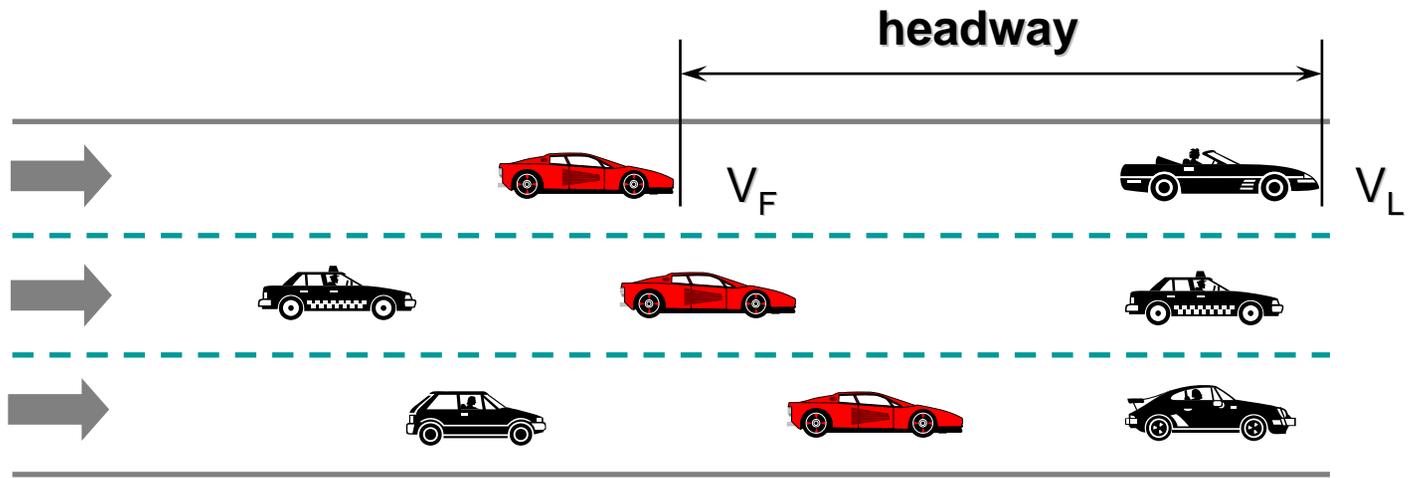
Amber interval response

Gap acceptance for permissive left-turns



Car-Following Logic

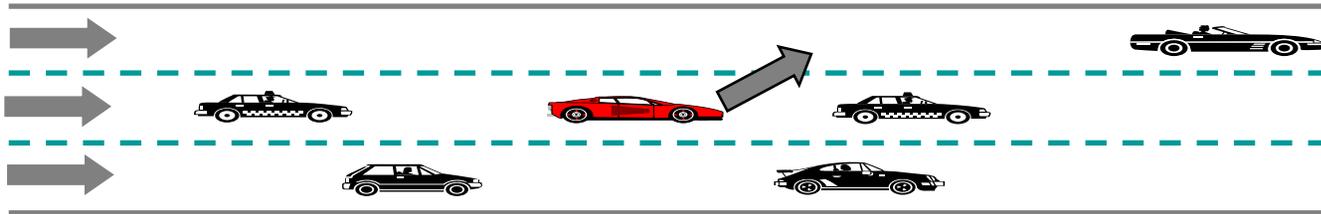
$$\text{Headway} = F(L, V_L, V_F)$$



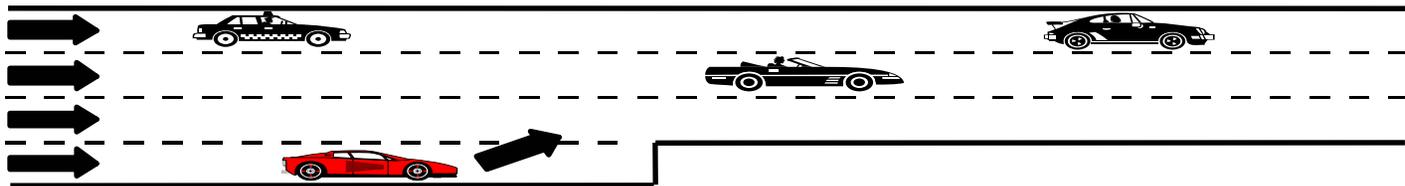


Lane-Changing Logic

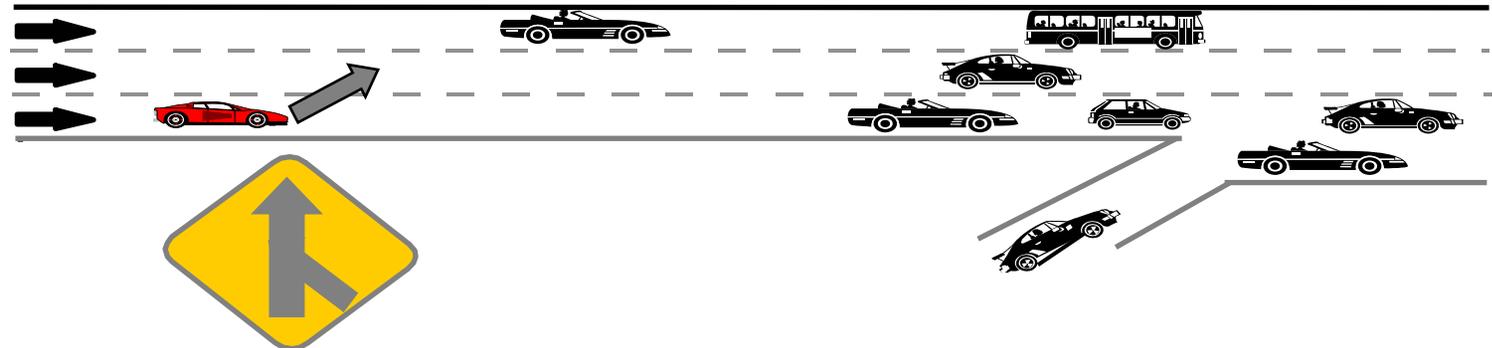
- Discretionary Lane Changing



- Mandatory Lane Changing



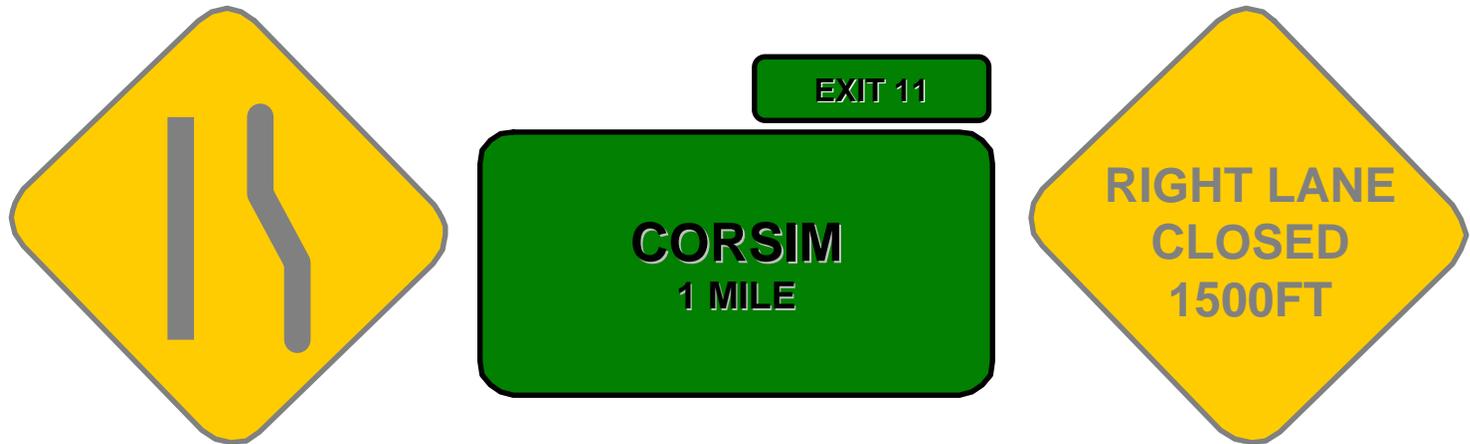
- Anticipatory Lane Changing





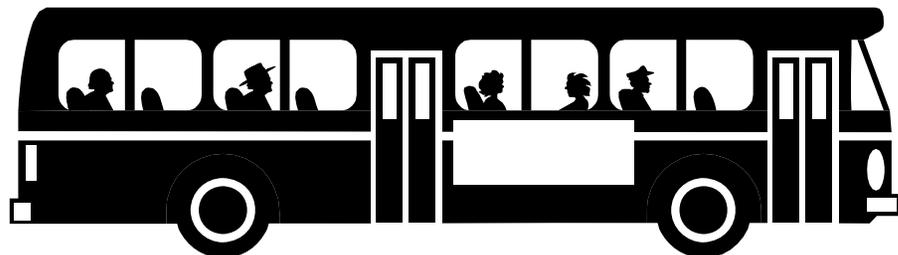
Look-Ahead Features

Responses to Advanced Warning Signs on Freeways





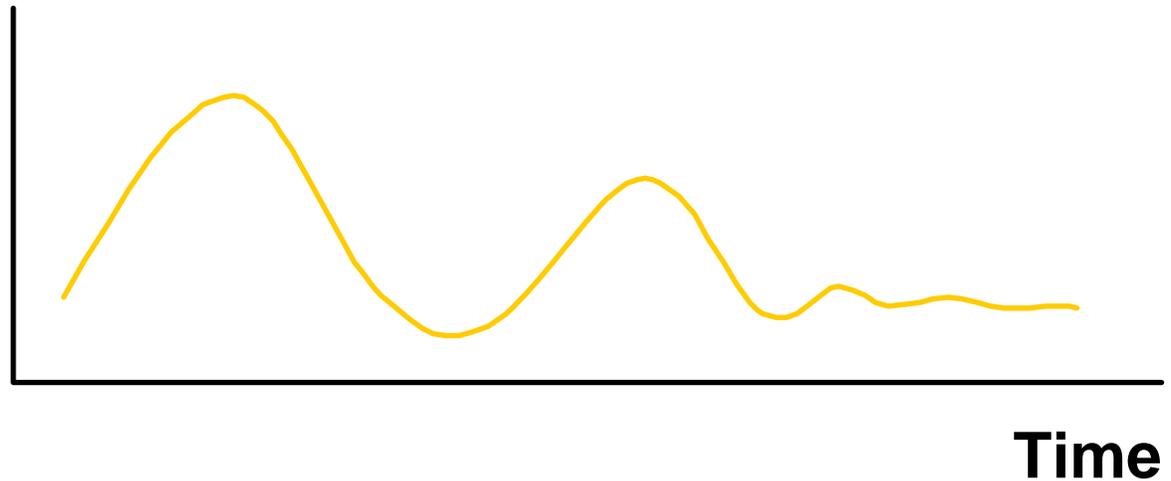
Bus Transit Operations





Time-Varying Demand

Traffic Demand





Input Data Requirements

- Run control data
- Network geometry data
- Traffic control data
- Traffic operations data
- Traffic demand data
- Calibration data
- Others



Outputs

- Graphics (Animation) files
- Static MOE's
 - Throughputs (vehicle trips; person trips)
 - Vehicle-miles or person-miles
 - Vehicle-minutes; person-minutes
 - Speed (mph)
 - Volume (veh/hr)
 - Travel and delay times (min; sec/veh)
 - Queue length, stops, phase failures, etc..
 - Fuel consumption (gal; mpg)
 - Pollutant emissions (CO, HC, NOx; kg/mi-hr)



Animation

TRAFVU - Montrose PM 2010 Alt 11.trf

File View Display Options Animation Window Help

x = 18882.77, y = 15878.26

LEGEND

VEHICLE COLORS

- Left
- Right
- Lt Diag
- Rt Diag
- Thru

INCIDENTS

- Blocked
- Restricted

SIGNALS

- Actuated
- Fixed
- Ramp Mtr

Anim. time=121.44



Animation

TRAFVU - Montrose PM 2010 Alt 11.trf

File View Display Options Animation Window Help

Montrose PM Existing.trf # 4 17:00:01.00 TP = 1

Montrose PM 2010 No Build.trf # 3 17:00:01.00 TP = 1

x = 20527.75, y = 14721.73

x = 16860.51, y = 14636.45

APC

