Evacuation Planning, Improvements, and Studies

Chester Wilmot, Ph.D., P.E.
Louisiana Transportation Research Center and
Louisiana State University

Presentation to FEHRL *March 30, 2012*

Hazards in the region

Tsunamis


Washington
Montana
North Dakota
Minnesota
Oregon
Idaho
Wyoming
South Dakota
Wisconsin
Michigan
Nebraska
Iowa
Illinois
Nevada
Utah
Colorado
United States
Kansas
Missouri
Indiana
Ohio
Pennsylvania
New York
California
Kentucky
West Virginia
Virginia
Oklahoma
Arkansas
Tennessee
North Carolina
Arizona
New Mexico
Mississippi
South Carolina
Texas
Alabama
Georgia
Louisiana
Florida
Gulf of Mexico
México
Cuba
New Brunswick
Prince Edward Island
Nova Scotia
Maine
Vermont
New Hampshire
Massachusetts
Rhode Island
Connecticut
New Jersey
Delaware
Maryland
District of Columbia

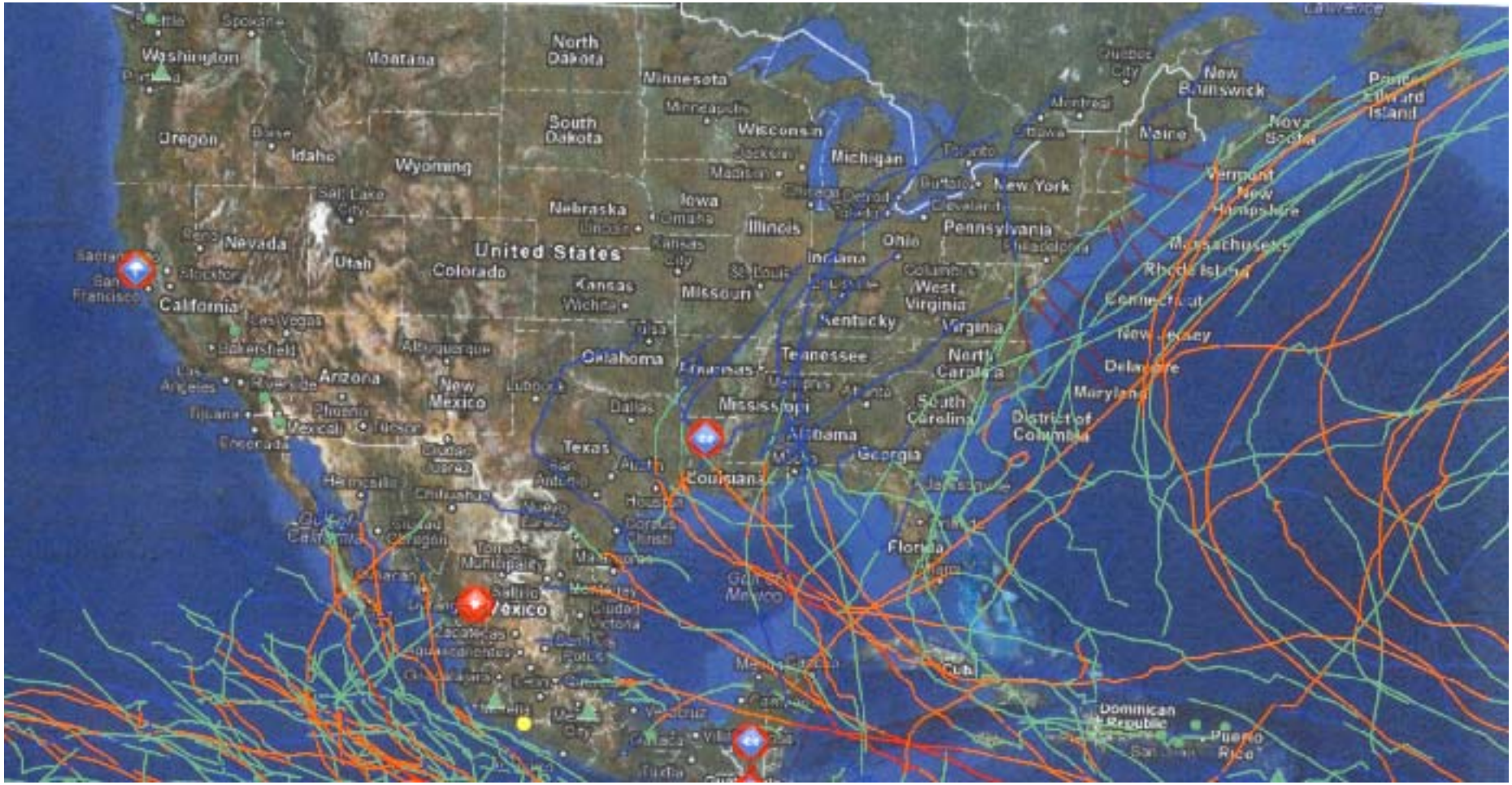
Wildfires


Washington
Montana
North Dakota
Minnesota
Oregon
Idaho
South Dakota
Wyoming
Wisconsin
Michigan
New York
Nebraska
Iowa
Illinois
Pennsylvania
Nevada
Utah
Colorado
United States
Kansas
Missouri
Indiana
Ohio
West Virginia
Kentucky
Virginia
California
Oklahoma
Arkansas
Tennessee
North Carolina
Arizona
New Mexico
Mississippi
South Carolina
Alabama
Georgia
Texas
Louisiana
Florida
Gulf of Mexico
México
Cuba
Maine
Vermont
New Hampshire
Massachusetts
Rhode Island
Connecticut
New Jersey
Delaware
Maryland
District of Columbia
Nova Scotia
New Brunswick
Dominican Republic
Puerto Rico

Tornados


Washington
Montana
North Dakota
Minnesota
South Dakota
Wisconsin
Michigan
Oregon
Idaho
Wyoming
Nebraska
Iowa
Illinois
Nevada
Utah
United States
Colorado
Kansas
Missouri
Indiana
Ohio
Pennsylvania
New York
California
Kentucky
West Virginia
Virginia
Tennessee
North Carolina
Oklahoma
Arkansas
Arizona
Mississippi
Alabama
Georgia
South Carolina
Texas
Louisiana
Florida
Maine
New Brunswick
Nova Scotia
Vermont
New Hampshire
Massachusetts
Rhode Island
Connecticut
New Jersey
Delaware
Maryland
District of Columbia
Gulf of Mexico
Gulf of California
México
Cuba
Dominican Republic
Puerto Rico

Hurricane paths 2005-2009



Evacuating from a hurricane

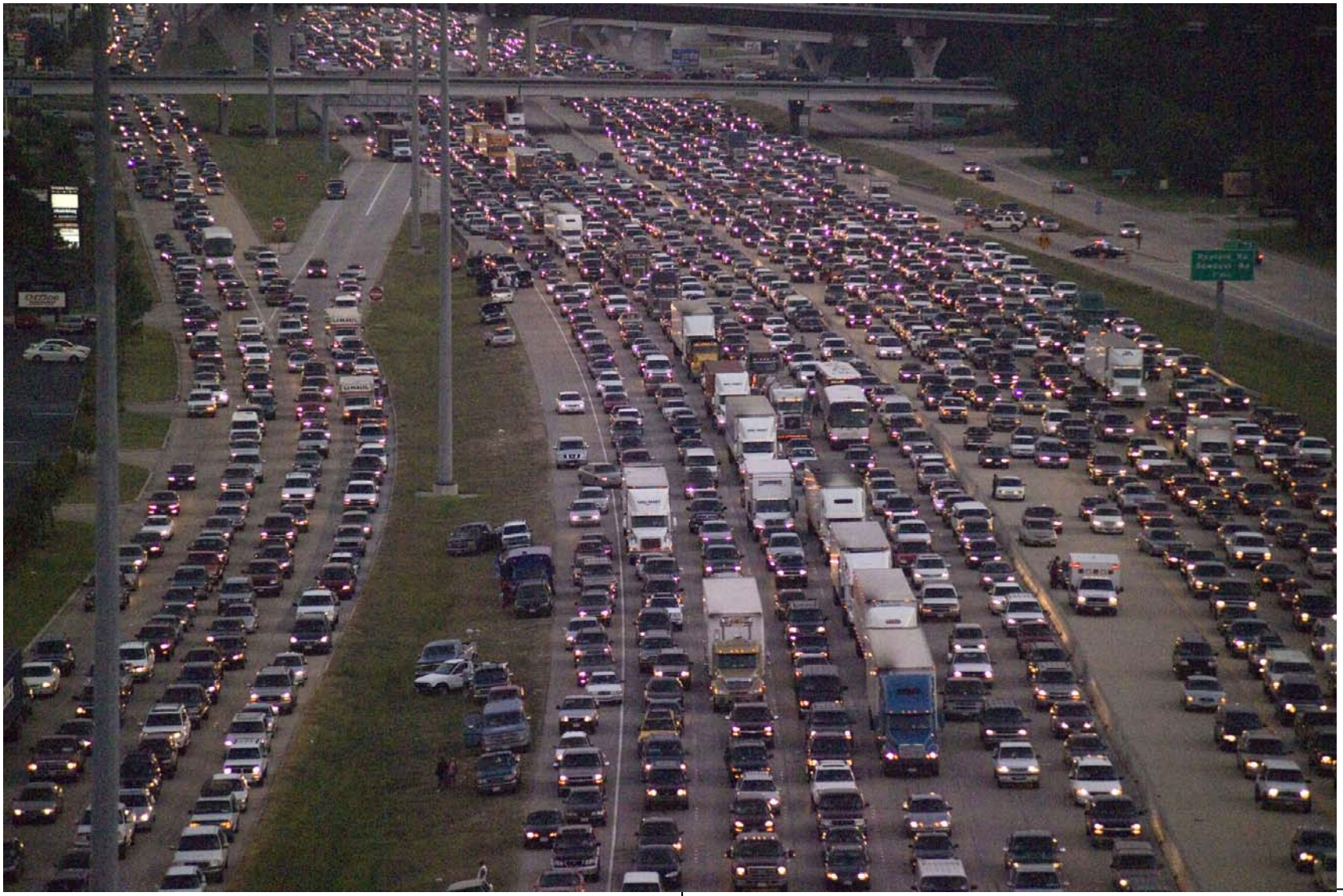
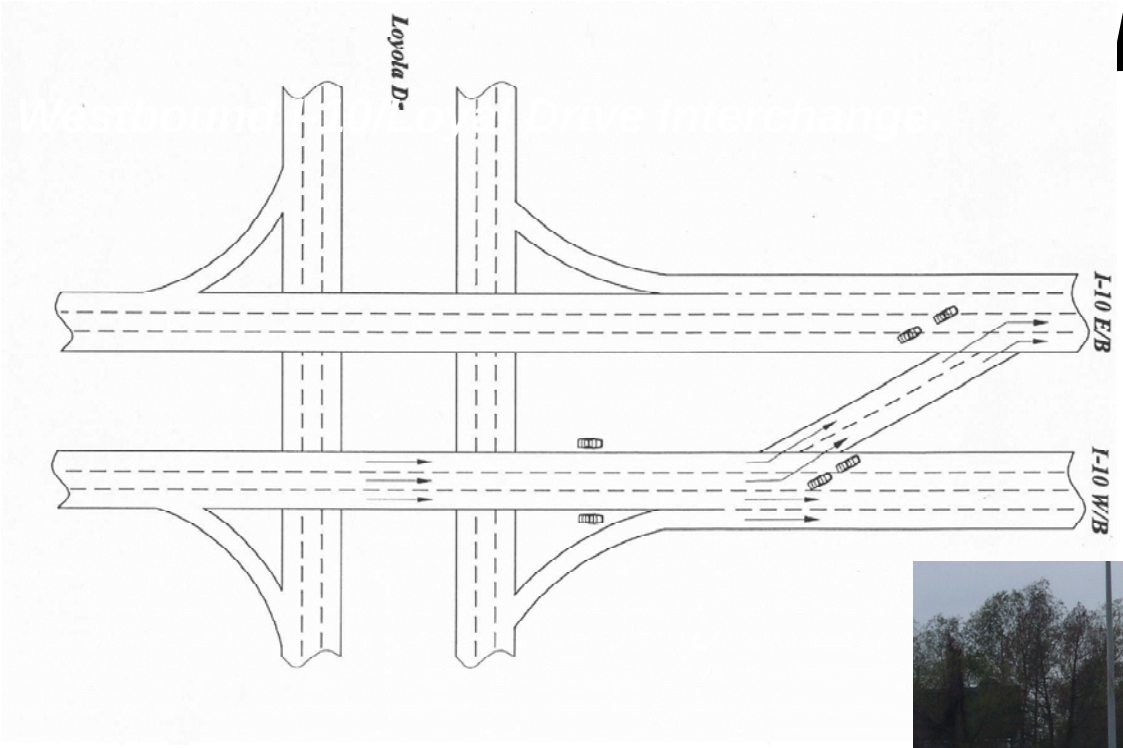


Photo Source: Yi-Chang Chiu, University of Arizona

Recent History in Louisiana

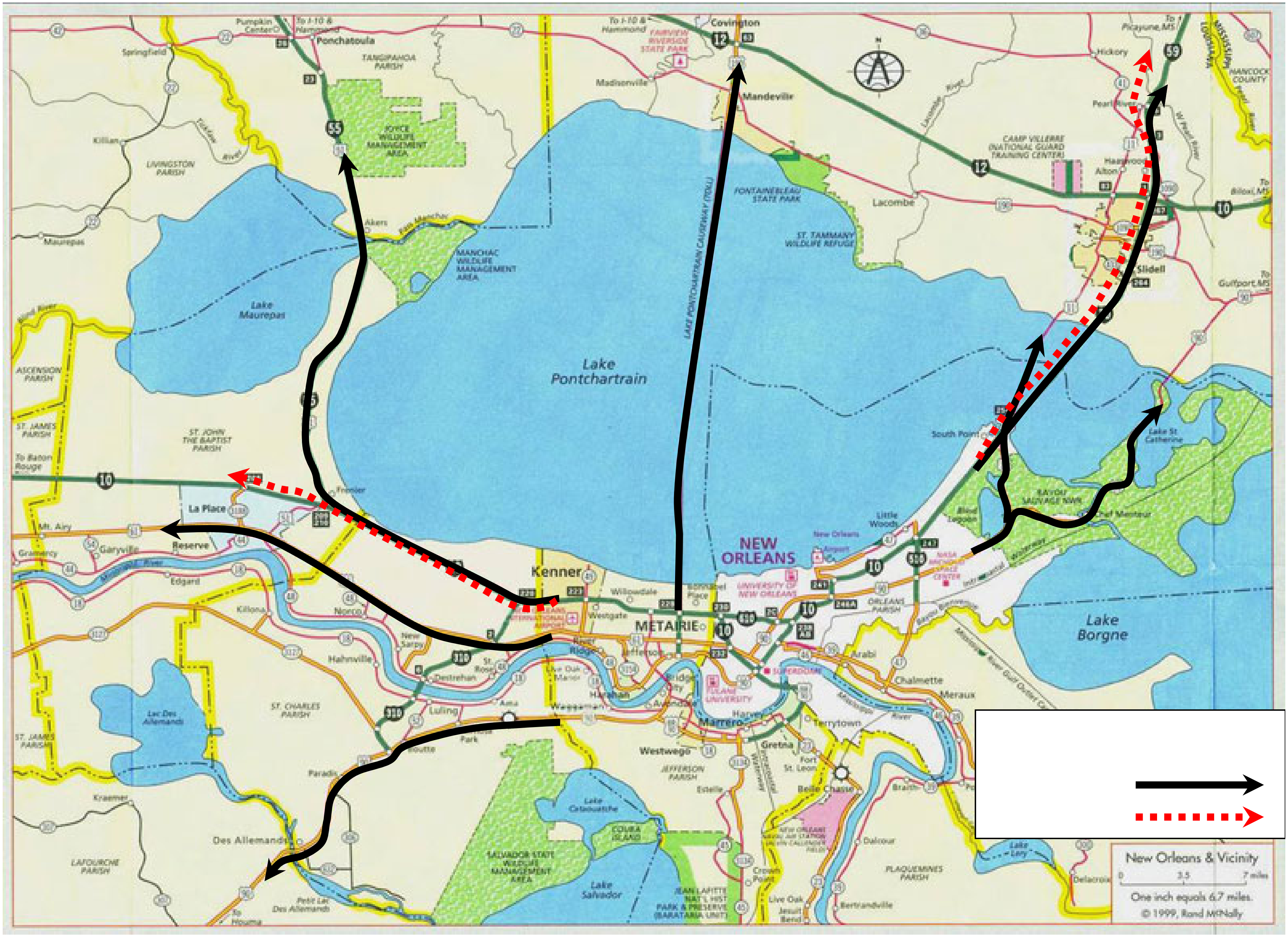
- *Prior to Hurricane Georges in 2000, there was no regional traffic management plan in LA*
- *No "designated" evacuation routes outside urban areas*
- *1st plan was developed in 2000 and included contraflow in New Orleans*
- *Used for the first time in 2004 for Hurricane Ivan - with questionable results*
- *"Revised plan" was developed in 2004-2005 and implemented for the first time for Hurricane Katrina*
- *Evacuation was quite effective for those with the desire and means to evacuate*
- *Plans for the evacuation of low-mobility populations were obviously "lacking"*

New Orleans Contraflow Initiation Point



Hurricane Ivan Evacuation - Interstate 10 (west of New Orleans)

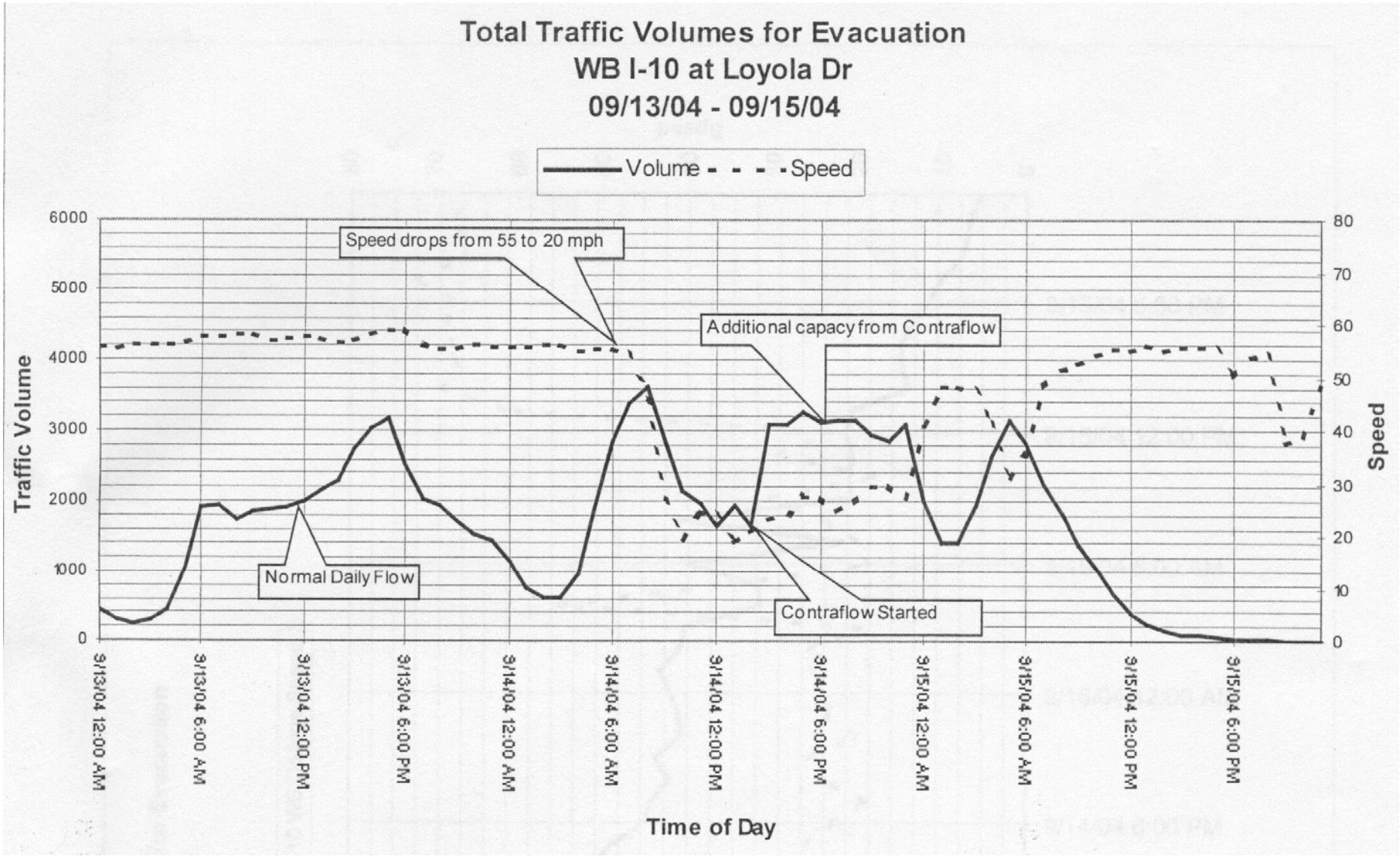
Photo Source: A. Caterella-Michel
Urban Systems, Inc.