The image displays a screenshot of the TRAFVU software interface, which is used for traffic simulation. The main window is titled "TRAFVU - Montrose PM 2010 Alt 11.trf" and contains a menu bar with "File", "View", "Display", "Options", "Animation", "Window", and "Help". Below the menu bar, there are four sub-windows, each showing a different traffic simulation scenario. The top-left window is titled "Montrose PM Existing.trf # 4 17:00:01.00 TP = 1". The top-right window is titled "Montrose PM 2010 No Build.trf # 3 17:00:01.00 TP = 1". The bottom-left window shows coordinates "x = 20527.75, y = 14721.73". The bottom-right window shows coordinates "x = 16860.51, y = 14636.45". Each window features a control panel on the left side with icons for "M", "O", "E", "P", and "APC". The bottom-right window also includes a playback control panel with buttons for "APC", "rewind", "play", and "fast forward".



Applications

Evaluation of Geometric Improvements
Intersections, Interchanges, & On/Off-Ramps

TRAFVU - denver2.tif

File View Display Options Animation Window Help

denver2.tif 8 1 00 00 48 00 7 F - 1

Total Anim. time - 4.44

Frame Delay (Seconds)

0.000 0.800 2.000

Frames/Time Step

1 1 30

LEGEND

VEHICLE COLORS

Random

INCIDENTS

Blocked

Restricted

Vehicle Track

Vehicle Id:	1978
Vehicle Fleet:	Truck
Vehicle Type:	3
Vehicle Length:	35
Driver Type:	10
USN Id:	226
BSN Id:	227
Lane Number:	3
Changing Lane:	No
Candidate Lane:	0
Dist. from USN:	438
Acceleration:	1
Speed (ft/sec):	84
Turn Code:	Through
Destination:	238
Leader ID:	1984
Follower ID:	1985
In Queue:	No

Start Exploring - DATSViewFD Microsoft Developer Studs TRAFVU - denver2.tif Microsoft Word - Document1 9:32 AM



Warning in Using Simulation Models

- Requirement of input data at a detail level
- Users' responsibility for input data accuracy
- Knowledge of simulation models capabilities and limitations
- Model calibration is not easy in some cases
- Limited capabilities in simulating ITS-related control strategies via CORSIM Run Time Extension



Microscopic Simulation Tools

- *Paramics*
- *CORSIM*
- *VISSIM*
- *INTEGRATION*
- *Dynasmart*
- *MITSIM*
- *TRANSIMS*
- *Others*



Applications

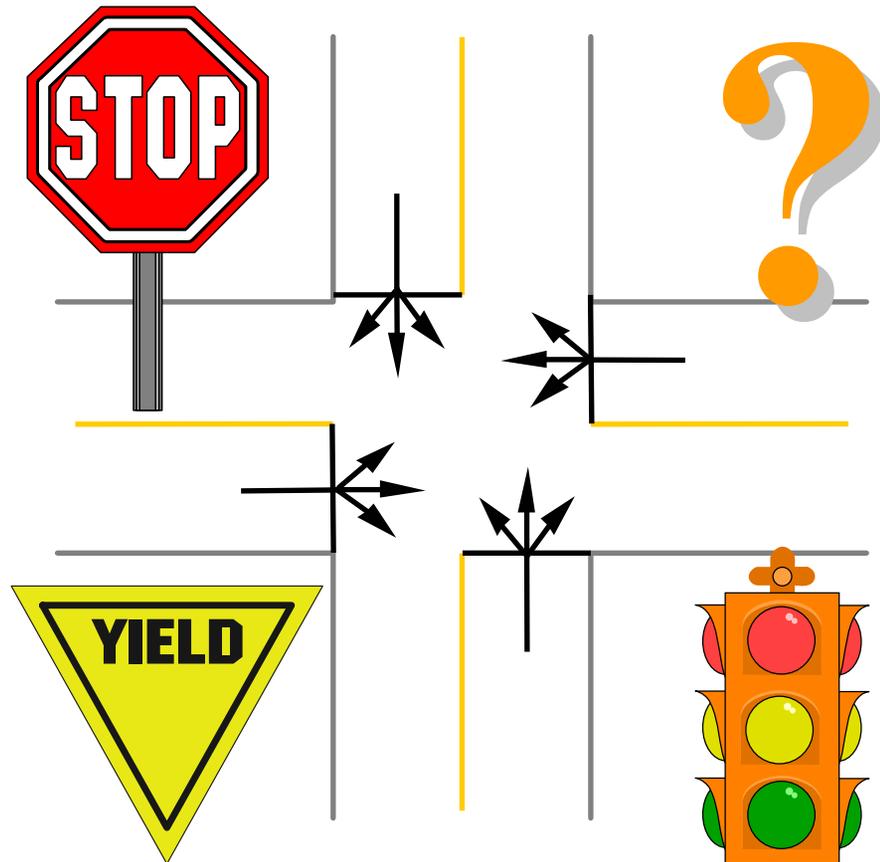
Traffic Operation Analysis
Parking Activities, One-Way System & Lane Use (HOV)