Lake Pontchartrain
Lake Maurepas
Lake Borgne
NEW ORLEANS
METAIRIE
Kenner
La Place
Reserve
Covington
Mandeville
Ponchatoula
Slidell
Lacombe
Marrero
Gretna
Westwego
Chalmette
Des Allemands
Lac Des Allemands
Lake Salvador
Lake Cataouatche
JOYCE WILDLIFE MANAGEMENT AREA
MANCHAC WILDLIFE MANAGEMENT AREA
FONTAINEBLEAU STATE PARK
ST. TAMMANY WILDLIFE REFUGE
SALVADOR STATE WILDLIFE MANAGEMENT AREA
LAKE PONTCHARTRAIN CAUSEWAY (TOLL)
CAMP VILLERE (NATIONAL GUARD TRAINING CENTER)
ST. JOHN THE BAPTIST PARISH
ST. CHARLES PARISH
JEFFERSON PARISH
ORLEANS PARISH
LIVINGSTON PARISH
TANGIPAHOA PARISH
PLAQUEMINES PARISH
LAFOURCHE PARISH
ASCENSION PARISH
ST. JAMES PARISH
To Baton Rouge
To Picayune, MS
To Biloxi, MS
To Gulfport, MS
To Houma
New Orleans & Vicinity
One inch equals 6.7 miles.
© 1999, Rand McNally

Problems Identified in Ivan

- *An over-reliance on the westward movement of traffic*
- *Confluence congestion created by the confluence of major evacuation routes in Baton Rouge, Hammond, Lafayette, Covington, and Slidell*
- *Inefficient loading of contraflow in New Orleans*
- *Inability to access up-to-date traffic information and provide timely and accurate traveler information to evacuees*


Total Traffic Volumes for Evacuation
WB I-10 at Loyola Dr
09/13/04 - 09/15/04
Volume
Speed
Speed drops from 55 to 20 mph
Additional capacy from Contraflow
Normal Daily Flow
Contraflow Started
Traffic Volume
Speed
Time of Day
6000
5000
4000
3000
2000
1000
0
80
70
60
50
40
30
20
10
0
3/13/04 12:00 AM
3/13/04 6:00 AM
3/13/04 12:00 PM
3/13/04 6:00 PM
3/14/04 12:00 AM
3/14/04 6:00 AM
3/14/04 12:00 PM
3/14/04 6:00 PM
3/15/04 12:00 AM
3/15/04 6:00 AM
3/15/04 12:00 PM
3/15/04 6:00 PM

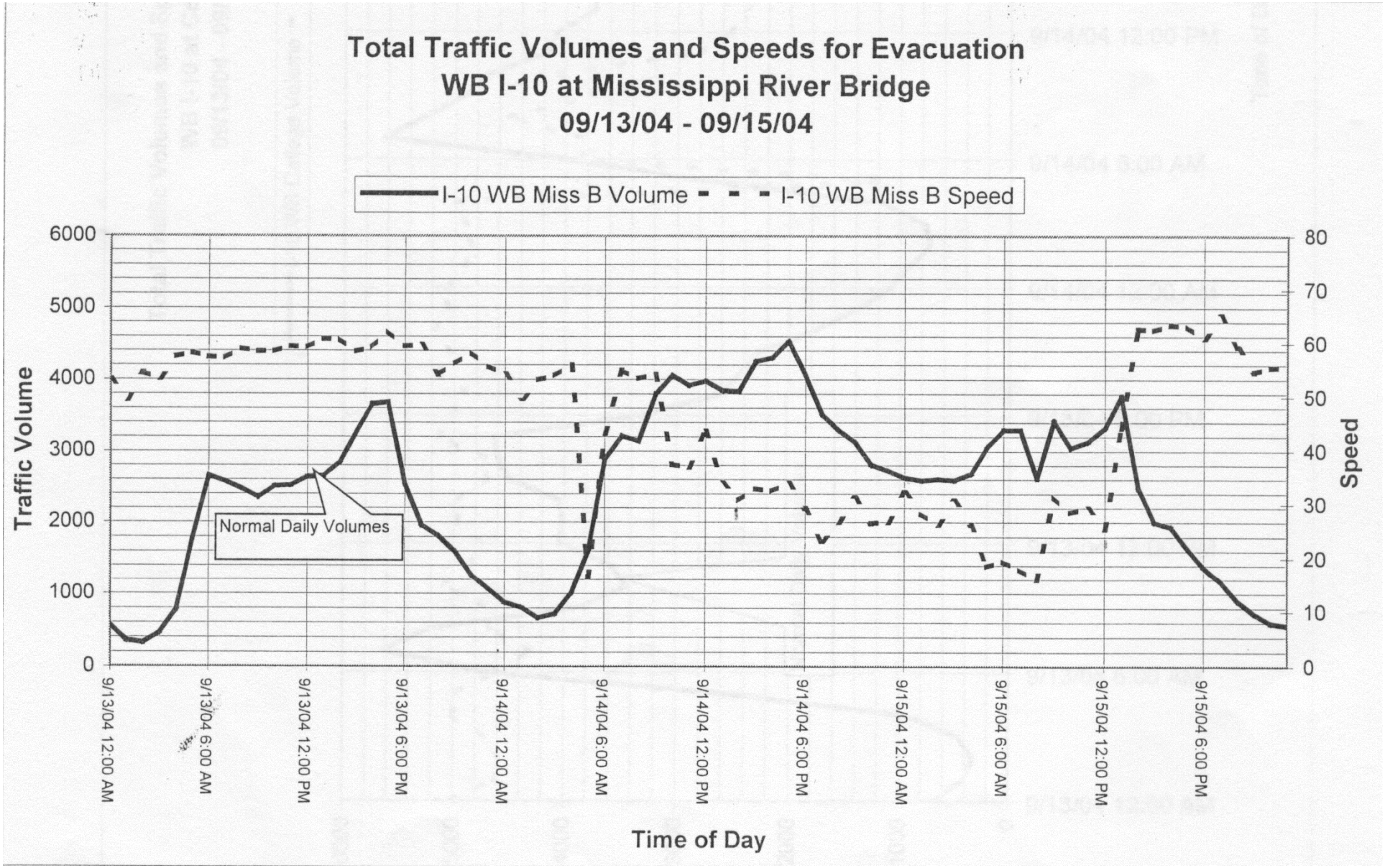
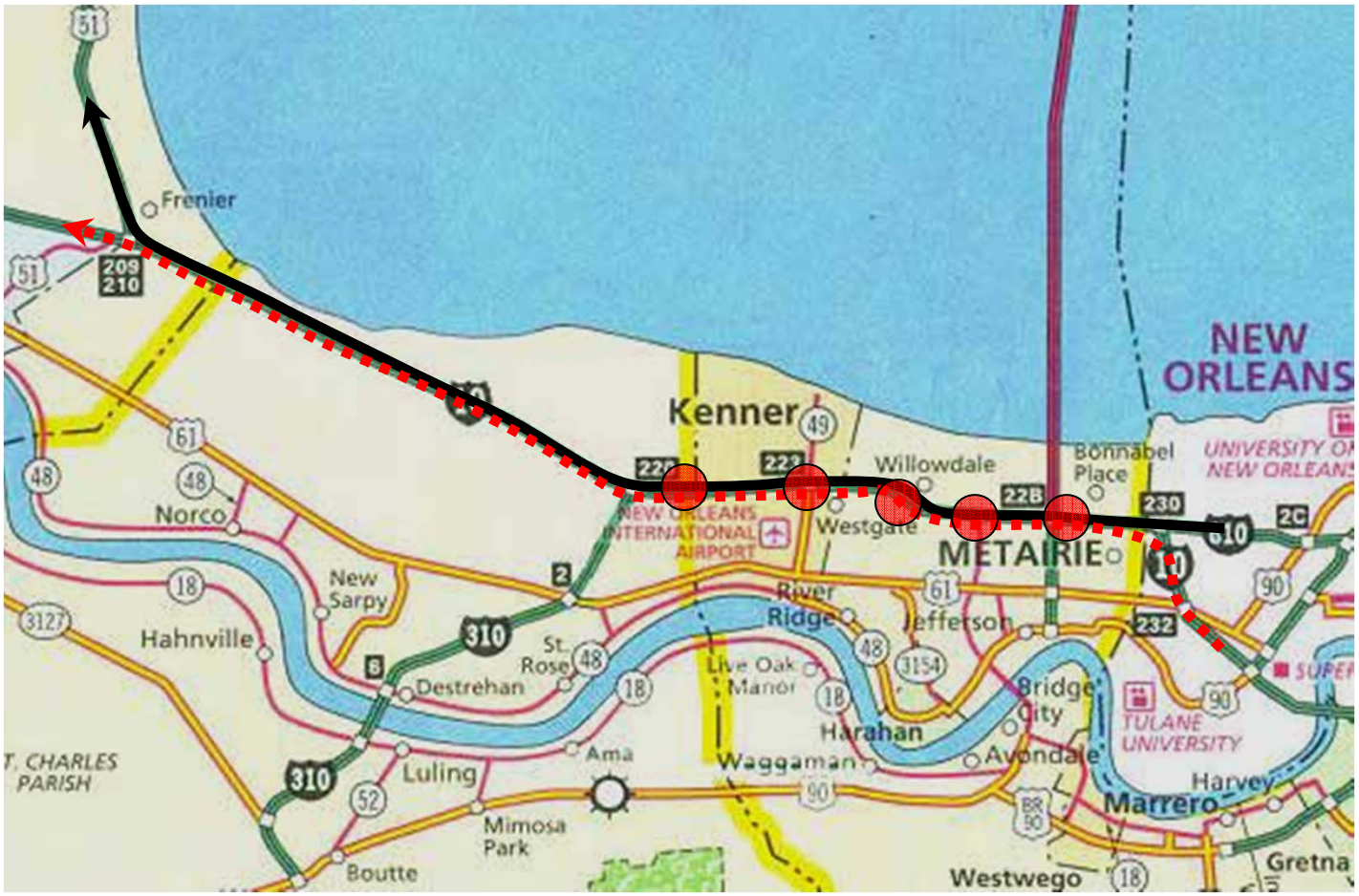


Figure Source: LaDOTD

Proposed Solutions

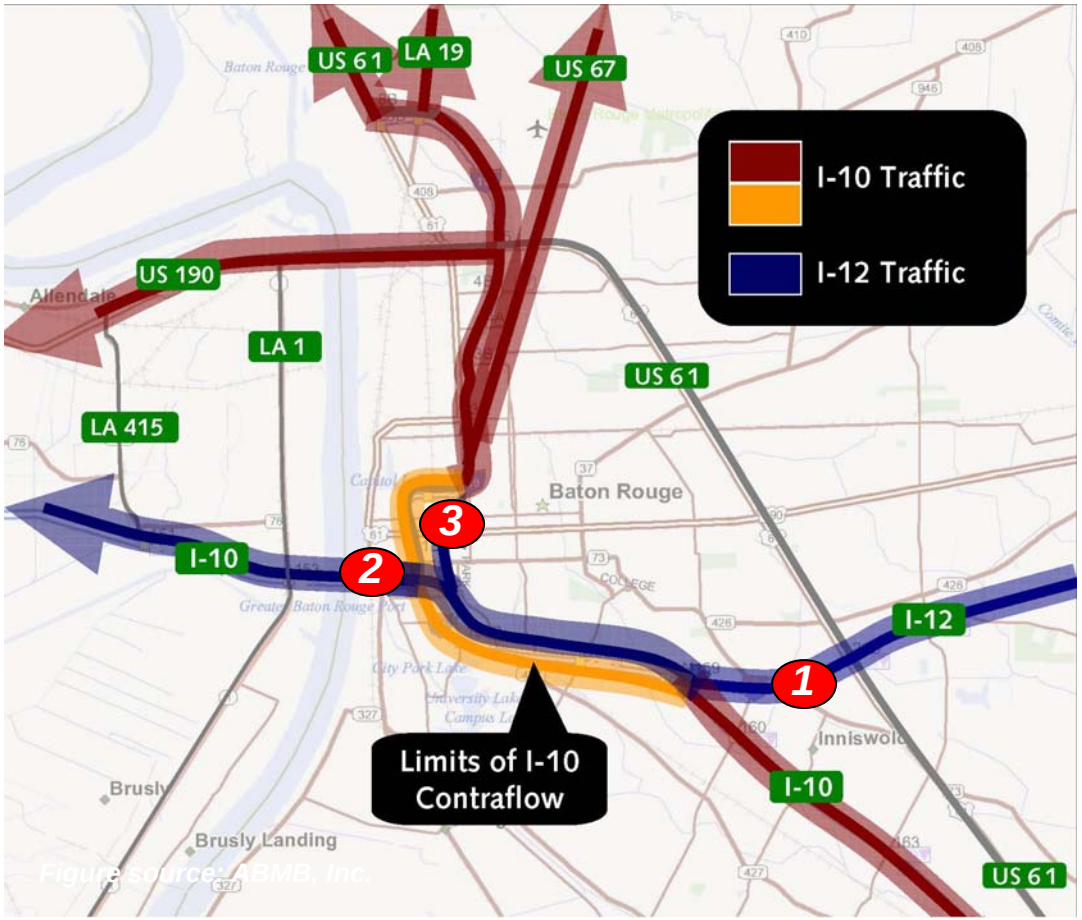
- ***Maximize the available routes out of the New Orleans area***
- ***Improve the loading of contraflow segments in New Orleans***
- ***Minimize or eliminate the congestion in Baton Rouge***
- ***Access up-to-date traffic information and provide timely and accurate traveler information to evacuees***

New Orleans Alternatives



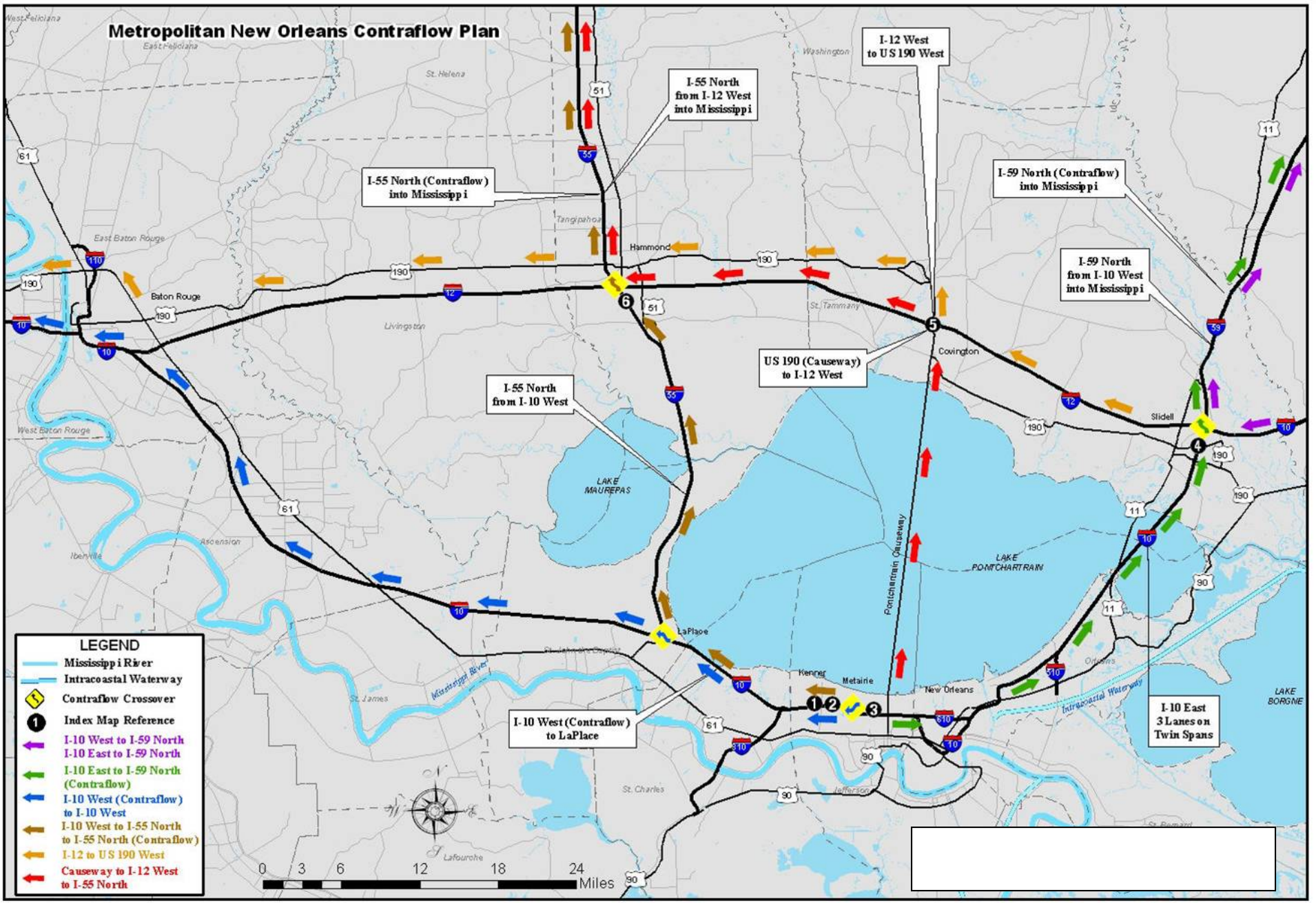
Scenario	12h volume at max. flow	Evacuees moved	Increase over no-c/f
Ivan w/o contraflow	*49,464 veh*	*123,660 people*	*-----*
Ivan w/contraflow	*67,224 veh*	*168,060 people*	*35.9%*
I-10/I-610 Loading Plan	*97,572 veh*	*243,930 people*	*97.3%*

Baton Rouge Alternatives

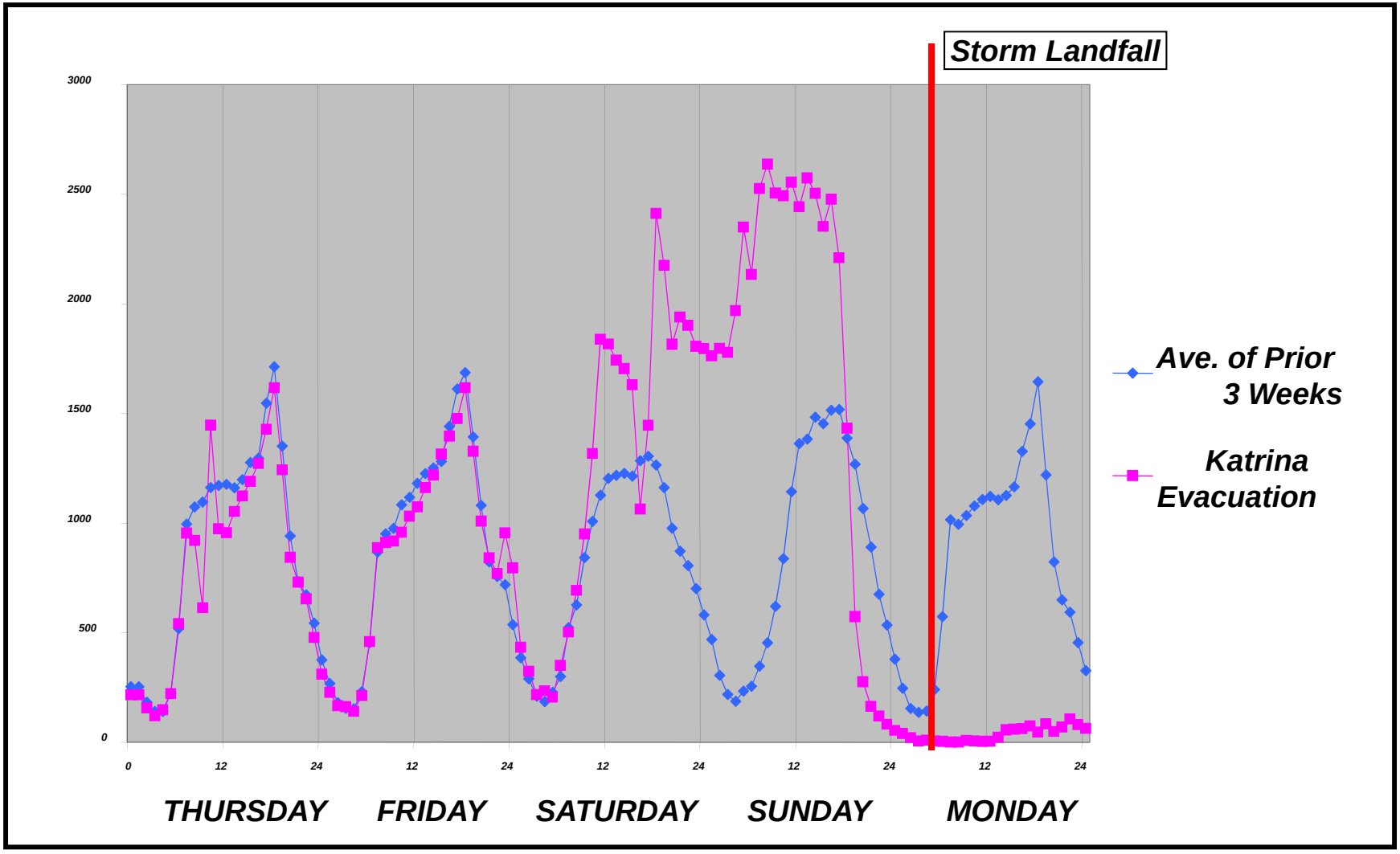


Location	Ivan – Speed	Flow Rate	w/Contraflow – Speed	Flow Rate
1 I-12 (bef. interchange)	16 mph	2,834 vph	56 mph	5,422 vph
2 I-10 (MS River Bridge)	28 mph	4,029 vph	22 mph	4,399 vph
3 I-110 (aft. interchange)	48 mph	2,067 vph	55 mph	3,701 vph

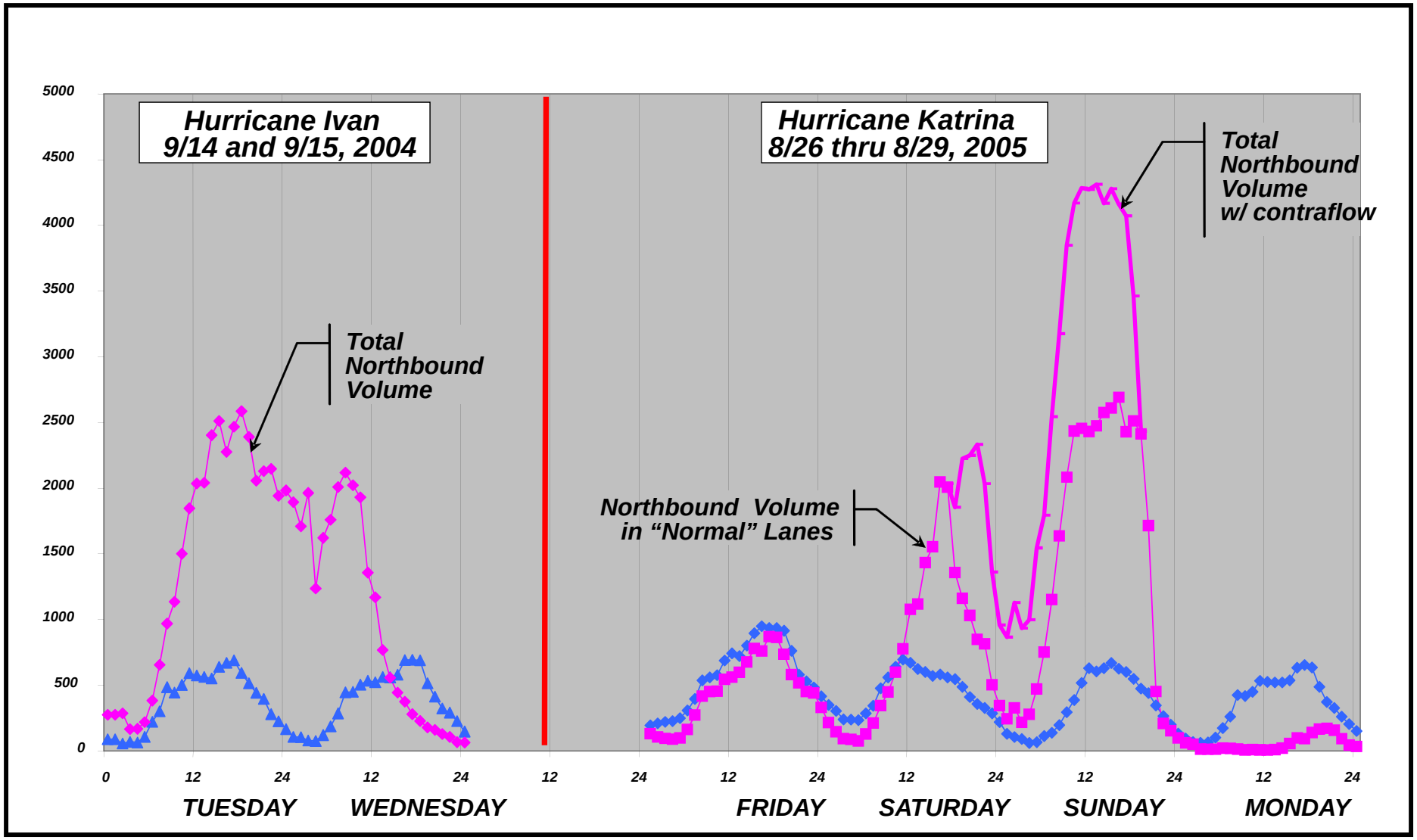
The Plan and Its Effects


Metropolitan New Orleans Contraflow Plan
I-12 West to US 190 West
I-55 North from I-12 West into Mississippi
I-55 North (Contraflow) into Mississippi
I-59 North (Contraflow) into Mississippi
I-59 North from I-10 West into Mississippi
US 190 (Causeway) to I-12 West
I-55 North from I-10 West
I-10 West (Contraflow) to LaPlace
I-10 East 3 Lanes on Twin Spans
LEGEND
Mississippi River
Intracoastal Waterway
Contraflow Crossover
Index Map Reference
I-10 West to I-59 North
I-10 East to I-59 North
I-10 East to I-59 North (Contraflow)
I-10 West (Contraflow) to I-10 West
I-10 West to I-55 North to I-55 North (Contraflow)
I-12 to US 190 West
Causeway to I-12 West to I-55 North
0 3 6 12 18 24 Miles
Hammond
Baton Rouge
Covington
Slidell
LaPlace
Kenner
Metairie
New Orleans
LAKE MAUREPAS
LAKE PONTCHARTRAIN
Pontchartrain Causeway
Intracoastal Waterway
LAKE BORGNE