Traffic Control

Sign and Signal Control Analyses at Intersections



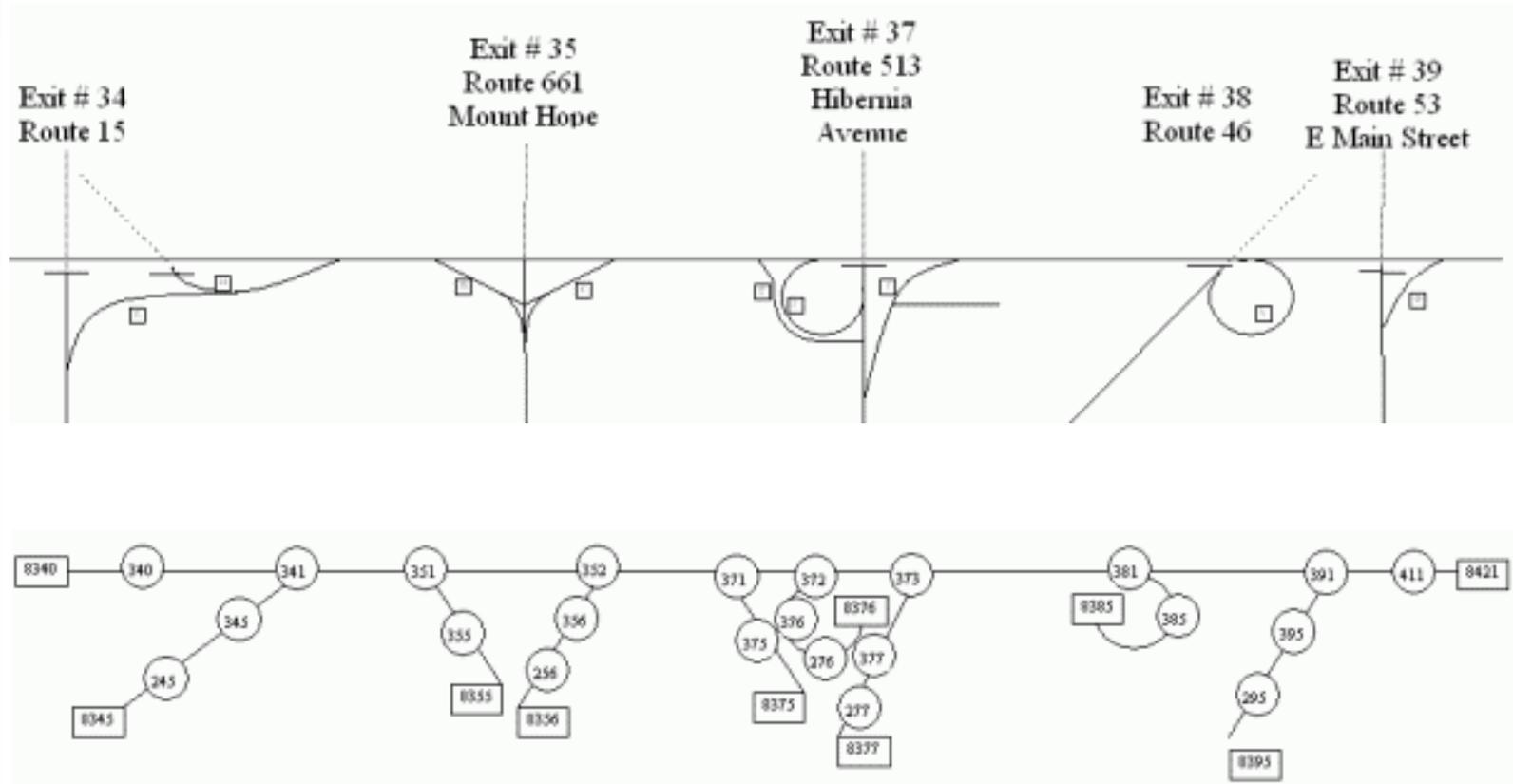


Freeway Capacity Analysis



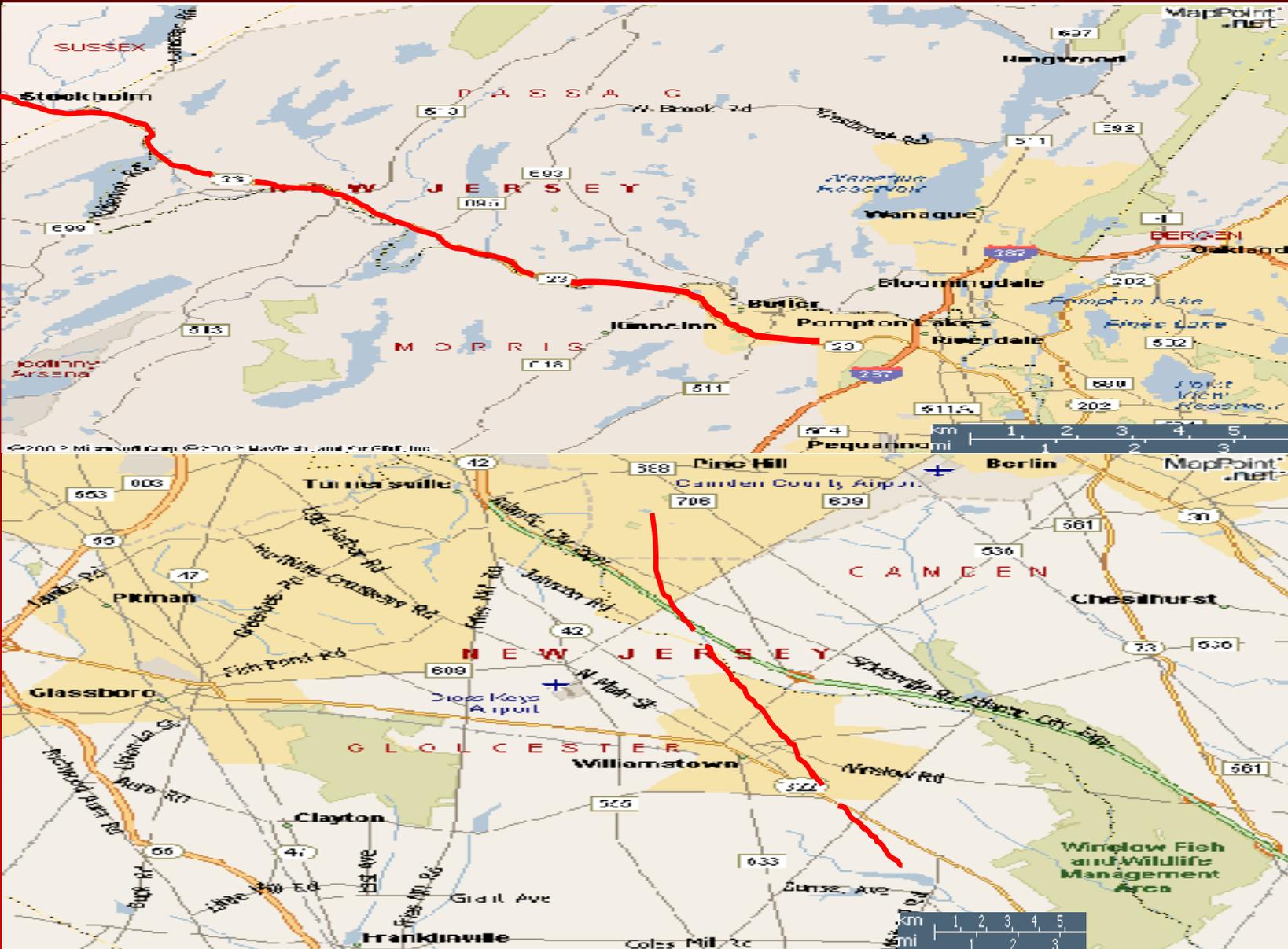


Ramp Metering on I-80



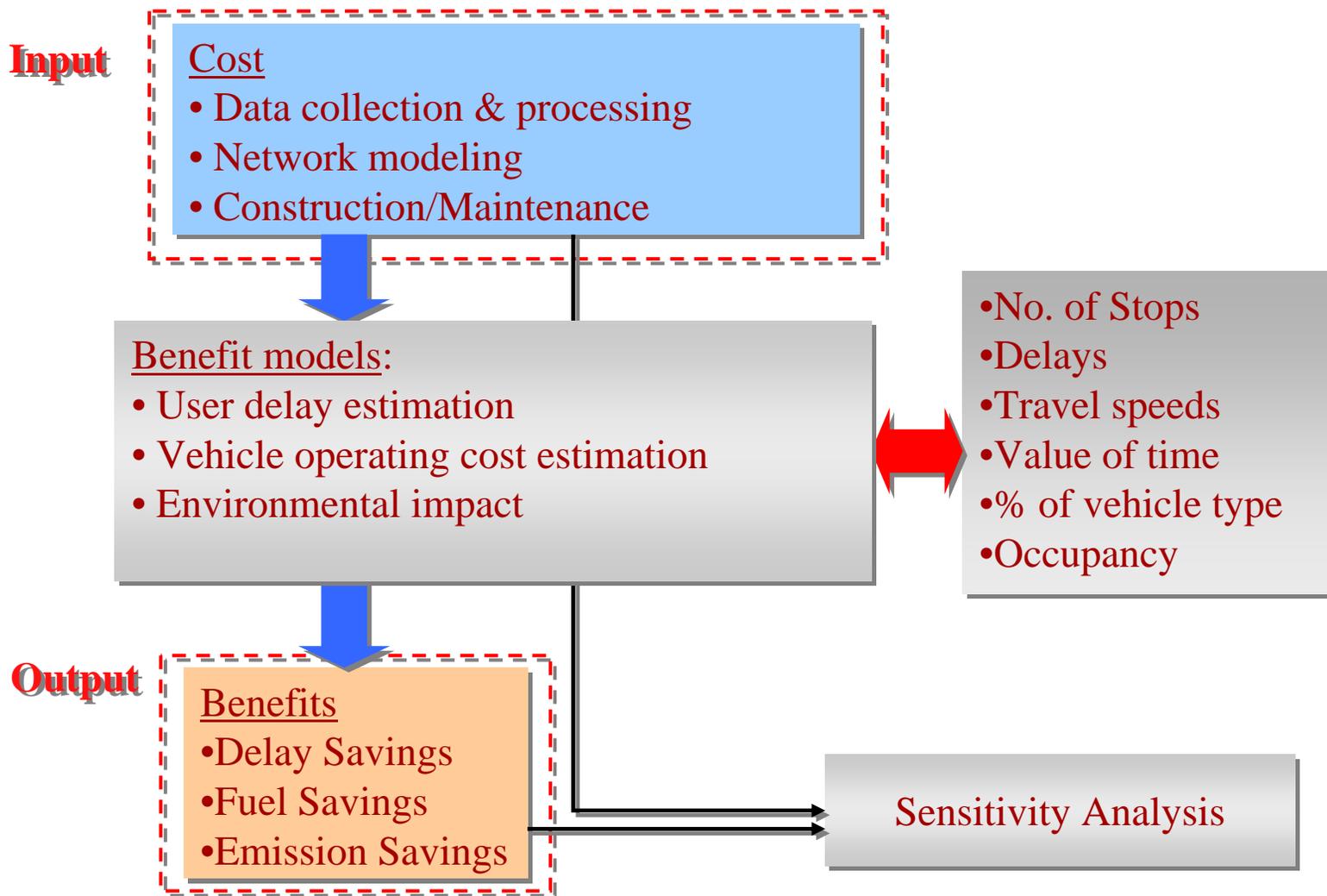


Signal Optimization on NJ Highways





Benefit Analysis - Signal Optimization



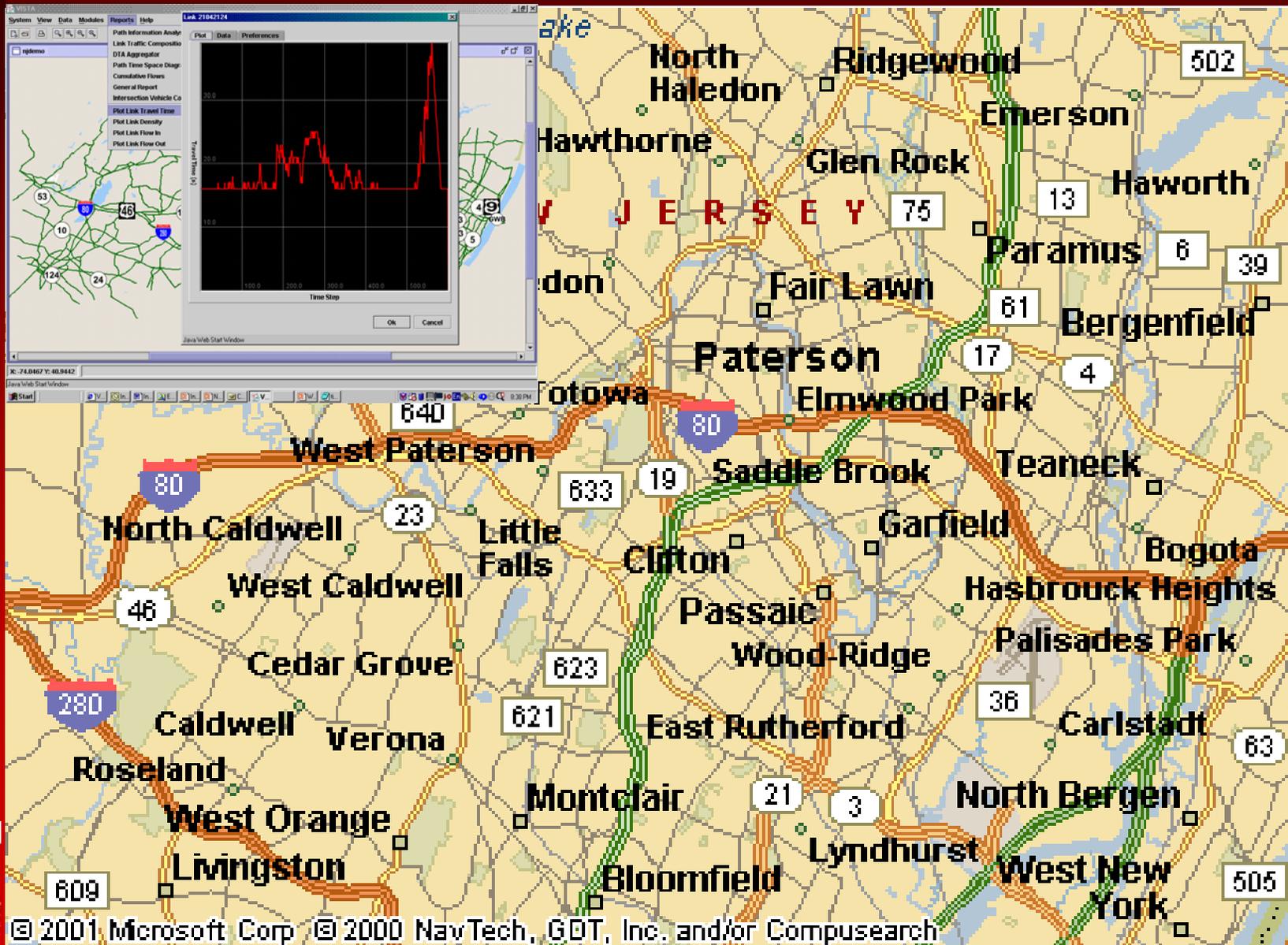


So. Jersey Motorist Information Systems



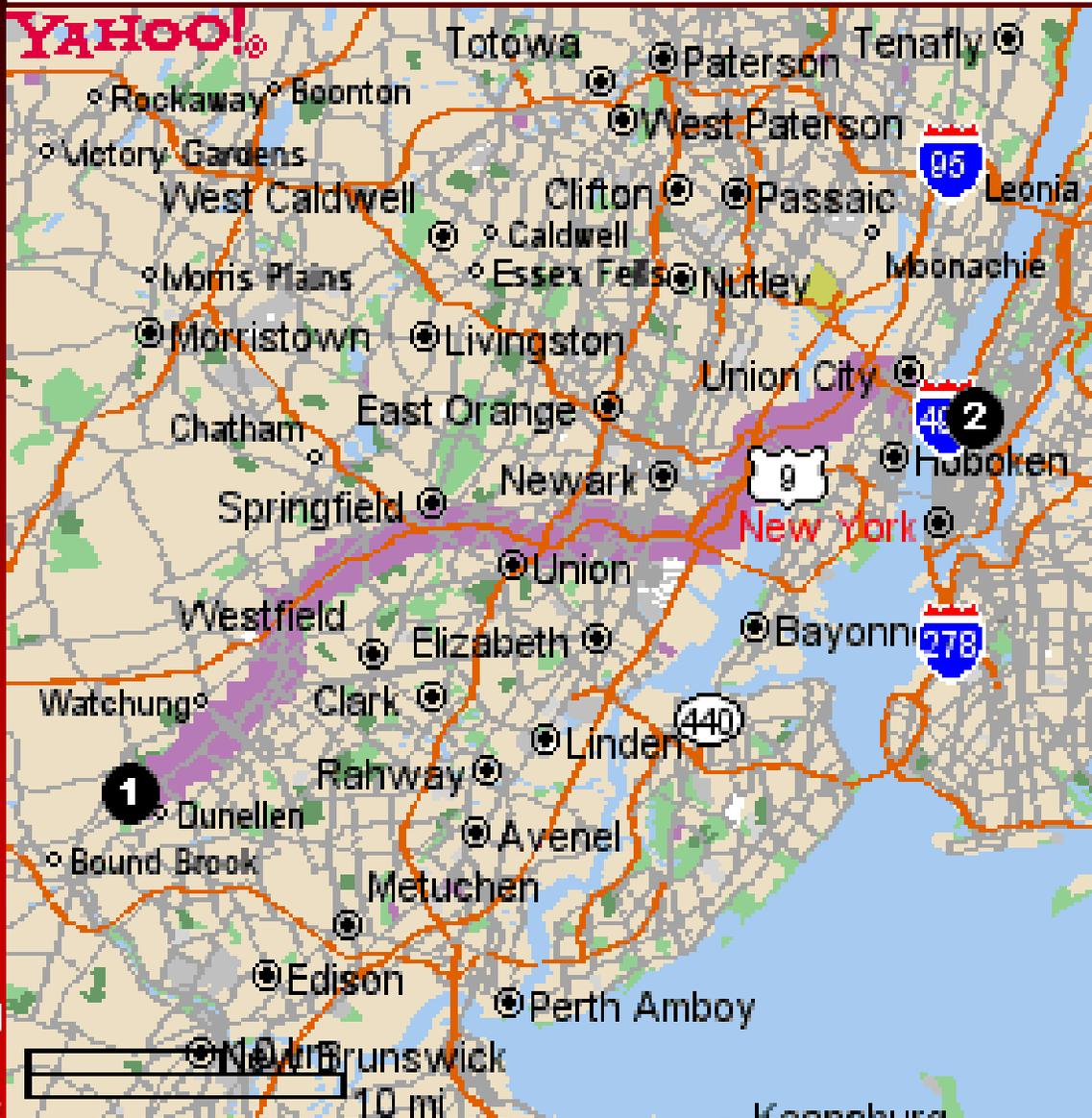