Duration of Evacuation Volume

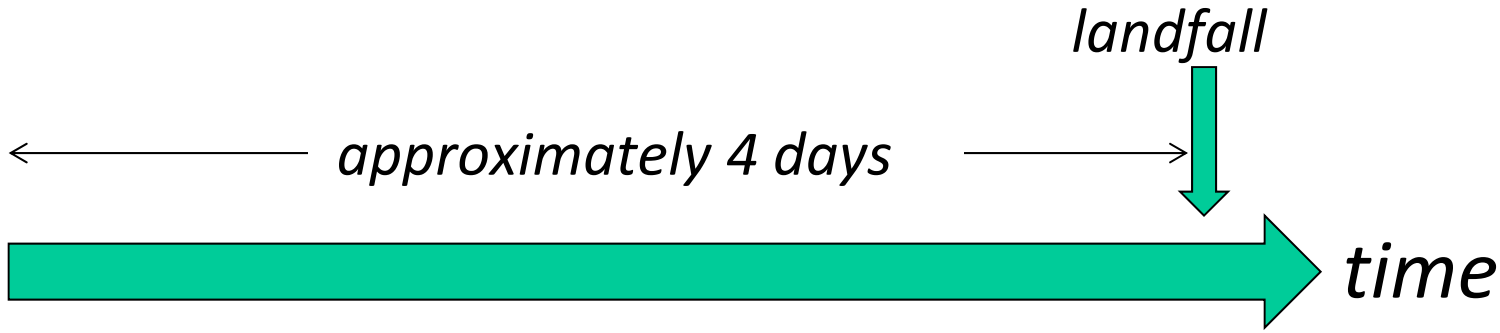


Effect of Contraflow on Traffic Volume

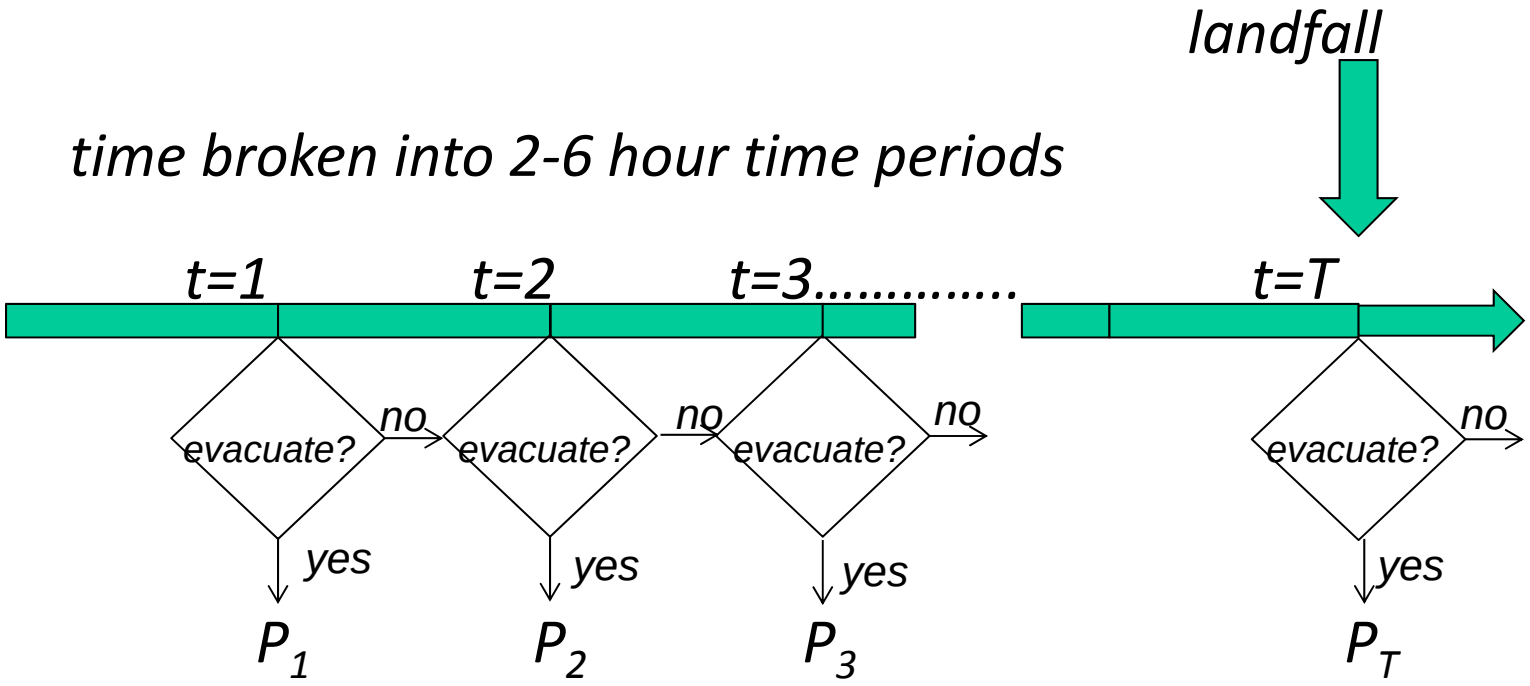


Hurricane evacuation modeling

Risk, actions, and evacuation behavior very time sensitive, so dynamic modeling necessary



Evacuation - a set of discrete choices

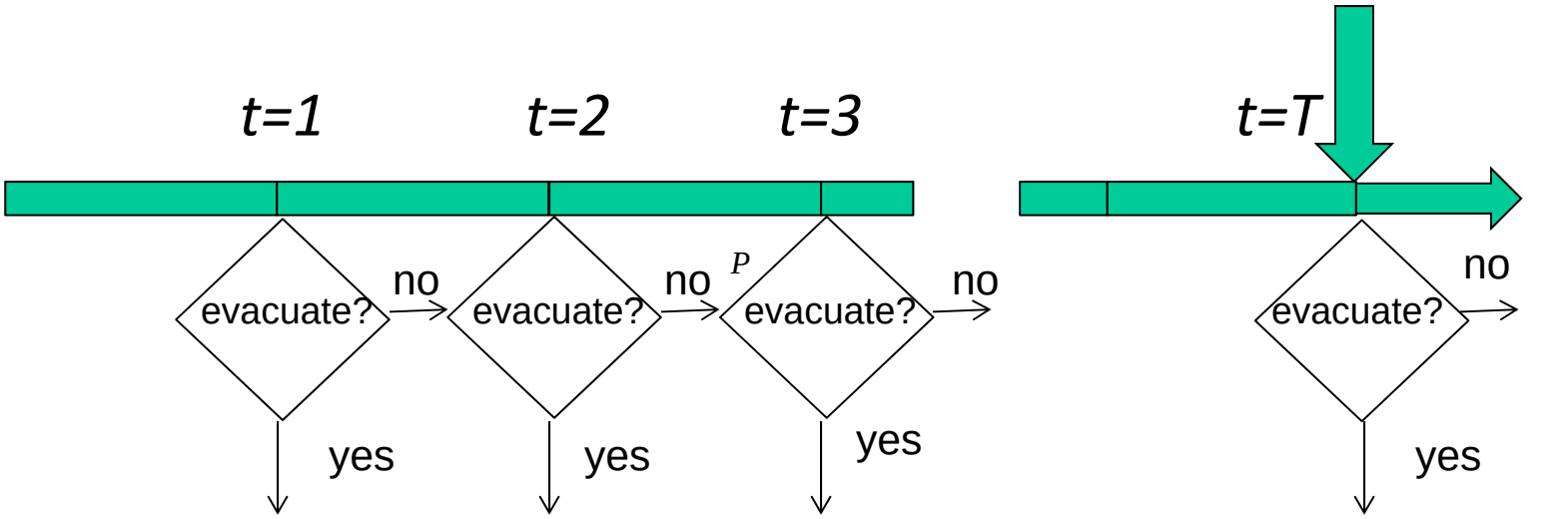


P_t = momentary probability of evacuating in time period t

Momentary evacuation decision P_t

- *P_t = f(current conditions)*
- *Current conditions include:*
  - *Storm intensity*
  - *Storm location*
  - *Storm speed*
  - *Type of dwelling*
  - *Risk of flooding*
  - *Administrative decisions (e.g. type and timing of evacuate orders, initiation and termination of contraflow)*

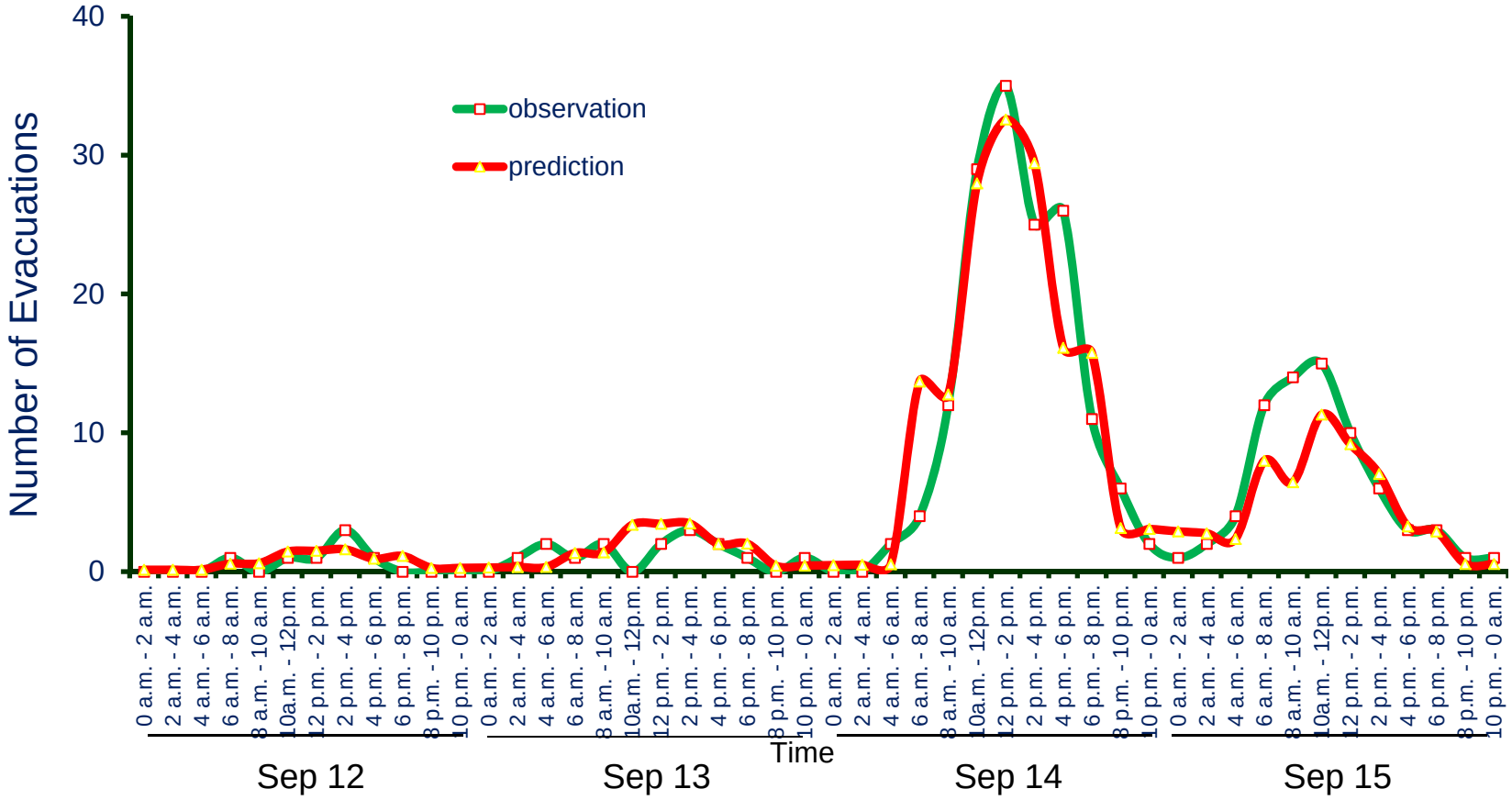
Entire evacuation decision



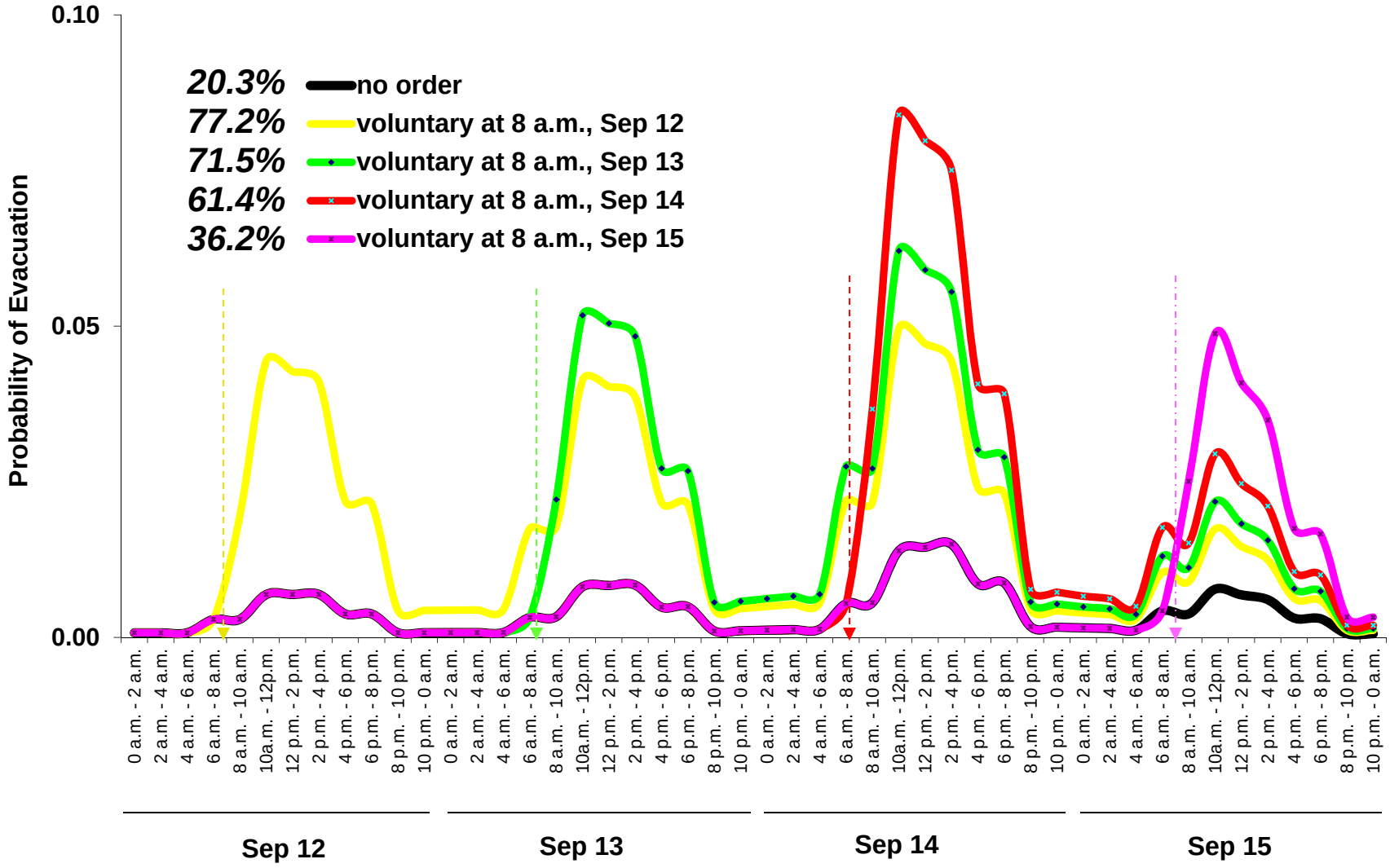
P_t = P_1 P_2 P_3 P_T

$P(evac)_t$ = P_1 $P_2(1-P_1)$ $P_3(1-P_2)(1-P_1)$ $P_T \prod_{t=1}^{T-1}(1-P_t)$

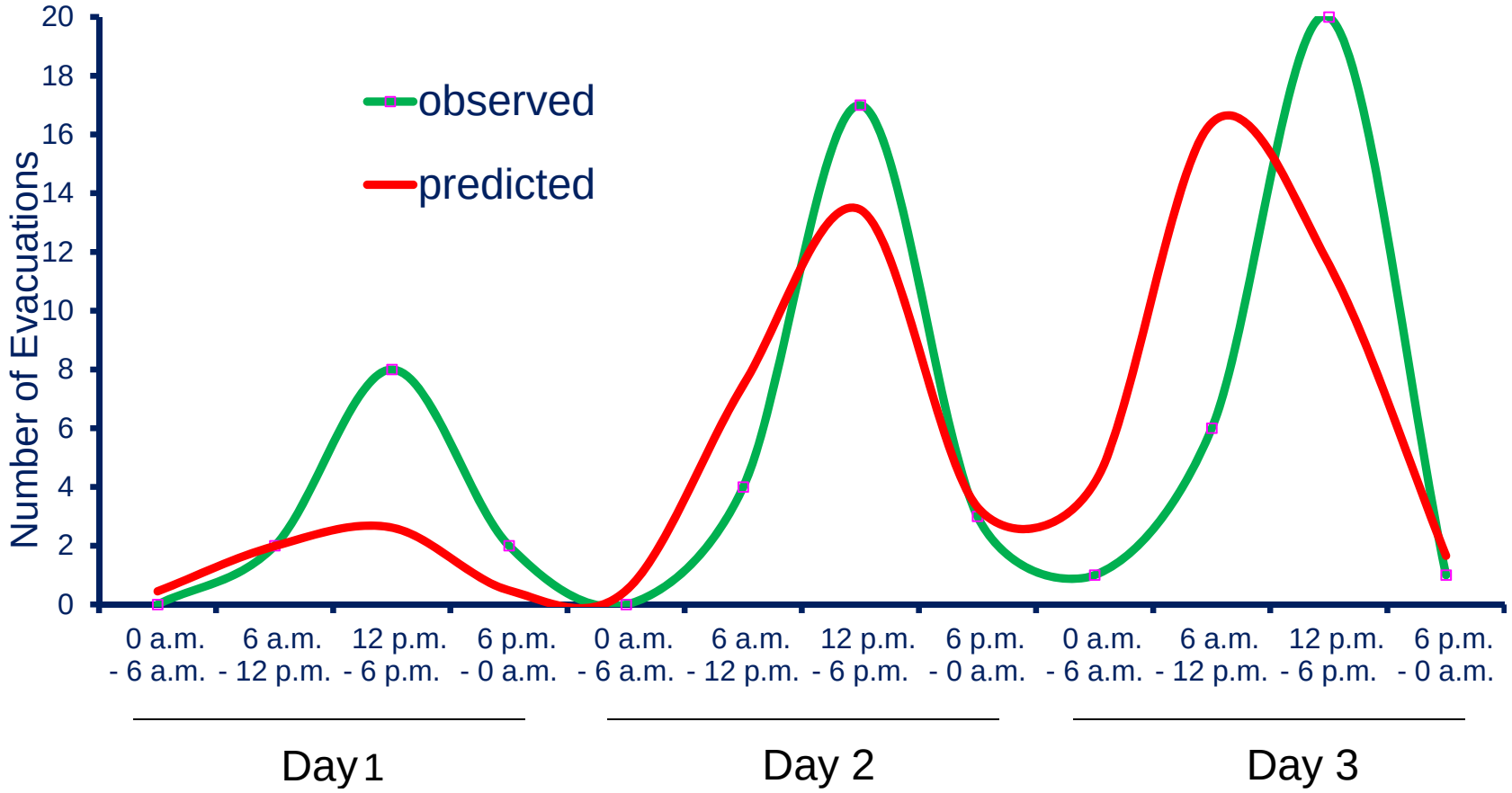
Model estimated on S.C. data



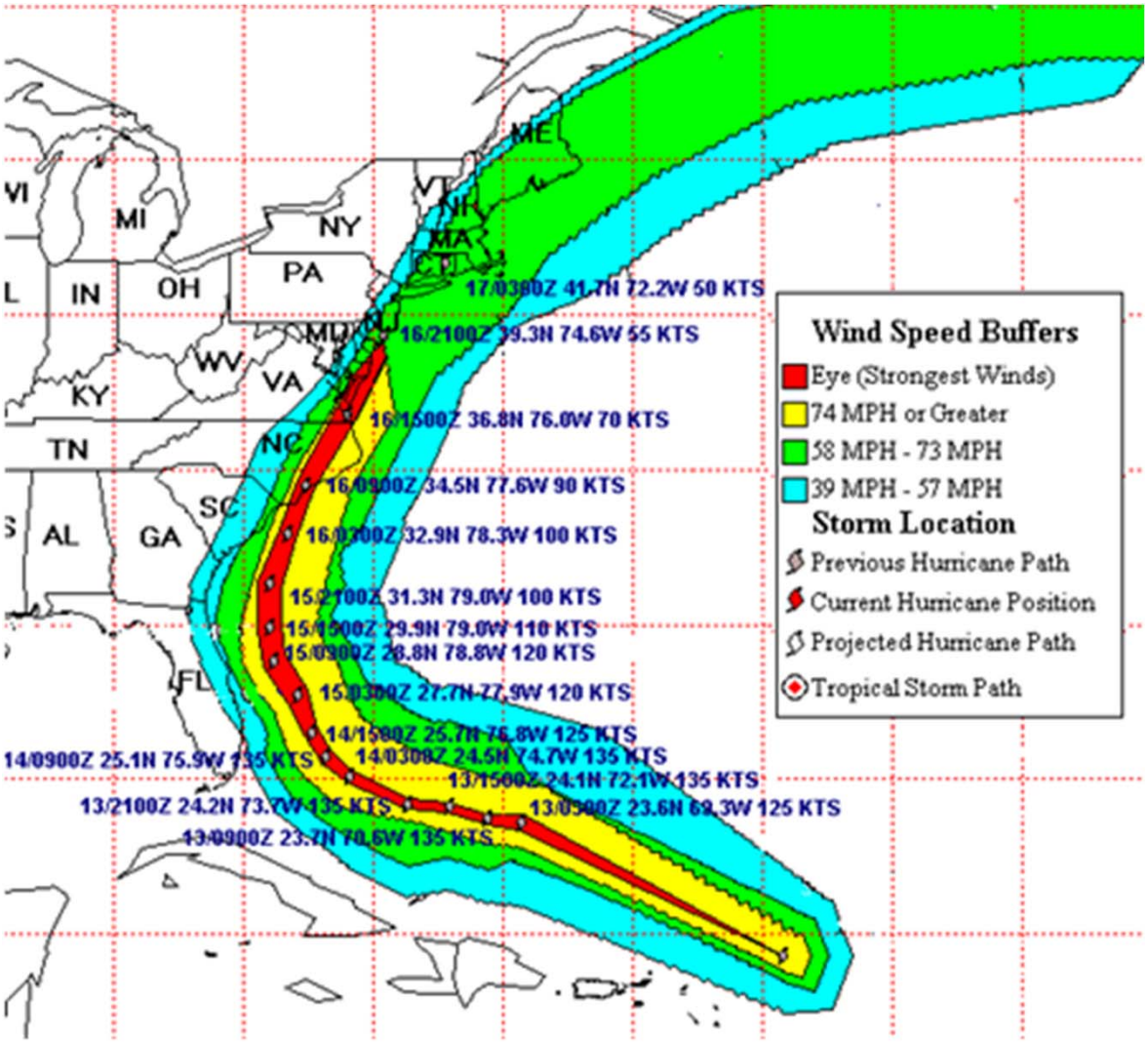
Voluntary Evacuation Orders at Same Time on Different Days