Development of Simulation/Assignment Model for ITS Evaluation





Travel Time Prediction



Starting from
22 West Way
Green Brook, NJ

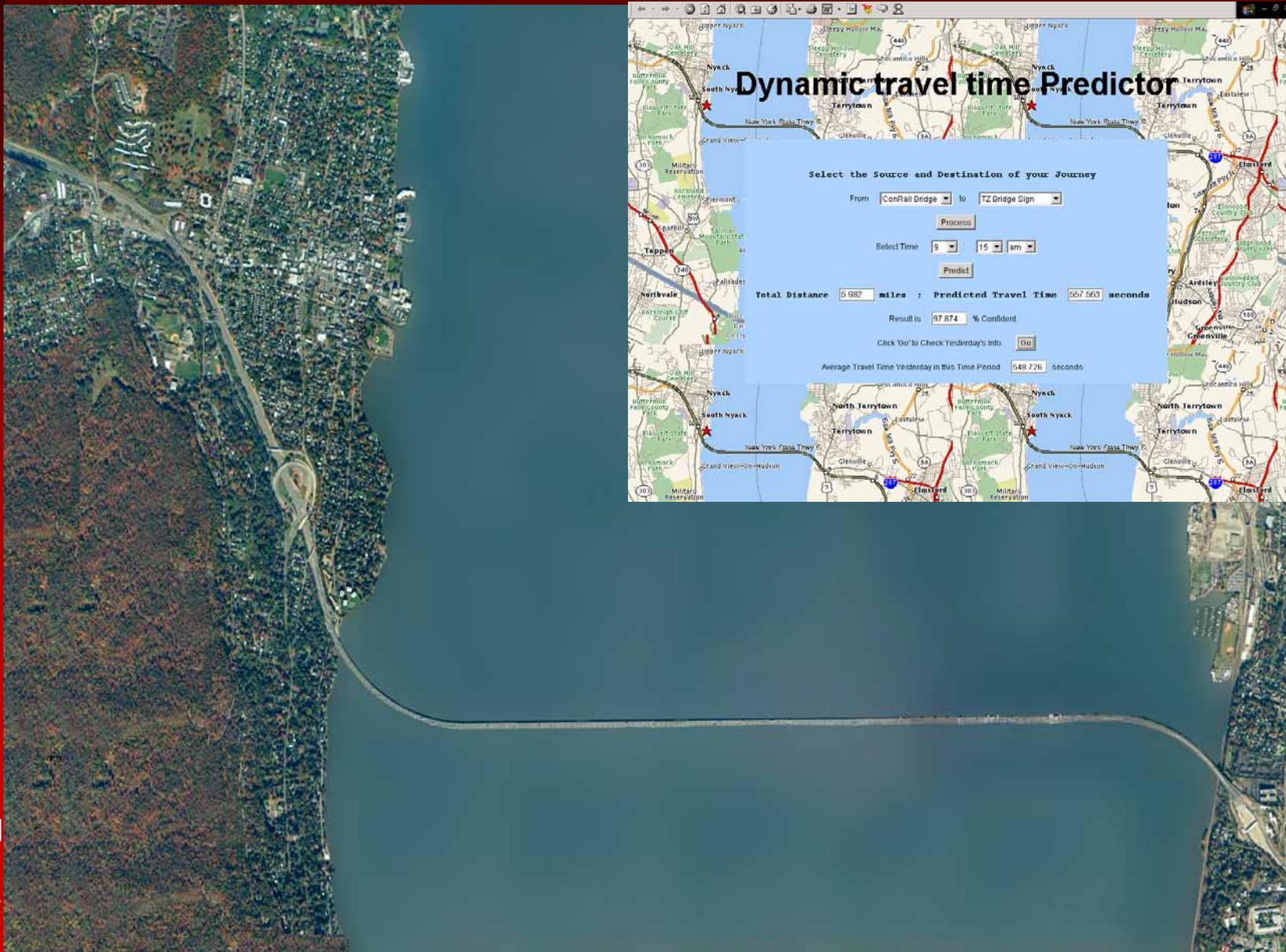
Arriving at
1605 Broadway
Ave., New York,
NY

Distance:
36.0 miles

Travel Time:
56 minutes



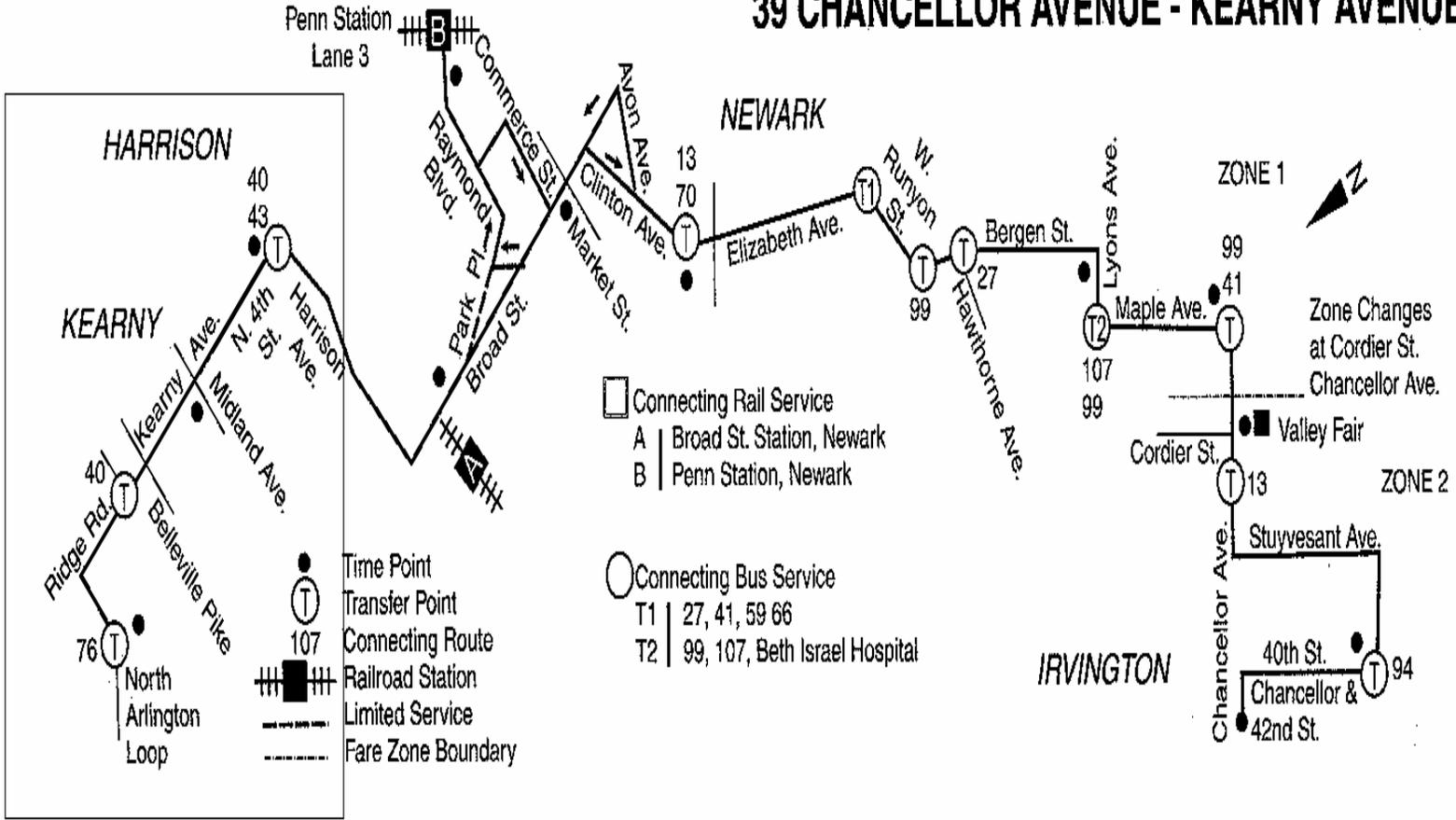
Travel Time Prediction for NY Thruway





Transit Simulation Model

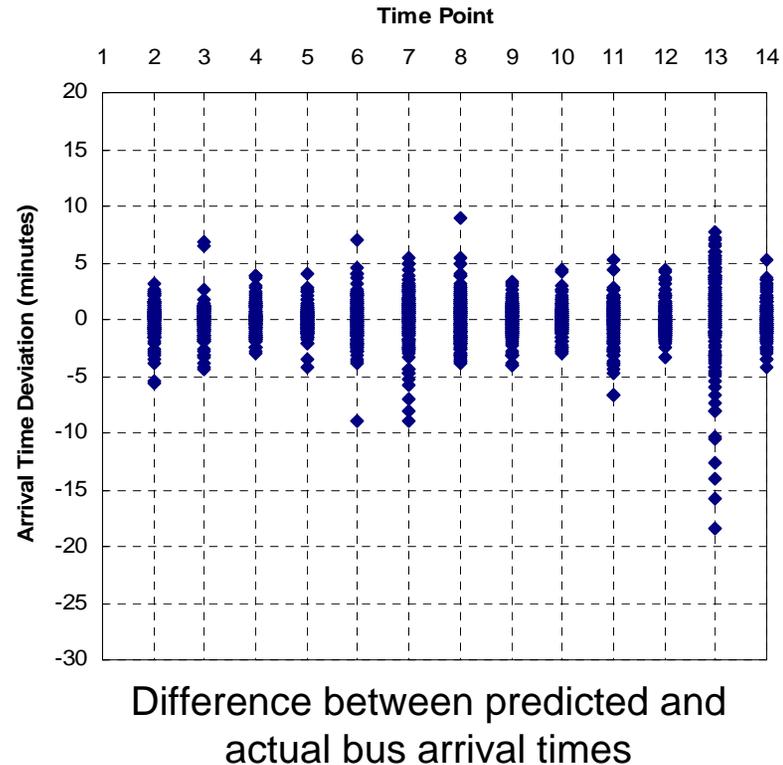
39 CHANCELLOR AVENUE - KEARNY AVENUE



Neural Network/Dynamic Algorithms to Predict Bus Travel Times

Sponsor: NJDOT for NJ Transit

- Objective: Develop a neural dynamic model (e.g., the integration of artificial neural networks and Kalman filtering algorithm) that can predict bus arrival information with the use of real-time and historic data
- Algorithm was tested on a selected NJ Transit route (Bus #62) and showed promising results
- Analysis helped to identify necessary improvements required for the successful implementation of the model





Newark Penn Station Circulation Study

Sponsor: NJDOT for NJ Transit

- Microscopic traffic simulation of Downtown Newark
- Evaluation of existing conditions and impacts of proposed improvements
- Recommended solutions for improved vehicle flow





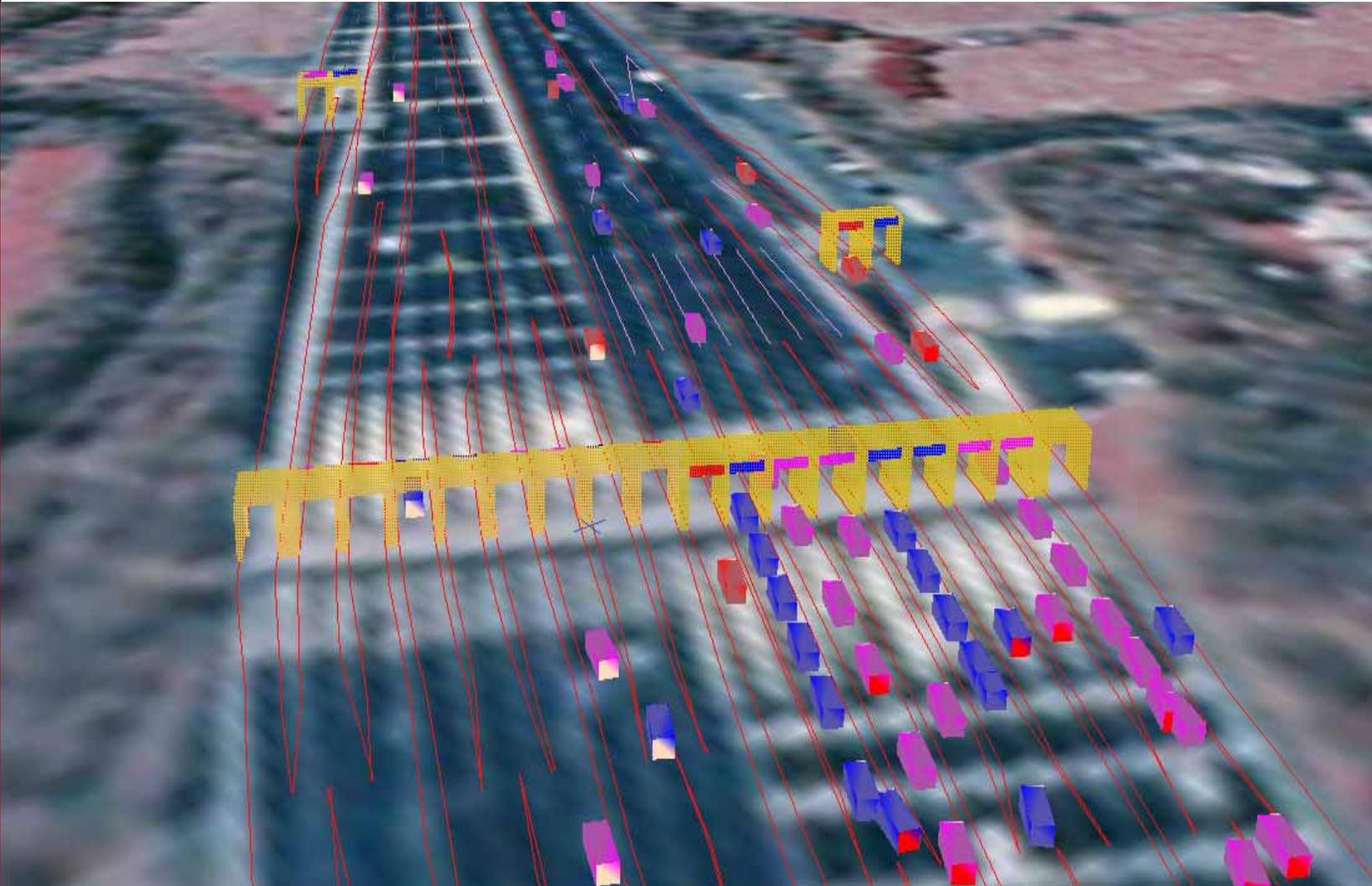
Network Optimization





Remove Barrier Tolls on the GSP

- *Detailed Visualization Abilities*



Garden State Parkway - Toll Removal Study

- Analyzed traffic congestion impacts as part of the development of a ten-year plan to remove toll barriers on Garden State Parkway
- Developed a traffic simulation model of the northern 50-mile section of the Parkway
- Alternative scenarios:
 - Maintain the existing toll plazas
 - Elimination of barriers in one or both directions
 - Construction of high-speed E-Z Pass lanes
- NJIT Report was part of the NJDOT Commissioner's submission to the Governor
- Implemented by the Acting Governor Codey