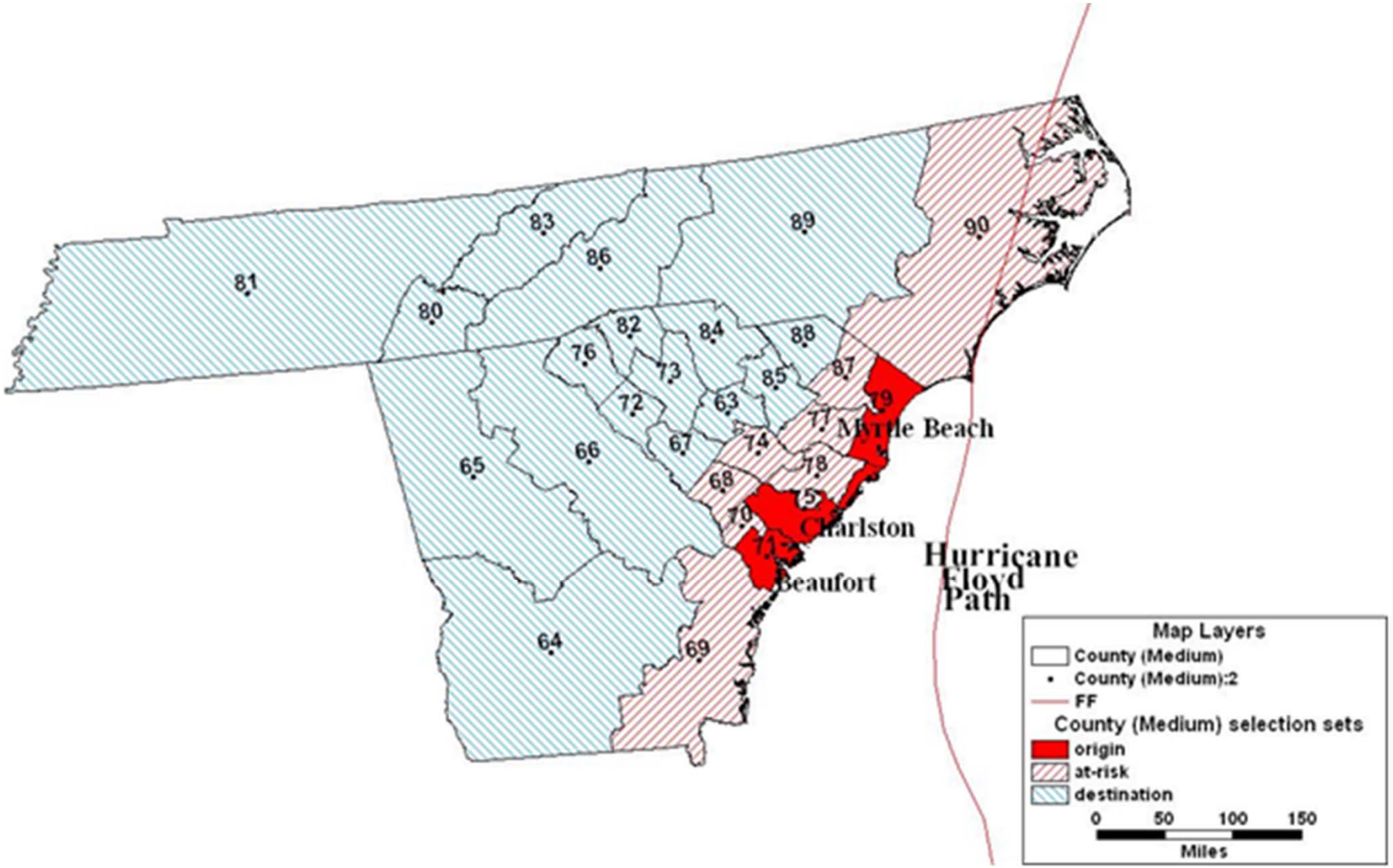
S.C. model applied in Louisiana



Wind speed diagram of hurricane Floyd



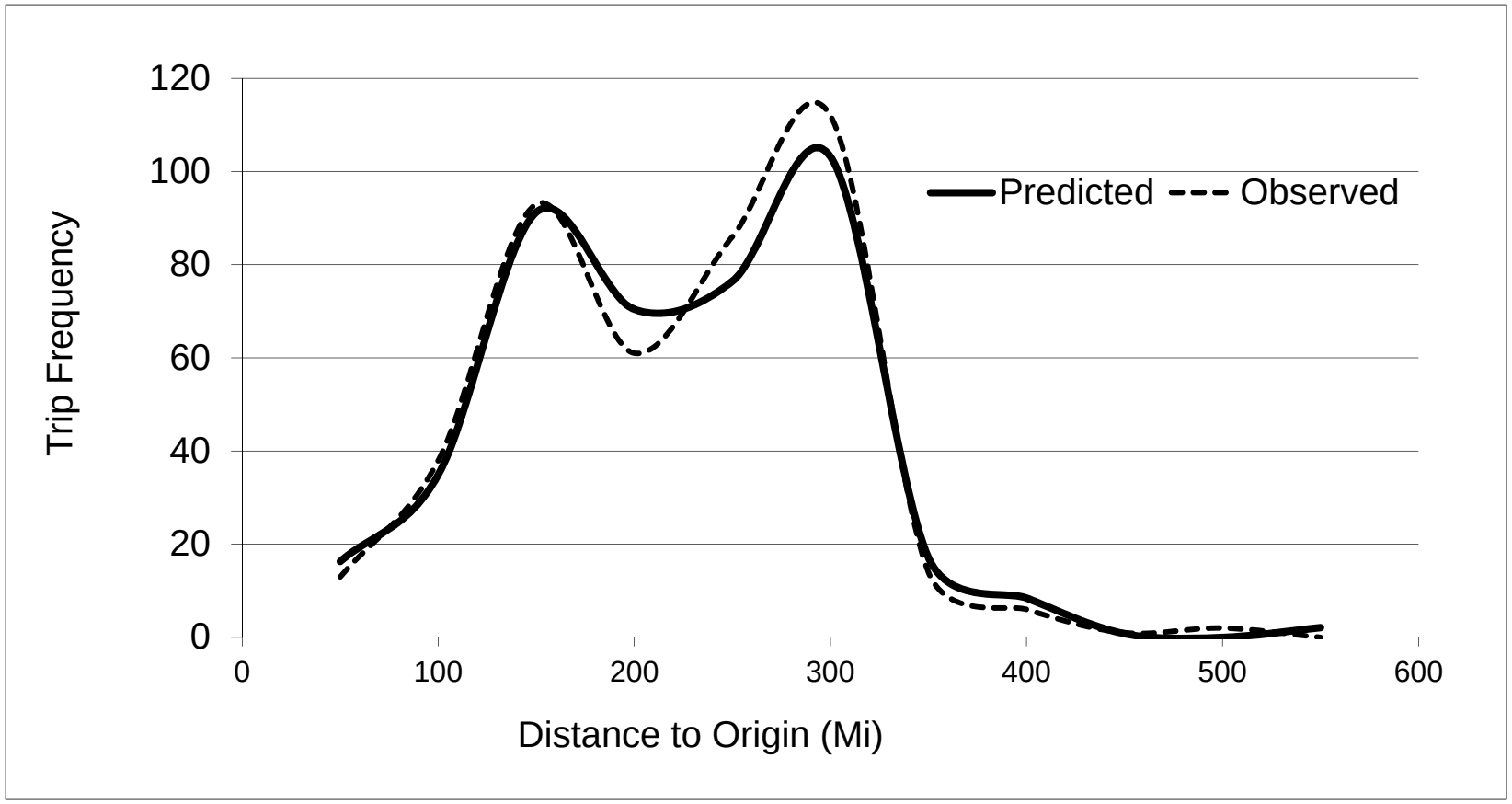
Evacuation destinations



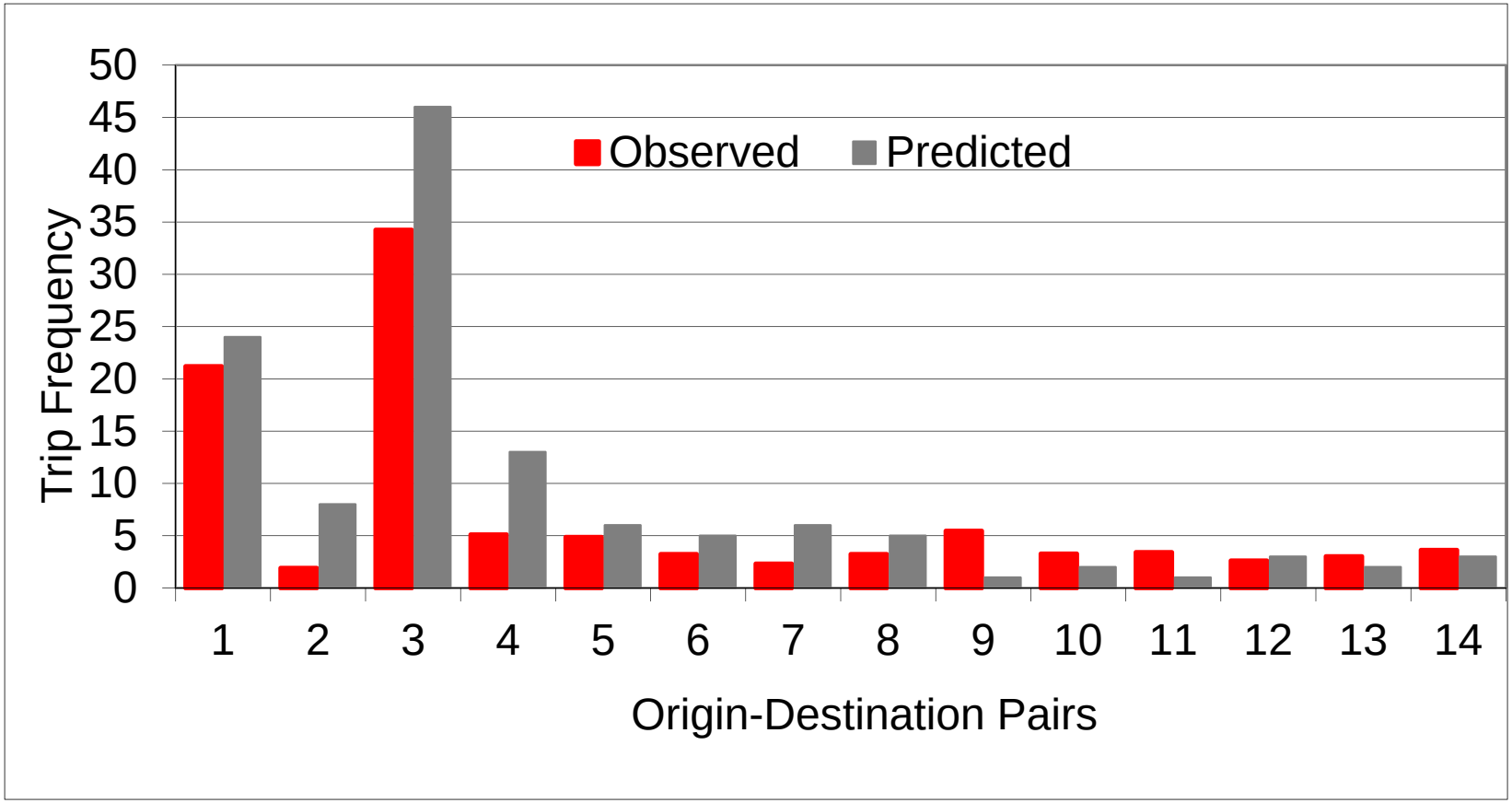
Variables in destination choice model

- ***Dynamic values of:***
  - ***Travel time from origin to destination in previous time interval***
  - ***Remaining accommodation available in each destination zone in previous time interval***
  - ***Predicted path of storm at time t***
  - ***Ethnic similarity between origin and destination zones***
  - ***MSA in destination zone?***

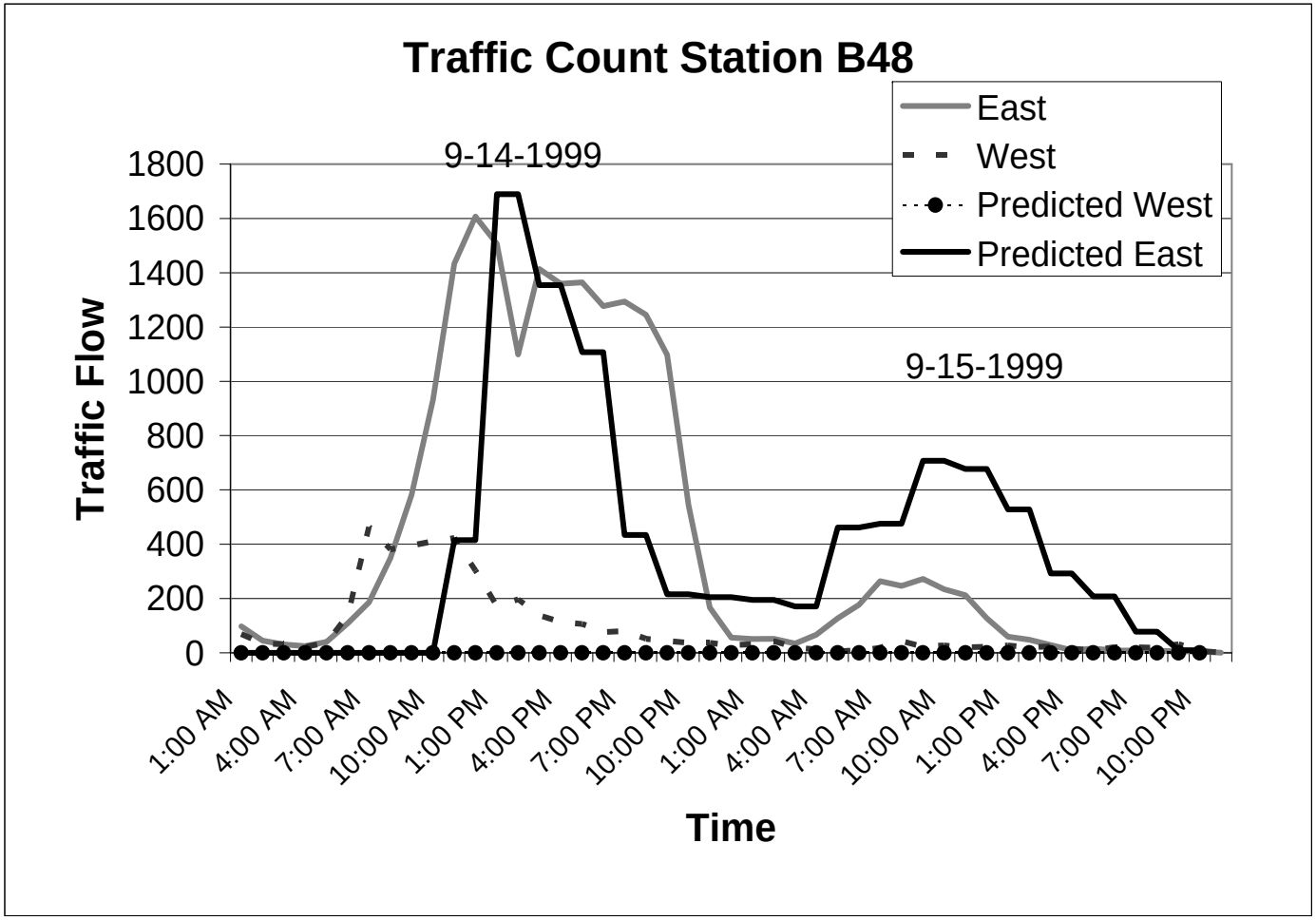
Trip length frequency distribution



Observed and predicted O-D



Observed and predicted traffic



Modeling Route Choice

- ***Factors:***
  - ***Shortest path***
  - ***Familiarity with route***
  - ***Services available (gas stations, rest areas)***
  - ***Safety of route (predicted path of storm at time of route choice)***
  - ***Facility class (freeway, arterial)***

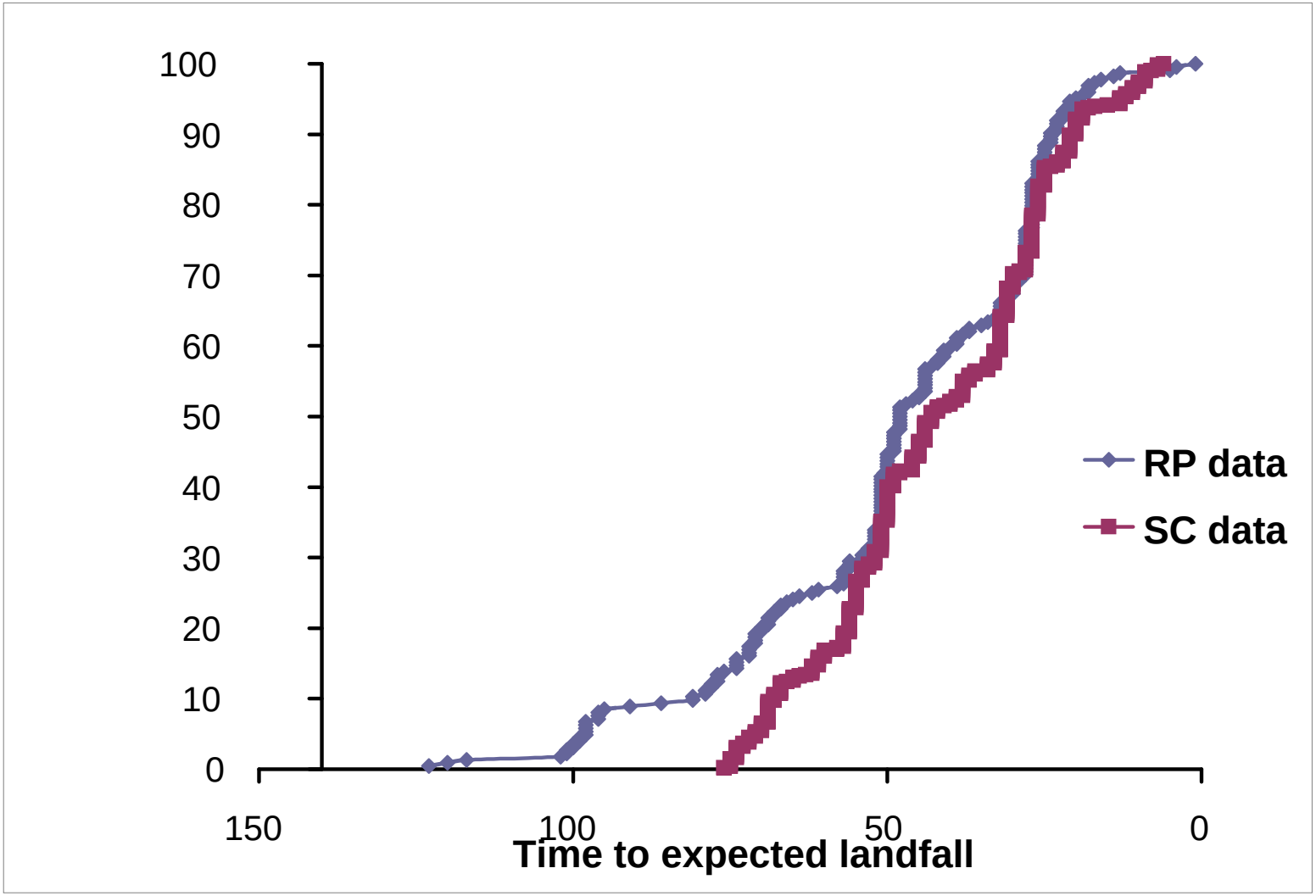
Applications

- ***New Orleans***
  - ***Testing the benefit of adaptive evacuation plans***
- ***Southern Louisiana (planned)***
  - ***Estimating traffic volumes for different storm scenarios and administrative decisions (e.g. contraflow, staged evacuation, selective evacuation, modified evacuation plans, road closing criteria)***

New data collection approach

- ***Hypothetical storms and administrative actions presented audio-visually in a DVD***
- ***Each storm presented in 4 time-based scenarios***
- ***Respondents state whether they would evacuate or not in each scenario***
- ***Each respondent subjected to 3 storms***

Evacuation departure times



Vehicles used

No. of vehs.	*Reported (%)*	*Stated (%)*
1	*58*	*67*
2	*33*	*29*
3	*5*	*3*
≥ 4	*4*	*1*

Type of refuge

Type	*Reported (%)*	*Stated (%)*
Friend/relative	*52*	*49*
Hotel/motel	*37*	*43*
Public shelter	*1*	*1*
Workplace	*1*	*1*
Other	*9*	*6*

Planned future use of model system

- ***Run on variety of storms***
  - ***Storm intensity, path, speed, surge***
- ***Apply alternative administrative strategies***
  - ***Vary the type and timing of evacuation orders, vary initiation and termination times of contraflow, test staged and selective evacuation plans, modify evacuation plans, and institute network changes***
- ***Identify best administrative strategy for each storm and store solutions for later retrieval***

Evacuation and Climate Change

- *Climate change may generate more severe storms*
- *Modeling permits vicarious exploration of alternatives aimed at establishing effective, efficient, and safe evacuation plans*
- *Your "Forever Open Road" is a road designed for resilience; we address the best operation of that road in crisis situations*

- *Thank you for your attention!*

National Study
Evacuation Pla

John L. Renne,
Thomas W
Todd Litma

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TRB

SPECIAL REPORT 294

The Role of Transit in Emergency Evacuation

SPECIAL RE

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Transportation's Role in Emergency Evacuation and Reentry

A Synthesis of Highway Practice

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

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Summary and Conclusion

- ***Evacuation plans in place to handle traffic and transportation needs***
- ***Opportunity to provide better and smarter solutions based on analysis and planning***
- ***Modeling has great potential to improve evacuation plans***

Photo Source: Lt. John Denholm
Harris Co. (TX) Sheriff's Office


Washington
Montana
North Dakota
Minnesota
Oregon
Idaho
Wyoming
South Dakota
Wisconsin
Michigan
New York
Maine
New Brunswick
Prince Edward Island
Nova Scotia
Vermont
New Hampshire
Massachusetts
Rhode Island
Connecticut
New Jersey
Delaware
Maryland
District of Columbia
Nevada
Utah
Colorado
United States
Nebraska
Iowa
Illinois
Indiana
Ohio
Pennsylvania
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West Virginia
Virginia
Kentucky
Arizona
New Mexico
Oklahoma
Arkansas
Tennessee
North Carolina
South Carolina
Mississippi
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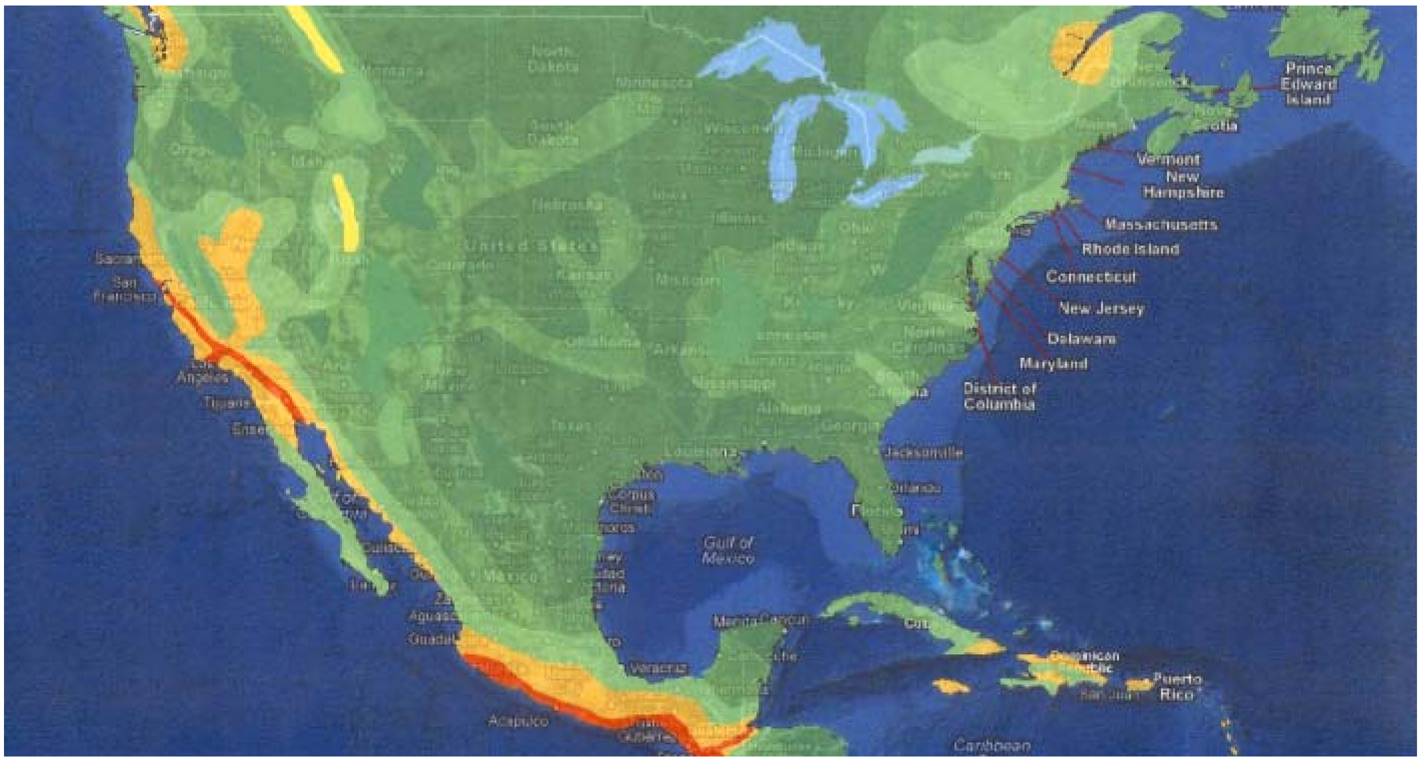
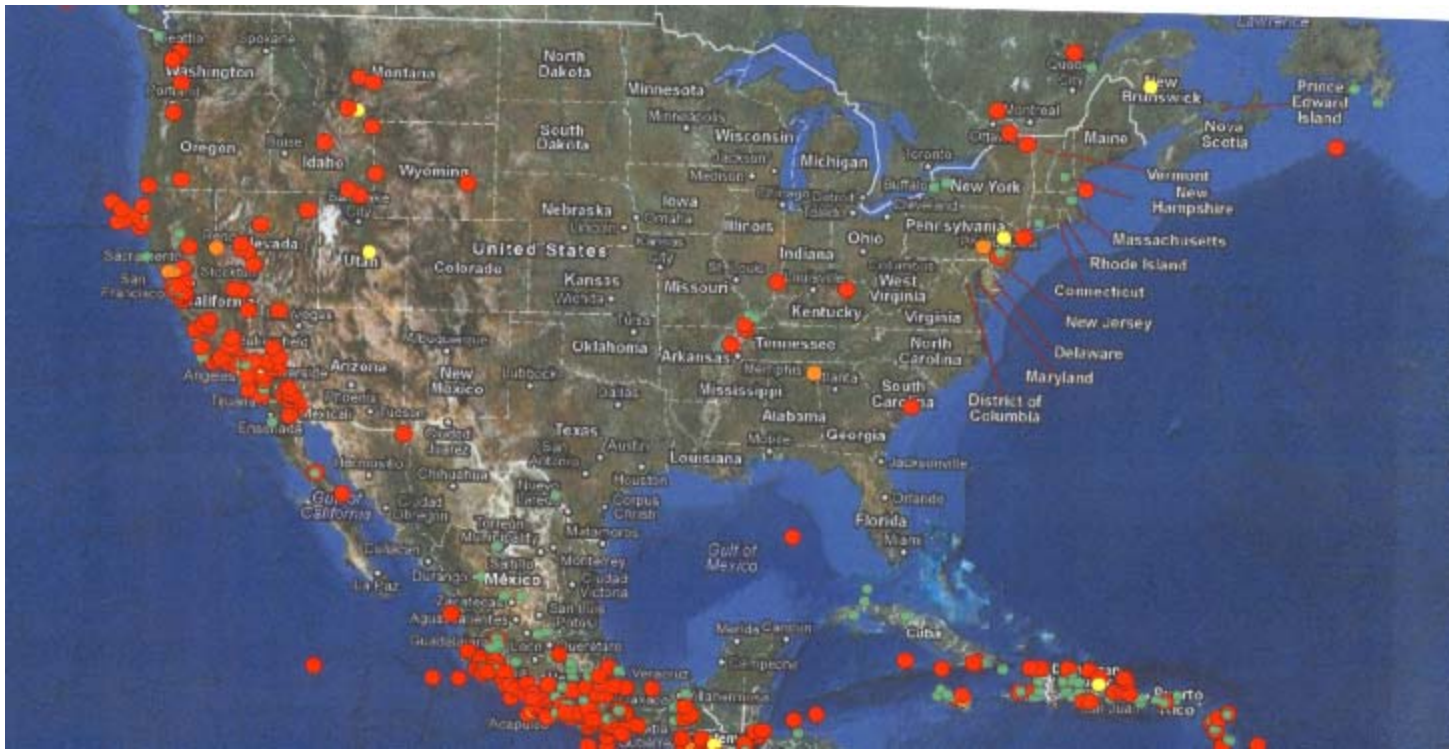
Georgia
Texas
Louisiana
Florida
Gulf of Mexico
Gulf of California
México
Cuba
Dominican Republic
Puerto Rico
Guatemala

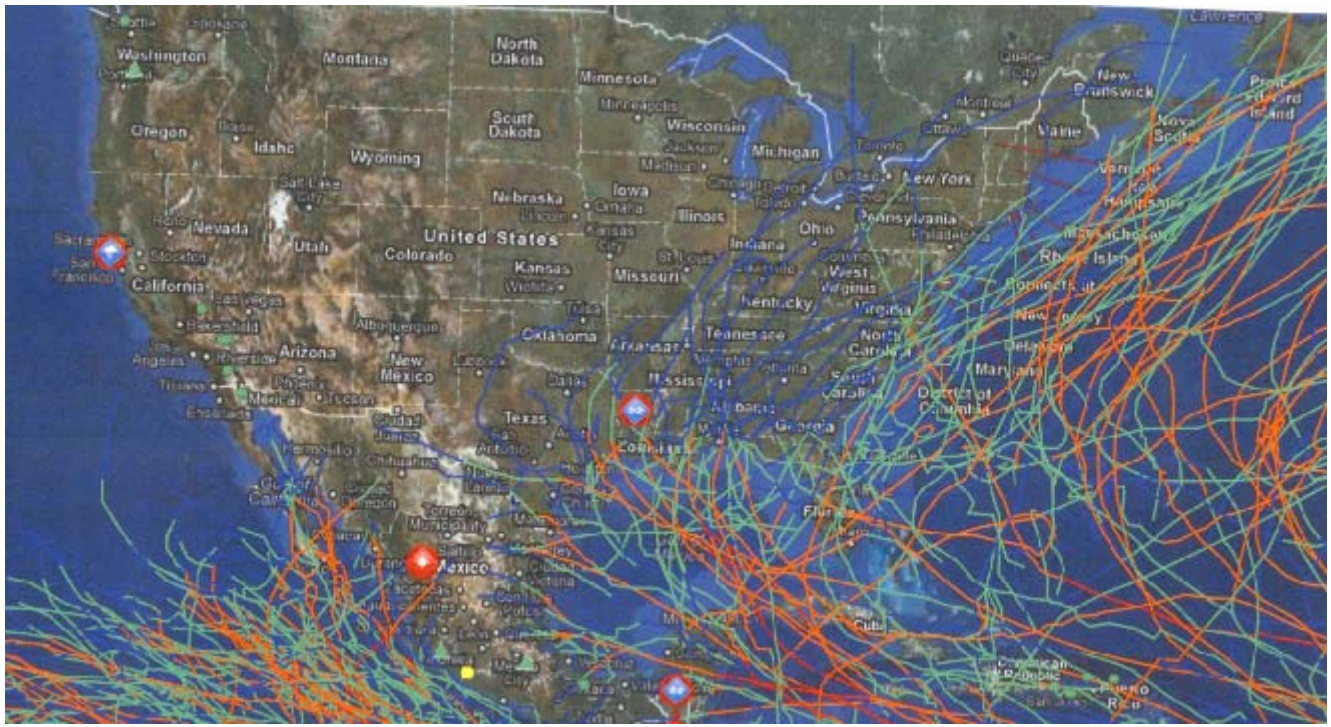

Prince
Edward
Island
Vermont
New
Hampshire
Massachusetts
Rhode Island
Connecticut
New Jersey
Delaware
Maryland
District of
Columbia
Gulf of
Mexico
Puerto
Rico
Jacksonville
Acapulco

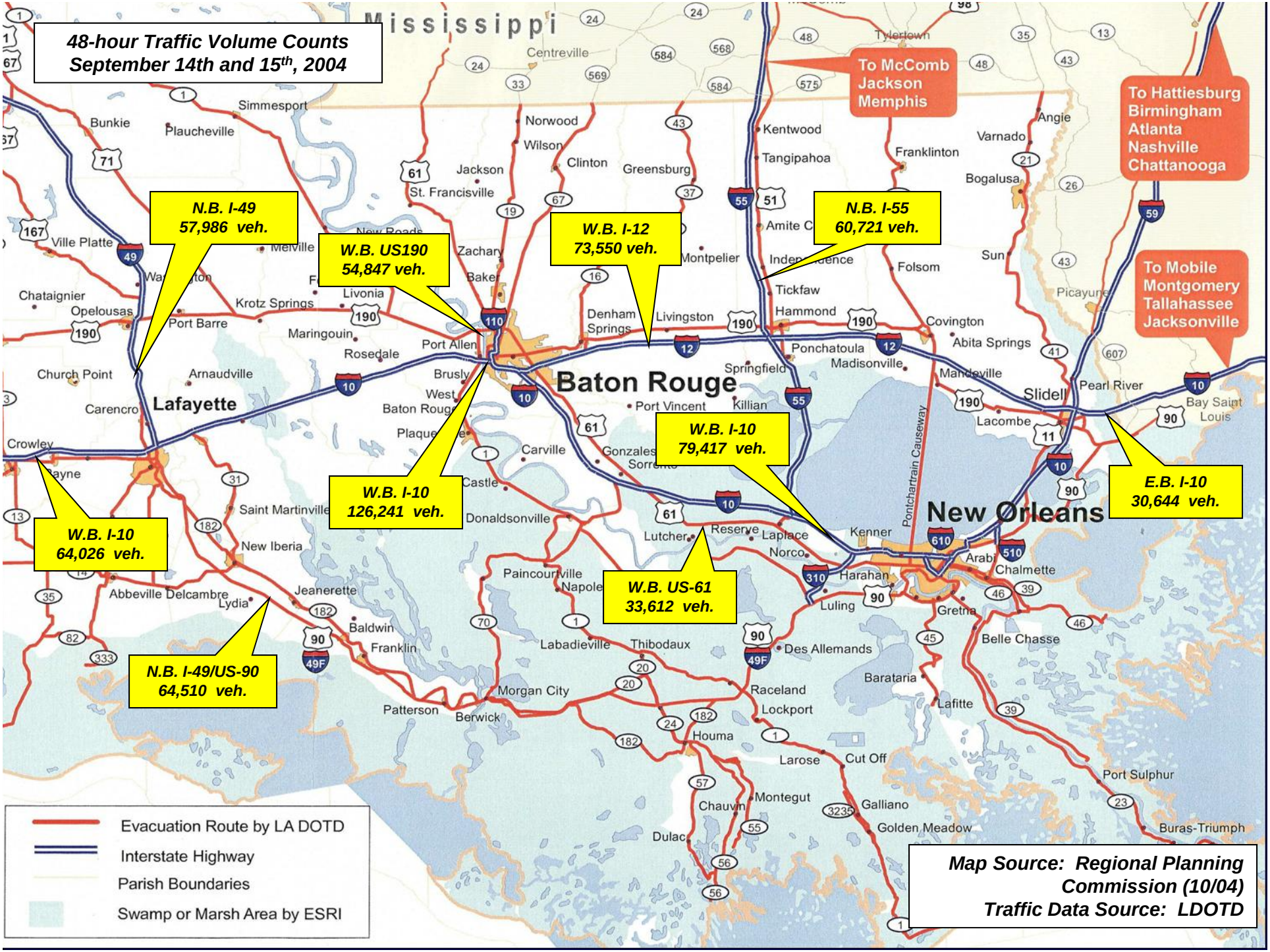
earthquakes

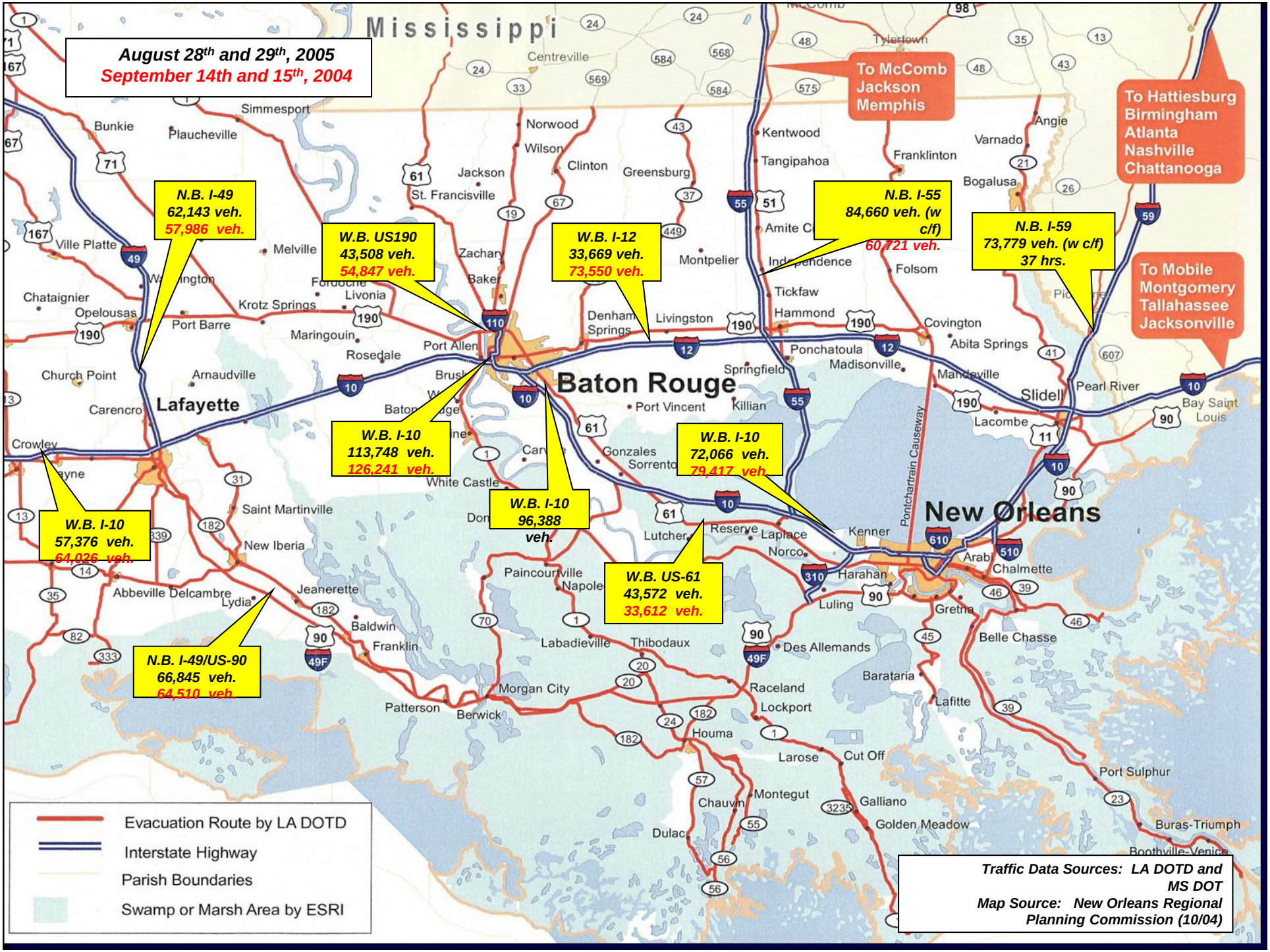


Hurricane intensity

Hurricane paths 2000-2009




48-hour Traffic Volume Counts
September 14th and 15th, 2004
N.B. I-49
57,986 veh.
W.B. US190
54,847 veh.
W.B. I-12
73,550 veh.
N.B. I-55
60,721 veh.
To McComb
Jackson
Memphis
To Hattiesburg
Birmingham
Atlanta
Nashville
Chattanooga
To Mobile
Montgomery
Tallahassee
Jacksonville
W.B. I-10
126,241 veh.
W.B. I-10
79,417 veh.
E.B. I-10
30,644 veh.
W.B. I-10
64,026 veh.
W.B. US-61
33,612 veh.
N.B. I-49/US-90
64,510 veh.
Baton Rouge
New Orleans
Lafayette
Evacuation Route by LA DOTD
Interstate Highway
Parish Boundaries
Swamp or Marsh Area by ESRI
Map Source: Regional Planning Commission (10/04)
Traffic Data Source: LDOTD


August 28th and 29th, 2005
September 14th and 15th, 2004
To McComb
Jackson
Memphis
To Hattiesburg
Birmingham
Atlanta
Nashville
Chattanooga
To Mobile
Montgomery
Tallahassee
Jacksonville
N.B. I-49
62,143 veh.
57,986 veh.
W.B. US190
43,508 veh.
54,847 veh.
W.B. I-12
33,669 veh.
73,550 veh.
N.B. I-55
84,660 veh. (w c/f)
60,721 veh.
N.B. I-59
73,779 veh. (w c/f)
37 hrs.
W.B. I-10
113,748 veh.
126,241 veh.
W.B. I-10
96,388 veh.
W.B. I-10
72,066 veh.
79,417 veh.
W.B. I-10
57,376 veh.
64,026 veh.
W.B. US-61
43,572 veh.
33,612 veh.
N.B. I-49/US-90
66,845 veh.
64,510 veh.
Mississippi
Baton Rouge
Lafayette
New Orleans
Pontchartrain Causeway
Evacuation Route by LA DOTD
Interstate Highway
Parish Boundaries
Swamp or Marsh Area by ESRI
Traffic Data Sources: LA DOTD and MS DOT
Map Source: New Orleans Regional Planning Commission (10/04)

Evacuation Basics

- *TEMPORAL AND SPATIAL*
- *Hazard Characteristics*
  - *Scale (how "big?" -> How far to evacuate), Amount of advanced notice, Shelter-in-place options*
- *Evacuee Characteristics*
  - *Who are they? Where are they? How many? How mobile? Behavior (if/when will they leave?), What are their needs?*
- *Transportation Resources*
  - *Modes, Highway Transit, Traffic Control, Traffic Management*
- *Communication, Communication, Communication*
  - *To/from, Across and between all levels, jurisdictions, agencies, and evacuees, Need for situational awareness*

Examples of Control Devices

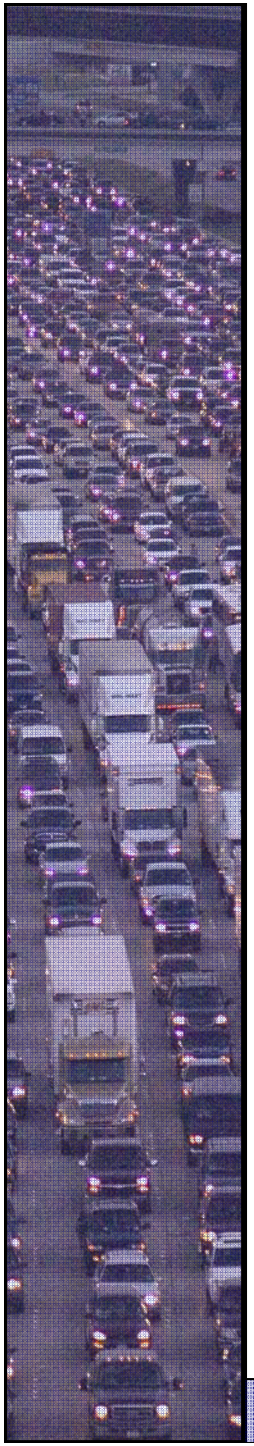
Examples of Control Devices

Examples of Control Devices

Examples of Control Devices

Examples of Control Devices

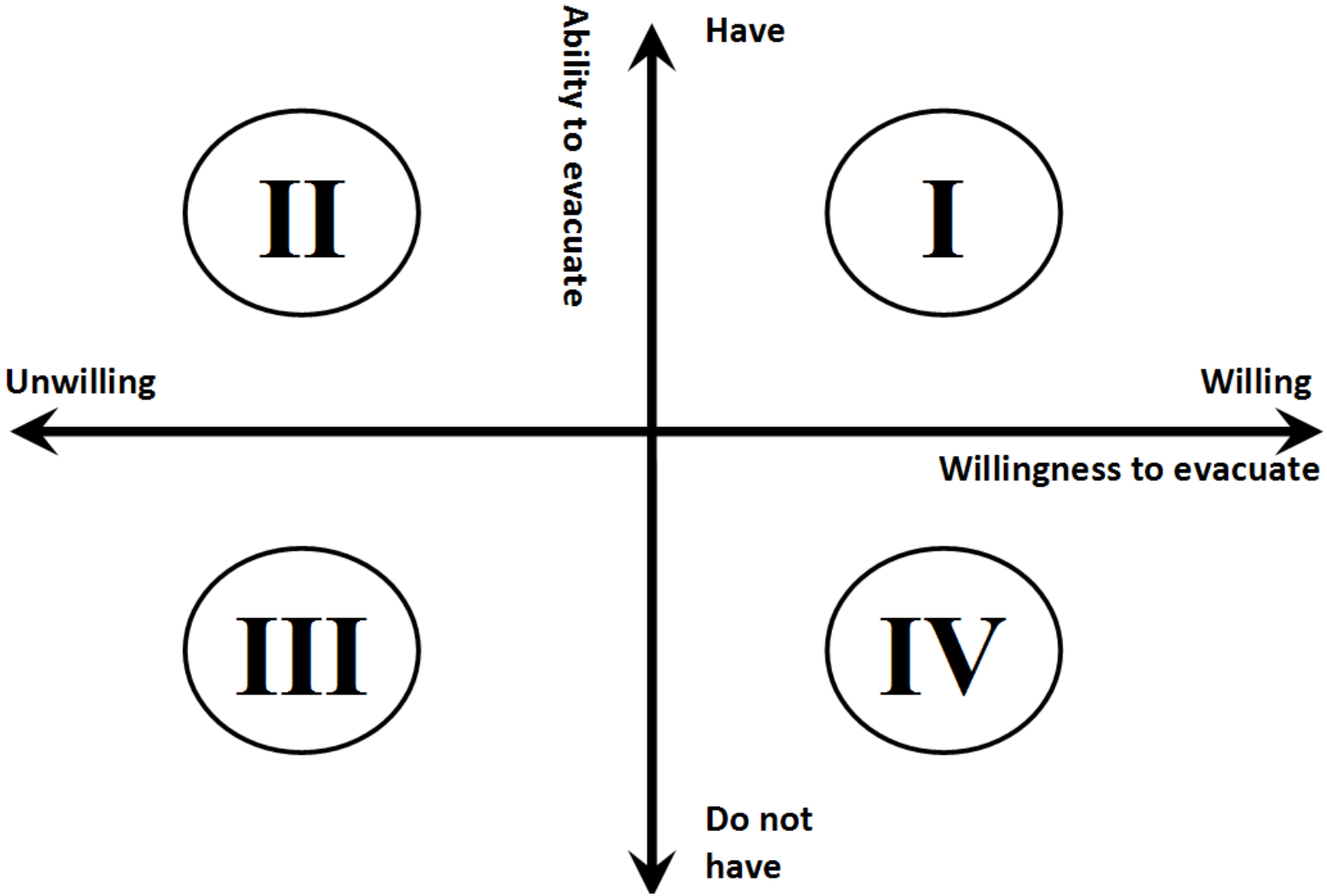
Examples of Control Devices



"Low Mobility" Evacuees

- ***Individuals without personal transportation, elderly, infirm, tourists, economically disadvantaged, prisoners, homeless, etc.***
- ***How many persons fit these description?***
- ***Where are they located?***
- ***Who are they and what are there needs? medicine, oxygen, dialysis, etc.***
- ***Who is responsible for them if they are unable to take of themselves?***
- ***Where do they go? How do they come back?***

Evacuee Categorization

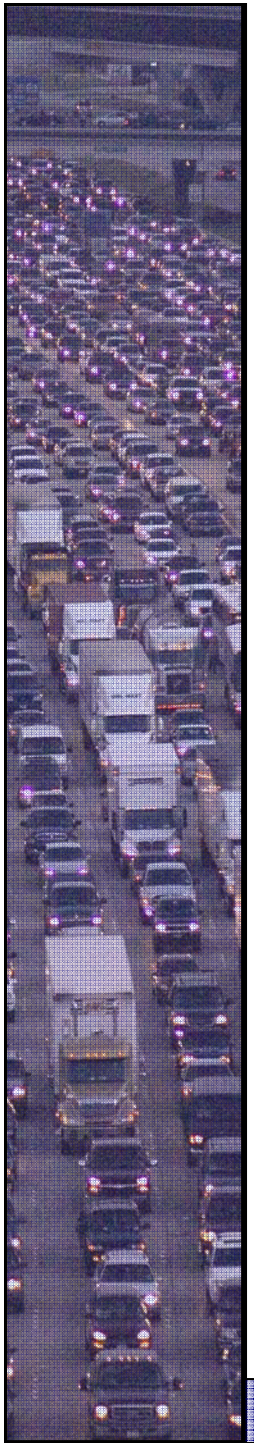


Problems of Low Mobility Evacuation Planning

- ***Existing traffic/transportation simulation systems are not created to model evacuation conditions***
  - ***Scale (e.g., number of vehicles)***
  - ***Scope (e.g. duration, geographic area)***
- ***Existing models do not permit the modeling and simulation of multiple modes of transportation simultaneously***
- ***Most models are not able to give analysts the MOE's they'd like or decision-makers the answers to questions they pose***
- ***Limited understanding and development of underlying behaviors of evacuation travel for different evacuee and mode types***