Route 139 Construction and ITS Simulation





Work Zone Optimization





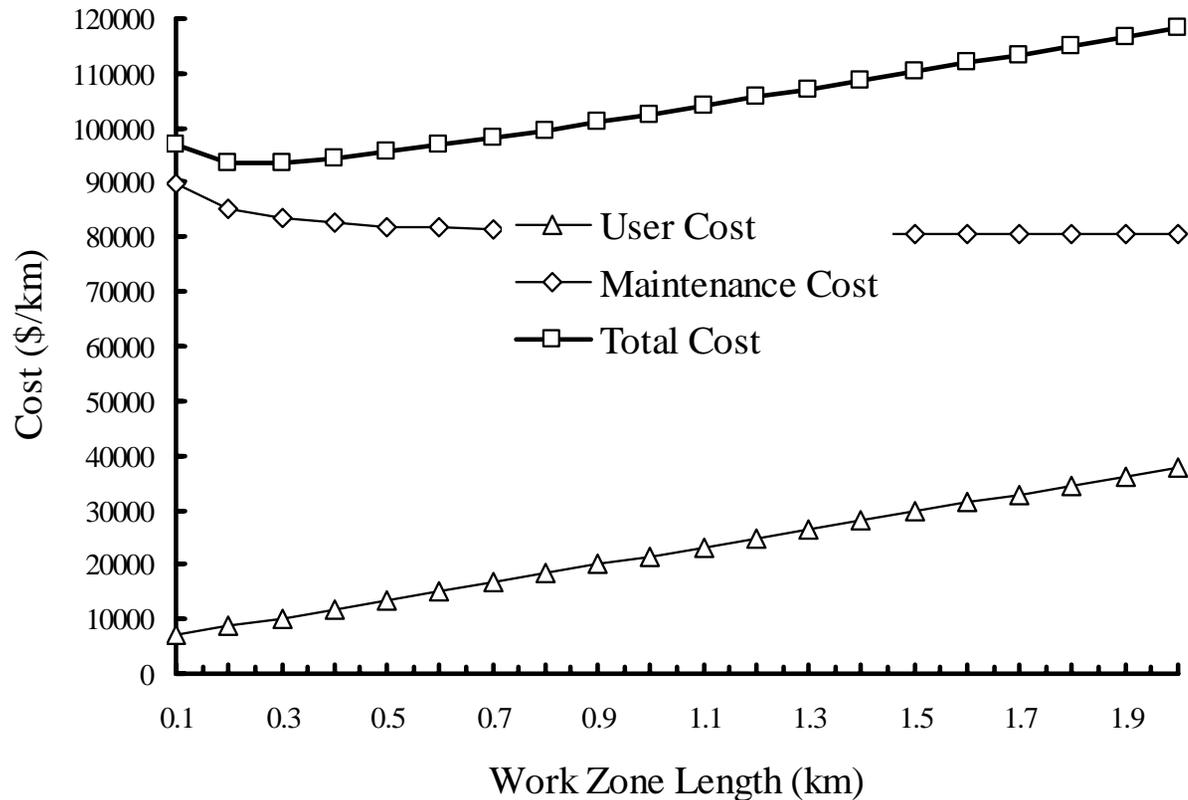
Work Zone Optimization





Costs vs. Work Zone Length

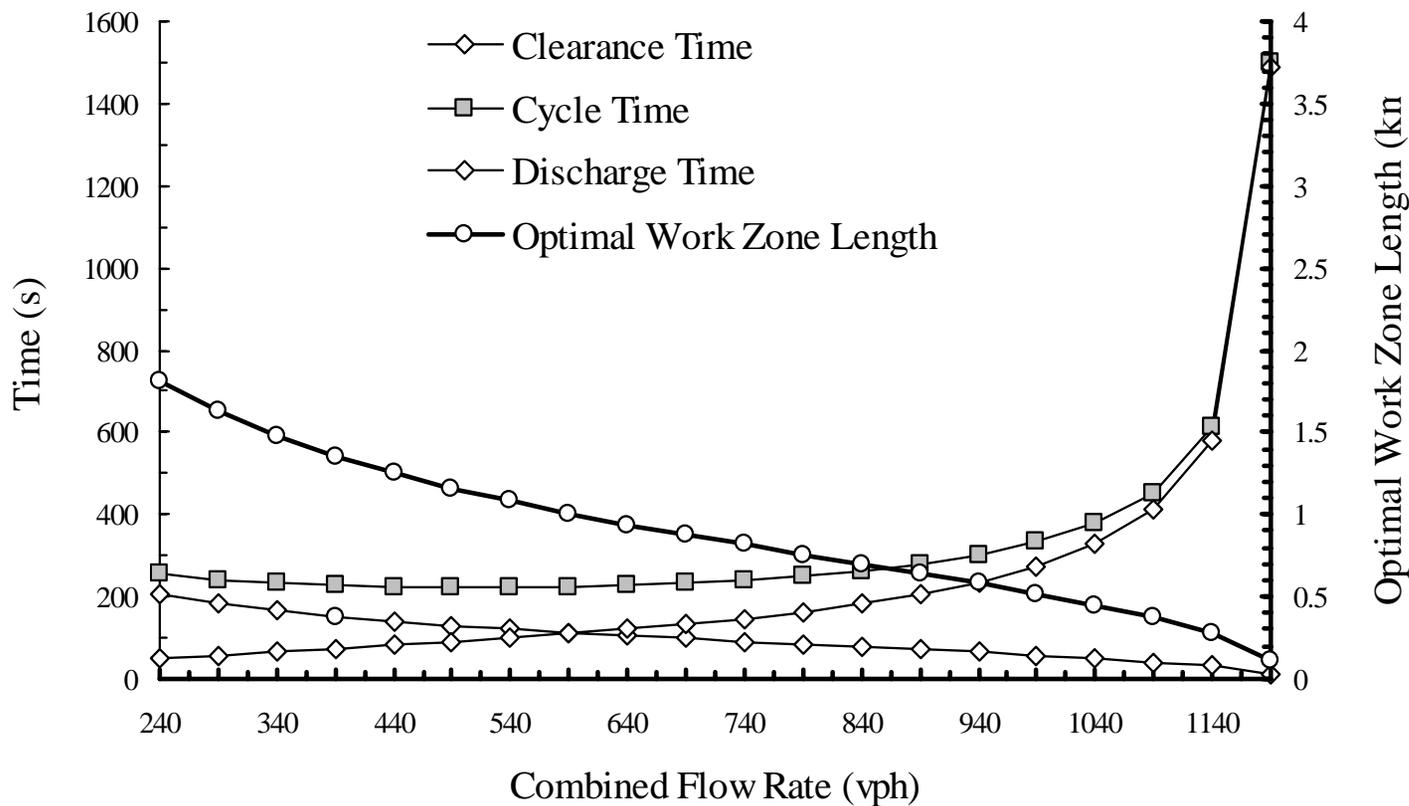
FIG. 6. User, Maintenance, and Total Costs vs. Various Work Zone Lengths (Combined Flow Rate = 1150 vph)





Optimal Work Zone Lengths vs. Flows

FIG. 4. Optimal Total Clearance, Discharge, Cycle Times and Optimal Work Zone Length vs. Combined Flow Rate





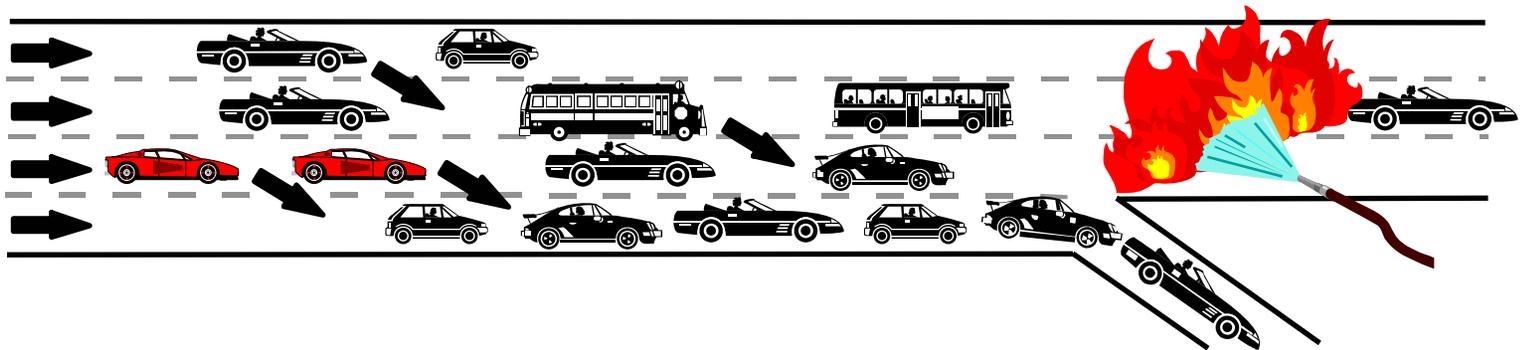
Emergency Events





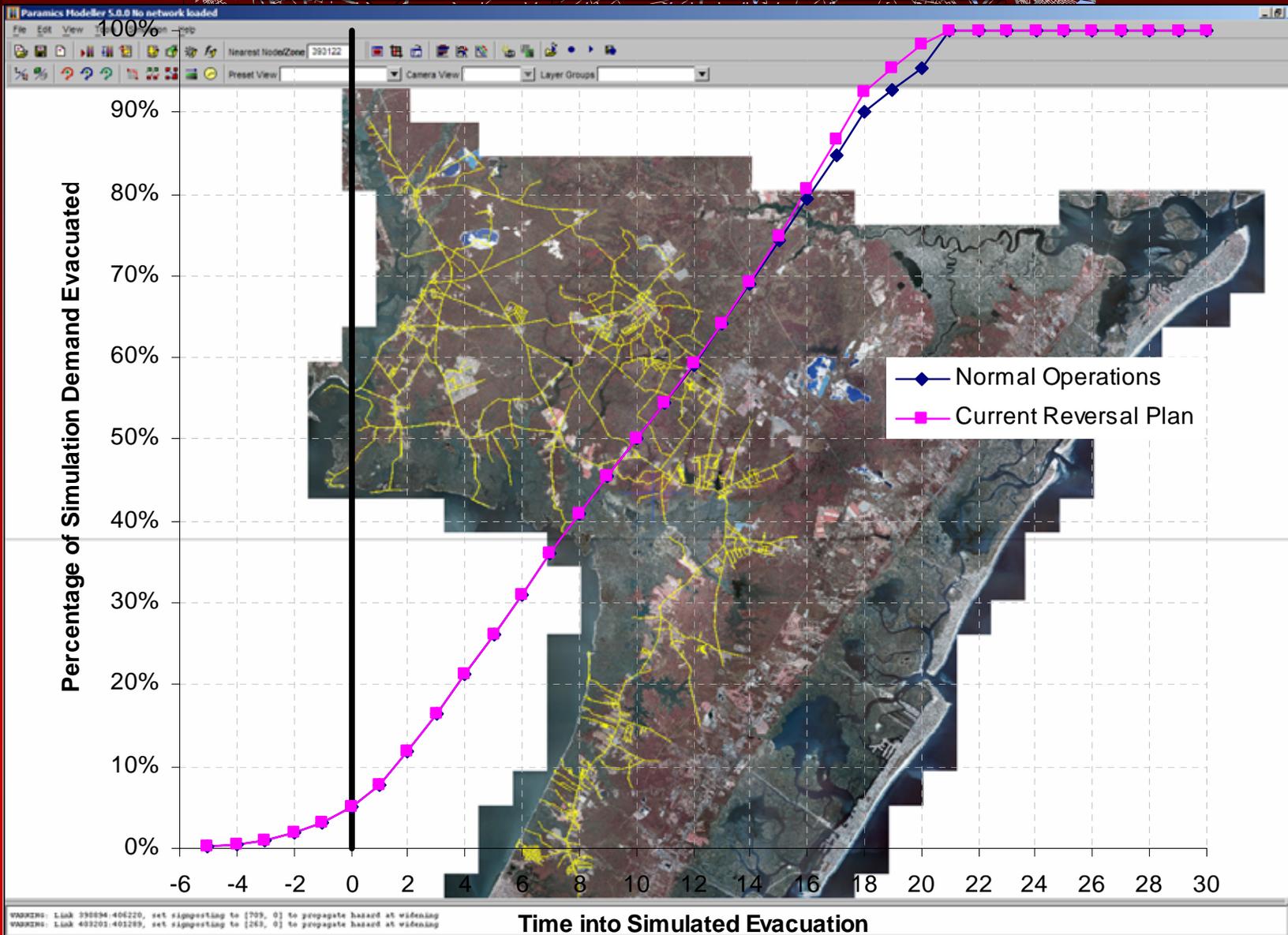
Traffic Diversion

Freeway Incidents and Diversion Analysis





Cape May Evacuation Study



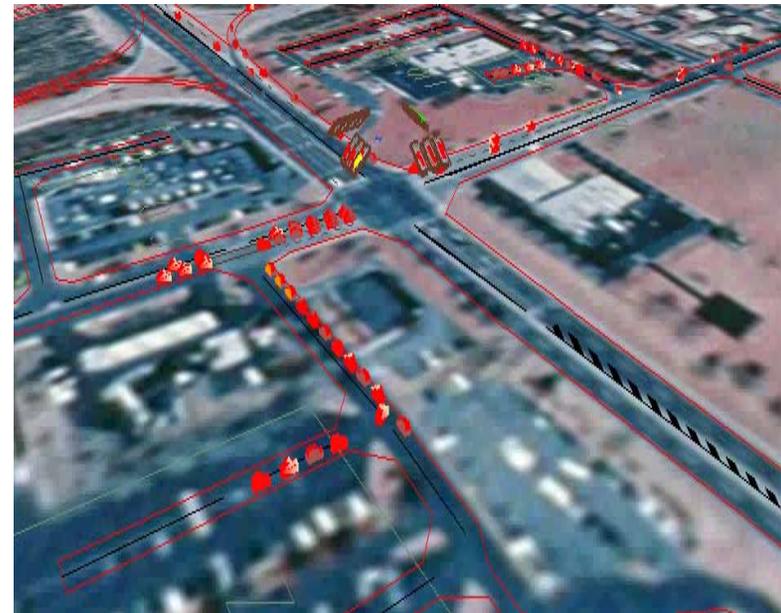


Development and Evaluation of Emergency Plans

No evacuation plan

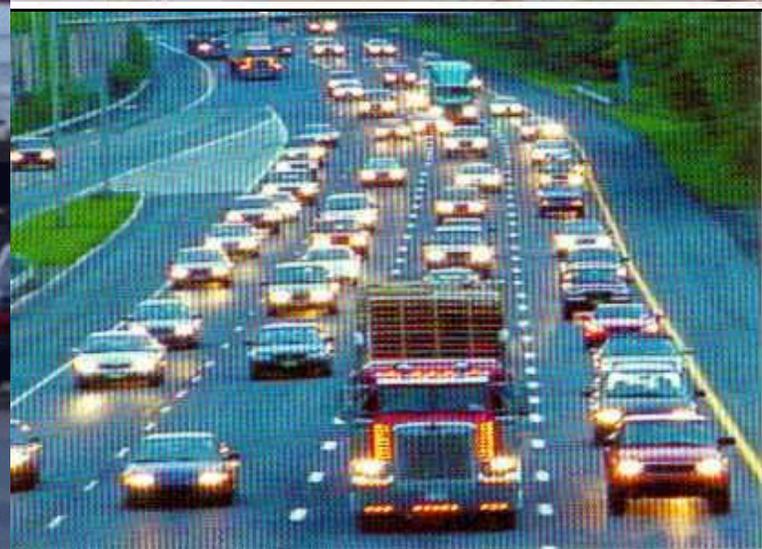


Evacuation plan in place





Managing Highway Incidents



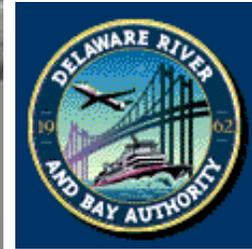


Traffic Operations Centers





Incident Management Program



TRANSCOMSM
TRANSPORTATION OPERATIONS COORDINATING COMMITTEE





National Center for Transportation and Industrial Productivity

...increasing Productivity through Transportation Improvements...



International Intermodal Transportation Center

... assists in facilitating economic development and quality of life improvement efforts linked to the International Intermodal Transportation Corridor



...a State-of-the-Art Transportation Information System for the 21st Century

A Leader in Technological Solutions and Transportation Data Analysis

TRANSPORTATION
NJIT

New Jersey Institute of Technology
A Public Research University

**Academic Program:
Interdisciplinary Program
in Transportation**

Civil Engineering
Industrial Engineering
Environmental Engineering
School of Management
School of Architecture



... assists in redeveloping and revitalizing abandoned and underutilized industrial sites



Transportation Information and Decision Engineering

... center committed to encouraging the growth of the Transportation Information and Decision Engineering Industry in New Jersey



Thank You