Problems of Modeling Evacuation Transportation Plans

- ***Existing traffic/transportation simulation systems are not created to model evacuation conditions***
  - ***Scale (e.g., number of vehicles)***
  - ***Scope (e.g. duration, geographic area)***
- ***Existing models do not permit the modeling and simulation of multiple modes of transportation simultaneously***
- ***Most models are not able to give analysts the MOE's they'd like or decision-makers the answers to questions they pose***



Recognized Limitations

- ***Existing traffic/transportation simulation systems are not created to model evacuation conditions***
  - ***Scale (e.g., number of vehicles)***
  - ***Scope (e.g. duration, geographic area)***
- ***Existing models do not permit the modeling and simulation of multiple modes of transportation simultaneously***
- ***Most models are not able to give analysts the MOE's they'd like or decision-makers the answers to questions they pose***
- ***Limited understanding and development of underlying behaviors of evacuation travel for different evacuee and mode types***

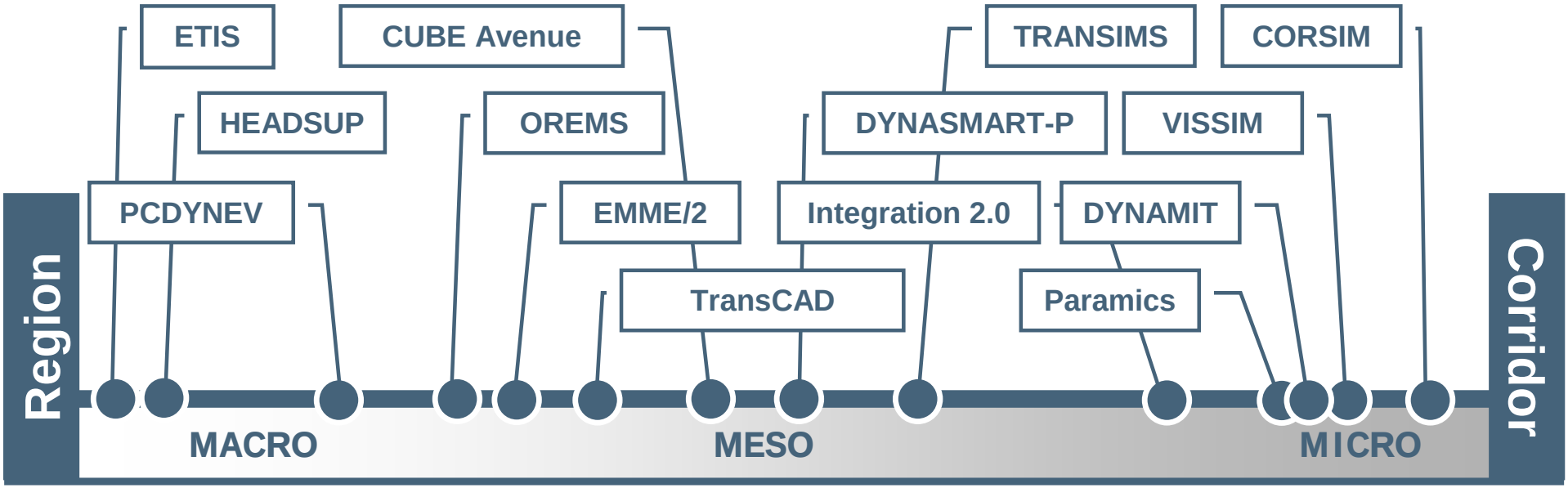
Current Research

- *Application of the TRANSIMS system*
- *Can be used to model very large geographical regions and large numbers of travelers*
- *Effort and expertise required to code and run*
- *Issues of verification, validation, and calibration*
- *Hardware and software requirements*
- *History, experience, and acceptance within the professional transportation community*
- *Not developed for the purpose of evacuation*

Evacuation Traffic Simulation

- *Has proven value*
- *Permits bottlenecks to be identified and potential solutions to be analyzed before they become problems*
- *Gives quantitative MOE results to decision-makers*
- *Allows effects of alternative strategies and adverse conditions to be assessed without consequence*

Evacuation Modeling Spectrum



From: "Structuring Modeling and Simulation Analyses for Evacuation Planning and Operations"

By: Hardy, Wunderlich, Bunchand, and Smith

Recognized Limitations

- ***Existing traffic/transportation simulation systems are not created to model evacuation conditions***
  - ***Scale (e.g., number of vehicles)***
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- ***Limited understanding and development of underlying behaviors of evacuation travel for different evacuee and mode types***

Assisted Evacuations

- *Evacuation planning has historically been targeted at persons with personal vehicles*
- *A substantial percentage of potential vulnerable populations do not have personal vehicles*
- *Plans to evacuate "carless" populations in many locations have been created relatively recently or are currently in development*
- *There have been few actual activations to gain knowledge and experience, nor tests, drills or simulations to evaluate potential weakness and needs*

TRANSIMS System

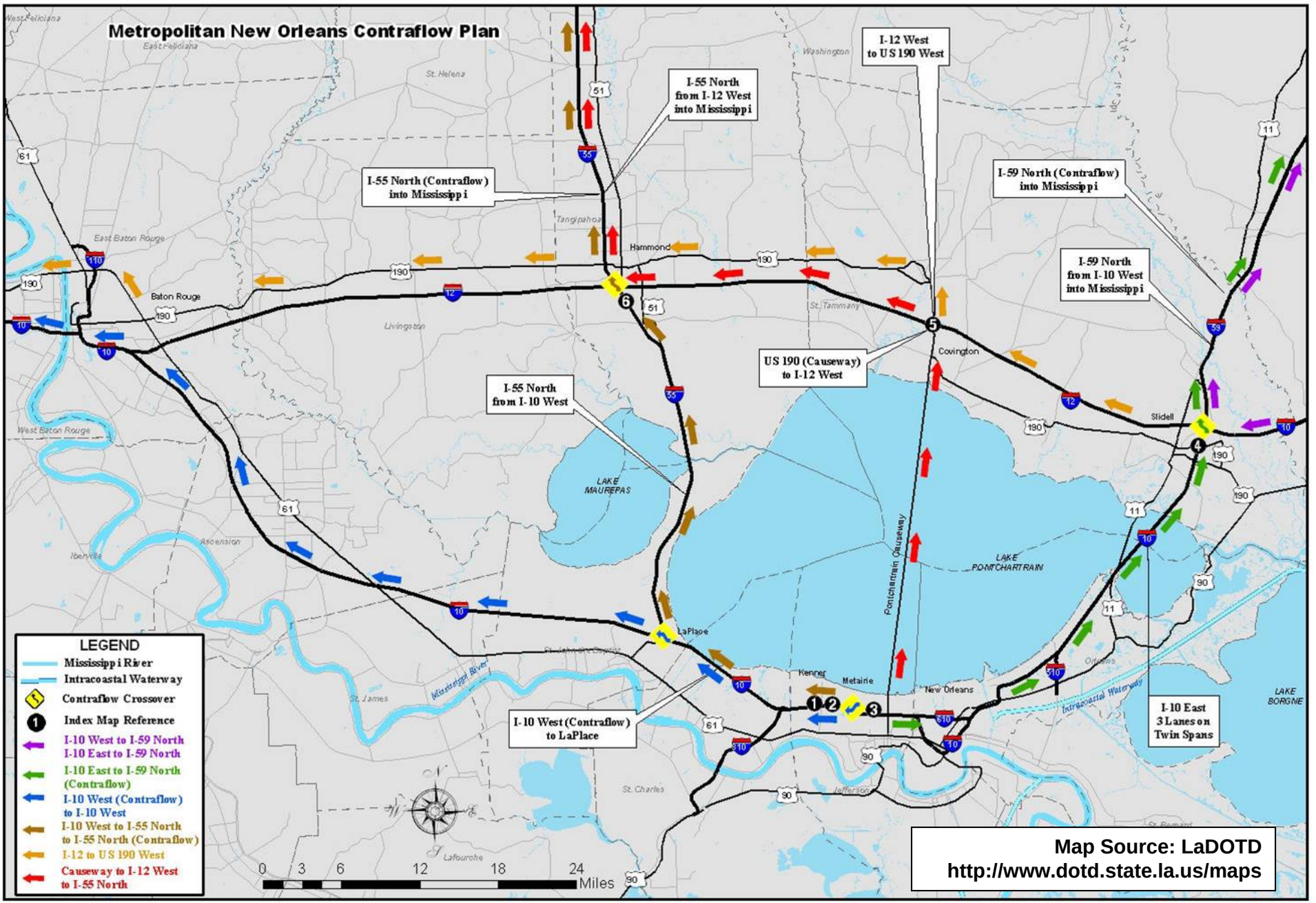
- *Incorporates aspects of planning and operations*
- *Model large geographical regions and large numbers of travelers*
- *Model populations, travel activities, routing, and analyses it with a microsimulator*
- *Open source and available*
- *Effort and expertise required to code and run*
- *Issues of verification, validation, and calibration*
- *Hardware and software requirements*
- *History, experience, and acceptance within the professional transportation community*
- *Not developed for the purpose of evacuation*

TRANSIMS Structure

- **Network Input**
  - Structure and characteristics of the transportation network (control, capacity, etc.) and activity locations
- **Population Synthesizer**
  - Creates a disaggregate synthetic population based on aggregate census zonal information
- **Activity Generator**
  - Travel surveys or observation of past evacuations
- **Router**
  - Spatial and temporal travel behavior and route assignments
- **Microsimulator**
  - Tracks and compiles movements and statistics of each agent (vehciles & peds)
- **Visualizer**
  - 3rd party developer Balfour Technologies Inc.

LSU Study - Approach

- ***Step 1 – Network development***
- ***Step 2 - "Base Model" validation and calibration based on 2005 Katrina evacuation***
- ***Step 3 - Code "New" New Orleans multimodal plan***
- ***Step 4 - "Base Model" validation and calibration based on 2005 Katrina evacuation***
- ***Step 5 - Code and test alternative plans and ideas***


Metropolitan New Orleans Contraflow Plan
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I-55 North from I-12 West into Mississippi
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I-59 North (Contraflow) into Mississippi
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US 190 (Causeway) to I-12 West
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I-10 West (Contraflow) to LaPlace
I-10 East 3 Lanes on Twin Spans
Hammond
Baton Rouge
Covington
Slidell
LaPlace
Kenner
Metairie
New Orleans
LAKE MAUREPAS
LAKE PONTCHARTRAIN
Pontchartrain Causeway
Intracoastal Waterway
LAKE BORGNE
Mississippi River
LEGEND
Mississippi River
Intracoastal Waterway
Contraflow Crossover
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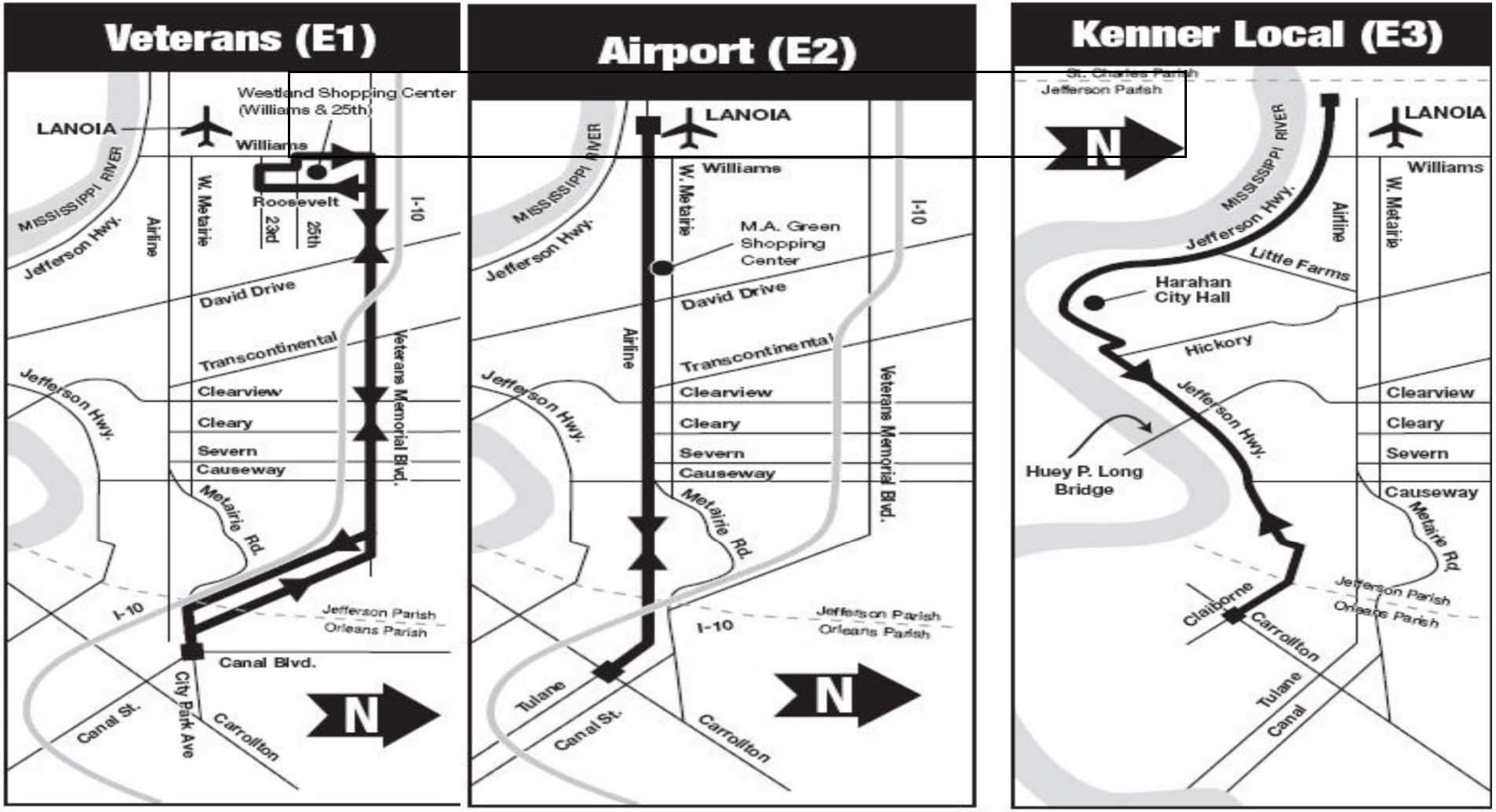
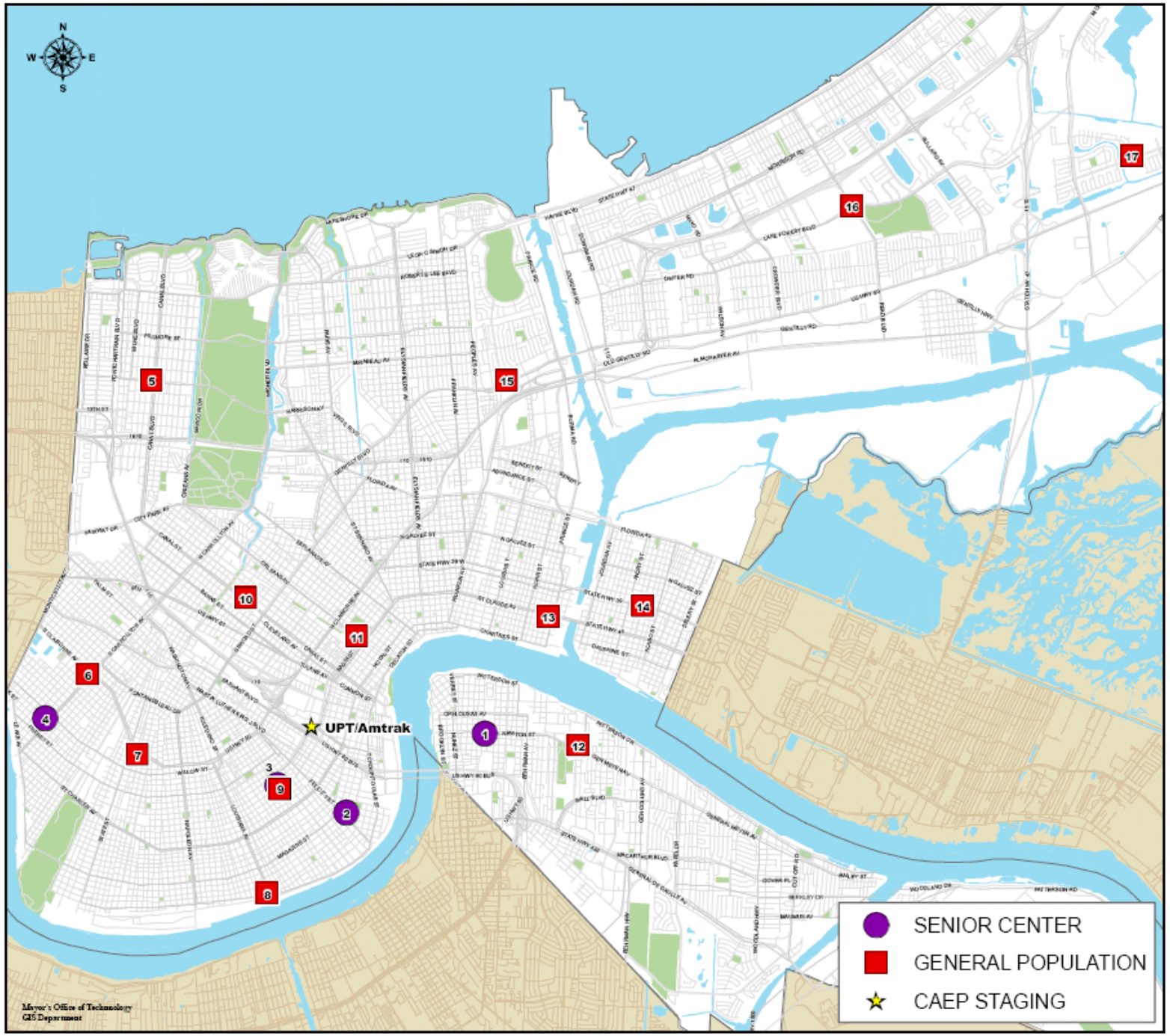
I-10 West to I-59 North
I-10 East to I-59 North
I-10 East to I-59 North (Contraflow)
I-10 West (Contraflow) to I-10 West
I-10 West to I-55 North to I-55 North (Contraflow)
I-12 to US 190 West
Causeway to I-12 West to I-55 North
0 3 6 12 18 24 Miles
Map Source: LaDOTD
http://www.dotd.state.la.us/maps

Jefferson Parish Bus Routes





Evacuation Pick-Up Locations

SENIOR CENTER LOCATIONS

1. Arthur Mondy Center
1111 Newton Avenue, Algiers

2. Kingsley House
1600 Constance Street,
Lower Garden District

3. Central City Senior Center
2020 Philip Street, Central City

4. Mater Dolorosa
1226 S. Carrollton Ave, Carrollton

GENERAL POPULATION

5. Smith Library Bus Stop
6300 Canal Blvd., Lakeview

6. Palmer Park
S. Claiborne and S. Carrollton,
West Carrollton

7. McMain High School
5712 S. Claiborne Ave, Broadmoor

8. Lyons Community Center
624 Louisiana Ave, Irish Channel

9. Dryades YMCA
1924 Philip Street, Central City

10. Warren Easton High School
3019 Canal Street, Treme

11. Municipal Auditorium
801 N. Rampart, 7th Ward

12. O. Perry Walker High School
2832 General Meyer, Algiers

13. Stallings Community Center
4300 St. Claude, Bywater

14. Sanchez Center
Caffin & N. Claiborne, Lower 9th Ward

15. Gentilly Mall Parking Lot
Chef Menteur & Press Dr., Gentilly

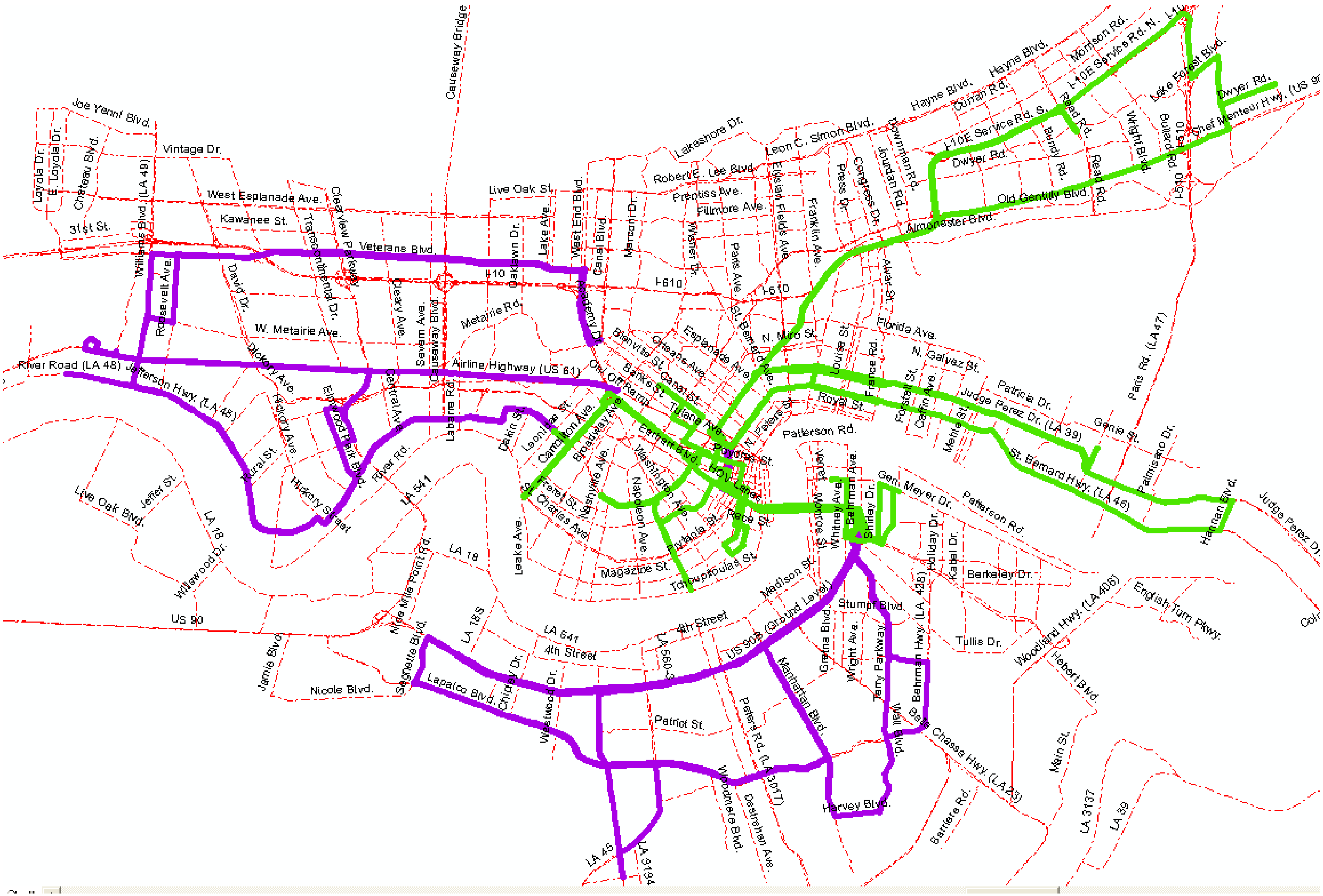
16. Walgreen's
Lake Forest & Read Blvd, NO East

17. Mary Queen of Vietnam
14001 Dwyer, New Orleans East

0 0.45 0.9 1.8 Miles

CITY OF NEW ORLEANS

City Assisted Evacuation Plan



Causeway Bridge
Joe Yenni Blvd.
Vintage Dr.
Loyola Dr.
E. Loyola Dr.
Chateau Blvd.
Williams Blvd. (LA 49)
West Esplanade Ave.
Kawanee St.
31st St.
Veterans Blvd.
Clearview Parkway
Transcontinental Dr.
David Dr.
W. Metairie Ave.
Roosevelt Ave.
River Road (LA 48)
Jefferson Hwy. (LA 48)
Dickory Ave.
Hickory Ave.
Rural St.
Hickory Street
Elmwood Park Blvd.
Central Ave.
Cleary Ave.
Severn Ave.
Causeway Blvd.
Airline Highway (US 61)
Metairie Rd.
I-10
Oaklawn Dr.
Live Oak St.
Lake Ave.
West End Blvd.
Canal Blvd.
Marconi Dr.
Pontchartrain Blvd.
I-610
Labarre Rd.
River Rd.
LA 541
Live Oak Blvd.
Jeffer St.
LA 18
Willowood Dr.
US 90
Jamie Blvd.
Nicole Blvd.
Nine Mile Point Rd.
Segnette Blvd.
Lapalco Blvd.
LA 18 S
Oakin St.
Leonidas St.
Carrollton Ave.
Broadway Ave.
S. Claiborne Ave.
Leake Ave.
Lakeshore Dr.
Robert E. Lee Blvd.
Prentiss Ave.
Fillmore Ave.
Leon C. Simon Blvd.
Elysian Fields Ave.
Franklin Ave.
Press Dr.
Congress Dr.
Jourdan Rd.
Bowman Rd.
Hayne Blvd.
Morrison Rd.
I-10E Service Rd. S.
I-10E Service Rd. N.
Lake Forest Blvd.
Dwyer Rd.
Read Rd.
Bundy Rd.
Wright Blvd.
Bullard Rd.
I-510
Chef Menteur Hwy. (US 90)
Old Gentilly Blvd.
Almonaster Blvd.
Paris Ave.
St. Bernard Ave.
N. Miro St.
Esplanade Ave.
Orleans Ave.
Bienville St.
Banks St.
Canal St.
Tulane Ave.
Earhart Blvd.
Poydras St.
HOV Lanes
Washington Ave.
Napoleon Ave.
Jefferson Ave.
S. Claiborne Ave.
St. Charles Ave.
Prytania St.
Magazine St.
Tchoupitoulas St.
Race St.
Florida Ave.
N. Galvez St.
Louisa St.
France Rd.
Royal St.
Patterson Rd.
Patricia Dr.
Judge Perez Dr. (LA 39)
St. Bernard Hwy. (LA 46)
Genie St.
Palmisano Dr.
Paris Rd. (LA 47)
Hannan Blvd.
Judge Perez Dr.
Forstall St.
Caffin Ave.
Mehle St.
Gen. Meyer Dr.
Patterson Rd.
Whitney Ave.
Behrman Ave.
Shirley Dr.
Holiday Dr.
Kabel Dr.
Berkeley Dr.
Madison St.
US 90B (Ground Level)
Stumpf Blvd.
Gretna Blvd.
Wright Ave.
Terry Parkway
Belle Chasse Hwy. (LA 23)
Behrman Hwy. (LA 428)
Tullis Dr.
Woodland Hwy. (LA 406)
English Turn Pkwy.
Hebert Blvd.
Main St.
LA 3137
LA 39
Barriere Rd.
Wall Blvd.
Harvey Blvd.
Manhattan Blvd.
Peters Rd. (LA 3017)
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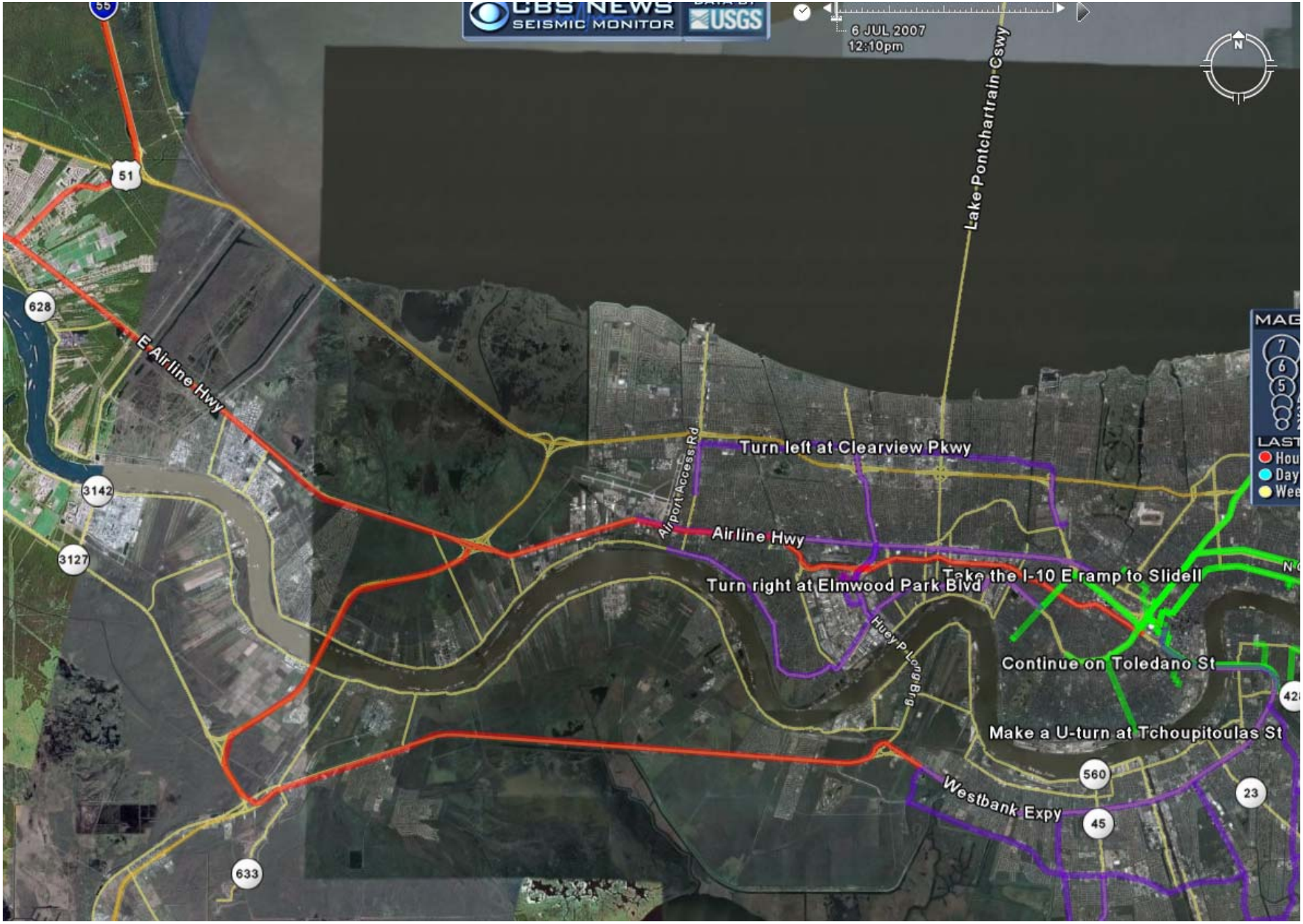
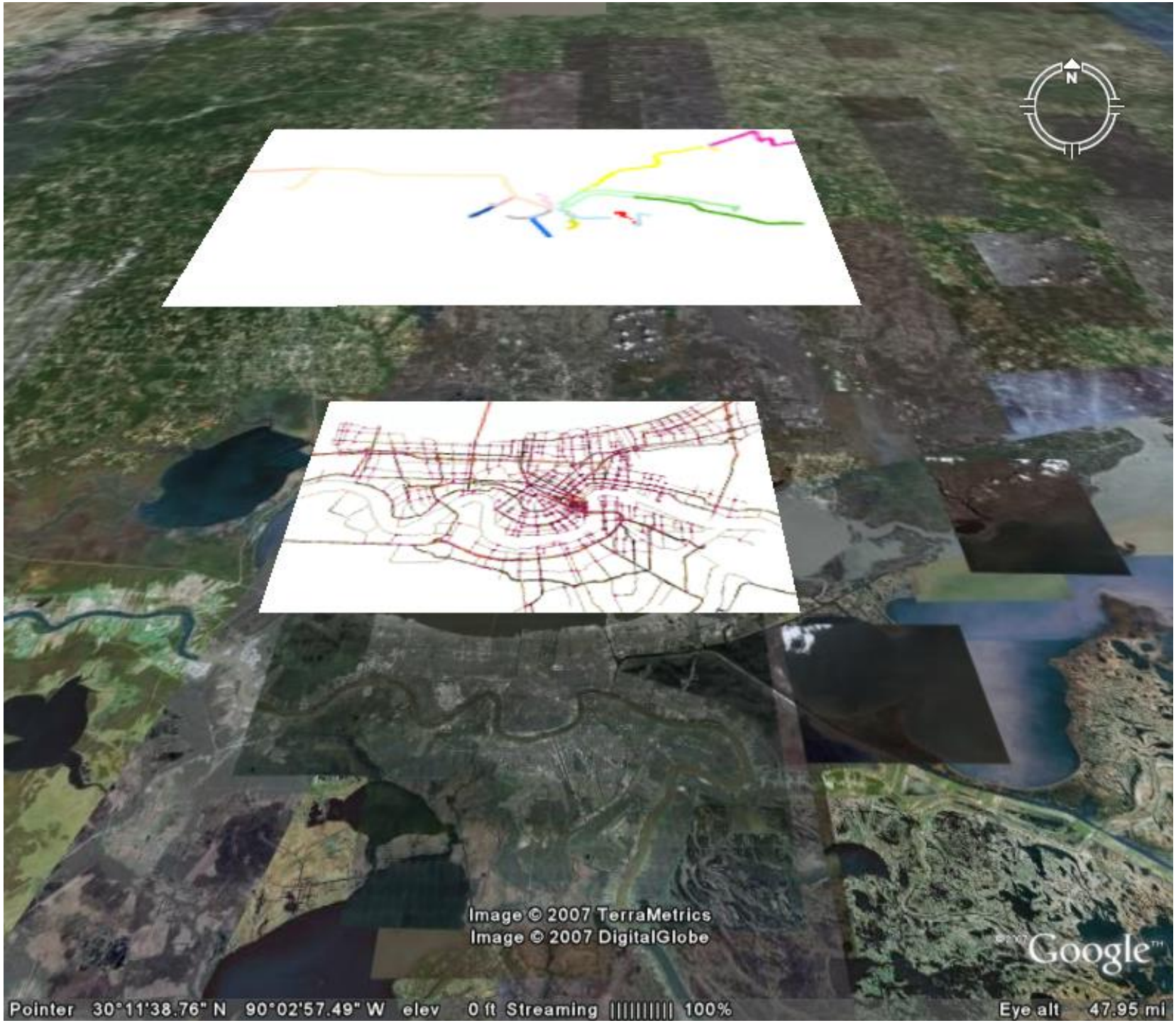
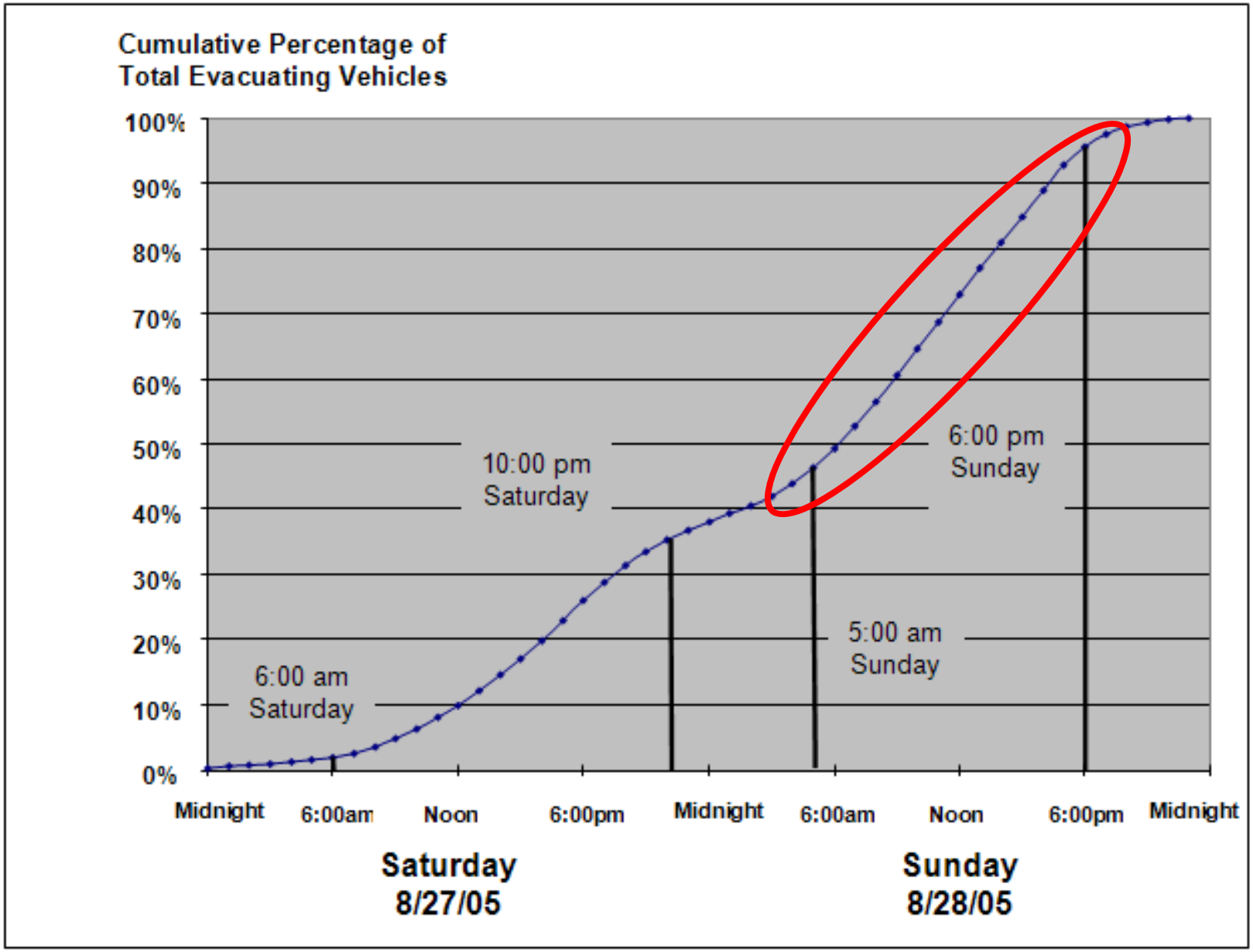
Woodmere Blvd.
Patriot St.
Westwood Dr.
Chidley Dr.
4th Street
LA 541
LA 45
LA 3134


CBS NEWS SEISMIC MONITOR
USGS
6 JUL 2007
12:10pm
Lake Pontchartrain Cswy
E Airline Hwy
Airport Access Rd
Turn left at Clearview Pkwy
Airline Hwy
Turn right at Elmwood Park Blvd
Take the I-10 E ramp to Slidell
Huey P Long Brg
Continue on Toledano St
Make a U-turn at Tchoupitoulas St
Westbank Expy
55
51
628
3142
3127
633
560
45
23


N
Image © 2007 TerraMetrics
Image © 2007 DigitalGlobe
Google™
Pointer 30°11'38.76" N 90°02'57.49" W elev 0 ft Streaming 100%
Eye alt 47.95 mi


Cumulative Percentage of
Total Evacuating Vehicles
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
6:00 am
Saturday
10:00 pm
Saturday
5:00 am
Sunday
6:00 pm
Sunday
Midnight
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Midnight
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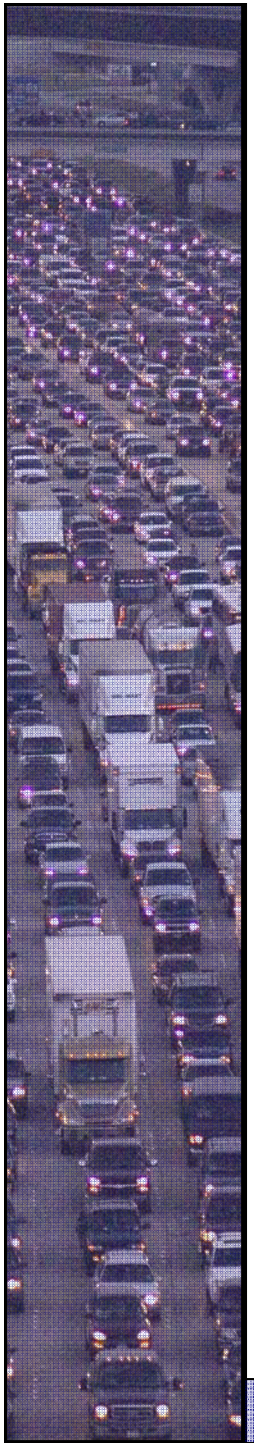
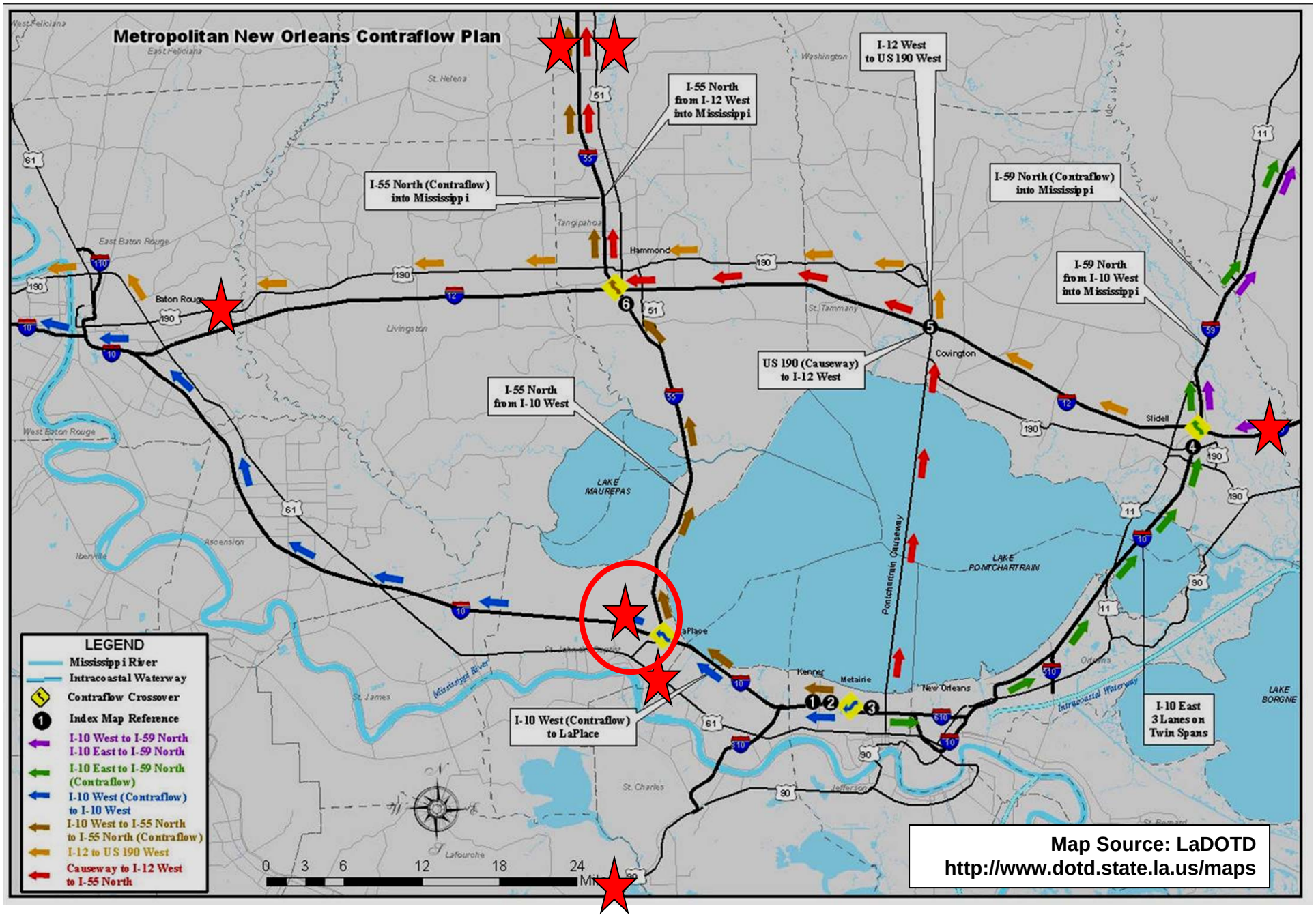
Noon
6:00pm
Midnight
Saturday
8/27/05
Sunday
8/28/05



Study Questions

- *Proof-of-Concept - Can TRANSIMS be used for evacuation analysis? Are its results reasonable?*
- *Develop a variety and range of hazard-response scenarios*
- *How many buses might be needed under various scenarios? What routes should they take?*
- *Potential to estimate the number of location of evacuees*
- *Examine the potential of alternate plans*


Metropolitan New Orleans Contraflow Plan
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I-55 North (Contraflow) into Mississippi
I-59 North (Contraflow) into Mississippi
I-59 North from I-10 West into Mississippi
US 190 (Causeway) to I-12 West
I-55 North from I-10 West
I-10 West (Contraflow) to LaPlace
I-10 East 3 Lanes on Twin Spans
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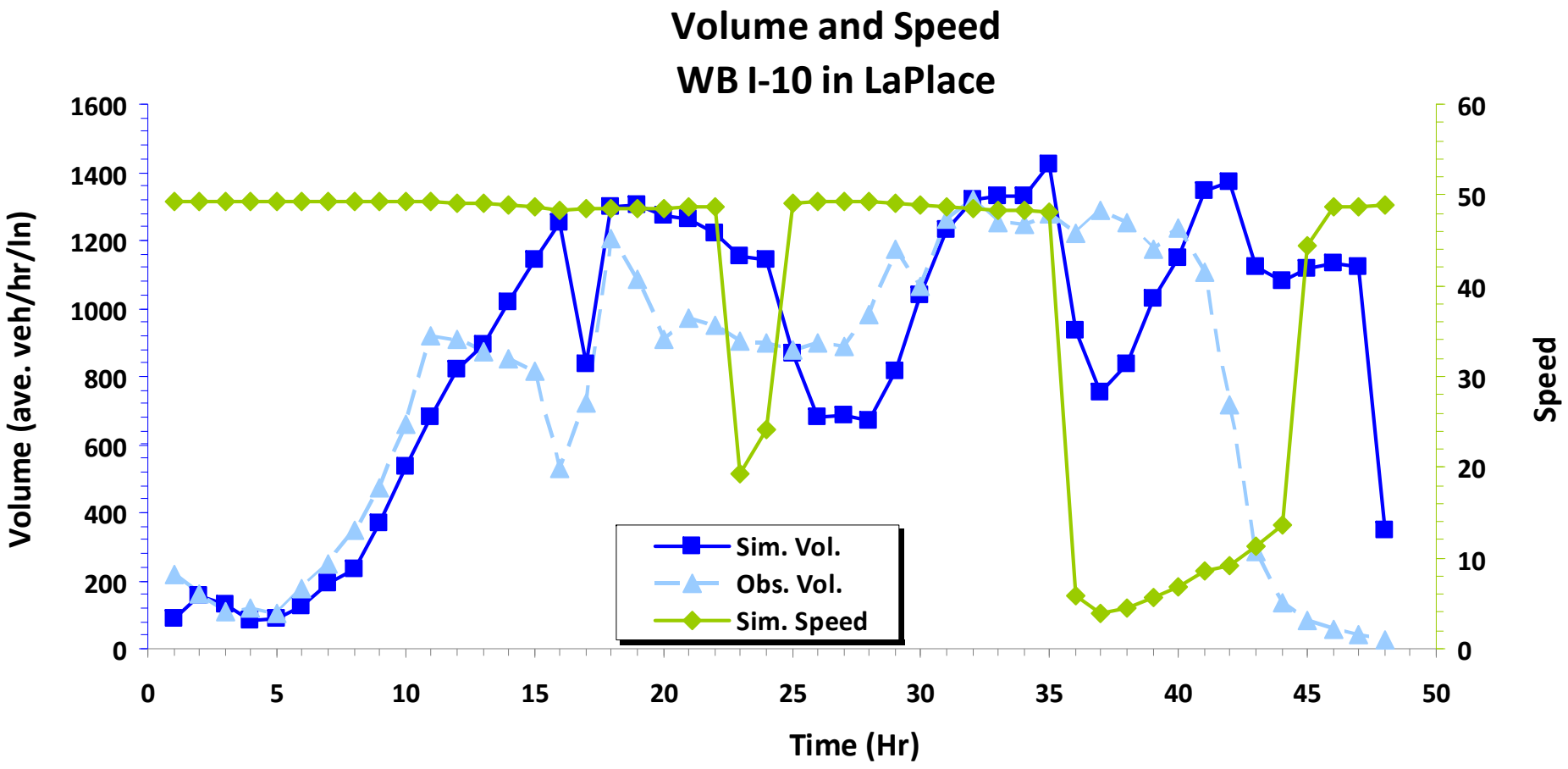
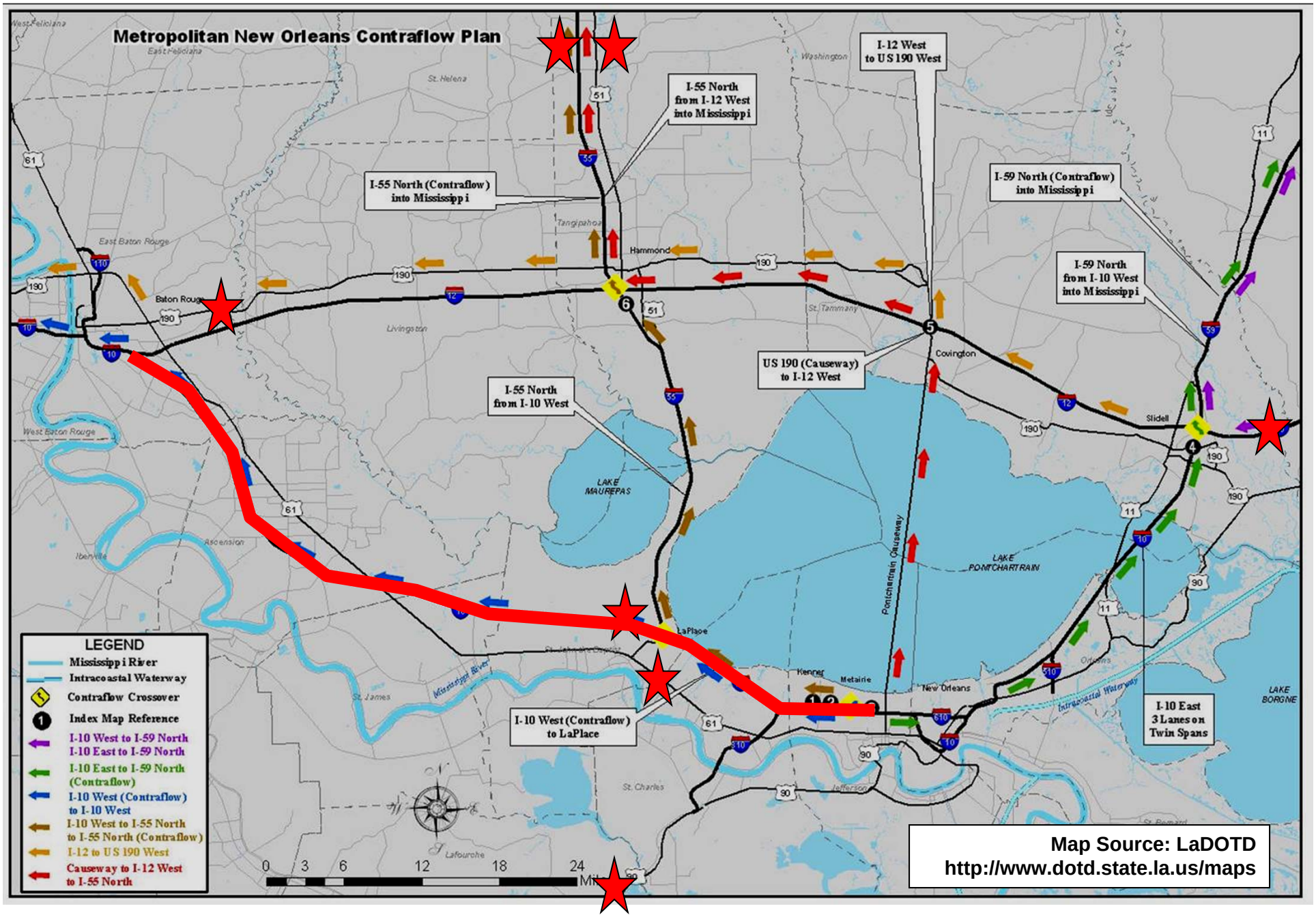
Causeway to I-12 West to I-55 North
0 3 6 12 18 24
Map Source: LaDOTD
http://www.dotd.state.la.us/maps



Network Link 58296 (DOTD Station 54 --2 miles W of US 51/I-55 Jct)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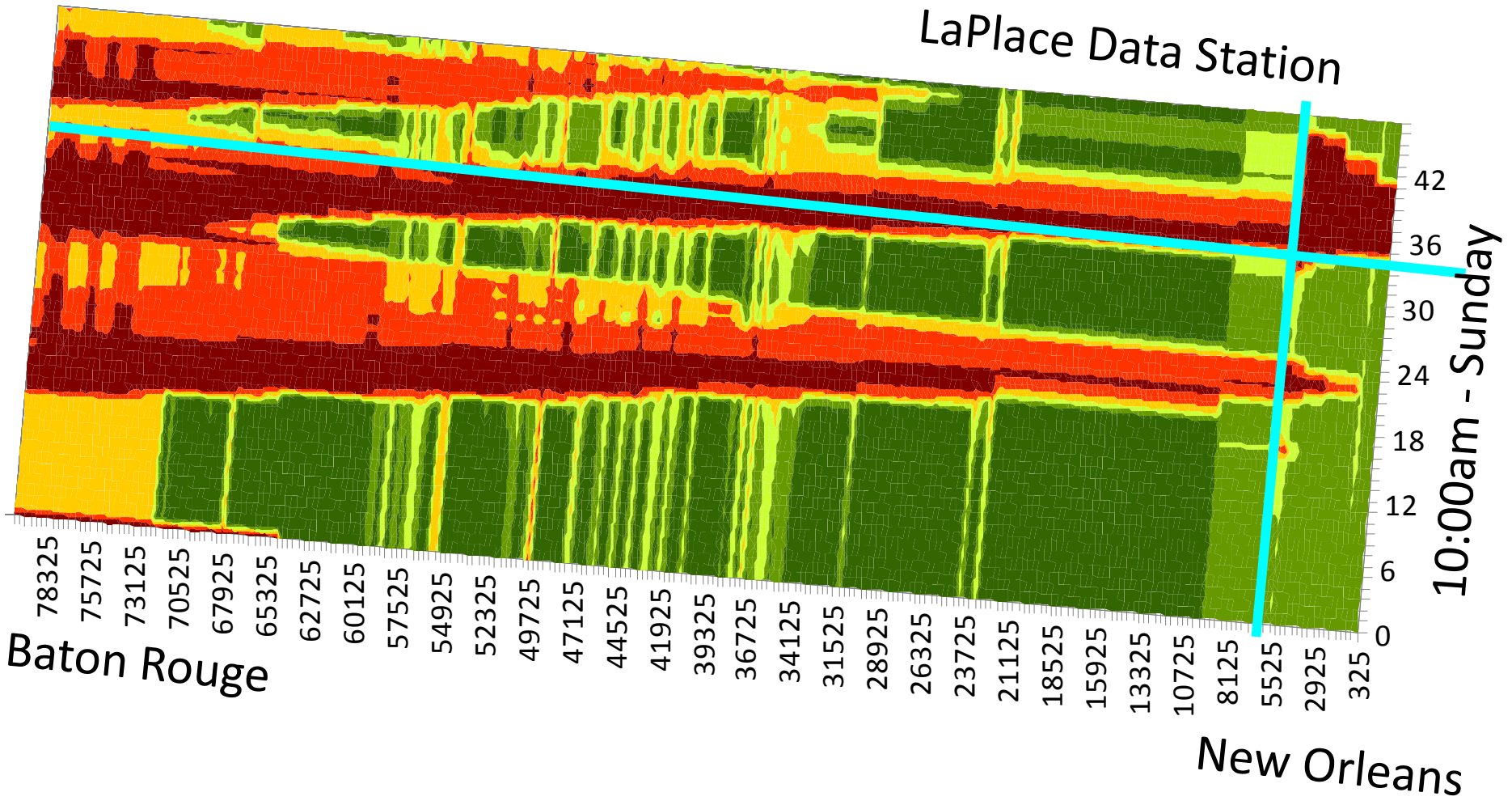
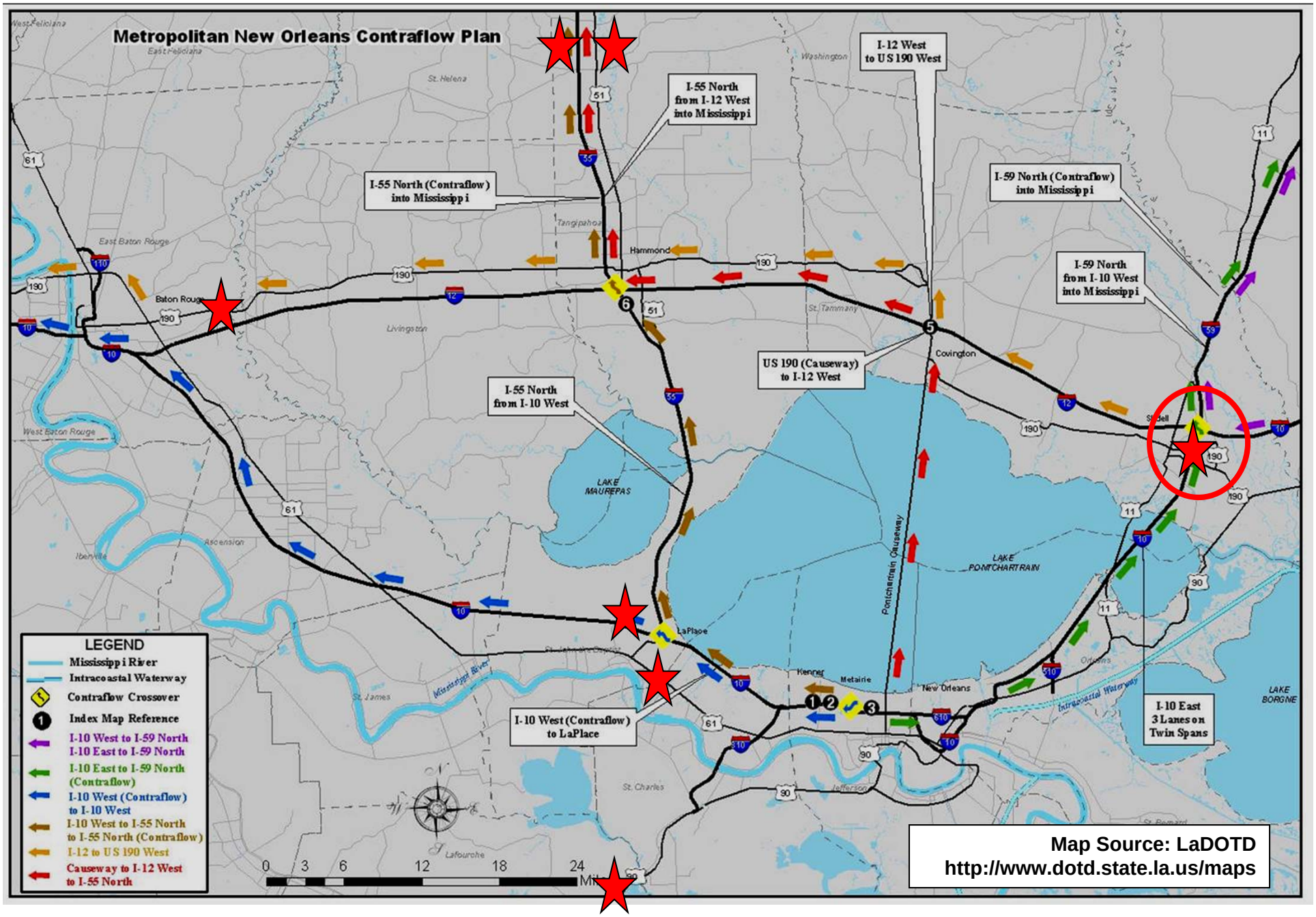


Westbound I-10 Traffic Speed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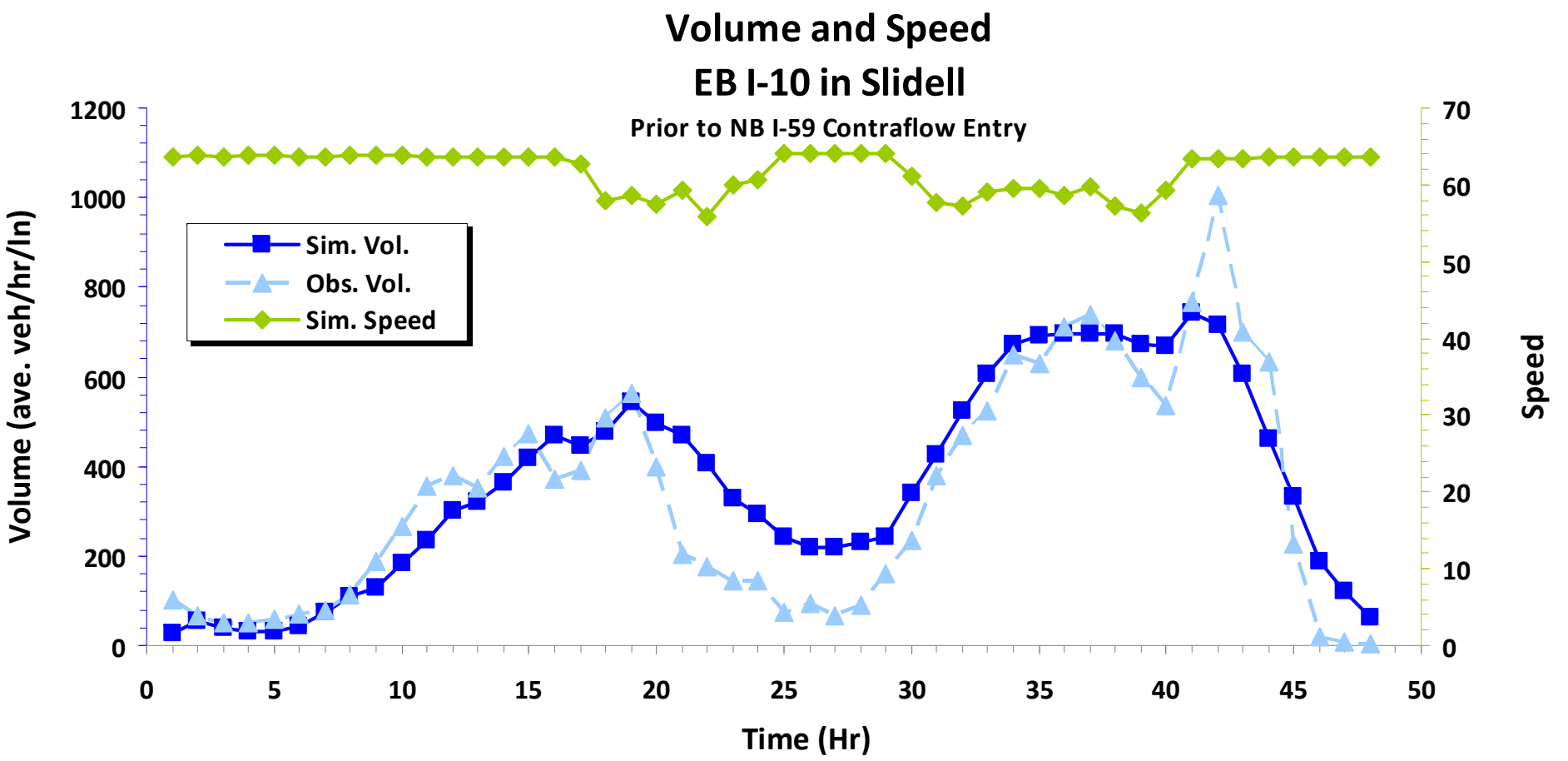
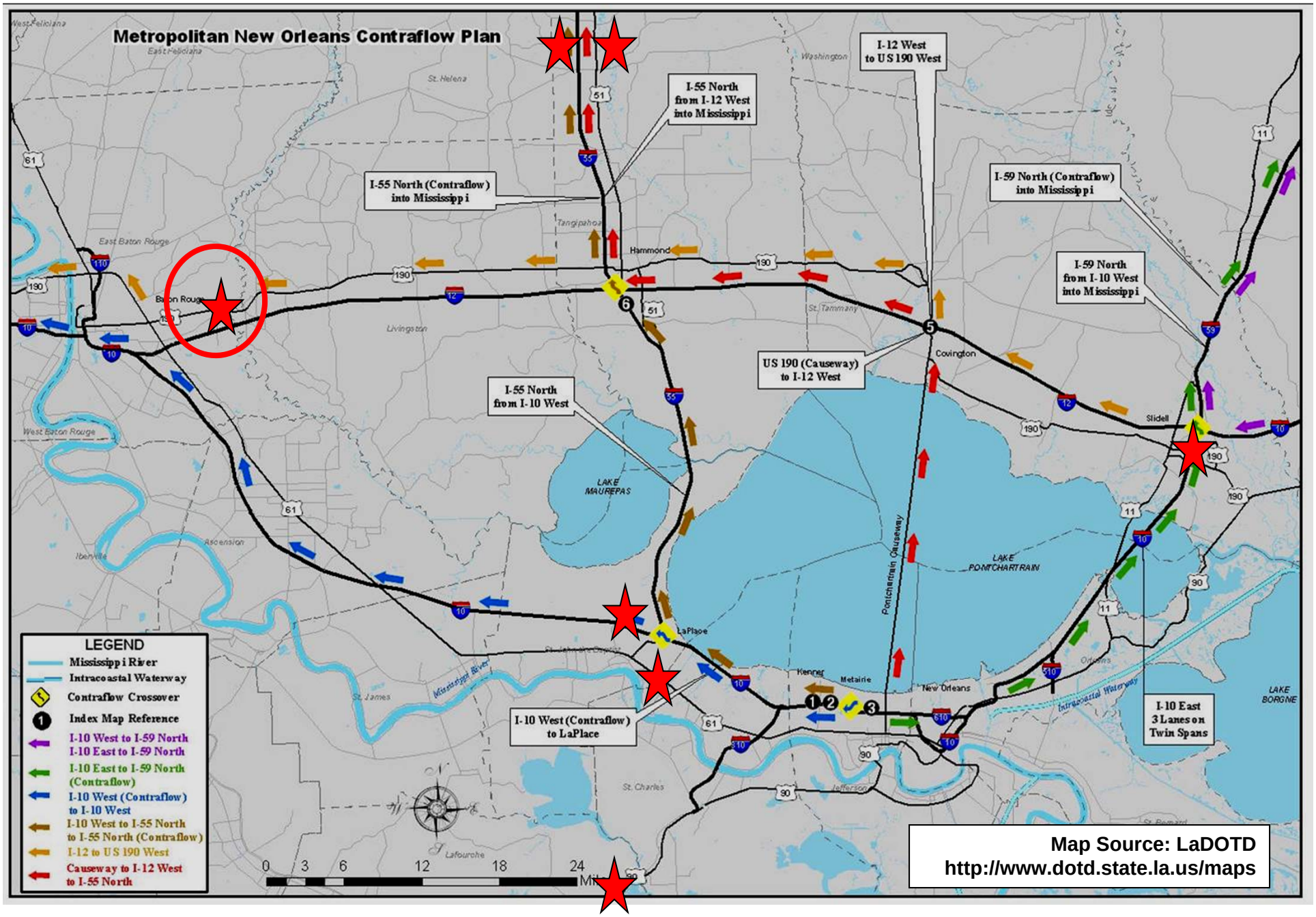


Network Link 56039 (Near DOTD Station 67 -- 1 mile S of I-12 , I-59 Jct)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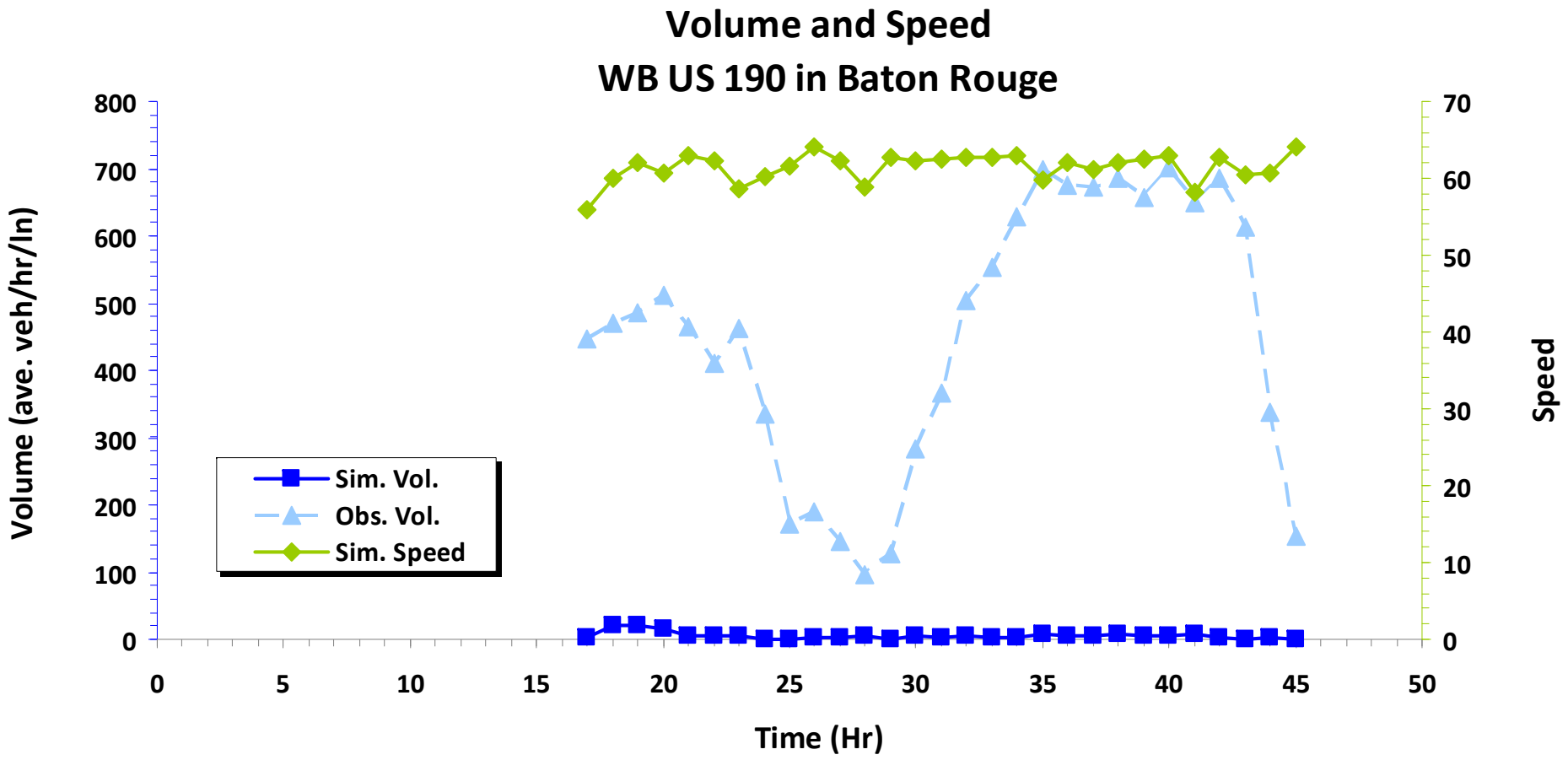
Map Source: LaDOTD
http://www.dotd.state.la.us/maps



Network Link 57784 (DOTD Station 18 -- 1.1 miles E of O'Neal Ln Jct)

US 190 WESTBOUND
Denham Springs@Amite River Bridge